2008-06-25

The Study of Superintendent Training and its Effects on Homebuilding Cycle Time

John Wesley Burk
Brigham Young University - Provo

A STUDY OF SUPERINTENDENT TRAINING AND ITS EFFECTS ON HOMEBUILDING CYCLE TIME

by

John W. Burk

A thesis submitted to the faculty of

Brigham Young University

in partial fulfillment of the requirements for the degree of

Master of Science

School of Technology

Brigham Young University

August 2008

BRIGHAM YOUNG UNIVERSITY

GRADUATE COMMITTEE APPROVAL

of a thesis submitted by

John W. Burk

This thesis has been read by each member of the following graduate committee and by majority vote has been found to be satisfactory.

_____	_____
Date	Jay P. Christofferson, Chair
_____	_____
Date	D. Mark Hutchings, Member
_____	_____
Date	Kevin R. Miller, Member

BRIGHAM YOUNG UNIVERSITY

As chair of the candidate's graduate committee, I have read the thesis of John W. Burk in its final form and have found that (1) its format, citations, and bibliographical style are consistent and acceptable and fulfill university and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

Date

Jay P. Christofferson
Chair, Graduate Committee

Accepted for the Department

Barry M. Lunt
Graduate Coordinator

Accepted for the College

Alan R. Parkinson
Dean, Ira A. Fulton College of Engineering and Technology

ABSTRACT

A STUDY OF SUPERINTENDENT TRAINING AND ITS EFFECTS ON HOMEBUILDING CYCLE TIME

John W. Burk

School of Technology

Master of Science

This study was conducted to determine how much time would be saved in the homebuilding cycle when field superintendents received training. The study took place during the 2007 calendar year with a production homebuilder in southern Nevada.

New technologies and techniques were introduced during weekly training meetings that were held at both the corporate office and construction job sites. A scheduling tool was introduced along with new procedures and policies. The superintendents were required to report daily on the tasks that had been completed. This gave the superintendent and upper management the ability to follow the home throughout the building process and track the results. Additionally, new policies were created to improve build quality and increase customer satisfaction.

This study compared over 300 homes built in 2006 (untrained superintendents) versus nearly 300 homes built in 2007 (trained superintendents). A substantial reduction in cycle time was found when compared to the homes built before the training period, with some projects reducing their average cycle time by over 140 days. Superintendent satisfaction in regards to the training was found to be above average. Through the reduction in cycle time, the company reduced their daily interest costs by nearly 3 million dollars.

ACKNOWLEDGEMENTS

I would like to thank my chair, Dr. Jay Christofferson, and my two committee members Dr. Kevin Miller and Dr. Mark Hutchings, for their efforts and continuous help through this process. Their advice and encouragement were valued. I would also like to thank Dr. Alexander Olsen and Marcy Upp for their expertise and assistance. This study would not have happened without the support of the Company, especially the Senior Vice President, who I'd also like to thank. Lastly, but most of all, I would like to thank my wife and two boys whose support and sacrifice have seen me through to the end.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Introduction

1.1 Background

With the housing boom of 2004 and 2005, many home builders scrambled to find skilled staff that could manage the incredible growth. According to the National Association of Realtors, new-home sales were expected to increase 7.1% to 1.29 million units in 2005, while housing starts—single-family and multifamily—were to be up 4.5 percent to 2.04 million units.[1] As with any construction-boom period, large production home builders were feeling the crunch to hire new management personnel to supervise the home-building process.

Very few builders expected what was to come in the following years. Home building came to a screeching halt, and not since 1995 have home production numbers been this low. It has become a totally different market, with the buyers making the calls and naming their own price. Builders are scrambling, trying to do everything they can to decrease costs and turn a profit.

One of the biggest factors in home-building profitability is the price of land. With land prices reaching as much as $850,000 an acre for residential parcels in southern Nevada, it became increasingly difficult to lower prices to sell homes. With the high price of land, it's necessary to build homes as fast as possible, as builders pay upwards of $90

[1] *NAR'S Home Sales Forecast Looking Stronger* [article on-line] (Business Wire, Oct 12, 2005, accessed 23 June 2006); available from http://findarticles.com/p/articles/mi_m0EIN/is_2005_Oct_12/ai_n15685910; internet

of interest carrying costs per day on a finished lot. With these facts, one southern Nevada home builder decided to implement a training program and introduce new policies to overcome the challenges facing the housing market.

Large home builders nationwide have business plans they try to execute to ensure their success. There can be many reasons that lead to a home builder failing to be successful in the competitive home-building market, one of them being the lack of an experienced, trained, and efficient workforce. With a housing boom like that of ’04 and ’05 comes expansive job growth, and if the organization fails to train their new employees, many hours and dollars could be wasted, perhaps even leading to the demise of that organization.

David Draper, a California recruiter for the Lewis Group, said, “This situation in the construction industry reminds me of the dot.com boom of the mid 1990’s – I see the same mania.” He noted, “That because of the demand for their talents, experienced building executives are jumping from firm to firm, lured by demand, larger salaries, and career advancement.” The shortage in the construction field during this boom not only applied to management but the specialty trades as well. In March of 2005, there were 115,600 people employed in the construction industry in Riverside and San Bernardino (California) counties, up from 74,800 in 2000 according to state figures. The number of building permits in these counties has more than doubled since last year.[2] This is not an anomaly, as California, Nevada, Arizona, Florida, and Virginia, as well as many other states, continued to see astronomical growth in the residential-construction field.

[2] Leslie Berkman, *Riverside, Calif.-area construction firms recruit workers* [article on-line] (The Press-Enterprise, Riverside CA 2005 accessed 18 March 2006) available from http://www.accessmylibrary.com/coms2/summary_0286-9164179_ITM; Internet

With this extreme growth came the necessity to hire individuals who were ill prepared to take on responsibilities that they were assigned. The company in this study once ran an ad that mentioned that no construction experience was necessary.

During the aforementioned housing boom, contractors were paying more to attract and retain workers and struggled to get enough skilled crews to stay on schedule.[3] The subcontractors that builders hired also struggled to find skilled labor. Some, unable to find enough skilled labor were resorting to more on-the-job training and relying on foremen for quality control.[4] Carol Smith performed a study in 2004 and had this to say regarding training in the residential construction environment:

> Typical organizations spend approximately 1.5 percent of revenues on training. Organizations that excel invest as much as 5 percent. The results of the larger training commitment include positive correlations with higher sales, greater productivity, fewer product defects, less attrition among personnel, and fewer days of work missed. Employees who are well trained require less time from managers and reflect well on the person who hired them. They make better decisions, solve problems faster, suggest more improvements and innovations, and enjoy their work. In today's job market, where many candidates constantly evaluate career options, training can be one of the factors that lead to retention of valued employees. To grow, whether by increasing share in a current market, expanding into a new market, or venturing into a new product line, companies need employees who are ready for promotion–what sports enthusiasts refer to as "bench strength." Training helps develop that talent.[5]

KB Home, one of the nation's largest home builders, recently began a new training program that involves the certification of all their subcontractors. As a result of the training, in just one year, KB Home in Las Vegas went from ninth to third in J.D.

---

[3] Ibid.
[4] Ibid.
[5] Carol Smith, *Train, train, train: and then train some more,* [article on-line] (Custom Home, Sept-Oct 2004, accessed 14 January 2006); available from http://findarticles.com/p/articles/mi_m0MOR/is_6_14/ai_n6227675; Internet

Power's customer satisfaction rank.[6] Warranty claims rarely exceeded 14 days and KB had fewer failed first inspections and callbacks, and shortened cycle times.[7] Leah Bryant, a regional manager for KB Home, stated, "We have a framer who has experienced a one-day savings on the same house they framed nine months ago. When you're building 3,000-plus homes a year, that's a lot of time."[8]

It's seems necessary to train tradesmen in their specific field. For instance, you can't properly plumb a house if you don't know how to solder copper pipe. Why do some home builders think they can hire management personnel and enter them directly into the field to often make significant decisions without any formal training? Organizations fail to train employees for several reasons. Marc Drizin, vice president of Walker Information Inc., states, "Training and development is critical in terms of employees feeling good about working for their organization, but I think most CEOs—and to a lesser extent, other managers, look at training and development as a cost."[9] Many large production home builders are recognizing the need to train management personnel within their organization. Pulte Homes, Centex, and Beazer Homes have each set up training programs to implement and infuse their formula for success to their employees (Builder Magazine, 2005).[10]

---

[6] Pat Curry, *Certified Savings*, [article on-line] (Big Builder, April 2004, accessed 15 May 2006) available from http://www.bigbuilderonline.com/industry-news.asp?channelID=55&sectionID=27&articleID=50868; Internet

[7] Ibid.

[8] Ibid.

[9] John McClenahen, (2003, October 21*). Headed for the exits: More training and development may entice manufacturing workers to stay on the job* [Electronic version]. *Industry Week, November 2003*, 17.

[10] Ibid.

1.2 Problem Statement

A privately held nationwide home builder, the seventh largest home builder in the Las Vegas market, hereafter referred to as “the Company,” has yet to develop a specific training program for its construction management division. As a result, according to its division senior vice president, it takes over 10 months to build a house that should take 4 to 5 months. This has been attributed not only to the enormous growth that the Company has experienced over the past two years, but also to the lack of effective workplace policies and a formal training program. The problem is that construction companies spend too much time building homes and the carrying costs are higher than they need to be.

1.3 Research Question

This case study identified the training needs of the Company, and implemented a training program to solve those needs. Performance was determined by the amount of time it takes to build a particular home plan, comparing the amount of the time taken for an equivalent plan prior to training. It was expected that with the proper training and the implementation of new policies, the scheduled amount of time it takes to build a home would decrease, and the assistant superintendent and superintendent would become more efficient in the home building process. It is also anticipated that the quality of the home at the time of completion would increase, leaving the construction personnel with a shorter punch list. Given the proper tools and training, it is anticipated that the construction managers of the Company would build a home in less time in addition to a better quality home with greater homeowner satisfaction. By implementing this training program, it’s anticipated that thousands of dollars in the form of interest carry would be saved by

reducing the cycle time, making the time and effort of the training program well worth the expense.

The focus of the thesis research is aimed at providing answers to the following five questions:

1. Is training of superintendents and managers effective in reducing the time it takes to build homes when compared to non-training control cases?
2. What is the superintendent's satisfaction with the training?
3. What is the level of satisfaction for those project-site managers who participate in construction efficiency improvement training as measured by an assessment survey?
4. Was the training worth the time and expense?
5. How much money was saved, if any?

1.4 Purpose

There is a great need for the Company to develop an effective training program and implement effective policy. Currently, it is taking too long for the construction management team to complete a house. The Company pays on average approximately $100 in interest carrying costs per day for each home being developed. The possibility of cutting several days off of the build time would save the Company thousands of dollars.

It is often said that the greatest thing a business can have is its reputation. The Company will not continue to experience the growth and profitability as it has recently if it continues without an effective training program. If this case study proves to be successful, small to medium home builders without a training program could use this

study as a benefit to help improve their construction processes and increase their home-building efficiency, while saving money at the same time.

The purpose of this study was to determine if the implementation of a training program and workplace policies reduced the time it took to build a home within this division in the Las Vegas housing market. It also determined if the cost of implementing the training program proved to be financially beneficial.

From 2004 to 2006, the Company experienced nearly an 80% increase in home closings. With this growth has come the Company's inability to hire and train enough effective field superintendents, which only exacerbates the time to build a home. Many companies of this size are experiencing the same problem. Carol Smith states, "Unfortunately, especially in small volume companies, training (and all of the advantages that come with it) is often lost amid the swirling details of running a business."

Research has shown that when a home builder implements a training program and is dedicated to it, productivity improves (Smith, 2004). To gain the greatest benefit from time and money invested in training, Smith states, "Training must be well-planned, effectively executed, and followed up with coaching activities. The two overriding goals of training are improvement in existing product, processes, and customer treatment and innovation—the conception of new product, processes, and service."

During this study, the needs of the training program were identified, and new policies and a training program were developed. The program was aimed at the superintendent and the assistant superintendent, striving to make them more productive and aware of the vast knowledge needed to be a successful home builder in today's real estate market.

1.5 Assumptions

This study assumed that superintendents within the company were similar to those in other home building companies within the Las Vegas area.

1.6 Delimitations

As with any research, especially in case studies where the researcher is more intimately involved, bias can be introduced. However, the primary results of this research are derived from historical Company data, making it difficult to influence researcher bias. Additionally, not every home inspector looks for the same problem areas during the inspection process. Therefore, the success of passing certain home inspections can sometimes depend entirely on which inspector shows up to the job site. To account for this, the study analyzed the data according to which jurisdiction the home was built, whether it be Henderson, the city of Las Vegas, or Clark County, Nevada. In order to have completed this case study in a timely manner, not everything that was included in the training was tracked. Therefore, the completed results and overall effectiveness of the entire training process as a whole may not be fully realized for several years. The study was limited to this division in the Las Vegas area.

1.7 Definitions

TracTime: A scheduling tool that tracks daily tasks. These tasks are tracked, and completion dates are recorded and observed by upper management on a daily basis. This allows management the opportunity to see “problem areas” quickly and have them addressed.

PCI (Pre-Carpet Inspection): An in-house inspection is performed by the area manager before carpet is installed. He or she ensures that there are no missing items or options and that the home is substantially completed and ready for the homeowners' walk through.

Homeowner walk: After the home is completed, homeowners are invited to walk the home with the project superintendent. This walk is intended to orient the homeowners with their home's options and functionality. During the walk, homeowners are allowed to point out any deficiencies that they would like addressed. Five calendar days later, the homeowner returns and "signs off" on the home, which indicates that he or she is accepting the home and any corrections that have been completed.

Zurich inspections: Zurich is the Company's insurance provider. Zurich performs quarterly inspections in which they look for correct building practices. The Company receives a rating between 1 and 10, with 10 being the highest. The higher the rating, the less the Company pays for their insurance.

Homeowner option processes: The process that a homeowner must take to select their options and how those options are given to the subcontractor and the superintendent by the Company

Buzzsaw: A computer program that allows subcontractors and superintendents the ability to view plans, contracts, permits, homeowner options, and so on, via the Internet. Subcontractors can use the program to upload bids and other information.

CHAPTER 2

Review of Literature

With the increased demand for more housing, greater demands will be placed upon the home builder to finish the project on time and within budget. In order for the demand for housing to be met, a greater collective effort among the contractor, subcontractor, and government subsidies needs to take place. With the rising land values in the southwest area of the United States, home builders who own land are always looking for a way to speed up the home building process to save money on escalating interest payments.

There are several different techniques that home builders use to reduce the cycle time of home building. Many companies may invest in new technology, while others use more innovative building materials and techniques. Training is another effective way to reduce the cycle time of home building. With a more informed and better-trained construction management team, the ability to build homes faster will increase.

To better understand the home-building process and the training needed for construction managers and contractors to increase productivity, a literature review was conducted. The literature review was focused on the following topics: 1) why training is needed, 2) different learning theories, 3) designing effective training, 4) the effects training has on the employees and their productivity, and 5) what production home builders have done with respect to training.

2.1 Why Training is Needed

Each construction project is different and therefore lends itself to productivity losses. Even if the same project is built adjacent to another project by the same contractor, different factors may influence the project's progress that weren't factors on the previous project (e.g., weather, construction personnel, and product availability).

Table 2-1 illustrates the various productivity increases in various industries in the United States as of 2002.[11] Although total U.S. productivity has been increasing at a rate of 2.7% annually, the construction industry has been increasing at a rate of less than 1% a year. From 1990 to 2004, the construction industry has been one of the worst industries in relation to increased productivity.[12]

Table 2-1 Productivity Increases for Various Industries

Industry	Productivity Increase (%)
Agriculture	3.64
Construction	0.8
Government	1.64
Manufacturing	2.6
Mining	3.17
Public Uitlities	5.4
Transportation	4.6

According to unpublished data compiled by the Bureau of Land Statistics, productivity in the construction industry reached a peak in 1968 and, except for a brief and small upturn between 1974 and 1976, has been falling ever since.[13]

[11] *Construction Review.* U.S. Department of Commerce, Washington D.C. 2002
[12] J. J. Adrian, *Construction Productivity: Measurement and Improvement* (Champaign: Stipes Publishing, 2004)
[13] S. G. Allen, "Why Construction Industry Productivity is Declining," *The Review of Economics and Statistics* 67 (November 1985): 661.

James J. Adrian, a noted professor and expert on construction productivity, found that approximately 45% of construction time is unproductive.[14] Adrian notes that the three sources of this unproductive time are equally attributed to labor, management, and the construction industry itself. There are many factors that have influences on construction productivity. From worker safety and regulations to adverse weather conditions, each project is different. So, let the question be asked: How can this decrease in productivity be overcome? There may be no perfect answer; however, training is seen to have a positive and statistically significant effect on productivity growth.[15]

Once a company realizes that they need a training program to become more productive, they can either outsource the development of the training program or choose to provide it internally. In order to develop an effective training program, one must first understand the fundamental basics of how people learn.

Learning is defined as a relatively permanent change in human capabilities that is not a result of growth processes.[16] Raymond A. Noe, a noted author and professor regarding the topic of training and development, states that these capabilities are related to specific learning outcomes. These outcomes are verbal information, intellectual skills, motor skills, attitudes, and cognitive strategies.[17] Verbal information includes facts, names, or bodies of previously stored knowledge; for a construction worker, this would include the names of different types of tools or the knowledge needed to follow a company's safety program. Intellectual skills include concepts and rules. It is crucial for

[14] J. J. Adrian, *Construction Productivity: Measurement and Improvement* (Champaign: Stipes Publishing, 2004),
[15] A. Barrett and Philip J. O'Connell, "Does Training Generally Work? The Returns To In-Company Training," *Industrial and Labor Relations Review* 54 (April 2001): 654.
[16] R. Gagne and K. Medsker, *The Conditions of Learning* (San Francisco: Jossey-Bass, 1991)
[17] R. A. Noe, *Employee Training and Development* (New York: McGraw-Hill Irwin, 2005), 138-152

the construction worker to acquire these skills in order to solve problems and show great customer service. Motor skills would include the ability to climb ladders, use a nail gun, or drive a truck. Another learning outcome would be the employee's attitude. An employee may be satisfied with their employment, or disgruntled. Training programs may be used to develop or change attitudes because attitudes have been shown to be related to physical and mental withdrawal from work, turnover, and behaviors that impact the well- being of the company.[18] The last outcome of learning, according to Noe, is cognitive strategies. This is the process of learning that applies to the learner's ability to regulate, or pay attention to, information, then selectively apply that information to the work setting. For example, a plumbing system that has just been installed has no water pressure, so the plumbing foreman must decide on which strategy he or she would use to solve the problem.

2.2 Different Learning Theories

There are several learning theories that describe the different processes in which people learn. Each theory relates to different aspects of the learning process described earlier. The different learning theories are reinforcement theory, social learning theory, goal setting theory, need theory, expectancy theory, adult learning theory, and information processing theory.[19]

[18] Ibid.
[19] Ibid.

The reinforcement theory emphasizes that people are motivated to perform or avoid certain behaviors of past outcomes that have resulted from those behaviors.[20] Noe describes the reinforcement theory and its processes below:

> There are several processes in reinforcement theory. Positive reinforcement is a pleasurable outcome resulting from a behavior. Negative reinforcement is the removal of an unpleasant outcome. The process of withdrawing positive or negative reinforces to eliminate a behavior is known as extinction. Punishment is presenting an unpleasant outcome after a behavior, leading to a decrease in that behavior. From a training perspective, reinforcement theory suggests that for learners to acquire knowledge, change behavior, or modify skills, the trainer needs to identify what outcomes the learner finds most positive and negative. Trainers then need to link these outcomes to learners acquiring knowledge, skills, or changing behaviors.[21]

This theory is used quite often in the production residential home building industry. For example, many superintendents and area managers are rewarded each month through a bonus program; for each house they close, they receive an allotted bonus, such as $200 for each home completed. This method is used to motivate the superintendent or area manager to build the homes faster.

The social learning theory theorizes that people learn from observing others that they think are knowledgeable and credible.[22] As with the reinforcement theory, behavior that is rewarded tends to be repeated. With the social learning theory, it is assumed that new skills or behaviors are learned from experiencing the consequences from that

[20] B. F. Skinner, *Science and Human Behavior* (New York: Macmillan, 1953), as quoted by Noe, *Employee Training and Development* (New York: McGraw-Hill Irwin, 2005)
[21] R. A. Noe, *Employee Training and Development* (New York: McGraw-Hill Irwin, 2005), 138-152
[22] Ibid.

behavior, or from observing others' consequences from using a certain behavior.[23] Included in this theory is the fact that people are influenced by their self-efficacy. Noe states that

> Self-efficacy is a person's judgment about whether he or she can successfully learn knowledge and skills. Self-efficacy is one determinant of readiness to learn. A trainee with high self-efficacy will put forth effort to learn in a training program and is most likely to persist in learning even if an environment is not conducive to learning. In contrast, a person with low self-efficacy will have self-doubts about mastering the content of a training program and is more likely to withdraw psychologically and/or physically. Learners are more likely to adopt a modeled behavior if it results in positive outcomes. If a behavior is reinforced, it will be repeated in the future.[24]

Gist points out that trainees who believe themselves to be incapable of learning the skill are likely not to try.[25] "Training programs that allow for successful practices of the target behavior are likely to produce feelings of self-efficacy. Further, low self-efficacy may produce training problems."[26]

Goal setting theory assumes that behavior results from a person's conscious goals and intentions.[27] "Goals influence behavior by directing energy and attention, sustaining effort over time, and motivating the person to develop strategies for goal attainment. Research suggests that specific goals result in better performance than vague, unchallenging goals."[28] Goals have been one of the most popular learning theories because many people believe that it simply works. If employees are committed to a goal,

---

[23] Ibid.
[24] Ibid.
[25] M. E. Gist, "Self-efficacy: Implications for Organizational Behavior and Human Resourced Management," *Academy of Management Review* 12: 472–485 as quoted by D. D. Steiner, et. al, *The Trainer-Trainee Interaction: An Attributional Model of Training* 12 (July 1991): 275.
[26] Ibid.
[27] E. A. Lock and G. D. Latham, *A Theory of Goal Setting and Task Performance* (Englewood Cliffs: Prentice Hall, 1990)
[28] E. A. Locke, et. al, "Goal Setting and Task Performance," Psychology Bulletin 90 (1984): 125–152.

performance improves; however, employees' performance may decline if the goal is believed to be unattainable.[29]

Need theories explain the value employees place on certain outcomes.[30] Employees will act in a certain way to fill or satisfy a deficiency. When need theories are discussed, Maslow's theory of needs is the most popular. His theory focused on the physiological needs, the need to interact with others, and self-esteem needs.[31] Maslow felt that most people try to satisfy their needs at the lowest level, then progress up a hierarchical scale. In relation to a training program, the facilitator identifies the needs of the trainees and communicates to them how the training will satisfy their needs. If the basic needs of the trainees are not met, they may view the training as useless and a waste of their time.

Expectancy theory suggests that a person's behavior is based on three factors: expectancy, instrumentality, and valence.[32] Expectancies are similar to self-efficacy in the fact that the trainee imagines them self-performing the behavior, then actually doing it. After the trainee has performed a certain behavior, he or she associates that behavior with a certain outcome; this is called *instrumentality*.[33] Valence is simply the value that the trainee places on an outcome. "From a training perspective, expectancy theory suggests that learning is most likely to occur when employees believe they can learn the content of the program; learning is linked to outcomes such as better job performance, a salary increase; or peer recognition; and employees value these outcomes."[34]

---

[29] R. A. Noe, *Employee Training and Development* (New York: McGraw-Hill Irwin, 2005)
[30] Ibid.
[31] Ibid.
[32] V. H. Vroom, *Work and Motivation* (New York: John Wiley, 1964)
[33] R. A. Noe, *Employee Training and Development* (New York: McGraw-Hill Irwin, 2005)
[34] Ibid.

Adult learning theory was developed out of the necessity to determine how adults learn. Malcom Knowles is most commonly associated with this theory, and he states that the model is based on several assumptions:[35]

1. Adults have the need to know why they are learning something.
2. Adults have a need to be self-directed.
3. Adults bring more work-related experiences into the learning situation.
4. Adults enter a learning experience with a problem-centered approach to learning.
5. Adults are motivated to learn by both extrinsic and intrinsic motivators.

As with almost all employee training programs, you are dealing with adults, so this theory is important to understand when developing a training program.

The last learning theory that discussed is the information processing theory. This theory proposes that information or messages taken in by the learner undergo several transformations in the human brain.[36] Gagne describes the information processing theory as follows:

> Information processing begins when a message or stimuli from the environment is received by receptors. The message is registered in the senses and stored in short-term memory. A search process occurs in memory during which time a response to the message or stimuli is organized. The response generated relates to one of the five learning outcomes; verbal information, cognitive skills, motor skills, intellectual skills, or attitudes. The final link in the model is feedback from the environment. This feedback provides the learner with an evaluation of the response given. This information can come form another person or the learner's own observation of the results of his or her action. A positive evaluation of the

[35] M. Knowles, *The Adult Learner,* (Houston: Gulf Publishing, 1990)
[36] W. C. Howell and N. J. Cooke, "*Training the Human Information Processor: A Review of Cognitive Models,"* (San Francisco: Jossey-Bass, 1991)

response provides reinforcement that the behavior is desirable to be stored in long-term memory for use in similar situations.[37]

Regarding a training program, this theory would be important to understand as it demonstrates that many adults will place learned behaviors in long-term memory if they receive positive feedback regarding that specific behavior.

2.3 Designing Effective Training

Billions of dollars are spent annually in the United States to further develop and train employees. Table 2.2, shows the amount of dollars spent annually on training in the United States.[38] With the billions of dollars that are spent annually in the United States on training, a company would want to design the training program to be as effective as possible.

Table 2-2 Annual Dollars Spent on Training in the United States

Dollars Spent on Employee Training in the United States Source: Training magazine's annual Industry Report and ASTD annual survey				
Report Year	$ Spent Annually in the U.S.	Average Spent Per Employee	% of Payroll	Average annual hours of formal training per employee
2005	$51.1 billion	$955	2.34%	32
2004	$51.4 billion	$820	2.52%	26
2003	$51.3 billion	$826	2.20%	28
2002	$54.0 billion	$734	2.00%	24
2001	$56.8 billion	$704	1.80%	
2000	$54.0 billion	$677	2.00%	

[37] R. M. Gagne, "Learning Processes and Instruction," *Training Resource Journal* 1 (1995/1996): 17–28.
[38] "Dollars Spent on Training." Available from http://www.radford.edu/~maamodt/HR%20Statistics/dollars_spent_on_training.htm; Internet, accessed 15 April 2006.

There should be a systematic approach to designing a training program. One of the most widely used models is the ADDIE approach. ADDIE stands for "Assess," "Design," "Develop," "Implement," and "Evaluate."[39]

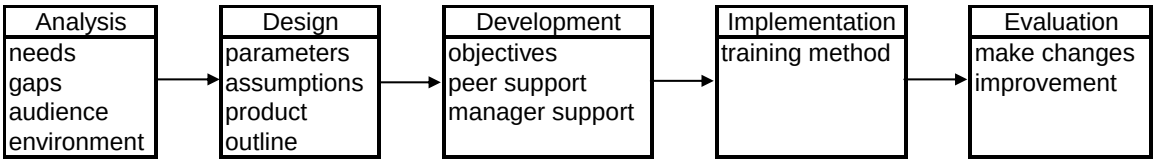

Fig. 2-1 ADDIE Approach to Training Design

> While many factors influence the effectiveness of training, a sound needs analysis is a crucial first step. Since self-assessment is increasingly popular as a basis for assessing needs, selecting trainees, and developing training programs, a thorough understanding of the individual and contextual characteristics which systematically influence these perceptions can usefully raise awareness among potential participants, their supervisors, and human resource professionals. Attention to participants' attitudes and perceptions, and other relevant individual and contextual factors, may enhance the effectiveness of an organization's training efforts.[40]

Additionally, a proper needs analysis provides information on who is to be trained, what needs to be trained, and how the results of the training program are to be evaluated.[41]

Designing the training is the next step in the ADDIE model. During this process, the needs assessment needs to be reviewed to determine what exactly needs to be trained. From here, learning objectives can be set and meaningful material established.

---

[39] M. Molenda, "In Search of the Elusive ADDIE Model," *Performance Improvement* (May/June 2003): 34-36.
[40] J. P. Guthrie and C. E. Schowoerer, "Individual and Contextual Influences on Self-Assessed Training Needs," *Journal of Organizational Behavior* 15 (September 1994): 419.
[41] J. K. Ford and R. A. Noe, "Self-Assessed Training Needs: The Effects of Attitudes Toward Training, Managerial Level, and Function," *Personnel Psychology* 40 (Month 1987): 39.

Following the design component of the ADDIE model is the development of the training program. The number one ingredient in order to have successful training is having managerial support. A study was conducted using data collected from a human relations 28-week training program. In this study, it was found that the training program, while approved by the president and vice president of the Company, was perceived by the trainees not to have the support of the executive staff.[42] As a result, the trainees felt that the executive staff neither understood the content of the training program, nor attempted to integrate it into the workplace. Additionally, it is noted that even if trainers are able to reinforce the desired behavior, that behavior has little chance of being transferred back to the workplace if the trainee's superior does not reward the learning. The superior must act as the reinforcer.[43] "Some of the most successful programs have been those in which employees have sat side-by-side with management in mapping out curricula and directing the day-to-day activities."[44] Ford and Noe suggested that managerial support may influence attitudes towards training and found that employees in supportive organizational environments were more likely to implement knowledge and skills acquired in training.[45] Additionally, support from supervisors and co-workers is likely to influence motivation to use the skills acquired in training.[46]

Once the needs have been assessed, the training material designed and developed, the training is ready to be implemented. There are several ways in which training can be offered to the trainee, with each having a different effect. The top ten training techniques

---

[42] H. H. Hand and J. W. Slocum Jr., "Human Relations Training for Middle Management: A Field Experiment," *The Academy of Management Journal* 13 (December 1970)" 407.
[43] Ibid.
[44] J. M. Mitchell, "Current Trends in Public-Employee Training," *Journal of Educational Sociology* 14 (January 1941): 294.
[45] J. K. Ford and R. A. Noe, "Self-Assessed Training Needs: The Effects of Attitudes Toward Training, Managerial Level, and Function," *Personnel Psychology* 40 (Month 1987): 39.
[46] Ibid.

used in businesses today are (1) videotapes, (2) lectures, (3) one-on-one instruction, (4) role plays, (5) games and simulations, (6) case studies, (7) slides, (8) computer-based training, (9) audiotapes, and (10) films.[47]

Videotapes can be effective if used properly. If the trainee passively watches the film, it will be less productive. "To be effective, the video should be stopped at certain points so the trainer can ask questions of the audience. This leads to active participation and feedback."[48] The main disadvantage for a company to use videos is the actual cost it is for them to produce such in-house training.

The next most popular training method is lecturing. This by itself can be a very poor training tactic because of the lack of trainee involvement and feedback. The lecturer plays a very important role in determining just how effective a training session can be. To help in the lecture process, it's helpful for the lecturer to be enthusiastic about his or her topic, have the ability to simplify difficult subject matter, and ensure that the information is up to date. Whenever the lecturer can add activities to the training process, the audience being trained is more engaged.[49]

One-on-one instruction can be very effective because it ensures that skills taught in training can be readily transferred to the job. One of the downsides regarding one-on-one training is the fact that the trainer may not be qualified to train. "As a result, the trainer many not be motivated to train or willing to accept the responsibility for training: thus, the training may be haphazard. There is also the possibility that the trainer may

[47] C. W. Read and B. H. Kleiner, "Which Training Methods are Effective?" *Management Development Review* 9 (1996): 24–29.
[48] Ibid.
[49] Ibid.

perform the job well but lack the ability to teach others how to do so."[50] The best advantage, however, is the fact that the learner and trainer can determine the pace of the training, so less time will be spent on skills that the learner may already possess.

Role-plays give the trainee the opportunity for feedback. The role-play itself lends to group discussion and encourages active participation and feedback. The role-play should be confined to training situations and mistakes should be treated with tolerance so participation will be encouraged.[51]

Games and simulations can be used to provide a sense of teamwork and allows for group participation. Sometimes the objectives of the game are not very clear, and as a result, trainees may leave the session unaware of what was to be learned. "For these reasons, the game must be carefully designed to meet the training objectives. The trainer must play a key role in setting the stage at the beginning of the game and leading a post-game discussion to be sure the objectives were met."[52]

Case studies can be a very effective tool in a training session. A case study usually includes an actual problem with its description. The problem is then left up to the trainees to fix. The main purpose of case studies is to stimulate discussion and provide feedback. This method is best suited for small group training; however, it can be used in large group settings as long as the large group can be divided up into smaller subgroups.[53]

Slides, such as PowerPoint presentations, are a popular pick among many organizations when it comes to training methods. They usually are used to provide a visual aid in a lecture setting. One disadvantage to this method is the lack of feedback

[50] C. W. Read and B. H. Kleiner, "Which Training Methods are Effective?" *Management Development Review* 9 (1996): 24-29.
[51] Ibid., 27.
[52] Ibid., 28.
[53] Ibid., 29.

and trainee participation. If the slides are combined with a group discussion, it can be much more effective.

Computer-based training is starting to become more popular. One of the great advantages to this type of training is that it allows the trainee to access the material when he or she wants at any location, whether it be on the Company's intranet or at home on the Internet. Additionally, trainees who need further instruction can obtain it without slowing down the process of the other trainees.[54] The biggest disadvantage to this training method is the initial cost of the development and the software needed to implement it. Computer-based training is best suited for training courses with a large trainee enrollment.

The use of audiotapes and films possess the same weaknesses as do videos. There is usually a lack of trainee participation and feedback opportunities. If used effectively, they can be beneficial as they demonstrate the proper behavior to be learned.

There isn't a single training method that is superior to another. One must look at the needs assessment regarding the trainees and decide which one will work best for the group. "When possible, it is best to pick a method that encourages active participation by the trainee and provides adequate feedback. This increases the likelihood that what is taught in training will be retained and later applied."[55]

The final component of the ADDIE model is evaluation. For a training program to be considered beneficial, the costs of the program must be outweighed by the increased productivity. The actual cost of the training program can be difficult to obtain, as the costs of the instructor, facilities, employees' time away from work, and the cost of

[54] C. W. Read and B. H. Kleiner, "Which Training Methods are Effective?" *Management Development Review* 9 (1996): 24–29.
[55] Ibid., 29.

developing the training program itself must be taken into account, as well as many other factors.

Training evaluation should include both formative and summative evaluation.[56] The formative evaluation is aimed at improving the training process. It should ensure the training program is well organized and runs appropriately, as well as satisfying the trainees' needs.[57] Usually, qualitative data can be collected to determine how the trainees and management felt about the training program. If the data collected is negative, the training program can be altered to better suit the needs of the trainees.

Summative evaluation is conducted to assess the trainees' behavior and changes regarding it due to the training program. In other words, it is important to find out whether or not trainees have acquired new skills, knowledge, attitudes, behavior, or other objectives from the training program. Noe addresses the reasons for evaluating a training program below, which are to:[58]

1. Identify the programs strengths and weaknesses;
2. Assess whether the content, organization, and administration of the program—including the schedule, accommodations, trainers and materials—contribute to learning and the use to training content on the job;
3. Identify which trainees benefit most or least from the program;
4. Assist the marketing programs through the collection of information from participants about whether they would recommend the program to others, why they attended the program, and their level of satisfaction with the program;

[56] M. V. Wart, N. J. Cayer, S. Cook, *Handbook of Training and Development for the Public Sector,* (San Francisco: Jossey-Bass, 1993)
[57] R. A. Noe, *Employee Training and Development* (New York: McGraw-Hill Irwin, 2005)
[58] Ibid.

5. Determine the financial benefits and costs of the program;
6. Compare the costs and benefits of training versus nontraining investments; and
7. Compare the costs and benefits of different training programs to choose the best program.

A training program that is not evaluated properly can lead to employee dissatisfaction. Noe states, "If trainees do not perceive that the necessary equipment, monetary support, or information necessary to meet job demands will be provided, learned skills may not be demonstrated on the job and consequently, no improvements in cost-related outcomes will be realized."[59]

2.4 The Effects Training Has on Employees and Their Productivity

Training has many positive effects for not only the employee but the workplaces as well. One of the benefits of employee training is greater job satisfaction. In a management training study, it was found that the trained group members became more satisfied with their work as a result of the training when compared to the untrained group members.[60] Additionally, those trained participants who had longer periods in the same job experienced a significant positive change in satisfaction with advancement scores when compared to the untrained group.[61]

Training is also found to significantly increase wage growth potential. In the same mentioned study, the trained group had positive increases significantly different form the untrained group. Another study had similar results. Bartel found that individuals who

[59] R. A. Noe, "Trainees' Attributes and Attitudes: Neglected Influences on Training Effectiveness," *The Academy of Management Review* 11 (October 1986): 739.
[60] R. J. House and H. Tosi, "An Experimental Evaluation of a Management Training Program," *The Academy of Management Journal* 6 (December 1963): 311.
[61] Ibid.

received training experienced significantly larger wage growth and longer job tenure.[62] Bartel also states, "Individuals who received more training in their first three months of employment have significantly faster productivity growth during their first two years with the employer."[63]

Training implementation can also create employee loyalty. In regards of a study performed to find the results of an in-company training program, the authors noted that if workers perceive training as a gift, they may also view it as a signal of employer commitment.[64] "For a firm, general training may be inexpensive insurance covering investment in a worker's specific training since research reports that employees receiving general training are more likely to remain with firms, thereby reducing turnover costs."[65] In her book entitled *Psychological Contracts in Organizations: Understanding Written and Unwritten Agreements,* Rousseau states,

> The provision of general training forms part of the psychological contract between the employer and the employee. The employee interprets the provision of general training as an unwritten sign from the employer about the nature of their relationship. The employee may thus interpret the provision of general training to mean that the employer sees the employee as being a core member of the organization, meaning that his or her position is more permanent than others.[66]

---

[62] A. P. Bartell, "Formal Employee Training Programs and Their Impact on Labor Productivity: Evidence From a Human Resources Survey," *National Bureau of Economic Research Working Paper Series,* (Cambridge, publisher, 1989)
[63] Ibid.
[64] A. Barrett and P. J. O'Connell, "Does Training Generally Work? The Returns to In-Company Training," *Industrial and Labor Relations Review* 54 (April 2001): 659.
[65] U. E. Gattiker, "Firm and Taxpayer Returns from Training of Semiskilled Employees," *The Academy of Management Journal* 38 (August 1995): 1154.
[66] D. M. Rousseau, *Psychological Contracts in Organizations: Understanding Written and Unwritten Agreement,* (California: Sage, 1995)

Most everyone agrees that effective training will increase productivity. In a study performed by Bartel, she found that businesses that were operating below their expected labor productivity levels in 1983 that introduced a training program increased their productivity levels significantly, some by as much as 17%. [67]

2.5 What Production Home Builders Have Done With Respect to Training

There are many production home builders in the industry today that have implemented formal training programs. They have done this to not only train their employees, but to help retain them as well.

Toll Brothers, a nationwide luxury home builder has implemented such a training program. Toll Brothers calls it their "Assistant Project Manager in Training" (APM) program.[68] In this program, the assistant project manager is immersed in a 16-month training program. Marc Buffet, a recent Toll Brother's recruit had this to say about the program: "When you're an APM trainee in auditing, you get to see, in glorious detail, what you'll be graded on for your entire Toll Career before you get immersed in a project."[69]

Jon Downs, vice president of human resources for Toll Brothers, states, "We try to train our project managers to not be construction managers, but to be well-rounded real estate professionals. They're cycled through different disciplines that ultimately are all the disciplines a project manager of a community will handle."[70]

---

[67] A. P. Bartel, "Productivity Gains From the Implementation of Employee Training Programs," *National Bureau of Economic Research Working Papers Series* (Cambridge,publisher, 1991),
[68] Pat Curry, "Front Line Education," [article on-line] (Big Builder Magazine, January 2005, accessed 15 May, 2006) available from http://www.tollcareercenter.com/pdfs/PMTraining.pdf; Internet
[69] Ibid.
[70] Ibid.

Toll Brothers assigns a mentor to each APM. This mentor tracks the performance of the trainee, and along with the division vice president's comments, creates the first evaluation that is placed into the employee's file.[71] A benefit that has come from this training program is employee loyalty. Downs states, "While the training program is demanding and intense, attrition is less than 5 percent, and it helps managers retain key employees."[72] In the project manager ranks, Toll Brothers has a turnover rate in the low teens. Down attributes this to the corporate culture that rewards employee loyalty and longevity by promoting from within.

Other builders have focused on key elements within their training program. Arvida, a large home builder in the Southeast, was having a problem closing on 5,000 units within a four-year period. To help overcome the obstacle of closing too slowly on their units, they implemented critical path-scheduling training. Arvida's focus on scheduling ultimately reduced the cycle time of certain construction activities from 30 days to less than a week.[73] As a result of this increased productivity, per employee revenues were increased from $700,000 to $1.8 million during the four-year period.[74] Kelly Daniel, the director of process control and improvement for Arvida, said, "A central scheduling system guides you to the issues that will veer you off the critical path. The issues instantly show up. It points to where you have a constraint and where you have to zero in."[75]

---

[71] Ibid.
[72] Ibid.
[73] Jay Holtzman, *Profound Productivity*, [article on-line] (Big Builder Magazine, April 4, 2003, accessed March 9, 2006) available from http://www.bigbuilderonline.com/Industry-news.asp?channelID=59&sectionID=66&articletype=1&articleID=1000029098; Internet
[74] Ibid.
[75] Ibid.

The San Diego division of William Lyon Homes was having trouble with inter-department communication and expectations. To help overcome this obstacle, a training program called "Change Your Shoes" was implemented.[76] The training program took more than a dozen sales managers and paired them with supervisors from other communities so they could see things from the other manager's perspective. They found that one of the major benefits of the training was giving managers an understanding of the issues that were facing the other departments. "That allowed them to accurately explain situations to customers in a positive way and to support each other throughout the home-buying process so that customers couldn't play one supervisor off another."[77] Many trainees commented that the training helped them relate to everyone else and improved the communication process.[78]

Pulte Homes, one of the nation's largest home builders, has involved the subcontractors into their training programs. Gary Grant, Pulte's vice president of the Minnesota division, decided to form an advisory board he called a partnership council.[79] Grant wanted the subcontractor's input on critical areas such as construction processes, job site safety, quality, and customer satisfaction.[80] Since implementing the program, the division has gone from (Curry, Quality Council 2003) building 30 homes a year with 25 employees in 1990, to building 850 homes with 89 employees in 2002. In addition, Pulte topped the Minneapolis market in the J.D. Power customer satisfaction surveys in 2002 and took a silver award in the NAHB's (National Home Building Association) 2003

[76] Pat Curry, *Sole Reversal*, [article on-line] (Big Builder Magazine March 1 2005, accessed February 13, 2006) available from http://www.builderjobs.com/article.hwx/Q/articleId.102037; Internet
[77] Ibid.
[78] Ibid.
[79] Pat Curry, *Quality Council*, [article on-line] (Big Builder Magazine, July 9, 2003, accessed January 28 2006) available from http://www.bigbuilderonline.com/Industry-news.asp?channelID=59&sectionID=65&articletype=1&articleID=1000030356; Internet
[80] Ibid.

National Housing Quality Awards.[81] One of Pultes's subcontractors had this to say about the new program: "We're a whole different company than we were five years ago. They take us to trainings and bring in consultants to do process flow training. We have the screws down so tight on the process that we know where we're dropping the ball."[82]

The program helped the Company re-evaluate its construction schedule to ensure smooth progress and has helped rewrite the purchasing department's specs and the general specifications for home maintenance.[83]

In conclusion, organizations that train their employees receive numerous benefits besides greater productivity. Employees who are well trained require less time from managers and reflect well on the person who hired them. Trained employees tend to make better decisions, solve problems faster, possess greater communication skills, suggest more improvements and innovations, have longer job tenure, receive higher salaries, and enjoy their work more thoroughly.

[81] Ibid.
[82] Ibid.
[83] Ibid.

CHAPTER 3

Research Methodology

3.1 Methodology

The amount of time that it is required to build and complete a home was the most important factor on which to focus the training program. The results, however, needed to be measurable and quantifiable. Throughout the home building process, there were several home inspections conducted by either county or city inspectors. During these inspections, completeness and correctness were accounted for by the inspector. Failed inspections caused delays during the construction and disrupt the timing of crucial activities throughout the process. Therefore, the training focused on the activities that needed to be completed to successfully pass the home inspections. In addition, training and policies were provided to help superintendents reduce the number of punch list items for each home.

The Company had approximately 20 construction management personnel at the time these trainings were conducted. The training was administered through the area managers and the division vice president. The results were tracked and compared to previous years' outcomes. Additionally, qualitative data was collected to determine the effectiveness of the training. This was done through personal interviews and a survey questionnaire. The study compared the data from the last 6 months of 2006 to the whole year of 2007. Training began in January of 2007.

3.2 Summary of Training Program

The training-program goals included the following:

1. Teach the Company superintendents and area managers construction management techniques such as utilizing more efficient scheduling techniques and programs for gaining greater control and planning of the integrated components of home-construction stages.
2. Have superintendents and area managers apply the learned techniques and develop more effective scheduling of construction components by utilizing the training tools and by providing additional support to ensure their understanding and ability to schedule and plan with greater efficiency and proficiency.
3. Make further training refinements by receiving feedback through assessment of their perceived value of the training.

3.3 Data Collection and Analysis Methodology

3.3.1 Delivery of Training Program

The training delivery was performed by holding weekly meetings in which every superintendent was required to attend. Prior to January 2007, there were no formal meetings being held. In these meetings, new management tools and policies were introduced to help the construction superintendent. The primary training program included topics such as scheduling, homeowners' walks, Buzzsaw, computer and e-mail use, and build quality.

It was decided by upper management that the construction managers were to meet on a weekly basis. The training meetings were approximately 90 minutes in length. In attendance were assistant superintendents, superintendents, area managers, and the

division senior vice President, who generally conducted the training sessions. An agenda was followed, and topics relevant to any construction problems were discussed.

The first topic that was focused on was scheduling. A scheduling tool was introduced to the construction managers that would allow them to track their construction activities, showing how many days ahead or behind they were on each house. The superintendent was responsible for reporting the construction status for each house on a daily basis. Additionally, managerial reports were created by the program that would show each superintendent's projects and the build times. These reports allowed the area managers the ability to look at any project and see when the house was delayed and by what construction activity. With this knowledge, the area manager and superintendent could pinpoint problem areas to work on to ensure that it would not happen again.

Part of the training program included adopting more effective policies. In previous years, the Company allowed the homeowner to move into his or her home with walk items still needing to be completed. The Company adopted a new policy, requiring the homeowner to conduct a second walk, five calendar days after the first. During this walk, the homeowner inspects the corrected items from the first walk and ensures that they are fixed to his or her satisfaction. The homeowner then "signs off" on the house, stating that he or she is satisfied with the completion of their home. The homeowner is not allowed to close on the house until the "Completion of Acceptance Form" has been signed.

Another policy that was introduced was the PCI, meaning "pre-carpet inspection". Too many houses were being walked by the superintendent without the home being 100% complete. The house may have been missing appliances, options, hardware, and so

on. The PCI is performed by the area manager and is intended to find any items that need to be corrected by the homeowner walk. Everything 12 inches from the floor and up is inspected and any corrections needed are noted. Carpet is not allowed to be installed until these items have been completed.

Along with new management tools and policies, computers and Internet access was introduced to each construction manager. Each job site was given a computer and each employee an e-mail address. Communication from the office and sales to the field would be conducted through e-mail.

A software program called Buzzsaw was also introduced. This program allows information such as floor plans, homeowner options, and scopes of work to be viewed and downloaded from the Internet. This program allowed the superintendent and subcontractor to verify options, permit numbers, plans, corrections, and other vital information while on the job site.

The training meeting also included quality control measures. Pictures showing examples of correct and incorrect building practices were viewed and commented on extensively. Various subcontractors were also invited to the meetings to improve communication and to ensure the Company's expectations were met regarding quality standards.

At the end of 2007, a questionnaire was given to the superintendents and area managers. Those who conducted the training were not present and the participants remained anonymous. The questionnaire-item content for assessing the training can be found in Appendix A.

3.4 Statistical Analysis for Training Assessment

3.4.1 Descriptive and Inferential Statistics for Satisfaction Survey Results

This portion of the study utilized SPSS software to produce frequency counts and averages along with potential correlations with the number of years experience with the Company and in the home construction industry. Results are presented in table format for the Likert items and a reporting of statistical significance values with correlations that have a p-value below 0.05. For the correlation portion, a nonparametric Spearman correlation procedure was utilized due to the small sample size.

3.4.2 Sample, Data Collection, and Analysis Methodology for Construction Cycle Time Research

The sample for this portion of the study consists of two subgroups of homes: those that were constructed under the direction of those without the training (control) versus those constructed after the application of the provided training (treatment). The subgroups were examined within individual job sites in order to control the effects of specific site/location dynamics, home model type (and associated square footage), and superintendent variations within a total of 8 job sites. In the case of the control (no training) subgroup, a total of 349 homes were examined in terms of variables needed in conducting statistical analysis. For the treatment (training) subgroup, 292 homes were utilized for the comparison. It must be noted that for the control group, data collection was conducted beginning in the second half of 2006 after all the logistics were put into place by the Company for the commencement of the study. Data values were collected for several variables that allowed for a meaningful comparison, and these variables and their operational definitions are discussed next.

The following is a listing of the 8 job sites and the sample size for each within the 2006 control subgroup and the 2007 treatment subgroup.

Job Site	2006 sample size	2007 sample size
BR	25	12
CY	33	20
LC	27	21
PA	33	52
PC	47	53
RV	57	48
VL	57	39
VV	70	47

3.4.3 Construction Cycle Times Variables and their Operational Definitions

The following variables along with their operational definitions form the basis for statistical analysis used to answer the question as to whether training provided for a statistically significant reduction in construction cycle times.

Variable	Operational Definition
ID	Superintendent ID number
Subgroup year (2007 with training) homes	Either Control (2006 with no training) or Treatment
Superindentent Years Experience	Number of years with home-construction Experience by superintendent
Plan Number	Specific plan number within job site

Square Feet	Total square footage for each home plan
Permit date	The date in mm/dd/yy form when permit was received to initiate construction
Final (finished) date	Certificate of Occupancy

3.5 Statistical Analysis for Cycle Times

3.5.1 Descriptive Statistics for Construction Cycle Time Study

For the data collected relative to the construction cycle time portion of this study, a data file was developed for each job site using Microsoft Office Excel; these files were then imported into statistical software for analysis. The initial analysis of the data involved finding descriptive statistics for all variables including both numeric frequencies counts, and graphs, including bar graphs for nominal and ordinal data, and histograms and box plots for scale data measurements. Additionally, the descriptive statistics are presented separately for the two subgroups of training (2007 homes) versus non-training (2006 homes) cases.

A breakdown of mean construction cycle times for each job site is presented nested within the training (2007) versus non-training (2006) groups and within home-plan size (square footage).

3.5.2 Inferential Statistical Analysis for Construction Cycle Time Study

To discern whether there was a significant reduction in the construction cycle times comparing the pre-training homes (2006) to the post-training homes (2007), analysis of covariance, using SPSS statistical software, was performed so that the size of

the home, measured in square footage, was controlled while comparing the means of the two groups. This approach maximized the likelihood that significant effects were a result of training and not other contributing factors such as home size. Additionally, the analysis was conducted within each job site to control for the specific job site attributes and other related dynamics that might have contributed to cycle time differences other than the effects of the intensive training aimed at producing greater efficiency in the home-construction process.

The results for this part of the study is presented for each of the 8 job sites and indicates whether there was a significant difference (reduction) in the mean construction cycle times comparing the no training (2006) homes to the training (2007) homes. In addition, a test of significance for the covariate of home-plan size (square footage) is presented.

3.5.3 Cost-Benefit Analysis for Cycle Times Reduction Resulting from Training

Based on the assumption (supported by prior, related research) that substantial savings occurred by having far fewer days to complete construction as a result of training, an analysis of the savings relative to the cost of training and program acquisition costs was conducted for the company. The daily interest costs for each home built was approximately $100. This cost was multiplied by the average number of reduced cycle days to compute an estimated per-home savings. Again, this value was contrasted with the training related costs.

CHAPTER 4

Results

4.1 Summary of Statistical Analysis for Training Assessment

The first part of the analysis dealt with assessing the training participant satisfaction regarding qualitative comments/offerings by training participants. The second part dealt with the statistical analysis for the construction cycle time.

The following is a summary of the mean ratings and mode for the 1-to-5 (1-is-the-lowest-to-5-is-the-highest rating) Likert scale for the training satisfaction survey for the sample (n=15) and the means for items 12 and 13, which deal with years of experience.

Item	Mean	Mode
1. You find the weekly superintendent meetings helpful.	4.13	4
2. You find TracTime to be a useful tool.	4.20	4
3. You find the PCI program to be effective.	3.33	4
4. The policy change regarding homeowner walks and the second walk/sign-off has been effective.	4.33	5
5. The superintendent meetings increased your overall knowledge.	3.93	4
6. The weekly meetings made clear what your duties and expectations are as a superintendent.	3.80	4
7. The weekly meetings enabled you as a superintendent to become successful and meet the Company goals.	3.87	4
8. The weekly meetings increased your understanding and knowledge, with regard to Zurich inspections.	4.40	5

9. The homeowner option process, from selections to the configuration list, is clear.	3.60	4
10. Buzzsaw has been an effective tool.	4.00	4
11. Computer, e-mail, and Internet access made your job easier.	4.60	5
12. Number of years with the Company.	4.70	2
13. Total number of years in the home-construction industry.	12.93	14

All rating items have a mean well above average and the mode was a rating of 4 for all items except for survey item 4 ("The policy change regarding homeowner walks and the second walk/sign-off has been effective"), item 8 ("The weekly meetings increased your understanding and knowledge, with regard to Zurich inspections"), and item 11 ("Computer, email, and internet access made your job easier"), with these particular items having a mode of 5 (highest rating). Below are comments given by the superintendents on selected questions.

4.2 Responses for Likert Survey Items 1 through 4

Item 1: You find the weekly superintendent meetings helpful.

"Keeps everyone on the same page."

"It's helpful to solve problems that arise."

"Keeps communication current."

"Opens communication between superintendents to discuss problems and solutions."

"It helps keep subcontractors up to date on the builder's position on current issues."

"Very helpful in helping you become updated."

"Good to bounce ideas around and address issues."

Item 2: You find TracTime to be a useful tool.

"Allows the baseline schedule to be followed and evaluated each day."

"It keeps everyone aware of the status of the homes you're building."

"Helps keep the Company informed."

"Helps keep me on my schedule."

"It's simple and effective."

Item 3: You find the PCI program to be effective.

"It provides another set of eyes."

"No, it's not effective because I walk my houses daily."

"It helps the subcontractors complete their homes faster."

"Yes, it's effective because it provides another set of eyes to catch things that I miss."

"It produces a cleaner house."

Item 4: The policy change regarding homeowner walks and the second walk/sign-off has been effective.

"Yes, because it gives me time to complete my items."

"It helps subs complete their items on time."

"It gives the buyer a sense of comfort that the items will be completed on time."

"There is now a clear cut method to getting a sign-off with clear time frames."

4.3 Qualitative Summary of Training Participants' Opinions

There are a number of comments that were made by training participants that are now presented in the context of a qualitative assessment.

The next responses were given to open-ended questionnaire items as listed below.

4.3.1 Open-ended Response Questions

1. Is there anything that inhibits you from completing your tasks sooner and more efficiently?

   Responses:

   "Occasionally, communication is slower than it should be."

   "Sales training would be effective, both for construction and the sales staff."

   "Options need to be selected in a timely manner."

   "Communication between sales and superintendents could be improved."

   "Getting option information is sometimes difficult."

2. What is the Company lacking in regards to training?

   Responses:

   "Nothing."

   "Training in regards to the new 2006 code."

   "Onsite training—from the start of the house to completion."

   "More training could be given on how to read plans."

   "Hiring qualified people."

   "Training is adequate."

3. Have you noticed a change in management at the Company? Has it been a help or hindrance?

    Responses:

    "The Company has had to make several changes to adapt to the market. They were good for the most part."

    "They've been helpful."

    "It has been a help in clarifying responsibility."

    "No change."

    "Yes, it's been helpful."

4.4 Descriptive Statistics for Survey Items 12 and 13

The tables for question 12 and 13 can be found in Appendix C. Item 12 solicited the "number of years with the Company" and item 13 asked for "total number of years in the home-construction industry." 4.7 was the average number of years that the superintendents have been with the company, with each superintendent averaging nearly 13 years in the homebuilding industry.

4.4.1 Correlation of Items 1 through 11 with Items 12 and 13

As for the correlation between the years of experience items 12 and 13, only two significant correlations were found. There is a significant positive correlation value of 0.614 ($p<0.015$) between item 12 (Number years with the Company) and the rating for item 9 (The homeowner option process, from selections to the configuration list is clear), indicating those with a higher number of years with the Company giving a higher rating of this training item. A significant negative correlation value of -0.543 ($p<0.036$) has

been found between item 13 (Total number of years in the home construction industry) and the rating for item 7 (The weekly meetings enabled you as a superintendent to become successful and meet the Company goals). Here, the indication is that those with less experience in the home construction industry rated the weekly meeting aspect of training higher than those with more experience. A complete display of correlation matrix results can be found in Appendix D.

4.5 Summary of Statistical Analysis for Construction Cycle Time Research

4.5.1 Means Breakdown and Analysis of Covariance Statistical Analysis for Construction Cycle Time Research

The results of the means breakdown and analysis of covariance for all of the job sites are presented in the table format and are located in Appendix E. The tables display the mean construction cycle time broken down by year and square footage for each job site, showing the average days saved.

4.5.2 Cost-Benefit Analysis for Cycle Times Reduction Resulting from Training

Based on the daily interest costs that the company spends on a house under construction, the savings were realized when multiplied by the number of days that were saved. Each project's interest's costs were approximated based on lot size and construction loan costs. When the number of days that were saved was multiplied by the sample size and daily interest costs, the savings per project was calculated.

For the 8 job sites examined in this study, the total days saved for the 292 homes built in 2007 is presented for each job site in table 4-1.

Table 4-1 Estimated Savings by Job Site in Days and Dollars

Job Site	2007 Sample Size	Average Days Saved	Daily Interest Costs	Total Savings
BR	12	76	$ 61.00	$ 55,632.00
CY	20	13	$ 120.00	$ 31,200.00
LC	21	35	$ 122.00	$ 89,670.00
PA	52	146	$ 120.00	$ 911,040.00
PC	53	48	$ 100.00	$ 254,400.00
RV	48	40	$ 70.00	$ 134,400.00
VL	39	156	$ 105.00	$ 638,820.00
VV	47	142	$ 140.00	$ 934,360.00
			Total	$ 3,049,522.00

Based on the savings values in the table above, the total estimated savings realized was $3,049,522. The total cost of training in time for employees (including travel time and actual time spent in weekly training meetings), in addition to computers, scheduling programs, and office support, was estimated to be $75,000. Thus, the total savings in just the year 2007 for the Company was estimated to be $2,974,522.

CHAPTER 5

Discussion and Conclusions

5.1 Findings of Statistical Analysis for Training Assessment

From the analysis of the training assessment, the salient research findings are as follows:

1) There was overall satisfaction with all average ratings (on a 5-point Likert scale) being well above average, with the mode (most frequently occurring response) being at least a rating of 4 (above average satisfaction) for all items. The lowest average was 3.33 for item 3, which stated "You find the PCI program to be effective**,"** and the highest rating of 4.70 was given to item 11 that asked if "Computer, e-mail, and Internet access made your job easier," followed by item 8, which asked if "The weekly meetings increased your understanding and knowledge, with regard to Zurich inspections," with a mean rating of 4.40.
2) Qualitative comments that were made indicate that for item 1 "You find the weekly superintendent meetings helpful." There was a common positive expression regarding improved communications, problem resolution, and employees being kept up-to-date on important matters affecting the construction process and progress. Comments on item 2—"You find TracTime to be a useful tool"—pointed to the appreciation that trainees had for this tool in helping them keep on schedule and keep Company managers aware of construction status. Regarding item 3—"You find the PCI program to be effective"—there was a feeling

that the program "provides another set of eyes," "makes for a cleaner home," and "expedites the construction process." For comments on item 4—"The policy change regarding homeowner walks and the second walk/sign-off has been effective"—there was a feeling that this change facilitated the completion of items in a timelier manner. Further open-ended response questions produced a variety of offerings, but there was a general positive feeling toward management changes, especially involving the use of the new software, efficiency tools, and computer applications, all for which training was provided.

5.2 Discussion of Means Breakdown and Analysis of Covariance Statistical Analysis for Construction Cycle Time Results

Analysis of the mean construction cycle times for the 8 job sites used in this study indicated that for most job sites, there was a substantial reduction in the average total cycle days when comparing pre-training versus post-training homes within each particular site. The average reduction, after training was provided, ranged from approximately 13 days to 156 days with an overall weighted (by job site sample size) mean for all homes examined in the aggregate sample being 91.5 days, or approximately 3 months.

Analysis of covariance was utilized in comparing the mean construction cycle days for pre-training versus post-training homes within each job site. This statistical procedure allowed for the control of plan size, in square feet, as the covariate. All but one of the 8 job sites yielded a statistically significant ($p<0.05$) reduction in the average construction cycle time. For the one job site (Las Colinas **)** that was not statistically significant, it was quite close to the criterion of $p<0.05$ with the significance value at this

job site being p=0.055; the average cycle time savings for Las Colinas was nevertheless seen to be 35 days.

Thus, there is reason to believe that the training program provided as part of this research study was successful in reducing the construction cycle time. There are however, a number of potential uncontrollable contributing factors that could have affected the outcome of the investigation, and they will be discussed next.

5.3 Validity Issues

With respect to this study, there are a number of imponderables and issues that may have affected the results and validity, including the following:

1) The internal validity factor of *history* is a source of concern in this study due to the drastic downturn in the housing and home-construction market in the Las Vegas area. This uncontrollable dynamic factor opens the potential for some to argue that the rather substantial reduction in average construction cycle time could be due to increased and rapid availability of subcontractors to complete projects in a more timely fashion. However, with the decrease in available work, subcontractors have reduced their labor force, making it more difficult for them to manage their projects. One such concrete contractor had 25 superintendents covering the Las Vegas area. They now have only 4 superintendents, making it more difficult for them to oversee each project.
2) Various inspection schedules by code inspectors were undoubtedly less demanding with the reduction in homes being built. One can argue that this allowed the inspector to perform all of their inspections assigned to them that day without them having to roll over inspections to the next day. However, inspectors

now have more time to perform their inspections. This allows them the ability to find deficiencies and fail the inspection.

3) An argument can be made to the effect that with such a downturn in the housing market, a greater sense of urgency in reducing construction cycle times developed in order to complete and sell off inventory while demand was curtailing.
4) The validity matter of *mortality* is a potential issue relative to this study in that there were numerous Company employees, including superintendents, who were terminated due to the drastic decrease in demand for new homes. This means that some of the reduction could be due to the retention of more efficient and qualified employees while terminating those who were less productive. Those retained by the Company may have become somewhat more efficient out of fear of potential termination in light of the deteriorating demand in the new home construction market.
5) Another potential validity issue in this case might be due to *maturation* and the fact that with increased experience time as a superintendent or manager, comes greater knowledge and competency in his or her performance. On average, the total years of experience in home construction by the superintendents was just under 13 years, with the average time with the Company for these individuals was reported at 4.7 years.

5.4 Conclusions and Recommendations

Based on the recorded and unrecorded comments of the superintendents and managers sampled in this study, it is felt that the training program was highly successful in reducing construction cycle time, while producing a more cleanly built home with a

reduction in punch-list items mentioned in numerous off-the-record comments by several of the Company's executives. The senior vice president stated that the training program influenced the reduction in cycle time much more than the market conditions. The overall reduction in cycle time is a considerable savings of not only time, but also, and most importantly, money for the Company, both of which being especially helpful in challenging economic times. With the company realizing nearly 3 million dollars in savings with only having invested $75,000, it can be assumed that this training program was very successful. It is unfortunate that the confounding effects of such a dynamic, down-turning market occurred during the time in which this study was conducted.

As for recommendations, it is the opinion of the author that further replication of this research be conducted over time in a variety of economic conditions, geographic locations, and home sizes to further solidify the validity and value of training effects found in this study. Also, it is valuable to continue developing and refining training to reflect newly developed technologies and to refresh the knowledge of those who have already benefited from efficiency and proficiency training programs.

BIBLIOGRAPHY

Adrian, J. J. *Construction Productivity: Measurement and Improvement.* Champaign: Stipes Publishing, 2004.

Allen, S. G. "Why Construction Industry Productivity is Declining." *The Review of Economics and Statistics*, 1985: 661.

Barrett, A., and P. J. O'Connell. "Does Training Generally Work? The Returns to In-Company Training." *Industrial and Labor Relations Review*, 2001: 654-659.

Bartel, A. P. "Forman Employee Trianing Programs and Their Impact on Labor Productivity: Evidence from a Human Resources Survey." *National Bureau of Economic Research Working Paper Series.* Cambridge: 1989

Bartel, A. P. "Productivity Gains from the Implementation of Employee Training Programs." *National Bureau of Economic Research Working Paper Series.* Cambridge: 1991.

Berkman, L *Riverside, Calif.-area construction firms recruit workers* [article on-line] The Press-Enterprise, Riverside CA 2005 accessed 18 March 2006; available from http://www.accessmylibrary.com/coms2/summary_0286-9164179_ITM; Internet

Construction Review. U.S. Department of Commerce, Washington D.C., 2002

Curry, P. *Certified Savings*, [article on-line] Big Builder, April 1 2004, accessed 15 May 2006; available from http://www.bigbuilderonline.com/industry-news.asp?channelID=55&sectionID=27&articleID=50868; Internet

Curry, P. *Front Line Education*, [article on-line] Big Builder Magazine, January 2005, accessed 15 May 2006; available from http://www.tollcareercenter.com/pdfs/PMTraining.pdf; Internet

Curry, C., *Quality Council*, [article on-line] Big Builder Magazine, July 9, 2003, accessed January 28 2006; available from http://www.bigbuilderonline.com/Industry-news.asp?channelID=59&sectionID=65&articletype=1&articleID=1000030356; Internet

Curry, P., *Sole Reversal*, [article on-line] Big Builder Magazine, March 1 2005, accessed February 13, 2006 available from http://www.builderjobs.com/article.hwx/Q/articleId.102037; Internet

Ford, J. K., and R. A. Noe. “Self-Assessed Training Needs: The Effects of Attitudes Toward Training, Managerial Level, and Function.” *Personnel Psychology*, 1987: 39.

Gagne, R.M., and Medsker, K. *The Conditions of Learning.* San Francisco: Jossey-Bass, 1991.

Gagne, R. M. “Learning Processes and Instruction.” *Training Resource Journal*, 1995/1996: 17–28.

Gagne, R.M., and Medesker, K. *The Conditions of Learning*, San Francisco: Jossey-Bass, 1991.

Gattiker, U. E. “Firm and Taxpayer Returns from Training of Semiskilled Employees.” *The Academy of Management Journal*, 1995: 1154.

Gist, M. E. “Self-efficacy: Implications for Organizationl Behavior and Human Resourced Management.” *Academy of Management Review* Vol. 12, July 1987: 472–485 as quoted by D. D. Steiner, et. al, “The Trainer-Trainee Interaction: An Attributional Model of Training” 12 (July 1991): 275.

Guthrie, J. P., and C. E. Schowoerer. “Individual and Contextual Influences on Self-Assessed Training Needs.” *Journal of Organizational Behavior*, 1994: 419.

Hand, H. H., and J. W. Slocum Jr. “Human Relations Training for Middle Management: A Field Experiment.” *The Academy of Management Journal*, 1970: 407.

Holtzman, J, *Profound Productivity*, [article on-line] Big Builder Magazine, April 4, 2003, accessed March 9, 2006 available from http://www.bigbuilderonline.com/Industry-news.asp?channelID=59&sectionID=66&articletype=1&articleID=1000029098; Internet

House, R. J., and H. Tosi. “An Experimental Evaluation of a Management Training Program.” *The Academy of Management Journal*, 1963: 311.

Howell, W. C., and N. J. Cooke. *Training the Human Information Processor: A Review of Cognitive Models.* San Francisco: Jossey-Bass, 1991.

Knowles, M. *The Adult Learner.* Houston: Gulf Publishing, 1990.

Locke, E. A., and G. D. Latham. *A Theory of Goal Setting and Task Performance.* Englewood Cliffs: Prentice Hall, 1990.

Locke, E. A., et. al. “Goal Setting and Task Performance.” *Psychology Bulleting*, 1984: 125–152.

McClenahen, J(2003, October 21*). Headed for the exits: More training and development may entice manufacturing workers to stay on the job* [Electronic version]. Industry Week, November 2003, 17.

Mitchell, J. M. "Current Trends in Public-Employee Training." *Journal of Educational Sociology*, 1941: 294.

Molenda, M. "In Search of the Elusive ADDIE Model." *Performance Imrpovement*, 2003: 34–36.

NAR'S Home Sales Forecast Looking Stronger [article on-line] Business Wire, Oct 12, 2005; accessed on 23 June, 2006; available from http://findarticles.com/p/articles/mi_m0EIN/is_2005_Oct_12/ai_n15685910; Internet.

Noe, R. A. *Employee Training and Development.* New York: McGraw-Hill Irwin, 2005.

Noe, R. A. "Trainees' Attributes and Attitudes: Neglected Influences on Training Effectiveness." *The Academty of Management Review*, Vol. 11. No. 4. 1986: 739.

Read, C. W., and B. H. Kleiner. "Which Training Methods are Effective?" *Management Development Review*, 1996: 24–29.

Rousseau, D. M. *Psychological Contracts in Organizations: Undertstanding Written and Unwritten Agreements.* Sage: 1995.

Skinner, B. F. *Science and Human Behavior*. New York: Macmillan, 1953, as quoted by R. A. New, *Employee Training and Development.* New York: McGraw-Hill Irwin, 2005.

Smith, C, *Train, train, train: and then train some more*, [article on-line] Custom Home, Sept-Oct 2004, accessed 14 January 2006; available from http://findarticles.com/p/articles/mi_m0MOR/is_6_14/ai_n6227675; Internet

Vroom, V. H. *Work and Motivation.* New York: John Wiley, 1964.

Wart, M. V., N. J. Cayer, and S. Cook. *Handbook of Training and Development for the Public Sector.* San Francisco: Jossey-Bass, 1993.

APPENDICES

APPENDIX A

Survey Questionnaire

Please rate the following item issues (1 through 11) by using the following scheme and answering in the blank provided:

1 = lowest
2 = less than average
3 = average
4 = above average
5 = highest

The degree to which:

1. You find the weekly superintendent meetings helpful. ____
2. You find TracTime to be a useful tool. ____
3. You find the PCI program to be effective. ____
4. The policy change regarding homeowner walks and the second walk/sign-off has been effective. ____
5. The superintendent meetings increased your overall knowledge. ____
6. The weekly meetings made clear what your duties and expectations are as a superintendent. ____
7. The weekly meetings enabled you as a superintendent to become successful and meet the Company goals. ____
8. The weekly meetings increased your understanding and knowledge, with regard to Zurich inspections. ____
9. The homeowner option process, from selections to the configuration list, is clear. ____
10. Buzzsaw has been an effective tool. ____
11. Computer, e-mail, and Internet access made your job easier. ____
12. Number of years with the Company. ____
13. Total number of years in the home-construction industry. ____

APPENDIX B

Descriptive Statistics for Survey Items 1 through 11

You find the weekly superintendent meetings helpful

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	2	13.3	13.3	13.3
	above average	9	60.0	60.0	73.3
	highest	4	26.7	26.7	100.0
	Total	15	100.0	100.0	

You find TracTime to be a useful tool

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	1	6.7	6.7	6.7
	above average	10	66.7	66.7	73.3
	highest	4	26.7	26.7	100.0
	Total	15	100.0	100.0	

You find the PCI program to be effective

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	lowest	1	6.7	6.7	6.7
	less than average	3	20.0	20.0	26.7
	average	3	20.0	20.0	46.7
	above average	6	40.0	40.0	86.7
	highest	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

The policy change regarding homeowner walks and the second walk/sign off is effective

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	2	13.3	13.3	13.3
	above average	6	40.0	40.0	53.3
	highest	7	46.7	46.7	100.0
	Total	15	100.0	100.0	

The superintendent meetings increased your overall knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	4	26.7	26.7	26.7
	above average	8	53.3	53.3	80.0
	highest	3	20.0	20.0	100.0
	Total	15	100.0	100.0	

The weekly meetings made clear what your duties and expectations are as a superintendent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than average	1	6.7	6.7	6.7
	average	5	33.3	33.3	40.0
	above average	5	33.3	33.3	73.3
	highest	4	26.7	26.7	100.0
	Total	15	100.0	100.0	

The weekly meetings enabled you as a superintendent to become successful and meet company goals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	4	26.7	26.7	26.7
	above average	9	60.0	60.0	86.7
	highest	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

The weekly meetings increased your understanding and knowledge with regard to Zurich inspections

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	2	13.3	13.3	13.3
	above average	5	33.3	33.3	46.7
	highest	8	53.3	53.3	100.0
	Total	15	100.0	100.0	

The homeowner option process, from selections to the configuration list is clear

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	7	46.7	46.7	46.7
	above average	7	46.7	46.7	93.3
	highest	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Buzzsaw has been an effective tool

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	average	4	26.7	26.7	26.7
	above average	7	46.7	46.7	73.3
	highest	4	26.7	26.7	100.0
	Total	15	100.0	100.0	

Computer, email, and internet access made your job easier

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	above average	6	40.0	40.0	40.0
	highest	9	60.0	60.0	100.0
	Total	15	100.0	100.0	

APPENDIX C

Descriptive Statistics for Survey Items 12 and 13

Descriptives

			Statistic	Std. Error
Number years with the Company	Mean		4.700	1.0520
	95% Confidence Interval for Mean	Lower Bound	2.444	
		Upper Bound	6.956	
	5% Trimmed Mean		4.417	
	Median		2.500	
	Variance		16.600	
	Std. Deviation		4.0743	
	Minimum		1.5	
	Maximum		13.0	
	Range		11.5	
	Interquartile Range		7.0	
	Skewness		1.244	.580
	Kurtosis		-.111	1.121
Total number of years in the home construction industry	Mean		12.933	1.8790
	95% Confidence Interval for Mean	Lower Bound	8.903	
		Upper Bound	16.963	
	5% Trimmed Mean		12.843	
	Median		12.000	
	Variance		52.960	
	Std. Deviation		7.2773	
	Minimum		2.5	
	Maximum		25.0	
	Range		22.5	
	Interquartile Range		13.0	
	Skewness		.299	.580
	Kurtosis		-1.112	1.121

Correlations for Items 1 through 6 with Items 12 and 13

Correlations

		Number years with the Homes	Total number of years in the home construction industry	You find the weekly superintendent meetings helpful	You find TracTime to be a useful tool	You find the PCI program to be effective	The policy change regarding homeowner walks and the second walk/sign off is effective	The superintendent meetings increased your overall knowledge	The weekly meetings made clear what your duties and expectations are as a superintendent
Number years with the Company	Pearson Correlation	1	.262	.099	.310	.179	.012	.167	-.073
	Sig. (2-tailed)		.346	.727	.261	.523	.966	.552	.797
	N	15	15	15	15	15	15	15	15
Total number of years in the home construction industry	Pearson Correlation	.262	1	.117	-.259	.266	-.179	.076	.008
	Sig. (2-tailed)	.346		.678	.351	.338	.524	.788	.976
	N	15	15	15	15	15	15	15	15
You find the weekly superintendent meetings helpful	Pearson Correlation	.099	.117	1	.319	-.063	-.103	.497	-.190
	Sig. (2-tailed)	.727	.678		.247	.823	.715	.059	.498
	N	15	15	15	15	15	15	15	15
You find TracTime to be a useful tool	Pearson Correlation	.310	-.259	.319	1	.000	.352	.398	.081
	Sig. (2-tailed)	.261	.351	.247		1.000	.198	.141	.774
	N	15	15	15	15	15	15	15	15
You find the PCI program to be effective	Pearson Correlation	.179	.266	-.063	.000	1	.616*	.547*	.775**
	Sig. (2-tailed)	.523	.338	.823	1.000		.015	.035	.001
	N	15	15	15	15	15	15	15	15
The policy change regarding homeowner walks and the second walk/sign off is effective	Pearson Correlation	.012	-.179	-.103	.352	.616*	1	.608*	.524*
	Sig. (2-tailed)	.966	.524	.715	.198	.015		.016	.045
	N	15	15	15	15	15	15	15	15
The superintendent meetings increased your overall knowledge	Pearson Correlation	.167	.076	.497	.398	.547*	.608*	1	.410
	Sig. (2-tailed)	.552	.788	.059	.141	.035	.016		.129
	N	15	15	15	15	15	15	15	15
The weekly meetings made clear what your duties and expectations are as a superintendent	Pearson Correlation	-.073	.008	-.190	.081	.775**	.524*	.410	1
	Sig. (2-tailed)	.797	.976	.498	.774	.001	.045	.129	
	N	15	15	15	15	15	15	15	15

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations for Survey Items

Correlations for Items 7 through 11 with Items 12 and 13

Correlations

		Number years with the Company	Total number of years in the home construction industry	The weekly meetings enabled you as a superintendent to become successful and meet company goals	The weekly meetings increased your understanding and knowledge with regard to Zurich inspections	The homeowner option process, from selections to the configuration list is clear	Buzzsaw has been an effective tool	Computer, email, and internet access made your job easier
Number years with the Company	Pearson Correlation	1	.262	-.126	.007	.602*	.023	.232
	Sig. (2-tailed)		.346	.655	.980	.018	.935	.406
	N	15	15	15	15	15	15	15
Total number of years in the home construction industry	Pearson Correlation	.262	1	-.025	-.541*	.133	-.006	.031
	Sig. (2-tailed)	.346		.929	.037	.635	.982	.913
	N	15	15	15	15	15	15	15
The weekly meetings enabled you as a superintendent to become successful and meet company goals	Pearson Correlation	-.126	-.025	1	.273	-.141	.000	.264
	Sig. (2-tailed)	.655	.929		.325	.616	1.000	.341
	N	15	15	15	15	15	15	15
The weekly meetings increased your understanding and knowledge with regard to Zurich inspections	Pearson Correlation	.007	-.541*	.273	1	.061	.385	.268
	Sig. (2-tailed)	.980	.037	.325		.828	.157	.335
	N	15	15	15	15	15	15	15
The homeowner option process, from selections to the configuration list is clear	Pearson Correlation	.602*	.133	-.141	.061	1	.000	.134
	Sig. (2-tailed)	.018	.635	.616	.828		1.000	.635
	N	15	15	15	15	15	15	15
Buzzsaw has been an effective tool	Pearson Correlation	.023	-.006	.000	.385	.000	1	.373
	Sig. (2-tailed)	.935	.982	1.000	.157	1.000		.171
	N	15	15	15	15	15	15	15
Computer, email, and internet access made your job easier	Pearson Correlation	.232	.031	.264	.268	.134	.373	1
	Sig. (2-tailed)	.406	.913	.341	.335	.635	.171	
	N	15	15	15	15	15	15	15

*. Correlation is significant at the 0.05 level (2-tailed).

APPENDIX E

Mean Construction Cycle Times for all Job Sites

Mean Construction Cycle Time by Year and Square Footage for BR Job Site

TOTAL CYCLE DAYS

year	sqrftage	Mean	N	Std. Deviation
NO TRAINING 2006	1402	186.10	10	10.365
	1624	183.67	3	13.279
	1895	173.00	2	.000
	1897	191.20	5	18.254
	2288	200.80	5	9.418
	Total	188.72	25	13.551
TRAINING 2007	1402	111.50	2	17.678
	1624			
	1895			
	1897	111.38	8	13.179
	2288	117.00	2	1.414
	Total	112.33	12	11.995
Total	1402	173.67	12	30.976
	1624	183.67	3	13.279
	1895	173.00	2	.000
	1897	142.08	13	42.968
	2288	176.86	7	41.611
	Total	163.95	37	38.478

From the results in this table, that there was a substantial reduction in the total construction cycle time for the year 2007 (post-training) compared to 2006 (pre-training), with an average reduction of over 76 days for the post-training homes as the average cycle days for 2006 pre-training homes was 188.72 while the post-training homes in 2007 was 112.33.

Analysis of Covariance Results for BR Job Site

Tests of Between-Subjects Effects

Dependent Variable: TOTAL CYCLE DAYS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	47871.846[a]	2	23935.923	149.929	.000
Intercept	17609.632	1	17609.632	110.303	.000
sqrftage	561.661	1	561.661	3.518	.069
year	47479.527	1	47479.527	297.401	.000
Error	5428.046	34	159.648		
Total	1047796.000	37			
Corrected Total	53299.892	36			

a. R Squared = .898 (Adjusted R Squared = .892)

From the results in this table, there was a significant ($p<0.001$) difference in the average construction cycle times comparing the year 2006 pre-training homes to the year 2007 post-training homes. It should be noted that the covariate variable of home size, in square footage, was not significant ($p=0.069$).

Mean Construction Cycle Time by Year and Square Footage for CY Job Site

TOTAL CYCLE DAYS

year	squareftage	Mean	N	Std. Deviation
NO TRAINING	1524			
	2356	187.00	4	27.350
	2741	161.11	9	10.741
	3175	159.20	20	23.176
	Total	163.09	33	22.358
TRAINING	1524	142.00	1	.
	2356	164.00	6	21.973
	2741	138.71	7	23.669
	3175	151.67	6	5.428
	Total	150.35	20	20.607
Total	1524	142.00	1	.
	2356	173.20	10	25.664
	2741	151.31	16	20.428
	3175	157.46	26	20.605
	Total	158.28	53	22.398

From the results in this table, there was a reduction in the total construction cycle time for the year 2007 (post-training) compared to 2006 (pre-training), with an average reduction of approximately 13 days for the post-training homes, as the average cycle days for 2006 homes was 163.09 while the post-training homes built in 2007 was 150.35.

Analysis of Covariance Results for CY Job Site

Tests of Between-Subjects Effects

Dependent Variable: TOTAL CYCLE DAYS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3270.971[a]	2	1635.486	3.584	.035
Intercept	29888.699	1	29888.699	65.500	.000
SFT	1249.494	1	1249.494	2.738	.104
year	2962.745	1	2962.745	6.493	.014
Error	22815.784	50	456.316		
Total	1353923.000	53			
Corrected Total	26086.755	52			

a. R Squared = .125 (Adjusted R Squared = .090)

From the results in this table, there was significant ($p<0.014$) difference in the average construction cycle times comparing the year 2006 pre-training homes to the year 2007 post-training homes. It should be noted that the covariate variable of home size, in square footage, was not significant ($p=0.089$).

Mean Construction Cycle Time by Year and Square Footage for LC Job Site

Report

TOTAL CYLCLE DAYS

year	sqrftage	Mean	N	Std. Deviation
NO TRAINING 2006	2409	217.2500	4	62.05038
	3209	238.3333	6	62.35597
	3307	204.6667	3	47.92007
	3514	266.3571	14	40.33439
	Total	246.0000	27	52.37439
TRAINING 2007	2409	212.5000	2	4.94975
	3209	203.5000	8	88.79189
	3307	192.7500	4	33.44025
	3514	228.8571	7	82.28695
	Total	210.7619	21	71.83725
Total	2409	215.6667	6	48.17745
	3209	218.4286	14	77.85066
	3307	197.8571	7	36.94784
	3514	253.8571	21	58.45450
	Total	230.5833	48	63.44702

From the results in this table, there was a reduction in the total construction cycle time for the year 2007 (post-training) compared to 2006 (pre-training), with an average reduction of approximately 35 days for the post-training homes, as the average cycle days for 2006 homes was 246.00 while the post-training homes built in 2007 was 210.76.

Analysis of Covariance Results for LC Job Site

Tests of Between-Subjects Effects

Dependent Variable: TOTAL CYLCLE DAYS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	21318.188[a]	2	10659.094	2.857	.068
Intercept	7421.385	1	7421.385	1.989	.165
sqrftage	6650.331	1	6650.331	1.783	.189
year	14486.709	1	14486.709	3.883	.055
Error	167881.478	45	3730.700		
Total	2741296.000	48			
Corrected Total	189199.667	47			

a. R Squared = .113 (Adjusted R Squared = .073)

From the results in Table 4.6, there was nearly a significant (p=0.055) difference in the average construction cycle times comparing the year 2006 pre-training homes to the year 2007 post-training homes. It should be noted that the covariate variable of home size, in square-footage, was also not significant (p=0.189).

Mean Construction Cycle Time by Year and Square Footage for PA Job Site

Report

TOTAL CYCLE DAYS

year	sqrftage	Mean	N	Std. Deviation
NO TRAINING 2006	1922			
	2574	295.25	12	57.403
	2843	303.14	7	43.272
	3124	309.79	14	29.944
	Total	303.09	33	43.482
TRAINING 2007	1922	127.00	1	.
	2574	216.40	5	87.071
	2843	149.33	21	46.839
	3124	152.75	24	32.336
	Total	157.08	51	48.675
Total	1922	127.00	1	.
	2574	272.06	17	74.379
	2843	187.79	28	81.494
	3124	210.61	38	82.814
	Total	214.44	84	85.455

From the results in this table, that there was a substantial reduction in the total construction cycle time for the year 2007 (post-training) compared to 2006 (pre-training), with an average reduction of approximately 146 days for the post-training homes, as the average cycle days for 2006 homes was 303.09 while the post-training homes built in 2007 was 157.08.

Analysis of Covariance Results for PA Job Site

Tests of Between-Subjects Effects

Dependent Variable: TOTAL CYCLE DAYS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	427342.239[a]	2	213671.120	96.810	.000
Intercept	34105.622	1	34105.622	15.453	.000
sqrftage	187.950	1	187.950	.085	.771
year	416807.398	1	416807.398	188.847	.000
Error	178776.463	81	2207.117		
Total	4468835.000	84			
Corrected Total	606118.702	83			

a. R Squared = .705 (Adjusted R Squared = .698)

From the results in this table, there was a significant ($p<0.001$) difference in the average construction cycle times comparing the year 2006 pre-training homes to the year 2007 post-training homes. It should be noted that the covariate variable of home size, in square-footage, was not significant ($p=0.771$).

Mean Construction Cycle Time by Year and Square Footage for PC Job Site

Report

TOTAL CYCLE DAYS

year	sqrftage	Mean	N	Std. Deviation
NO TRAINING 2006	1746	202.50	6	28.020
	1772	185.61	18	16.999
	2014	191.00	2	1.414
	2478	187.00	3	13.454
	2565	244.00	1	.
	3139	186.35	17	16.981
	Total	189.60	47	19.926
TRAINING 2007	1746	152.20	10	47.098
	1772	126.19	16	13.303
	2014	132.00	3	31.177
	2478	122.17	6	26.430
	2565	144.00	2	26.870
	3139	158.13	16	38.490
	Total	141.28	53	34.763
Total	1746	171.06	16	47.171
	1772	157.65	34	33.700
	2014	155.60	5	39.125
	2478	143.78	9	39.150
	2565	177.33	3	60.781
	3139	172.67	33	32.309
	Total	163.99	100	37.504

From the results in this table, there was a substantial reduction in the total construction cycle time for the year 2007 (post-training) compared to 2006 (pre-training), with an average reduction of approximately 48 days for the post-training homes, as the average cycle days for 2006 homes was 189.60 while the post-training homes built in 2007 was 141.28.

Analysis of Covariance Results for PC Job Site

Tests of Between-Subjects Effects

Dependent Variable: TOTAL CYCLE DAYS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	59679.021[a]	2	29839.511	36.377	.000
Intercept	151680.418	1	151680.418	184.911	.000
sqrftage	1536.105	1	1536.105	1.873	.174
year	57618.266	1	57618.266	70.241	.000
Error	79567.969	97	820.288		
Total	2828519.000	100			
Corrected Total	139246.990	99			

a. R Squared = .429 (Adjusted R Squared = .417)

From the results in this table, there was a significant ($p<0.001$) difference in the average construction cycle times comparing the year 2006 pre-training homes to the year 2007 post-training homes. It should be noted that the covariate variable of home size, in square-footage, was not significant ($p=0.174$).

Mean Construction Cycle Time by Year and Square Footage for RV Job Site

Report

TOTAL CYCLE DAYS

year	sqrftage	Mean	N	Std. Deviation
NO TRAINING 2006	1346	144.67	6	22.722
	1574	139.50	4	19.018
	1696	139.67	12	16.642
	1772	143.04	26	17.970
	1915	140.44	9	14.328
	Total	141.84	57	17.222
TRAINING 2007	1346	98.00	1	.
	1574	99.22	9	14.122
	1696	105.12	26	14.129
	1772	99.33	6	7.763
	1915	96.83	6	5.981
	Total	102.10	48	12.722
Total	1346	138.00	7	27.227
	1574	111.62	13	24.449
	1696	116.03	38	21.958
	1772	134.84	32	23.886
	1915	123.00	15	24.883
	Total	123.68	105	25.070

From the results in this table, there was a substantial reduction in the total construction cycle time for the year 2007 (post-training) compared to 2006 (pre-training), with an average reduction of approximately 40 days for the post-training homes, as the average cycle days for 2006 homes was 141.84 while the post-training homes built in 2007 was 102.10.

Analysis of Covariance Results for RV Job Site

Tests of Between-Subjects Effects

Dependent Variable: TOTAL CYCLE DAYS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	41186.958[a]	2	20593.479	86.885	.000
Intercept	10978.439	1	10978.439	46.319	.000
sqrftage	40.026	1	40.026	.169	.682
year	41145.202	1	41145.202	173.594	.000
Error	24176.032	102	237.020		
Total	1671422.000	105			
Corrected Total	65362.990	104			

a. R Squared = .630 (Adjusted R Squared = .623)

From the results in this table, there was a significant ($p<0.001$) difference in the average construction cycle times comparing the year 2006 pre-training homes to the year 2007 post-training homes. It should be noted that the covariate variable of home size, in square-footage, was not significant ($p=0.682$).

Mean Construction Cycle Time by Year and Square Footage for VL Job Site

Report

TOTAL CYCLE DAYS

year	sqrftage	Mean	N	Std. Deviation
NO TRAINING 2006	1922	256.80	5	78.871
	2575	278.59	17	71.921
	2843	265.42	12	94.132
	3124	303.61	23	86.108
	Total	284.00	57	82.961
TRAINING 2007	1922	121.13	8	8.659
	2575	123.25	12	8.159
	2843	126.13	8	19.766
	3124	139.33	9	27.102
	Total	127.32	37	18.016
Total	1922	173.31	13	82.688
	2575	214.31	29	95.101
	2843	209.70	20	100.874
	3124	257.41	32	105.275
	Total	222.33	94	100.955

From the results in this table, there is a substantial reduction in the total construction cycle time for the year 2007 (post-training) compared to 2006 (pre-training), with an average reduction of approximately 156 days for the post-training homes, as the average cycle days for 2006 homes was 284.00 while the post-training homes built in 2007 was 127.32.

Analysis of Covariance Results for VL Job Site

Tests of Between-Subjects Effects

Dependent Variable: TOTAL CYCLE DAYS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	560474.052[a]	2	280237.026	65.831	.000
Intercept	32728.115	1	32728.115	7.688	.007
sqrftage	9727.384	1	9727.384	2.285	.134
year	495879.123	1	495879.123	116.489	.000
Error	387376.724	91	4256.887		
Total	5594321.000	94			
Corrected Total	947850.777	93			

a. R Squared = .591 (Adjusted R Squared = .582)

From the results in this table, there was a significant ($p<0.001$) difference in the average construction cycle times comparing the year 2006 pre-training homes to the year 2007 post-training homes. It should be noted that the covariate variable of home size, in square-footage, was not significant ($p=0.134$).

Mean Construction Cycle Time by Year and Square Footage for VVJob Site

Report

TOTAL CYCLE DAYS

year	sqrftage	Mean	N	Std. Deviation
NO TRAINING 2006	1402	259.00	7	56.448
	1624	334.00	1	.
	1895	289.60	10	69.899
	1897	268.20	10	74.417
	2058	205.67	6	177.676
	2288	283.89	9	34.758
	2635	307.11	27	83.626
	Total	282.94	70	87.071
TRAINING 2007	1402	118.29	7	9.123
	1624			
	1895	146.00	2	.000
	1897	125.29	17	13.023
	2058	157.13	8	60.051
	2288			
	2635	160.85	13	57.370
	Total	140.38	47	42.475
Total	1402	188.64	14	82.704
	1624	334.00	1	.
	1895	265.67	12	84.391
	1897	178.22	27	83.468
	2058	177.93	14	121.264
	2288	283.89	9	34.758
	2635	259.58	40	102.413
	Total	225.68	117	100.755

From the results in this table, there was a substantial reduction in the total construction cycle time for the year 2007 (post-training) compared to 2006 (pre-training), with an average reduction of approximately 142 days for the post-training homes, as the average cycle days for 2006 homes was 282.94 while the post-training homes built in 2007 was 140.38.

Analysis of Covariance Results for VV Job Site

Tests of Between-Subjects Effects

Dependent Variable: TOTAL CYCLE DAYS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	601759.034[a]	2	300879.517	59.567	.000
Intercept	69744.497	1	69744.497	13.808	.000
sqrftage	30274.254	1	30274.254	5.994	.016
year	515385.528	1	515385.528	102.034	.000
Error	575824.624	114	5051.093		
Total	7136312.000	117			
Corrected Total	1177583.658	116			

a. R Squared = .511 (Adjusted R Squared = .502)

From the results in this table, there was a significant ($p<0.001$) difference in the average construction cycle times comparing the year 2006 pre-training homes to the year 2007 post-training homes. It should be noted that the covariate variable of home size, in square-footage, was significant ($p=0.016$).