How to Reduce Motorcycle Theft in Parking at a Manaus Shopping?

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Abstract

According to a survey conducted by the Brazilian Association of Shopping Centers in 2016, every nine days, a mall is robbed in Brazil. Faced with this scenario, shopping malls are increasingly concerned with customer safety, as they sell to consumers the idea of safety, convenience and comfort. In mall X, located in one of the busiest Manaus (Amazon capital in Brazil) city avenues, it was found that expenses with robberies and theft reimbursement in parking areas increased considerably in 2015. Thus, this article aims to propose low cost actions to reduce robberies and theft in the parking areas of this mall with the highest incidence of claims. Data were collected through spreadsheets and reports from the Customer Service System (CSS) and the outsourced contractor to operate the parking service. After data collection and analysis, it was concluded that motorcycle parking is the part of parking most affected by the problem, and possible solutions such as control by labels and helmet locks are suggested, and it is up to the mall managers to choose which of the improvement proposals are more feasible.

Keywords: Mall; Robberies; Theft;

1. Introduction

According to the Brazilian Association of Shopping Centers (ABRASCE, 2016), a Shopping Center would be:

> "[...] a shopping center designed under a single administration, made up of stores intended for commercial operation and services, subject to standard contractual rules, to maintain the balance of offer and functionality, ensuring integrated living and paying accordingly. with billing.

> In general, shopping malls have a differential compared to traditional forms of commerce, because they sell the idea of safety, convenience and comfort, mainly due to their larger and better structure, which adds market advantage over the competition."

Nevertheless, a survey conducted by this Association in 2016 revealed that every nine days, a mall is robbed in Brazil. The study recorded 203 robberies in five years, considering the period from 2008 to 2013. In addition, it was found that jewelry stores, because they have high value products, and parking areas,

because they are isolated and poorly monitored, are the targets. most targeted by the bad guys.

In Manaus, capital of Amazon state, Brazil, the situation seems to be so different, according to a survey conducted in 2009 and released in 2010 by the city's State Department of Public Security (SSP), the number of shopping mall robberies nearly doubled when compared to the two years. There were 20 thefts in 2010 and 11 in 2009. In addition, from January to August 2010, there were 205 cases of theft, of which 149 occurred in shopping malls in the North Zone.

In light of the above, the question is: "How to reduce the number of robberies and thefts in the Mall parking through the use of Industrial Engineering management tools?".

To answer this question, we chose a mall called X to serve as a case study for the research. It is located at Avenida Djalma Batista, close to schools and universities which justifies the large flow of vehicles and people, considerably larger than in other malls in the region.

The study was developed in Shopping X's Operations Department, which has among several responsibilities to reduce expenses generated by thefts and robberies in the parking areas of this mall.

The search is relevant for the following reasons:

First) for Shopping Managers: reduction of claims directly affects the company's image and increases sales. Thus, the research is relevant because it helps to reduce costs and give more security to those who use the project, and can be used as a benchmark for other mall managers;

Second) for Shopping Customers: Shopping mall customers are looking for a safe and comfortable environment, with concepts of home, shopping and entertainment. Claims reduction provides safety and comfort;

Third) for academia: knowledge of quality tools and their applications in a commercial sector, such as shopping malls, helps and enriches the debate in academia, as well as may point to new research needs on the subject. Also the article could be used in the class rooms for educational purposes.

Thus, the general objective of this paper is to analyze and suggest economic actions to reduce the amount of robberies and theft at the X shopping mall parking lot in Manaus.

The research has the following specific objectives:

1) Map the parking areas and their surroundings with the highest occurrence of accidents;

2) Identify the causes related to the problem, as well as possible solutions;

3) Select the most viable solutions with their respective budgets as proposals for improvements to reduce theft and parking theft.

2. Theoretical Referential

2.1. Statistics on robberies and theft in Manaus

According to the Brazilian Institute of Geography and Statistics (IBGE, 2010) Demographic Census, Amazonas is the 14th most populous state in Brazil with 3,590,985 inhabitants, being the capital, Manaus, occupied by 1,861,838 residents, representing 51.84 % of people living in the state.

The city of Manaus is divided into 63 neighborhoods distributed in 6 administrative zones (Midwest, Mid-South, East, North, West, South) that concentrate quite heterogeneous housing contingents (Figure 1). The northern zone is the most populous, with more than 500 thousand inhabitants.

The capital was considered in 2016 as the 23rd most violent city in the world, according to an article written from OGLOBO (2016). In addition, a survey of the State of Amazonas Passenger Transport Union (Sinetram) found that more than 2,600 burglaries were reported by the ten companies operating in Manaus public transport between January and November 2015. According to Sinetram, this number represents an average of 7 rounds a day.

Due to the large population, according to the State Department of Public Security (SSP), the North Zone in 2010 was considered the most dangerous. It was record-breaking in the number of thefts, with 12,076 records compared to a total of 36,056 cases in the capital.
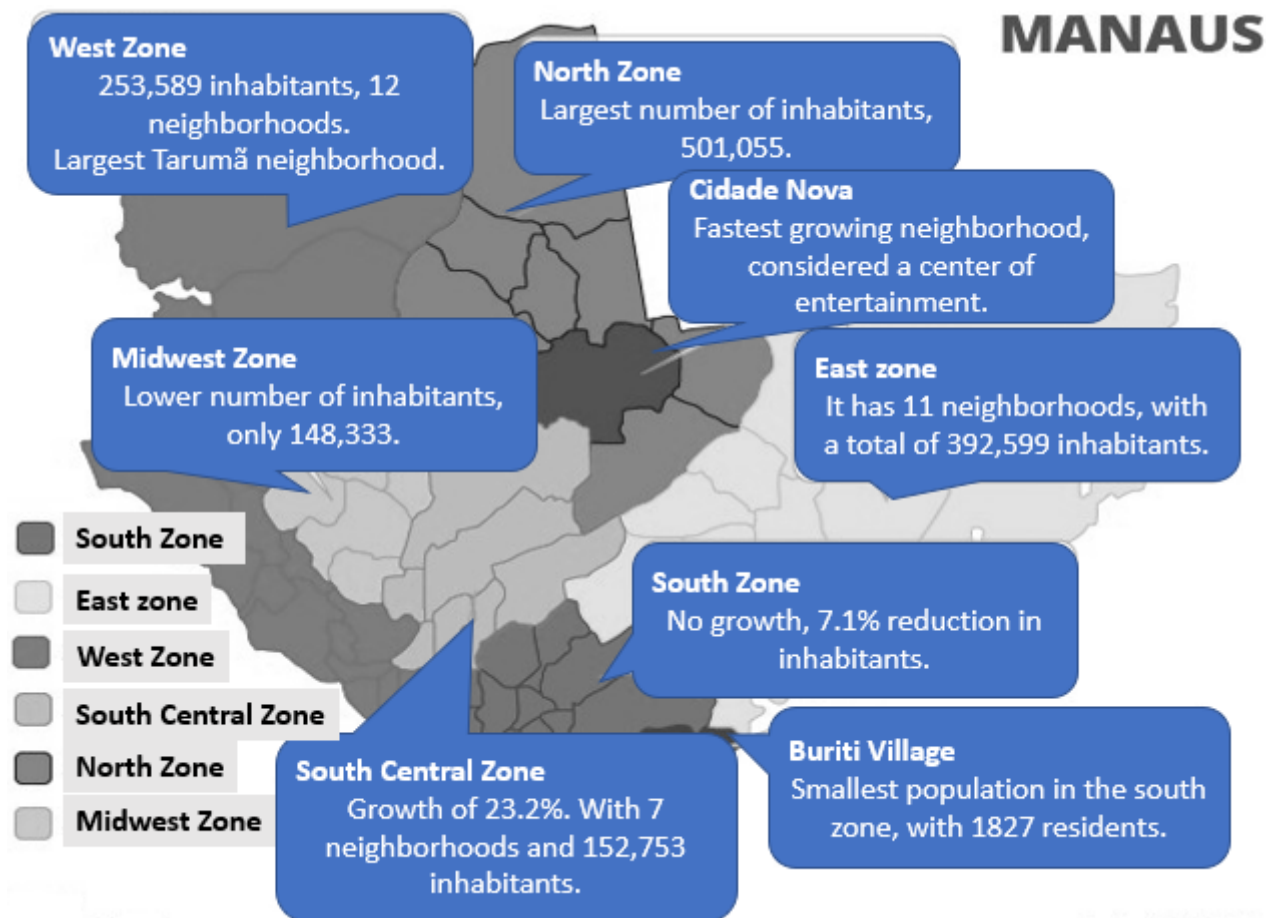
Figure 1 - Map of Manaus zones
Source: Demographic Census (IBGE, 2010).

Still, according to the SSP, the most common types of crime committed in the city are robberies and theft. Approximately 52% of police reports filed at police stations are robberies and 19% related to thefts, mainly cell phones and handbags.

2.2. Solutions to reduce shopping center claims

According to researches surveyed and reported by the Brazilian Association of Shopping Centers (ABRASCE, 2016), technological advances and team training are becoming increasingly efficient and accurate regarding the security of large shopping centers.

Most shopping centers have, besides the human effective, high quality cameras with excellent image resolution, with presence sensors and visual identification. In addition, monitoring social networks is essential and important to track external movements such as trawlers and similar claims, as well as applications that map areas and indicate preventive actions.

Currently, monitoring rooms are intelligence centers responsible for security management. In this place, specialized professionals gather data capable of mapping information of crimes committed in the region where the enterprise is located, such as patterns of robberies and demonstrations that may hinder the flow of visitors.

In addition, shopping malls need to increasingly invest in specialized security guards to deal directly with security management. Training, theoretical or practical, is important to prepare the workforce, but not only to support and provide information to clients, employees must be prepared to respond appropriately to any type of claim.

Still on a news article published on Abrasce's website, Seg One, a company that offers consulting and training, developed an application to perform an audit of mall security processes, helping the manager to have real-time information on what is happening. According to the company, another application that can be used is the panic alarm that has low cost and can be installed on a computer store or mobile phones of people working on the site, just having access to the internet.

In addition to applications, a security company, Cocil, has revealed that some image analytic software is effective when it comes to shopping mall security. They have artificial intelligence algorithms that analyze camera images in real time to detect non-standard behaviors that can lead to risk situations.

A company that performs cleaning services, Verzani, has developed software that maps all occurrences, showing the places with the highest occurrence and indicating the areas that need security reinforcement. After entering the data, their analysis is done by the technical area that generates a mathematical matrix identifying the areas of highest risk and level of each: low or high.

In addition, stores now have an alarm system that prevents theft. It works through an antenna and a printed circuit that are discreetly hidden under the bar code label, so the sensors in the circuit are detected by the vertical bars on the shop door. These bars emit electromagnetic waves, so when someone passes them carrying an unpaid product, the sensor attached to the object interacts with the waves and makes the alarm ring.

2.3. Quality tools

2.3.1. Stratification

According to Werkema (2006), stratification is the division of a given data group into several subgroups according to desired factors, which are known as stratification factors. In other words, the causes identified in processes that have some kind of variation are stratification factors of a data set. Factors such as: machines, time, methods, people, measurements and others are natural factors for data stratification.

As an example, it is possible to stratify: 1) the time, where results vary at different times of the day; 2) the location, where results have significant variation across different plants or areas; 3) inputs, when it is possible to verify variation for each supplier and 4) the individual, the difference in results is related to the type of employee in a particular job.

Stratification can be done in various ways, being at the author's discretion to use and identify the one that best fits his studies, and can be done by graphs and tables. However, it is necessary to emphasize that any and all factors that undergo alteration must be registered in order to have a complete diagnosis in order to list the main causes of the problem.

2.3.2 Verification Sheet

The Verification Sheet, as shown in Chat 1, is a means of facilitating, organizing, and standardizing data collection and recording so that further data compilation and analysis is optimized.

Motor Assembly Check Sheet

Name of Data Recorder: Lester B. Rapp

Location: Rochester, New York

Data Collection Dates: 1/17 - 1/23

Defect Types/ Event Occurrence	Dates							TOTAL
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
Supplied parts rusted		||||||||	|||||	||||	||			20
Misaligned weld			|||			||		5
Improper test procedure								0
Wrong part issued					||				3
Film on parts								0
Voids in casting					||||	||			6
Incorrect dimensions						||		2
Adhesive failure								0
Masking insufficient									1
Spray failure			|||||					5
TOTAL		10	13	10	5	4		

Chat 1 – Verification or check sheet example
Source: ASQ`s Excel Template

A check sheet is a form in which the items to be examined are already printed to facilitate data collection and recording (WERKEMA, 2006).

The main objectives of using the check sheet are: a) to facilitate the work of the data collector; b) organize the data during the collection, avoiding the need to organize the data later and c) standardize the data that will be collected, regardless of who performs the collection.

Among several kinds of check sheets, the following stand out: a) the distribution of an item is used to analyze the distribution of the values of a control item of interest associated with a process. It is usually necessary to use the histogram to this kind of analysis; b) classification used to subdivide a particular characteristic of interest into its various categories, for example, a check sheet that points out the types of problems that cause a product to fail; c) troubleshooting is used to identify where certain defects are

occurring in a product, for example; and d) troubleshooting is very similar to that of classification, but it allows for a more detailed stratification of factors, making the work of identifying the causes easier.

According to Werkema (2006), to elaborate a verification sheet, the following steps are followed:

Step 1) Define the purpose of data collection;

Step 2) Determine the type of check sheet to be used;

Step 3) Establish an appropriate title for the check sheet;

Step 4) Include fields for the registration of the names and codes of the departments involved;

Step 5) Include fields for the registration of the names and codes of the products considered;

Step 6) Include fields to identify the persons responsible for completing the check sheet;

Step 7) Include fields for data source record;

Step 8) Present in the proposed verification sheet simplified instructions for its completion;

Step 9) Raise awareness among all persons involved in the process of obtaining the objective data and the importance of the collection;

Step 10) Inform all persons involved in the data collection process exactly what, when and how it will be measured;

Step 11) Instruct all persons involved in data collection on how to complete the verification sheet;

Step 12) Ensure that all stratification factors of interest have been included in the check sheet;

Step 13) Perform a pre-test before using the check sheet to identify possible failures in the preparation of the sheet.

2.3.3 Pareto Diagram

The Pareto Chart is made through the results of an analysis, with the objective of classifying the items in order of priority. Studies by Vilfredo Pareto found that the 80/20 ratio occurred very often, i.e. 80% of quality problems occurred due to 20% of the probable causes arising from them.

According to Corrêa (2007), Pareto is conceptualized as a way of separating the few vital elements in an analysis and separating them from the most trivial ones.

According to Werkema, (2006). The Pareto chart is a bar chart in which the bars are sorted from highest to lowest and a curve is plotted showing the accumulated percentages of each bar. It can be of two types: Pareto Chart for effects and Pareto Chart for causes. The first orders the problems presented by the company so that the main problem can be identified, while the second orders the causes of each problem presented by the company.

The Pareto for purposes chart can be used to sort problems in the five dimensions of Total Quality, such as: 1) quality, for example, number of customer complaints, percentage of defective products, etc; 2) cost, maintenance costs, warranty repairs, and others; 3) delivery, lack of raw materials in stock, wrong delivery rates and delays in delivery; 4) morale, absenteeism and labor claims rates; and 5) safety, such as the number of accidents suffered by product users, the severity rates of accidents and the number of occupational accidents.

The Pareto chart (Figure 2) for causes may refer to: 1) process information or measurements, measurement methods; 2) equipment such as maintenance; 3) methods or procedures, such as clarity of information; 4) inputs, batch, storage; 5) environmental conditions, such as lighting, supplier and 6) people, such as age

and training.

						Table 1						
Player	Sachin	Rajan	Mukul	Gautam	Karan	Bhuvan	Ravi	Wasim	Krishan	Nasim	Sunil	Total
Runs Scored	15	111	65	12	85	10	20	45	5	3	4	375

		Table 2	
Player	Runs Scored	Cumulative Score	Cum.% Score
Rajan	111	111	29.60
Karan	85	196	52.27
Mukul	65	261	69.60
Wasim	45	306	81.60
Ravi	20	326	86.93
Sachin	15	341	90.93
Gautam	12	353	94.13
Bhuvan	10	363	96.80
Krishan	5	368	98.13
Sunil	4	372	99.20
Nasim	3	375	100.00

Figure 2   - Pareto chart example

Source: Sharma Narender <https://www.youtube.com/watch?v=bZ5SYjzmRsk >
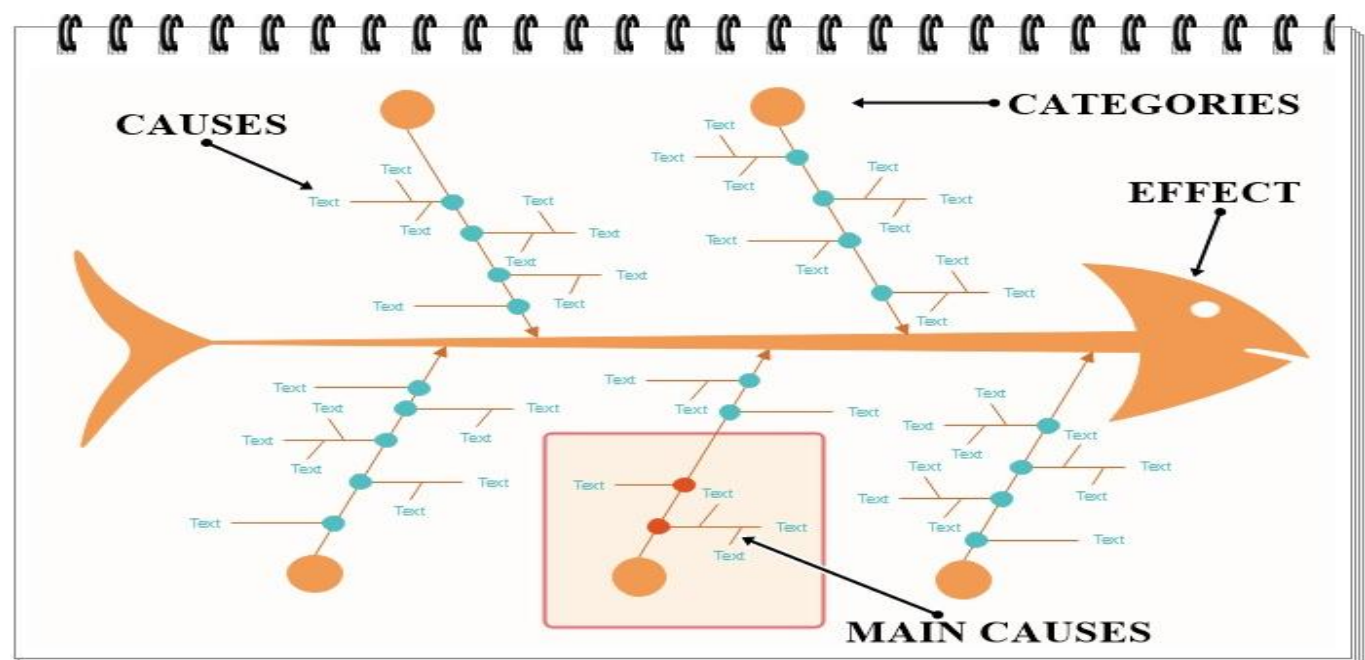
Figure 3 - Causes and Effect Diagram Example

Source: Adapted from Edraw Max version   9.4.1

2.3.4 Cause and Effect Diagram

Created by Dr. Kaoru Ishikawa, it is a well known quality tool used to determine the causes of a given effect. According to Tubino (2007), the cause and effect diagram allows complex processes to be divided into simpler and therefore more controllable processes. Which means that the effects would be split into several other minor problems. In other words, the diagram helps to get an overview of the problem, making

it easier to understand the solutions to them.

The cause and effect diagram is a figure composed by an effect, the categories and causes (Figure 3), which represent a significant relationship between an effect and its possible causes. There are probably several categories of major causes. Often these fall into one of the following categories: Man, Machines, Methods, Materials, Measure, Environment (Meio Ambiente) known in Brazil as the 6Ms (RAMOS, 2000, p. 98).

In Japan, this tool is used also to identify causes to explain why a project is successful or for prevention reasons (Figure 4).
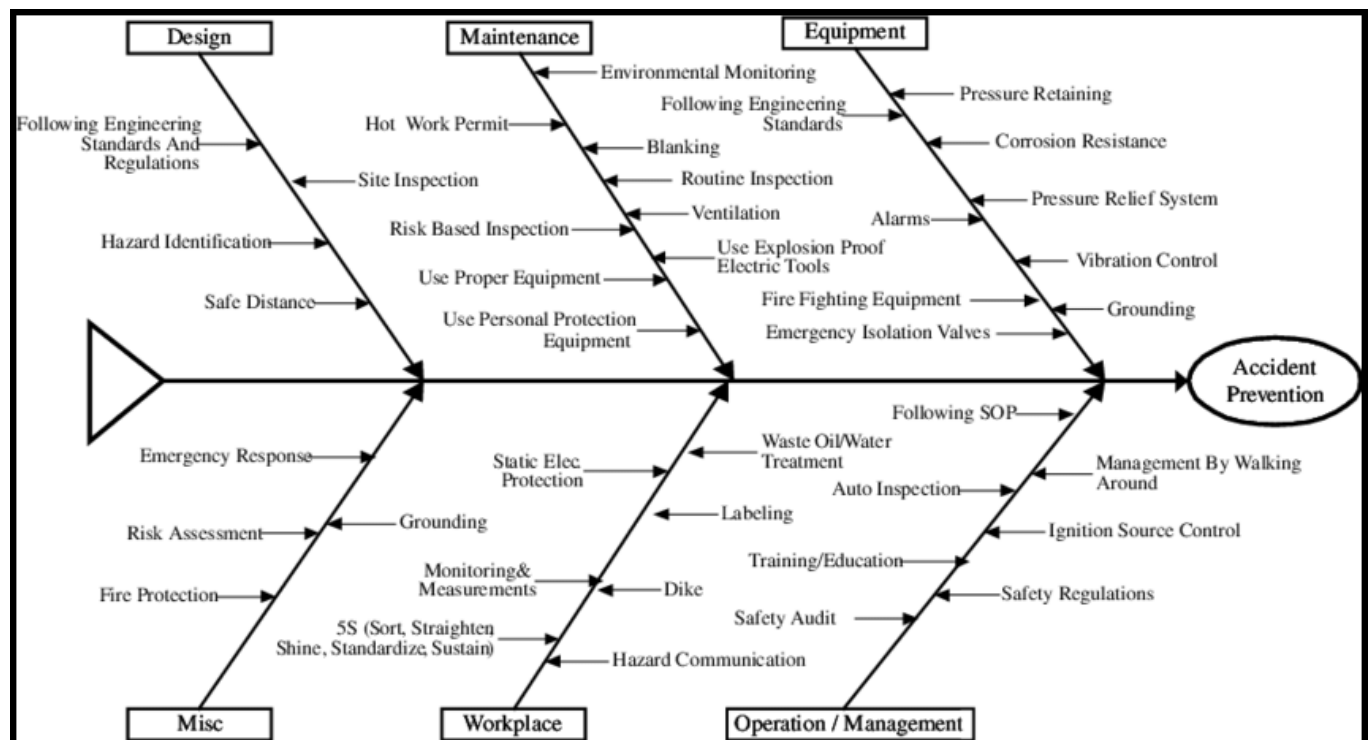
Figure 4 – An example of cause and effect diagram used for prevention aims

Source: Chang and Lin (2006 p. 55)

2.3.5 Flowchart

The flowchart is the diagram that represent various stages of the process. Diagrams are made up of sequential decision and action steps, each of which has its own symbology that helps to understand the system of its nature. Much of the variation in a process can be eliminated only when the manufacturing process is known. This means that the production sequence, or stages, influences the ultimate variability of product characteristics (RAMOS, 2000 p. 102).

A flowchart can be used for project development, project management, development of knowledge, to improve communication, process, as well as to identify risks and contribute to solve problems (TAGUE, 2005 p. 7 and 8).
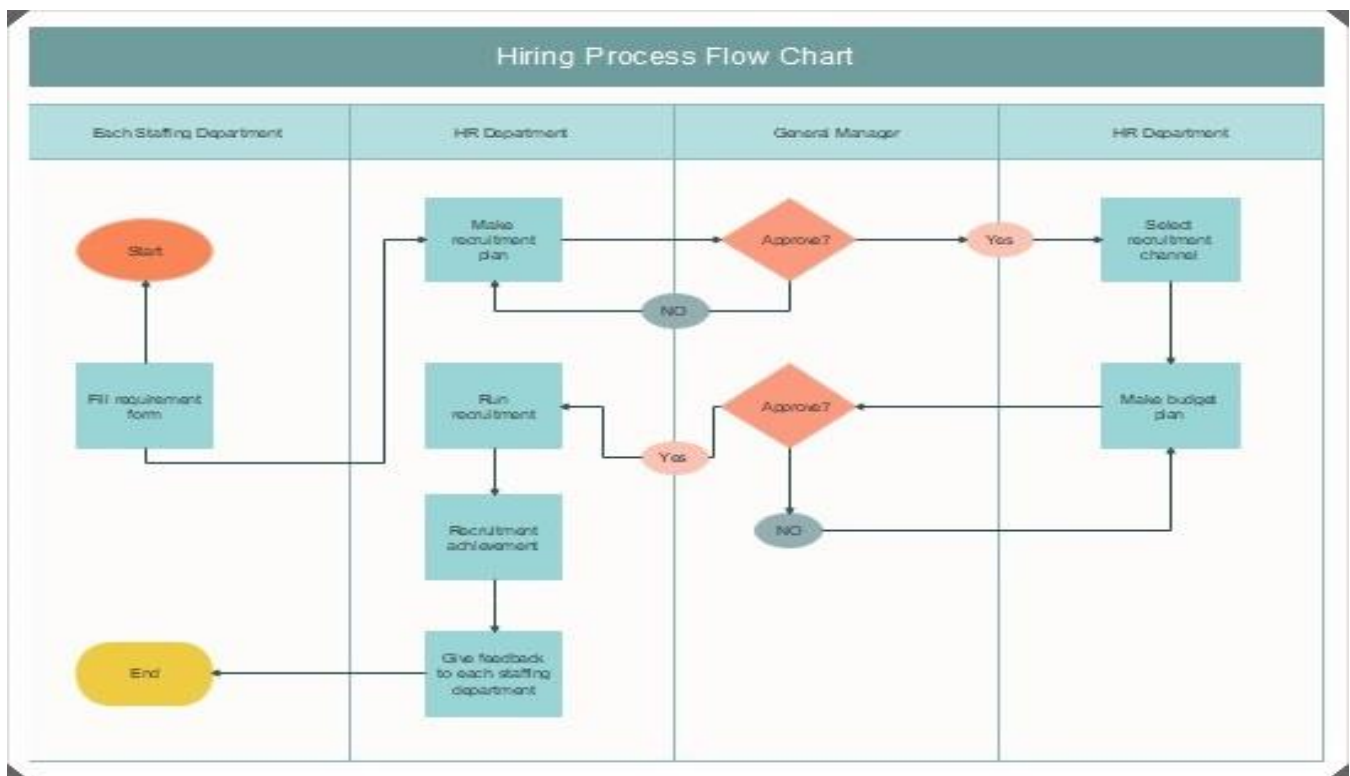
Figure 5 – Example of Functional Flow Chart
Source: EdrawMax 9.4.1 version
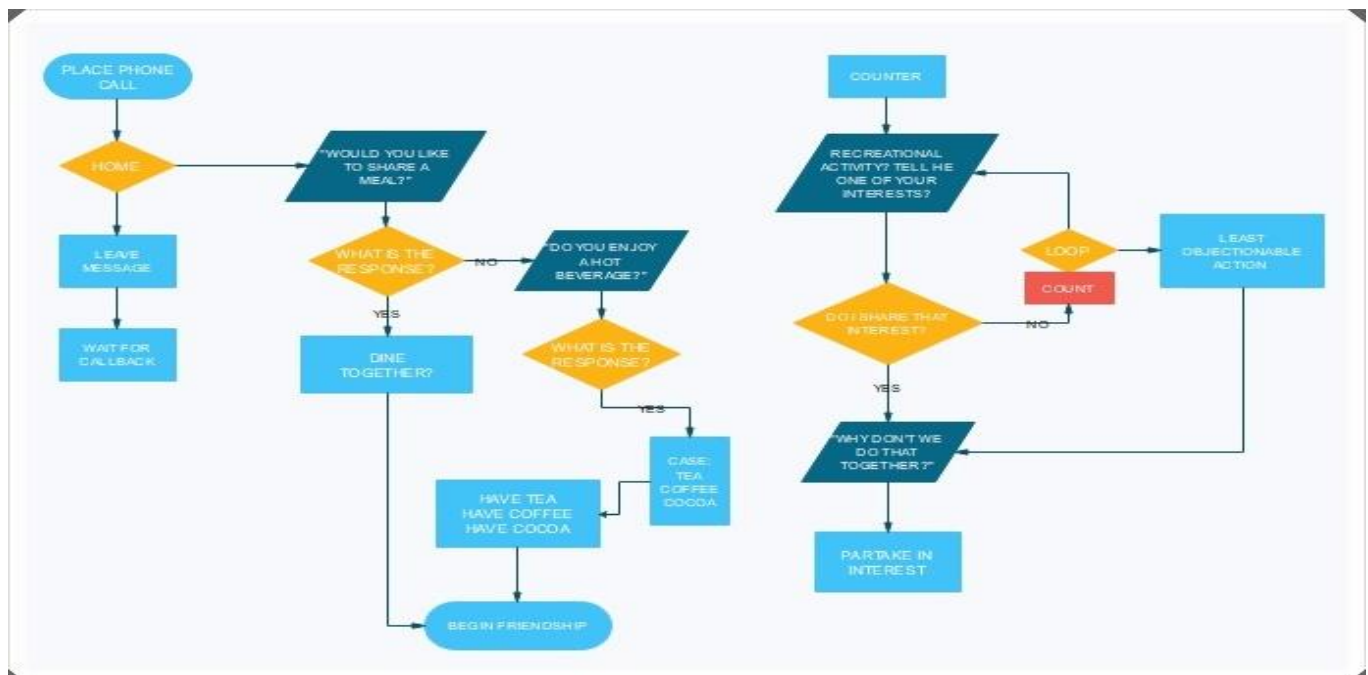
Figure 6 – Example of two Linear Flow Chart
Source: EdrawMax 9.4.1 version

Granfelt (2017) proposed some orientations to help micro and small businesses to understand how to use flowcharts to document their processes, including suggestions of some software. However, since the valuable contributions of Frank and Lilian Gilbreth (GILBRETH; GILBRETH, 1921), as well as Goldstine and Neumann (1947 and 1948), several evolutions happened with flowcharts, from the stardardization (ISO

1028:1973; ISO 5807: 1985; ANSI 2016) with guidance, until the creation of several types of flowchart in the market such as functional (Figure 5), linear (Figure 6) and vertical (Figure 7).

VERTICAL FLOWCHART		Lead Time (in hour):	04:14:34

Main symbol			10	02:14:24	52,80%	Company:		X	
	■	Operation	10	02:14:24	52,80%	Company:		X	
	➡	Transfer of material	0	0	0,00%	Type of process:	Standard		New
	◆	Decision or Measure	5	2:00:10	47,20%	Process` name:	Energy System Measurement		
	▣	Documentation	0	0	0,00%	Department:	Quality Assurance		
	▼	Storage	0	0	0,00%	Data:	September 17th 2016		

Steps	Symbols	X Time	Accum.	% Accu	Type of operation and description
1	▢ ➡ ◇ ▯ ▽	00:04:00	00:04:00	1,6%	Manual: to prepare the sample and connecting the cables
2	▢ ➡ ◇ ▯ ▽	00:00:15	00:04:15	1,7%	Manual: open the Energy System Measurement
3	▢ ➡ ◇ ▯ ▽	00:01:44	00:05:59	2,4%	Manual: to insert sample data
4	▢ ➡ ◇ ▯ ▽	00:00:01	00:06:00	2,4%	Manual: to start the test by clicking START
5	▢ ➡ ◇ ▯ ▽	00:01:52	00:07:52	3,1%	Automatic: to stabilize sound and adjust image
6	▢ ➡ ◇ ▯ ▽	01:00:00	01:07:52	42,4%	Automatic: to put the sample in Standby mode
7	▢ ➡ ◆ ▯ ▽	00:40:00	01:47:52	42,4%	Automatic: to measure the power in static mode
8	▢ ➡ ◆ ▯ ▽	00:10:00	01:57:52	46,3%	Automatic: to measure the power in dynamic mode
9	▢ ➡ ◆ ▯ ▽	00:10:00	02:07:52	50,2%	Automatic: to measure the power in internet mode
10	▢ ➡ ◇ ▯ ▽	00:00:05	02:07:57	50,3%	Automatic: to set up the sample for the factory mode
11	▢ ➡ ◇ ▯ ▽	01:00:00	03:07:57	73,8%	Automatic: to put the sample in Standby mode
12	▢ ➡ ◆ ▯ ▽	01:00:00	04:07:57	97,40%	Automatic: to measure the power in Standby mode
13	▢ ➡ ◆ ▯ ▽	00:00:10	04:08:07	97,47%	Automatic: to measure the area and the screen visible diagonal
14	▢ ➡ ◇ ▯ ▽	00:00:10	04:08:17	97,53%	Automatic: to generate the report
15	▢ ➡ ◇ ▯ ▽	00:06:17	04:14:34	100,00%	Manual: to pack the sample

Figure 7 – Example of a Vertical Flow Chart

Source: Author

2.3.6 5W1H or 5W2H

According to Candidio (2009), it is a recommended quality method for the elaboration of the action plan. Its construction is simple, widely used by organizations.

For each goal to be performed, there is the establishment of the actions to be performed, as well as the deadlines and responsible for each of them. In addition, all actions to be developed are in the form of a schedule. Basically, it consists of answering 7 questions: What?; Where?; Who?; When?; Why? How and How much (optional) ?

The 5W2H is used to diagnose a problem and built a plan actions. The method visualize the appropriate solution of a problem, with possibilities of monitoring the execution of an action. Seeking to facilitate understanding by defining methods, deadlines, responsibilities, objectives and resources. To illustrate, Figure 8 shows parts of an Action Plan developed in 2018 by Industrial Engineering Course of FT/UFAM

to help graduate students to decide the imigration or not to a new Pedagogical Project Course.
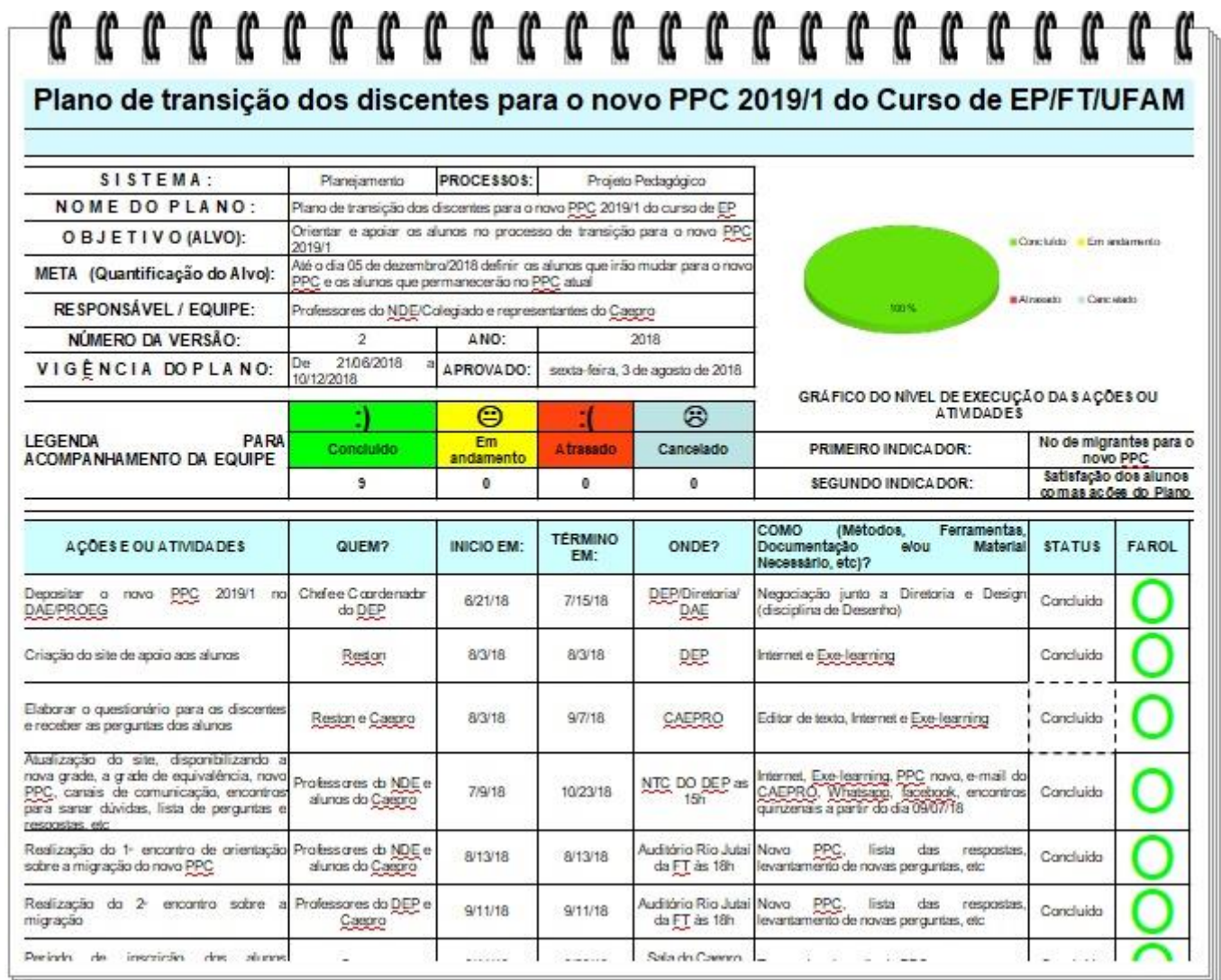
Figure 8 – Example of an Action Plan developed by using 5W1H method.

Source: Author

3. Case study profile

The study was conducted at Shopping X, located in the city of Manaus, on Djalma Batista Avenue, an interconnection road for the entire city, reason by which it is one of the most popular shopping malls in Amazon`s capital. This scenario contributes to the ranking of 13th place as the highest revenue mall for the company that manages it.

The research was specifically carried out with the mall's operations sector, whose main function is parking control, which has 1,754 vacancies, 1,185 of which are located in the garage building that supports most of vehicles; 59 in the VIP parking; 76 in motorcycle parking and 434 vacancies in open areas near the main shopping access entrances.

According to reports extracted from the parking system used in the mall itself, the flow on normal days (considered here, days without promotion and far from festive dates) is 800 to 900 vehicles; On holidays, holidays and promotional periods, the flow is between 1,000 and 1,080 cars, including motorcycles.

	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez	Acum
Real 2015	3	2	3	4	3	4	2	5	4	7	3	7	47
Meta 2016	2	2	2	3	2	3	2	4	3	6	2	6	37
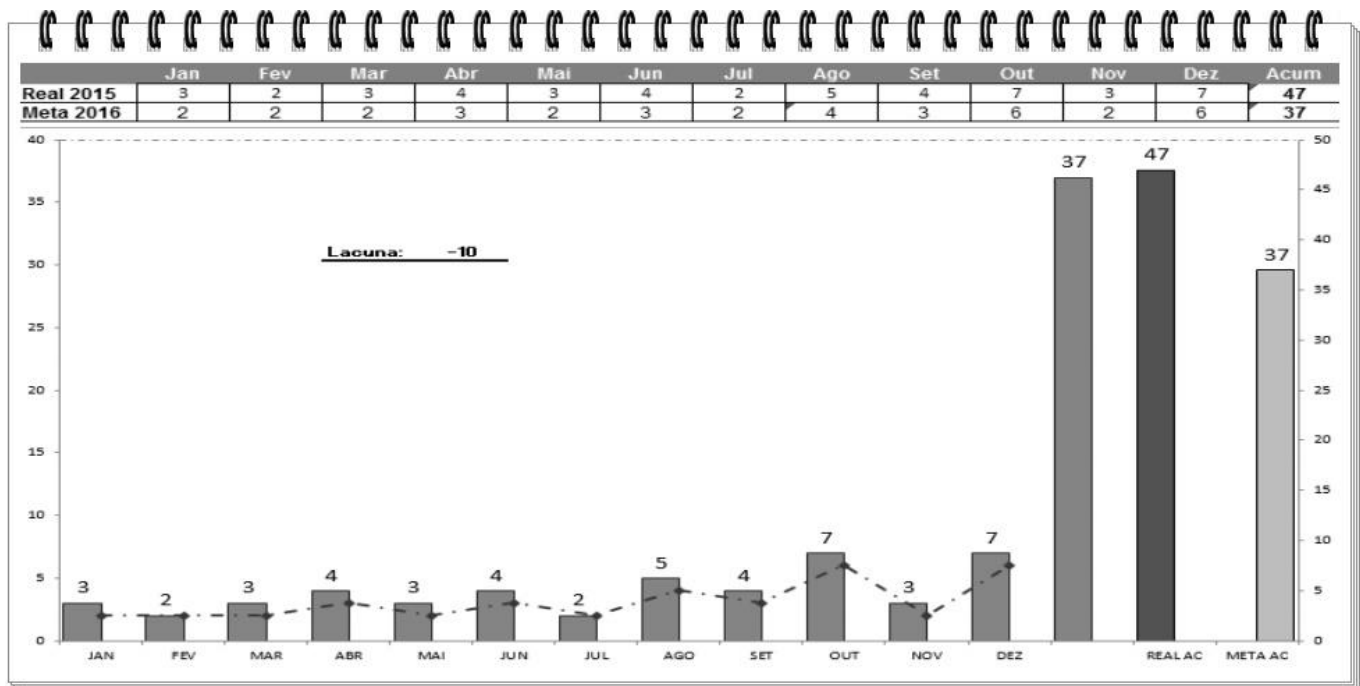
Figure 9 – Complaints numbers (Real 2015 x Target 2016)

Source: Author (2016)

In the last year of 2015, the department diagnosed a considerable increase in complaints related to parking robberies and theft. The number of customer service reports (CSS) has been tracked by managers on a daily basis, as well as expenses related to refunds and reimbursements arising from this issue.

Figure 9 shows the number of complaints (excluding material damage from this analysis, verifying only robberies and thefts), which occurred in 2015, as well as a management goal set for 2016: reduce the number of complaints by 20% in relation to each month of the previous year.

4. Methodology

This is an applied research, characterized as quantitative, because the collected data were pointed numerically according to the frequency of reports and expenses raised monthly in relation to shopping mall claims. It is also considered as qualitative since it is a case study with biography and document investigations. It was part of a research plan developed by the author to conclude the Industrial Engineering Course at FT/UFAM. The stages of the research are detailed in Chart 2, prepared between the second semester of 2016 and the first semester of 2017.

With respect to data collection, it happen between December 2 and 16, 2016. Much of the data was already recorded in spreadsheets and competency reports of the Customer Service System (CSS) and others were extracted from the accounting balance of the parking companies responsible for operating the parking service.

CSS reports and spreadsheets record information on general claims, such as: vehicle breakdowns, as well as parking robberies and theft. The number of alleged robbery and theft occurrences was recorded daily over a two-year period from January 2015 to December 2016 by CSS assistants. These records were compiled in spreadsheets and subsequently viewed in graphs and tables for better understanding.

The accounting balances of parking companies have a field of operating expenses, which can verify the amount paid in claims. For this research, were raised monthly amounts paid, from January 2015 to December 2016, with parking robberies and theft. These costs have been digitized into spreadsheets, especially for charting. In addition, attached with the monthly balance sheets, there are all justifications for reimbursement forwarded by the legal, thus enabling the investigation of possible causes of service delivery of the mall with regard to customer safety.

After gathering the information mentioned above, the data were analyzed from December 16, 2016 to January 21, 2017. In this analysis we used the main quality tools already mentioned through spreadsheets to propose robberies and theft reduction solutions in the Parking.

Schedule 2016 and 2017	November	December	January	February
Presentation of article template	04			
Theme presentation	04			
Introduction	04 – 08			
Development: discussion presentation of the bibliographic review	18/11 - 02/12			
Data collect		02 - 16		
Data analysis		16/12 - 21/01		
Discussion of results			21/01 - 11/02	
Final considerations and delivery to advisor			21/01 - 11/02	
Simulation of presentation and article correction				11 - 15
Slide and article improvements				15 - 18
Article defense				22 - 24

Chart 2 - Research plan

Source: Author (2016)

5. Discussion

The discussion of the results took place from January 21 to February 11, 2017. For a better understanding of the results it was necessary to investigate:

First) the history of occurrences of accidents in the parking lot, in order to quantify robberies and theft records;

Second) the history of reimbursement expenses, with the purpose of measuring the amount paid monthly with reimbursements;

Third) the possible causes related to compensation;

Fourth) and stratify the occurrence by location, in order to understand which parking areas have the highest occurrence record;

Fifth) the main causes with compensations;

Sixth) and classify the causes that most impact the results, prioritizing actions to reduce them.

5.1. Occurrence of Parking Claims

According to information recorded by the Customer Service System, in 2015, the number of claims reported by the mall's customers is 47, with attention to the months of October and December, where there can be noted the spikes of events related to parking claims. These values can be explained in these months due to the higher vehicle flow that is directly related to promotion periods and holiday season dates.

Compared to 2015, Figure 10 demonstrates that 2016 started with an increasing number of reports, which can be observed until May, in the following months, there was a reduction in complaints. This reduction may be justified by the hiring of an employee to supervise the parking of motorcycles, as well as the free use of luggage storage for the storage of helmets. However, this reduction was not significant regarding the management target set for 2016, 20% compared to 2015, so it was necessary to obtain a maximum of 11 CSS records related to robberies and thefts.

	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez	Acum
Real 2015	3	2	3	4	3	4	2	5	4	7	3	7	**47**
Real 2016	5	3	3	6	6	5	1	3	3	5	2	3	**45**
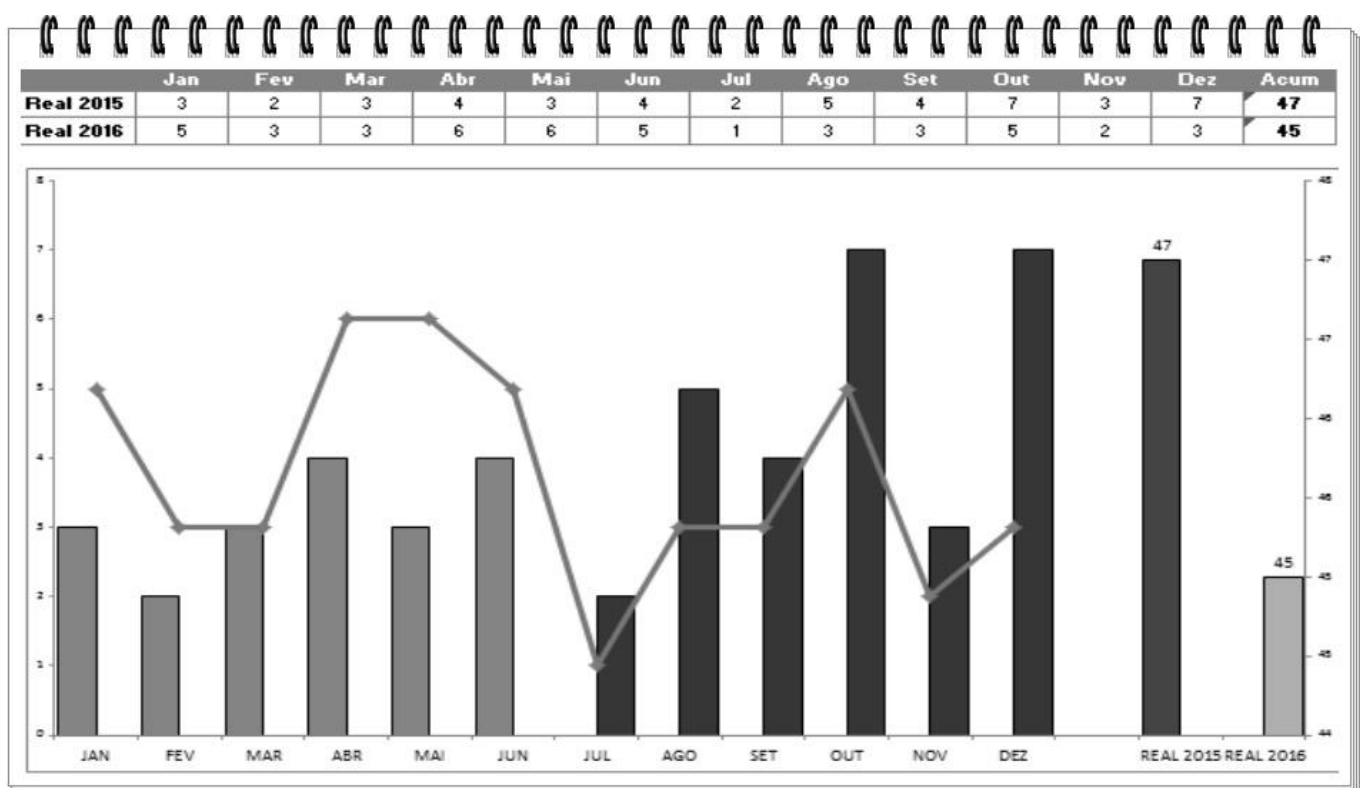
Figure 10 – Number of occurrences of Parking Claims (2015 x 2016)

Source: Author (2016)

5.2. Claim Expense History

The Figure 11 shows the amount paid monthly with parking claims reimbursements.

In 2015, the accumulated R$ 29,737.41 represents a significant amount when compared to 2016. In the latter there was a significant reduction in expenses of this kind.

This is due to some actions implemented such as hiring employees and space to store the helmets, as already mentioned in the previous item.

	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez	Acum
Real 2015	0	428	93	500	750	904,28	15288,7	686	3141,43	946	0	7000	R$ 29.737,41
Real 2016	170	436	350	340	500	696	100	964	804,23	1350	3714	0	R$ 9.424,23
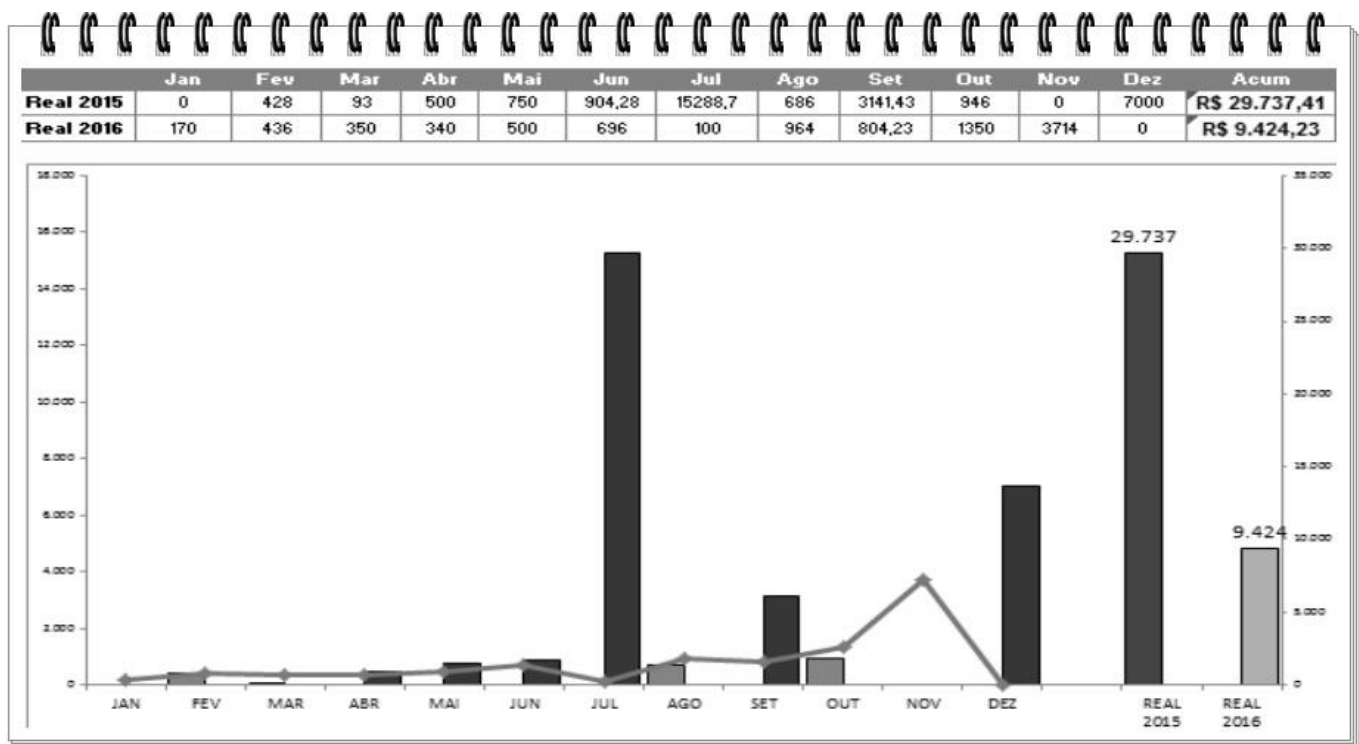
Figure 11 - Expenses with Compensations (2015 x 2016)

Source: Author (2016)

5.3. Possible Causes Related to Compensation

To discriminate the possible causes related to the considerable payment with reimbursements, it was used the cause and effect diagram that follows as Figure 12. Noting that the completion of this tool was performed with managers and parking operators.

Among the causes considered for theft in motorcycle parking was the signaling warning to customers to take the helmet with him or to keep it in the space intended for this, which is insufficient for the number of spaces available. There is only one sign in the parking lot giving orientation to not leave the helmet on the bike. For the left volume locker, there are 30 for 76 spaces. In addition, the hypothesis of inadequate guidance given to customers by employees staying in the parking has been hypothesized, they should guide customers as signposts suggest.

Regarding theft occurrences located in the VIP area, it is known that the checklist of vehicles is a standard procedure that must be performed, but in some cases the document is not filled due to the high flow of cars. Regarding the cased that occur in the garage building and in outside parking areas, the possible cause is due to the absence of images that can prove that this happened, which is directly related to the positioning of the cameras in these locations.

In addition, there are rounds at specific times in all these areas, but they have not been appropriate, which may be related to the poor positioning of the rounds, and it is necessary to readjust them in the hardest hit areas.
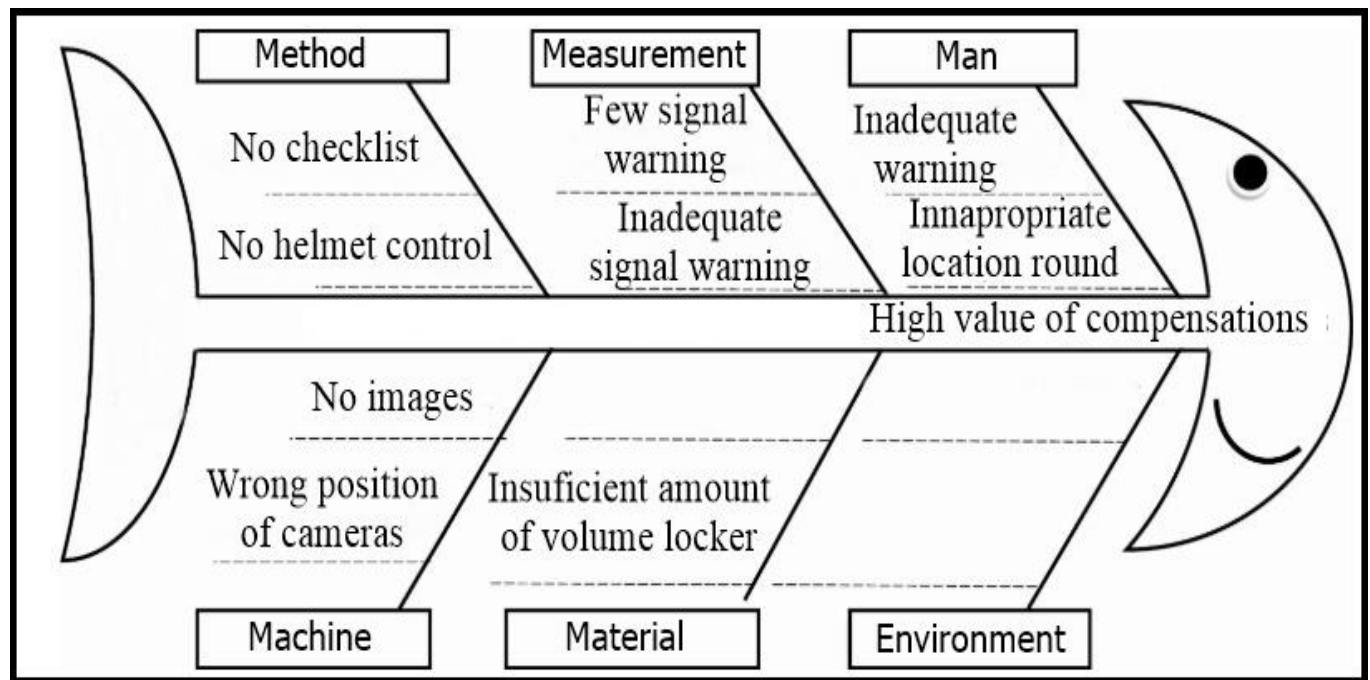
Figure 12 - Possible causes related to the high value with compensations

Source: Author (2016)

5.4 Claim Stratification by Location

To better understand the data recorded by the CSS in 2015 and 2016, it was necessary, first, to understand the parking areas most affected by robberies and thefts (Figure 13) by location in 2015.

Figure 13 shows the percentage of parking lot robberies and thefts reported by customers in 2015. It can be seen that among the 12 mapped areas, motorcycle parking is the place with the most reports related to robberies and thefts, with 41.7% of occurrences. The second most critical location is G1, with 21.7%.

It is important to note that these areas are the closest to the main entrance to the mall, located in the middle of Darcy Vargas Avenue, which concentrates a very expressive daily flow.

In 2016 (Figure 14), motorcycle parking and the G1 remain the critical areas. However, it can be verified a reduction of claims occurred in G1, comparing with 2015, this finding can be justified by the renting of the space for marketing events.

In short, motorcycle parking is the area most targeted by villains. In addition, it is possible to verify that the VIP area, despite not having a considerable percentage of claims, is a place of attention, as the region is controlled by the parking valet and is widely used by customers with higher purchasing power.
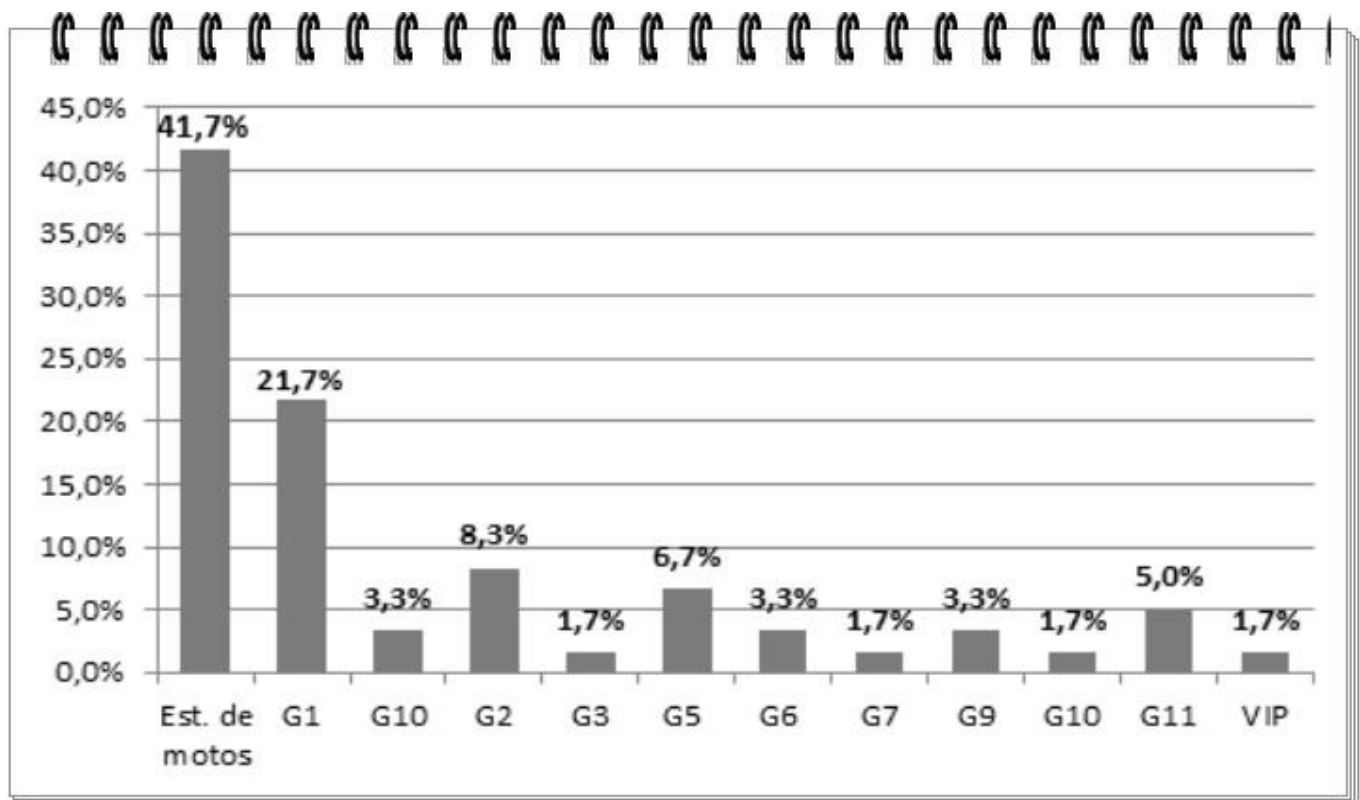
Figure 13 - Percentage of Claims by Location in 2015

Source: Author (2016)
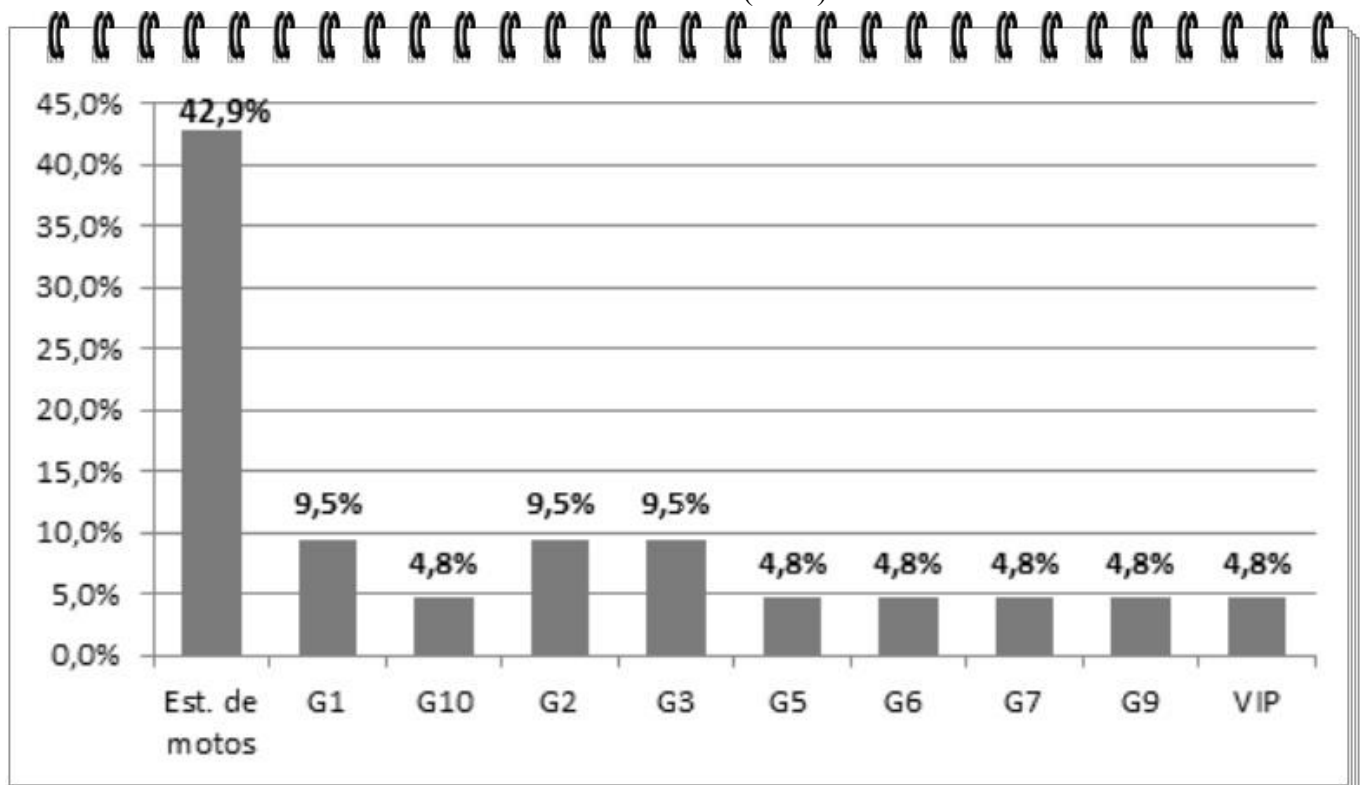
Figure 14 - Percentage of Claims by Location in 2016

Source: Author (2016)

5.5 Top Causes of Motorcycle, G1 and VIP Parking Claims

In this analysis, all accounting statements and reimbursement responses sent by the legal entity for each

specific case were considered.

Considering Chart 3, it can be seen that the mall reimbursed 42 cases related to helmet thefts in 2015 and 2016. In these cases, the legal department advised compensation for failing to provide services such as:

a) the absence or insufficient space to store helmets;

b) lack of signs in the motorcycle parking informing the customer to take the helmet with them when all luggage is occupied and not to leave the helmet on the motorcycle, storing it in a designated place, as directed by the mall.

As for the theft of money, cases that occurred in the VIP parking lot, the legal department suggested compensation for not filling the check-in list of vehicles, which is directly related to workforce failures. It must be filled daily by the valet hired for this and other functions.

In cases related to steppe theft and other belongings of less value, the compensation occurred due to the lack of camera images in specific locations of the garage building, which may be related to the poor positioning of the cameras. In the garage building, cameras are placed at the entrance of each floor, making it difficult to keep up with possible theft or suspicious movement near vehicles.

In addition, it can be seen (Chart 3) that approximately R$ 22 thousand were spent in 2015 and 2016 on expenses for the reimbursement of helmet theft in motorcycle parking.

Items	Helmet	Money	Steppe	Other
2015	22	5	7	13
2016	20	7	8	10
Total Frequency	42	12	15	23
Cause	Little or no storage; signs	VIP checklist not completed	No camera images	No camera images
Expenses (R $)	R$ 22.322,13	R$ 235,00	R$ 1.120,00	R$ 15.484,51

Chart 3 - Compensations data (2015 and 2016)

Source: Author (2016)

5.6 Prioritization of Actions

As shown in Figure 15, more than half (55%) of reimbursements are related to insufficient storage (volume locker) and inadequate signage in motorcycle parking.

Given this finding, some cheap actions to reduce helmet theft expenses will be suggested.

After conducting a study on how to reduce helmet theft, it was suggested two actions:

Tag Control and Helmet Lock Control.
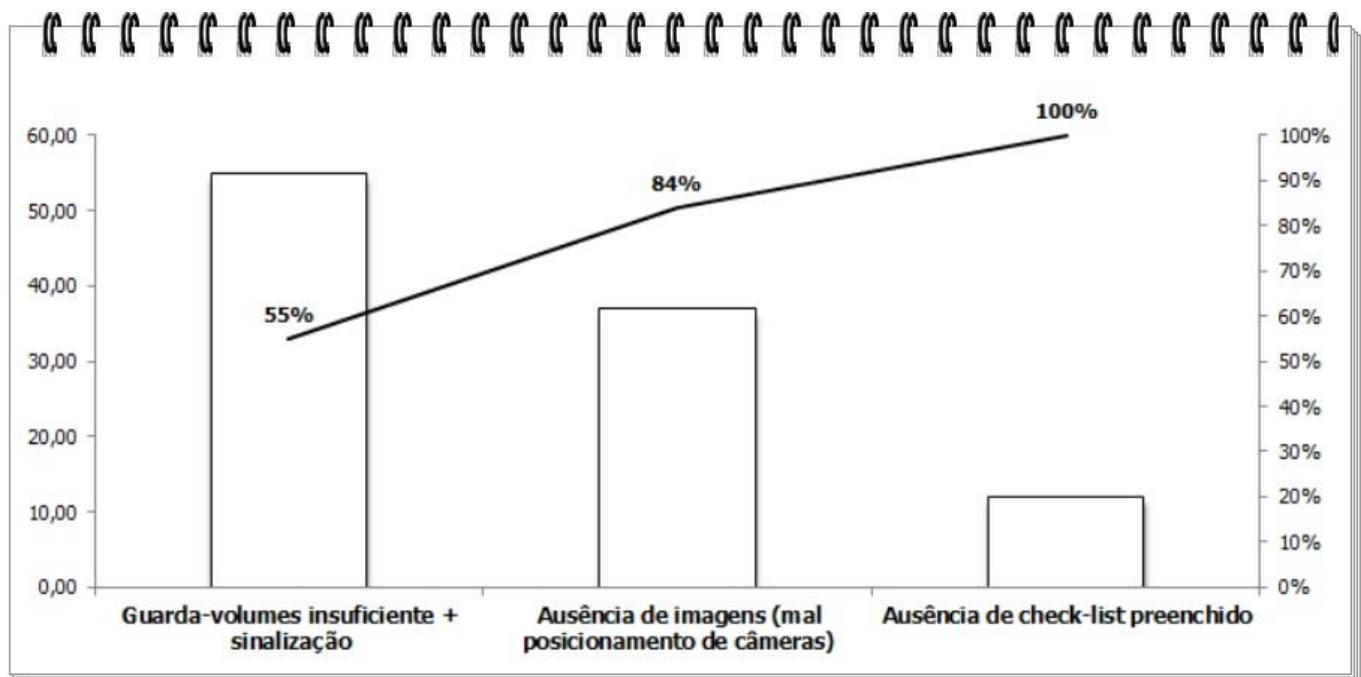
Figure 15 - Main causes that impact reimbursement expenses

Source: Author (2016)

5.6.1 Tag Control

This proposal is based on a tag control. With the help of a label maker, as shown in Figure 16, the employee in the motorcycle parking lot would approach each customer as soon as he entered and exited the parking lot, performing the five steps of the procedure shown in Figure 17.
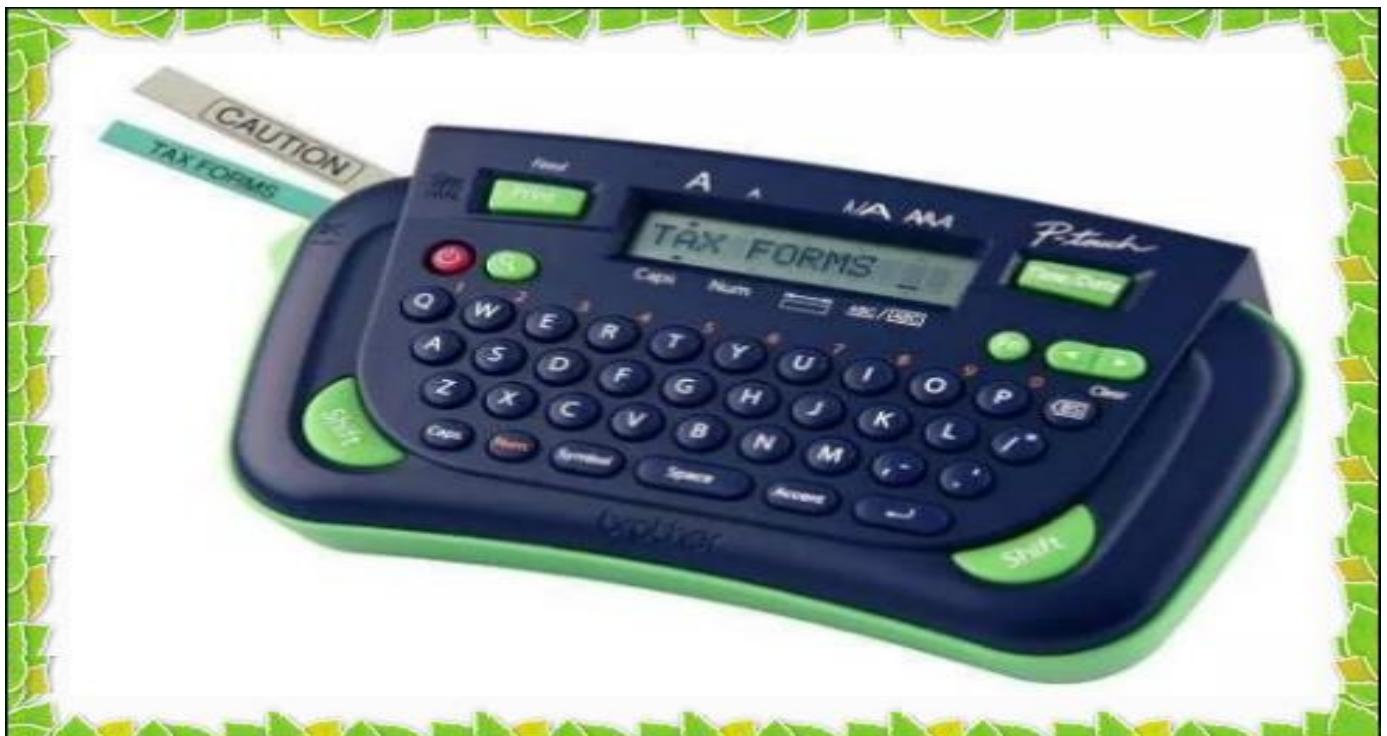
Figure 16 - Brother Pt 80 Labeler

Source: Free Market.
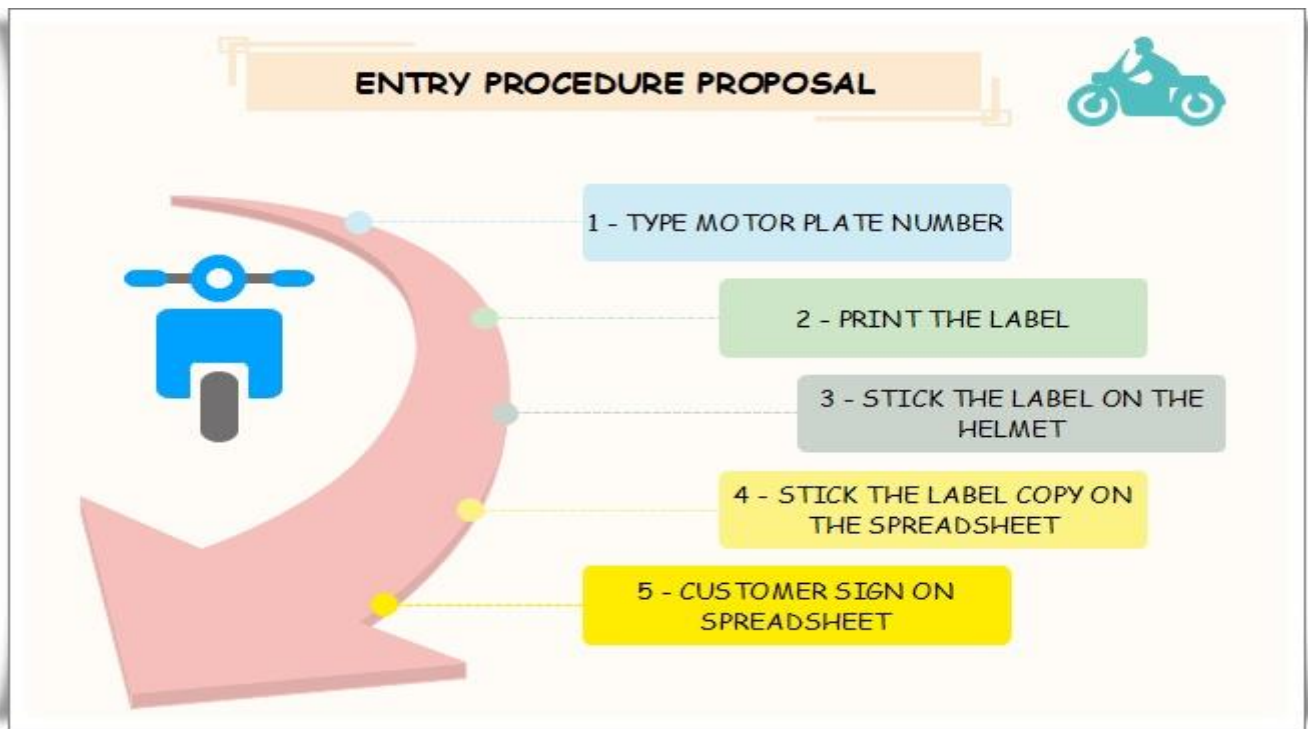
Figure 17 – Entry procedure proposed flowchart

Source: Author (2016)
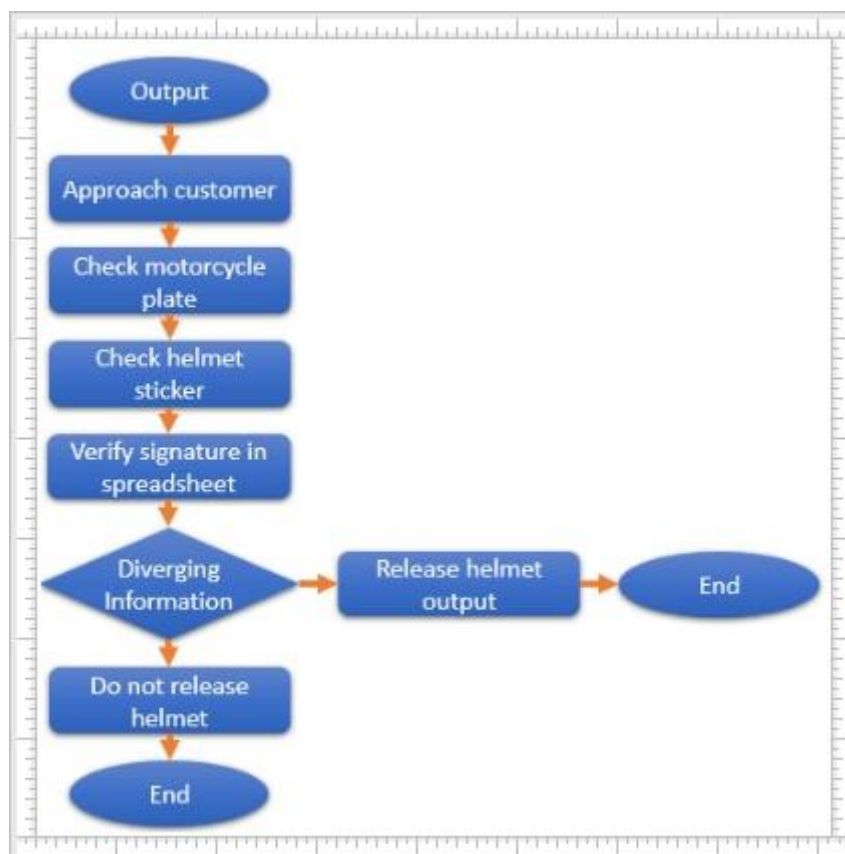
Figure 18 - Exit Procedure Flowchart proposal

Source: Author (2016)

Basically, it will take five steps, to type the motorcycle license plate, print the label, stick it to the helmet and a control sheet, and request the customer's signature. The spreadsheet should contain at least two fields, one for pasting the label and the last for customer signing.

The checkout procedure (Figure 18) is just a conference, the employee with the control sheet in hand would approach the customer at the checkout terminal to verify the label on the helmet by crossing this information with the worksheet. With converging information, the customer would be released, otherwise the helmet exit would not be allowed. In cases where the customer does not have a helmet label or control sheet record, the customer would normally be released, indicating that the employee located in the parking lot has failed. After propose the two procedures, it was made a market research to identify the mot viable solutions, as a result, Chart 4 presents the resources to be used, as well as acquisition costs, with the lowest market prices according to the free market.

Resources	Lowest price
Brother Pt80 Labeler	R$ 192.00
Brother Ribbon (231-Piece Reel)	R$ 51.30
A4 Fill Paper (500 pcs)	R$ 168.85
TOTAL	R$ 261.14

Chart 4 - Resources and Costs of the solutions

Source: Author (2016)

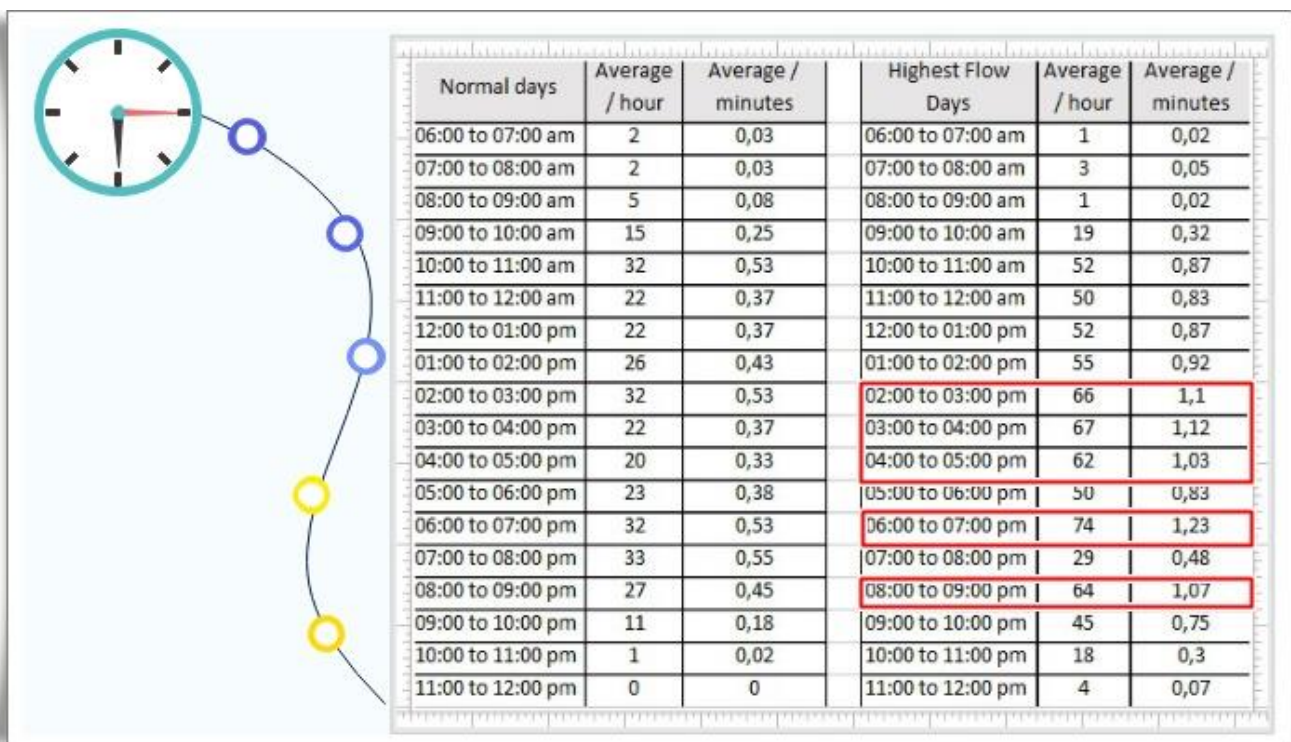| Normal days	Average / hour	Average / minutes	Highest Flow Days	Average / hour	Average / minutes
06:00 to 07:00 am	2	0,03	06:00 to 07:00 am	1	0,02
07:00 to 08:00 am	2	0,03	07:00 to 08:00 am	3	0,05
08:00 to 09:00 am	5	0,08	08:00 to 09:00 am	1	0,02
09:00 to 10:00 am	15	0,25	09:00 to 10:00 am	19	0,32
10:00 to 11:00 am	32	0,53	10:00 to 11:00 am	52	0,87
11:00 to 12:00 am	22	0,37	11:00 to 12:00 am	50	0,83
12:00 to 01:00 pm	22	0,37	12:00 to 01:00 pm	52	0,87
01:00 to 02:00 pm	26	0,43	01:00 to 02:00 pm	55	0,92
02:00 to 03:00 pm	32	0,53	02:00 to 03:00 pm	66	1,1
03:00 to 04:00 pm	22	0,37	03:00 to 04:00 pm	67	1,12
04:00 to 05:00 pm	20	0,33	04:00 to 05:00 pm	62	1,03
05:00 to 06:00 pm	23	0,38	05:00 to 06:00 pm	50	0,83
06:00 to 07:00 pm	32	0,53	06:00 to 07:00 pm	74	1,23
07:00 to 08:00 pm	33	0,55	07:00 to 08:00 pm	29	0,48
08:00 to 09:00 pm	27	0,45	08:00 to 09:00 pm	64	1,07
09:00 to 10:00 pm	11	0,18	09:00 to 10:00 pm	45	0,75
10:00 to 11:00 pm	1	0,02	10:00 to 11:00 pm	18	0,3
11:00 to 12:00 pm	0	0	11:00 to 12:00 pm	4	0,07

Figure 19 - Average time (in min) of motorcycles in normal and highest flow days

Source: Author (2016)

The solution presented requires time to execute, so for the simulation purposes, several parking reports

have been pulled from the system to evaluate the parking entry flow per hour on high and low flow days. Figure 19 shows an average time of motors per minute on normal (excluding weekends, promotional and holiday periods) and in highest flow days. In this accounting were chosen 3 days of January and 3 days of February 2015.

It can be seen that the motorcycle flow per minute is less than 1, so that the checklist can be completed and the procedures described could be executed in appropriate time.

Already on high flow days (this weekends, holidays and promotion periods have entered this calculation) the average of bikes per minute is approximately 1, only in some specific hours as highlighted in red color. This finding is not disadvantageous, since the employee would be able to do the two procedures   suggested. According to specifications of the labeler (Figure 16), the print speed is a maximum of 7.5 mm per second, making it possible to perform the entire procedure.

5.6.2 Helmet Lock Control

Control by helmet locks is one of the simplest proposals among those mentioned.

It does not require any manual control, just that the motorcycle parking attendant approached the customer when he entered, would later attach the helmet to the motorcycle with the help of one of the suggested locks below and save the key, in cases where exist. On leaving, the client would ask the employee to unlock the helmet and he would be released.

Figure 20 presents options for keyed helmet locks that will be held by the employee. These options are the best priced on the market, however, they are easy to damage. However, with the frequent presence of the employee overseeing the parking lot, this would not be a serious problem, because even if the employee was absent from the parking lot, it would take some time to be able to violate one of these materials.

Figure 20 - Option 1 and 2 for Helmet Locks
Source: Free Market

On the other hand (Figure 21), option 3 is a hard-coded helmet lock. Very simple to apply, having the advantage of establishing a unique helmet release code that would only be known to the parking attendant. The only disadvantage is that its acquisition cost is relatively higher than the other options mentioned above.

Figure 21 - Option 3 for Code Helmet Lock
Source: Free Market

Finally, Chart 5 shows a column recording the acquisition value for 45 units of each option mentioned above, this amount (45) is the difference from the 75 spaces with 30 luggage storage units that motorcycle parking already has.

Resource	Lowest price	Price of 45 units
Option 1 - Key Lock	R$ 24.99	R$ 1.124,55
Option 2 - Key Lock	R$ 49.90	R$ 2.245,50
Option 1 - Code Lock	R$ 199.00	R$ 8.955,00

Chart 5 - Optional Features and Costs of the products
Source: Author (2016)

6. Final Considerations

The general objective is to analyze and suggest economic actions to reduce the amount of robberies and thefts in shopping mall motorcycle parking X. The following specific objectives are: 1) Map the parking areas and their surroundings with the highest number of accidents; 2) Identify the causes related to the problem, as well as possible solutions; 3) Select the most viable solutions with their respective budgets as proposals for improvements to reduce robberies and thefts in the parking.

Data collection and analysis were performed in the Shopping X Operations department. Data were mapped according to the occurrence of claims registered by the CSS. Through this information, it was possible to stratify the parking areas with the highest incidence of claims, revealing that parking motorcycles had 41.7% and 42.9%, in 2015 and 2016, respectively, the highest percentage of thefts, with G1 being the second parking area with approximately 20% of occurrences.

Subsequently, possible causes related to theft in motorcycle parking and G1 were raised. In the first, the helmet was the most stolen object, having as its main causes the insufficient amount of luggage and signaling, arranged in the motorcycle parking lot. In the second, various types of belongings were stolen, having as main cause related to the absence of images from the cameras, due to their mispositioning. Without these images it was impossible for the legal entity to establish a non-compensation opinion.

However, among the causes cited, the insufficient amount of luggage and signaling represent 55% of reimbursement expenses, meaning that most reimbursements are related to helmet thefts in motorcycle parking.

Given the above scenario, actions were suggested in order to reduce such problem. The first proposed solution was to control the entry and exit of the motorcycles using a label labeler, with an investment cost of only R$ 261.14. The second proposal focused on the control of helmets by key locks, option 1 and 2, and code, option 3. Being the cheapest option 1, approximately, R$ 1,000.00 and the most expensive option 3 costs R$ 8,955.00. This amount of 45 locks is considered enough to meet the demand of 75 vacancies. Option 2 is the best cost-effective choice, because the investment is not so high and the process control would not require much execution time.

The main lessons learned were the use of quality tools for schematic and problem solving, as well as generic knowledge about the mall market and its security systems that are constantly disclosed by ABRASCE.

One limitation of the research was regarding the disclosure of images of the parking areas studied, being restricted due to the organization's confidentiality policy. Thus, it is suggested that the mall managers opt for the solution proposal that is within their budgets and can contribute significantly in reducing theft and helmet theft. And for future research, it is recommended to investigate the impact of the news procedures on the reduction of robberies and thefts, as well as on customer satisfaction.

7. Acknowledgments

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