

A NEW GENERATION OF PROVIDING MAINTENANCE SERVICES – HOW TO TRANSFORM OPPORTUNITIES IN REAL RESULTS FOR CLIENTS

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Abstract

In the current business environment there is an increasing of competitiveness for the best results through developing market-share, profit and client satisfaction. This tendency makes the companies evaluate their business practices all the time creating an environment of continuous improvement. On the other hand, the competitiveness among companies in the same area reflects on the following parameters: price, quality, and delivery time to attend the final client who has a better solution with all these combined parameters.

In the last years, teams focused in identify losses in the industrial process and transform it in gain opportunities were created in many companies. In this scheme, a new generation of providing maintenance services to support the clients in identifying these gain opportunities was established, in 2007, by a Brazilian Maintenance Service Company in one of their clients, named “*3G - Grupo de Geração de Ganhos*”, in English the translation would be: Team of Gain Generation.

Firstly, this team with Specialized Maintenance Company and of some clients departments members built a Map of Losses of all Industrial Process.

71 opportunities were identified and evaluated in the quality and quantity aspects through the Added Value Engineering concepts. Secondly, the potential financial gains and the investments’ needed for each opportunity were analyzed. Finally, the opportunities were taken as priority in agreement with the Strategic Investment Directions of the client.

These opportunities have a potential gain of US\$ 1 million for the client and are related to the following areas: productivity, process variability, logistics, industrial maintenance, equipment life-cycle, setting-up and quality.

This work has the objective to show how the Map of Losses was built, the methods used to analyze the identified opportunities, the adopted added value engineering concepts and how the studies are being solved trough PDCA Cycle of Solution Problems.

Keywords: productivity, loss management, industrial process

1 The Added Value Engineering inside the Maintenance Area

In the current scenario of the world economy, the industrial maintenance area has a large influence in the competitiveness, profitability and productivity in the companies of all kind of markets. According to ARCURI (2003), the companies have preponderant paper in the development of the countries and for the results to be concrete and absolute the activity of industrial maintenance has an essential strategic paper.

In Brazil, the maintenance activity, according to ABRAMAN (Brazilian Association of Maintenance), has a budget about US\$ 26 billion a year, being 34% employees in personnel, 32% in materials and spare and 23% with contracted services. That last number reflects a market of US\$ 5 billion for service maintenance companies.

In this market, according to SARATT & FONTANELLA (1994), an administration tool is used commonly as a business philosophy by the companies that consist of the commercialization of specialized services that are secondary to them like maintenance and focus their efforts in the core-business to achieve more competitiveness and quality.

The use of service maintenance companies became more intense, affirms TOMÉ (1998), in Brazil, in the last decades, when there was an entrance of Brazil in the globalization process. This factor motivated the companies develop effective strategies based in processes of partnerships with service maintenance companies through the administration of assets looking for excellence in: quality, productivity and reduction of costs.

It is more and more noticed the participation of the maintenance area in the Brazilian industrial scenario. This area, now, is receiving larger investments in the companies, with the objective of providing subsidies for a better adaptation to the technological evolution that is imposed in the new world economy.

Together with the service maintenance companies, it came to the vision of the Engineering of Applied Value, that is a methodology that seeks to the elaboration of a Map of Losses, that gives emphasis in the importance and in the way of as it involves the customer's several areas for study of the opportunities through the PDCA Cycle (to plan, to do, to check and to act) of Solution of Problems (DEMING, 1990).

To develop this work the service maintenance company inserted in the context of the maintenance the engineering studies that added value to the processes of the client, in other words, engineering of solutions that seek to transform the data in information, information in knowledge and knowledge in profitability.

2 The 3G Study Group

The Group of Earnings Generation appeared, starting from the perception of the maintenance that the client (company of the nutritious branch) was without resources to give solutions for chronic problems.

Starting from a proposal of the maintenance engineering, in mutual consensus with the production sectors, quality, engineering, financial, it was noticed that, these "problems" if treated in a correct way, they would become opportunities of great financial return. Being like this, the 3G Study Group was formed.

2.1 The Objectives of 3G Study Group

The main objectives of the 3G Study Group were: to identify points of losses in all of the areas of the company, to qualify and to quantify the identified losses in a meticulous way, to study solutions and alternatives of the identified problems, to analyze technical and economical viability of the studies and to execute the proposed and approved solutions.

2.2 The 3G Study Group Formation

Firstly, they were established the prerequisites for the formation of the 3G Study Group. This group would be of essential importance in the selection of the points to be studied, therefore should have the capacity to visualize the largest fragilities of the system, as well as the potential of the return of the investment.

- The following premises were established for the formation of the 3G Study Group:
- The 3G Study Group was led by a professional with management competence;
- The 3G Study Group had representatives, of the productive areas, engineering, processes and support areas, as maintenance, quality, safety, logistics and financial;
- It was elaborated the Map of Opportunities of the Productive Areas;

- The opportunities were qualified, it were established alternatives of investments and it were accomplished technical and economical analysis of viability of the studies;
- It were validated the identified opportunities and it coordinated the execution of the proposed solutions;
- It was facilitated the access to the productive areas and necessary information for qualification and quantification of losses;
- It drove solutions for minimization of the impact of the identified losses;
- In the case of the proposed solutions, the 3G Study Group studied resources and necessary investments for establishment of analysis of Return of Investment for presentation to the Industrial Management.



Picture 1: The Teamwork

3. Tool of QUALITATIVE and QUANTITATIVE Analysis – Elaboration of the Map of Opportunities

The Qualification and Quantification of the identified losses were subdivided in 3 (three) great groups, Process, People and Equipments. And for each group it was listed the main points to be analyzed, according to picture 2.

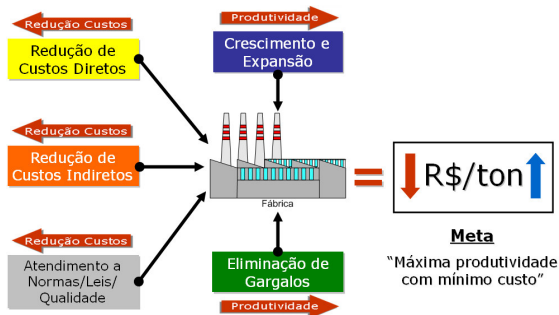
Processos	Pessoas	Equipamentos
Matéria Prima	Treinamento	Manutenção
Embalagem	Automação	Obsolescência
Contaminação	Instrução Técnica	Plano Manutenção
Formulação	Troubleshooting	Lubrificação
Armazenamento	Set-up	Instrução Trabalho
Fluxo de Processo	Organização	Sobressalentes
Logística		Planejamento
Procedimentos		
Perdas em R\$ - Investimento - TIR - Payback		

Picture 2: The analyze of the opportunities

3.1. QUALITATIVE Classification of the Map of Opportunities

The establishment of the Engineering of Qualitative Value is important to classify the opportunities in specific strategic areas of the company, as growth and expansion, service to norms and etc.

With the qualitative analyses of the opportunities, it was achieved, basically, two focuses: reduction of costs and increase of the productivity. With that, they were defined 5 (five) basic classes.



Picture 3: Qualitative Classification

3.2 Qualitative Value Criteria of the Opportunities

To obtain a quantitative value, in other words, a weight for each qualitative class was defined punctuations for the five classes. This proposed punctuation went to the encounter of the current and future expectations of the company.

CRITÉRIOS DE VALOR QUALITATIVO	PONTUAÇÃO PROPOSTA
Crescimento e Expansão	5,0
Eliminação de Gargalos	4,0
Redução de Custos Diretos	3,0
Atendimento a Normas/Leis/Qualidade	2,0
Redução de Custos Indiretos	1,0

Picture 4: Qualitative Criteria

3.3. QUANTITATIVE Classification of the Map of Opportunities

The establishment of the Quantitative Engineering of Value is important, to evaluate the economical viability of each identified opportunity. For so much, the area of accounting of the nutritious company was consulted and it was defined the ranges of values of Investments and Gains possible, they would have the following premises:

- VPL (Liquid Present Value) > 0, in other words, the investment flow and gains possible, in the value today, there is a tax of discount of 16%, has to be larger than reduce to zero.

- The identified possible earnings in the opportunity will need to happen in the same year, in other words, the payback of the project will have to be smaller than 1,0 year.

3.4 Quantitative Value Criteria of the Opportunities

For each ranges of monetary values, in Real (R\$), of Earnings or Investment, punctuations were attributed, being to smallest earnings value or investment to smallest punctuation and the largest earnings value or investment the largest punctuation.

CRITÉRIOS DE VALOR QUANTITATIVO	PONTUAÇÃO PROPOSTA
GANHO POTENCIAL	<ul style="list-style-type: none"> ≤ R\$ 25.000/ANO: 1,0 > R\$ 25.000/ANO E ≤ R\$ 250.000/ANO: 3,0 > R\$ 250.000/ANO: 5,0

Picture 5: Quantitative Criteria to Potential Gain

CRITÉRIOS DE VALOR QUANTITATIVO	PONTUAÇÃO PROPOSTA
INVESTIMENTO NECESSARIO	<ul style="list-style-type: none"> ≤ R\$ 10.000/ANO: 1,0 > R\$ 10.000/ANO E ≤ R\$ 100.000/ANO: 3,0 > R\$ 100.000/ANO: 5,0

Picture 6: Quantitative Criteria to the Investment

3.5 Final Punctuation for the Map of Opportunities

The Final Punctuation, it was calculated as illustration X, using the evaluation aspects: qualitative, quantitative, potential of gains identified and return on the investment.



Picture 7: The Final Equation

4 Final Methodology for Administration of the Opportunities – The Cycle of Earnings Administration

The priority opportunities, it was listed in the application of the tool of qualitative and quantitative analysis; they were treated with the administration methodology, nominated PDCA Cycle (DEMING, 1999).

The system of Earnings Administration, based on this methodology, guarantees that the opportunities are being planned correctly, executed, verified corrected, and its treatment is being effective.

The PDCA Cycle Basic elements are 4 (four), however, to facilitate the administration of the studies, the cycle it was subdivided in 8 steps:

- **PLANNING (PLAN):** process step where is determined how the problem will be analysed and solved;
 - (1) Problem identification;
 - (2) Observation;
 - (3) Process analysis;
 - (4) Action Plan;
- **EXECUTION (DO):** process step where the solution is realized evaluating the progress of the results expected;
 - (5) Action;
- **VERIFICATION (CHECK):** process step where the results are evaluated in a critical way;
 - (6) Verification;
- **CORRECTIVE ACTIONS (ACTION):** process step where the improvements are done and future actions are setting up;
 - (7) Standardization;
 - (8) Conclusion;

This Earning Management Cycle, always is run and run to the continuous quality improvement.



Picture 8: The PDCA Cycle

5 Application of the Engineering of Qualitative and Quantitative Values in a Food Company

The practical application of that Tool of Value Engineering, inside of the Losses Administration, it was used in a Food Factory located in the metropolitan area of Curitiba, Paraná State in the south of Brazil and had the following stages:

Step 01 - (1st month): Team formation – 3G Study Group;

- Leader;
- Facilitator;
- Executive Team
- Technical Support;

Step 02 – (2nd to 3rd month): Team Preparation;

- Training in the Techniques of de PDCA Cycle;

Step 03 – (3rd to 4th month): Construction of Opportunities Map about Productive Areas;

Far to this last step, the methodology of application of these tools of analysis, quantitative and qualitative, constituted in the following activities:

- 12 accomplished meetings;
- Analysis of 71 identified opportunities through 144 applied Hh;
- Studies process through qualitative and quantitative indicators, gains opportunities and the need of investments;
- Identification of 34 potential opportunities;
- Identification of 7 critical opportunities;

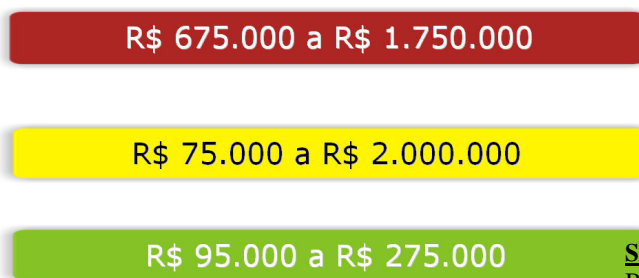
With this tool it was possible to determine and table and criterias to analyze the opportunities identified:

ENGENHARIA DE VALOR

	1 → 3 → 6 → 9 → 12 → 15							
GANHO POTENCIAL ↑	5	25	75	150	225	300	375	5
	3	9	27	54	81	108	115	3
	1	1	3	6	9	12	15	1
								INVESTIMENTO ↑

Picture 9: The Added Engineering Value Table

The three color division in the table are classified in agreement with the Potential Gains.



Picture 10: Potential Gains Divisions

Step 04 – (4th to 5th month): Approval for the Director Board to initiate the study of 7 critical studies;

Step 05 – (5th month): Work Planning: Responsible, Resources, Support and Deadlines;

Step 06 – (5th to 8th month): Consolidation of real gains and need investments to the 7 critical opportunities;

Starting from the sixth step, 7 priority studies were developed with PDCA Cycle Methodology that constituted in the following activities:

- Approximately, 120 days of observations of the processes;
- Approximately, 60 days of collection of data;
- Approximately, 360 hours of calculations and analysis of the data;
- More than 40 collaborators involved indirectly;
- Approximately, 13 involved suppliers;
- More than 14 million statistics data manipulated;
- 6 meetings were accomplished, to treat of several subjects;

Step 07 – (8th month): Elaboration of a report of results, composing the 6 (six) studies of the 3G. In general each study was composed of:

- Study introduction;
- Study objective;
- Methodology of the study and indication of the current stage of the study;
- Considerations of the system or process;
- Conception and Concepts;
- Times and Methods;
- Statistical analysis;
- Data of Process;
- Data of Costs;
- Technician-financial analyses of alternatives;
- Test Results;
- Studies of Process Optimization;
- Elaboration of process flowcharts;
- Pictures;
- Comparisons of the Ideal and Current Processes;
- Description and Quantification of the Losses;
- Partial conclusions;
- Suggestions of Next steps;

Step 08 – (8th month): presentation to the Direction Board about the results of these 7 studies.

6 Study of Cases

Among the seven works developed with the methodology described above, two are more important. The Vertical Packers Replacement and the Weight Variability Reduction of the Product "X."

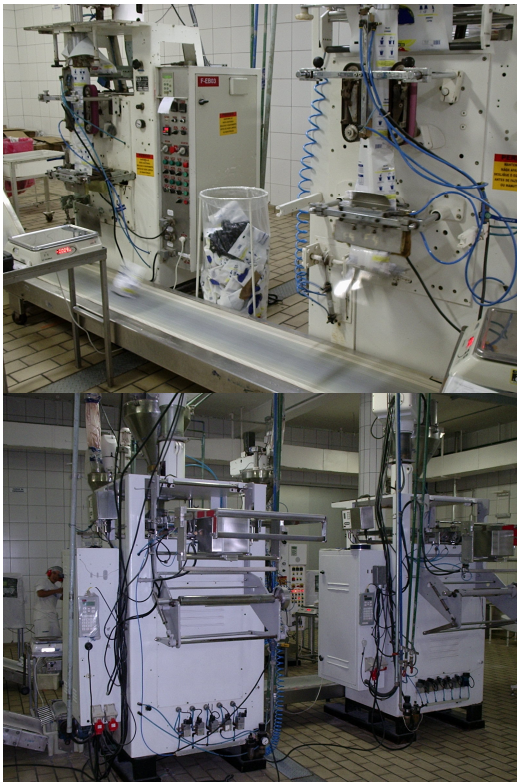
6.1 CASE 1: Vertical Packers Replacement

6.1.1 Objective:

Analyze the technical and financial viability to replace two old Vertical Packers.

6.1.2 Methodology Study:

- Data Analyze of:
 - Electric Energy;
 - Compressed air;
 - Maintenance;
- Data Analyze of:
 - Production;
 - Workers influence;
 - Film packing losses;
- Comparison of benefits and costs among de current machines and the new ones of different suppliers;



Picture 11: The Vertical Packers

6.1.3 Considerations:

- Period of Observation:
 - Nov/2007 to Jan/2008;
- Production data:
 - Electric energy data were measured;
 - Air Compressed data were listed through observation and calculation;
 - Production Data were listed through Shift Books;
 - Maintenance data were measured by the CMMS;
 - Film packaging losses were listed through Shift Book notes;
- Process considerations:
 - The area works in 2 shifts, 15 h/day, e 23 days/month;
- Costs considerations:
 - Film packaging average costs;
 - Electric energy average costs;
 - Compressed air average costs;

6.1.4 Results Achieved

The total cost with expenses with: electric power, compressed air, workers, maintenance and packing losses is about R\$1.696/yr.

With these data a quantitative table was set up, that evaluated the cost for production of 1 kg of the product

and it was compared with the costs that the new machines, of 5 different manufacturers.

With the value of the estimated investment and the foreseen economy, the "Payback" was calculated for the 5 alternatives.

Together with the quantitative data, a qualitative table was set up, that evaluated and considered other relevant data for the study. This technician-financial table considered: cost/kg of product, foreseen economy, payback, location of the supplier of the machine, differential of the machine, period of delivery, payment forms, amounts of machines sold in Brazil, CLP brands, main customers and reliability.

ANÁLISE TÉCNICO-FINANCEIRA DE ALTERNATIVAS

OBJETIVOS	PESO DAS NOTAS	ALTERNATIVA #0	ALTERNATIVA #1	ALTERNATIVA #2	ALTERNATIVA #3	ALTERNATIVA #4	ALTERNATIVA #5
		MÁQUINAS ATUAIS	FABRICANTE 1	FABRICANTE 2	FABRICANTE 3	FABRICANTE 4	FABRICANTE 5
Quanto por kg de produto	30	R\$ 0,042/kg	R\$ 0,013/kg	R\$ 0,011/kg	R\$ 0,012/kg	R\$ 0,014/kg	R\$ 0,013/kg
Nota		6	1	2	3	5	4
Economia prevista	30	-	R\$ 209.464,09	R\$ 201.101,39	R\$ 184.014,43	R\$ 185.559,06	R\$ 189.500,17
Nota		6	1	2	3	5	4
Payback	30	-	3,7 anos	2,3 anos	1,8 anos	1,2 anos	1,3 anos
Nota		6	5	4	3	1	2
Localização de Fábrica	20	-	Alphaville - São Paulo	Guarulhos - São Paulo	S. Bernardo C. - São Paulo	Curitiba - Paraná	Curitiba - Paraná
Nota		3	2	2	2	1	1
Diferencial	20	-	Renome de Empresa (Alta Qualidade)	Qualidade Máquinas (Muito Cliente)	Kit para adaptar dolls distribuidor.	Kit p/ acionamento da mesa p/ servomotor.	Não troca Mordida; Desator B; perfilado;
Nota		6	2	2	5	5	1
Prazo de Entrega	10	-	4 a 5 meses	3 a 4 meses	4 a 5 meses	2 a 3 meses	2 meses
Nota		5	4	3	4	2	1
Formas de Pagamento	30	-	FINAME; MODERNAQ.	FINAME;	BOLETO BANCÁRIO; LEASING;FINAME;	Sinal 50% + Entrega 50%+ 30% em 21 dias;	FINAME;
Nota		6	1	1	1	5	1
Qde de Máquinas no Brasil	10	-	> 100 embaladoras/ano	> 1.000 atualmente	30 segund mács. constr. outras máquinas	Não Formeca	>200 atualmente
Nota		6	1	2	3	5	4
Marca do CLP	20	-	Allen Bradley	Allen Bradley	Allen Bradley	ATOS	Publico ATOS ou Allen Bradley
Nota		3	1	1	1	2	1
Principais Clientes	10	-	Avat Foods; Nestlé; Sada; Paragás; Sarc; Cargill etc.	Range; Koch; Nestlé; Ferruzzi; Tadmor; etc.	Pepper; Gaster; Koch; Marel; Wincor; Sarc; Viger;	Não Formeca	All Brands; Boudier; Bepi; Harsco; Kati; etc.
Nota		6	1	1	2	5	2
Confiabilidade	30	-	Excecente	Excecente	Muito Boa	Regular	Muito Boa
Nota		6	1	1	2	5	2
TOTAL		1310	430	460	570	910	520
RANKING:		6º lugar	1º lugar	2º lugar	4º lugar	5º lugar	3º lugar

PESO DAS NOTAS (REFERENTE A IMPORTÂNCIA):	10 = Pouco Importante
	20 = Média Importância
	30 = Muito Importante
NOTA (CRITÉRIO DE AVALIAÇÃO):	1 = Primeira Melhor Opção à
	6 = Sexta Pior Opção

Picture 12: Table of Alternatives of Replacement

6.2 CASE 2: The Weight Variability Reduction of the Product "X"

6.2.1 Objective:

Analyze the data of weight variability of the product "X", in the production line 2, to analyze the distribution statistical of the products "X", to evaluate the capability of the production line and to count the losses in the process;

6.2.2 Study Methodology:

- Analysis of the steps of the process of production of the product of the Line 2 (59 days of observations in processes and different products), considering the methodology "Right First Time";
- Collecting of, approximately, 14 million data, a very representative sample of the production system, for statistic analysis;

- It was invested, at least, 80 hours, just for preparation of the data for the calculations (Generation of 176 spreadsheets of Excel);
- Data collecting of the 2007 production, to establish the medium taxes of production (kg/day);
- Analysing of the costs with MP, to establish medium cost of the products (R\$/kg);



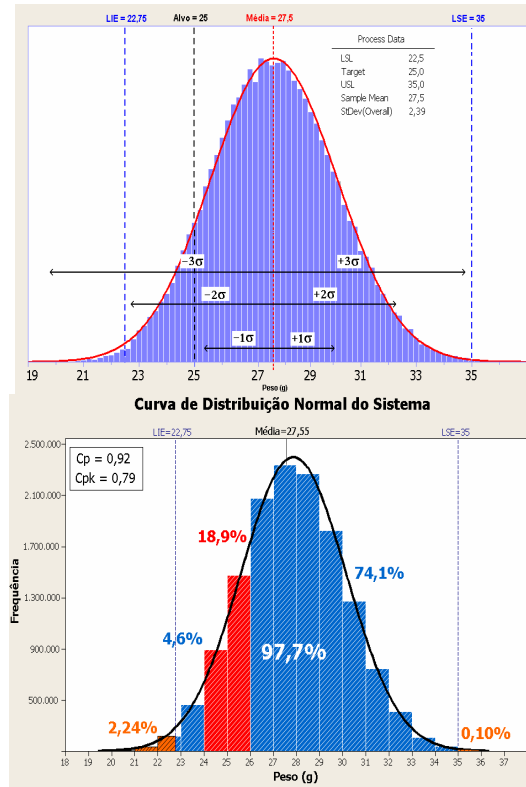
Picture 12: Productive Process of the Product “X”

6.2.3 Study Consideration:

- Period de observation:
 - Sep/07 to Jan/08;
- Production Data:
 - Weight samples analyzed in the X-ray machine;
 - Spreadsheet of the shift books;
 - 2007 Production Planner;
 - Analysis of the data samples through the Minitab15 *Estatistical Software*;
- Process Considerations:
 - The area works in 3 shifts, average of 7,5 h/shift and 22,5 h/day;
- Costs Considerations:
 - Average costs of raw material;
 - Average costs of film packaging, 2007 data;

6.2.4 Achieved Results

With the methodology "Right First Time", it was appeared that the effectiveness of the process is of 56%. With the statistical analyses, the normal distribution of the data was observed. However, with the values of Cp and Cpk it was proved that the process is decentralized and no-capable. And the most important, the variation of the weight of this product around an average, it was causing losses of, approximately, R\$ 1 million a year.



Picture 13: Normal Distribution Graphic

Nível da Qualidade	Defeitos (PPM)	% Conforme	Índice Capabilidade (Cpk)	Custo da Não-Qualidade
2 Sigma	308.537,0	69,15%	Ínstável	Não Aplicável
3 Sigma	66.807,0	93,32%	0,5 = Cpk < 0,83	25 a 40%
4 Sigma	6.210,0	99,3790%	0,83 < Cpk < 1,17	15 a 25%
5 Sigma	233,0	99,97670%	1,17 < Cpk < 1,50	5 a 15%
6 Sigma	3,4	99,99966%	= 1,5	<1%

Fonte: WERKEMA CONSULTORES, líder no Brasil na difusão do Lean Seis Sigma.

Picture 14: The losses in financial meaning

7 CONCLUSION

Due to the need, every time more, of the companies look for excellence in their processes turned its more competitive in delivery, prices and quality, that tool of Analysis of Opportunities, developed by the Engineering of Maintenance, it has been allowing to evaluate qualitative and quantitatively the losses and auxiliary in the technician-financial decisions of the company.

With the application of this tool the identified losses become earnings opportunities for company. With the Map of Opportunities, the company has a powerful material for assertive decisions, concentrating their efforts in opportunities of great economical potential, that allow to do plus, with minus, and with quality.

In the CASE 1, the study was used to the decision of changing the old machines and the process choice of which the best machine to be acquired.

In the CASE 2, the study proved the losses that were just intuitive. And as action plan, it will be implanted, with the maintenance engineering support, SPC (Statistical Control of Process) and the technique of risk analysis, called HAZOP (Hazard and Operability Study). Both, seeking the continuous improvement of the process.

The development of this study like the two mentioned, does with that the company, as a whole, see the service maintenance company as a partner to add more value to its goods and products more than expected. With that, the partnership vision is more and more solidified and harmonics.

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