

Kaizen and Job Satisfaction- A Case Study in Industrialized Homebuilding

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Abstract

Research Question/Hypothesis: Do Lean concepts implemented through Kaizen events affect job satisfaction levels in an industrialized homebuilder plant?

Purpose: To explore the impact of Lean through Kaizen events on job satisfaction levels for an industrialized homebuilder plant.

Research Design/Method: Company-wide questionnaires were used to characterize the current state of job satisfaction levels at the plant. Then a Kaizen event at one production station was used as a case study to evaluate levels of job satisfaction before and after Lean implementation.

Findings: Results from the case study revealed an increase in job satisfaction (+11.4%) after Lean implementation. While workers with more experience appear to have lower job satisfaction, there was no significant difference in job satisfaction between age groups.

Limitations: The study was limited to the industrialized homebuilding sector and the study period was limited to the transformation phase during the Kaizen event in one production station. Impact of the Kaizen event was only measured on job satisfaction levels.

Implications: Findings from this research will contribute to a better understanding of the applicability of Lean strategies in the housing industry and its impact on job satisfaction.

Value for practitioners: This paper disseminates results in an important topic within Lean Construction by identifying enabler factors to ensure successful Lean Construction implementation.

Keywords: Kaizen, Lean, Job Satisfaction, Industrialized Housing

Paper type: Case Study

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Introduction

The factory built industry is plagued with high levels of turnover and absenteeism. MHRA (2005) found that the level of employee absenteeism in the US industrialized housing industry is 6%, twice that of the overall industrialized sector; and the level of employee turnover is 61%- far greater than any other industry (e.g. 28% in construction and 17% in manufacturing). Absenteeism also creates daily disruption on the shop floor, resulting in lost productivity and reduced quality. Together with labor turnover, absenteeism is an important measure of job satisfaction. These high values of absenteeism and labor turnover in the industrialized homebuilding industry are evidence of workforce challenges that need to be addressed. Past research shows that an increase in responsibilities and abilities of front line workers, required in Lean, increases job satisfaction (Appelbaum et al., 2000). However, there is little quantitative research directly addressing the relationship between participatory work arrangements, such as Lean, and job satisfaction (Vidal, 2007). In order to explore this void in the literature, this paper explores the impact of Lean concepts through Kaizen events on job satisfaction for one workstation within an industrialized homebuilder. In addition, the relative difference on job satisfaction levels across various seniority (e.g. length of tenure within the organization) levels is also examined.

The fine-tuning that made the Toyota production system, now known as Lean, really work came not from upper management, nor from the engineers, but from the shop floor in the form of employee suggestions (Summer, 2007 from Yasuda, 1990). In general, the success of any process improvement initiative strongly depends on employees' active involvement and motivation to continuously improve their working environment. These employees are the ones who perform their jobs daily and their knowledge, skills and efforts are invaluable to any process improvement initiative. Furthermore, employees inherently want to do a good job. They want a job that allows them to use their knowledge and skills. Lean companies successfully ingrain a Lean culture in their workforce. In previous research, Kaizen has been used to improve working climate, working methods, and working experiences (Farris et al., 2009). Kaizen is a Lean tool that strives toward perfection by eliminating waste (non-value added activities from the perspective of the customer) by empowering employees with the responsibility, time, and tools/methodologies to uncover areas for improvement and to support change. The purpose of a Kaizen is to continuously improve and install a Lean culture in the company through the use of Lean principles and tools. Employee empowerment and group activity have been shown to have a positive influence on job satisfaction and employee loyalty (Jun et al., 2006). Thus, the implementation of process improvement techniques in an organization can positively impact employees' job satisfaction. This paper will present empirical results from a pilot study on the impact of Kaizen events on job satisfaction from an industrialized homebuilder plant.

US industrialized homebuilding

In past decade, US industrialized homebuilding has held its overall market share of 5% to 7%, through the rise and fall of the housing market (U.S. Census Bureau, 2011).



Industrialized houses are constructed offsite, transported to a building lot, and assembled into a finished home. There are several approaches used by industrialized homebuilding including homes built as panels (e.g. panelized or pre-cut homes) or units (e.g. modular homes). In both cases, all of the construction materials and construction details are similar to conventional site-built homes, with minor changes to accommodate transportation and installation. Industrialized homes comply with state and local building codes similar to those applied to conventional site built homes. Most industrialized homes are wood framed, however some others are light-gauge steel framed, structural insulated panels (SIPs) or pre-cast concrete panels.

Most US industrialized workforce, are dedicated to one company with little specialty subcontracted work. The ready availability of a highly skilled, dedicated workforce is an important advantage of industrialized homebuilding (Mullens, 2011). Furthermore, all of the required construction activities are designed to be synchronized, which minimizes delays due to poor coordination and scheduling of subcontracted work. When delays occur, the factory can respond as a unit with its dedicated workforce by temporarily moving cross-trained workers to a trouble station, and/or working overtime (Mullens, 2011). In some cases, workers might be required to work overtime to accommodate demands or delays. Depending on the extent/duration of the overtime and the nature of the labor force, mandatory overtime may improve or worsen worker satisfaction and employee turnover (Mullens, 2011). Hence, the working environment and conditions impacts workers' job satisfaction.

Job satisfaction

Job satisfaction is defined as the extent of satisfaction an employee extracts from performing an assigned task (Muchinsky, 2006). Furthermore, Mutanen et al. (1983) argue that job satisfaction relates to tasks' characteristics such as monotony, type of work, control over the work, and the working methods. For example, if a worker does not have the necessary skills to effectively perform a task, this situation can cause frustration and lead to job dissatisfaction. Unstable job environment is another factor which may drive job dissatisfaction and employee turnover (Dormann et al., 2001). Herzberg (1967) identified several satisfiers and dissatisfiers that affect job satisfaction. Satisfier factors related to job content includes task achievement, task achievement recognition, task nature, task responsibility, and task capability; whereas dissatisfier factors refer to the job environment including conditions under which a job is being performed (i.e. company policies and administration), quality of working conditions, type of supervision, and salary. Further, job satisfaction is a function of individuals' social and psychological conditions and factors including the working conditions or working environment as a cognitive aspect (Miller, 1980).

The literature offers several tools to evaluate employees' job satisfaction such as the Job Diagnostic Survey (JDS). The JDS was designed to be used both in the diagnosis of jobs prior to their redesign, and in research and evaluation activities aimed at assessing the effects of redesigned jobs on workers (Hackman et al., 1975). JDS provides measures of five core dimensions:

- *Skill Variety*- degree to which a job requires a variety of different activities to carry out the work



- *Task Identity*- degree to which the job requires completion of a whole and identifiable piece of work
- *Task Significance*- degree to which the job has a substantial impact on the lives or work of other people
- *Autonomy*- degree to which the job provides substantial freedom, independence, and discretion to the employee scheduling the work and determining the procedures to be used in carrying out the work
- *Feedback*- degree to which the worker receives information of the actual results of his/hers work activities.

Once employees' job satisfaction is known, then management can evaluate strategies to improve or maintain desired levels. Previous literature presents various strategies. Morton (1948) explored strategies to improve employees' job satisfaction, and suggested aligning employee's experience, potential ability, training, and natural capability and the type of work. Further, Morton (1948) suggested creating job interest by recognition of commendable performance and explaining the significance of work. Furthermore, Kalleberg (1977) found that work values and job rewards influence job satisfaction positively. The length of employment affects job satisfaction, in particular task significance (Katz, 1978). Further, designing task and managing new employees in an efficient manner aids in raising job satisfaction (Katz, 1978). Similarly, Roberson (1990) explored strategies to enhance job satisfaction and found that higher levels of goal commitment, chances of goal success and goal clarity as the best approach.

Employees' demographics may be the other aspect significant to job satisfaction. Most recently Sledge et al. (2011) demonstrated that job satisfaction is a result of external and internal influences including cultural, gender, institutional, socio-economic and societal issues. 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 and seniority had lower levels 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), who found that organizational commitment affects job satisfaction positively at various levels of an organization.

In the construction industry, Porter et al. (1973) related job satisfaction to employees' turnover and absenteeism rates. Previously, Herzberg (1967) argued that elements like the type of working environment, job definition, quality of task, and type of supervision influences job satisfaction among workers. Wright et al. (2002) correlated organizational goal clarity and commitment with job satisfaction. Most recently, Broeck et al. (2010) found that paying attention to employees' satisfaction levels might furthermore enhance employees' functioning and, therefore, help to reduce costs associated with turnover, and increase productivity. Based on this literature, the construction industry can experience similar issues.

Job satisfaction and Lean

Typically, Lean results are associated with waste elimination, cycle time reduction, redesigning of the work environment, modification or change in the sequence of processes, and quality improvement. Lean can change working methods and working environments which may affect beliefs, values, and working practices of employees (Chatman et al., 2001). Thus, Lean may affect employees' job satisfaction. Further, Hook et al. (2008) studied the organizational culture of the industrialized housing industry and found that after Lean implementations (e.g. changes in work floor order and visibility), worker attitude and culture changed. Employee turnover and absenteeism inversely affects the job satisfaction (Porter et al., 1973) and is a major issue in the US construction industries. Previous research found that job satisfaction as a core element in the company's culture. Lean also affects behavior of employees through learning new and improved processes, and has a positive impact on company's culture (Wiklund et al., 2002). The implementation of Lean resulted in employees learning redesigned processes that are more effective, and in turn positively impacted the company's culture (Hook et al., 2008), and in turn job satisfaction. Therefore, Lean has the potential to transform the culture and behavior of employees to one that is more proactively efficient resulting in higher level of job satisfaction.

Previous research on Total Quality Management (TQM) based continuous process improvement led to improved job satisfaction and employee loyalty (Jun et al., 2006). Furthermore, the literature shows some potential links showcasing that an effective Kaizen, a Lean tool, can positively impact job satisfaction. Individuals working in an organized climate 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. Similarly, Lingard et al. (2004) found that better working environments and planned activities also raises commitment of workers to perform their duties. Reduction in workload due to efficient and improved processes may lead to decreased stress among workers performing the activities planned (Shoaf et al., 2004). Thus, Kaizen events have a link with job stress due to reduction in workload and efficient working procedures.

Kaizen events

In practice, Lean concepts can be implemented through Kaizen events, an intensive and focused approach to process improvement. 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 targeting waste reduction or elimination (PDTP, 2002). These events have three phases as shown in Figure 1. The first phase is planning and preparation, the second phase is the implementation of the process improvement event, and the third phase entails the presentation of the results (PDTP, 2002). According to PDTP (2002), the first phase is to explore the possible areas of improvement by observing the current process, current culture (practices being followed), and exploring 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. In this study, Kaizen events are chosen as a Lean tool for continuous improvement to evaluate its impact on job satisfaction in a modular homebuilding company.

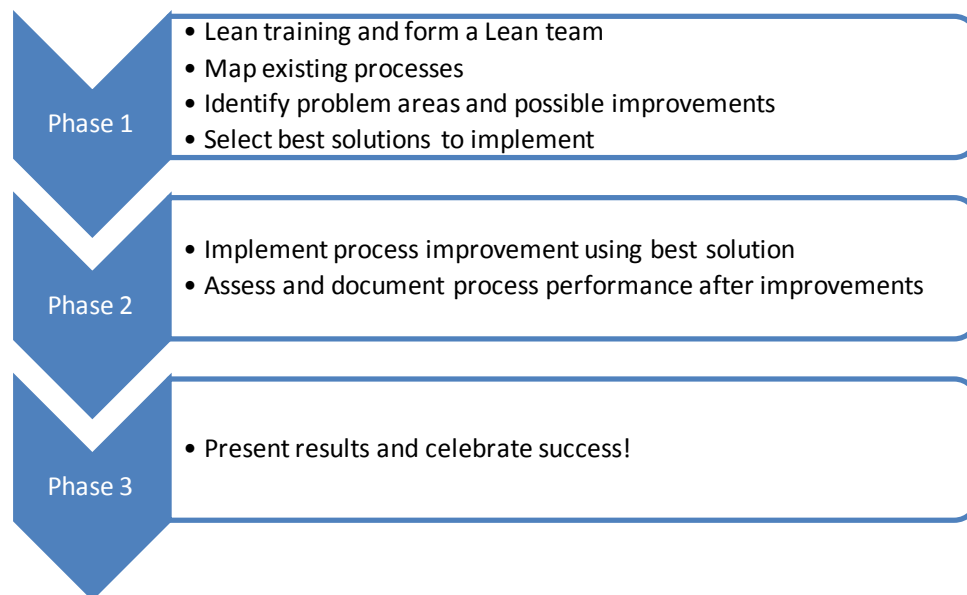


Figure 1: Typical Kaizen Event Structure (modified from PDTP, 2002)

Research design and method

An industrialized homebuilder was selected for this study. This homebuilder produces modular homes, which are either stick built (base, walls and ceiling) or a combination of stick built with Structural Insulated Panels (SIP) (walls and ceiling). The production rate was 12-15 homes per month at the time of the study. The company uses precise assembly equipment and repetitive assembly-line techniques. The plant layout follows a sequential building process according to the manufacturing process for the homes, which includes 19 stations. At the time of this study, the plant had about 100 employees working on different stations across the plant.

The production process at this manufacturer was experiencing several areas of concern, as reported by the plant manager, that may hinder or prevent planned production expansion, including: 1) Inadequate material flow and procurement 2) Variable production rate among stations, in particular the base framing station (station 1) and 3) Insufficient workforce. This study focuses on station 1 where the base frame for the modular homes is manufactured, and due to the sequential nature of the construction process the work on the consecutive stations depends on station 1. In the past, delays in station 1 had a major impact in meeting the manufacturer's production schedule. In order to address their current situation of insufficient workforce, this case study explores the usability of Lean, in particular Kaizen, to improve job satisfaction on Station 1. The study is based on the assumption that by improving employee's satisfaction through well defined and an

improved work environment will address their issue of insufficient workforce. The approach entailed two phases.

Phase I- Company-wide Empirical Study of Job Satisfaction-the purpose of the company-wide empirical study was to characterize the current level of employees' job satisfaction at the targeted industrialized homebuilder plant prior to any Lean practices. In order to determine the level of job satisfaction a tailored version of the Job Diagnostic Survey (JDS: Hackman et al., 1975) was used. This survey was tailored to the industrialized homebuilding industry and focused on three of the five components of job satisfaction (Hackman et al. 1975): task identity, task significance, and autonomy. These categories were the focus of the survey because they were expected to be most affected by the Kaizen, whereas the other two factors, skill variety and feedback, were not expected to change as a result of the Kaizen. Skill variety depends on the job content, which would not change (the process of building a house would remain relatively constant), and the feedback questions were directed at upper-level management style, which the Kaizen did not attempt to change since it focused on only internal processes of one workstation.

The questionnaire used had two sections: 1) Employees' demographics, and 2) Job satisfaction questions from the JDS. The demographic section provides information regarding work experience of the individual worker (e.g. employees' age, gender, years of work experience at the participating company, years of work experience in construction and current station where they work). Section two of the questionnaire includes 11 questions related to job satisfaction on a Likert-scale of 1 to 5. Responses to the 11 questions were summed to reach a single job satisfaction score, with higher scores indicating higher levels of satisfaction (range from 11 to 55). Scores on negative questions were reversed before summing for the analysis. To assess validity of the questions, Cronbach's alpha was calculated on the responses to these 11 questions from the 82 workers. Correlations were calculated between each pair of items (55 pairs) because high correlations would indicate items that address the same concept. Last, factor analysis was used to determine groups of questions that are related to the same underlying constructs and to calculate the percentage of variance in responses explained by the questions (rather than random chance). The combination of a high Cronbach's alpha, low number of highly correlated pairs, and high percentage of explained variance will indicate a reliable questionnaire instrument. The 11 questions covered the following topics (* indicates reverse-scored items):

- Ability to complete tasks and have clearly visible and identifiable results
- *Make insignificant contributions to the final product
- *Job arranged so that entire pieces of work are not completed from start to finish
- Job arranged to completely finish any work started
- Work affects the well-being of others in important ways
- *Work has little consequence to anyone else
- *Job is not important to company's survival
- Have complete responsibility for deciding how and when work is done
- *Have very little freedom in deciding how work is done
- *Job does not allow use of discretion or participation in decision-making



- Job gives considerable freedom in doing work.

In addition, this phase analyzed the relationship of job satisfaction levels with seniority level (e.g. years of work experience in the construction industry). The following hypotheses were framed to determine the relationship of job satisfaction with work experience prior to Lean implementation.

Null Hypothesis:

H0: There is no relationship of job satisfaction with seniority levels (e.g. work experience)

Alternative Hypothesis:

H1: Job satisfaction is related to seniority level.

Phase II- Impact on Job Satisfaction after Lean Implementation-the purpose was to characterize the state of employees' levels of job satisfaction after implementing Lean through a Kaizen event at Station 1. In addition, an analysis of difference in job satisfaction levels by seniority level was also performed. Kaizen events followed the structure in Figure 1. The data collection timeline for the research spanned five weeks. During the first week, workers filled out the questionnaire pre- Kaizen event, and researchers conducted work sampling and time studies over a period of approximately 4 hours to determine the current productivity of the station. Value-added activities were defined as any activities that contribute directly to creating the base frame. Non-value activities were considered non-productive time and included activities such as measuring, walking, materials handling, assisting, cleaning, etc. 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 station 1 worked under the improved process for one month. Then, the fifth week researchers performed the post-improvement work sampling and time study for an additional 4 hours to measure any changes in the process. After conducting the Kaizen event, the workers at the base framing station (Station 1) were asked to fill out the questionnaire to measure the employee's job satisfaction post-Kaizen. Further details on the Kaizen event performed on Station 1 are documented in Ikuma, Nahmens and James (2011).

In order to determine changes in job satisfaction (e.g. before and after Kaizen), a gap analysis was performed. The gap analysis entails the calculation of the difference between the employee's ranking of their job satisfaction from pre and post-Kaizen questionnaires. The gap score needs to be positive, if there was an increase in job satisfaction after the Kaizen event successful completion. The sample size for the gap analysis was the number of workers at the targeted station (Station 1). The following proposition was framed:

P₁: Kaizen event increases employees' job satisfaction



Results

Phase I- Company-wide empirical study of job satisfaction

Employees completed the questionnaire pre-Kaizen during a monthly safety meeting for a total of 82 responses, which includes all 5 workers at Station 1. The responses to the 11 job satisfaction questions had a Cronbach's α of 0.646. For exploratory research, Cronbach's α levels greater than 0.60 are considered acceptable (Hair et al., 2010). Inter-item correlations revealed that only 12 of the 55 correlated pairs had correlations above 0.30, but factors analysis revealed five significant factors (eigenvalues > 1 ; Johnson, 1998). Using an equamax rotation, all 11 items loaded onto one of the five factors at ≥ 0.60 and explained approximately 70% of the variance in responses, which is quite high. Due to the acceptability of the Cronbach's α score, the high factor loadings of the factor analysis, and the high percentage of variance explained by the factor analysis model, we summarized that the survey had acceptable reliability in this novel setting of industrial homebuilding employees.

To analyze the variation in job satisfaction due to experience in the construction industry, workers' responses were sorted according to their years of experience (Table 1): level-I (experience 0-8 years), level-II (experience 8-20 years), and level-III (experience 20-45 years). While workers with more experience appear to have lower job satisfaction, there was no significant difference in job satisfaction between age groups according to the one-way ANOVA comparing job satisfaction for the three age groups ($\alpha = 0.05$).

Table 1. Average job satisfaction scores categorized by seniority levels

Seniority Levels	# of workers	Job satisfaction			
		Mean	SD	Max	Min
Level I	27	36.7	7.4	48	25
Level II	36	38.0	7.6	54	19
Level III	13	33.9	5.9	48	24
Total*	82	36.4	7.3	54	19

*6 workers did not indicate years of experience but are included in the total.

The demographics of the 5 workers in Station 1 (Kaizen group) were compared to the rest of the workers that complete the questionnaire (77 workers) in terms of baseline job satisfaction, age, years at the company, and years of construction experience using individual factors t-tests (alpha = 0.05). The Station 1 workers did not vary significantly from the rest of the company for any of the factors ($p > 0.095$), so we inferred that the effects of Kaizen may impact both groups similarly.

Phase II- Impact of Kaizen on job satisfaction

The process improvement implementations via the Kaizen event improved the cycle time at the targeted department by 55%, or from 2.25 min/ft² to 1.02 min/ft² (0.209 min/m² to 0.095 min/m²) while still producing the same base frame using the same basic processes. In addition, the value added time increased by 16% (from 41% to 57%). More



details on the results of the Kaizen event can be found in Ikuma, Nahmens and James (2011).

The gap analysis to determine changes in job satisfaction with the 5 workers at Station 1 was performed using the pre and post-Kaizen job satisfaction scores (Table 2). While the overall job satisfaction scores improved by 11.4% after the kaizen, a paired t-test ($\alpha = 0.05$) to compare job satisfaction before and after the kaizen event showed no statistically significant improvement ($p = 0.211$).

Table 2. Descriptive statistics of gap score for job satisfaction for the 5 workers in station 1

Job Satisfaction	P1	P2	P3	P4	P5	Mean (SD)	Percentage Improvement
Baseline	26	42	36	28	35	33.4 (6.5)	
Post-Kaizen	39	40	38	33	36	37.2 (2.8)	
Gap (Post Kaizen - Baseline)	13	-2	2	5	1	3.8 (5.7)	11.4%

Discussion

The current study evaluated changes in job satisfaction as a result of a Kaizen event at a modular homebuilder in one station. To determine these possible changes, a baseline company-wide job satisfaction survey was conducted, followed by a Kaizen event at the base framing station (Station 1). The workers at Station 1 were surveyed again after the Kaizen to determine changes in job satisfaction. The pre-Kaizen company-wide job satisfaction survey revealed that workers on average had slightly negative job satisfaction (average score 36.4 out of 55, with the midpoint of the scale at 44). Based on the observations and interaction with employees before the implementation of the Kaizen event, their working environment lacked well-defined work, freedom in performing tasks, and quality of the work (Hackman et al., 1980). These are key drivers of job satisfaction. Job satisfaction appeared to be lower for workers with more years of construction experience, although this relationship was not statistically significant.

Results from the Kaizen event showed a 55% improvement in cycle time for Station 1 after the improvements, enabling the crew to double production. In addition, a reduction in non-value added activities by 16% was also achieved. Better task assignment and role definition during the preplanning stage of the Kaizen event were some aspects responsible for these improvements. In general, the implementation of Lean concepts via Kaizen events resulted in improvements for job satisfaction. Results from the five surveyed employees at Station 1 after implementing Lean concepts revealed an increase in job satisfaction (11.4%) as compared to their pre-Kaizen ratings, although this improvement was not statistically significant. The teamwork required to complete the Kaizen events may have contributed to increased job satisfaction, similar to results found by Park et al. (2008) that job satisfaction improves with improvement in teamwork. After the Kaizen event, roles were defined and standard procedures were revised to include a pre-planning step (e.g. “morning huddle”) to inform workers about details of that day’s work. Furthermore, several work processes were modified to increase productivity. These



changes may have had a positive impact on job satisfaction because workers knew what to expect and the requirements for a productive day, and they had a better understanding of the process and individual roles among workers. Research from Park et al. (2008) supports these conclusions as they suggest that job satisfaction within the organization improves as the employees have better acquaintance with the working procedure and working environment.

In general, an increase in job satisfaction after a Kaizen event was evident. Conclusions from the case study are supported by the findings of Chatman et al. (2001) and Hook et al. (2008) regarding Lean concepts being an enabler to change working methods and environment, and in turn affecting the attitude, values, and working practices of the employees.

Limitations and future research

Some limitations to the study results must be noted. The study was limited to one modular homebuilding company. As a part of future work, future studies can be performed in an increase sample of modular manufacturer or expanded to other homebuilding industry (e.g. panelized, on-site stick built, etc). In addition, the study period was limited to the transformation phase during the Kaizen event at one department of the company. Therefore, the impact of the Kaizen event was only measured on job satisfaction soon after the Kaizen was completed. Future research may involve the study on the impact on employees' involvement long after the Kaizen event completion (e.g. 1, 3, 6, 9 and 12 months after implementation).

Due to limitations in availability of workers, this study was not able to have a true control group of employees who did not participate in kaizen. The company-wide survey was completed at baseline but not after the kaizen, which would confirm that changes seen in the kaizen group were due to the kaizen and not other changes at the company. However, we do have evidence that the kaizen group was not significantly different from the rest of the company in terms of baseline job satisfaction, age, company tenure, and construction experience. This suggests that results from the kaizen on job satisfaction may be extended to the company if kaizen events were conducted in other areas of the facility.

Finally, the study was very small (5 workers), which makes drawing statistically significant conclusions from the analysis difficult. Future research can increase the size of the study group and follow up with the control group at the same time as the study group to account for potential confounding factors that would influence changes in job satisfaction.

Conclusions

This study shows evidence of another potential outcome of using Kaizen in construction processes- improved job satisfaction. This current research linked changes in job satisfaction to Lean events, specifically Kaizen, in a modular homebuilder. While the Kaizen had a positive effect on production levels by doubling output, the results show that Kaizen also has the potential to improve job satisfaction, which may in turn support lower



absenteeism and turnover. Together, Lean and increased job satisfaction may increase productivity of construction workers.

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