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QUALITY OF TECHNICAL ASSISTANCE: ECONOMIC EVALUATION OF THE QUALITY IN TECHNICAL ASSISTANCE PROCESSES

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ABSTRACT

This study aims to analyze the economic feasibility of hiring new technicians in order to meet the existing demand for technical assistance. For this, a sensitivity analysis was performed and the data was collected in a qualitative and quantitative way. After that interviews were carried out and quality tools were applied, such as: brainstorms, cause and effect diagram and also financial and cost data was collected during the process. Thus, it was possible to identify that the main causes of the problem is the unavailability of technicians. Thus, an initial solution was developed to create financial configurations to assess which decision would be most plausible. Finally, the best performance scenario was to hire only one new technician, as it maximizes the company's net profit and the representative percentage of that profit from the generated revenue; it was also considered to what extent the solution could be applied. This research is important not only for the studied company, but also for others that have similar problems and need instructions to create a direction for a solution.

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Keywords: Costs; Sensitivity Analysis; Quality in Service; Processes; Technical Assistance.

1. INTRODUCTION

In recent years, the service sector has grown significantly in Brazil (Brazilian Institute of Geography and Statistics - IBGE, 2017), directly contributing to Brazilian economic production. The PAS (Annual Service Survey), conducted by IBGE, collects important data to understand the behavior of the Brazilian service offer market. In 2014, it was estimated that 1,332,260 companies are primarily engaged in providing services, generating R$ 1.4 trillion in net operating revenue. The service sector, in 2014, employed 13 million people paying R$ 289.7 billion in salaries. (IBGE, 2014).

The country's current economic situation has caused the service sector to grow, however, the quality of services are important for customer's loyalty and, consequently, for the increase of a company's revenue. The increased participation of the service area in the economy is an ideal scenario for the development of research in this area. When the data collection for this research was carried out, it was found that there was little information related to the technical assistance area, the costs related to it, as well as to its studies. The problem in service provision is inserted in several areas and in different sectors.

Understanding the need to apply and invest in service quality is extremely important for the organization to make continuous improvements in management and in the offered services. Companies always aim to generate revenue and this increase in profitability often comes from the implementation of new technologies, each time more efficient and cheaper. However, specialized labor and quality programs to reduce defects (which will always be intrinsic to production) generate costs for the company.

In this study, the analyzed company reported having problems in the execution of technical assistance, due to the inability to provide services, which could compromise quality and, consequently, its costs. With the reported problem, the following research question was reached: do hiring new technicians in the assistance sector improve the service efficiency level of a multinational company while maintaining financial viability? From this point on, two lines of research that could serve as possible ways to solve the problem emerged. One is related to the analysis of whether it is economically viable to expand the technical support team. The other is related to the analysis of whether the company has a gain in productive efficiency by expanding the current technical assistance team.

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The present study focused mainly on analyzing the existing costs of large technical assistance company. Carrying out sensitivity analysis by developing a four year economic scenario study, proposing solutions to the problems presented. The objective was to conduct a sensitivity analysis on the hiring of new technicians in the technical assistance sector of a multinational company, aiming to improve the sector's efficiency.

For this, our study sought to identify the company's inherent technical assistance problems and its main causes, as well as to list the existing costs in technical assistance. Therefore, generating financial scenarios and performing a sensitivity analysis in order to discover the best scenario as a possible solution for the reported problems by the company. Finally, the referred study is important not only for the analyzed company, but also for others that have similar problems and seek to understand and create a solution for them.

2. THEORY

This section presents definitions and tools that support the development on the following subjects: Costs; Sensitivity analysis; Quality of Service and Technical Assistance.

2.1. Cost analysis

Megliorini (2012) specifies two main types of services in service companies, namely repetitive and specific services. Repetitive service involves the same tasks to be performed continuously. The specific services will depend on the task required by the customer and this is the type of service that the technical assistance in question fits into. Therefore it is essential to study all the intrinsic costs of assistance so that you can further analyze and develop them later. One of the main cost segregations is to separate them into direct and indirect costs. Still, another fundamental cost for this study is the labor cost, which can be direct or indirect depending on who is performing this service.

In order to perform the analysis of the costs of technical assistance and thus better use the data in the following steps of the study, it will be necessary to divide the costs into Direct Costs and Indirect Costs. For Bruni and Famá (2011), direct costs are those that are easy to identify where and how much of the costs are being appropriated to the product.

In a manufacturing environment, an example of direct cost would be the raw material used to manufacture the product, as there is a notion of the quantity and to which product it is being directed. In a service company, such as the technical assistance for this work, one of the direct costs will be the labor of the technicians who are responsible for performing the

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assistance. This is because technicians are solely responsible for performing the service and are in the field almost all the time.

Therefore, all available technicians' time will be aligned as a direct labor cost. Indirect costs, on the other hand, are the costs that are often more complicated to appropriate to products, because it is not clear how much and where this cost was appropriated to products. These costs are more difficult when tracking the exact proportion that was appropriated in the different end products, unless each machine has its own water and electrical register, as in the case of electricity and water (Bruni & Famá, 2011).

Similarly to industries, in the service providers there are direct and indirect labor costs. Direct labor refers to the costs of employees who work in the execution of the service provided. However, if there are any inconveniences such as the service car being in maintenance, power outages, or lack of material to be used to perform tasks, these costs are not included as direct production cost and indirect cost. This happens because it refers to the time that the technicians ceased to perform their activities and therefore did not work for the execution and delivery of the requested service (Hirschfeld, 2007).

Direct cost has as one of its calculation bases the hourly wage of employees, however, the social and labor charges are disregarded. These charges include employee salaries on Sundays, holidays and absences that may be paid if warranted. It also includes vacation, 13th salary and contributions to INSS and FGTS. The direct cost of labor corresponds to the actual working hours, including overtime and hazardous and unhealthy work hours, plus the mentioned charges. The technicians of the company under analysis are paid monthly; however there are no hiring outsourced or per hour technicians (Mergliorini, 2012).

Charges are expenses that the company has in relation to the employee in addition to the employee's salary. These costs must be dissolved over the twelve months of the year and not only during the nine months that the employee actually worked, excluding holidays, vacations, weekends and justified absences.

2.2. Financial Analysis and Sensitivity

For Rojo (2006) scenario simulation is an important tool and constitutes a previous step to the act of planning. If simulations and scenarios are always up to date, they serve during implementation as a source of information that will facilitate control. The scenarios also serve as a starting point for decision making.

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However, scenario simulation alone is not enough to evaluate and make a decision about a context. It is essential to understand other items that will help to study possible decision making, such as: income statement, income and net income.

The Income Statement is an accounting document that aims to detail the formation of the net income of a year by the comparison of revenues, costs and expenses of a company. It is a financial summary of a company's operating and non-operating results (Carvalho, Decotelli & Elia, 2009).

For Carpinetti (2012), the term quality within a company is very subjective, proving that, there are around four distinct but connected concepts. The first concept is that many believe quality is aligned with a product's characteristics, such as its efficiency and life cycle. Another point of view is the association of quality with the relative value of the product or service, so there must be a price considered fair for the efficiency of the product. In the third definition the quality corresponds to the fulfillment of the characteristics proposed by the product, that is, the quality level depends on how appropriate the product is in relation to the project characteristics. Finally, the most consistent with the present is quality being associated with consumer satisfaction, that is, with the degree of satisfaction that the product or service meets customer needs (Carpinetti, 2012).

According to Chiroli (2016) and Chiroli et al., (2016), quality can be defined as philosophies, methodologies and practices that have the purpose of excellence in business, individuals and company issues. Understanding these concepts is essential for understanding quality in an organization.

Companies that can keep their customers loyal do so by lowering overheads, lowering operating costs, and thus increasing their profits. A 5% reduction in customer numbers can lead to a decrease in profits of up to 50% (or more). The 5% increase in the number of its clients can increase the company's income from 25% to 75% (Copacino, 1997).

Keeping existing customers loyal is less expensive than getting new ones. Expenses with acquiring new customers can cost up to five times more than the necessary to maintain current ones. Therefore, consumer loyalty contributes to an improvement in the company's revenue (Wills, 2009). Loyalty can be seen as a result of the excellence of the service offered, therefore, the better the service offered, the better the advertising and the increase in loyalty (Reichheld & Teal, 1996).

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One of the most decisive factors in hiring a customer service after technical qualification is the price (Brazilian Central of Service Sector [CEBRASSE], 2017). Table 1 shows the main factors of hiring a service.

Table 1: Decisive factors for buying services in Brazil

Buying factors (%)	
Technical qualification	78.1
Price	68.8
Experience	34.4
Technology	21.9
References	21.9
Localization	9.4

Source: Cebrasse (2017)

Technical qualification is the most decisive factor for purchasing services in Brazil, followed by price. This means that if the service does not have quality in its service hardly a customer will make the purchase of the product.

Quality management in service requires investments known as quality costs in order to reduce the costs of non-quality, that is, the costs from the lack of proper and necessary management. For this, there are analyzes that must be done on quality costs aligned with continuous improvement. This analysis is fundamental in technical assistance, purpose of this study, to survey the costs included in the current management, as well as their classifications; thus highlighting possible process improvements (Mergliorini, 2012).

Based on the considerations of Megliorini (2012), the quality cost classifications are:

a) Costs due to internal failures: associated with nonconformities detected before the service is provided. In the case of technical assistance, these costs are aligned with the lack of perception of poor quality assistance and provision;

b) Costs due to external failures: defects found after the service has been performed.

These costs include:

I. Additional technical assistance costs;

II. Costs of contract breach;

III. Costs of lawsuits;

IV. Costs for quality assessment;

V. Prevention Costs.

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2.3. Quality Tools

The attributes of quality are very specific, depending on the area of operation and varying with the type of market, product, service, life cycle, and customers who are willing to pay (and how much to pay) for quality (Paladini, 2007). Carpinetti (2012) emphasizes that, to conquer the market and remain competitive, it is essential to understand the needs of customers, as well as the product or service to be offered.

To maintain and improve the quality of a service, a continuous improvement process is required. Carpinetti (2012, p. 40) describes the continuous improvement steps as:

a) Identification of priority problems;

b) Observation and data collection;

c) Analysis and search for root causes;

d) Planning and implementation of actions;

e) Verification of results.

However, quality tools have been developed to support these actions. Each tool has its own resolution for specific problems in producing products or services. There are several quality tools. However, this study will present only two quality tools that will be the flowchart and the cause and effect diagram.

It is a widely used tool to schematically represent a process. They are created in the form of graphs illustrating in an uncomplicated way the flow of information between the elements. Through the flowchart it is possible to characterize the work being performed, the time required to perform the process, as well as who is performing and who is responsible for the activity. Even more, the flowchart is created with the support of standardized geometric figures and arrows, joining these figures, facilitating the understanding of the information flow and process steps, allowing later the optimization of processes in the organization (Fitzsimmons & Fitzsimmons, 2014).

The cause-and-effect diagram, also known as the Ishikawa diagram or the fishbone diagram, was another quality tool selected to be used. The tool proposes to represent the problems of a process by aligning them with its cause, that is, it highlights the roots of existing problems. This method of inquiry is very important because once the cause of the problem is identified and solved, and not only the resolution of the problem itself; the chances of other problems arising decreased considerably (Montgomery, 2004).

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3. METHODOLOGY

This study sought to carry out a scenario analysis on the economic viability of a company in hiring new technicians, in order to meet the existing demand for technical assistance. The research could be characterized as qualitative-quantitative, and the data used for this study were collected in two ways:

a) Formal interview with employees;

b) Provision of qualitative and quantitative data by the company.

First, a formal interview was conducted with technicians and professionals responsible for technical assistance, with the aim of better understanding the process and problems from the point of view of those who need to face them daily, thus seeking to understand the reasons and origins of difficulties in offering assistance, as well as the benefits and their quality.The company's financial statements for the year 2017 were also granted so that a survey of costs in the sector could be carried out.

The method aligned with this type of work is the hypothetical-deductive method, since an existing problem encountered and the lack of knowledge about it, was the starting point for this study. Thus, two fronts of analysis were made based on deductions from the process, analyzing both the economic viability of the expansion of the technical support team, as well as the analysis of the gain in productive efficiency when expanding the current technical assistance team by the company.

For Kasanen (1993), the study method can be considered constructive, as it defined a problem and then created possible solutions to real problems. This study also aimed to try to implement the solution in this case to see if there would be improvements in the system, in the process and in the overall performance.

For Oyegoke (2011), there are six essential phases for the development of a constructive process:

1) Discover a problem with the potential to be investigated;

2) Understand the subject;

3) Develop an initial solution;

4) Demonstrate that the solution can work;

5) Validate the theory about the theories existing in the organization;

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6) Assess the extent to which the solution can be applied.

These are the six steps that this work has taken in the next sections to provide a quality service solution.

Qualitative and quantitative data were provided by the company and served as study variables for the simulation of the scenarios. Thus, the study variables used were information related to the year 2017 on: the process performed in technical assistance, the number of existing employees in this sector, direct and indirect costs related to technical assistance that were extracted from the financial statements of the company of the year of 2017, main complaints made to the company, as well as the number of assistance provided, materials and equipment used in the processes. 34 simulations were carried out, that is, 34 scenarios were designed, carrying out an economic sensitivity analysis for a horizon of 4 years.

It was decided to use symbols to better identify what is happening each year. The symbols and their meanings are detailed in Table 2.

Table 2: Meaning of the symbols used in the elaboration of contexts

Symbol	Description
	When this symbol appears, it means that a new technician will be hired in the first month of the year, and with it all its inherent costs
	When this symbol appears, it means that two new technicians will be hired in the first month of the year, and with them all their inherent costs
+	When this symbol appears, it means that one training started in the first month of the year, with all its inherent cost.
++	When this symbol appears, it means that two trainings started in the first month of the year, with all its inherent cost.
=	It means that the hired technician has already finished its training and with it its respective expenses. Remaining only labor costs and others.
==	It means that the two hired technicians have already finished their training and their respective expenses with them. Remaining only costs with labor and others.
Original	When this symbol appears, it means that there was no hiring

Source: Author (2017)

The scenarios were created using all possible combinations, taking into account some considerations. Every Year 1 should not start with costs from previous years, that is, every Year 1 will start with Original, ☻ ou ☻☻. This happens, because as the scenario will be a recommendation of what assistance should do in the next four years, the company needs to be free to make the decision from the first year on, without depending on past years, which in this

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case, they cannot be recovered. Adopting this methodology, the possible scenarios are shown in Table 3.

Table 3: Fifteen possible scenarios

	SCENARIO 1	SCENARIO 2	SCENARIO 3	SCENARIO 4	SCENARIO 5	SCENARIO 6	SCENARIO 7	SCENARIO 8
YEAR 1	Original	+	++	Original	Original	Original	Original	Original
YEAR 2	Original	+	++	+	++	Original	Original	Original
YEAR 3	Original	=	==	+	++	+	++	Original
YEAR 4	Original	=	==	=	==	+	++	+
	SCENARIO 9	SCENARIO 10	SCENARIO 11	SCENARIO 12	SCENARIO 13	SCENARIO 14	SCENARIO 15	
YEAR 1	Original	+	+	+	Original	Original	Original	
YEAR 2	Original	++	+	+	+	+	Original	
YEAR 3	Original	+	+	=	++	+	+	
YEAR 4	++	=	+	+	+	+	++	

Source: Author (2017)

After simulating each scenario with their respective costs, an analysis on the income statement, net income and the representative percentage of profit on revenue will be done to decide which scenario is the most profitable for assistance and then, suggest the adoption of the plan.

3.1. Company characterization

The company where the study was conducted refers to a French multinational that has been operating in Brazil for 70 years. It is a leader in power distribution management and the manufacture of electrical components such as inverters and circuit breakers. The unit under study is located in Cajamar, São Paulo countryside. It has around 580 employees, and technical assistance is responsible for 16 of them. Of these, 10 are field technicians and the rest are assistants, analysts, interns and a manager who remain in attendance.

One of the company's activities is to provide services through technical assistance - the focus area of this study, of the Start-Up type, this means that it only installs or maintains the products sold by the company, inside or outside the period of customer quality assurance. Company technical assistance is required for the following two reasons:

a) The company's products are very specific and complex, it is unlikely that an electrical technician from another company or even self-employed would know how to install and/or perform repairs.

b) If customers call for outsourced technical assistance, the product warranty will be forfeited.

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The products sold by the company are of high monetary value and usually large, making it difficult and impossible to move for maintenance or repair in the technical assistance within the company. Thus, technicians need to travel to the customer base.

The main products that the company sells and provide assistance service are: low (around 690v) and medium (up to 36000v) voltage circuit breakers and inverters; meters; programmable logic controllers (PLC), human machine interface (HMI), servo motors and servo drives.

In order to understand the processes performed by the technical assistance, a flow chart was made, as shown in Figure 1.

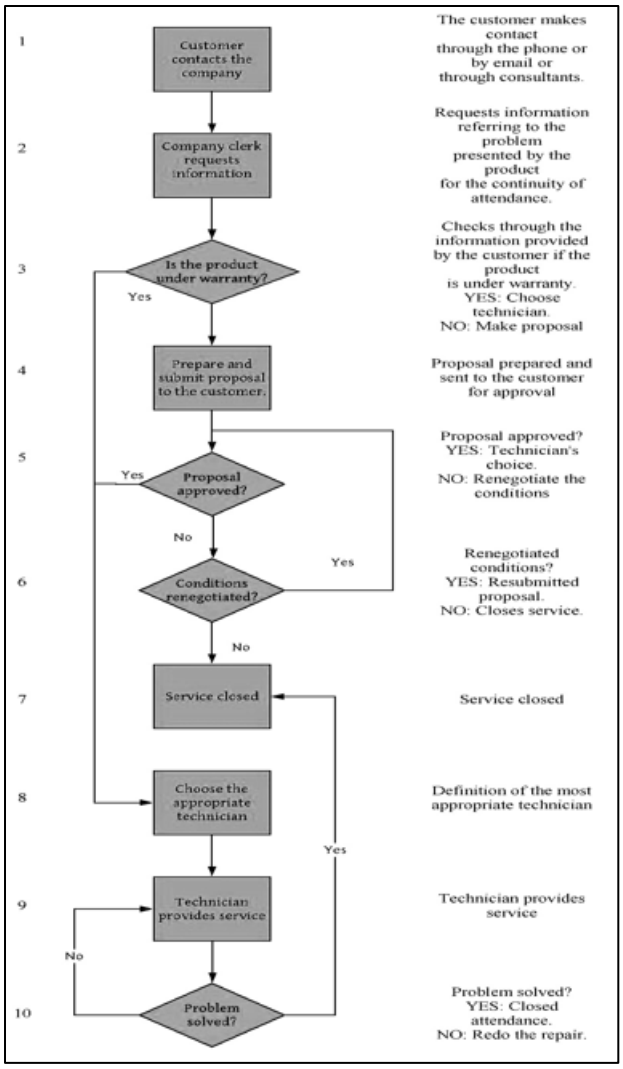

Figure 1: Technical Assistance Flowchart

As can be seen in Figure 1, it is possible to understand the whole operation of the process. Initially the customer calls for assistance, informs the problem and whether or not the product is under warranty. If the product is under warranty, service directs a responsible

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technician and schedules a date. If the product is out of warranty it is necessary to create a proposal with the possible inherent costs. Suppose the customer accepts the proposal, the assistance schedules a date and directs the technician.

However, if the client does not accept this proposal another is formulated. After the technician has been in field, it is checked whether the problem has been resolved. If not resolved, another date is scheduled for the technician to return. If the problem has been resolved the assistance creates a cost memo, a document with all the details of the costs incurred during the assistance. Finally, the invoice is generated and sent to the customer.

4. METHODOLOGY APPLICATION

In order to achieve the objectives proposed in this study, the first step to be taken was, from the constructivist approach, to discover a problem that has the potential to be investigated and to understand the subject, as described in the following topic. In this regard, due to significant complaints in the company's technical assistance area, the focus was on this area.

4.1. Discover and understand the company's technical assistance issue

To better understand the company's technical assistance problem, an interview was conducted with the manager responsible for the sector and technicians working in the company. During the interview, it was reported that the company currently has about three thousand customers. The technical assistance covers an average of 35 customers per month, noting that the current demand for this service is around 41 customers per month. From this information could be noticed a clear a problem in the sector, which does not have an adequate staff for its demand. Thus, customers who were not serviceable within the month, the dates are rescheduled for subsequent months. This occurs with an average of 6 customers per month.

Taking into account the 10 technicians on the technical support staff, each technician covers about 3.5 customers per month. To meet the real demand, it would be necessary at least 2 new technicians to improve the company's service level and reduce customer complaints. Technical visits are carried out by scheduling priority and priority is also given to customers who purchase products of higher monetary value and/or more frequently.

It has also been reported by industry professionals that the main complaint from customers is the delay in getting a technical visit, and often when the visit is finally scheduled, it is canceled or postponed. On the company’s side, both the technicians and those responsible are aware of the problem, and the reason for these inconveniences is that they do not have enough technicians to perform all the required services.

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From the information, a cause and effect diagram was created, which aims to identify the main causes of a main problem, as shown in Figure 2.

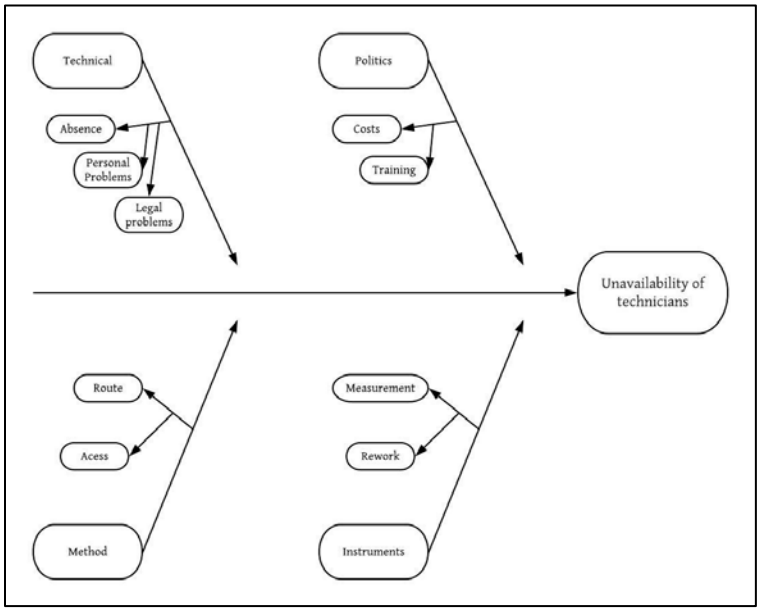

Figure 2: Cause and effect diagram to analyze technician shortages
Source: Own Authorship, 2018

Based on this key problem, another brainstorming was performed to define the possible causes of the four main basic strands that can occur within a company: politics; technician; method and instruments. Another interesting objective of the diagram is to identify the causes that can be easily quantified.

To better understand the problem of the company's technical assistance, an analysis of its costs was made, in order to identify and quantify the costs of non-quality, which will come from the costs of unproductive labor by technicians.

4.2. Cost analysis and calculation

In order to carry out cost analyzes of the company, it was necessary to collect all costs of technical assistance with the management. During the brainstorming meeting for the development of the Ishikawa diagram, managers realized that cost and training were largely responsible for the technician unavailability problem. To understand this problem, the costs related to 2017 were analyzed, as shown in Table 2.

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Table 2: Costs of technical assistance

Costs of technical assistance
Labor cost
Travel and locomotion
Snacks and meals
Airline tickets
Vehicle expenses
Phone and cellphone
Building and facility maintenance supplies
Service for building and facilities maintenance
Service for tool and device maintenance
Copy print
Office supplies
Depreciation of machinery and equipment
Tool depreciation
Depreciation of measuring devices
Depreciation of furniture and utensils
Depreciation of data processing equipment
Meals in the cafeteria
Medical and dental care
Rent
Electricity
Water
Training

All of these costs were made available in a spreadsheet from January to December of 2017. Rent, electricity and water costs were apportioned in proportion to the technical assistance provided by the area it represents in the company. Since the company has 20,000m^2 and the assistance has 600m^2, which corresponds to 3% of the total area, these three costs were apportioned to a proportion of 3% of the total cost. Therefore, the rental cost that the assistance has is R$ 21,000.00 (3% of the total rent paid by the company for the 20,000m^2). The same reasoning was made for electricity and water.

The cost of training deserves attention in the data analysis, because during the meeting with the assistance management, it was informed that when a new technician is hired they need to undergo a series of training. On average, it takes two years for the technician to be able to go alone to the field. When asked about the value of this training, it was reported that six trainings take place during these two year period to develop a new technician. Each training costs R$1,800.00 for the sector. As there are six, the total training cost was R$10,800.00. Diluting this value in twenty-four months, which is the time to condition a technician, the value is R$ 450.00 per month. So when simulating hiring a technician you should add the amount of R$ 450.00 per month for two years to the costs of assistance. If in the year there is no technician hiring, the value will be zero.

4.2.1. Direct Labor Costs

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After this identification, it was time to work on labor cost data to divide it into direct and indirect labor cost, because the data provided came with a single labor cost account. Firstly, it is noteworthy that labor costs include salaries and social and labor charges of employees. According to Megliorini (2011), the charges and salaries are the costs with the employee in addition to the salary itself. These are achievements ensured by law that came from union agreements or negotiations with the company.

As in the technical assistance there are the employees who work only in the technical assistance sector and the technicians who perform in the field assistance, it was decided that the field technicians will be the direct labor, since it is possible to measure all their available time that is being applied in the accomplishment of the assistances. Managers, interns and assistants will be identified as indirect labor.

4.2.2. Calculation of productive and unproductive hours

During the interview with one of those responsible for technical assistance it was reported that on average 2 technicians per month are missing two days each. To calculate the productive and unproductive hours, the method described by Megliorini (2011) was used.

4.2.3. Labor Cost Calculation

To calculate the cost of direct labor it is necessary to find out the cost/hour of each employee. For this, the cost of direct labor of each technician was divided by the number of hours of work per month. As employees work from Monday to Friday, 8.4 hours a day, it adds to 168 hours a month. So the calculation to find out the cost/hour was to divide each technician's labor cost by 168 (hours).

4.2.4. Calculation of Salary and Charges

Labor costs are composed of salary plus social and labor charges. To be calculated it depends on numerous variables such as salary, vacation, FGTS, notice and paid absences. To facilitate the calculation of these charges, Megliorini (2011) suggests the elaboration of a table to calculate the percentage that should be applied on top of the employee's salary, according to Table 3.

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Table 3: Charges for monthly employees

		Charges for monthly staff			
		Charges	Groups		
			A	B	C
Group A	1	INSS	0.2		
	2	SESI SESC			
	3	SENAI SENAC			
	4	INCRA			
	5	SEBRAE			
	6	EDUCATION SALARY			
	7	SAT			
	8	FGTS	0.02		
Group B	9	DSR		-	
	10	VACATION + 1/3 OF VACATION		0.1212	
	11	HOLIDAY		-	
	12	NOTICE		0.084	
	13	SICKNESS AID		0.00091	
	14	13rd SALARY		0.09091	
	15	Accrued absences		0.01	
	16	FGTS DEPOSIT WAIVES WITHOUT CAUSE			0.01568
Group C	17	PARTIAL TOTAL	0.3	0.30703	0.01568
	18	CUMULATIVE INCIDENCE		0.09211	
	19	TOTAL CHARGES		0.71482	
	20	PERCENTAGE		71.48%	

Source: Adapted from Megliorini, 2011

After considering all the cost elements to better understand the highlighted problem which is the lack of professionals in technical assistance, an initial solution to this problem was developed, so it was decided to create scenarios for the sector each with a 4 year horizon. The hiring of new technicians, therefore, will evaluate the feasibility of hiring one, two or no new technicians.

4.3. Developing the Initial Solution

From the analysis of the problems, and the unfolding of the costs inherent to the technical assistance process in the company, the proposed solution will be based on the construction of scenarios, where each scenario will present a proposal for hiring technicians, where it will be possible to evaluate the viability.

Fifteen scenarios were developed, each with a 4-year horizon. To meet the demand of 41 clients per month, it was certain that 2 more technicians will be able to meet this demand, as each technician covers 3.5 clients per month, and at the moment with 10 technicians there are 35 clients per month. The purpose of each scenario will be to simulate how assistance costs, including annual adjustments and other expenses will behave if the company hires one, two, or no technicians in the year.

After simulating each scenario with its respective costs, an analysis will be made of the income statement, net income and the representative percentage of income over revenue, to

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decide which scenario is the most profitable for the assistance and thus suggest the adoption of the plan.

4.4. Income Statement

For Megliorini (2011), the Income Statement for the Year is a calculation performed at every closing of a period, usually annual, to determine how much revenue, costs and net income there was in that period. Tables 4 (a) and 4 (b) exemplify how the Income Statement will be calculated for the end of each simulated year.

Table 4: Calculation of Revenue (a) and Income Statement (b)

(a)

Income calculation	
Productive hours/Month	1583.32
Hours/Year	18999.84
Hour price	R$100.00
Revenue	R$1.899.984.00

(b)

Statement of income for the year			% of Revenue
	Sales revenue	R$1.899.984.00	
(-)	Fixed costs	R$742.393.32	
(=)	Partial profit	R$1.157.590.68	60.93%
(-)	Indirect costs	R$853.324.86	
(=)	Net profit	R$304.265.82	16.01%

To calculate the revenue, the productive hours in the year were multiplied by the amount charged per hour of service of each technician, corresponding to R$ 100.00. This value was reported by the management at the same meeting that the Ishikawa Diagram was discussed. From revenue it is deducted the fixed cost, resulting in partial profit. Finally, to determine net income it is necessary to subtract from partial profit the indirect cost.

The following percentages correspond to the percentage representing the partial and net income from revenue. The representative percentage of net income over revenue is an important variable as it needs to be as large as possible. It would not be possible to decide which scenario is ideal considering only the revenue and net profit generated. If revenue increases, then net profit is likely to increase also, and this fact alone cannot be related to the false impression that the scenario is doing well.

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Therefore, the analysis of the percentage share of net and partial income over revenue (which are the percentages in Table 9 (b)) will show us whether the share of net or partial income is increasing regardless of the increase in revenue. Since each scenario will have its net profit, and ,the percentage that this profit represents from revenue; it will be through these two variables that it will be able to determine which scenario was most profitable and thus suggest what should be done about when and how many technicians to hire.

5. DEMONSTRATION THAT THE SOLUTION CAN WORK - SCENARIO RESULTS

From the 15 possible scenarios, each with a 4 year horizon, there were a total of 60 combinations (scenario x year). Some are identical to others and did not need to be simulated more than once, so there were 34 simulations, as shown in Table 5.

Table 5: Simulations and their respective scenarios and years

SIMULATION	1	2	3	4	5	6	7	8
(SCENARIO,YEAR)	[1,1];[4,1];[5,1];[6,1];[7,1];[8,1];[9,1];[13,1];[14,1];[15,1]	[1,2];[6,2];[7,2];[8,2];[9,2];[15,2]	[1,3];[8,3];[9,3]	[1,4]	[2,1];[10,1];[11,1];[12,1]	[2,2];[11,2];[12,2]	[2,3];[12,3]	[2,4]

SIMULATION	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
(SCENARIO,YEAR)	[3,1]	[3,2]	[3,3]	[3,4]	[4,2];[13,2];[14,2]	[4,3];[14,3]	[4,4]	[5,2]	[5,3]	[5,4]	[6,3];[15,3]	[6,4]	[7,3]	[7,4]	[8,4]

SIMULATION	24	25	26	27	28	29	30	31	32	33	34
(SCENARIO,YEAR)	[9,4]	[10,2]	[10,3]	[10,4]	[11,3]	[11,4]	[12,4]	[13,3]	[13,4]	[14,4]	[15,4]

Some simulations will represent more than one combination (scenario x year). This means that these combinations have the same costs. After simulating and verifying the results, it was found that scenario 2 is ideal. In this scenario occurs hiring only one new technician in the first year. Therefore, the following calculations and results will only belong to this scenario.

5.1. Discussion of Scenario 2 Results

After presenting the results of the ideal scenario, it is necessary to discuss the presented values in a more comparative way. Although scenario 2 has the best performance, there are other scenarios just as good, however, with a cumulative net profit and slightly lower margin over revenue. Therefore, the second best scenario is 12, which hires two new technicians, one in the first year and the other in the last, thus meeting the demand of the 41 monthly clients that the service has. The accumulated net income for the four years of scenario 12 was R$

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2.121.057.11, not too far from that of scenario 2 (R $ 2,174,930.18). The cumulative values of all fifteen scenarios are shown in Table 6.

Table 6: Net profit and net profit margin over accumulated revenue

SCENARIO	ACUMULATED NET PROFIT	% NET PROFIT OVER ACUMULATED REVENUE
1	R$ 966.613,30	12.72
2	R$ 2.174.930,18	24.06
3	R$ 1.611.179,50	18.92
4	R$ 1.425.575,62	17.43
5	R$ 1.884.550,71	21.51
6	R$ 1.268.081,20	15.87
7	R$ 1.569.557,06	17.88
8	R$ 1.116.828,48	20.21
9	R$ 1.267.048,46	19.87
10	R$ 2.043.455,28	21.59
11	R$ 2.080.981,86	22.89
12	R$ 2.121.057,11	23.54
13	R$ 1.596.516,01	18.92
14	R$ 1.533.017,26	17.89
15	R$ 1.418.301,18	15.68

According to Table 7, both direct and indirect labor costs have only increased over the years.

Table 7: Comparison of direct and indirect labor cost values from scenario 2

YEAR	TOTAL COST OF INDIRECT LABOR	TOTAL COST OF DIRECT LABOR
1	R$ 27.070,45	R$ 59.897,74
2	R$ 27.485,64	R$ 60.796,21
3	R$ 27.897,93	R$ 61.708,15
4	R$ 28.316,40	R$ 62.633,77

Finally, it was possible to demonstrate that the presented solution can work and be applied in the assistance. It was also clarified that there is more than one efficient decision that it can be adopted. Assistance may also choose a scenario that meets demand but nevertheless lowers its net profit. This relationship and the final technical assistance decision take the company's policy very much into account, that is, its principles for making profit.

6. CONCLUSION

Having carried out studies with the data provided by the company, the corresponding cost analyzes were carried out and possible scenarios were generated, considering that: considering the current resources for that moment, the best result is presented in scenario 2, that is, the hiring a new technician. Scenario 2 shows higher net income in the proposed 4 years.

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Other scenarios were analyzed, including hiring the necessary number of technicians to meet the demand for services, without causing a significant reduction in the net profit of the technical assistance sector compared to scenario 2.

Thus, on the issues raised at the beginning of this article, it can be concluded that it may be economically viable for the company to expand its technical support team. This premise was accepted, as the best scenarios determined that the best way to expand the net result is to hire one or even two new technicians. It was also concluded that there may be a gain in productive efficiency by expanding the current technical assistance team.

This aspect was verified, as it was verified that if the company increases its team with the hiring of two more technicians it will be sufficient to meet the current demand for services, as well as there will be a reserve of workforce to meet a possible increase in the demand for services.

The present study tried to cover the largest amount of available data, analyzing and relating them. However, some data could not be included in this analysis, such as the correct deduction of ISS = service tax. This index varies from municipality to municipality and it is worth mentioning that technical assistance covers the entire country. Thus, the ideal would be to track the exact location and the amount of assistance provided in each municipality, in order to bring a result closer to reality, and may even find a different result from that presented in this study.

This ISS problem was raised with the company, however, the company preferred not to disclose these figures. Finally, the final limitation is in the subjectivity of the individual who leads the study to what is considered direct and indirect cost.

In this sense, it is suggested that, in future studies, a greater number of visits to technical assistance be carried out, and also that the technician be supervised more frequently, in order to better understand the routine and all existing processes, during execution procedures, thereby helping to determine exactly what the direct costs are.

However, the present study managed to achieve its objective by carrying out the analyzes proposed at the beginning of this study and also by selecting a decision that aims to obtain greater net profit, without causing loss of quality and efficiency. Although, it is known that for most of the current companies, the main focus is to obtain the highest possible profit, even if to obtain this highest profit it is necessary to put aside environmental care, compromise the legality and even compromise the quality of the service offered customers.

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Appendix A

A formal interview was conducted with technicians and those responsible for technical assistance in order to better understand the problems from the point of view: those who face daily, trying to understand how the reasons and origins of the setbacks of the offer of assistance and its quality. The questions asked during an interview were:

a) How many customers does the service have?

b) What is the customer demand per month?

c) How many employees does the assistance have?

d) Is there priority in the projects?

e) Are there customer complaints?

f) Is there a lot of waiver of customer service?