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IMPACTS OF DEFECTS ON CUSTOMER SATISFACTION IN RESIDENTIAL BUILDINGS

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ABSTRACT

Impacts defects have on customer satisfaction are hard to quantify, but they should not be ignored because of poor understanding of the intangible costs related to quality may lead to poor decision-making. However, data about building defects and customer satisfaction surveys are not usually analyzed together. This study used a database of the technical assistance department in a Brazilian construction company and results from their customer satisfaction surveys. The study seeks to address the lack of in-depth analysis of issues concerning customer satisfaction and defects, and how they are related. By cross-analyzing data from the defects database and the customer satisfaction surveys, on a unit-by-unit basis, relationships between the occurrence of defects, the customer perception of these defects, and the impact they have in customer satisfaction were found. Results revealed that some customers can be dissatisfied with the building quality and are still satisfied with the project, which indicates that the overall satisfaction is a complex variable that is related to a number of features. Moreover, the occurrence of defects did not seem to impact the customer satisfaction negatively if defects were fixed under the warranty period, and the non-occurrence of defects had a positive impact on the customer satisfaction.

KEYWORDS

Quality, defect, customer satisfaction, value, waste.

INTRODUCTION

Koskela (2000) proposes a production model – the TFV theory – that integrates three points of view: product transformation (T), flow (F), and value generation (V). To generate value and deliver it to the customer, production units must incorporate customer requirements in their processes and manage them to assure the product is delivered as expected. Defining customer's requirements and checking them against the customer's perception of the product's value should be an integral part of the production/construction

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process. It is also worth noting that these requirements and what the customer values are in constant evolution, and production processes should be designed and managed accordingly. According to Salvatierra-Garrido et al. (2012), the concept of value is ambiguous, has different interpretations, and subjective aspects. The value generation view has an important role in the value conceptualization and often the value of a product/service is associated with the fulfillment of the customer requirements. Research about value generation in construction focuses mostly on product development and design management, and not so much on the production process and the product handover to the client (e.g., Salvatierra-Garrido et al. 2012, Alves et al. 2009).

Construction quality is an important attribute for customers of residential buildings, and it is related to how the building conforms to specifications, and how reliably the building functions (Othman, 2015). One way to objectively measure the quality of buildings is by measuring the occurrence of defects in the final product (Ng, at al., 2011).

Defects in residential buildings are a significant problem for the construction industry worldwide (Rotimi at al., 2015). The occurrence of defects generates rework and extra costs with repairs, which are the most evident drawbacks of this problem, but it might also impact the customer satisfaction. Customer satisfaction can be broadly defined as how well a company matches what the customer expects from a product. The customer has requirements and expectations that s/he expects to be fulfilled when a product is acquired and used. The customer satisfaction may be a good performance metric for a project and represents one of the factors that lead customers to be loyal to a company, allowing them to pay more when buying again from a specific company, and recommending a company to relatives and friends. Conversely, the non-fulfilment of customer's expectations plays a greater role than their fulfillment, accordingly, companies should deliver what the customer expects in a reliable and consistent fashion to avoid losing customers and market share (Anderson and Sullivan, 1993). Having loyal customers is important for companies' reputation, and for their overall success (Othman, 2015).

Quality programs are supposed to improve processes in the construction industry, reducing the occurrence of defects. The theory of the cost of quality addresses the concept of economic level of quality (ELQ), which is obtained when the sum of prevention costs, appraisal costs, and the cost to deal with the defects are minimal. The ELQ is the cost of quality model most frequently used, but these costs are only the most visible and easy to account for (Schiffauerova and Thomson, 2006). The cost of opportunities lost and other intangible costs, e.g., loss of customers due to defects or depreciation of the company's image, are difficult to account for and can only be estimated, but they are equally important and can be costlier than expected. Poor understanding of the cost of lost opportunities and intangible costs related to quality may lead to poor decision-making (Heagy, 1991). Malchi and Gurk (2001) show that companies perceived by the customers as high-quality companies are much more profitable than companies seen as low-quality companies. Moreover, the negative impact of customer claims has increased with the increasing use of social medias, including medias specialized in customer complaints. Therefore, dissatisfied customers can easily and negatively impact other potential customers (Kärkkäinen et al., 2012).

Although defects are supposed to impact customer satisfaction, there is a gap in the literature on the topic, which lacks consistent data to test this hypothesis. The construction industry needs to understand how defects in the use phase of projects (those that actually reach customers) impact their satisfaction, so companies can use this information to enhance their value generation. The objective of this study is to investigate how defects impact the customer satisfaction using data collected through interviews with customers of residential units.

DATA COLLECTION ABOUT DEFECTS IN CONSTRUCTION

Studies about defects occurrence in residential buildings usually have a major limitation: the data collection process (Brito et al. 2011). Most construction companies do not generate reliable data for research purposes about the defects in their buildings due to lack of resources, poor process design (to generate and collect data), or little importance given to this problem. The companies that do generate useful data about these defects may not provide it to researchers, worried about potential liability implications. To address this problem, previous studies asked users of buildings about defect occurrences in their units (Jiboye 2012, Fauzi et al. 2012, Ng et al. 2011), or used databases provided by building managers with information about the defects as described by users (Brito et al., 2011). However, using the user's description of defects has limitations: lack of training/knowledge about defects by the user, and reliance on the customer's memory. One way to address these problems would be collecting data from databases in technical assistance departments (TADs) of construction companies. TADs deal with customer claims, and their database documents the technical inspections that are done to identify the defects claimed by the customers and determine whether or not the defect is covered by the builder/supplier warranty. By crossing information from reported customer's claims and surveys, when the companies actively reach out to the customer, it is possible to evaluate the consistency of the data and obtain a more reliable method to collect data.

RESEARCH METHOD

Data were collected in a medium size construction company that does both development and construction in the state of São Paulo, Brazil (Company A). Company A established in the market 35 years ago, it is ISO 9001-certified since 2009, and it is one of the biggest players in its region (northwestern part of the state). This study had access to their Customer Satisfaction Surveys (CSSs) and their database from the TAD. Eight projects were included in this study, and they will be referred to as Projects 1 to 8, categorized according to the date of project handover to clients.

Company A's CSS consists of an interview. The Customer Care Service calls the customer and talks about the survey's purpose. If the customer agrees to answer the survey and meets the requirements defined to qualify as a respondent, the attendant starts the interview; if not the caller will call the next unit. For the purpose of the CSS, the customer is defined as the person who bought the unit (signed the contract), and might or might not live in the unit. All the answers are documented in an online spreadsheet, and the caller is trained to clarify any questions the customer may have about the survey. The CSS is

divided into three parts. The first part was used to survey all projects, and its pre-defined questions are shown in Table 1. To capture more objective elements that influence customer's satisfaction and to obtain the main concerns of the customers, Company A's CSS was improved in the last two projects of this sample, Projects 7 and 8. After being asked about their overall level satisfaction with the project (Part 1), customers were asked openly to cite positive and negative features of the project (Part 2). The features cited in Part 2 were grouped by the Quality Department in representative groups. For instance: the item "building quality" groups citations like defects, poor paintings, unlevelled tiles, and any other problem related to the construction quality. The "unit design" groups citations like "small living room", "poor tiles specification", and any others related to the unit design. Part 3 was implemented in Project 8's CSS aiming to investigate the impact of defect occurrence in customer satisfaction.

Analysis of the data was done by investigating potential correlations between the *overall satisfaction* (Q.8) stated in Part 1 of the CSS and the *satisfaction with the building quality* (Q.3) and with the *technical assistance service* (Q.7).

Table 1: Survey questions and related areas

	Question
Part 1	Q1. Did the design of Project X fulfill your expectations, yes or no?
	Q.2 If not, which of these items did not fulfill your expectation: the unit design, the finishing specification, or the common areas?
	Q.3 Regarding the building quality, are you satisfied or dissatisfied?
	Q.4 Regarding the sales service, are you satisfied or dissatisfied?
	Q.5 Regarding the commercial service, are you satisfied or dissatisfied?
	Q.6 Regarding the service during the construction site visiting, are you satisfied or dissatisfied?
	Q.7 Regarding the TAD service after the handover, are you satisfied or dissatisfied?
	Q.8 Overall, are you satisfied with the Project X, yes or no?
Part 2	Q.9 Cite features of Project X that you like?
	Q.10 Cite features of Project X that you dislike?
Part 3	Q.11 Did you had any defects in your unit, yes or no?
	Q12. What were the defects? (if answer to Q.11 is yes)
	Q13. Did the defects were fixed under the warranty, yes or no? (if answer to Q.11 is yes)
	Q14. How did the occurrence/non-occurrence of defects impact your satisfaction: positively, neutrally, or negatively?

The results of CSS Part 2 were cross-checked against those of Part 1 to verify the consistency of customers' answers. If answers to questions in Part 2 appeared incompatible with those in Part 1, the transcription of the customer's speech was reviewed to verify whether or not there were inconsistencies in the data collected, i.e., when a customer declares to be satisfied with *building quality* in Part 1 - Q.3 but cites the *building quality* as a feature that s/he dislikes in Part 2 - Q.10.

Company A's TAD receives the claims from their Customer Care Service and inspects units to verify and/or identify the claimed defects. This process defines whether or not these defects are covered by the project's warranty policy, before they can be fixed by

Company A. The results of the CSS Part 3, where customers are asked about the defects occurrence in their units, were cross-checked against the database from the TAD, where all the defects identified in the technical inspection are documented. This cross-check investigated the relationship between the defects identified by the TAD, customers answers about the defect occurrence in their units, and the impact of the defects on their satisfaction.

RESULTS AND DISCUSSION

Table 2 presents the summary of CSS – Part 1 (company and project-specific). From all eight projects analyzed, totaling 948 residential units, 255 customers agreed to participate on the survey. The *overall satisfaction* of customers is mostly high across all eight projects (Q8 – column G, min=75%, max=97%, avg=87%), and it is higher than the *satisfaction with the design* (Q1 – column D, min=40%, max=90%, avg=73%) and with the *building quality* (Q7 – column E, min=50%, max=94%, avg=70%). The analysis shows that the *overall satisfaction* of residential buildings customers is a complex variable, composed of a number of aspects as indicated in the literature (Othman, 2015). It is somewhat surprising that some customers are not satisfied with the *building design* and with the *building quality* and, at the same time, present high levels of *overall satisfaction* regarding the project. The literature points out to some particular aspects of residential projects which are more relevant to customers than others, e.g., location (Alves et al., 2009), and that might carry more weight in shaping customer satisfaction regarding the project. Local aspects and characteristics of the construction industry/market also influence the customers *overall satisfaction*. In Brazil, where the study was developed, delays in the delivery of residential projects are usual, and sometimes delays are measured in months or even years. In more extreme cases, companies might go bankrupt, and neither deliver the project nor the money paid by customers. Such characteristics of the local market, not covered in the survey, might also help explain the results.

Table 2: Customer Satisfaction Survey – Company A – Part 1 (N = 255)

Project (A)	Handover (B)	Survey (C)	Design Q1 (D)	Building Quality Q7 (E)	Technical Assistance Q6 (F)	Overall Satisfaction Q8 (G)
Project 1	Apr., 11	Sep., 11	80%	53%	42%	75%
Project 2	Sep., 11	Mar., 13	72%	77%	77%	97%
Project 3	Jul., 12	May. 13	90%	88%	76%	95%
Project 4	Dec., 12	Sep., 13	89%	94%	94%	94%
Project 5	Nov., 12	Sep., 13	80%	53%	42%	73%
Project 6	Dec., 12	Sep., 13	68%	73%	86%	86%
Project 7	Feb., 14	Jun., 15	40%	50%	90%	85%
Project 8	Jun., 14	Feb., 16	68%	73%	86%	86%
Average (avg)			73%	70%	74%	87%

Analysis of the relationship between the *overall satisfaction* and satisfaction with the *building quality* revealed a weak correlation between these items (0.37). The same weak correlation was observed between the *overall satisfaction* and the *technical assistance*

service (0.30). Thus suggesting that these items, in this market, might not be good predictors of customer satisfaction when looked in an isolated fashion.

A more detailed analysis revealed that 66% of the customers dissatisfied with the *building quality* also declared to be satisfied with the project (high levels of *overall satisfaction*); and that 70% of the customers dissatisfied with the *technical assistance* service are *overall satisfied* with the project. These findings align with Fauzi et al. (2012), who found no correlation between the building quality and the customer satisfaction in Malaysia: customers with high level of defects in their houses were still satisfied with them.

Table 3 shows the results obtained from Part 2 (project-specific) of the survey, for projects 7 and 8 only, when customers freely indicated positive and negative features of the project. Analysis of Table 3 results shows that the *building quality* is the most frequently cited negative feature. The *technical assistance service* is ranked in both projects as a negative feature as well. It is worth noting that customers only contact the technical assistance if they have a defect in their units. In Project 8 it is worth noting that the *building quality* was cited six times as a negative feature and two times as a positive feature (values differ from person to person)

Table 3: Customer Satisfaction Survey – Part 2 (Positive and Negative Features)

	Project 7		**Project 8**	
Positive Features	Location	11	Common areas	11
	Common areas	6	Gardens	7
	On-time delivery	3	Location	4
	Entrance hall	3	Building quality	2
	Others	9	Unit design	2
			Customer service	2
			Others	6
Negative Features	Building quality	15	Building quality	6
	Floor (in general/stains/grouting)	9	Technical assistance service	3
	Wall air-conditioner unit	5	Unit design	3
	Small unit area	4	Incorrect information from realtors	3
	Technical assistance service	3	Customer service	2
	Only on entrance in the unit	2	Same garage gate for getting in and out	2
	Others	13	Finishing	2
			Others	6

Cross-checking the CSS's Part 2 (project-specific) with the results from Part 1 (company and project-specific) revealed that both customers that cited the *building quality* as a positive feature for Project 8 answered that they were satisfied with the *building quality* in Part 1, however, 2 of the 6 customers who cited the *building quality* as a negative feature answered they were satisfied with the *building quality* in Part 1. By looking at the answers provided by these customers, they complained in Part 2 about the *building quality* of the

common areas, however, the Part 1 of the CSS is focused on the unit, not the common areas. In Project 7, this type of inconsistency happens 3 times out of 15 answers: in one case the complaint in Part 2 of the CSS was focused on the unit floor; in the second case the customer cited the quality of the floor and the painting of the unit as negative features; and in the third case, the bad smell in a drain in the bathroom was cited. It seems that these three customers have some complaints about the quality of the building, but they were overall satisfied with it.

The Part 3 (unit-specific) of the CSS, only conducted for Project 8, was cross-checked with the data from the TAD's database. The results are shown in Figure 1. By comparing the defects cited by customers and the defects documented in the TAD's database, it is clear that the customers are not able to remember and precisely cite the defects they had in their units. Depending exclusively on the customers' memory to report previous or current defects does not appear to be a reliable method for academic studies about defects.

The list of problems documented in the TAD database does not present defects that could risk the health and safety of the customers (e.g., structural problems). The defects documented affect the aesthetics and functionality of the residential unit; however, they still allow the users to live in the unit, even during the repairs. This result is aligned with Forcada et al.'s (2013) study about the Spanish construction industry, which showed that the builders' inspection focuses on major problems while the customers usually identify minor functional and aesthetics problems. These surveys were conducted 20 months after Project 8 was delivered. This time-frame should be enough to allow defects to manifest themselves in the units and be noticed by customers. One limitation of this database, as mentioned before, is that customers might not report defects to the construction company, especially after the warranty period expires, because the repair will probably be denied by the builder. Each element in the building has a different warranty period, for example, damages in finishes after the handover have no warranty, but the warranty period for waterproof membranes is five years.

Figure 1 reveals that the *non-occurrence of defects* affects positively the satisfaction of 10 out of 12 customers (83%). Six out of ten customers who experienced defects in their units had the defects fixed during the warranty period, and 4 of them indicated that this positively impacted their satisfaction. Therefore, apparently, customers are still satisfied with the product if they have minor problems that are fixed by the builder. One customer declared one minor defect that was fixed on its own (just pushed the aluminum frame back to its place) and had a positive impact on her satisfaction. Apparently, the customers in this specific market expect some defects in their units, and, if defects do not happen, or if they are fixed free of charge, the costumer's quality requirements are still fulfilled. Three customers who answered the survey did not live in the units surveyed (they owned the units but were not users).

The TAD failed to fulfill the customer expectations in both cases where negative impact was reported. In one case the fixed defect reoccurred. In the second case, the customer was not available to talk or to open the apartment in commercial hours, so the claim was closed twice due to lack of communication between the builder and the customer.

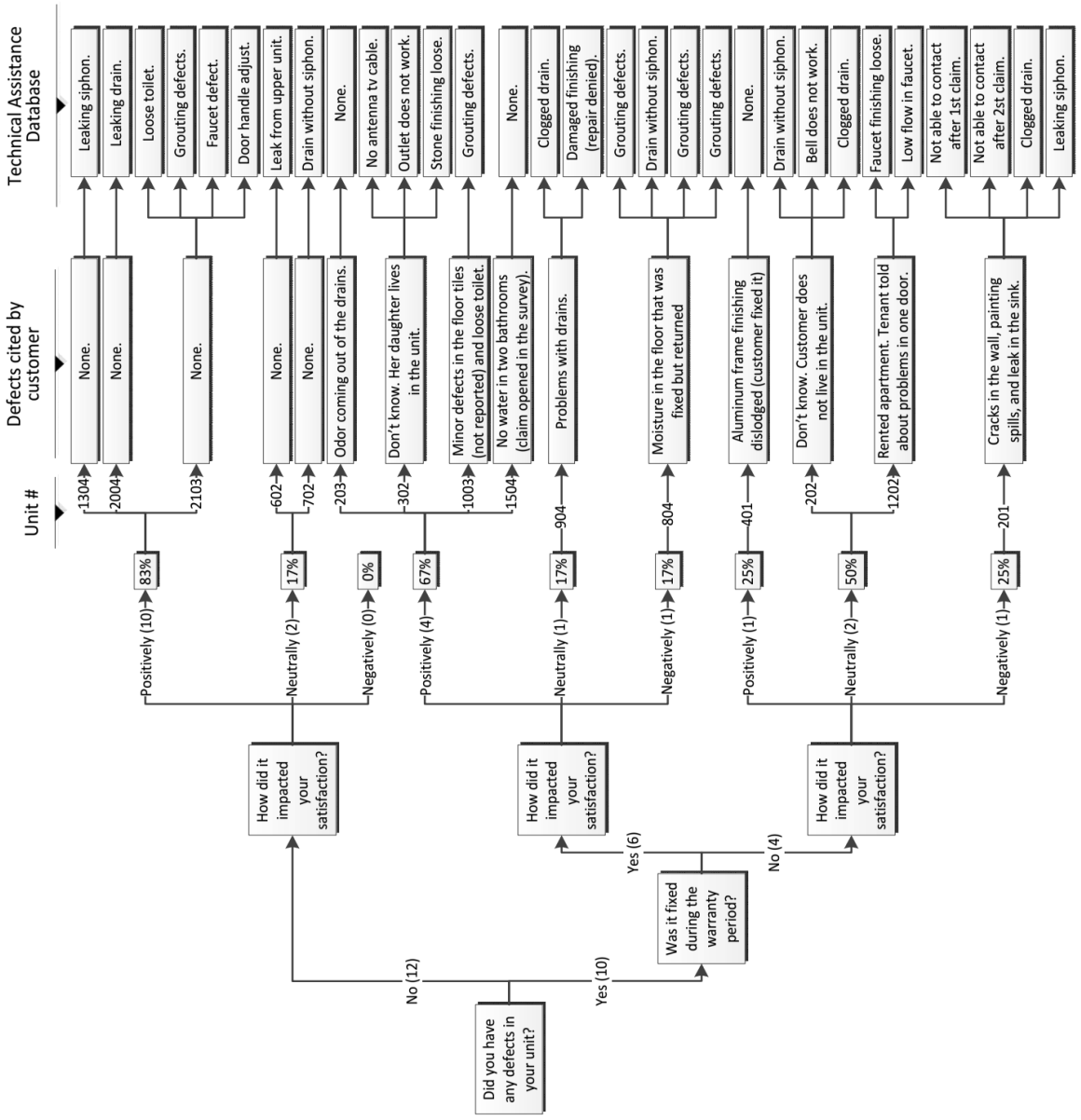

Figure 1: CSS – Part 3 cross-checked with TAD database

The customer from one of the units of Project 8 (203) reported a repaired defect that was not documented in the database. The employees of the TAD, when asked about this inconsistency, said that the solution for this defect was so simple that the customer may have met them in the building, and they fixed it immediately without documentation. This might indicate that problems might be under-reported if they involve minor repairs. For some customers, it is not clear the difference between the condominium and the builder employees, so it is possible that the customer complained about the defect to a condominium employee, who solved the problem because it was easy to solve. According to the TAD employees, these situations are possible but rare.

CONCLUSIONS

The building quality is a concern for customers of residential projects (Part 2 of the CSS) but the impact of defects occurrence in their satisfaction is not as critical as initially expected. The study revealed that customers in the studied market appear to expect some minor defects in a new residential unit, and when defects are absent or when the repairs are done under warranty terms by the builder, customers are positively impacted. The performance of the TAD seems to play an important role in customer satisfaction: customers who indicated that defects caused a negative impact on their satisfaction were the ones who had bad experiences with the technical assistance service.

Data availability is a challenge, thus reliable data about the defects should be used in the analysis to make appropriate inferences about the relationship between the occurrence of defects and customer satisfaction. Asking the customer about defects that occurred in their units is not effective, and construction companies may not have reliable data for further analysis if they rely solely on customers' memories.

One limitation of this study is that it analyzed data from a specific area in Brazil, and some aspects have to be considered. In Brazil, problems related to delays in project delivery, and companies that go bankrupt are still a concern. In this context, minor defects that neither risk the user's health nor interrupt the unit use may be given less importance. The analyzed data from the CSS and from the TAD database are consistent. Therefore, to expand this study with more generalizable findings, future research could analyze data from other companies, including companies in other countries where the mentioned problems are not a major concern.

Suggestions for future research include a more detailed analysis of Kano's satisfaction model, which categorizes product attributes as: *attractive attributes*, those that satisfy customers if met, but do not dissatisfy them if unmet; *one-dimensional attributes*, that are linearly related to the customer satisfaction, so the more they are fulfilled, the higher the satisfaction is; and *must-be attributes* which are expected by the customer to be completely fulfilled. Not fulfilling *must-be attributes* causes dissatisfaction, but fulfilling them does not impact customer satisfaction. (Yang, 2005). Although we did not use Kano's method for categorizing the attributes, the building quality represented by the occurrence/non-occurrence of defects does not seem to match a must-be attribute, as expected. Customers that had defects in their units were still satisfied with the overall project. When no defects were found, customers declared that their satisfaction level was positively impacted, so the building quality seems to fit in the one-dimensional attribute in Kano's model. Additional research is needed to test these claims.

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