

# Innovating Management Control by Dynamic Analysis of Pareto in a Hotel Business

Anderson Rodrigues dos Santos<sup>1</sup>, Flávio de São Pedro Filho<sup>2</sup>, Fabricio Moraes de Almeida<sup>3</sup>, Marcelo José Peres Gomes da Silva<sup>4</sup>, Tiyao Sui-Qui<sup>5</sup>

Administrator graduated from the Federal University of Rondônia (UNIR), Brazil. Collaborator of the GEITEC / UNIR / CNPq, Brazil. E-mail: [anderson\\_srodrigues@hotmail.com](mailto:anderson_srodrigues@hotmail.com)

Post-Doctor in Management and Economics from the University of Beira Interior (UBI), Portugal. PhD in Business Administration from the University of São Paulo, Brazil. PhD in Business Management from the Autonomous University of Asunción, Paraguay. Professor and Researcher at UNIR, in the Undergraduate and Masters Courses. Coordinator of GEITEC - Group of Research in Management of Innovation and Technology of UNIR / CNPq, Brazil. E-mail: [flavio1954@gmail.com](mailto:flavio1954@gmail.com)

Doctor in Physics, Professor and Researcher for the Doctoral Course in Regional Development and Environment at the Federal University of Rondônia (UNIR), Brazil, Deputy Coordinator of GEITEC – Research Group on Management of Innovation and Technology, UNIR, Brazil. E-mail: [dr.fabriciomoraes@gmail.com](mailto:dr.fabriciomoraes@gmail.com)

Specialist in Computer Networks and Data Communications at the State University of Londrina (UEL), Brazil. Collaborator of the GEITEC / UNIR / CNPq, Brazil. Email: [engcompmarcelo@hotmail.com](mailto:engcompmarcelo@hotmail.com)

PhD student in Urban Studies, Université du Québec a Montreal (UQAM). International Collaborator of the GEITEC / UNIR / CNPq, Brazil. E-mail: [tiyaosui@gmail.com](mailto:tiyaosui@gmail.com)

**Abstract**— This paper deals with the Pareto Analysis of problems observed and criticized by clients in a hotel establishment in the municipality of Porto Velho, capital of the State of Rondônia. The general objective of the research is to study the use of Pareto Analysis in these problems that annoy the clients; (1), to group the data in descending order of frequency and to calculate the cumulative values (2), and indicating innovation for managerial control through a tool for Pareto Analysis in a dynamical way (3). The methodology of the qualitative-quantitative approach, of an exploratory nature, is adopted; the bibliographic survey and the field research are applied in support of the case study. Through the database system that the company under study possesses, the data necessary to be used in the Pareto Analysis are obtained, completing the first specific objective; the grouping of these data in descending order of absolute frequency, the calculation of the cumulative values, the preparation of the Pareto Diagram and the analysis carried out successfully completed the second specific objective; and finally the study is finished with the creation of a tool that allows a more dynamic analysis of the scenario in which the company is inserted, as a proposal of innovation for the institution to perform its practical and dynamic analyzes, useful in decision making. This study is a contribution of the academy to managers who work with complex decisions in hotel or related establishments interested in customer satisfaction.

**Keywords**— Administration. Analyze. Management. Innovation. Pareto.

## I. INTRODUCTION

This study deals with the Pareto Analysis of the frequent problems that are observed and criticized by clients in a hotel located in the municipality of Porto Velho, Capital of the State of Rondônia. A field survey was conducted with data collection from the company's bank, which stores the comments and suggestions of its guests. The collection made possible the Pareto Analysis in relation to the significant points that the management should make efforts for conceptual improvement towards the user clientele. In addition an innovative proposal is created from the elaborated tool.

## II. OBJECTIVES

This work has as general objective to study the use of Pareto Analysis in the frequent problems of a three-star hotel. In order to reach this objective, the specific objectives are to gather the necessary data to analyze the problem (1); group the data in descending order of frequency and calculate the cumulative values (2); indicate innovation for managerial control through a tool for Pareto Analysis in dynamic mode (3).

## III. THEORETICAL AND CONCEPTUAL REVIEW

The Pareto Law, or Principle 80/20 was created by the Italian economist Vilfredo Pareto. It explains that a large number of consequences (80%) comes from a small range of causes (20%). The studies were deepened by the economist so that it became possible to observe that other phenomena follow this same statistical distribution, many

of them situated in the business scenario. Contemporary authors such as Ayyub (2014) and Gopalakrishnan (2012) emphasize the importance of this Law as an aid in decision making and a qualitative increase in managerial processes; according to these scholars, the Pareto Analysis that involves the principles of the Law itself is an indispensable tool for the Administration to operate and dedicate efforts in that minority of factors that have a great impact on corporate profits.

### 3.1 Data required for Pareto Analysis

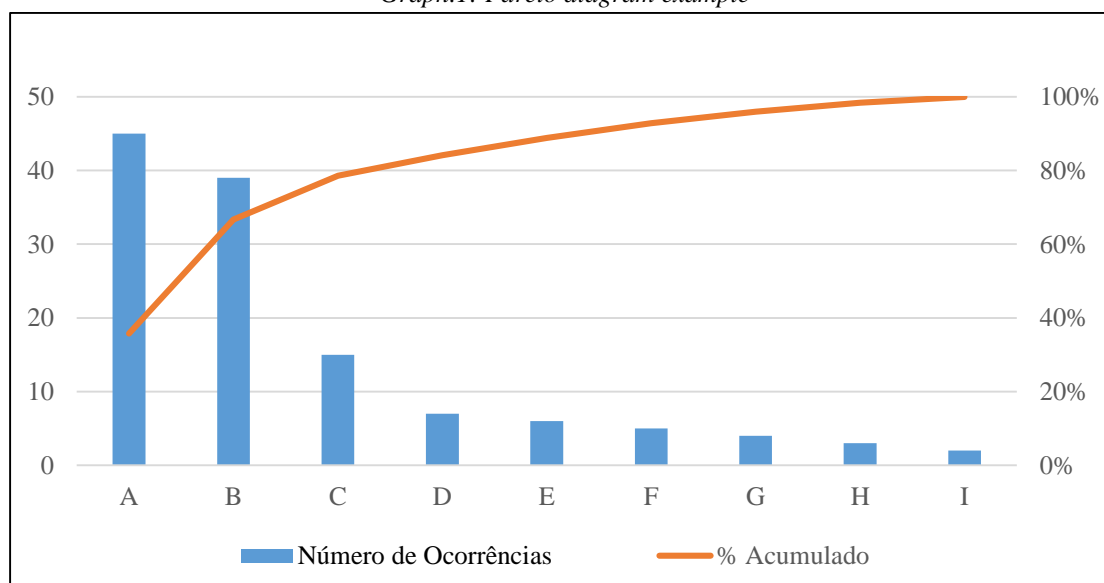
According to Dumas, Rosa, Mendling, and Reijers (2013) any phenomenon that has statistical distribution, as in the case of 80% of sales that comes from 20% of customers, can be analyzed in the context of Pareto Law. For this it is necessary to collect all the information and data of that phenomenon so that the analysis is efficient. Moreover, as discussed by Evans and Lindsay (2014), this dominance relation (80-20) is not an invariable constant; on the contrary, it is mathematically elastic according to the reality and quantity of data observed. Therefore, the data needed for an analysis need not

necessarily establish this fixed degree of statistical correlation, but rather present a similar nature in which the cause and effect relationship are coexistent.

### 3.2 How to perform a Pareto Analysis

Ayyub (2014), Cirillo (2012), Russell and Cohn (2012), Spensley (2012) and Kaliszewski (2012) argue that Pareto Analysis is possible through the construction of the Pareto Diagram. The diagram consists of a column chart in which occurrence frequencies are placed in descending order, allowing easy visualization of the most important (higher frequency) and those that are trivial (lower frequency) aspects. In practice, it is possible to construct the graph following four steps: gather all the data that will be used for analysis (1); sort them in descending order of absolute frequency (2); calculate the cumulative frequency of each of the observed items and transform it into percentage numbers (3); construct the vertical bar graph of the absolute frequencies and place the cumulative frequency curve, forming a single diagram (4). Graph 1 below exemplifies the trend of a Pareto Diagram.

Graph.1: Pareto diagram example



Source: by the author\*Number of occurrences

\*Accumulated

### 3.3 Innovation in Pareto Analysis

Drucker (2014) comments that companies, in order to survive the market, constantly seek ways to innovate their products and processes. In addition, one of the most practical and appreciable ways to innovate is to create something that can be used to improve what is already exposed in the current reality. Pareto analysis, according to Cirillo (2012) and Russell and Cohn (2012), would be more adequate and efficient if it were added to the reality of the enterprise. Thus, it is possible to use this analysis from a tool that is molded according to the needs of the company, making it dynamic and convenient for the decision-making context and the scenario in which

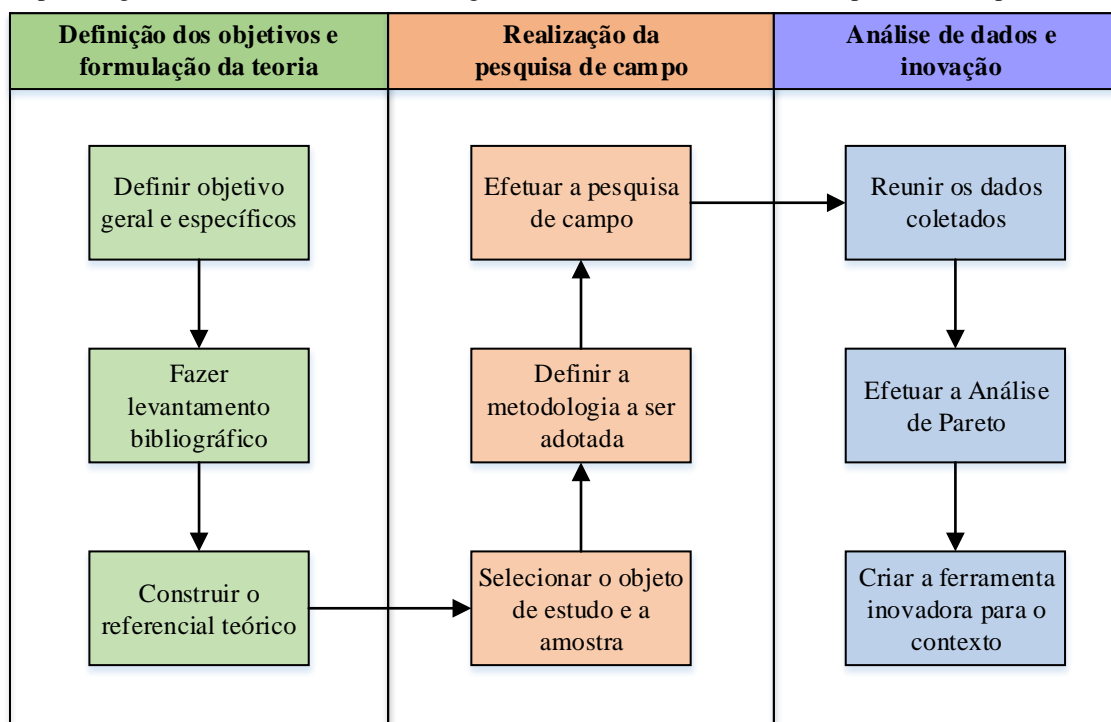
companies are located; this would be the way to innovate with focus on malleability, practicality and speed, bringing significant benefits to the business.

## III. METHODOLOGICAL PROCEDURES

Prodanov and Freitas (2013) emphasize that a scientific research is the accomplishment of a planned study, possessing its scientific methods of approaching the problem. Also, they cite the main characteristics of a research, in which they are divided in nature, approach, ends, technical procedures, sample and instruments of data collection. In this context, this research has a nature of the applied type; it is a qualitative-quantitative approach; has

exploratory purposes; gathers technical procedures of bibliographic survey, case study and field research; brings intentional sample; and as instruments of data collection, an interview and documentation survey was used. To facilitate the planning of the research, the methodological

procedures were followed in three phases - definition of the objectives and formulation of the theory (1); conducting field research (2); and data analysis and innovation (3). Figure 1 illustrates the flow of the procedures, while in Table 1 it is the descriptive of each phase of this flow.



Source: by the author

Fig.1: Flow of procedures adopted

Table.1: Description of the flow phases of the procedures

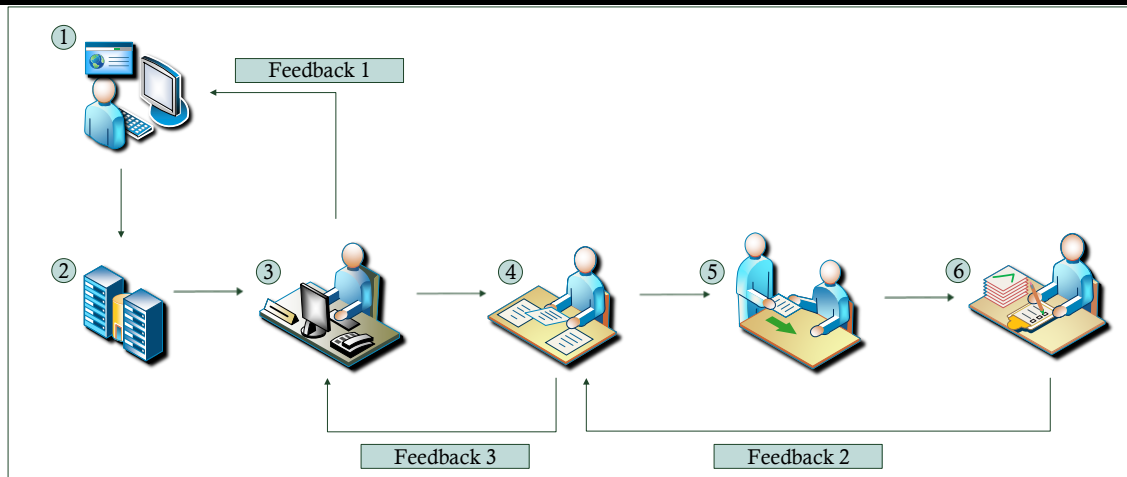
| Phases  | Descriptive   |
|---|---|
| <b>Definition of objectives and formulation of theory</b> | It defines the general purpose of the study and the specific objectives to achieve it. Next, the main recent works (2012-2015) that comment on the subject are selected in the literature, thus constructing the referential. |
| <b>Conducting field research</b>                          | The object of study and the applied methodology are chosen. Field research begins, using as main tools of data collection the interview and the documentation in the company's database.                                      |
| <b>Data analysis and innovation</b>                       | All collected data are collected for the analysis. After building the diagram, an innovative tool is created to make this whole process more dynamic.   |

Source: By the author

#### IV. CASE STUDY ON PARETO ANALYSIS IN A HOTEL ESTABLISHMENT

The hotel under study is located in the municipality of Porto Velho, capital of the State of Rondonia. It has been rated three stars and is therefore considered a tourist hotel. It was built in 2012 in the region and has a good location for tourists, being only 10 minutes away from the airport. All rooms are equipped with air-conditioning, free Wi-Fi, mini bar, cable TV, electric

shower, hall for events (accommodation for 200 people) and in some rooms include a balcony, pool and hot tub. It is among the most frequented hotels in the city and has a large clientele. In addition, it has a system of direct contact with customers, in which criticism, praise and recommendations can be made freely. This system is part of the hotel's entrepreneurial strategy, being illustrated by Figure 2 and described in Table 2 below.



Source: By the author

Fig.2: Customer contact system and operations flow

Table.2: Description of the processes

| Processes | Description  |
|-----------|--|
| 1         | The customer can comment on the hotel on the company's own website, where he will be free to display any impressions, criticisms, suggestions or compliments he had while staying. The user can identify (with name and email) or still be anonymous. If you identify yourself, the customer will receive an email of thanks for the contribution (feedback 1).  |
| 2         | The comments posted on the hotel website automatically go to the company database, which is managed by Microsoft Access software. The software organizes the comments in a worksheet on a first-come, first-served basis and can be accessed later by the Information Manager (3) who is responsible for organizing all the files in this database.  |
| 3         | Information Manager accesses the database through Microsoft Access and performs file verification. For the comments that have identification is made, through the same software, a response of thanks for the contribution (feedback 1) and sent. Finally, it sends the criticisms and suggestions filtered as more pertinent to the General Manager (4) and, those that he judged of less relevance, archives them. |
| 4         | The General Manager receives the criticisms and suggestions from the clients and analyzes them. If the comment is of great importance and impacts the business, the manager prepares the service order and directs the Operations Manager (5). If the General Manager judges that the comment does not have some degree of relevance, he forwards the Information Manager to proceed with the feedback.              |
| 5         | The Operations Manager receives the service order and performs preliminary registration, generating ordinal numbering in the document. The entire collection of what will be necessary to complete the request will be at your charge. Stipulated deadlines must be met in order to avoid unnecessary costs and to undermine the company's profits.  |
| 6         | Upon completion of the service, the Operations Manager prepares the completion document that will be attached to the service request document for the General Manager (feedback 2). The General Manager, with possession of the completion document, forwards to the Information Manager (feedback 3) to process the process and the control in the database.  |

Source: By the author

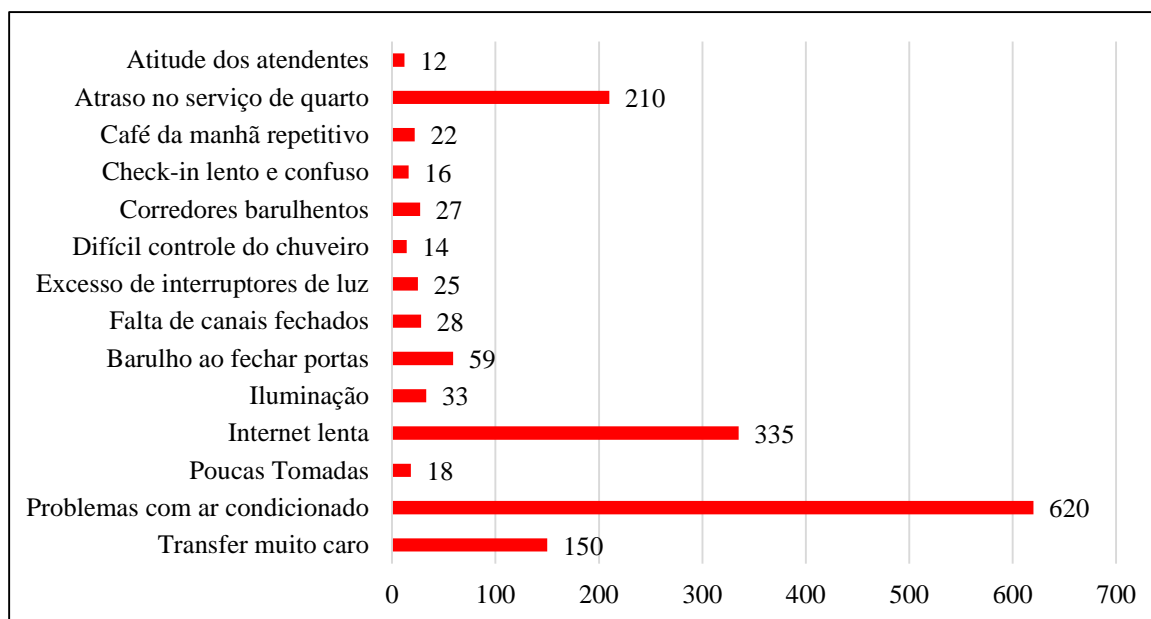
This allows the company to align its strategies for customer satisfaction and, through Pareto Analysis, it is possible to focus on the main problems to be solved.

### 5.1 Survey of data

Data were collected from the aforementioned system. It was verified that the complaints revolve around 14 typologies: attitude of the attendants; delay in room

service; repetitive breakfast; slow and confusing check-in; noisy corridors; difficult to control the shower; excess light switches; lack of closed channels; noise when closing doors; lighting; slow Internet; few takes; problems with air conditioning; and very expensive transfer. These data are shown in Graph 2 below and, afterwards, Table 3 describes each observed problem.

Graph.2: Number of reports of frequent problems



Source: By the author

•Attitude of the attendants • Delay in room service  
 •Repetitive breakfast •Slow and confusing check in •Noisy  
 corridors •Difficult shower control •Excess light switches

•Lack of closed channels •Noise when closing doors  
 •lighting •Slow internet •Few takes •Problems with air  
 conditioning •Very expensive transfer

Table.1: Description of problems

| Reported Issues                | Description  |
|--------------------------------|--|
| Attitude of the attendants     | Attendants sometimes do not act politely and courteously.              |
| Delay in room service          | Room service is available on request.                                  |
| Repetitive breakfast           | Breakfast does not change as the days go by.                           |
| Slow and confusing check in    | The hosting process is slow and loses in practicality.                 |
| Noisy corridors                | The soundproofing of the rooms is not enough.                          |
| Difficult shower control       | Electric showers are not practical and have faults.                    |
| Excess light switches          | There are so many lamps and each has a switch.                         |
| Lack of closed channels        | The channels available leave something to be desired in entertainment. |
| Noise when closing doors       | Some doors are not aligned and lubricated.                             |
| Lighting                       | The lighting is weak, damaging at the time of reading.                 |
| Slow Internet                  | The internet provided, although free, is very slow.                    |
| Poucas tomadas Few takes       | A limited number of outlets are available in the room.                 |
| Problems with air conditioning | Air conditioning to cool down at night.                                |
| Very expensive transfer        | High cost on airport-hotel transfer within walking distance.           |

Source: By the author

Thus, during the current year, 12 reports were made regarding the attitude of the attendants; 210 delays in room service; 22 on repetitive breakfast; 16 addressing the slow check-in; 27 on noisy corridors; 14 reports of difficulty in controlling the shower; 25 of excess light switches; 28 of lack of closed channels; 59 Concerning the noise of closing the doors; 33 reports on poor lighting in rooms; 335 about the slow internet; 18 about the low number of outlets available; 620 alleging problems in the air conditioning; and 150 commissions on the high cost on the transfer. These data will be duly organized in the

following section for later to be performed the Pareto Analysis.

## 5.2 Sorting of collected data and Pareto Analysis

Before performing the analysis, it is necessary that the data is properly organized in descending order of absolute frequency (number of reports). In addition, one must calculate the total accumulated value (1) and that of each observed item (2). For the first, only all the absolute frequencies are summed and the total number of reports is obtained; and finally to the second, the sum of the absolute frequencies of the item and its predecessors is divided by

this total accumulated value, obtaining the accumulated value of each problem, in percentage quantity. Table 4 shows the result of this ordering process.

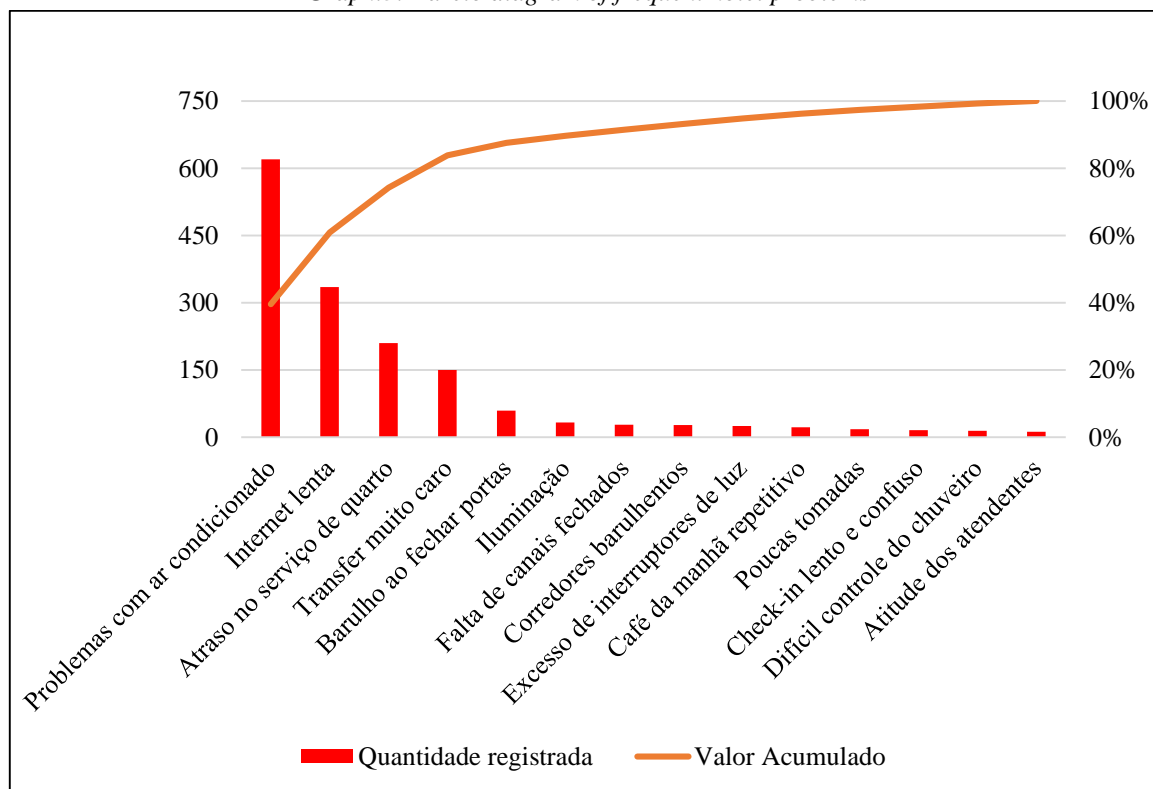
Table.2: Ordered data

| Reported Issues                | Number of reports | Accumulated value |
|--------------------------------|-------------------|-------------------|
| Problems with air conditioning | 620               | 40%               |
| Slow internet                  | 335               | 61%               |
| Delay in room service          | 210               | 74%               |
| Very expensive transfer        | 150               | 84%               |
| Noise when closing doors       | 59                | 88%               |
| Lighting                       | 33                | 90%               |
| Lack of closed channels        | 28                | 91%               |
| Noisy corridors                | 27                | 93%               |
| Excess light switches          | 25                | 95%               |
| Repetitive breakfast           | 22                | 96%               |
| Few takes                      | 18                | 97%               |
| Slow and confusing check-in    | 16                | 98%               |
| Difficult shower control       | 14                | 99%               |
| Attitude of the attendants     | 12                | 100%              |
| <b>TOTAL</b>                   | <b>1569</b>       | <b>100%</b>       |

Source: By the author

In the possession of the data properly ordered, there remains the construction of the graph for Pareto Analysis, or Pareto Diagram. For this task, a vertical bar graph is used in this descending order of absolute frequency and a curve is plotted representing the accumulated values of each observation, these being recorded on the secondary axis. Graph 3 represents the Pareto Diagram of this situation.

Graph.3: Pareto diagram of frequent hotel problems



Source: By the author



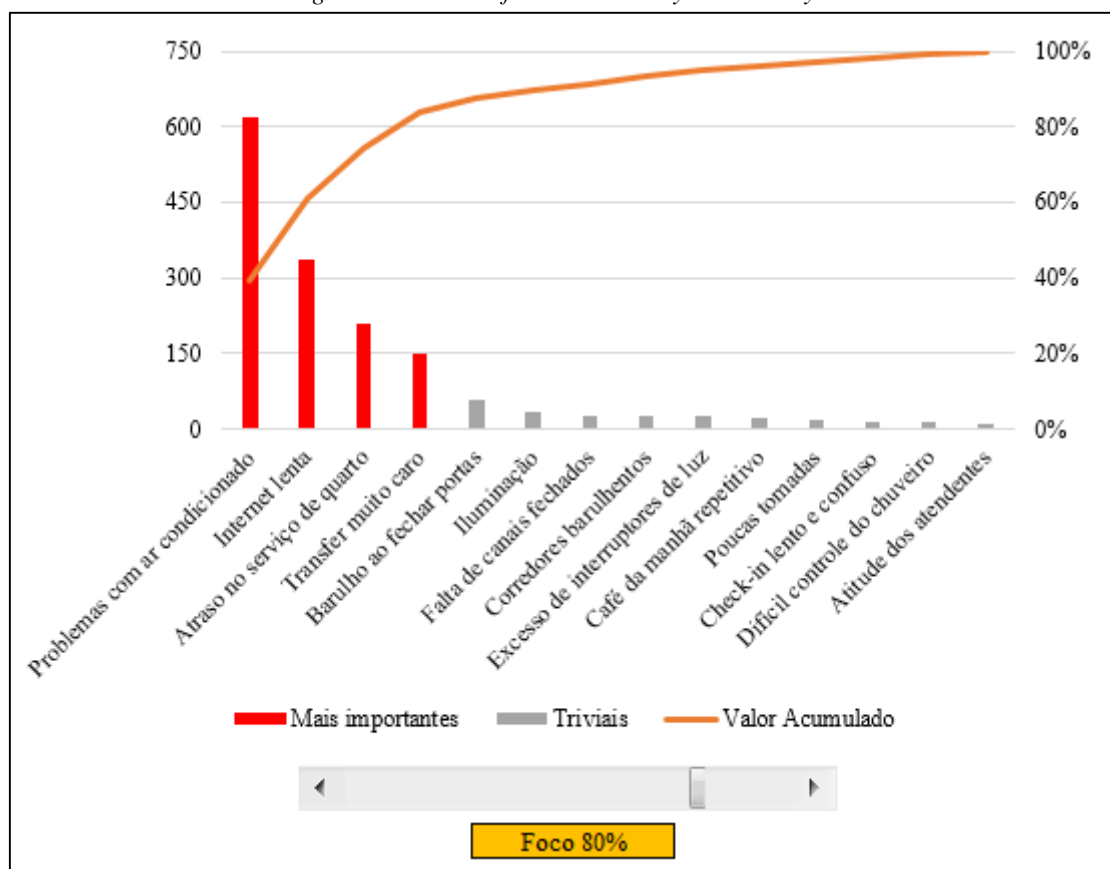
•Problems with air conditioning •Lack of closed channels oning •Slow internet •Delay in room service •Very expensive transfer  
 •Noise when closing doors •Lighting •Lack of closed channels •Noisy corridors •Excess light switches •Repetitive breakfast  
 •Few takes •Slow and confusing check-in •Difficult shower control •Attitude of the attendants

It is possible to notice that, for example, 80% of the frequent problems involve problems with air conditioning, slow internet, delay in room service and very expensive transfer. This information directly supports hotel management where it can work on a small range of issues and still have a big impact on results. However, despite the importance of this diagram in aiding decision-making processes, it in itself can make it difficult to understand and does not provide such "practical" readings to facilitate decision making. Thus, it is necessary to create a tool that makes this process more "practical" and provide the information according to the need and availability of the hotel. This creation characterizes innovation within this context and is exposed in the following section.

### 5.3 Innovation for managerial control through a tool for Pareto Analysis

Using Microsoft Excel (version 2010 or later) you can create an automated worksheet for calculations and a PivotChart that makes it easy to read. The graph created must have a scroll bar where the decision maker can change the amount of problems that he or she wants to focus on, and the graphical layout should highlight the minority of the items that will be the targets of the improvement decisions. So, for example, if the administrator wants to focus on 80% of the problems presented, he needs only to select this amount of focus, and the most important items that should be focused to achieve what is expected will automatically appear on the graph. The scroll bar serves to simulate the amount of problems that the administrator wants to make their efforts. Figure 3 illustrates this tool created.

Fig.3: Tool created for the Pareto dynamic analysis



Source: By the author

•Problems with air conditioning •Lack of closed channels oning •Slow internet •Delay in room service •Very expensive transfer  
 •Noise when closing doors •Lighting •Lack of closed channels •Noisy corridors •Excess light switches •Repetitive breakfast  
 •Few takes •Slow and confusing check-in •Difficult shower control •Attitude of the attendants

\*More important

\*Trivial

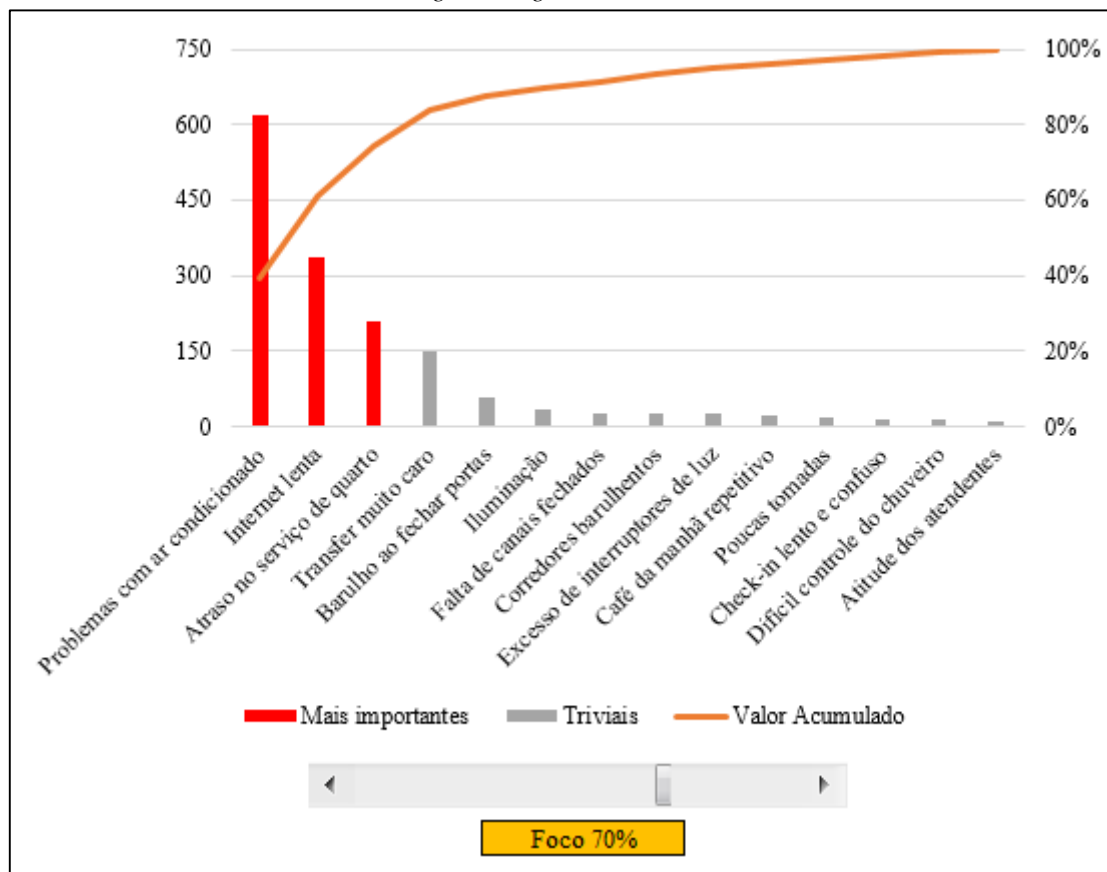
\*Accumulated value

FOCUS 80%

It is observed that the most important items that should be focused on an assumed goal of 80% of the problems are clearly highlighted in the chart. Also, it is noted that the problems that cause less impact (trivial) are highlighted differently from the most important, thus allowing a greater contrast between these two realities. Using the scroll bar you can change this goal according to

the reality and strategy of the company, for example, if the administrator finds it convenient to work with a focus of 70% of the problems, it is only necessary to use the scroll bar to select this focus and instantly we obtain the items that should be focused for this new goal, as shown in Figure 4.

Fig.4: Using the tool created



Source: By the author

•Problems with air conditioning •Lack of closed channels •Slow internet •Delay in room service •Very expensive transfer  
 •Noise when closing doors •Lighting •Lack of closed channels •Noisy corridors •Excess light switches •Repetitive breakfast  
 •Few takes •Slow and confusing check-in •Difficult shower control •Attitude of the attendants

\*More important

\*Trivial

\*Accumulated value

Focus 70%

In this way, it is possible to observe the most important problems that must be focused in order to reach a stipulated goal of improvement and, still, one can perceive those problems that are trivial and do not impact in a significant way in this goal. Pareto analysis then becomes dynamic and fast-viewing, allowing the decision-maker to act with confidence, malleability, and efficiency. In support of this tool is used the Excel worksheet itself as a support to store the data and automate the calculations necessary to obtain the information. Placing the appropriate formulas in cell distributions across the worksheet can minimize efforts with mathematical accounts, allowing anyone to do or simulate an analysis

without needing mathematical or statistical knowledge in the area. In fact, there are several combinations of formulas that can be used to achieve the same result, some simpler and some more complex. In this task, the author brings one of the possible ways to configure and automate the Excel spreadsheet and from there create the dynamic tool for Pareto Analysis discussed in Figures 2 and 3. The formatting will be described below and the meaning of the formulas used are shown in Table 5 below and, at the end, the worksheet should be in the molds of Figure 5, being able to differentiate in relation to the number of observations, values or even the layout of preference.



Table.5: Formulas used

| Excel formulas used  | Meaning   | Mathematical expression                    |
|--|---|--|
| <b>SUM(\$B\$2:B2)/SUM(\$B\$2:\$B\$15)</b>                                  | $\frac{\text{Accumulated Reg. Amount}}{\text{Total Amount}} = \text{Accumulated value}$ | $\frac{F_{ac}}{F_t} = F_{rac}$             |
| <b>INDEX(\$C\$2:\$C\$15;SEERRO(CORRESP(\$B\$17;\$C\$2:\$C\$15;1);0)+1)</b> | Conditional rounding of the accumulated values (always for the top item)                | $Se\ n_a < x \leq n_b$<br>$x\ assume\ n_b$ |
| <b>SE(\$B\$18&gt;=C2;B2;NA());<br/>SE(\$B\$18&lt;C2;B2;NA())</b>           | Condition of numerical existence  | $x \in R / x \geq n$<br>$x \in R / x < n$  |

Source: By the author

|    | A                               | B                     | C               | D                | E        |
|----|---------------------------------|-----------------------|-----------------|------------------|----------|
| 1  | Problemas observados            | Quantidade registrada | Valor Acumulado | Mais importantes | Triviais |
| 2  | Problemas com ar condicionado   | 620                   | 40%             | 620              | #NOME?   |
| 3  | Internet lenta                  | 335                   | 61%             | 335              | #NOME?   |
| 4  | Atraso no serviço de quarto     | 210                   | 74%             | 210              | #NOME?   |
| 5  | Transfer muito caro             | 150                   | 84%             | #NOME?           | 150      |
| 6  | Barulho ao fechar portas        | 59                    | 88%             | #NOME?           | 59       |
| 7  | Iluminação                      | 33                    | 90%             | #NOME?           | 33       |
| 8  | Falta de canais fechados        | 28                    | 91%             | #NOME?           | 28       |
| 9  | Corredores barulhentos          | 27                    | 93%             | #NOME?           | 27       |
| 10 | Excesso de interruptores de luz | 25                    | 95%             | #NOME?           | 25       |
| 11 | Café da manhã repetitivo        | 22                    | 96%             | #NOME?           | 22       |
| 12 | Poucas tomadas                  | 18                    | 97%             | #NOME?           | 18       |
| 13 | Check-in lento e confuso        | 16                    | 98%             | #NOME?           | 16       |
| 14 | Difícil controle do chuveiro    | 14                    | 99%             | #NOME?           | 14       |
| 15 | Atitude dos atendentes          | 12                    | 100,0%          | #NOME?           | 12       |
| 16 |                                 |                       |                 |                  |          |
| 17 | Foco                            | 74%                   |                 |                  |          |
| 18 | Valor Acumulado                 | 74%                   |                 |                  |          |
| 19 | Valor do Scroll bar             | 74                    |                 |                  |          |

Source: By the author

Excel Fig.5: Data collected and organized in Excel worksheet

\*Problems observed   \*Quantity recorded   \*Accumulated value   \*More important   \*Trivial  
 •Problems with air conditioning •Lack of closed channels •Slow internet •Delay in room service •Very expensive transfer  
 •Noise when closing doors •Lighting •Lack of closed channels •Noisy corridors •Excess light switches •Repetitive breakfast  
 •Few takes •Slow and confusing check-in •Difficult shower control •Attitude of the attendants  
 Focus  
 Accumulated value  
 Scroll bar value

Columns A and B refer to the recorded data and must be in descending order of quantities. Column C, which represents the accumulated values of each item of this order, can be easily obtained by the formula "**= SUM (\$B\$2: B2) / SUM (\$B\$2: \$B\$15)**" arranged in cell C2 and copied to C15. Next, the scroll bar is inserted through the

tab path "DEVELOPER - Insert - Scroll Bar", adding the scroll value of the bar with cell B19. The focus, which should be shown as in the example in Figures 3 and 4, being a percentage magnitude, will be the scrollbar value divided by 100, so cell B17 must have the formula "**= B19 / 100**". In B18 the accumulated value of the item closest to

the focus for later use as reference in columns D and E must be included, then the formula= \$C\$2: \$C\$15; SEERRO (\$B\$17;\$C\$2:\$C\$15; 1); 0) +1) to obtain this value and adapt it to the intervals between observations. Columns D and E must present data that are true for the range proposed in cell B18, with column D for the most important data and column E for the trivial of that interval. In this way, the formula in D must be "= SE (\$B\$18) = C2; B2; NA ())" disposed in cell D2 to D15, and the formula in E must be = SE\$B\$18 <C2 ; B2; NA ()) "disposed in cell E2 through E15. Once this is done, the worksheet is ready to finally generate the chart.

The data that the graph requires is contained in columns A, C, D, and E; where in A we have the name of each series, in C if we have the accumulated values that must be shown in a curve in the graph, and in D and E the absolute frequencies that satisfy the interval and that must be arranged in vertical bars in the diagram. By configuring the bars that represent columns D and E with distinct colors, highlighting them from each other, and even organizing the layout of the graph, the tool is created and ready to be used in the molds of Figures 3 and 4.

## V. FINAL CONSIDERATIONS

This research sought to study the use of Pareto Analysis in the problems that are observed by the clients of a three star hotel, located in the municipality of Porto Velho, capital of the State of Rondonia. Three specific objectives were established that involved the collection of data, the organization of these for the analysis and the creation of a tool as innovation in this context. From a database system that the company owns, the stored information was collected to be used in the analysis, completing the first specific objective. By grouping these data in the relative order of decreasing frequency and calculating the cumulative values with subsequent creation of the Pareto Diagram, the analysis was performed and thus the second specific objective was successfully completed. As a third and last specific objective, the study concluded that a tool was created that allows a more dynamic analysis of the scenario in which the company is inserted, the latter being disclosed as a proposal of innovation for the institution to carry out its analyzes in a more practical and dynamics, thus forging more efficient decision-making.

## REFERENCES

- [1] Ayyub, B. M. (2014). **Risk analysis in engineering and economics**. Boca Raton: CRC Press.
- [2] Cirillo, R. (2012). **The economics of Vilfredo Pareto**. New York: Routledge.
- [3] Drucker, P. (2014). **Innovation and entrepreneurship**. New York: Routledge.
- [4] Dumas, M. et al. (2013). **Fundamentals of business process management**. New York: Springer Science & Business Media.
- [5] Evans, J.; Lindsay, W. (2014). **An introduction to six sigma and process improvement**. Stamford: Cengage Learning.
- [6] Gopalakrishnan, N. (2012). **Simplified six sigma: methodology, tools and implementation**. New Delhi: PHI Learning.
- [7] Kaliszewski, I. (2012). **Quantitative Pareto analysis by cone separation technique**. New York: Springer Science & Business Media.
- [8] Prodanov, C. C.; Freitas, E. C. (2013). **Metodologia do trabalho científico: métodos e técnicas da pesquisa e do trabalho acadêmico**. Novo Hamburgo: Feevale.
- [9] Russell, J.; Cohn, R. (2012). **Pareto chart**. Stoughton: Book on Demand.
- [10] Spenley, P. (2012). **World class performance through total quality: a practical guide to implementation**. Swindon: Springer Science & Business Media.