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## The effects of Lean on employees' affective attitude in a modular homebuilding manufacturer

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# **THE EFFECTS OF LEAN ON EMPLOYEES' AFFECTIVE ATTITUDE IN A MODULAR HOMEBUILDING MANUFACTURER**

A Thesis

Submitted to the Graduate Faculty of the  
Louisiana State University and Agriculture and Mechanical College  
in partial fulfillment of the  
requirements for the degree of  
Masters of Science in Industrial Engineering

in

The Department of Construction Management and Industrial Engineering

By

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## **ABSTRACT**

Many organizational problems are related to job dissatisfaction, job-related stress, and lack of commitment in workers. Employees' Affective Attitude (EAA) involves these three factors: job satisfaction, job stress, and commitment. This research is aimed at measuring the impact of Lean concepts on EAA factors. While providing an overview of Lean production and construction, this study focuses on one fundamental Lean concept, Kaizen. This thesis describes a case study showcasing the application of Lean concepts through Kaizen events and its impact on EAA for a modular homebuilder company.

Based on previous literature a conceptual model was developed describing the potential links between Kaizen events and EAA factors. The conceptual model also took into account employee's seniority level (work experience) which might have an impact on the three factors of EAA. To measure three factors of EAA, an Employees' Affective Attitude Questionnaire (EAAQ) was compiled from other validated questionnaires. The research methodology entailed two phases Phase I aimed at developing a company-wide baseline of the current levels of EAA at a modular homebuilding company without Lean practices. In addition, Phase I analyzed any variation due to employees' seniority level on their EAA factors. Phase II aimed to characterize the state of EAA factors after implementing Lean concepts through a Kaizen event.

After surveying 82 employees in Phase I and conducting a Kaizen event at one department in Phase II, results revealed an increase in job satisfaction (11.5%) and commitment level (15.9%); whereas there a decrease in job stress level (6.7%). Results from Phase I- (pre-Kaizen), indicated that employees had moderate level of job satisfaction, commitment, and job stress for all seniority level. After conducting the Kaizen event, results of Phase II revealed that employee experienced increase in their job satisfaction and commitment level, and a decrease in

job stress level among all seniority levels. In general, the case study results suggested that Lean concepts (e.g. eliminating production waste, improving productivity, and enhancing worker's role perception) were also good concepts for improving EAA factors among different seniority levels at the modular homebuilder company.

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1. Motivation**

In the past decade, an increase of competition in the global market has led U.S. companies to change their manufacturing techniques (Modarress et.al, 2005). U.S. companies are now switching towards techniques, like Lean production, to cope with the changing trend of the market and remain competitive. Lean techniques aid in reducing cycle time, improving quality, and increasing flexibility in companies' processes (Modarress et.al, 2005). Furthermore, the implementation of Lean concepts has a positive impact on the culture of a company (Hook et.al, 2008). Lean also affects behavior of employees through learning new processes and has a positive impact on company's culture (Wiklund et.al, 2002). Therefore, Lean principles have the potential to transform the culture and behavior of employees, to one that is more proactively efficient. This thesis focuses on the construction industry, in particular the modular homebuilding.

Based on recent literature, implementing Lean concepts in construction processes may affect culture and behavior of employees positively (Hook et. al, 2008). Thus, it highlights the importance on shaping the culture of a company, through the use of Lean strategies in the construction industry. The construction industry is challenged with Employees' Affective Attitude (EAA) issues (e.g. low job satisfaction, low commitment and high levels of stress) at different organizational levels (Lingard et.al, 2007). The objective of this thesis is to explore the impact of Lean concepts, in particular Kaizen events, on the EAA in a modular homebuilder company. In addition, the relative difference on worker's EAA ratings across various seniority levels is also examined.

## **1.2. Significance**

The current research will generate awareness about the impact of Lean concepts on EAA in the modular homebuilding industry. This research will also benefit construction industries who intend to implement process improvement techniques like Lean construction, in terms of knowledge and awareness about the it potential impact on EAA.

## **1.3. Lean Construction and Kaizen Events**

Lean construction is a managerial approach for improving productivity of construction companies (Byrne et.al, 2006). The implementation of Lean construction principles results on employees learning redesigned processes that are more effective, and in turn positively impacts the company's culture (Hook et.al, 2008). Value stream mapping, five S, and Kaizen are some of the Lean tools used to improve construction processes. In this thesis, Kaizen events are chosen as a Lean tool for continuous improvement to evaluate its impact on EAA levels in a modular homebuilding company.

Kaizen is a Japanese word, which means continuous improvement and aims at enhancing the operation under a controlled working environment (Brunet et.al, 2003). Kaizen events also aim at improving the process, so that workers yield efficient performance (Brunet et.al, 2003). Kaizen events are team based activities, which aims at reducing production waste (PDTP, 2002). A successful Kaizen event is the result of a well-planned and well-structured effort that provides room for determining the root cause of problems and implementing the solution. These events have three phases: 1) planning and preparation, 2) implementation of the event, and 3) presentation of the results (PDTP, 2002). According to PDTP (2002) the first phase of Kaizen events is to explore the possible areas of improvement by observing the current process, current culture (practices been followed), and to explore solutions to improve the process. The implementation of improvement and assessment of the improved process forms the second phase

of Kaizen events. The presentation of results after the accomplishment of process improvement is executed in the third phase of Kaizen events. Further, in order to carry out an effective Kaizen event certain measures must be taken, which involves Lean team formation, identification of current culture, mapping of current process, problem identification, determination of baseline, target for improvement, and determination of variables (PDTP, 2002).

#### **1.4. Employees' Affective Attitude (EAA)**

According to Fazio et.al (1978), EAA is defined as views, outlook, and beliefs of employees towards their job. EAA is shaped by employee's work experience, and attitude regarding company's culture (Fazio et.al, 1978). Typically, employees develop different attitudes towards their work depending on their working environment and working methods (Monge et.al, 2008). In addition, EAA entails three factors: job satisfaction, job stress (stress related to workload), and commitment (Kraus, 1995). A questionnaire was developed by Rodwell et.al (1998) to measure these factors for an Australian information technology company. These factors are significant for EAAs' effectiveness and the critical role it plays in the organization's success and its development (Byrne et.al, 2006). For example, job satisfaction among employees has critical characteristics like well-defined work, freedom in performing task, quality of the work, and goal clarity (Hackman et.al, 1980). In the construction industry, all of these factors play an important role in the success of a construction project. The questionnaire developed by Rodwell et.al (1998) has been used in this thesis to measure the three EAA factors.

#### **1.5. Lean and EAA**

In previous research, Kaizen has been shown as an effective tool for the change of working climate, working methods, and working experiences (Farris et.al, 2009). The influence on EAA during a Lean implementation is a result of education, training, and participation of employees contributing towards organizational learning (Wiklund et.al, 2002). Kaizen promotes

employee empowerment and group activity, which have a positive influence on job satisfaction and employees' loyalty (Jun et.al, 2006). Process improvement initiatives like Lean promotes resource optimization, reduction in variability of process, and defect free product leading to the improvement in performance, quality of work, and reduction in job stress (Karwowski et.al, 2004). Thus, the implementation of process improvement techniques in an organization can positively impact three factors of EAA.

### **1.6. Research Purpose and Conceptual Model**

The purpose of the current study was to explore the following research question: Does Kaizen improves EAA in a modular homebuilding manufacturer? Based on an extensive review of the Lean and EAA literature, a Kaizen-EAA conceptual model was developed to address this research question (Figure 2.1). The conceptual model identifies the expected link between the Kaizen events with EAA (commitment, job satisfaction, and job stress). The concept involves the Kaizen events impacting the current working culture which ultimately may influence EAA among workers of modular homebuilding company. This conceptual model was evaluated by conducting an Employees' Affective Attitude Questionnaire (EAAQ) among the construction workers and analyzing their affective attitude before and after participation in Kaizen events.

### **1.7. Methodology**

For this study, a local modular homebuilder manufacturer was selected. The participating modular homebuilder manufacturer built stick-built and SIP walls for their homes. The company was well positioned in the residential market and was in the process of growing and expanding during the time of this study. This company was in urgent need to improve its productivity to effectively meet its customers' demand. In order to efficiently cope with growing customers' demands, the company chose to implement Lean through Kaizen events. The aim of

implementing a Kaizen event was to eliminate production waste, improve productivity, and enhance worker's role perception. The objectives of this research were:

1. To quantify the levels of EAA factors for the company prior to the Kaizen event.
2. To evaluate the impact of worker seniority (e.g. overall work experience in the construction industry) on EAA factors.
3. To determine and analyze the impact of Kaizen events on EAA factors at the targeted department.

The Kaizen-EAA conceptual model explores potential improvements on the EAA factors after the Kaizen events completion. To evaluate the improvements as mentioned above; a research methodology was framed.

Phase I of research methodology involved completing the EAAQ with 82 construction workers, which yielded the current state of EAA prior to Lean implementation (e.g. pre-Kaizen). The work experience of employees, collected as a part of the demographic information in EAAQ, was used to identify any variation in EAA factors. The results and analysis of the EAAQ ratings for the 82 construction workers without Lean was used to achieve the first and second objective of this research. To achieve the first objective, a descriptive analysis of the responses was performed. A regression analysis was used to analyze the demographic information and questionnaire ratings to accomplish the second objective. The outcome of Phase I was a company-wide baseline for EAA factors prior to Lean implementation.

Phase II dealt with the pilot study, which focused on the implementation of Lean concept through conducting Kaizen events on one department of the modular homebuilding company. Kaizen events followed the structure in Figure 2.1, which is later described in the background

and literature review chapter of this thesis. To assess the success of Kaizen events, the performance data pre and post-Kaizen was analyzed and performance percentage improvement was calculated.

After conducting the Kaizen event, the workers at the targeted department were asked to fill the EAAQ to measure the state of employee's affective attitude post- Kaizen. Then, the pre and post-Kaizen EAAQ ratings were analyzed using a Gap analysis. The Gap analysis showed changes in EAA factors due to the Kaizen event. The Gap analysis helped to achieve the third objective of the research.

In addition, pivot tables were used to graphically compare the EAA factors by seniority level for pre and post- Kaizen. Then tables were generated for each EAA factor to compare the mean value of the EAA ratings by seniority for post- Kaizen with the company- wide baseline (from Phase I).

Following the data analysis, the next step was to infer and conclude based on the obtained results. Subsequently, inference and conclusions, limitations, and future research scope were also presented.



## **CHAPTER 2**

### **BACKGROUND AND LITERATURE REVIEW**

#### **2.1. Lean Production: An Overview of the Construction Industry**

Lean production started with the Toyota Production System (Ohno, 1988), where its implementation made a revolutionary change in the manufacturing sector. Lean production concepts emerged from the Japanese manufacturing industry, which aims at improving production efficiency and efficient utilization of resources by eliminating or reducing the waste (Womack et.al, 1996). Lean production is based on five fundamental principles: 1) Identify the customer values, 2) Identify the value stream and challenge all wasted steps, 3) Produce the product when the customer wants it and, once started, keep the products flowing continuously through the value stream, 4) Introduce pull between all steps where continuous flow is impossible, and 5) Manage toward perfection (Womack et.al, 1996).

In the construction, application of the Lean production model stems from a discussion of Koskela et.al (1998) work, which emphasized the importance of the production process flow. Furthermore, Lean is a whole management system and workers are responsible for maintaining continuous flow of work and information in the production process (Ballard et.al, 2005). Similarly, Ballard et.al (2005) argues that Lean thinking is a new way to manage construction.

The construction process being associated with variability in process and labor productivity, Miller et.al (2002) revealed improvements in construction process effectiveness by reducing this variation. Ballard et.al (2005) suggested the better productivity by improving the labor flow reliability using Lean construction principles. The work flow if made predictable can be matched with the labor flow and the other resources (Ballard et.al, 2005). Besides the variation in labor flow productivity, Alburu et.al (2004) promoted the scope of implementing

Lean construction principles in supply system of the construction industry. On time delivery of the information and the materials promotes the less cost of construction (Alburu et.al, 2004).

Feasibility of the project management system via Lean construction principles was investigated by Conte (2002). The project management systems were found to be effective in monitoring the operating performance of the project using Lean construction principles. An important prerequisite for using the Lean construction principles in the construction projects is harmony between the contractors and subcontractors. To support it, Miller et.al (2002) found the considerable decrease in construction costs as a result of appropriate harmony among contractors and subcontractors.

Hook et.al (2008) discussed the implementation of Lean principles in construction, particularly in the industrialized homebuilding industry, throughout the organization from top management to the labor force. Previously, Freire et.al (2002) developed a methodology based on Lean concepts, which was applicable to areas like projects, clients, resources, and administration. Hook et.al (2008) studies showed the successful implementation of Lean, which requires an organizational culture change leading to increased worker motivation and responsibility for flow, quality and continuous improvement, through leadership. Hook et.al (2008) reported that adoption of Lean construction principles initiates the organizational learning thereby affecting the organizational culture. Freire et.al (2002) improved methodology considered the three different models for design process: conversion, flow, and value. This methodology involved stages for incorporating the changes and improvements consisting of evaluation, implementation, control, and standardization. Bertelsen et.al (2002) conceptualized the production in three ways (transformation, flow, and value). They emphasized the effective management of the production system in construction using Lean construction principles.

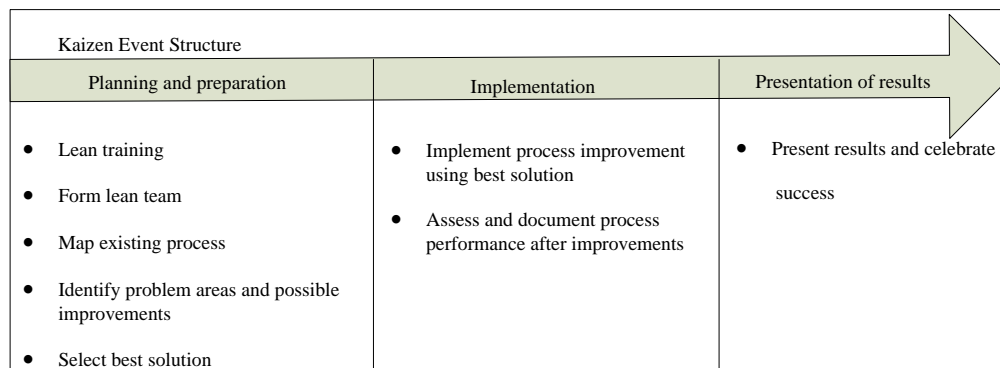
Lean construction principles scope in the simulation of project is also an emerging concept. According to Halpin et.al (2002) the technological development in the construction sector has enhanced the use of simulation techniques to schedule and design the process. His research explored relationship between the Lean construction and simulation, which also included the evaluation of the benefits after implementing the Lean construction principles using simulation technique. In his research, he also compared the similarities between process improvement based on simulation techniques and process design based on Lean construction principles.

## **2.2. Kaizen Event**

Kaizen, typically referred to as an event, is an intensive and focused approach to process improvement. This Lean tool seeks operational perfection by eliminating waste – non-value added activities from the perspective of the customer. Conducting the Kaizen event helps to eliminate waste by empowering employees with the responsibility, time, and tools to uncover areas for improvement and to support change (Brunet et.al, 2003). This type of activity is team based and involves employees from different levels of the organization. Traditionally, the purpose of the Kaizen event is to indeterminately improve and install a Lean culture in the company through the use of Lean principles and tools (Brunet et.al, 2003).

The benefits of Kaizen may be associated with both individual workers as well as the company performance. In terms of company's benefit, Kaizen reduces the overhead cost due to production waste, it improves the quality of the product by reducing the non value added activities, and it reduces the total cycle time for production process (PDTP, 2002). From the worker's perspective, Kaizen benefits them in terms of the working culture or environment, freedom and ease in work, and enhances initiatives and innovation for work (PDTP, 2002). Kaizen has proven to be effective as an organizational improvement mechanism which supports

employee development and improves the work environment (Farris et.al, 2009). Thus, the Kaizen event can be a good strategy to improve IB. In order to achieve these benefits, the Kaizen event needs to be implemented in an organized manner with well defined roles for the participants. According to PDTP (2002), the traditional Kaizen events entail three phases: 1) planning and preparation, 2) implementation, and 3) presentation of the results (Figure 2.1). The planning and preparation phase involves the formation of Lean team, observation of the existing process, identifying the problem areas, brainstorming the possible improvements, and selecting the feasible solutions. The second phase is to implement the improvements or solutions, assess the improved process, and compare the existing and improved process to evaluate changes. The third phase involves the presentation of reports and results to company authority and plant manager. To successfully conduct the Kaizen event, these three phases should be identified and implemented (PDTP, 2002). This Kaizen event structure was included in the Kaizen-IB conceptual model.



**Figure 2.1** Typical Kaizen Event Structure (modified from PDTP, 2002)

### 2.3. Organizational Culture

Organizational culture is defined as the belief, values, and practices shared by the employees of organization towards achieving organizational effectiveness (Blunt, 1991).

Organizational culture is the main focus and barrier to improve the organizational effectiveness (Boan, 2006). Change in organizational culture is the major transformation in beliefs, values, and working practices of employees, therefore it serves to be the main focus of organization (Boan, 2006). The major transformation in beliefs, values, and working practices is difficult to achieve; therefore it is a barrier to improve organizational effectiveness (Boan, 2006).

Organizational culture is related to four traits, which are necessary to achieve organizational effectiveness. Denison et.al (1995) identified adaptability, mission, involvement, and consistency as four essential traits of organizational culture. Denison et.al (1995) correlated these four traits to employee satisfaction and performance. Further, he concluded that an employee who is adaptive to changing nature of work, familiar with the mission of organization, involved and consistent with his work has better satisfaction and performance. In support, Gordon et.al (1992) found that the adaptability is a strong aspect of organizational culture which affects the overall performance of an organization. He surveyed 11 U.S. insurance companies to correlate the organizational culture with effectiveness of the organization if its employees have a better adaptability to the work.

Organizational culture varies with the different organization and depends on the attitude, beliefs, values, and practices being followed within a particular organization. To support this fact, Chatman et.al (2001) did the comparative study of organizational culture for four industries and found the culture to be different in every industry. Their comparative study involved the qualitative analysis of organizational culture which included the case study incorporating interviews and observations. Their main area of focus was organizations' values, beliefs, and various practices (innovativeness, opportunistic, decisiveness, supportive demanding, imitativeness, quality of work, team oriented, etc) in the working environment. Sengupta et.al

(2005) analyzed the influence of organizational culture over the working behaviors of the managers of the firms. They conducted the study on 250 managers who participated in a common training program. They analyzed two items of organizational culture: organizational belief and organizational practices and found the direct correlation with the working behavior of managers. Thus, organizational culture influences the working behavior of an individual.

The change in organization occurs through different ways like strategic change and process change. To study this change Latta (2009) analyzed the influence of leading change in organization on organizational culture. He concentrated on organizational change from conceptual and process point of view. He defines conceptual change as initiatives which are strategic and aims as the desired outcomes. Further, he also defines process change as steps in sequences which are actually implemented to bring necessary change in organizational culture. In his studies, he concluded that organizational culture is influenced at both conceptual change and process change stages. The present thesis concentrates only on change in organizational culture at process change stage.

#### **2.4. Individual Behavior (IB)**

IB is defined as study and knowledge about the attitude and actions or deeds of an individuals working in an organization (Amett, 1988). IB is also associated with dimensions like organizational climate and organizational culture (Volgering et.al, 1996). The organizational climate is influenced by the structural perspectives (structure of an organization), perceptual perspectives (individuals' perception of working climate), interactive perspective (interaction between the individuals), and cultural perspective (individuals sharing the common interest) (Volgering et.al, 1996). Similarly, the organizational culture is influenced by holistic perspectives (traditional ideas and concepts practiced by individuals), variable perspectives (varying practices and behavior of individuals under controlled environment of work), and

cognitive perspectives (individuals' perception and evaluation of working environment) (Volgering et.al, 1996).

IB also depends on the interaction of human organization and human communication (Monge et.al, 2008). Organizational culture represents the languages, attitudes, and beliefs of the employees (Muchinsky, 2006). The change in organizational culture is predominant after new business strategies and changing global trends which may also impact language, attitudes, and beliefs of the employees (Muchinsky, 2006). The influence on IB due to changing environment of business to sustain in competition may be due to organizational cultural change. In support, Johnson (1990) states, participation of other industries or firms to contribute in innovative ideas and implement new business strategy for coping in the sophisticated economy impacts IB. Supportive organizational climate, in terms of employees' higher level of autonomy, confidence, perception of higher degree of risk, and fellowship during the work plays significant role in impacting IB (Ireland et.al, 1976). The stable and ethical IB influences job satisfaction. Koh et.al (2001) supports it and suggests that leaders should promote the ethical individual behavior, thereby enhancing the job satisfaction among workers. Previously, Pettit et.al (1997) in their findings explored that IB is a strong factor in enhancing the job satisfaction. Personal control is also significant in maintaining satisfaction among the workers. Spector (1982) explains personal control as employees' locus of control (employees' work area and work environment), which is related to satisfaction, performance, supervision, and role perception. Later, Spector (1986) also found the higher level of job satisfaction in an organization is associated with higher level of perceived control. For perceived control in an organization he measured variables supervision, commitment, and communication at various organizational levels and correlated them with raised job satisfaction. Spector (1978) previously studied the organizational frustration and its

effect on the individual behavior in an organization. He concluded that organization frustration promotes job dissatisfaction, inequity, and organizational aggression like sabotage, strike, etc.

Studies on the effect of performance feedback information over IB were also significant. Muchinsky et.al (1980) explored that performance feedback information of the workers in an organization directly affects the IB. The study revealed that the source of feedback, type of feedback, and reliability of feedback logically interact and affects the IB. Muchinsky (2000) in later studies also raised factors of emotions in workplace to be considered in IB. In his studies, he stressed on ceasing the negligence of emotions in the workplace while analyzing the IB.

In the construction sector, the industry involved in the modular homebuilding manufacturing has resemblance with the organizational structures and levels. The manufacturing of homes is carried out by the construction workers at the manufacturing departments resembling the factory or industry environment. In the modular manufacturing company, interaction between top level authority, management, line supervisors, and the construction workers make IB a significant element to be considered. The construction workers' performance and productivity may be dependent on Rodwell et.al (1998) findings about the organizational workers' attitude, due to resemblance of the modular homebuilding industry with the working environment of an organization.

According to Lingard et.al (2007) the U.S. construction sector is one of the major organizations and also faces organizational related problems making IB issues critical. IB in the construction industry is related to work-life balance of a construction worker or an individual, which maintains organizational effectiveness and occupational health. Dabke et.al (2008) shows concern for job satisfaction of the construction workers in the construction industry to maintain effective IB. In his study, he surveyed thirty nine construction workers to examine their satisfaction about the work, pay, benefits, and job security. Leung et.al (2008) states affective



commitment, job performance, and job satisfaction of the construction workers and professional as significant to optimize their performance. His study revealed that the job acceptance and teamwork serves as a variable that affects the relationship between affective commitment and job satisfaction. Park et.al (2008) surveyed the thirty seven workers to analyze the job satisfaction of workers working in a team. He conducted his study over 37 work teams of Korean civil engineering management industry, and he concluded that the workers have high job satisfaction working in a team regardless of the task complexity. This study leads to the fact that the teamwork enhances job satisfaction affecting the IB positively.

Leung et.al (2008) observed the construction workers, team leaders, and projects managers involved in a construction project and reported that stress is negatively affected due to the time deadlines, uncertainties of projects, and the dynamic environment. He conducted the study to investigate the impact of stress on the performance of workers, and he surveyed 108 workers from the construction sector. He concluded that the performance of the workers slows down with the stress impacting IB negatively. The stress during the site activities among the workers was examined by Djebarni (1996) where the author conducted interviews with the 71 site managers. The study of the author was concentrated on the job stress, and the findings proved that stress during the work is one of the causes for decrease in the performance.

#### **2.4.1. Employees' Affective Attitude**

The quality of the attitudes such as, attitude based on work experience, and attitude are predictors of individual behavior (Fazio et.al, 1978). Since IB refers to the interaction and behavior of individuals at particular level within the organization, individuals' attitude plays a major role in predicting IB (Leipzig et.al, 1990). To prove this Kraus (1995) conducted the Meta-analysis of literature correlating the attitude with behavior. The results of his study indicated

attitude as a predictor for behavior of individuals. Later, Rodwell et.al (1998) reported EAA to be a significant element affecting IB in an organization and analyzed EAA using job satisfaction, job commitment, and job related stress.

The correlation of job satisfaction, job commitment, and job related stress with EAA were previously determined by Griffin et.al (1986) in their research studies. They identified job satisfaction, commitment, and job stress as factors influencing or affecting the employees' affective attitude. The correlation of these three factors with IB was identified by Rodwell et.al (1998) for the individuals. These three factors affect the EAA, which in turn affects the IB and represents the focus of this paper. Thus, all the three factors (job satisfaction, commitment, and job stress) have an important role to play not only in terms of the individual worker's performance and productivity, but also in terms of an organization as a whole.

#### **2.4.1.1. Job Satisfaction**

Job satisfaction is defined as the extent of satisfaction an employee extracts while performing the assigned task (Muchinsky, 2006). Job satisfaction has variable related to attitude which explains likeliness of people about their job and different aspects of job (Spector, 2008). Job satisfaction relates to tasks' characteristics such as monotony, type of work, control over the work, and the working methods. The same type of work may be a source of dissatisfaction among the workers. If a worker does not have the necessary skills to effectively perform the task, this situation can also cause job dissatisfaction (Mutanen et.al, 1983). Similarly, workers incapability of controlling their work might also contribute to job dissatisfaction, which may in turn affect the IB negatively. Unstable job environment condition is another factor which may drive job dissatisfaction and job changeovers (Dormann et.al, 2001). Further, Locke (1970) revealed that the job satisfaction is the attainment of job values during the performance or to the degree to which the performance is carried out. He further explains that, performance is a result

of action and affects the individual values, knowledge, and beliefs which in turn affect job satisfaction. A Meta analysis using the previous studies and research by Laffaldano et.al (1985) correlates job performance with job satisfaction positively. Fisher (1980) also correlated performance with job satisfaction in which he mentions 1) Measures of the attitudes is in relation with nature of job and 2) Measures of satisfaction are in relation with individuals work related behavior. Later, Petty et.al (1984) investigated the relationship between individual job satisfaction and job performance using the Meta analysis for cumulative research findings in the same area and reported it to be positively correlated. Besides, considerable efforts, persistence, development of plans and strategies regarding work, and attentive attitude may lead to enhanced job satisfaction (Locke et.al, 1990).

Job satisfaction factors like satisfiers and dissatisfiers were identified by Herzberg (1967). He found the fundamental difference between the factors (satisfiers and dissatisfiers), referring satisfiers to job contents like task achievement, task achievement recognition, task nature, task responsibility, and task capability. He contrasted dissatisfiers by referring it to job environment like conditions (company policies and administration) under which job is being performed, quality of working condition, type of supervision, salary received. Further, job satisfaction or dissatisfaction is a function of individuals' social and psychological conditions and factors including the working conditions or working environment as a cognitive aspect (Miller, 1980). In monetary terms, job satisfaction has found to be more with employee gaining upper earnings as compared to employee gaining lower earnings (Hamermesh, 2001).

Morton (1948) explored the chances for giving job satisfaction to employees. He suggested assigning employees the type of work, which is practicable and to which employee suits the most considering experience, potential ability, training, and natural capability. Further, Morton (1948) suggested creating job interest by recognition of commendable performance and

explaining the significance of work. He also puts the responsibility on management shoulders to ensure job satisfaction and supervision to avoid the hassles and misunderstanding with the employees. In another study, Kalleberg (1977) examined the job satisfaction in terms of the work values and job rewards related to the dimensions of work such as intrinsic behavior, convenience, financial, relation, resource adequacy, opportunities in career, co worker relationships. In his findings, he concluded the work values and job rewards influence job satisfaction positively. The length of employment may also affect the satisfaction in job. Katz, (1978) took the initiative to analyze job satisfaction variation with the length of the employment and found a positive relationship among them. He also reported task significance as one of the dimensions of the work has positive relationship with job satisfaction for the employees new to organization. Further, designing task and managing new employees in efficient manner aids in raising job satisfaction (Katz, 1978).

Roberson (1990) contributed goal success, goal commitment, and goal clarity as factors affecting the job satisfaction. Roberson (1990) explored enhanced job satisfaction is related to higher goal commitment, higher chances of goal success, and good goal clarity. Knowledge of goal attainment means and deadlines for goal attainment also contribute towards raised job satisfaction (Roberson, 1990). Organization policies, work environment conditions, job characteristics, and personal factors also play a major role in the employee's job satisfaction (Porter et.al, 1973). Employee turnover and absenteeism inversely effects the job satisfaction and is one of the concerned issues in the U.S. construction industries (Porter et.al, 1973). Exceptionally, Judge et.al (1998) argues that irrespective of the work conditions and job attributes, job satisfaction is also affected by core self-evaluation which aids employees to evaluate their satisfaction level in an organization. Demographics may be the other aspect significant to job satisfaction. Clark (1996) explored the relationship of age, education, place of

employment, and duration of work with the job satisfaction. He surveyed 5000 British employees and concluded that the employees around age 30 with higher education, longer duration of work have low level of job satisfaction. He also found that employees working in larger establishments have higher rate of absenteeism which contributes to lower level of job satisfaction.

Wright et.al (2002) conducted the study on public sector employees and supported the fact there exist a variation in job satisfaction due to variation in work content and environment. In their study, they examined public sector employees in terms of their conflict in organizational goal, organization goal clarity, commitment, and constraints in procedure affecting the job satisfaction. Commitment affecting job satisfaction was also supported by Bull (2005). He found that organizational commitment affects the job satisfaction positively at the various levels of an organization.

#### **2.4.1.2. Job Stress**

Job stress can be related to the job dissatisfaction, excessive work, limited time for completion, and personal problems (Bagot, 1978). Job stress among workers may arise also due to poor fit between the workers' abilities and working environment. These affect workers not only psychologically but also physiologically disrupting their normal functioning during the work (Jamal, 1990). Job stress is a feeling of discomfort that may arise due to determinants like time deadlines and anxiety, which may lead to the outcomes like reduced motivation, degraded performance, dissatisfaction, and low commitment (Parker et.al, 1983).

According to Parkington et.al (1979) discrepancy in employee's service orientation and management service orientation from employee's view lead to role ambiguity and role conflict. He further examined that the role ambiguity and role conflict are the potential reasons for

causing job stress among employees. In support, Rizzo et.al (1970) examined the complex organization system and apprehended the rising of the role ambiguity and role conflict in it. They also remarked job stress among employees as a consequence to the role ambiguity and role conflict. Work overload as another potential factor for job stress was investigated by Perrewe et.al (1989). After surveying 125 employees, Perrewe et.al (1989) concluded that if work is carried out in controlled environment, then the impact of the work overload on job stress can be mitigated. On the similar background, Spector (2002) also apprehended the job stress to be an essential concern for an organization. Enhanced control environment of job or task have the potential to mitigate job stress ill effects (Spector, 2002).

To differentiate between job stress and stress, Schuler (1980) defined stress in terms of an individual's physiological (heart rate, blood pressure, headache, etc.), psychological (dissatisfaction, forgetfulness, negativism, apathy, etc.), and behavioral (absenteeism, low performance, low job involvement, loss of responsibility, etc.) symptoms. This study concentrates on the behavioral symptom of stress among workers related to their job. Job stress can be divided in four different conditions: stress associated with task, personal factors causing stress, coping with the process, and indicators of stress (Ivancevich et.al, 1983). He explained all these conditions which are responsible to create job stress among the workers. He found stress associated with task, reflects the work overload, ambiguity during the work, conflict within the group or with administration, and fear of physical damage during the work. According to Ivancevich et.al (1983), the second condition (personal factors) includes the family conflicts and financial tensions. He further explains that the job stress may be caused due to coping up with the process, which involves initiation of the coping activities to produce high performance results. The fourth condition explained by him is consistent unusual performance by the skilled

workers, which is a high indicator of stress and needs to be verified by an examination of performance and a managerial observation. The current research is only concentrated on stress associated with the task and unable to cope up with the process.

Job stress may also affect job satisfaction and performance in a negative sense, and to support, Sullivan et.al (1992) performed the literature search from two decades based on this relationship. In their research, they examined this relationship at individual, group, and organizational level and found this relationship to be true at each level. Previously, Schuler (1982) found job stress to be dependent on the individual needs who desires resolution of the dynamic conditions of uncertainty. An individual working in an environment involved with the dynamic nature, stress of coping with it may yield unproductive output (Schuler, 1982). Employees' health may also be a matter of concern after the job stress. An individual undergoing job stress may suffer with physical and mental illness thereby reducing its working capability (Beehr et.al, 1978).

Viswesvaran et.al (1999) studied the influence of the social support over job stress. In his research, he concluded that the social support from the employees or workers in groups and organization, aids in mitigating the level of the job stress of an individual. He justified the above argument by conducting the Meta analysis of the literature based of the social support and job stress. Besides this, significant contribution of Cooper et.al (1997) led the identification of three intervention strategy to manage the job stress at workplace. The primary intervention was associated with the reduction of existing sources of stress in the work environment and second intervention promoted the development of the self-awareness and suggesting the relaxing techniques to an individual undergoing stress (Cooper et.al, 1997). The tertiary intervention in his findings was related to rehabilitation, proper treatment, and recovery services to those individual who suffered the ill effects of job stress. The findings of Cooper et.al (1997) can be

correlated with Lean implementation mitigating the effects of job stress. Lean implementation involves the process streamlining which can mitigate the stress related to work environment. In addition, process becomes more spontaneous after implementation of Lean which may also reduce effects of job stress.

Further, Narayanan et.al (1999) examined the potential factors such as work overload, interpersonal conflict, lack of controlled environment of work, and reported them to be the major stressors among the employees. Also, due to the interruptions in work by coworkers or supervisor, emotional attachment with the work, administration or top authorities workload over the employees also cause physical and mental stress among the employees (Makin et.al, 1988).

Design of new job or redesign an existing job for an individual may have a greater autonomy and greater control, and studies of Schuler et.al (1986) supports it. He suggests that at initial level, selection of an individual should be made according to their personality and preferences in order to match a particular job profile. In addition, Schuler et.al (1986) also suggests a performance appraisal for employees to justify expectations of organization from them and privilege of rewarding for their contributions towards an organization. In addition, he also discuss reducing the uncertainty in job and encouraging effective participation to get better understanding of the work as alternatives for reducing the effects of job stress.

#### **2.4.1.3. Commitment**

Commitment is the extent to which an employee feels attachment or trustworthiness towards an organization (Muchinsky, 2006). Also, commitment is an attitude of the worker towards an organization which predicts the degree of participation for a worker in an organization (Harrison et.al, 1998). Commitment can be classified into three components: 1) Recognition of organizational goals 2) Attitude of hard work and 3) Aspiration of continuing in organization (Spector, 2008). Commitment also includes considerable effort of workers on



behalf of an organization, belief in organizational goals and values, and desire to maintain membership in the organization (Chen, 2004). Commitment may be an attitudinal commitment. Mowday et.al (1979) states that an attitudinal commitment allows individual to know organization and its goals, which in turn drives him to perform efficiently for attaining the organizational goals. Commitment is a binding force that makes an individual stick to its course of action for achieving the set organizational goals (Meyer et.al, 2001). Commitment at the workplace is a serious concern, which has the potential to influence the efficiency of organization and well being of employees (Meyer et.al, 2001). If organization provides an interesting or relative job, controlled job environment, supportive nature of work, freedom in decision making, considerable wages, and career opportunities, levels of commitment is expected to be high among the workers (Mottaz, 1988). The foci of commitment in an organization may represent the groups and coworkers to which an employee is attached. Based on this, Becker et.al (1993) classified employees as locally committed, globally committed, committed, and uncommitted employees. Locally committed employee deals with working groups and supervisor whereas globally committed employee deals with management and top authorities of an organization (Becker et.al, 1993). The committed employee is a combination of locally and globally committed employee and vice-versa represents uncommitted employee (Becker et.al, 1993).

Commitment is found to have positive relationships with the motivation, job performance and job satisfaction (Gamble et.al, 2008). Workers that are committed to an organization tend to perform at the higher levels and are less likely to leave their jobs. According to Gamble et.al (2008), the role of commitment is critical in effectiveness of IB and committed worker play a significant role in the success of an organization. Putte et.al (1990) performed explanatory study to examine relationship between commitment and communication. As a part of analysis, data

was collected from 122 white collar employees and relationship was found to be valid between commitment and communication. Further, Postmes et.al (2001) explored the horizontal communication and vertical communication link to the commitment. The horizontal communication in his study was referred to an informal, social, and economic communication among proximate colleagues, whereas the vertical communication was defined as communication with management sharing the strategic information. Postmes et.al (2001) revealed that the vertical communication has stronger influence on commitment as compared to the horizontal communication at both organizational and group level. Randall (1987) related consequences of lower level, moderate level, and higher level of commitment to an organization's success. In her studies, she reported the lower level of commitment to be harmful and improper in function from an individual's and organizational perspectives. Moderate level of commitment has got the potential to maintain the balance between the organizational requirements and individual requirements (Randall, 1987). Further, she examined and found that individual with higher level of commitment may excel in their career hastily, but may experience personal, work related, and family problems. Thus, overcommitted employees may become incapable to meet the requirements of an organization (Randall, 1987).

The influence of personal characteristics, job and characteristics, and work experiences on commitment may be the area of concern. Steers (1978) analyzed 119 engineers to correlate the above characteristics with commitment. He classified personal characteristics as education, age, and requirements or desire for career opportunities. Identification of the task, employee interaction, and feedback were considered as job characteristics in the study. Further, dependability over organization and attitude associated with the group was reflected as work experiences. Steers (1978) reported these characteristics as essential factors for enactment of the effective commitment towards an organization goal.

Later, Steers et.al (1983) stated that the commitment is influenced by the four factors: personal factors, job factors, structure or design of the organization, and work experience. Personal factors include age, education, and goal achievement; whereas the job factors are related to task identification, challenges in job, and the feedback. Structure or design of the company such as freedom to participate in the decision making and centralization and decentralization of the organization influences commitment as described by Steers et.al (1983). Further, he explains work experiences such as dependability of an organization, attitude of the working groups towards an organization, and perception of the self-importance to the organization, plays a major role in influencing the commitment. Blau et.al (1987) scrutinized the influence of the job involvement and commitment on organization's turnover and employees' absenteeism. Lower level of job involvement and commitment was reported to effect organizations' turnover negatively. Further, he proved that lower level of commitment is responsible for higher rate of absenteeism among the organization's employees.

## **2.5. Relationship between Organizational Culture and EAA**

The relationship between the organizational culture and EAA is direct as Hofstede (1998) reported. In his research he surveyed 2,590 employees and identified the direct relationship between organizational culture and attitudes of employees. Further, Aarons et.al (2006) also studied the influence of organizational climate and culture over EAA in the service (public sector) organization. They surveyed 47 public sector organizations and found the direct correlation between culture and attitude. Similar results were also reported by Gregory et.al (2009) where they analyzed 99 firms to find correlation between culture and attitudes of employees.

The organizational culture impacts the EAA through organizational learning during organizational change. Harris (1994) analyzed the organizational culture towards transformation

and organizational learning during process improvement initiatives. The analysis was based on questionnaire feedback of 226 employees from manufacturing firms, observations, and semi-constructed interview. The questionnaire concerning the EAA was also completed with same sample in which job satisfaction, organizational commitment, and job stress was included as items. The correlation analysis yielded the impact of organizational culture on EAA during transformation and organizational learning. Rashid et.al (2004) also reported the influence of organizational culture over attitudes of employees during the organizational change based on the questionnaire ratings of employees from 258 manufacturing industries. Later, Alas et.al (2006) on the similar background studied the impact of organizational culture on EAA during organizational change. He conducted the studies in 38 companies where he surveyed 906 employees to analyze the impact. He concluded that organizational culture during organizational change predicts attitudes of employees towards organizational learning.

**Table 2.1** Organizational Culture, Individual Behavior, and EAA Definitions

<b>Terms</b>	<b>Author (year)</b>	<b>Definition</b>
Organizational culture	Blunt (1991)	Defined as the belief, values, and practices shared by the employees of organization towards achieving organizational effectiveness
Individual behavior	Amett (1988)	Defined as study and knowledge about the attitude and actions or deeds of an individuals working in an organization
Employees' Affective Attitude	Fazio et.al (1978)	Defined as views, outlook, and beliefs of employees towards the aspects of their job. EAA develops due to work experience, and attitude regarding culture of work being followed at the work place

## **2.6. Relationship of Lean with EAA Factors**

According to PDTP (2002), Lean is associated with the elimination of production waste, reduction of the cycle time, redesigning of the work station layout, modification or change in the sequence of process, and improvement in the quality. Lean concepts can change working

methods and working environment which may affect the belief, values, and working practices (Chatman et.al, 2001) of the employees. Thus, Lean concepts may affect the employees' affective attitude.

Hook et.al (2008) analyzed the organizational culture of industrialized housing industry before implementation of Lean tools and techniques. They perform the qualitative analysis of organizational culture through observations and interviews before Lean principles implementation to analyze change. They also performed quantitative analysis of organizational culture through a production questionnaire to predict the current culture of the company with respect to Lean principles. The production questionnaire was based on 17 practices representing the working culture of company. The 17 practices were work floor layout, set up times, scheduling, small lot sizing, waste reduction, response to defects, error proofing, continuous improvement, teamwork, multifunctional workers, quality leadership, decentralized responsibilities, motivation, work floor maintenance, visual information, maintenance of equipment and tools, and standardized work. The results of the production questionnaire yielded the need for improvement in terms of work floor maintenance, work floor layout. In their findings, they concluded change in work floor order and visibility changes the culture and attitude of workers.

Business system improvement initiatives like Lean production targets the optimization of resources and improvement in effectiveness of the processes which have the potential to impact the job stress and workers well-being as a part of work environment (Karwowski et.al , 2004). In significant research, Karwowski et.al (2004) reported the impact of business system improvement strategies to affect the working climate leading to impact job stress negatively. Further, he recommended the accomplishment of optimization for the process considering the individual satisfaction, health, and safety.

**Table 2.2** Table of References for Lean, Lean construction, and EAA Factors

<b>Author and year</b>	<b>Lean</b>	<b>Lean Construction</b>	<b>EAA Factors</b>
Fazio et.al (1978)			X
Bagot (1978)			X
Spector (1978)			X
Mowday et.al (1979)			X
Muchinsky et.al (1980)			X
Mutanen et.al (1983)			X
Griffin et.al (1986)			X
Ohno (1988)	X		
Koskela et.al (1998)		X	
Kraus (1995)			X
Womack et.al (1996)	X		
Rodwell et.al (1998)			X
Miller et.al (2002)		X	
Bertelsen et.al (2002)		X	
Conte (2002)		X	
Freire's et.al (2002)		X	
Halpin et.al (2002)		X	
Wiklund et.al (2002)	X		X
Karwowski et.al (2004)	X		X
Ballard et.al (2005)		X	
Hook et.al (2008)		X	X
Monge et.al (2008)			X
Zu et.al (2009)	X		X

Based on the extensive literature review on Lean, Lean construction, and EAA factors a Table 2.2 is been created above, which describes the contribution of various researches conducted on related topics.

According to Hook et.al (2008), Lean Construction principles impact or change organizational culture. Previously, Hofstede (1998), found the link between organizational culture and EAA, stating that change in culture of work affects the attitude of employees. Griffin et.al (1988) found the correlation of three factors: job satisfaction, job stress, and commitment with EAA. Rodwell et.al (1998) later developed a questionnaire which measured these EAA

factors for an Australian information technology company. Job satisfaction factors like monotony and control over job was the result of research by Mutanen et.al (1983), whereas job stress factors like job dissatisfaction and excessive work were studied by Bagot (1978). The factors of commitment like attitude of hard work and knowledge of organizational goals were the results of study by Mowday et.al (1979) who correlated these factors to commitment of employees in an organization.

## **2.7. Role of EAA Factors in the Construction Industry and Current Research**

### **2.7.1. Job Satisfaction**

Porter et.al (1973) related job satisfaction in the construction industry to the factors like employees' turnover and absenteeism. Previously, Herzberg (1967) revealed working environment (freedom in performing task), well defined job, quality of task, and type of supervision in an industry influencing satisfaction among workers. Wright et.al (2002) correlated the organizational goal clarity and commitment with job satisfaction. Based on this literature, the construction industry with the similar characteristics of the industry can experience issues related to work environment, absenteeism (due to an attitude of unimportant contribution towards organizational goals), supervision, goal clarity, well defined work, and commitment towards work. Therefore, job satisfaction among construction workers is expected to experience impact or influence.

For the current study, job satisfaction in the conceptual model is considered in the context of the well-defined work, freedom in performing task, quality of the work, goal clarity, absenteeism, and commitment towards the job.

### **2.7.2. Job Stress**

Bagot (1978) and Jamal (1990) reported that the industry workers suffers from job stress due to job dissatisfaction, excessive workload, time constraints for completion of a job, poor fit

between work characteristics and workers capability, and personal problems. Further, Jamal et.al (1992) revealed job stress to be more frequent in shift related working culture. The construction industry workers with similar industry environment may experience job dissatisfaction, mental stress due to time deadlines, and physical stress due to excessive workload.

The scope of the job stress in the conceptual model involves time deadlines for task (mental stress), stress at individual level (both physical and mental stress), excessive overload of work or physically demanding work, poor fit between assigned work and workers capability (mental and physical stress).

### **2.7.3. Commitment**

Harrison et.al (1998) and Meyer et.al (2001) reported the job involvement and supportive nature of an industry to be driving factors for commitment among the industry workers. Gamble et.al (2008) and Steers (1978) investigated factors like task identification, motivation, and job satisfaction and found a link to a commitment among the industry workers. Blau et.al (1987) and Steers et.al (1983) scrutinized dependability of industry and job involvement influencing commitment of the industry workers. Therefore, the construction workers exposed to such industry environment or working culture may experience influence or impact on their attitude (commitment).

The present study reflects commitment in terms of the motivation among workers, job satisfaction, better task identification, supportive nature of industry (resulting in dependability of industry), and job involvement of the workers.

Based on the extensive literature review summarized above, Table 2.3 summarizes and defines each EAA factor as used in this research. Each EAA factors role in construction industry and current research has been tabulated below.

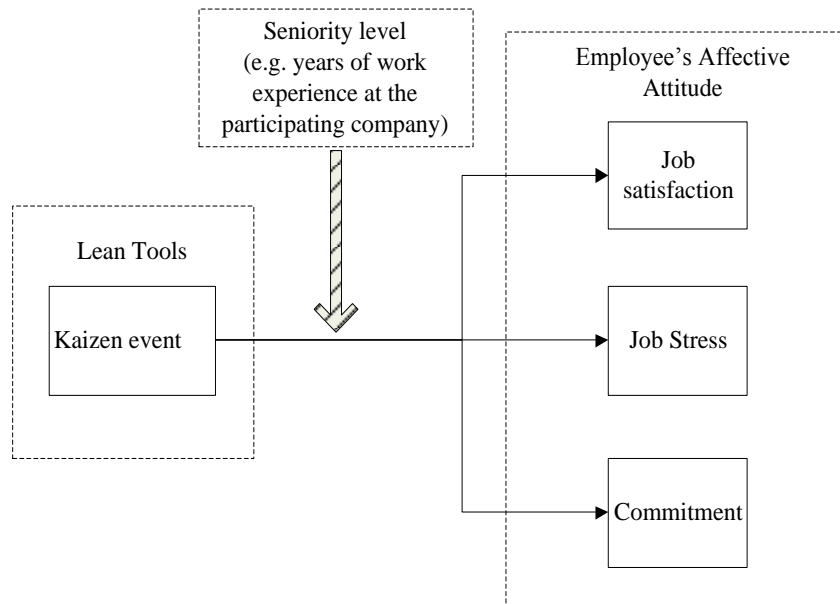


**Table 2.3** EAA Factors in the Construction Industry and Current Research

EAA factors	Role in Construction Industry and current research
1. Job Satisfaction	It relates to satisfaction in the context of well defined work, freedom in performing task, quality of the work, goal clarity, reduced absenteeism, and commitment towards job.
2. Job Stress	It is associated with time deadlines for task (mental stress), stress at individual level (both physical and mental stress), excessive overload of work or physically demanding work, poor fit between assigned work and workers capability (mental and physical stress).
3. Commitment	It reflects motivation among workers, job satisfaction, better task identification, supportive nature of industry (resulting in dependability of industry), and job involvement of workers.

## 2.8. Conceptual Model

The current study proposes to explore the impact of Lean concepts through a Kaizen event on EAA. Based on previous literature, Figure 2.2 displays the proposed Kaizen-EAA links. In addition, it examines potential difference in EAA levels due to seniority level (e.g. years of work experience in the construction industry).



**Figure 2.2** Conceptual Model: Proposed Kaizen-EAA Links

Individuals working in an organized climate of work have better job satisfaction (Muchinsky, 1977). Typically, Kaizen events lead to a well-organized and coordinated work environment, which may in turn influence job satisfaction of workers. Similarly, Lingard et.al (2004) found that better working environment of planned activities also raises commitment of workers to perform their duties. Reduction in the work load due to efficient and improved processes may lead to decrease in stress among the workers to perform the activities planned (Karwowski et.al , 2004). The conceptual model (Figure 2.2), proposes that a Kaizen event have a link with job stress due to reduction in work load and efficient working procedures.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

The purpose of this research was to explore the usability of Lean concepts in improving EAA in a modular homebuilding company. The aim of the study was to determine and analyze the impact of implementing Lean concepts through the Kaizen event on EAA.

#### **3.1.Objectives**

1. To quantify the levels of EAA factors for the company prior to the Kaizen event.
2. To evaluate the impact of worker seniority (e.g. overall work experience in the construction industry) on EAA factors.
3. To determine and analyze the impact of the Kaizen event on EAA factors at the targeted department.

#### **3.2. Research Scope**

The scope of this research was to identify the impact of implementing Lean concepts through the Kaizen event on EAA in a modular homebuilding company. This research also served as a base to analyze the influence of seniority within the company on EAA factors in a modular homebuilding company before and after exposing workers to Lean concepts.

#### **3.3.Research Methodology Flow Chart**

The research methodology flow chart is presented in Figure 3.1. The research methodology is divided in to Phase I and Phase II for data collection, data analysis, and results of individual phase. The two phases finally merge for concluding the results of Phase I and Phase II.



(Table 3.1. con'd.)

<b>Authors (year)</b>	<b>Research Purpose</b>	<b>Findings</b>
Jun, M., Cai, S., & Shin, H. (2006)	To assess the impact of TQM over job satisfaction and employee loyalty.	TQM practices positively impacted job satisfaction and employee loyalty.
Wiklund, H., & Wiklund, P. S. (2002)	To identify successful approaches to improve organizational learning and in turn individual behavior.	Six Sigma was identified as a successful approach to initiate organizational learning, which impacted commitment and job satisfaction positively.
Karwowski, W., Shoaf, S., Genaidy, A., & Huang, S. H. (2004)	To evaluate how the improvement in performance impacted the quality of working life of employees.	Results revealed: 1. Positively impacted employees' well being and job satisfaction and 2. Reduced job stress.

### **3.5. Phase I- Company-Wide Empirical Study of EAA Factors**

The purpose of the first Phase is to characterize the current level of EAA at a modular homebuilding company without Lean practices. In addition, to analyze the relationship of EAA factors with the seniority level (e.g. years of work experience in the construction industry). The Phase I of research seeks to answer the following questions:

1. What is the current level of EAA factors in the participating company without Lean practices?
2. Is there any relationship of EAA factors with seniority level in the participating company without Lean practices?

#### **3.5.1. Data Collection Plan**

In order to determine the level of EAA factors, an Employees' Affective Attitude Questionnaire (EAAQ) was framed and utilized to collect data. This questionnaire is a modified version of the questionnaire developed by Rodwell et.al (1998). Results from his study on an Australian information technology company revealed that EAA has three factors- commitment ( $p < 0.001$ ), job satisfaction ( $p < 0.001$ ) and job stress ( $p < 0.01$ ). Rodwell et.al (1998) also measured

the scale reliabilities for three EAA factors in the questionnaire and determined values of 0.78, 0.91, and 0.91 for job satisfaction, commitment, and job stress, respectively.

The EAAQ used in Phase I has two sections: 1) Employees' demographics, and 2) Questions for each EAA factors (Appendix B). The demographic section provides information regarding work experience of the individual worker. The demographic information collected includes employees' age, gender, years of work experience at the participating company, years of work experience in construction and current station where they work. Further, section two of this questionnaire examines EAA's three factors –job satisfaction, commitment, and job stress on the Likert-scale of 1-5. Section two of the EAAQ has a total 27 questions-12 questions assessing job satisfaction, 8 questions assessing commitment, and 7 questions assessing job stress. EAAQ questionnaire involves a set of both positive and negative questions. The total of negative questions is 7 for job stress and rests of the questions are positive. Workers were asked to rank each question on a five point Likert-scale, with the most positive (strongly agree) scoring 5 and the most negative (strongly disagree) scoring 1 for the questions related to job satisfaction and commitment. Since the questions related to job stress were negative questions the likert scale was inverted, in which the most negative (strongly agree) scoring 5 and the most positive (strongly disagree) scoring 1. Therefore, a score of 5 in job stress meant that the worker had more stress than a worker that scored 1. During the Phase I, workers of the participating modular homebuilding company were asked to complete the EAAQ, prior to any introduction of Lean concept to the employees. To complete the EAAQ workers were asked to rank each question on a five point Likert-scale.

### **3.5.2. Data Analysis Plan**

Upon receiving the completed company-wide EAAQ, data was entered into a spreadsheet. The answers for each question were recorded in a numerical format. If the worker

left any question unanswered, he or she was not included in the analysis and that pertains to the blank answer.

In Phase I, data analysis of the company-wide EAAQ has two parts: 1. Descriptive characteristics including basic statistics of the questionnaire, and 2. Linear Regression Analysis to identify any relationship of EAA factors with employees' seniority level.

**1. Descriptive Characteristics-** in order to characterize the current level of EAA factors at the participating modular homebuilding company without Lean practices, basic statistics (e.g. mean, maximum, minimum, variance, and standard deviation) characterizing all responses were calculated for each question. The descriptive statistics involved the three variables- job satisfaction, commitment, and job stress as EAA factors. Scores for each of these variables was determined by calculating the mean of each variable per worker. Then, to find the overall mean, the averages for all mean values were calculated. The overall mean values were then referenced to the five points Likert-scale to form the company's baseline for EAA factors without Lean principles.

The equations from 1 to 6 were used to calculate the mean ratings of EAA factors were,

For job satisfaction:

$$\text{Overall Mean} = \frac{JS_1 + JS_2 + JS_3 + \dots + JS_{82}}{82} \dots \text{equation (1)}$$

Where  $JS_i$  = Mean of job satisfaction per worker and  $i = 1, 2, 3, \dots, 82$

$$JS_i = \frac{Q_1 + Q_2 + Q_3 + \dots + Q_{12}}{12} \dots \text{equation (2)}$$

Where  $Q_i$  = ranking of the individual worker for 12 questions of job satisfaction and

$i = 1, 2, 3, \dots, 12$

For commitment:

$$\text{Overall Mean} = \frac{CO1+CO2+CO3.....+CO82}{82} \dots\dots\dots\text{equation (3)}$$

Where CO<sub>i</sub>= Mean of commitment per worker and i= 1,2,3.....82

$$CO_i = \frac{Q1+Q2+Q3.....+Q8}{8} \dots\dots\dots\text{equation (4)}$$

Where Q<sub>i</sub>= ranking of the individual worker for 8 questions of commitment and

i= 1,2,3.....8

For job stress:

$$\text{Overall Mean} = \frac{JST1+JST2+JST3.....+JST82}{82} \dots\dots\dots\text{equation (5)}$$

Where JST<sub>i</sub>= Mean of job stress per worker and i= 1,2,3.....82

$$JST_i = \frac{Q1+Q2+Q3.....+Q7}{7} \dots\dots\dots\text{equation (6)}$$

Where Q<sub>i</sub>= ranking of the individual worker for 7 questions of job stress and

i= 1,2,3.....7

Since the data collected by the EAAQ on years of experience were continuous numbers rather than a discrete, the data was manipulated to create ranges and categories of seniority levels. Then a cluster analysis was conducted on the seniority level data resulting in different three clusters (p-value = 0.000). Another result from cluster analysis was cluster membership which displayed the membership of workers' seniority level to a particular cluster respectively. Based on the maximum and minimum seniority level for each cluster three categories of seniority levels were generated as follow: I (0-8 years of work experience) , II (9-20 years of work experience), and III (20-45 years of work experience).



The descriptive statistics table included the basic statistics of EAA factors with respect to their overall work experience. This provided the company wide-baseline of EAA factors categorized by seniority level.

2. **Normality Test-** a normality test (Kolmogorov-Smirnova  $\alpha = 0.05$ ) was conducted to check the distribution of the data. The null hypothesis for normality test stated that the data is normally distributed, and alternative hypothesis stated that the data was not normally distributed. Results from the normality test revealed insufficient information to reject the null hypothesis ( $p > 0.05$ ). Since the data was normally distributed, parametric statistic techniques were used for the data analysis.
3. **Hypothesis Testing-** The following hypotheses were framed to determine the relationship of EAA factors with work experience without Lean principles.

Null Hypothesis:  $H_0$ : There is no relationship of EAA factors with seniority levels (e.g. work experience)

Alternative Hypothesis:  $H_1$ : Job satisfaction has relationship with seniority level.

$H_2$ : Commitment has relationship with seniority level.

$H_3$ : Job stress has relationship with seniority level.

In order to explore potential relationships between the seniority level and EAA factors, correlation analysis was performed. After obtaining the correlation coefficients for job satisfaction, commitment, and job stress a linear regression analysis was performed to further analyze the type of relationship. The first step in the linear regression analysis was to plot scatter diagrams using the EAAQ ratings of EAA factors and overall work experience for pre- Kaizen in the participating company. The independent variable was overall work experience of participating

workers and the dependent variables were the three EAA factors. The scattered plot revealed the pattern of variation for the data sets of EAA factors and work experience. The second step was to select the model relating EAA factors to seniority level by drawing the line resembling the pattern obtained from scattered plot. Subsequently, linear regression analysis was performed to estimate the parameters like intercept and slope of the line representing linear regression model. The statistical software Minitab version 16 was used to perform the linear regression analysis. In addition, a T-test was performed at a significance level of 0.05, to calculate the p-value and explore any significant relationship of EAA factors with the seniority level in the participating company without any Lean practices. The third step was to perform fitted line test to estimate the goodness of fit of the linear regression model with the scattered data. Fitted line test yielded  $R^2$  value which showed the percentage of seniority level data responsible for linear variation in EAA factors.

### **3.5.3. Outcomes**

The following outcomes are expected from the data analysis in the Phase I:

1. Company-wide EAA baseline for the participating company without any Lean concepts practices.
2. EAA factors' that have statistical significant relationship with workers' seniority. A company-wide EAA baseline categorized by seniority level.

The overall mean values of each EAA factor are compared with the five point Likert-scales. This served as a basis to assess if there is a need for improvement in a specific EAA factor (e.g. to increase its score to a maximum of 5 points).

The results of the linear regression analysis served as a basis to assess whether employees' seniority level influenced employee's ratings of EAA factors in a company without any Lean practices. The company-wide EAA baseline by seniority also provided a scope to analyze the difference in EAA factors due to seniority level after Lean principles implementation.

### **3.6. Phase II- Pilot Study: Impact on EAA Factor's Level after Lean Principles Implementation**

The purpose of the Phase II is to characterize the state of EAA factors after implementation of Lean concepts, through the Kaizen event. In addition, analysis of difference in EAA factors by seniority level was also performed. The second phase of this research seeks to answer the following questions:

1. Did the implementation of Lean principles improve or hinder EAA factors in the targeted department?
2. Are there differences in EAA factors due to seniority level in the department after Lean implementation compared with the company-wide baseline?

#### **3.6.1. Pilot Study**

The pilot study was conducted at a local modular homebuilding company. The pilot study entails conducting the Kaizen event, including documenting pre and post- Kaizen performance data and EAA pre and post-Kaizen. The purpose of collecting and analyzing the performance data is to showcase the level of success of the Kaizen event.

Employees at the targeted department (e.g. base framing department) were asked to complete an EAAQ post-improvement to evaluate the effects of the Kaizen event over the EAA factors (as compared to their initial EAA rankings from Phase I). Since this is a pilot study the sample size was limited to the number of workers at the targeted department.

### **3.6.2. Kaizen Event**

For the present study, the Kaizen event was performed in three phases. Phase I of the Kaizen event included the analysis and documentation of the current production process, involving work sampling (to measure value added and non-value added times) and time study (to document cycle time). The non-value added activities included: giving assistance, idle, break, measurement, receiving/giving instructions, cleaning, getting tools, getting materials, walking, not available, and inspecting. The work sampling was performed by documenting the type of activity performed by the worker in 1-minute intervals. In addition, brainstorming sessions were conducted with the plant manager and line supervisor to document current issues and explore possible areas for improvement.

Phase II of the Kaizen event was to implement the changes in the process which was determined jointly with the plant manager, line supervisor and area workers. After the improvements coordinated by the plant manager and supervisor were accomplished, the post-improvement performance data was documented. Then, the data collected in the first and second step of the Kaizen was analyzed and compared. Phase III of the Kaizen event included the presentation of the results and conclusions to the company's management.

### **3.6.3. Data Collection**

The data collection timeline was five weeks. During the first week, workers filled the EAAQ pre- Kaizen event, and researchers conducted the work sampling and time study. In addition, brainstorming sessions were conducted to document current issues and explore possible areas for improvement. Subsequently, in the second, third, and fourth week the improvements suggested were implemented by the workers. The workers at the selected department worked under the improved process during a week. During the fifth week researchers perform the post-improvement data collection, including the work sampling and time study to measure any

changes in the process. After completion of the Kaizen event, the next step was to determine the level of EAA factors post- Kaizen. During Phase II, workers from the targeted department were asked to complete the EAAQ, in order to determine their state of EAA after the Kaizen event. The EAAQ was similar to the one used in Phase I, except for the addition of two extra questions related to workers participation in the Kaizen event (Appendix C).

#### **3.6.4. Data Analysis**

Upon receiving the completed EAAQ post- Kaizen, the data was entered into a spreadsheet. The answers for each question were recorded in a numerical format. If the worker left any question unanswered, he or she was not included in the analysis and that pertains to the blank answer.

In Phase II, the data analysis has four parts: 1. Kaizen assessment to evaluate the performance improvement in the targeted department, 2. Gap analysis to calculate the change in EAA rankings and 3. Pivot tables as a graphical representation of the variation in EAA rankings by seniority level for pilot study workers. 4. Comparison of Phase I and Phase II to compare post-improvement EAA rankings by seniority with the company-wide baseline.

- 1. Kaizen Assessment-** in order to showcase the success of the Kaizen event, the documented levels of performance pre and post-Kaizen event were analyzed and the percentage of performance improvement calculated.
- 2. Gap Analysis-** in order to determine changes on an employee EAA factors' rankings, a gap analysis was performed. The gap analysis entails the calculation of the difference between the employee's ranking of each EAA factor from pre and from the post- Kaizen event questionnaires. First, scores for each of the EAA variables were determined by calculating the mean of each variable per worker, individually from the pre (Phase I) and the post- Kaizen event (Phase II) questionnaires. The mean

values from Phase I and Phase II were then subtracted to calculate the gap score. The Gap score was calculated for the same set of workers that participated in Phase I and in Phase II, and completed the EAAQ (e.g. pre and post- Kaizen). Then, using the gap score of each EAA factor of each worker the basic statistics was calculated and Box Plot diagrams were created. The main idea for creating Box Plot diagrams were to graphically represent the location of median with respect to positive or negative gap score.

The gap score needs to be positive, if there was an increase in job satisfaction or commitment after the Kaizen event successful completion. Whereas, the gap score needs to be negative, if there was a decrease in job stress after the Kaizen event successful completion. The sample size for the gap analysis was the number of workers at the targeted station.

The gap score was used to assess the impact on EAA factors after the Kaizen successful completion. The following propositions have been framed:

P<sub>1</sub>: The Kaizen event increased employees' job satisfaction

P<sub>2</sub>: The Kaizen event increased employees' commitment

P<sub>3</sub>: The Kaizen event decrease employees' job stress

- 3. Pivot Tables-** in order to compare the EAA factors with work experience at the targeted department pre and post Kaizen event, pivot tables were generated for each EAA factor. Microsoft Excel was used to generate the pivot tables for each EAA variable. Each individual worker of the pilot study was assigned a serial number (1, 2, ....n) for identification. The pivot table was formatted with the seniority levels in the rows and mean values of EAA factors in the columns. Since, seniority level of the pilot study workers belonged to Category I and Category II of seniority level, the

further data analysis was performed with these categories only. The serial number of the pilot study workers entered in the pivot table corresponds to its seniority group level in rows and its EAA factors mean rankings in columns. Pivot tables also include the change in average ( $\Delta$  Avg) value representing the increase or decrease in the EAA factors' level due to seniority level of the worker after a successful Kaizen event. The propositions for the difference in  $\Delta$  Avg value of different seniority level categories are assumed as follows:

- If difference in  $\Delta$  Avg value of different seniority level categories is more than 1, then a substantial difference is considered.
- If difference in  $\Delta$  Avg value of different seniority level categories is between 1 and 0.5, then a moderate difference is considered.
- If difference in  $\Delta$  Avg value of different seniority level categories is less than 0.5, then an insubstantial difference is considered.

**4. Comparison of Phase I and Phase II-** In addition, a table was generated to compare the average EAA ranking by seniority for post- Kaizen with the company-wide average by seniority. Three tables were generated which consists of individual EAA factor in the column, with seniority level in the rows. The mean values from the company-wide baseline and the post-Kaizen by seniority are entered in to the table. The mean values of 82 construction workers for company-wide baseline are then compared with mean values of the five pilot study workers for post-Kaizen. Potential implications of the results are also discussed.

### **3.6.5. Outcomes**

The following outcomes are expected from the data analysis of Phase II:

1. The impact on EAA factors level for the targeted station after the successful Kaizen event completion.
2. A comparison of the EAA factors post-improvement by seniority to the company-wide EAA baseline (from Phase I).

The positive and negative score of Gap analysis shows a positive or negative impact on EAA factors level post- Kaizen, within the employees of the targeted department. The pivot tables for pilot study employees pre and post- Kaizen are compared to assess any changes on the net ranking of each factor due to the Kaizen event. In addition, within each plot chart, the EAA factors level by seniority post-improvement are compared with the company-wide baseline.



## **CHAPTER 4**

### **RESULTS**

This chapter includes the results for the EAAQ ratings of the employees with and without Lean. Data analysis like descriptive statistics, regression analysis, gap analysis, pivot table, and comparison of Phase I and Phase II are also presented later in the chapter. The time study and work sampling results with and without Lean are also included in this chapter.

The results are divided into the following two major sections:

1. Phase I- Company-wide Empirical Study of EAA factors
2. Phase II- Pilot study: Impact on EAA factors level after Lean principles implementation

#### **4.1. Phase I- Level of EAA Factors for the Company without Lean Principles**

This section of results includes the descriptive characteristics of 82 construction workers of the company without Lean practices. Further, the regression analysis results for statistical significant relationship of EAA factors with the workers' seniority are also presented.

##### **4.1.1. Descriptive Characteristics**

**Data Collection Process for Pre-Kaizen-** EAAQ was distributed among the 82 construction workers to determine their EAA factors ranking for pre-Kaizen. The meeting with all the construction workers was organized in association with the plant manager. The meeting took place in the lunch room where the workers were requested to fill the questionnaire during the break hours. Before the filling the questionnaire, the objective of the questionnaire was introduced to each worker in a brief introductory session. The directions for filling the questionnaire were also explained during the introductory session. In addition, each worker was assured about the confidentiality of their responses. The average time taken by the worker to fill

the whole questionnaire was about 15 minutes. The completed questionnaires were then collected to perform the analysis of the rankings.

Table 4.1 below show the questionnaire ratings of EAAQ without Lean for the 82 construction workers. EAAQ had total 12 negative questions out of 27 which were reverse scored. In case of positive questions, the score of 5 represents most positive (strongly agree), and for 1 represents the most negative (strongly disagree). On the contrary, for negative questions the score of 5 represents most negative (strongly agree), and for 1 represents most positive (strongly disagree).

The mean, maximum, minimum, median, and standard deviation values were tabulated based on the EAAQ ratings without Lean. The three variables in the rows represent the three EAA factors: job satisfaction, commitment, and job stress. Scores for each of these variables were determined by calculating the mean of each variable per worker, resulting on 82 mean values. To find the overall mean, averages for all 82 mean values were then calculated. The mean values in the table are the overall mean for the three factors of EAA without Lean (Table 4.1).

**Table 4.1** EAAQ Ratings for 82 Construction Workers of Company without Lean Practices

<b>Employees' Affective Attitude</b>	<b>Mean</b>	<b>Max</b>	<b>Min</b>	<b>Median</b>	<b>Standard Deviation</b>
Job satisfaction	2.94	3.67	1.93	3.12	0.53
Commitment	2.90	3.32	1.89	3.01	0.44
Job stress	3.38	3.70	3.17	3.42	0.20

To analyze the variation in levels of the EAA factors due to seniority level, Table 4.2 was created. Workers' responses were sorted according to their seniority level. The workers were grouped according to categories of seniority levels- I (work experience 0-8 years), II (work experience 9-20 years), and III (work experience 20-45 years).

**Table 4.2** Average EAA Factors Scores Categorized by Seniority Levels (n=82)

Seniority Levels	# of workers	Job satisfaction			Commitment			Job stress		
		Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
Category I (0-8 yrs)	34	2.92	4.08	2.17	2.91	4.5	1.75	3.46	5.00	2.14
Category II (9-20 yrs)	35	2.81	3.87	1.75	2.83	3.87	1.75	3.22	4.43	2.00
Category III (20-45 yrs)	13	3.12	4.08	2.50	2.87	3.25	2.50	3.40	4.71	2.29

In order to identify the significant difference in EAA factors with respect to three categories of seniority level for pre – Kaizen, ANOVA was performed using Table 4.2. The seniority level categories were selected as independent variables and the EAA factors were selected as dependent variables. The mean values of EAA factors corresponding to seniority level categories in Table 4.2 were used as an input data to ANOVA. The results from ANOVA yielded a p-value of 0.71 which is greater than the significance level of 0.05.

#### 4.1.2. Normality Test

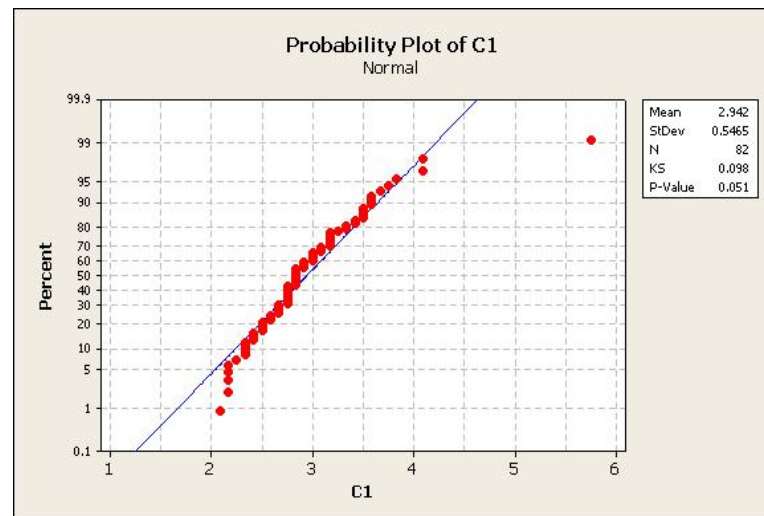
This section includes results from the normality test performed to check the normal distribution of the data. Kolmogorov-Smirnova normality test was performed at significance level of 0.05. Table 4.3 exhibits the results of this normality tests. The input data was the mean values of workers in EAAQ without Lean ranking (n=82). The p-values obtained for job satisfaction, commitment, and job stress were 0.051, 0.152, and 0.151 (Table 4.3), which is greater than the significance level of 0.05 at which the normality test has been performed. Based

on this we cannot reject the null hypothesis stating that data is normally distributed. Therefore, the normal distribution of the data allows performing the parametric test (linear regression analysis) for analyzing the variation in EAA factors with respect to seniority level for pre-Kaizen.

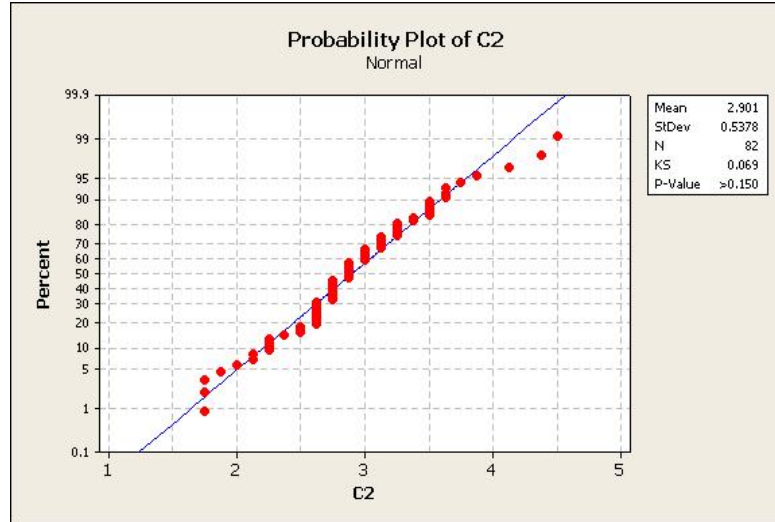
**Table 4.3** Normality Test Results for 82 Construction Workers EAAQ Ratings without Lean

Kolmogorov-Smirnova: Normality Test				
	N	SD	K-S Statistic	p-value
Job satisfaction	82	0.546	0.098	0.051
Commitment	82	0.538	0.069	0.152
Job stress	82	0.647	0.068	0.151

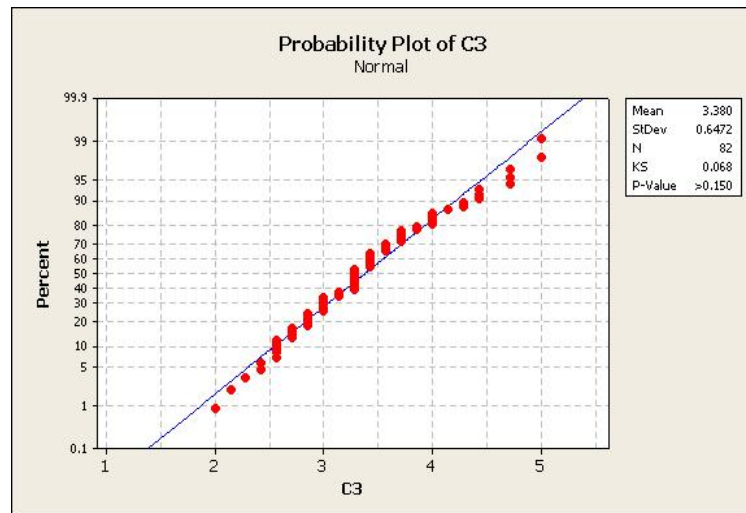
The probability plot of the job satisfaction, commitment, and job stress rankings are shown in Figures 4.1, 4.2 and 4.3. The variables C1, C2, and C3 represent job satisfaction, commitment, and job stress, respectively. Conclusions regarding the hypothesis can be made based on the obtained p-values for EAA factors in the normality test.



**Figure 4.1** Probability Plot for Job Satisfaction (C1)



**Figure 4.2** Probability Plot for Commitment (C2)



**Figure 4.3** Probability Plot for Job Stress (C3)

#### 4.1.3. Hypothesis Testing

This section includes the hypothesis testing of the null hypothesis ( $H_0$ ) and alternative hypothesis ( $H_1$ ,  $H_2$ ,  $H_3$ ) stated in section 3.5.2 of the research methodology section. The hypothesis testing has been performed at significance level of 0.05 using a T-test in linear regression analysis.

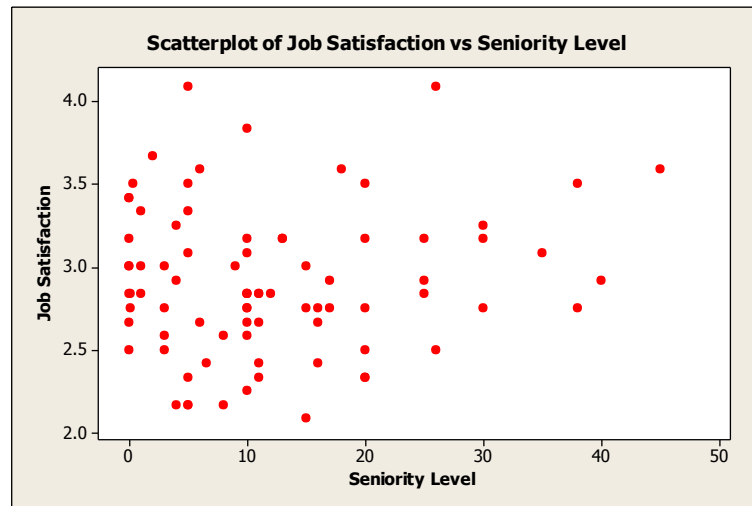
Before the hypothesis test, correlation analysis has been performed to identify correlation between EAA factors and seniority level for pre-Kaizen. The correlation analysis yielded the correlation coefficients for each EAA factors with respect to seniority level of construction workers. Correlation coefficients for job satisfaction, commitment, and job stress were 0.10, 0.21, -0.06 respectively, with respect to the seniority level. Positive correlation coefficients for job satisfaction and commitment reflected their positive relationship with seniority level. On the other hand, the negative correlation coefficient for job stress reflected its negative relationship with seniority level. In addition the p-value to identify significant correlation of seniority level with EAA factors was determined as 0.362, .061, and 0.570. Based on these p-values, it can be concluded that at 0.05 significance level correlation of seniority level with EAA factors is not significant.

**Table 4.4** Correlation Analysis Results for EAA Factors and Seniority Level (n=82)

Variables	Seniority Level	Job satisfaction	Commitment	Job stress
Seniority Level	1			
Job satisfaction	0.10	1		
Commitment	0.21	0.13	1	
Job stress	-0.06	0.11	0.09	1

After, determining the correlation coefficient, the next step was to analyze the pattern of variation for EAA factors with respect to seniority level of workers. To analyze this pattern, the linear regression analysis was performed using the ratings of the EAA factors (job satisfaction, commitment, and job stress) and seniority level data sets. The results of the linear regression analysis included the scatter plot, regression model, parameter estimates, and good fit plot which are presented in Table 4.5, 4.6, and 4.7 and Figure 4.4, 4.5, 4.6, 4.7, 4.8, and 4.9. for three EAA factors.

#### 4.1.3.1. Job Satisfaction



**Figure 4.4** Job Satisfaction Variation with respect to Seniority (n=82)

Figure 4.4 display a scatter diagram of job satisfaction versus seniority level. The pattern of dots slopes from lower left of the graph to upper right of the graph suggesting the positive correlation between the job satisfaction and seniority level.

Further, the model relating job satisfaction to seniority level was developed by drawing the line resembling the pattern obtained from scattered plot. In order to estimate the parameters like intercept of the line, slope of the line, test statistic, and p-value, linear regression analysis were performed using Minitab version 16. The regression equation  $JS = 2.85 + 0.00419 SL$  for job satisfaction (JS) versus seniority level (SL) was determined by using the job satisfaction rankings of the 82 construction workers. A T-test was also performed to determine significant relationship of job satisfaction with seniority level for pre-Kaizen. Table 4.5 represents the linear regression analysis and T-test results entailing the coefficients (intercept and slope), SE coefficients, T-stat value and p-values. For job satisfaction as the dependent variable the coefficient value is 0.004 which represents the positive slope of the regression model for job

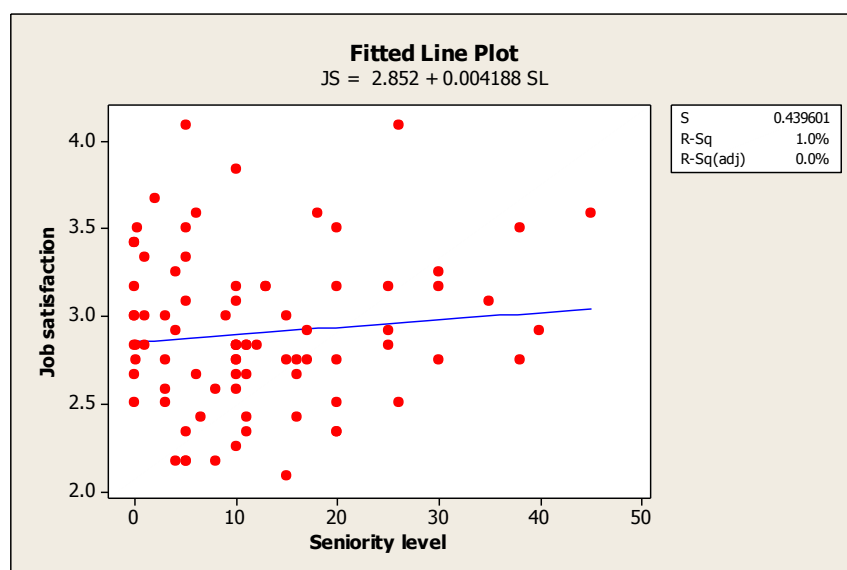
satisfaction and seniority level. Further, the p-value of 0.362 in Table 4.5 represents that relationship of job satisfaction with seniority level is not significant at 0.05 significance level.

**Table 4.5** Parameter Estimates of the Linear Regression for Job Satisfaction and Seniority Level (n=82)

Predictor	Coefficients	SE coefficient	T-stat	p-value
Intercept	2.852	0.073	38.840	0.000
Seniority level	0.004	0.004	0.916	0.362

Following the parameter estimates, a fitted line test to estimate the fitness of the linear regression model with the scattered data was performed. The results of fitted line test yielded the standard error, R-sq, and R-sq(adj) as 0.439, 1.0%, and 0.0%.

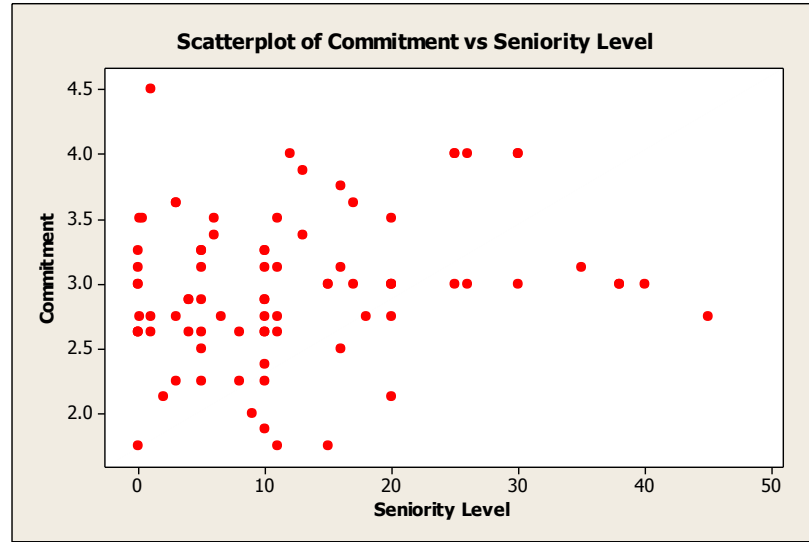
The fitted line plot for job satisfaction variation with respect to seniority level is shown in Figure 4.5. The regression equation in Figure 4.5 shows the coefficient of SL as 0.0042 representing a positive slope. The R-sq value of 1% represents the goodness of fit of the regression model for job satisfaction and seniority level for pre-Kaizen.



**Figure 4.5** Fitted Line Plot for Job Satisfaction Vs. Seniority (n=82)



#### 4.3.1.2. Commitment



**Figure 4.6** Commitment Variation with respect to Seniority (n=82)

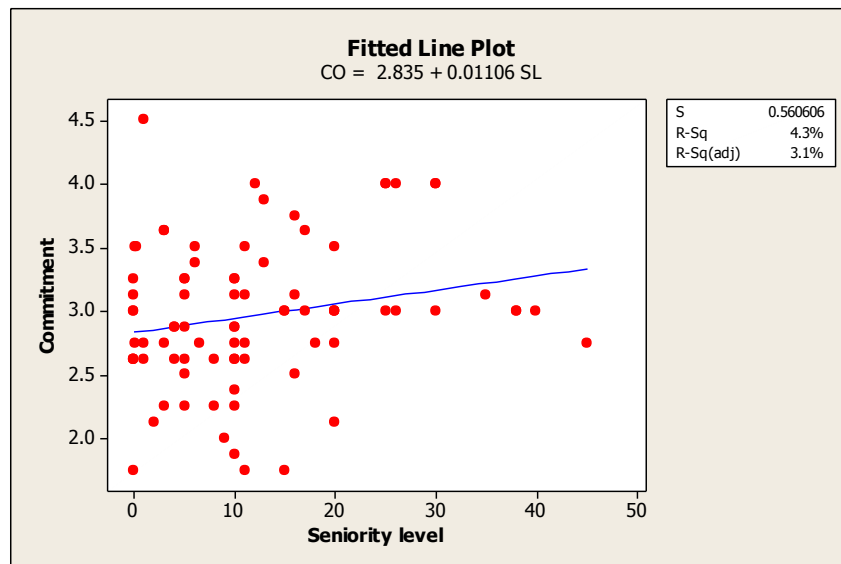
Figure 4.6 display a scatter diagram of commitment versus seniority levels. The pattern of dots slopes from lower left of the graph to upper right of the graph suggesting the positive correlation between the commitment and seniority level.

The resulting regression equation was  $CO = 2.83 + 0.0111 SL$  for commitment (CO) versus seniority level (SL). Table 4.6 displays the linear regression analysis and T-test results entailing the coefficients (intercept and slope), SE coefficients, T-stat value and p-values. For commitment as the dependent variable the coefficient value is 0.011 which represents a positive slope.. Further, the p-value of 0.061 was not significant at a 0.05 significance level.

**Table 4.6** Parameter Estimates of Linear Regression for Commitment and Seniority Level without Lean

Predictor	Coefficients	SE coefficient	T-stat	p-value
Intercept	2.835	0.094	30.270	0.000
Seniority level	0.011	0.005	1.900	0.061

Following the parameter estimates, a fitted line test to estimate the fitness of the linear regression model with the scattered data was performed. The results of fitted line test yielded the standard error, R-sq, and R-sq(adj) as 0.561, 4.3%, and 3.1%.



**Figure 4.7** Fitted Line Plot for Commitment Vs. Seniority (n=82)

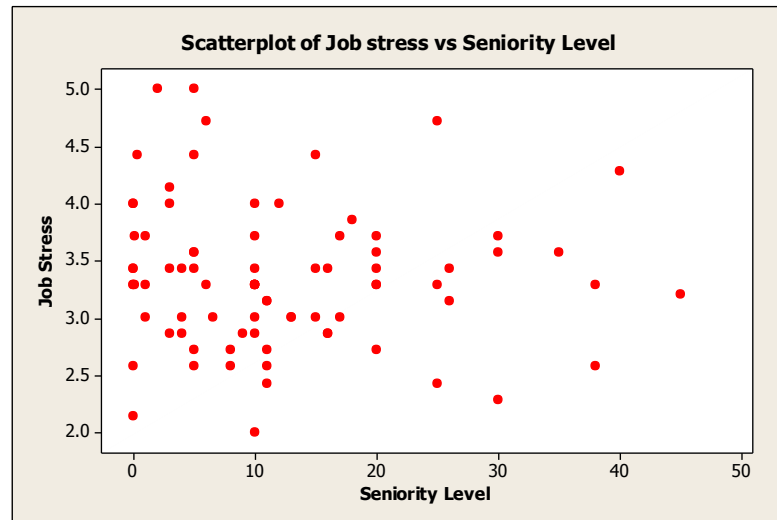
The fitted line plot for commitment variation with respect to seniority level is shown in Figure 4.7. The regression equation in Figure 4.7 shows the coefficient of SL as 0.011 representing a positive slope. The R-sq value of 4.3% represents the goodness of fit of the regression model for commitment and seniority level for pre-Kaizen.

#### 4.3.1.3. Job Stress

Figure 4.8 displays a scatter plot diagram of job stress versus seniority levels. The pattern of dots slopes from upper left of the graph to lower right of the graph suggesting a negative correlation between the job stress and seniority levels.

The resulting regression equation for job stress (JST) versus seniority level (SL) was  $JST = 3.39 - 0.00368 SL$ . Table 4.7 represents the linear regression analysis and T-test results entailing the coefficients (intercept and slope), SE coefficients, T-stat value and p-values. For job

stress as the dependent variable the coefficient value was -0.004, which represents a negative slope. Further, the p-value of 0.570 was not significant at a 0.05 significance level.



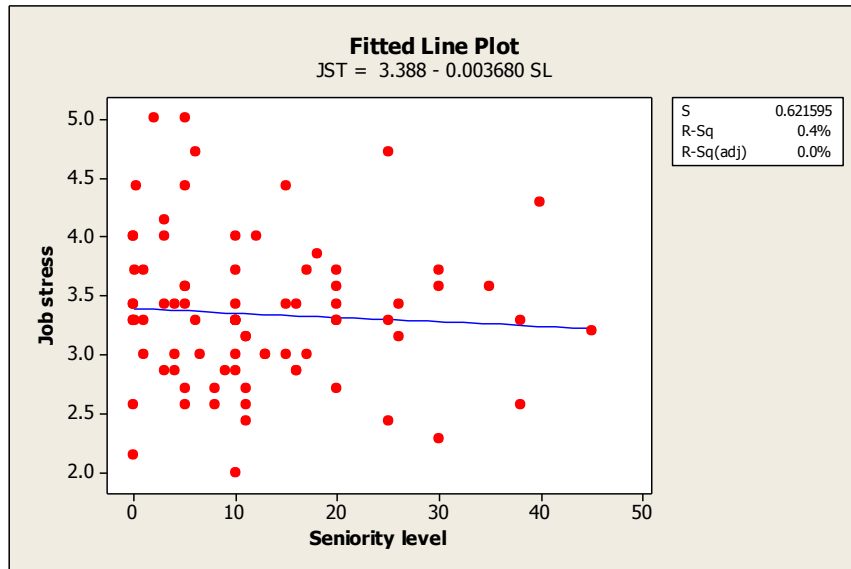
**Figure 4.8** Job Stress Variation with respect to Seniority (n=82)

After the parameter estimates, a fitted line test to estimate the fitness of the linear regression model with the scattered data was performed. The results of fitted line test yielded the standard error, R-sq, and R-sq(adj) as 0.622, 0.4%, and 0.0%.

**Table 4.7** Parameter Estimates of Linear Regression for Job Stress and Seniority Level Without Lean

Predictor	Coefficients	SE coefficient	T-stat	p-value
Intercept	3.388	0.104	32.630	0.000
Seniority level	-0.004	0.006	-0.570	0.570

The fitted line plot for job stress variation with respect to seniority level is shown in Figure 4.9. The regression equation shows the coefficient of SL as -0.004 representing a negative slope. The R-sq value of 0.4% represents the goodness of fit of the regression model for job stress and seniority level for pre-Kaizen.



**Figure 4.9** Fitted Line Plot for Job Stress Vs. Seniority (n=82)

## **4.2. Phase II- Pilot Study: Impact on EAA Factors Level after Lean Principles Implementation**

### **4.2.1. Kaizen Event Results**

The pilot study focuses on the first department of the participating modular company where the base frame for the modular homes is manufactured. The resources of the base frame department in terms of labor were 5 workers. In the past, delays in this department had a major impact in meeting the manufacturer's production schedule. Initially, analysis and documentation of the current production process without Lean was performed. Work sampling (to measure value added and non-value added times) and time study (to document cycle time) was adopted for measuring performance. The non-value added activities involved activities like assistance, idle, break, measurement, directions, cleaning, getting tools, getting materials, walking, not available, and inspecting. The work sampling was performed by documenting the activity performed by the worker in 1-minute intervals for each individual worker for the duration of one complete cycle.

In addition, brainstorming sessions were conducted with the plant manager and line supervisor to document current issues that prevented them to meet demand from successive departments and explore possible areas for improvement.

The improvements in the process were determined jointly with plant manager, line supervisor and area workers to address the current issues. The improvements in general included: revising their standard procedures including a pre-planning step, department layout redesign, and improving staging tools strategy. Preplanning step incorporated morning huddle to discuss floor plans and assign roles before the starting of process. After the improvements coordinated by the plant manager and supervisor were accomplished, the process was again performed with improved procedure and improve workplace settings. During the improved process, work sampling and time study was again performed for comparing the performance associated with pre and post- Kaizen. The Kaizen event which included the process of collecting current performance data for pre and post-Kaizen, brainstorming sessions, implementation of improvements lasted approximately 3 weeks. Table 4.8 and 4.9 shows the performance data capture through the time study and work sampling.

**Table 4.8** Time Study Data for Cycle Time at Targeted Department

	Pre-Kaizen	Post-Kaizen	Improvement
Labor hours (min)	952	899	55%
Labor hours (min)/ sq ft	2.25	1.02	55%

**Table 4.9** Work Sampling Data for Value Added and Non Value Added Activities at Targeted Department

Activities	Pre- Kaizen	Post- Kaizen	Improvements
Value added	41%	57%	16%
Non value added	59%	43%	-16%

**Kaizen Assessment-** results in Table 4.8 shows that the processes improvement implementations via the Kaizen event, improved the cycle time at the targeted department. Labor hours (min) represent the time taken by 5 workers to complete the entire base framing process of one house. Overall there is an improvement in value added activities by 16% as displayed in Table 4.9. With the improvements in the cycle time, value added activities, and non value added activities, justifies the success of the Kaizen event.

**Data Collection Process for Post-Kaizen-** EAAQ was again distributed among the pilot study workers to determine their EAA factors rankings for post- Kaizen. The data collection procedure for post- Kaizen was the same as that for pre-Kaizen. The average time taken by the individual worker to fill the questionnaire was 15 minutes. The time span between the data collection for pre and post-Kaizen was approximately 3 weeks. The filled questionnaires were then collected for the comparative analysis of the pre and post- Kaizen rankings.

#### **4.2.2. Gap Analysis Results**

The purpose of the Gap analysis was to determine the changes in EAA factors ranking of the pilot study workers after the Kaizen event successful completion. The mean values per variable of each pilot study worker were calculated from pre and post- Kaizen rankings of EAAQ. These mean values were then subtracted to obtain the gap score. Table 4.10 contains the gap score for individual workers per EAA factors.

In Table 4.10 the gap scores for job satisfaction are positive for all the workers except for worker #1, which means overall there is a positive improvement in the job satisfaction after Lean. The gap scores are positive for all workers in case of commitment, which indicates the positive improvement after Lean. In case of job stress, workers #1 and #3 have positive gap score, but others workers shows the negative gap score. However, the majority of the pilot data

shows a reduction in job stress. Further, basic statistics of the gap score for job satisfaction, commitment, and job stress, were performed and displayed in Table 4.11.

**Table 4.10** Gap Scores for EAA Factors

# of workers	Average Job Satisfaction		Gap Score	Average Commitment		Gap Score	Average Job Stress		Gap Score
	Pre-Kaizen	Post-Kaizen		Pre-Kaizen	Post-Kaizen		Pre-Kaizen	Post-Kaizen	
1	4.08	3.50	-0.58	3.25	4.10	0.85	2.60	3.30	0.70
2	3.42	3.92	0.50	4.37	5.00	0.63	4.72	4.00	-0.72
3	3.00	4.10	1.10	4.50	5.00	0.50	3.00	4.00	1.00
4	3.75	4.00	0.25	4.13	4.80	0.67	4.29	3.10	-1.19
5	3.50	4.20	0.70	3.50	4.00	0.50	4.43	3.35	-1.08

The gap scores of the 5 pilot study workers for the three EAA factors were used to generate Box Plot diagrams. Figure 4.10 below is the box plot for all three factors of EAA which display the results graphically.

In Table 4.11, the mean and percentage improvement for the job satisfaction is 0.41 and 11.5% representing the positive improvement. Further, the median value for job satisfaction in Table 4.11 is 0.58 and in Figure 4.10 lies in the range of positive gap scores which represents positive improvement. In addition, the mean and percentage improvement for the job stress is -0.24 and 6.7% representing the decrease in job stress level. Further, the median value for job stress in Table 4.11 is -0.72 and in Figure 4.10 lies in the range of negative gap scores which represents a decrease in job stress level.

Also, the mean and percentage improvement for the commitment in Table 4.11 is 0.63 and 15.9% representing the positive improvement. Further, the median value for commitment in Table 4.11 is same as mean (0.63) and in Figure 4.10 lies in the range of positive gap scores which represents positive improvement.

**Table 4.11** Basic Statistics of Gap Score for EAA Factors

Employees' Affective Attitude	Mean	Max	Min	Median	Standard Deviation	Percentage improvement
Job satisfaction	0.41	1.10	-0.58	0.58	0.63	11.5
Commitment	0.63	0.85	0.50	0.63	0.14	15.9
Job stress	-0.24	1.10	-1.19	-0.72	1.12	6.7



**Figure 4.10** Box Plot of Gap Scores for Job Satisfaction, Commitment, and Job Stress

#### 4.2.3. Pivot Tables

The main idea for creating the pivot tables was to graphically represent the EAA factors variation by seniority level. Table 4.12, 4.13, and 4.14 display each EAA factor by seniority level for the pre and post- Kaizen of the five pilot study workers. Since the seniority level of the pilot study workers falls into Category I (0-8 years of work experience) and Category II (9-20



years of work experience), the rows of the pivot tables are created based on these two categories only. The seniority level of 4 pilot study workers fall in the Category 1 whereas the seniority level of 1 pilot study worker belongs to the Category 2. The EAA factors mean rankings for pre-Kaizen and post-Kaizen are placed in columns. The serial number of each worker in the pivot table corresponds to its seniority group level and its EAA factors mean rankings.

The change in average ( $\Delta$  Avg) for each seniority level represents the increase or decrease in the job satisfaction level due to seniority level of the worker after a successful Kaizen event. In Table 4.12, workers in Category I and II recorded 0.57 and 0.50, respectively increase on their scoring for job satisfaction. Also the 3<sup>rd</sup> worker whose work experience is less than 12 years showed the highest increase in his job satisfaction level due to improvements.

Table 4.13, shows that workers in Category I and II recorded a 0.62 and 0.62, respectively, increase in their commitment levels. Also the 1<sup>st</sup> worker whose work experience is less than 12 years showed the highest increase in his commitment level due to improvements.

**Table 4.12** Job Satisfaction due to Seniority Level for Five Pilot Study Workers Pre and Post- Kaizen

Serial No. of workers	Job satisfaction mean values for pre-Kaizen						
Work Experience	3.00	3.42	3.50	3.75	4.08	Avg <sub>b</sub>	$\Delta$ Avg = Avg <sub>p</sub> - Avg <sub>b</sub>
Category I (0-8 years)	3		5	4	1	3.58	0.57
Category II (9-20 years)		2				3.42	0.50
Serial No. of workers	Job satisfaction mean values for post-Kaizen						
Work Experience	3.50	3.92	4.00	4.10	4.20	Avg <sub>p</sub>	
Category I (0-8 years)	1		4	3	5	4.15	
Category II (9-20 years)		2				3.92	

Table 4.14, shows workers in Category I and II recorded -0.12 and -0.72, respectively, as a decrease in their job stress levels. In addition, the 4<sup>th</sup> worker whose work experience is less than 12 years showed the highest decrease in his job stress level due to improvements.

**Table 4.13** Commitment due to Seniority Level for Five Pilot Study Workers Pre and Post-Kaizen

Serial No. of workers	Commitment mean values for pre-Kaizen						
Work Experience	3.25	3.50	4.13	4.38	4.50	Avg <sub>b</sub>	$\Delta \text{Avg} = \text{Avg}_p - \text{Avg}_b$
Category I (0-8 years)	1	5	4		3	3.85	0.62
Category II (9-20 years)				2		4.38	0.62
Serial No. of workers	Commitment mean values for post-Kaizen						
Work Experience	4.00	4.13	4.75	5.00	Avg <sub>p</sub>		
Category I (0-8 years)	5	1	4	3	4.47		
Category II (9-20 years)				2	5.00		

**Table 4.14** Job stress due to Seniority Level for Five Pilot Study Workers Pre- and Post-Kaizen

Serial No. of workers	Job stress mean values for pre-Kaizen						
Work Experience	2.60	3.00	4.29	4.43	4.72	Avg <sub>b</sub>	$\Delta \text{Avg} = \text{Avg}_p - \text{Avg}_b$
Category I (0-8 years)	1	3	4	5		3.58	-0.12
Category II (9-20 years)					2	4.72	-0.72
Serial No. of workers	Job stress mean values for post-Kaizen						
Work Experience	3.10	3.30	3.35	4.00	Avg <sub>p</sub>		
Category I (0-8 years)	4	1	5	3	3.44		
Category II (9-20 years)				2	4.00		

#### 4.2.4. Comparison of Phase I and Phase II

Tables 4.15, 4.16, and 4.17 compare the company-wide baseline (Phase I) with the results from the pilot study (Phase II).

**Table 4.15** Comparison of Job Satisfaction for Company-Wide Baseline and Post- Kaizen by Seniority Level

Seniority Levels	Job satisfaction			
	Company-wide baseline		Post- Kaizen	
	# of workers	Mean	# of workers	Mean
Category I (0-8 yrs)	34	2.92	4	4.15
Category II (9-20 yrs)	35	2.81	1	3.92

**Table 4.16** Comparison of Commitment for Company-Wide Baseline and Post- Kaizen by Seniority Level

Seniority Levels	Commitment			
	Company-wide baseline		Post- Kaizen	
	# of workers	Mean	# of workers	Mean
Category I (0-8 yrs)	34	2.91	4	4.47
Category II (9-20 yrs)	35	2.83	1	5.00

**Figure 4.17** Comparison of Job Stress for Company-Wide Baseline and Post- Kaizen by Seniority Level

Seniority Levels	Commitment			
	Company-wide baseline		Post- Kaizen	
	# of workers	Mean	# of workers	Mean
Category I (0-8 yrs)	34	3.46	4	3.44
Category II (9-20 yrs)	35	3.22	1	4.00

## **CHAPTER 5**

### **CONCLUSIONS AND DISCUSSION**

This chapter includes the conclusions and discussion of the outcome of Phase I and II of the research methodology. Conclusions based on the data analysis like descriptive statistics, linear regression analysis, gap analysis, pivot table, and comparison of Phase I and Phase II are derived and discussed. Conclusions based on the time study and work sampling results for pre and post-Kaizen is also included in this chapter to justify the successful Kaizen event at the targeted department. Limitations, recommendations, and future research are presented in the concluding sections of this chapter.

The conclusions are divided into the following two major sections:

1. Phase I- Company-wide empirical study of EAA factors.
2. Phase II- Pilot study: Impact on EAA factors level after Lean principles implementation.

#### **5.1. Phase I- Company-Wide Empirical Study of EAA Factors**

The descriptive characteristic results answer the first research question of Phase I in terms of current level for job satisfaction, commitment, and job stress in the participating company without Lean. The results also reveal the company-wide base-line for EAA factors level pre-Kaizen. According to these results, the workers' response for job satisfaction was determined close to a Likert scale of 3 which represents undecided response. To be more precise, the current state of job satisfaction pre-Kaizen on an average for company workers was slightly towards disagreement of being satisfied. Therefore, based on the Table 2.3 of chapter 2 the

current job satisfaction reflects slight disagreement for an environment with a well-defined work, freedom in performing task, and quality of the work.

Further, the workers' response for commitment was found close to a Likert scale of 3 (undecided). Therefore, it can be concluded that the current state of commitment for pre-Kaizen on average for company workers reveals slight disagreement of being committed. Therefore, based on the Table 2.3 the current commitment reflects slight disagreement for motivation, better task identification, supporting nature, and job involvement.

In addition, workers' response for job stress was between the Likert scale of 3 (undecided) and 4 (agreement). On this basis, the company workers for pre-Kaizen possess a moderate level of job stress. Therefore, based on Table 2.3, the current job stress shows moderate agreement for mental stress due to time deadlines, stress at the individual level, excessive work, and the poor fit based on workers' capability.

Subsequently, the company-wide EAA factors baseline may be used to screen the workers for future Kaizen events. Ideally, the workers with lower level of EAA factors should be considered as top candidates to participate in the Kaizen event.

In addition, the identification of variation in EAA factors categorized by seniority level was also a part of the research methodology. Descriptive characteristic results show the variation in EAA factors with respect to Category I (less experienced), Category II (more experienced), and Category III (most experienced) seniority level. In order to identify the statistical significance of these variation ANOVA was performed. The ANOVA results for EAA factors as dependent variables and seniority level categories as independent variable yielded a p-value of 0.71 which is greater than 0.05. Therefore, at 0.05 significance level, it can be concluded that variation in EAA factors with respect to seniority level categories are not significant. After observation, the

mean values for job satisfaction show an increasing tendency with respect to seniority level categories but is not statistically significant. The commitment mean values are almost same for all seniority level, but job stress mean values show a non-significant decreasing tendency with respect to seniority level.

The second research question of Phase I is based on the relationship of EAA factors with seniority level. Linear regression analysis results show little linear relationship for job satisfaction, commitment, and job stress with seniority level. The positive slope values for the linear regression model indicate that job satisfaction and commitment of the construction worker have the increasing tendency with increase in seniority level. Whereas, the negative slope values indicate the decreasing tendency of job stress level with the increase in seniority level. The fitted line plot for job satisfaction, commitment, and job stress displayed an R-square value of 1%, 4.3%, and 0.4% which leads to the conclusion that seniority level of the construction workers explains only 1%, 4.3%, and 0.4% of the linear variation in their job satisfaction, commitment, and job stress level. The remaining 99%, 95.7%, and 99.6% variation in job satisfaction, commitment, and job stress level of the employees may be due to some other factors. Some potential factors, that warrant further analysis, may be other demographic information such as gender, age, and years of work experience at the company which was not used in the data analysis. Also, the p-values obtained from the T-test for job satisfaction, commitment, and job stress are 0.36, 0.061, and 0.570, respectively to test the significance of variation in EAA factors due to seniority level. Since, the p-values for all EAA factors are greater than the significance level of 0.05; we cannot reject the null hypothesis ( $H_0$ ). Therefore it can be stated that at 0.05 significance level, we do not have sufficient evidence to accept  $H_1$ ,  $H_2$ , and  $H_3$  and conclude that

job satisfaction, commitment, and job stress variation among workers is significant with seniority level.

Finally, it can be concluded that there is little linear relationship of the EAA factors with seniority level, and at 0.05 significance level it is not significant. Job satisfaction and commitment level increases and job stress level decreases with the increase in seniority level based on their slope values for the linear regression model.

The results obtained from Phase I are similar with the findings from Rodwell et.al (1998) studies, who found a positive correlation for job satisfaction and commitment with respect to seniority level, whereas negative correlation of job stress with seniority level. The increasing tendency of job satisfaction and commitment with the seniority level can be explained by the findings of Park et.al (2008) who suggests that job satisfaction within the organization improves as the employees have better acquaintance with the working procedure and working environment. , Similarly, results from the case study showed a negative correlation of job stress with the seniority level. This could be explained due to the familiarity with the work dynamics and working environment of the more experienced workers. In support, Leung et.al (2008) found that job stress of the employees varies as the employee gets acquainted with the dynamics of work. Hence, job stress measurements in the future should show less stress as workers the use to the new work dynamics and improvements.

## **5.2. Phase II- Pilot Study: Impact on EAA Factors Level after Lean Principles Implementation**

According to the rankings based on the Likert scale the current state of EAA factors in Phase I revealed that there is a need for improvement in the process which may impact the attitude of the workers. Based on the literature, Lean principles have the potential to change the

culture of workers in terms of working climate and practices. Literature also suggests that change in working climate and practices impacts the views, outlook, and beliefs representing the EAA.

Therefore, the next step is to implement Lean principle and measure the impact on EAA factors. The company-wide EAA factors baseline can be used to screen workers at the selected department for implementing Lean principle like the Kaizen event. Workers with low rankings for EAA factors may serve as a potential candidate for the Kaizen event.

Results from the Kaizen event show 55% improvement in cycle time for the selected department for pilot study after the improvements enabling the crew to double the production. In addition, a reduction in non-value added activities by 16% is also recorded. Better task assignment and role definition during the preplanning stage of the Kaizen event were some aspects responsible for these improvements. The workers systematic approach to perform the assigned task led to the reduction of non-value added activities. The other aspects responsible for improvements were the organized work area which reduced the material handling and tools inaccessibility. Therefore, the results from the Kaizen event suggest that it was a successful implementation of Lean concepts. In particular by increasing the production rate, making working procedure more efficient, and improving the work area layout at the selected department.

After the completion of the successful Kaizen event, the next step was to measure the impacted EAA at the targeted department. Gap analysis is performed to measure the impacted EAA and to answer the first research question of Phase II.

Based on the average gap score, percentage improvement, and median of box plot, the propositions made for the gap analysis can be justified. The positive gap score, positive percentage improvement, and median for job satisfaction justify that the Kaizen event increased



employees' job satisfaction. Similarly, the positive gap score, positive percentage improvement, and median for commitment justify that the Kaizen event increased employees' commitment. On the other hand, the negative gap score, negative percentage improvement, and median of justify that the Kaizen event decreased employees' job stress. Finally, results from the case study shows that implementation of Lean principles have the potential to improve EAA factors in the targeted department.

On the basis of literature, the following conclusions can also be derived:

1. An increase in job satisfaction after a Kaizen event reflects that a Kaizen event promotes well defined work, more freedom in performing tasks, and an increase in the quality of the work.
2. Improvement in commitment of workers after the Kaizen event reflects improvement in motivation among workers, better task identification, and job involvement of workers.
3. A decrease in job stress after the Kaizen event reflects decrease in mental stress due to time deadlines, decrease in physical and mental stress, reduction in overload of work, and the appropriate fit between work and workers' capability.

Conclusions from the case study are supported by the findings of Chatman et.al (2001) and Hook et.al (2008). They found that Lean concepts can change working methods and working environment which may affect the attitude, values, and working practices of the employees. The results of gap analysis also justify the conceptual model which presented the link between the Kaizen event and EAA factors. Similarly, findings of Muchinsky (1977) and Lingard et.al (2004) prove to be true for job satisfaction and commitment being impacted due to improvements from the case study. Also in the concept model, assumption for the job stress being impacted due to improvements proves to be true.

The pivot tables are formed to analyze the variation in EAA factors due to seniority of pilot study workers for pre and post- Kaizen. The pivot tables seek to answer the second research question of Phase II.

For, job satisfaction the difference in  $\Delta$  Avg value for Category 1 (less experience) and Category 2 (more experience) is 0.07 which is less than 0.5. According to propositions there is an insubstantial difference in Category 1 and Category 2 workers in terms of their job satisfaction. Therefore, the job satisfaction rankings due to seniority for pre and post- Kaizen reveal that workers in Category I are more satisfied than workers in Category 2

Further, for commitment the difference in  $\Delta$  Avg value for Category 1 and Category 2 is 0. Therefore, there is no difference in Category 1 and Category 2 workers in terms of their commitment or workers of Category 1 and Category 2 are equally committed. Subsequently, for job stress the difference in  $\Delta$  Avg value for Category 1 and Category 2 is 0.6 which is greater than 0.5 and less than 1. According to propositions there is a substantial difference in Category 1 and Category 2 workers in terms of their job stress Therefore, the job stress rankings due to seniority for pre and post- Kaizen reveals that due to the implemented improvements workers in Category 1 had the highest reduction in job stress as compared to the workers in Category 2. Finally, it can be concluded from the results of the case study that there is difference among EAA factors due to seniority of the construction workers.

Then, results from Phase I and Phase II were compared by tabulating EAA factors for company-wide baseline and post -Kaizen Results showed that the job satisfaction was lower for Category I and Category II workers from the company- wide baseline as compared to same category workers from the post- Kaizen. Therefore, based on the results from the case study, it

can be concluded that job satisfaction of all ranges of work experience were increased after the successful completion of the Kaizen event.

In addition, commitment rankings for Category I and Category II workers from company-wide baseline were less as compared to same category workers from post- Kaizen. This leads to the conclusion that successful completion of the Kaizen event aids the improvement in commitment level of workers towards the company.

Also, job stress rankings of workers from company-wide baseline and post-Kaizen were compared. Results showed that job stress for Category I workers from company- wide baseline are higher than those Category I workers from post- Kaizen. The workers with less work experience displayed a reduction in their job stress level after successfully completing the Kaizen event. The process was modified during the Kaizen event for the purpose of experimentation which resulted in the change in dynamics of work. Similarly to Leung et.al (2008) results from the pilot test showed a variation on job stress due to the changes in work dynamics.

Also, results from the pilot study showed that workers in Category II tend to have higher levels of job stress as compared to the original baseline of the participating company. The workers from Category II experienced job stress with the improved process which reflects their unwillingness and non-acceptance to the improved process. Since Kaizen is a continuous improvement process; the further improvement in the process may drive Category II worker to accept the changes.

Since the pilot study workers of Category I and Category II have shown the improvements in their EAA factors' level after the successful Kaizen event; it can be expected that the workers from company-wide baseline of same category will also show similar improvements after participating in the future Kaizen event.

## **Limitations**

The following were the limitations associated with the study:

1. The study was limited to the modular home building company.
2. The measurement of Kaizen impact was limited to one department of the company.
3. Impact of the Kaizen event was only measured on EAA.
4. The study period was limited to the transformation phase during the Kaizen event at one department of the company.
5. Since Kaizen is a continuous improvement process results are expected to be different for future transformation phases.

## **5.3. Future Research**

Based on the limitations, this study incorporates few ideas for future research. Following are some propositions which can be set as a base for future studies:

1. Since the study was limited to only modular home building company, future studies can be performed in other manufacturing industries. The manufacturing industries which are involved in using precise assembly equipment and repetitive assembly-line techniques can be studied using the Lean concept like the Kaizen event. Time study, work sampling, and interviews can be performed to identify issues and areas for improvement in the existing manufacturing process. The impact of improvements over the workers attitude can then be measured using validated questionnaires for employees' attitude.
2. Future studies can be performed over the impact of individual phases of Kaizen structure over EAA factors. The questionnaire based on the Likert-scale can be developed which contains the items measuring the impact of individual phases of Kaizen over EAA factors.

3. Since impact on only EAA was measured, the impact on employees' involvement after the Kaizen event completion can also be a part of future research. The employees' involvement can be measured using a validated questionnaire containing the items measuring employees' involvement.

#### **5.4. Lessons Learnt and Research Significance**

The Lean concepts have got the potential to improve not only the process but also the EAA factors like job satisfaction, commitment, and job stress. The implementation of Lean principles initiates the education, training, and participation of employees for eliminating production waste, improving productivity, and enhancing worker's role perception in the company. The EAA transforms and changes after working with the improved and efficient working process resulting from implementation of Lean principles. This research can help the companies who desire to implement Lean principles and can serve as a base in decision making for process improvement initiatives. The results of this research may help these companies to identify the after effects of Lean principles, for example the impact on EAA.

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**APPENDIX A**

**CONSENT FORM**

Dear Participant:

This survey is designed to document employees' affective attitude strategies of your company.

The purpose of this project is to understand and evaluate the impact of Lean principles, implemented through the Kaizen event, on employees' affective attitude. This study has been approved by the Institutional Review Board (IRB), and the contact information can be found in the next page which has to be noted down upon signing this form.

Your answers for the questionnaire will be kept completely confidential and your identity will be protected. Participation and non participation is completely your decision and will not affect your current employment status. If the questions of questionnaire are not comfortable for you to answer feel free to skip it or stop filling it further. Your participation is on voluntary basis and will be highly appreciated. By participating you will greatly contribute in our process of understanding the impact of Lean principles on employees' affective attitude.

By signing this consent form, it is believed that you have read and understood the idea and purpose of this survey and you give your consent to participate in it. This sheet with your signature will be detached from the actual survey to protect your identity. The next page contains contact information of Principal Investigator's and IRB for your reference which is to be separated by you after completing the survey.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Thank you for participation!

## **APPENDIX B**

### **EAA QUESTIONNAIRE PRE- KAIZEN PRE- KAIZEN**



## Part I. Demographic information

1. Gender: Female or Male
2. Age: \_\_\_\_\_
3. Years of work experience: \_\_\_\_\_
4. Years of work at LASBH: \_\_\_\_\_
5. Work area/station: \_\_\_\_\_

## Part II. Questions- please circle your answer

	Statements	Strongly Disagree					Strongly Agree				
1	I do a complete task from start to finish. The results of my efforts are clearly visible and identifiable	1	2	3	4	5					
2	I make insignificant contributions to final product	1	2	3	4	5					
3	My job is arranged so that I do not have a chance to do an entire piece of work from beginning to end	1	2	3	4	5					
4	My job provides me the chance to finish completely any work I start	1	2	3	4	5					
5	What I do affects the well being of other people in very important ways	1	2	3	4	5					
6	What I do is of little consequence to anyone else	1	2	3	4	5					
7	My job is not very important to the company's survival	1	2	3	4	5					
8	Many people are affected by the job I do	1	2	3	4	5					
9	I have complete responsibility for deciding how and when the work is to be done	1	2	3	4	5					
10	I have a very little freedom in deciding how the work is to be done	1	2	3	4	5					
11	My job does not allow me an opportunity to use discretion or participation in decision making	1	2	3	4	5					
12	My job gives me considerable freedom in doing the work	1	2	3	4	5					
13	I am willing to put in a great deal of effort beyond that is normally expected in order to help this organization to be successful	1	2	3	4	5					
14	I talk up this organization to my friends as a great organization to work for	1	2	3	4	5					
15	I feel very little loyalty to this organization	1	2	3	4	5					
16	I would accept almost any type of job assignment in order to keep working for this organization	1	2	3	4	5					
17	I find that my values and the organization values are very similar	1	2	3	4	5					
18	I am proud to tell others that I am a part of this organization	1	2	3	4	5					
19	I could just as well be working for a different organization as long as the type of work were similar	1	2	3	4	5					

	Statements	Strongly Disagree			Strongly Agree	
20	This organization really inspires the best in me in the way of job performance	1	2	3	4	5
28	I have enough time to do my job properly	1	2	3	4	5
29	There is too much stress in my job	1	2	3	4	5
30	Most people in this job feel overwhelmed by the work	1	2	3	4	5
31	Recently I have felt constantly under strain at work	1	2	3	4	5
32	My job demands too much of me	1	2	3	4	5
33	My job involves too much of stress	1	2	3	4	5
34	I think my workload is excessive	1	2	3	4	5

## **APPENDIX C**

### **EAA QUESTIONNAIRE POST- KAIZEN**

**Part I. Demographic information**

1. Gender: Female or Male
2. Age: \_\_\_\_\_
3. Years of work experience: \_\_\_\_\_
4. Years of work at LASBH: \_\_\_\_\_
5. Work area/station: \_\_\_\_\_

**Part II. Please circle Yes(Y) or No (N)**

1. Did you participated with your team in the meeting : Y/N
2. Did you participate in the process improvement changes at your station: Y/N

**Part III. Questions- After the improvement implemented in your station, please circle your answer**

	Statements	Strongly Disagree Strongly Agree				
1	From start to finish I completed my task and I can clearly visualize and identify my results for work	1	2	3	4	5
2	To final product I made significant contribution	1	2	3	4	5
3	My job was arranged and I did not perform entire piece of work from beginning to end	1	2	3	4	5
4	The work I started provided me the opportunity to finish it completely	1	2	3	4	5
5	The work I did affected the well being of other people in very important ways	1	2	3	4	5
6	The work I did was of little consequence to anyone else	1	2	3	4	5
7	For company's survival my job was not very important	1	2	3	4	5
8	The work I did affected many people	1	2	3	4	5
9	While performing the task I had complete responsibility for deciding how and when the work has to be done	1	2	3	4	5
10	While performing the task I felt little freedom in deciding how the work needs to be done	1	2	3	4	5
11	In decision making my job did not allowed me an opportunity to use discretion or participation	1	2	3	4	5
12	While performing the work my job my job gave me considerable freedom in it	1	2	3	4	5
13	In order to help this organization in its success, I was willing to put in a great deal of effort beyond that is normally expected	1	2	3	4	5
14	I discussed with my friends about this organization as a great organization to work with	1	2	3	4	5
15	Towards this organization I felt very little loyalty	1	2	3	4	5
16	In order to continue working for this organization , I accepted almost any type of job assignment	1	2	3	4	5
17	I found the organization values and my values were very similar	1	2	3	4	5
18	Being a part of this organization I felt pride	1	2	3	4	5

	Statements	Strongly Disagree Strongly Agree				
19	As the type of work was similar I could work for different organization	1	2	3	4	5
20	In terms of job performance this organization inspired the best in me	1	2	3	4	5
28	To do my job properly I did not have enough time	1	2	3	4	5
29	I had too much stress in my job	1	2	3	4	5
30	In this job most people felt overwhelm after the work	1	2	3	4	5
31	Recently I felt constant strain at work	1	2	3	4	5
32	The work I performed demanded too much of me	1	2	3	4	5
33	The work I performed involved too much of stress	1	2	3	4	5
34	After the work I did I thought my workload was excessive	1	2	3	4	5

## **VITA**

Digvesh Khot was born in 1983 in Bhopal, Madhya Pradesh, India. In 2005, he completed his bachelor's degree (B.Tech) in mechanical engineering from Maulana Azad National Institute of Technology, Bhopal, India. He served as a research scientist in Defense Research and Development Organization, India, from September 2005 – June 2008. He joined Louisiana State University in August 2008 to pursue a master's (M.S.) in industrial engineering. His technical interests are lean manufacturing and six sigma.