Research Article

Evaluating the Impact of Region, Season and Temperature on Customer Satisfaction for Construction Coating Projects

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ABSTRACT

The growing importance of facility management (FM) has engendered new opportunities and challenges in the industry. One of the challenges as an FM is the need to consistently achieve high-quality end-product to satisfy the built environment's users (visitors, owners, and occupants). To achieve this, FMs typically hire and outsource most of the construction work and ensuring high satisfaction at the end of every project is critical for success. On the other hand, the contractors also need to ensure that the FMs are satisfied with their quality of work. Customer satisfaction scores during the post-occupancy evaluation stages have emerged as an essential tool to measure the applicators' performance and the satisfaction level of the facility manager. One of the important sectors within the construction industry is construction coatings that are applied to the finished surface, such as roofs, floors, and walls, that improve surface properties such as appearance, waterproofing, and resistance from scratch or wear and tear. The literature review shows little research on the impact of critical job parameters like the region, season, and temperature on the customer satisfaction score within the construction coating sector. To identify additional factors that can improve the customer satisfaction score, the researchers studied various parameters like the job region, the season of installation, the temperature at which the applicators installed the products, and its effect on customer ratings collected from end-users/FM's. The study showed that out of the three factors of region, season, and installation temperature, the region and the season significantly affected the overall customer satisfaction rating. This study also provides additional parameters to improve customer satisfaction scores for facility managers seeking to enhance project success and for applicators who want to improve customer satisfaction ratings for construction coating projects.

Keywords: Temperature; Season; Coating; Customer Satisfaction; Region

INTRODUCTION

The International Facility Management Association defines facility management (FM) as encompassing multiple disciplines to ensure the built environment's functionality by integrating people, places, processes, and technology (IFMA). One of the critical functions of an FM is operating and maintaining the high performance of their buildings with optimal cost, quality, and time (Enoma, 2006; Atkin & Brooks, 2015). FM's essential functions are space planning, asset management, and financial management (Mousavi et al., 2020). Occupant satisfaction (Gajjar et al., 2018), environmental guidelines for users (Shin et al., 2018), and control of various risks (Grussing and Liu, 2014) are some of the other focus areas within FM. Due to the variety of FM job functions, the last few decades have seen a significant evolution in FM as an emerging research and well-defined discipline (Shin et al., 2018). This rise can be credited to the increasing demand to achieve high performance of the built environment by end-users and owners (Lavy & Shohet, 2009). Moreover, FM's role in corporate-related decisions has also increased (Paek & Sojková 2019). To perform these various job functions and maintain the high performance of the built environment, FMs need to typically rely on outsourcing some of these services to qualified external vendors that can meet the performance requirements of an FM, especially construction vendors (Gajjar et al., 2018).

From the vendor's perspective, performance management and assisting facility managers in optimizing their operations are also paramount (Tripathi & Jha, 2018). The vendors are also looking for ways to satisfy FM's performance requirements and meet their satisfaction (Amaratunga & Baldry 2002). Kagioglou et al. (2001) define performance measurement as "the process of determining how successful organizations or individuals have been in attaining their objectives and strategies." The construction industry has evolved from a typically perceived product-based industry to a product and services-based industry (Nudurupati et al., 2007). With the advent of new technologies and management philosophies in the construction

industry, performance management systems are also evolving (Gajjar et al., 2015, Rezgui et al., 2010). Various researchers have identified multiple factors to measure the performance of construction vendors to ensure competitiveness and profitability, such as key performance indicators within the construction like productivity, cost, quality, and safety (Hussain et al., 2019, Tripathi & Jha, 2018, Sharma et al., 2017; Rashvand & Zaimi, 2014, Chan & Chan, 2004, Ahmed & Kangari 1995). Post Occupancy Evaluation (POE) is one method where the performance is measured by evaluating the finished product and service during the occupancy stages after construction for continuous improvement (Gajjar et al., 2015; Turpin-Brooks and Viccars, 2006; Fisk, 2001). One of the key performance indicators within POE is customer satisfaction (Hussain et al., 2019, Nguyen, 2019, Silva & Warnakulasooriya, 2016, Rashvand & Zaimi, 2014, Chan & Chan, 2004, Ahmed & Kangari, 1995).

According to Onubi et al. (2020) and Zeithaml et al. (2016), the construction industry defines customer satisfaction as "the clients' feedback on whether their expectations or yearnings about the project are met or not." Modern business management philosophies also strongly focus on customer satisfaction to improve companies' offerings (Rahimi & Kozak, 2017). Various studies suggest that customer satisfaction is an essential means of obtaining a competitive advantage in the marketplace (Hussain et al., 2019, Rahimi & Kozak, 2017, Rashvand & Zaimi, 2014). Customer satisfaction has also increased market share, improved profitability, and increased repeat sales (Rahimi & Kozak, 2017). From the vendor's perspective, it is in their best interest to satisfy the FM to secure future work (Tripathi & Jha, 2018). The literature shows that a good customer satisfaction score is vital to prove the vendor's capability and FMs to gauge the vendor's ability to perform projects and services successfully.

One of the sectors within the construction industry is the construction coating sector. Construction coatings are applied to the finished surface, such as roofs, floors, and walls, that improve surface properties such as appearance, waterproofing, and resistance from scratch or wear and tear. Owing to unique requirements and specialized skills necessary for executing coating applications, facility managers typically depend on hiring external vendors (Gajjar et al., 2018). It is in the best interest of facility managers to hire qualified and competent vendors to apply coating products with a proven record of high customer satisfaction. However, considering the nature of the coating project, it is critical to understand the factors necessary to achieve high customer satisfaction for coating projects besides the competent vendor executing the project. This study aims to: (i) Evaluate customer satisfaction ratings for a national manufacturer that were collected using the POE method for construction coating projects. (ii) Identify the impact of regions, seasons, and temperature of coating system installation on customer satisfaction ratings.
(iii) Evaluate if the seasons or temperature contribute to the high customer satisfaction index (eight and above out of ten) and low customer satisfaction index rating of jobs (eight or below out of ten). In summary, the main objective of this study is to evaluate the impact of factors such as regions/location, seasons, and temperature of installation on the overall customer satisfaction ratings for qualified applicators on coating projects.

METHODOLOGY

Study Participants

The applicators and end-users/FMs from one of the largest construction coating manufacturers were selected for this study. The subject manufacturer gave the researchers a list of completed projects every month for four years. This information included critical project information such as end-user's name, end-users contact information, project's name, project's date of installation, project address, project's location, project's area in square feet (SF), the applicator (applicator) responsible for installing the manufacturer's product, and the warranty details (Gajjar et al., 2016). The project information received from the manufacturer of each project was transferred to an electronic online platform by the researchers to track project data.

Survey Questionnaire

To collect data regarding customer satisfaction, a survey questionnaire was developed to gather critical information about the performance of the manufacturer's product and the performance of the applicator responsible for installing the product. The post-occupancy evaluation (POE) method in the form of an owner satisfaction questionnaire has been previously implemented in the construction industry (Gajjar et al., 2016). The questionnaire for the study was developed jointly by the researchers and subject matter experts (SMEs) from the manufacturer organization.

- Customer Satisfaction of the Applicator (scale of 1 to 10; 1 being lowest – 10 being highest)
- Would you hire the applicator o(applicator) again? (Yes/No)
- Customer Satisfaction with the coating system (scale of 1 to 10; 1 being lowest – 10 being highest)
- Would you purchase the system again? (Yes/No)
- Overall Customer Satisfaction (scale of 1 to 10; 1 being lowest – 10 being highest)

The survey questionnaire was distributed to the end-users/FM within four weeks of project completion.

TABLE 1.—Overall Customer Satisfaction

No	Criteria	Unit	Rating
1	Overall customer satisfaction	(1-10)	8.9
2	Customer Satisfaction - Coating System	(1-10)	9.0
3	Percent of customers that would purchase the system again	%	96%
4	Customer Satisfaction - Applicators	(1-10)	8.9
5	Percent of customers that would hire same Applicator again	%	95%
6	Total job area (of job surveyed)	SF	80 M
7	Total number of jobs surveyed	#	2,414
8	Total number of jobs	#	6,064

TABLE 2.—Classification of Jobs per Region

Job Region	Total Jobs (#)	Total SF (#)	Total SF (%)	Overall Customer Satisfaction Rating
Midwest	352	13.5 M	17.49%	8.61
Northeast	319	11.3 M	14.62%	8.87
South	1000	31.1 M	40.27%	9.08
West	743	21.3 M	27.62%	8.97

Data Collection and organization

The manufacturer provided critical information for 6,064 completed coating projects for four years. Four attempts were made to contact the end-user to fill out the survey questionnaire for each project. The first contact was initiated within two weeks of receiving the manufacturer's project information via email and fax. The end-users were given five days to respond to the survey questionnaire via email. If the end-user was non-responsive, three additional attempts were made to contact them via phone over ten days at different days and times. If the end-user failed to respond after four attempts, the end-user was labeled "non-responsive." A total of 2,414 end users out of 6,064 jobs (response rate of 39.8%) responded to the survey totalling approximately 80 million square feet (SF) of job area.

The impact of the region, season, and installation temperature on customer satisfaction was analyzed in three steps. After initial data sorting, factorial classification by region (the location of the job of installation) was done. U.S. Census Bureau classifies the country into four regions: Midwest, Northeast, South, and West (Census Gov, 2013) based on the Geographic Names Information System (GNIS) identifying its geographical location. The data were categorized into four distinct seasons based on the month of installation of the coating system. The installations in December, January, and February were classified as "Winter"; March, April, and May were categorized as "Spring"; June, July, and August were categorized as "Summer," and jobs installed in September, October, and November were categorized as "Fall." Average temperatures for each job were recorded based on the installation date of the job (Weather Underground, 1995), assisting in factorial classification according to the installation temperature. The temperatures were categorized into increments of 10 °F starting from 21-30 °F until 91-100 °F.

Data Analysis

Data from the survey were analyzed by one-way analysis of variance (ANOVA) was applied to investigate whether there existed statistically significant divergences or differences between the overall customer satisfaction ratings from various groups concerning factors, namely, region, season, and temperature of installation using the Statistical Package for Social Sciences (SPSS 28.0 for Windows) software. The statistical analysis method of One-way ANOVA was used for comparing the mean scores of the customer satisfaction ratings. The study considered normality of dependent variables, homogeneity of population variance, and independence of the observation (Field 2006). On observation of statistically significant difference on pairwise comparison in data, a post-hoc analysis was performed using Tukey's HSD test. The categorical variables were placed in homogeneous groups, and then multiple pairwise comparisons were made between the customer satisfaction ratings of these groups. The third step of the study was the stratified analysis of the sample data. It evaluated the impact of factors on each group, namely, high rating index and low rating index jobs. Analysis through one-way ANOVA to study the influence of region, season, and temperature of installation of the job was conducted on each of the two groups separately.

ANALYSIS AND DISCUSSION

The results of the customer satisfaction ratings collected over four years for the subject manufacturer, are shown in Table 1 below.

The average overall satisfaction for the 2,414 jobs was 8.9 out of 10. The overall customer satisfaction was used for further analysis since it captures all the critical project component's end user's satisfaction. Researchers have provided a detailed breakdown (Item 2-5) of the customer satisfaction for the product and the applicator. Items 6-8 provide the general statistical information of the project data included in the study.

Region

The region or location where the job is executed is a critical characteristic of the project and might impact the customer satisfaction rating owing to numerous parameters. Table 2 provides the classification of coating projects according to different regions in the US. The South region has the maximum total jobs and the total job

TABLE 3.—High Rating Index and Low Rating Index Project Information – Regions

Job Region	Total Jobs (#)	High Rating Index Jobs (#)	Low Rating Index Jobs (#)
Midwest	352	308	44
Northeast	319	297	22
South	1000	915	85
West	743	677	66

area, followed by the West, Midwest, and Northeast region.

Analyzing the overall customer satisfaction rating for each region, it was deduced that the South region in the US received the highest customer satisfaction rating of 9.08 out of 10, followed by West (8.97 out of 10) and Northeast (8.87 out of 10). The Midwest region received the lowest customer satisfaction rating of 8.61 out of 10.

To compare the effect of different regions on overall customer satisfaction, results were analyzed using a one-way ANOVA between-group design. This analysis revealed a significant effect on customer satisfaction scores by region at the $p < 0.05$ level between at least two groups [$F(3, 2397) = 10.191$, $p = 1.95 \times 10\text{-}06$]. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the Midwest region ($M = 8.60$, $SD = 1.76$) was significantly different than the South region ($M = 9.08$, $SD = 1.3$) and the West region ($M = 8.98$, $SD = 1.4$). (Descriptive statistics Table A1, ANOVA Results Table A2 and Tukey's HD Results Table A3 in Appendix A)

Table 3 provides the information for the number of coating projects based in the US regions divided into high rating index and low rating index jobs.

Figure 1 shows the overall customer satisfaction rating for each region mapped for high and low rating index jobs. For high rating index jobs, the South region in the US received the highest customer satisfaction rating of 9.38 out of 10, followed by West (9.30 out of 10), Northeast (9.15 out of 10), and Midwest (9.12 out of 10). For low rating index jobs, the South region in the US also received the highest customer satisfaction rating of 5.79 out of 10, followed by West (5.59 out of 10), Northeast (5.04 out of 10), and Midwest (5.02 out of 10).

To compare the effect of different regions on overall customer satisfaction divided into "high rating index" and "low rating index" jobs, results were analyzed using one-way ANOVA, a between-group design. The analysis revealed a significant effect on customer satisfaction scores of high rating index jobs at the $p < 0.05$ level between at least four groups [$F(3, 2181) = 13.258$, $p = 0.02 \times 10^{-06}$]. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the Midwest region ($M = 9.12$, $SD = 0.79$) and the mean

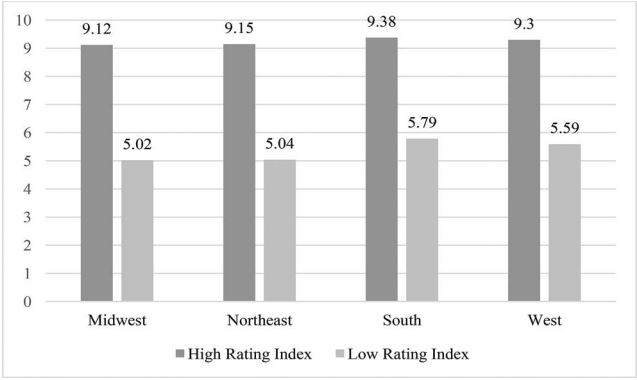


FIGURE 1.—High Index and Low Index Ratings of Overall Customer Satisfaction vs. Region

score for the Northeast region ($M = 9.15$, $SD = 0.77$) was significantly different than the mean score for the South region ($M = 9.38$, $SD = 0.73$) and the mean score for the West region ($M = 9.31$, $SD = 0.78$). (Descriptive statistics Table B1, ANOVA Results Table B2, Tukey's HSD Results Table B3 in Appendix A)

One-way ANOVA analysis revealed no significant effect on customer satisfaction scores of low rating index jobs at the $p > 0.05$ level between any of the twelve groups [$F(3, 212) = 2.093$, $p = 0.102$]. As shown in Table C2 in Appendix A, the results indicate that customer satisfaction scores for low-performing applicators are unaffected by the job's region or location. (Descriptive statistics Table C1 in Appendix A)

The results in Table 4 below indicate that customer satisfaction ratings for vendors are considerably higher in the South and West regions compared to the Midwest region. This possibly implies that high-performing applicators installing coating systems are more likely to be in the South and West regions. There could be other factors contributing to the difference in the performance of the applicators across the different regions, e.g., climatic zones, environmental considerations, customer expertise, workforce skillset, and quality of installation. Firstly, it can be observed that the climatic zones in the South and West regions of the country are primarily tropical and subtropical, with a higher average annual temperature range. In comparison, the Midwest and Northeast regions are continental climatic zones with a lower average yearly temperature range (NOAA National Centers for Environmental Information, 2022). The climatic conditions could be more conducive for installing construction coatings in the South and West regions leading to improved construction coating projects and thus resulting in better customer satisfaction ratings. Secondly, clients and owners could implement their expertise in selecting appropriate coating and applicator for the installation resulting in improved satisfaction experiences. Or on the contrary, they could be unaware of the quality of product and workmanship

TABLE 4.—REGION wise Analysis of Variance for Overall Customer Satisfaction

df	F-value	Mean Square	p-value	Post Hoc (Tukey's HSD) Result
Overall Customer Satisfaction Rating				
3	20.520***	10.191	0.000	Midwest (8.60) < South (9.08) & West (8.98)
High Rating Index Jobs				
3	13.258***	7.685	0.000	Midwest (9.12) & Northeast (9.15) < West (9.31) & South (9.38)
Low Rating Index Jobs				
3	2.093*	7.364	0.102	-

Note: F values - ***p < 0.01; **p < 0.05; and *p < 0.1

benchmark, leading to higher customer satisfaction ratings. Thirdly, there could be increased skilled labor in the South and West regions that have migrated from the colder Northeast and Midwest regions. Further, the labor could receive better training opportunities in the former regions, resulting in a higher quality of workmanship and installation, thus improving customer satisfaction ratings in the regions.

Furthermore, the customer satisfaction scores for the Midwest and Northeast regions for "high rating index" jobs are considerably distinct compared to the West and South regions. The difference reflects that customer satisfaction scores tend to be higher even within the group of high rating index jobs in the South and West regions. Customer satisfaction scores for the Midwest and Northeast region fall in the lower strata of high rating index jobs. The probable implication could be that even a top-performing applicator will have a high probability of higher customer satisfaction scores in the West and South regions compared to the Midwest and Northeast regions. Thus, low-rated manufacturers could be recommended to work in the South and West regions for improving their customer satisfaction ratings.

Season

Seasons can considerably affect the application process and execution of coating systems by the applicator owing to ambient temperature and humidity conditions that are liable to vary at different times of the year. Table 5 provides the information for coating projects based on different seasons in the US. The table shows that the Fall season had the maximum number of job areas (in square footage), followed by the Summer, Spring, and Winter seasons.

TABLE 5.—Project Information - Seasons

Installation Season	Total Jobs (#)	Total Area (SF)	Total Area (%)
Fall	794	26.4 M	34.12%
Spring	489	15.5 M	20.13%
Summer	803	23.7 M	30.73%
Winter	375	11.6 M	15.01%

It was noted that the Spring season in the US received the highest customer satisfaction rating of 9.11 out of 10, followed by Summer (9.02 out of 10) and Fall (8.85 out of 10). The Winter season received the lowest customer satisfaction rating of 8.79 out of 10. (Descriptive statistics Table D1 in Appendix A)

For studying the effect of season on customer satisfaction rating, a one-way ANOVA analysis was conducted that revealed a significant effect at $p < 0.05$ level between at least two groups [$F(3, 2397) = 5.402$, $p = 0.001$]. Post hoc comparisons using the Tukey HSD test indicated that the mean score during the Spring season ($M = 9.11$, $SD = 1.29$) was significantly different than the Winter season ($M = 8.79$, $SD = 1.58$) and the Fall season ($M = 8.85$, $SD = 1.61$) as shown in Table 7 below. (ANOVA Results Table D2, Tukey's HSD Results Table D3 in Appendix A)

The results indicate that customer satisfaction ratings are most impacted during the Spring and Winter seasons. The customer satisfaction rating is highest in the Spring season and lowest in the Winter season, suggesting that applicators should consider the season a crucial factor when aiming for high customer satisfaction ratings. Installation of coating systems during the Spring season would yield the highest satisfaction ratings, thus deduced as the ideal time for execution.

The impact of season on the stratified distribution of high rating index and low rating index jobs was also analyzed. Table 6 below highlights the distribution of high rating index and low rating index jobs for each season, indicating the maximum number of high rating index jobs

TABLE 6.—High Rating Index and Low Rating Index Project Information – Season

Factors	Overall Customer Satisfaction Ratings	Number of High Rating Index Jobs	Number of Low Rating Index Jobs
Spring	483	448	35
Fall	773	693	73
Summer	784	727	56
Winter	361	317	44

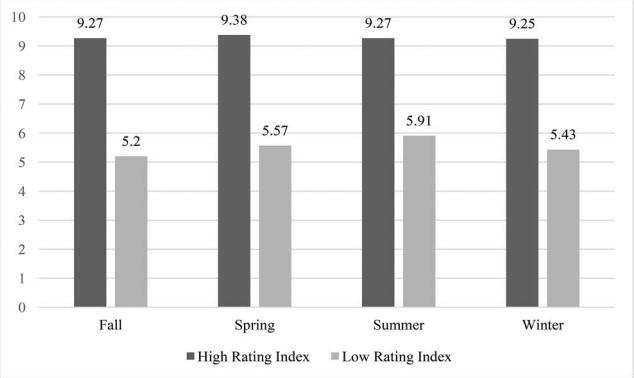


FIGURE 2.—High Index and Low Index Ratings of Overall Customer Satisfaction vs. Season

during the Summer season and minimum during the Winter season.

Figure 2 shows each season's overall customer satisfaction rating based on the high rating index and low rating index. For high rating index jobs, the spring season in the US received the highest customer satisfaction rating of 9.38 out of 10, followed by Fall and summer (9.27 out of 10) and winter (9.25 out of 10). For low rating index jobs, the summer season in the US also received the highest customer satisfaction rating of 5.91 out of 10, followed by spring (5.57 out of 10), winter (5.43 out of 10), and Fall (5.2 out of 10).

To compare the effect of different seasons on overall customer satisfaction divided into "high rating index" and "low rating index" jobs, results were analyzed using one-way ANOVA, a between-group design. (Descriptive statistics Table E1 in Appendix A)

As per results recorded in Table 7 below, the test revealed a significant effect of season on overall customer satisfaction of high rating index jobs at the $p < 0.05$ level between at least two groups [$F(3, 2181) = 2.771$, $p = 0.040$]. Post hoc comparisons using the Tukey HSD test indicated that the mean score during the Spring season ($M = 9.38$, $SD = 0.72$) was significantly different than the Winter season ($M = 9.26$, $SD = 0.79$). (ANOVA Results Table E2, Tukey's HSD Results Table E3 in Appendix A)

TABLE 8.—Project Information – Seasons vs. Job Region

Job Season	Midwest (#)	Northeast (#)	South (#)	West (#)
Fall	155	153	233	235
Spring	34	27	288	134
Summer	122	101	289	265
Winter	25	38	190	109

The findings imply that the Spring season is more conducive than the Winter season for securing high customer satisfaction ratings for installation jobs of coating systems by manufacturers and applicators. Moreover, the study paves the path forward for applicators, suggesting preference of Spring season for achieving performance goals and objectives, per se, increased customer satisfaction.

One-way ANOVA analysis revealed no significant effect of season on customer satisfaction scores of low rating index jobs at the $p > 0.05$ level between any of the twelve groups [$F(3, 212) = 1.625$, $p = 0.185$]. The results in Table F2 in Appendix A indicate that customer satisfaction scores for low-performing applicators are unaffected by the season in which the job was executed. (Descriptive statistics Table F1 in Appendix A)

Season in Job Region

Regions are spread across varied geographical locations that differ in the intensity of seasonal parameters. Therefore, the next part of the study entailed an analysis of all projects for the impact of region and season on customer satisfaction ratings. Table 8 provides the information for coating projects for different seasons within individual regions in the US.

Figure 3 shows the overall customer satisfaction for each season for the Midwest, Northeast, South, and West regions. The Spring season received the highest cumulative (36.25 out of 40) and regional overall customer satisfaction rating for each region (Midwest – 9.01 out of 10; Northeast – 9.0 out of 10; South – 9.12 out of 10; West –

TABLE 7.—SEASON wise Analysis of Variance for Overall Customer Satisfaction

df	F-value	Mean Square	p-value	Post Hoc (Tukey's HSD) Result
Overall Customer Satisfaction Rating				
3	5.402***	10.942	0.001	Spring (9.11) > Winter (8.79) & Fall (8.85)
High Rating Index Jobs				
3	2.771**	1.629	0.040	Spring (9.38) > Winter (9.26)
Low Rating Index Jobs				
3	1.625	5.756	0.185	-

Note: F values - ***$p < 0.01$; **$p < 0.05$; and *$p < 0.1$

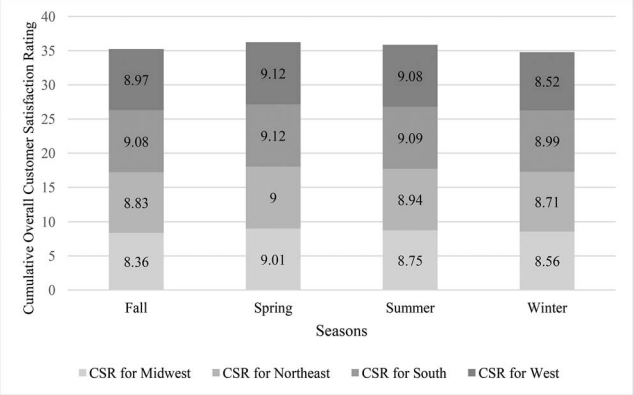


FIGURE 3.—Stacked Bar Chart - Customer Satisfaction Rating by Season and Region

9.12 out of 10). The Winter season received the lowest customer satisfaction rating for the Northeast, South, and West region, and the lowest cumulative overall customer satisfaction (34.78 out of 40). The Fall season received the lowest customer satisfaction rating for the Midwest region. Applicators can expect better cumulative and regional overall customer satisfaction rating during Spring season.

Figure 4 shows the cumulative overall customer satisfaction rating for each region across all seasons. It is observed that Winter season lowers the cumulative overall customer satisfaction rating values. The chart demonstrates that applicators in the South region receive better customer satisfaction ratings across all seasons. The study provides evidence for the Spring season and the South region emerging as preferable and rewarding choices for manufacturers and applicators.

Further in the study, researchers conducted one-way ANOVA tests (Descriptive statistics and ANOVA results Appendix A) to compare and evaluate the effect of different seasons on the overall customer satisfaction for each

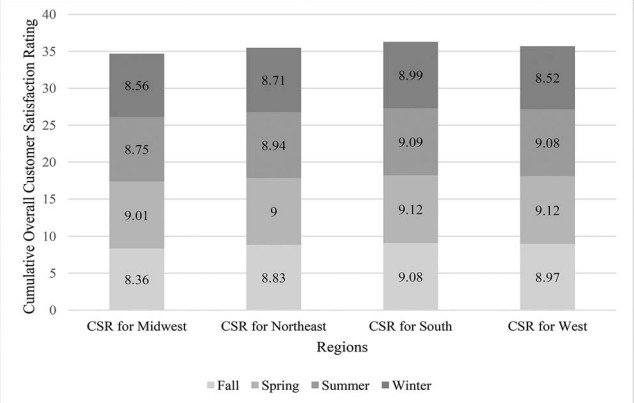


FIGURE 4.—Stacked Bar Chart - Customer Satisfaction Rating by Season and Region

TABLE 9.—SEASON for Region Analysis of Variance for Overall Customer Satisfaction

df	F-value	Mean Square	p-value	Post Hoc (Tukey's HSD) Result
MIDWEST Region				
3	2.145*	6.607	0.094	-
NORTHEAST Region				
3	0.369	0.721	0.775	-
SOUTH Region				
3	0.408	0.690	0.747	-
WEST Region				
3	5.055**	9.788	0.002	Winter (8.52) is significantly different from all seasons, Fall, Spring and Summer

Note: F values - ***p < 0.01; **p < 0.05; and *p < 0.1

of the four regions. The results as shown in Table 9 below, indicated no significant effect of season on customer satisfaction in the Midwest region at the $p > 0.05$ level between any of the twelve groups [$F(3, 344) = 2.145$, $p = 0.094$]; in Northeast region at the $p > 0.05$ level between any of the twelve groups [$F(3, 315) = 0.369$, $p = 0.775$]; in South region at the $p > 0.05$ level between any of the twelve groups [$F(3, 995) = 0.408$, $p = 0.747$].

However, there was a significant effect of seasons on overall customer satisfaction for the West region at the $p < 0.05$ level between at least two groups [$F(3, 731) = 5.055$, $p = 0.002$]. Post hoc comparisons using the Tukey HSD test indicated that the mean score during the Winter season ($M = 8.52$, $SD = 1.63$) was significantly different. (Descriptive statistics Table G7 and ANOVA and Tukey's HSD results in Table G8 and G9 in Appendix A).

The study results imply that the effect of the season as a factor is most pronounced in the West region. Thus, applicators and applicators in the West region are suggested to consider the time of the year for job installation and execution for ensuring optimum customer satisfaction and performance of the coating system. Further, the study deduces that applicators should avoid the Winter season for new execution projects and jobs, especially if customer satisfaction ratings are a crucial consideration for the job's success. This may be relevant to applicators/vendors relatively nascent in the market/industry since there may be many reasons to perform applications in the Winter season other than customer satisfaction results. It is observed from results in Table 9 that winter season has lowest overall customer satisfaction rating for the West region in comparison with all seasons.

TABLE 10.—Project Information – Temperature Range

Temperature Range (F)	Total Jobs (#)	Total Area (SF)	Total Area (%)
21–30	36	1.4 M	1.89%
31–40	137	6.1 M	8.04%
41–50	266	9.0 M	11.93%
51–60	402	11.3 M	15.05%
61–70	608	20.4 M	27.03%
71–80	627	17.9 M	23.72%
81–90	293	8.5 M	11.24%
91–100	34	8.3 M	1.10%

Installation Temperature

As evident from the results of the study conducted for effect of Season on overall customer satisfaction rating, Winter season has a significant effect in comparison to the other seasons. Thus, taking this further, the analysis of variance test was conducted to evaluate the effect of installation temperature on the customer satisfaction rating. 2,403 jobs were analyzed since the subject manufacturer was unable to provide the installation date for 11 jobs. Table 10 provides the information for coating projects sorted according to different installation temperatures in the US. As the data indicates, the temperature range of 61–70 °F represented the maximum total job area followed by 71–80 °F, whereas the temperature range of 91–100 °F represented the lowest total job area.

Figure 5 shows the overall customer satisfaction rating for each temperature range. The temperature range of 91–100 °F received the highest customer satisfaction rating of 9.3 out of 10, followed by 61–70 °F (9.1 out of 10) and fall (8.85 out of 10). The temperature range of 51–60 °F received the lowest customer satisfaction rating of 8.73 out of 10. After initial analysis, the highest overall customer satisfaction for the temperature range of 91–100 °F, which only accounted for 1.1% of the total job area and 1.4% of the total number of jobs, was excluded from the study. To evaluate the relationship between installation temperature and overall customer satisfaction with clarity we analyzed the distribution of number of high index rating jobs according to the temperature range.

Table 11 below compares the percentage of high index rating jobs to the total number of jobs documented in each temperature range, highlighting that the total number of jobs is maximum in the temperature range of 61 – 80 °F.

To study effect of installation temperature on the overall customer satisfaction One-way Analysis of Covariance – ANCOVA test with covariates - region and season was conducted. For the study, the ranges of temperature were divided in three Temperature Groups depicted by their codes (as shown in Table 11 above):

1. Cold = 1 (Temp Range: Temperature Codes 2,3,4)
2. Moderate to Warm = 2 (Temp Range: Temperature Codes 5,6,7)
3. Hot = 3 (Temp Range: Temperature Codes 8,9)

The results as shown in Table 12 above indicate that while Job Region has a significant impact on the Overall Customer Satisfaction Scores at $p < 0.05$, there is no statistically significant effect of temperature range on overall customer satisfaction rating at $p > 0.05$. Figure 6 plots the total number of high index rating jobs for each temperature range for the four regions, Midwest, Northeast, South, and West along with the cumulative for all the regions. It can be deduced from the graph that the temperature ranges of 61–70 °F and 71– 80 °F ranked highest with the maximum number of high index rating jobs within each region. This indicates that the range of temperature for installing coating systems by applicators in the range of 61-80 °F renders higher customer satisfaction ratings.

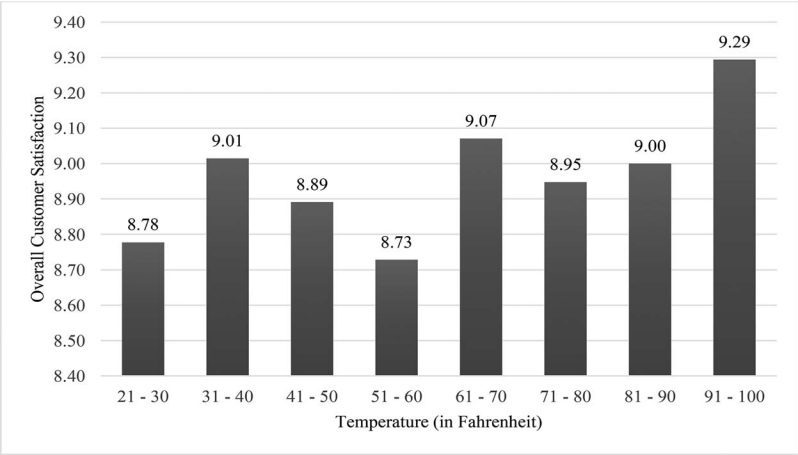


FIGURE 5.—Overall Customer Satisfaction – Temperature

TABLE 11.—High Index Rating Jobs vs. Total Jobs

Temp. Code	Temperature Range (°F)	Total Jobs (#)	High Index Rating Jobs (#)	% Of Total Jobs per Temperature Range	% Of High Index Rating Jobs for Temperature Range
2	21–30	36	34	1.41%	94%
3	31–40	137	127	5.29%	93%
4	41–50	266	234	9.74%	88%
5	51–60	402	356	14.81%	89%
6	61–70	608	579	24.09%	95%
7	71–80	627	558	23.22%	89%
8	81–90	293	237	9.86%	81%
9	91–100	34	31	1.29%	91%

Figure 7 shows the total number of low index rating jobs for each temperature range for the four regions, Midwest, Northeast, South, and West. It is evident again that the installation during the lower temperature range results in the lower customer satisfaction rating. The impact of low temperature on installation performance can be a subject of future study.

CONCLUSION

The main objective of this study was to analyze customer satisfaction ratings for one subject national manufacturer collected using the POE method for construction coating projects and its co-relation to three critical factors of job region, season, and temperature. This study aimed to provide FMs with factors other than qualified applicators to increase the customer satisfaction and quality of construction coating projects.

The study showed that out of the three factors of region, season, and the installation temperature, only the region and the season had a significant effect on the overall customer satisfaction rating. The customer satisfaction ratings for the South region received the highest overall customer satisfaction rating for all jobs and high index rating jobs. This implied that FMs located in the South region are better positioned to achieve higher customer satisfaction than other regions. The research indicates that a coating company's presence in the South doesn't guarantee a higher customer satisfaction rating. Still, the location of FM in the South region has an advantage over other regions for selecting a contractor that will deliver a job with a higher customer satisfaction rating.

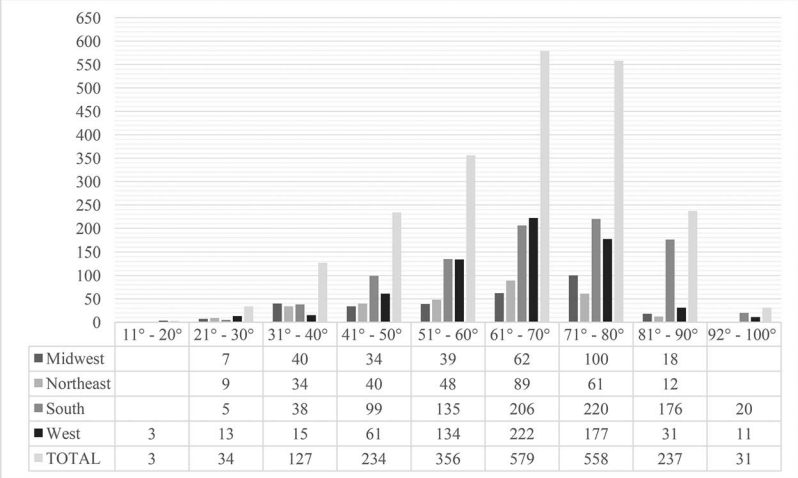
The customer satisfaction rating for the Spring season received the highest customer satisfaction rating for all jobs and high index rating jobs. Spring season also received the highest customer satisfaction rating for individual regions in the US; however, only the West region was statistically significant. The research outcomes imply that facility works executed during the Spring season would yield higher customer satisfaction ratings. This aids the FMs in scheduling activities for the facility operations and maintenance at a preferred time of the year, increasing the probability of improved quality of services.

The study also observed that the ideal installation temperature range for high customer satisfaction is between 61 ° to 80 °F. The study further deduced that jobs executed in the West region in Winter season will lower the customer satisfaction ratings. The study observed that while the Winter season reflected lower customer satisfaction ratings, the effect of the lower temperature range on the customer satisfaction rating was not statistically significant. There could be several reasons for the above two factors not to be correlated. E.g., unavailability of better-quality skilled labor by coating companies during

TABLE 12.—Analysis of Co-Variance for Overall Customer Satisfaction with Region and Season as Covariates

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	37.699[a]	4	9.425	4.656	<.001
Intercept	13166.603	1	13166.603	6504.166	.000
Season Code	.236	1	.236	.117	.733
Job Region Code	**35.050**	**1**	**35.050**	**17.315**	**<.001**
Temperature Group	2.289	2	1.145	.565	.568
Error	4850.304	2396	2.024		
Total	197215.000	2401			
Corrected Total	4888.002	2400			

[a]R Squared = .008 (Adjusted R Squared = .006)



	11° - 20°	21° - 30°	31° - 40°	41° - 50°	51° - 60°	61° - 70°	71° - 80°	81° - 90°	92° - 100°
Midwest		7	40	34	39	62	100	18	
Northeast		9	34	40	48	89	61	12	
South		5	38	99	135	206	220	176	20
West	3	13	15	61	134	222	177	31	11
TOTAL	3	34	127	234	356	579	558	237	31

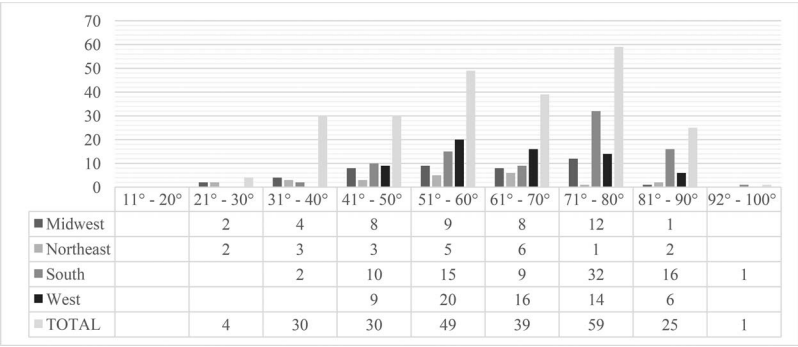
FIGURE 6.—Number of High Index Rating Jobs per Region vs. Temperature

the Winter season, the difficulty experienced by FMs in scheduling construction coating activities in the Winter season due to inclement weather conditions, or owners and clients becoming increasingly critical about the quality of workmanship delivered by the vendors. The evaluation and analysis of the factors, Winter season, and low installation temperatures not being related or linked to the study's findings can be a likely domain for future research.

This study is helpful for FMs since it provides additional project parameters to consider, besides applicator qualification and capability, when installing coating projects to ensure project success and support the functions of an FM. The application of the study outcomes as assistance to FMs in performing their functions is undeniable. The primary role of the FM is to ensure "occupant satisfaction" and "proper functioning of the building services and operations" (Gajjar et al., 2018; Atkin & Brooks, 2015). Achieving high customer satisfaction ratings because of the installation of high-quality coating products through high-performing construction coating contractors/vendors/coating companies, FMs are providing visual and thermal comfort to the customer. The study findings thus assist the FMs in selecting contractors and collaborations that will assure a better quality of installation in construction coating projects. Therefore, facility professionals can use the results to understand factors contributing to improved customer satisfaction ratings to enhance the delivery of services in their facility.

The study is also helpful for current and new coating applicators that want to increase the probability of achieving higher customer satisfaction ratings. In summary, the South region, Spring season, and the Installation temperature between 61 ° to 80 °F are likely to increase the probability of achieving a higher customer satisfaction rating in the US.

As far as the limitations of this work, the data was collected within the US and does not apply to other countries. Also, since this study only provides data from one subject national manufacturer, it should be considered as a case study. Similar studies to include other coating manufacturers and other industries within construction need to be conducted.



	11° - 20°	21° - 30°	31° - 40°	41° - 50°	51° - 60°	61° - 70°	71° - 80°	81° - 90°	92° - 100°
Midwest		2	4	8	9	8	12	1	
Northeast		2	3	3	5	6	1	2	
South			2	10	15	9	32	16	1
West				9	20	16	14	6	
TOTAL		4	30	30	49	39	59	25	1

FIGURE 7.—Number of Low Index Rating Jobs per Region vs. Temperature

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APPENDIX A

TABLE A1.—Descriptive Statistics of the Customer Satisfaction Rating by Region

Region	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Midwest (1)	348	8.60	1.764	.095	8.41	8.79	0	10
Northeast (2)	319	8.87	1.393	.078	8.71	9.02	1	10
South (3)	999	9.08	1.299	.041	9.00	9.16	1	10
West (4)	735	8.98	1.403	.052	8.88	9.08	1	10

TABLE A2.—ANOVA results of the Customer Satisfaction Rating by Region

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	61.560	3	20.520	10.191	.000
Within Groups	4826.443	2397	2.014		
TOTAL	4888.002	2400			

TABLE A3.—Tukey's HSD of the Customer Satisfaction Rating by Region

Job region code	N	Subset for alpha = 0.05	
		1	2
1 (Midwest)	348	8.60	
2 (Northeast)	319		8.87
4 (West)	735		8.98
3 (South)	999		9.08
Sig.		*1.000*	*0.96*

Note: Sig: = significance

TABLE B1.—Descriptive Statistics of the Customer Satisfaction Rating by Region for High Rating Index Jobs

Region – High Rating Index Jobs	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Midwest (1)	304	9.12	.791	.045	9.03	9.21	8	10
Northeast (2)	297	9.15	.770	.045	9.06	9.24	8	10
South (3)	914	9.38	.734	.024	9.34	9.43	8	10
West (4)	670	9.31	.780	.030	9.25	9.37	8	10

TABLE B2.—ANOVA results of the Customer Satisfaction Rating by Region for High Rating Index Jobs

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	23.055	3	7.685	13.258	.000
Within Groups	1264.238	2181	.580		
TOTAL	1287.293	2184			

TABLE B3.—Tukey's HSD of the Customer Satisfaction Rating by Region for High Rating Index Jobs

		Subset for alpha = 0.05	
Job region code	N	1	2
1 (Midwest)	304	9.12	
2 (Northeast)	297	9.15	
4 (West)	670		9.31
3 (South)	914		9.38
Sig.		*.940*	*.481*

Note: Sig: = significance

TABLE C1.—Descriptive Statistics of the Customer Satisfaction Rating by Region for Low Rating Index Jobs

					95% Confidence Interval for Mean			
Region – Low Rating Index Jobs	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Min.	Max.
Midwest (1)	44	5.02	2.387	.360	4.30	5.75	0	7
Northeast (2)	22	5.05	2.149	.458	4.09	6.00	1	7
South (3)	85	5.79	1.497	.162	5.47	6.11	1	7
West (4)	65	5.58	1.836	.228	5.13	6.04	1	7

TABLE C2.—ANOVA results of the Customer Satisfaction Rating by Region for Low Rating Index Jobs

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	22.091	3	7.364	2.093	.102
Within Groups	745.905	212	3.518		
TOTAL	767.995	215			

TABLE D1.—Descriptive Statistics of the Customer Satisfaction Rating by Season

					95% Confidence Interval for Mean			
Season	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Min.	Max.
Fall (1)	773	8.85	1.607	.058	8.74	8.97	0	10
Spring (2)	483	9.11	1.293	.059	8.99	9.22	1	10
Summer (3)	784	9.02	1.217	.043	8.94	9.11	1	10
Winter (4)	361	8.79	1.578	.083	8.63	8.95	1	10

TABLE D2.—ANOVA results of the Customer Satisfaction Rating by Season

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	32.827	3	10.942	5.402	.001
Within Groups	4855.176	2397	2.026		
TOTAL	4888.002	2400			

TABLE D3.—Tukey's HSD of the Customer Satisfaction Rating by Season

		Subset for alpha = 0.05		
Season Code	N	1	2	3
4 (Winter)	361	8.79		
1 (Fall)	773	8.85	8.85	
3 (Summer)	784		9.02	9.02
2 (*Spring*)	483			9.11
Sig.		*.886*	*.201*	*.762*

Note: Sig: = significance

TABLE E1.—Descriptive Statistics of the Customer Satisfaction Rating by Season for High Rating Index Jobs

					95% Confidence Interval for Mean		
Season – High Rating Index Jobs	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Min.	Max.
Fall (1)	693	9.27	.777	.030	9.22	9.33	8	10
Spring (2)	448	9.38	.723	.034	9.32	9.45	8	10
Summer (3)	727	9.27	.770	.029	9.21	9.32	8	10
Winter (4)	317	9.26	.796	.045	9.17	9.34	8	10

TABLE E2.—ANOVA results of the Customer Satisfaction Rating by Season for High Rating Index Jobs

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.888	3	1.629	2.771	.040
Within Groups	1282.406	2181	.588		
TOTAL	1287.293	2184			

TABLE E3.—Tukey's HSD of the Customer Satisfaction Rating by Season for High Rating Index Jobs

	Subset for alpha = 0.05		
Season Code	N	1	2
4 (Winter)	317	9.26	
3 (Summer)	727	9.27	9.27
1 (Fall)	693	9.27	9.27
2 (Spring)	448		9.38
Sig.		*.981*	*.080*

Note: Sig: = significance

TABLE F1.—Descriptive Statistics of the Customer Satisfaction Rating by Season for Low Rating Index Jobs

					95% Confidence Interval for Mean			
Season – Low Rating Index Jobs	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Min.	Max.
Fall (1)	80	5.20	2.207	.247	4.71	5.69	0	7
Spring (2)	35	5.57	1.720	.291	4.98	6.16	1	7
Summer (3)	57	5.91	1.550	.205	5.50	6.32	1	7
Winter (4)	44	5.43	1.744	.263	4.90	5.96	8	10

TABLE F2.—ANOVA results of the Customer Satisfaction Rating by Region for Low Rating Index Jobs

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	17.267	3	5.756	1.625	.185
Within Groups	750.728	212	3.541		
TOTAL	767.995	215			

TABLE G1.—Descriptive Statistics of the Customer Satisfaction Rating by Season for Midwest Region

Season for MIDWEST Region	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Fall (1)	156	8.36	2.158	.173	8.02	8.70	0	10
Spring (2)	35	9.03	1.272	.215	8.59	9.47	5	10
Summer (3)	132	8.78	1.194	.104	8.57	8.99	3	10
Winter (4)	25	8.56	2.002	.400	7.73	9.39	1	10

TABLE G2.—ANOVA results of the Customer Satisfaction Rating by Season for Midwest Region

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19.822	3	6.607	2.145	.094
Within Groups	1059.658	344	3.080		
TOTAL	1079.480	347			

TABLE G3.—Descriptive Statistics of the Customer Satisfaction Rating by Season for Northeast Region

Season – NORTHEAST Region	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Fall (1)	153	8.83	1.572	.127	8.58	9.08	1	10
Spring (2)	27	9.00	.734	.141	8.71	9.29	8	10
Summer (3)	101	8.94	1.264	.126	8.69	9.19	2	10
Winter (4)	38	8.71	1.334	.216	8.27	9.15	5	10

TABLE G4.—ANOVA results of the Customer Satisfaction Rating by Season for Northeast Region

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.163	3	.721	.369	.775
Within Groups	615.041	315	1.953		
TOTAL	617.204	318			

TABLE G5.—Descriptive Statistics of the Customer Satisfaction Rating by Season for South Region

Season – SOUTH Region	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Fall (1)	233	9.08	1.294	.085	8.91	9.24	2	10
Spring (2)	288	9.12	1.256	.074	8.98	9.27	3	10
Summer (3)	289	9.09	1.193	.070	8.95	9.23	3	10
Winter (4)	189	8.99	1.516	.110	8.77	9.21	1	10

TABLE G6.—ANOVA results of the Customer Satisfaction Rating by Season for South Region

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.069	3	.690	.408	.747
Within Groups	1682.996	995	1.691		
TOTAL	1685.065	998			

TABLE G7.—Descriptive Statistics of the Customer Satisfaction Rating by Season for West Region

Season – WEST Region	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Fall (1)	231	8.97	1.405	.092	8.79	9.16	1	10
Spring (2)	133	9.12	1.467	.127	8.87	9.37	1	10
Summer (3)	262	9.10	1.226	.076	8.95	9.25	1	10
Winter (4)	109	8.52	1.625	.156	8.21	8.83	1	10

TABLE G8.—ANOVA results of the Customer Satisfaction Rating by Season for West Region

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	29.364	3	9.788	5.055	.002
Within Groups	1415.330	731	1.936		
TOTAL	1444.694	734			

TABLE G9.—Tukey's HSD for the Customer Satisfaction Rating by Season for West Region

	Subset for alpha = 0.05		
Season Code	N	1	2
4 (Winter)	109	8.52	
1 (Fall)	231		8.97
3 (Summer)	262		9.10
2 (Spring)	133		9.12
Sig.		*1.000*	*.781*

Note: Sig: = significance

TABLE H1.—Descriptive Statistics of the Customer Satisfaction Rating for Installation Temperature

					95% Confidence Interval for Mean			
Installation Temperature (in °F)	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Min.	Max.
20–30 = 2	36	8.78	1.775	.296	8.18	9.38	1	10
31–40 = 3	137	9.01	1.188	.102	8.81	9.22	4	10
41–50 = 4	266	8.89	1.597	.098	8.70	9.08	1	10
51–60 = 5	400	8.74	1.821	.091	8.56	8.92	0	10
61–70 = 6	608	9.07	1.199	.049	8.98	9.17	1	10
71–80 = 7	627	8.95	1.317	.053	8.84	9.05	1	10
81 –90 = 8	293	9.00	1.395	.081	8.84	9.16	2	10
91–100 = 9	34	9.29	.906	.155	8.98	9.61	7	10

TABLE H2.—ANOVA results of the Customer Satisfaction Rating by Range of Installation Temperature

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	34.253	7	4.893	2.412	.018
Within Groups	4853.750	2393	2.028		
TOTAL	4888.002	2400			