Optimizing the Help Desk Process in a Public Institution through a Disruptive Strategy using a New Integrative Methodology BPM-Six Sigma-Kaisen

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Abstract

This research is based on two problematic situations: the poor performance of the Help Desk process in a public institution, and the absence of a methodology to improve processes appropriate to Peruvian reality and in particular to a public institution. Therefore, the objective of the research is to improve the Help Desk in a public institution, through a disruptive strategy using a new BPM-Six Sigma-Kaisen integrative methodology supported by ICT.

This methodology comprises six phases: Business Modeling, Define, Measure, Analyze, and Improve with IT, Simulate and Control, in each of the six phases, business, quality and statistical techniques tools are used with correctly sampled, measured and analyzed data. It is concluded that the application of the new methodology allows: obtain a more efficient process, optimize the values of KPIs: registered incidents, resolved incidents, duration of attention and user satisfaction and thus ensure that tasks generate value for users.

Keywords
BPM, TIC, Six Sigma, Methodology, Help Desk.

1. Introduction
Customer satisfaction is one of the essential objectives for any company that seeks to build customer loyalty (Acosta 2018), which is why most organizations worldwide are focused on providing a high-quality service, becoming an important objective, but it is also an difficult process and arduous to apply in organizations (Martínez 2020).

To measure customer satisfaction, the organization "Ciudadanos al Día" carried out a general measurement, based on a sample of 11,711 surveys in 123 public institutions in the 25 regions of Peru, the result of which was that 51% of citizens expressed satisfaction with the service provided by public institutions see figure 1. In summary, there is a low level of citizen satisfaction in relation to the quality of care of the services offered in the entities of the Peruvian public administration, detecting the main defects in order to establish opportunities for improvement (López et al. 2018).

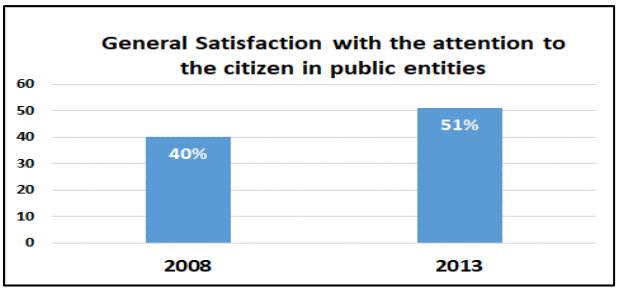

Figure 1. General Satisfaction with the attention to the citizen in public entities. Source: Citizens per Day

These opportunities for improvement arise from several circumstances: non-compliance with the actions or tasks posed for the development of the objectives, problems that arise that affect the process, analysis of losses and setbacks, so that these opportunities are the starting point of the improvement of business processes (Ricardo-Cabrera et al. 2018). In addition, opportunities for improvement related to the productivity of the organization are linked to the adoption of appropriate business processes. Therefore, optimizing and ensuring the smooth implementation of process activities significantly improves organizational efficiency and customer satisfaction (Al-Hawari 2020).
Between processes, the IT help desk process is a vital need for large institutions that rely heavily on IT services and resources. Because it serves as a single point of contact (SPOC) between IT staff and users regarding requested and informed services (Al-Hawari 2021). This tool allows you to make daily decisions that influence how technological incidents are resolved, and prevent processes in different areas from being affected for a long time, and thus achieve user satisfaction (Rodriguez et al. 2018).
In the institution publishes CONECTAMEF, an entity important for economic development, seeks to mitigate two aspects: a) the poor performance of the Help Desk process, in terms of total recorded incidents, total resolved incidents, duration of attention, which is causing customer dissatisfaction, so it is necessary for users to have an efficient solution being clear that today different organizations are increasingly dependent on IT to achieve their plans and objectives , strengthening the quality of the services provided by the organization to users; and (b) the lack of a methodology to improve processes appropriate to national reality and public organizations with strong support from Information and Communication Technologies.
By developing and implementing a new BPM-Six Sigma-Kaisen integrative methodology supported by ICT for the Help Desk Area in a Public Institution, we are interested in optimizing processes and improving customer satisfaction.

1.1 Objectives

The objective of the research is to improve the Help Desk in a public institution, through a disruptive strategy using a new BPM-Six Sigma-Kaisen integrative methodology supported by ICT. Improve the indicators: Total incidents resolved / day, duration of care, Customer Satisfaction, Total Registered Incidents in the Help Desk process of public institutions.

2. Literature Review

According to researchs, it establishes that the requirement of continuous improvement is discussed in equivalent clauses of different management systems. An integration model was developed that incorporated the TQM philosophy of continuous improvement as a baseline for integration (Talapatra et al. 2018). A hierarchical framework of various Total Quality Management (TQM) implementation barriers was investigated and developed in the context of the garment industries (RMG) in Bangladesh (Talapatra and Uddin 2019). Many companies in the world use the integration of Company Management Systems that provide competitive advantages from synergies of different management policies, better alignment of policies, objectives, better productivity, and efficiency of the organization (Talapatra et al. 2019). An investigation in Colombia implements an Integrated Quality System (ISO 9001 standard, process management, innovation, knowledge management, and accreditation guidelines) for higher education (Fontalvo et al. 2021). In Malaysia, Research that focused on the construction industry, in terms of performance and innovation, it were combined, international standards in quality, environment, safety, supply chain to form an integrated management system (IMS) (Zainol et al. 2021).

3. Methods

During the research we developed a new integrative methodology, based on well-known methodologies such as Business Process Management (BPM), Six Sigma, Kaisen, ICT and the contributions of the researcher. Systemic Thinking was used as an integrative element of the best proposals of each of the revised methodologies, oriented to

the improvement of processes in the Help Desk of a Public Institution. The researcher was an active participant within the company. The figure 2 shows the generation of the new methodology for process management.

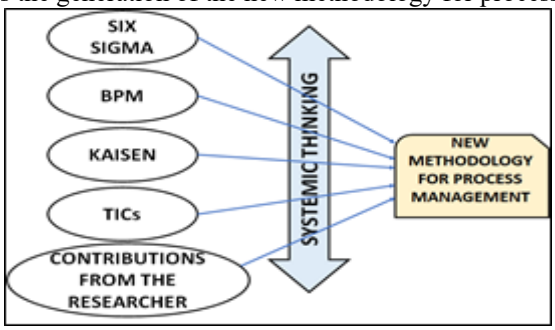

Figure 2. Shows the new methodology for process management

New Methodology

The new methodology that structures the life cycle of a project to redesign processes comprises 6 phases, Figure 3 shows the conceptual model of the new methodology, all its phases were implemented.

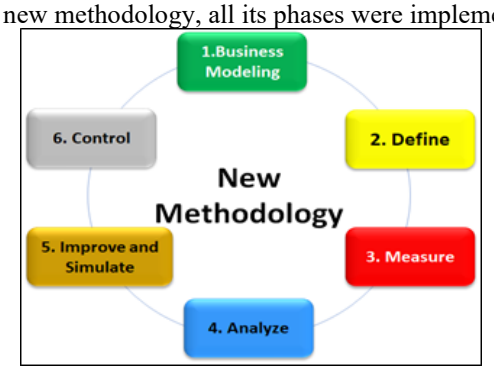

Figure 3. Conceptual Model of the New Method

Phases

1. Business Modeling: We started with the systemic approach of the organization, models were generated for the diversified company: Products, Places, Clients and Business Portfolio. Then we prioritized the UEN and the most important one called CONECTAMEF was chosen,

Company Description: Public Institution responsible for planning, directing and controlling matters relating to budget, treasury, indebtedness, accounting, fiscal policy, public investment and economic and social policy.

Vision: Sector that drives sustained economic growth, which contributes to a better quality of life for Peruvians, ensuring a responsible and transparent fiscal policy, within the framework of macroeconomic stability.

Mission: Harmonize economic and financial policy, through transparency and fiscal responsibility, contributing to the country's sustained economic growth.

Services and their Clients: User Service Centers-Conectamef: Help Desk, Inquiries, Training, Technical Assistance. Economic Information Economic Transparency Portal. Government Procurement, Tax Court, Taxpayer Advocate.

Clients: Taxpayers, Investors (public, private), users, public entities (CONECTAMEF 2019).

Stakeholders: Internal: Directorate General, Administrative, Employee and Worker; External: State Organizations (SUNAT, Central Reserve Bank of Peru), Suppliers (National Government, Regional Governments, Local Governments),Service Providers(Entel, Emapica. Electrodunas). Figure 4 shows the public institution's business portfolio, and the most important UEN CONNECTMEF.

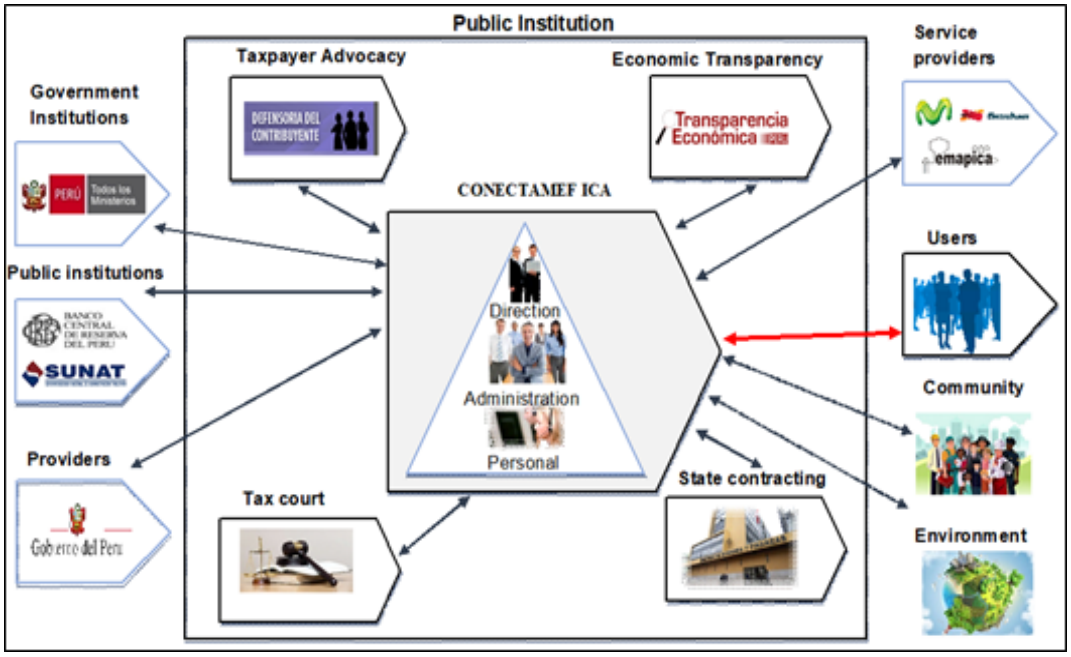

Figure 4. Business Portfolio of the Public Institution and Strategic Business Unit CONECTAMEF

For this UEN, business models such as the Value Chain were developed, from which the business processes were identified. The most important process was chosen the HELP DESK to redesign it.

2.Define: The problem or ("AND") was defined in tangible and quantifiable terms, with a specific description.

The project was determined considering the objectives of the organization and the requirements of the customer, looking for ctQs (critical characteristics for quality). We elaborate the context diagram, the matrix of voice of the client VoC , CTQ, Diagram of the current process(Bizagi 2020).

In the figure 5 shows the context diagram of the Help Desk process.

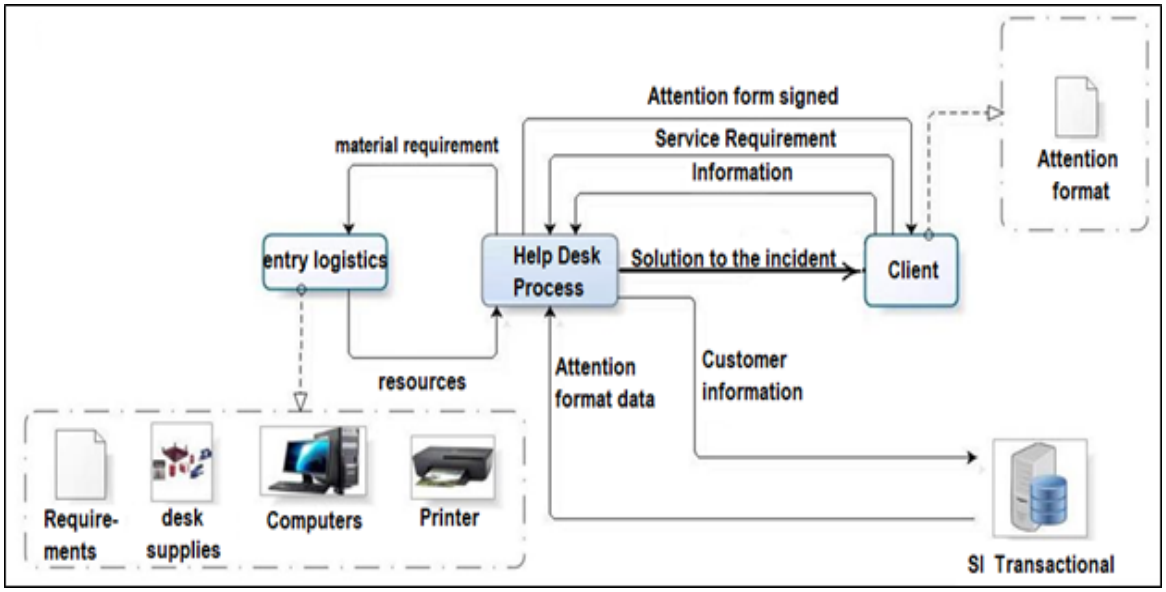

Figure 5. Context diagram

In this analysis the table 1 shows the voice of customers

Table 1. Voice of Customers

Defining the Voice of the Customer (VoC)	Description	Critical for Quality (CtQ)
The total number of incidents recorded per day exceeds what is established.	The total number of incidents recorded will be within the specified by the financial institution.	The total recorded incidents must not be ≥ 65 per day.
The total number of incidents for resolution on the indicated day is not met.	The total of resolved incidents must be fulfilled on the scheduled day.	The total number of resolved incidents must be = 68 per day.
Delays in attention.	Customer service will be within specification.	Duration of Care must be ≤ 13 mins.
The client does not agree with the attention.	When receiving service, customer satisfaction must be good.	Customer satisfaction is very good.

The current business process modeling was performed, as shown in Figure 6.

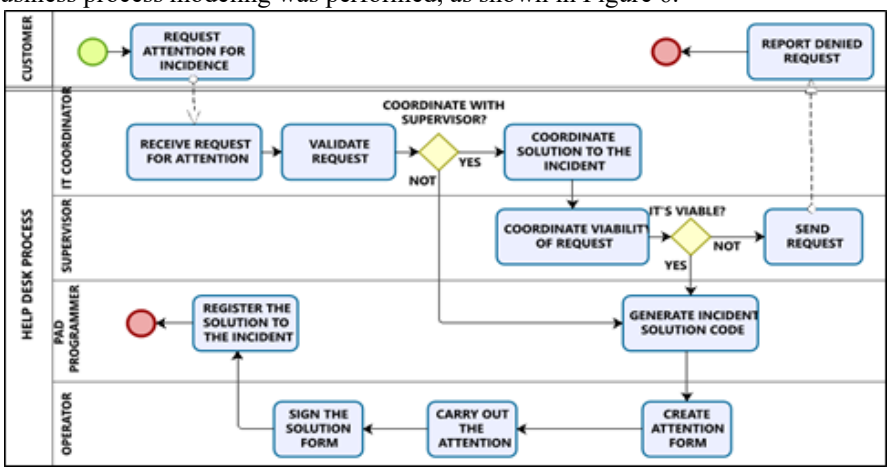

Figure 6. Modeling the Current Business Process

3.Measure: The measuring capacity of the "Y". The plan to Collect Data was created for this case study: Total Recorded Incidents per day, Total Incidents Successfully Resolved in the day, Duration of care, Customer Satisfaction that measures the state of care. The possible influence on the CtQ (Critical to Quality) was determined, it was elaborated: the operational definitions with KPIs and specifications, The Frequency Distribution of the KPIs. The value of the mother Sigma (SixSigma 2020). The capacity of the process for the KPIs were calculated.
In the table 2 and 3 show the Calculation of the value of Sigma Mother and Sigma level.

Table 2. Calculation of value Sigma Mother: a) Calculation of Sigma value b) Defects and opportunities

Description	Value
Defects in the Help Desk process	The incidents recorded per day are high (23) The incidents resolved per day are very low (24) Longer duration of customer service to resolve the incident (21) User dissatisfaction when receiving their care (21)
Number of Opportunities	4
Number of Transactions processed	30
Amount of Defects	89

Defects	89
Evaluated Units	30
Opportunities by Units	4

Calculation of defects per million opportunities:
DMPO ((Number of Defects) / (Number of Units x Number of Opportunities)) * 1000,000
DPMO=89/ (30*4) =741 666

Table 3. Sigma level

DPMO:	**741666**
Sigma level:	**0,85**

4.Analyze: we carry out the data analysis: a) Exploration: considering Y = customer dissatisfaction with the service. We elaborated the Pareto , diagram of defect opportunities, KPI behavior diagrams, Histograms to understand the process of each KPI. b) Generation of hypotheses: Cause-effect diagram Potential causes. c) Validation: correlation between Y of each KPI and possible causes.
We did the Process analysis: a) Exploration: the flow diagram of the current process was elaborated. b) Analysis of activities with times and the value it brings. c) General Validation, Diagram of Real Causes-Effects.
The table 4 shows the opportunities for defects.

Table 4. Opportunities for defects.

Defects Opportunities	Frequencies
High time for the response of the request.	32
Failure to register the Attention Code.	1
The established procedures are not followed.	4
Little supervision of operators.	3
High time for validation of customer data.	51
Incorrect maintenance of equipment.	3
Absence of Controls to the Signed Attention Form.	5
High time for the response of the feasibility of the requirement.	4
High time for the response of the application denial.	8
High time for system registration.	2
Total	102

Behavior Diagram
The behavior diagrams of KPI_1 , KPI_2, KPI_3 and KPI_4 have been developed, as an example the KPI_4 behavior diagram is shown.
KPI_4: Customer Satisfaction
Y_4: User indicates that attention is bad
Figure 7 shows the behavior of KPI_4.

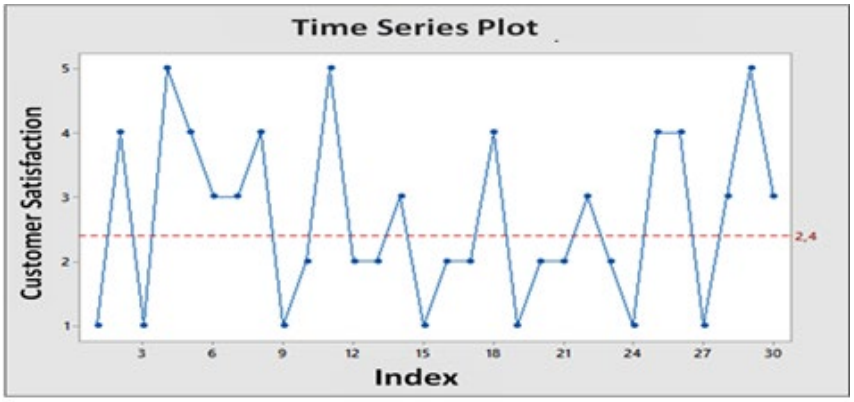

Figure 7. Time Series Chart for KPI_4

There are no trends on the chart, therefore these are common causes, the table 5 shows the potential causes.

Table 5. Potential causes

Potential Causes		Type
X_{22}	Requirements response on incorrect days	Methods
X_{23}	The operator does not answer clearly	Personal
X_{24}	Failure in the reprogramation of the attention	Methods
X_{25}	Inadequate organizational climate	Environment
X_{26}	Operator inefficiency	Personal

Process Analysis

In the table 6 shows an analysis of activities.

Table 6 shows an analysis of activities.

N°	Process stage	Add Value	Does'nt add value	Time
1	Request Attention for Incidence	X		2 min.
2	Receive Request for Attention	X		30 s.
3	Validate Request		X	4 min.
4	Coordinate Incident Solution	X		2 min.
5	Coordinate viability of the requirement	X		40 s.
6	Send Reply		X	15 s.
7	Report denial of request		X	25 s.
8	Generate Incident Solution code	X		55 s.
9	Create Attention Form	X		28 s.
10	Carry out Attention	X		16 s.
11	Sign the Solution Form		X	15 s.
12	Register the Solution to the Incident	X		35 s.

5.Improve and Simulate: This phase checks results for the necessary improvements that have not yet been completed, most basic process test cases, and simulation provide the group with great achievements at this stage (Sigma, 2017). The tentative solutions were generated, we carry out the validation and choice of solutions: Evaluation of tentative solutions according to effort and impact, selection of final solutions, Process simulation, Application of final solutions, Improved context diagram with IT / SI support, Improved processes flow diagram with IT / SI support. Process mission. Process vision. Goals.

Final Solutions Application

Figure 8 shows the enhanced context diagram with IT/SI support.

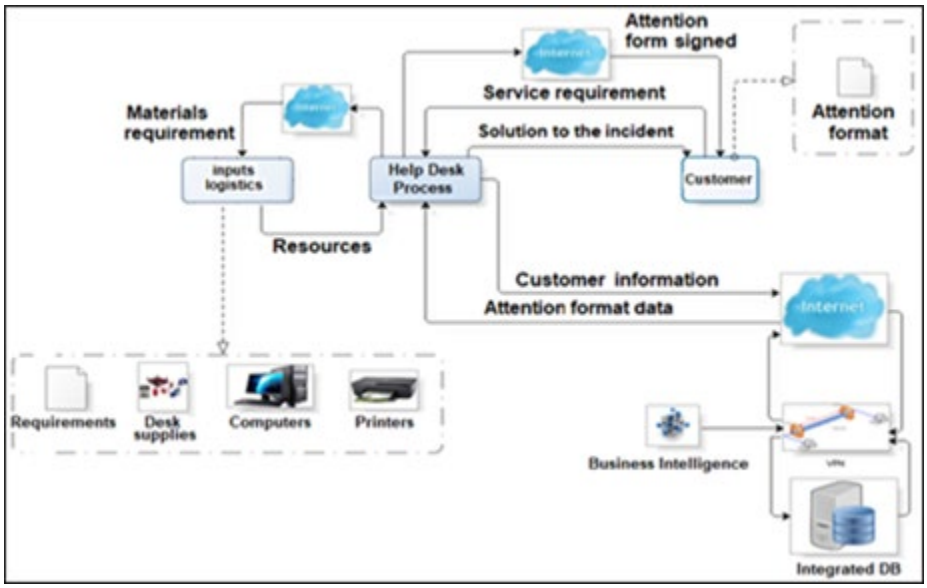

Figure 8. Improved Context Diagram with IT/SI Support.

Figure 9 shows the improved flowchart supported by IT/SI.

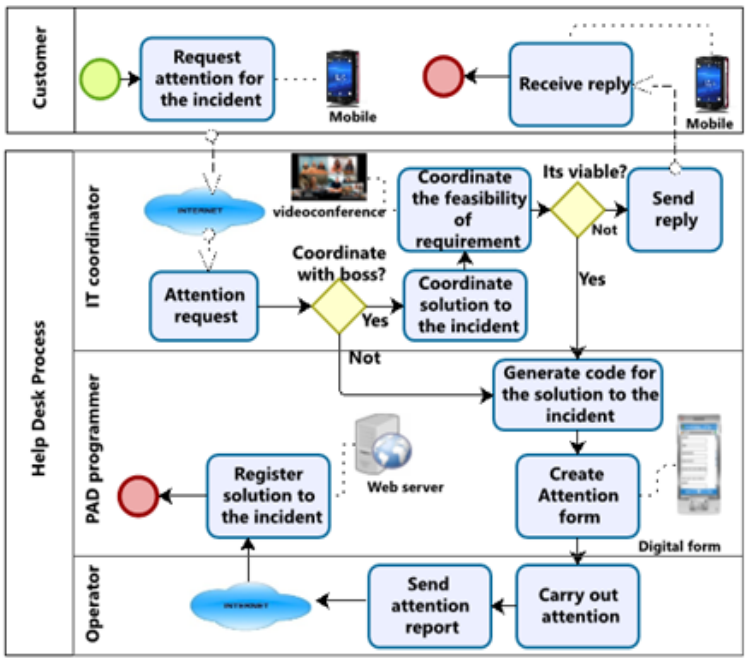

Figure 9. Improved Flowchart Supported in IT/SI.

6. Control: The purpose of the control phase is to establish tools that ensure that key variables remain within the accepted variations in the long term. We carry out the Control plan : Measurement points were proposed in the process. Were drawn up graphs to observe the performance of the process.

The performance of the "Y" problem and the process as well as the presence of Xs(real causes) in the process were monitored. The relevant corrections were made. And we support ourselves with descriptive graphics like dasboard. Also with I-MR control graphs (Individual Data and Mobile Range) for KPIs. And finally the sigma value was calculated. The Figure 10 shows the flowchart of the process indicating the KPIs

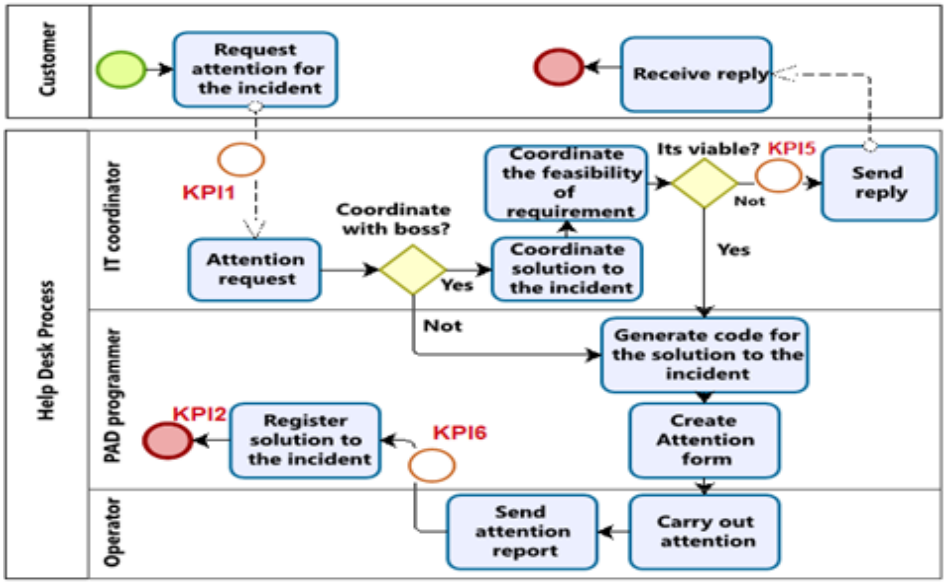

Figure 10. Process Flowchart.

Calculate Sigma Value: Table 7, table 8, and table 9 show the Sigma level calculation.

Table 7. Activity analysis

Description	Value
Defects in the Help Desk processes	The incidents registered per day are too many to the established range (9) The incidents resolved per day are very few within the established range (2) Longer duration of customer service in resolving the incident (4) User dissatisfaction when being attended (13)
Number of Opportunities	4
Number of services reviewed	30
Amount of Defects	28

Table 8. Defects and Opportunities.

Defects	28
Evaluated Units	30
Opportunities by Units	4

Calculation of defects per million opportunities
DMPO= (Number of defects)/ (Number of Units x Number of Opportunities) x 1000,000
DPMO=28/ (30*4) =233333

Table 9. Sigma level

DPMO:	233333
Sigma level :	2,23

4. Data Collection

The techniques and instruments for the collection of information in the development of the research were related to direct observation through observation sheets, surveys with questionnaires, the execution of structured and directed interviews through the interview form. The team had the support of administrative, customer, business office and other personnel, to gather information on the attention and service provided to the customer. Population: it is considered as elements to analyze all the Help Desk attentions in the Public Institution; N = Indeterminate; Sample size: this research considers a sample of 30 processes of the Help Desk in the Public Institution, a value used in research projects as reported by the author Peter Pande in his book "The Practical Keys of Six Sigma" (Pande 2004).Confidence level: this

research work has considered that a confidence level of 95% has a margin of error of 5%. 4 KPIs were identified for which the present investigation has been worked.
Table 10 2shows the results of the Pre-Test and Post Test for I_1, I_2, I_3, and I_4.

Table 10. Pretest and Post Test Results for: I_1, I_2, I_3 and I_4

	I1: Total Incidents registered		I2: Total Incidents resolved		I3:Duration of attention		I4: Customer satisfaction	
N°	Pre test	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test
1	46	51	45	52	10	8	1	5
2	41	47	47	49	11	10	4	4
3	44	51	45	50	15	10	1	1
4	41	49	43	48	18	13	5	5
5	47	50	49	51	12	11	2	4
6	45	52	54	53	14	11	3	4
7	42	45	47	48	17	9	3	5
8	58	53	46	52	14	10	2	4
9	37	50	46	48	16	12	3	2
10	38	46	51	43	15	13	2	5
11	53	53	47	51	14	11	5	4
12	45	51	44	52	16	11	2	3
13	55	53	45	51	13	11	2	5
14	56	53	49	49	15	11	1	3
15	35	46	43	50	11	9	1	4
16	49	52	47	51	15	9	2	2
17	35	50	51	52	9	9	2	4
18	33	45	46	48	17	10	4	3
19	44	52	49	52	15	13	3	4
20	36	47	47	50	11	10	2	3
21	50	53	45	53	16	9	2	2
22	44	51	56	52	16	8	1	5
23	53	53	43	53	12	11	2	4
24	57	52	46	51	11	9	3	5
25	57	49	46	50	13	9	2	2
26	36	46	47	48	12	11	2	3
27	34	52	43	52	17	13	1	1
28	35	51	53	49	14	12	3	3
29	54	52	46	51	16	10	4	2
30	57	50	48	51	15	13	3	5

5. Results and Discussion

5.1 Numerical Results:

The table 11 shows that there is an improvement in the values of the Is

Table 11. Means of the Is for the Pre-test and Post-test

Indicator	Pre test (Mean: $\bar{x}_1$)	Post test (Mean: $\bar{x}_2$)	Comment
Total Recorded incidents	45.23 Incidents	50.17 Incidents	...
Total Resolved Incidents	47.13 Incidents	50.33 Incidents	...
Duration of attention	14.00 min.	10.53 min.	...
Customer satisfaction	...	...	Not contrasted. Qualitative Indicator

5.2 Graphical Results

Indicator: Customer Satisfaction: I_4

Pretest values: The figure 11 shows pretest customer satisfaction in percentages.

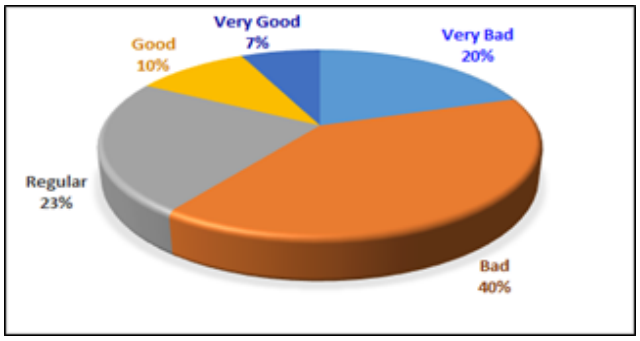

Figure 11. Customer Satisfaction

20% of the time Customer Satisfaction was recorded as Very Bad by customers.
Only 7% of the time Customer Satisfaction was recorded as Very Good by customers.
Only 10% of the time Customer Satisfaction was recorded as Good by customers.
23% of the time Customer Satisfaction was registered as Regular.
40% of the time Customer Satisfaction is Bad

Post Test Values: The figure 12 shows the post-test customer satisfaction in percentages.

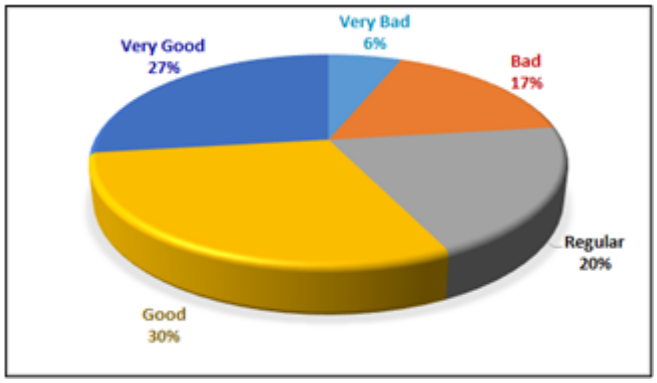

Figure 12. Customer Satisfaction

6% of the time Customer Satisfaction was recorded as Very Bad by customers.
27% of the time Customer Satisfaction was recorded as Very Good by customers
30.00% of the time Customer Satisfaction was recorded as Good by customers.
20.0% of the time Customer Satisfaction was registered as Regular.
17% of the time Customer Satisfaction is Bad.

5.3 Validation

Validation of the samples used for the Pretest and Post Test indicators (Is) was performed.

I_1: Total Registered Incidents

The table 12 shows the total registered incidents.

Table 12. Total registered incidents

Pre	46	41	44	41	47	45	42	58	37	38	53	45	55	56	35
test	49	35	33	44	36	50	44	53	57	57	36	34	35	54	57
Post	51	47	51	49	50	52	45	53	50	46	53	51	53	53	46
test	52	50	45	52	47	53	51	53	52	49	46	52	51	52	50

Hi: The application of the integrative methodology BPM-six sigma- kaisen supported by ICTs will increase the Total Registered Incidences (Post Test) with respect to the sample to which it was not applied (Pretest).

$$Hi: \mu 1 < \mu 2$$

$\mu 1$ = Average of total incidents recorded in the Pre-test.
$\mu 2$ = Average of total incidents recorded in the Post Test.

$$Ho: \mu 1 \geq \mu 2 \qquad Ha: \mu 1 < \mu 2$$

The student t-test was applied, and the following result was obtained as shown in Table 13:

Table 13. Student's t test Summary for I_1.

	Pre test	Post test
Mean ($\bar{x}$)	45,26	50,27
Observations (n)	30	30
Hypothetical difference of means	-4,97	
T calculated: t_c	-3,23	
p- value (one tailed)	0,002	

Because the p-value (0.002) < α (0.05), the results provide the evidence needed to reject the null hypothesis (Ho), and the alternating hypothesis (Ha) is true. The test turned out to be significant.

I_2: Total Resolved Incidents

Hi: The Application of the IT-supported Process Management Model will increase the Total Resolved Incidents (Post Test) with respect to the sample to which it was not applied (Pretest).

Hi: $\mu 1 < \mu 2$

$\mu 1$ =Average of the Total Resolved Incidences in the Pretest.
$\mu 2$ =Average of total resolved incidents in the Post Test.

Ho: $\mu 1 \geq \mu 2$ Ha: $\mu 1 < \mu 2$

The table 14 shows the summary of the Student's t test for I_2 .

	Pre test	Post test
Mean ($\bar{x}$)	47,13	50,33
Observations (n)	30	30
Hypothetical difference of means	-3,200	
T calculated: t_c	-4,52	
p-value (one tailed)	0,000	

Because the p-value (0.000) < α (0.05), the results provide the evidence needed to reject the null hypothesis (Ho), and the alternating hypothesis (Ha) is true. The test turned out to be significant.

I_3:Duration of Attention

The table 15 shows the summary of the Student's t test for I_3.

Table 15. Summary for I_3 Student's t Test.

	Pre test	Post test
Mean ($\bar{x}$)	14,00	10,53
Observations (n)	30	30
Hypothetical difference of means	3,467	
T calculated: t_c	6,78	
p-value (one tailed)	0,000	

Because the p-value (0.000) < α (0.05), the results provide the evidence needed to reject the null hypothesis (Ho), and the alternating hypothesis (Ha) is true. The test turned out to be significant.

6. Conclusion

- The process improvement methodologies justified their relevance for the generation of the New Methodology.
- The Systemic Thinking is a good integrating element of Methodologies for the improvement of processes.
- After the implementation of the New Methodology, the Help Desk process in the Public Institution was improved.
- By applying the New Methodology, the Total Registered Incidents per day improved from a mean of 45.23 to 50.17.
- When the New Methodology was applied, the Total Incidents Resolved per day improved from a mean of 47.13 to 50.33.
- The application of the new methodology reduced the duration of customer service from a mean of 14 to 10.53 minutes.
- By applying the new methodology, customer satisfaction improved. In the pretest, only 17% of customers registered good and very good satisfaction. In the post test, 57% of the clients registered good and very good satisfaction.
- In the last decade, globalization has changed the world, as organizations face new exigencies from stakeholders. This integrative methodology will add value to the business through the optimization of the Help Desk process, improves user satisfaction, it is simple to implement in public institutions, it can also be implemented in organizations with different areas of activity, dimensions and market positions.

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He obtained a scholarship from the AOTS-Japan and NIPA-Corea, he was consultant IDB-PNUD-Peruvian Congress. Advisor of the winner First Award Paper CONEIMERA2018. Advisor IEEE chapters at the National University of Callao And Ricardo Palma University. Advisor First General Project Prize over 5000 projects in the Romero Group contest. First projects in the INTERCON, CONEIMERA congress and was nominated for the Graña y Montero Prize for Research in Peruvian Engineering. Nominated Peruvian Research Southern Prize 2019 and nominated research award 2018 MEXICO. He has published more than 50 papers in Peru and internationally, served as author and advisor of articles published in IEEExplore, Scopus and other database, organizer of international academic events and editor of proceedings, He teaches at the postgraduate and undergraduate level, with 30 years of experience. He graduated as an Electronic Engineer from Ricardo Palma University in Lima Peru, obtained his Master's Degree and his Doctorate.