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S&OP Maturity Model to Increase the Successful Inventory Management Initiatives in Industrial Machinery Rental Peruvian SMEs

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Abstract:

Currently, most Peruvian SMEs are growing in the informal sector, thus they fail to establish their processes correctly or to have adequate inventory management. This has become a critical factor for their development, causing both economic and structural problems. On the other hand, there is a lack of research on inventory management in service companies. Therefore, a model is proposed for managing the inventories of service companies in the industrial machinery rental sector based on the Sales Operation Planning (S&OP) tool. This model is based on a maturity model allowing the company to evaluate its current situation and identify the necessary requirements to be able to scale up S&OP development in the company. The proposed model was implemented in a case study in Lima-Peru where the results obtained indicate that the inventory management was considerably improved, achieving an adequate S&OP level. The main problem, namely the Overstock was reduced by 47.67%, which proves that the proposed model is effective and efficient. Thus, this model becomes a high value tool that reveals the actions needed to reach the ideal S&OP level.

Keywords: Demand forecast, Inventory management, Maturity model, SMEs, S&OP

I. INTRODUCTION

According to the 2017 Global Entrepreneurship Index (GEI), Peru is the seventh economy with the highest level of entrepreneurship at performance level in Latin America and the Caribbean. However, it is now known that most of the Peruvian SMEs are setup with the aim of entrepreneurship, which is why 74% of them do not establish their processes correctly in terms of supply chain and especially inventory management. According to INEI reports, 40.8% of these companies do not have input, output, and storage controls over their inventories, which often causes them economic problems. [1]

On the other hand, we highlight the importance of the service sector, as INEI states that the item with the greatest presence in the services market is that of the "services provided to other companies" with 24.84%. Moreover, studies show that the net income according to economic activity in the sector is one of the most important in the Peruvian market, since it has an economic impact of 17.9%. Moreover, the same institution affirms that companies belonging to this sector have had a continuous growth from 2010 to 2016. [2]

Therefore, it has been found that there are currently various ways of managing inventories in the study sector. Some of the authors such as Roberto Montanary and Guiseppe Vignali point out that the best way to manage the inventory level is through EOQ which allows determining precisely how much inventory will be adequate to meet the demand. [3] Furthermore, Hatefi, S.A. Torabi, and P. Bagheri argue that to achieve proper inventory management, a linear model based on ABC should be used, which allows different items to be classified quantitatively and qualitatively in an integrated manner. The author Brojeswart Pal proposes an efficient inventory model that considers stock-outs by means of a simulation, where all stakeholders, such as suppliers and customers, are aligned so that the stock level can be determined. Moreover, Asif Salam uses simulation to analyze the relationship between inventory management and service level, which makes use of forecasts and safety stock for greater efficiency.

However, we have seen that these inventory management models are not optimal for the identified issue because they use tools that fail to meet the objectives. First of all, ABC is a methodology without much development to be considered as a main tool within an inventory management model, since it only classifies products by cost and fails to take into account other considerable variables. On the other hand, the EOQ cannot be used because it is based on assumptions and is not very accurate. Furthermore, this tool is efficient in the management of a single product while these items belong to different teams.

The article presents five categories: state of the art, description of the contribution, validation of the proposal and conclusions. All these categories will be further developed as mentioned above.

II. STATE OF THE ART

Based on research, we could analyze different areas of study on inventory management improvement through Sales Operation Planning (S&OP). Lâm Laurent Lim and Bruno A. Calfa agree to provide simulation models to develop S&OP efficiently. The articles that agree to use simulation have as their main objective to satisfy the uncertain demand taking into account the different areas of companies. [5] For such purpose, the authors highlight a data optimization approach to understand the uncertainty of demand and supply. Furthermore, the authors consider important factors such as long lead times for material procurement, sales flexibility, emergency supply, and accurate forecasting. [6]

On the other hand, we found the research by Sayeh Noroozi and Hana Hulthen that covers the theoretical framework. The authors in this category provide information relevant to the S&OP tool implementation. First, the authors show a modular approach to S&OP using decoupling points that are differentiated into modules and which allow for identification of decision variables. [7] Secondly, five important steps are provided for S&OP correct implementation in order to achieve efficiency and effectiveness and to create a more effective framework for S&OP implementation. [8]

Furthermore, there are studies that cover S&OP models, and authors R. Affonso, F. Marcot, and Antonio Marcio have proposed methods that allow identifying important factors to achieve S&OP execution. On the one hand, they show the importance of considering suppliers and customers in the supply chain without losing their autonomous decision-making power. In turn, they should be related to the sales and operations area (inventory management) for best results. On the other hand, they show that factors such as product complexity and process complexity have some impact on manufacturing operational performance in terms of quality, flexibility, and delivery. [9]

Regarding the effectiveness approach, authors James Anthony Swaim and Scott C. Ambrose determined the factors that make S&OP successful by integrating the different areas of the company. Namely, all members should be engaged with the organization and the work they do. [10] Senior management should also demonstrate interest and collaboration. In turn, collaboration plays one of the most important roles as an intermediary between social cohesion, centralization, information quality, process quality, and rewards and incentives to achieve S&OP effectiveness. [11]

Meanwhile, authors Rogelio Olivaa, Linea Kjellsdotter, and Anna-Lena Alvekrans take as a reference application cases that allow visualizing how S&OP is currently being developed in different companies of different places and sectors. First of all, through these studies, it is possible to know which are the techniques and tools for integrating an organization with differences between areas through an S&OP process. [12] Second, they identify possible barriers to S&OP implementation and facilitators who can eliminate those barriers. Thirdly, they show that S&OP is more efficient by improving and specializing in the knowledge of managers and workers. Fourth, they demonstrate how to carry out the S&OP implementation process and what aspects of the planning environment such as context, inputs, structure, processes, and outcomes drive the need and opportunities for successful S&OP implementation. Finally, they show that a higher degree of S&OP maturity results in immediate improvements in inventory management. [13]

Finally, other authors such as Linea Kjellsdotter Ivert and Richard E. Plank take planning as a pillar of their research. These authors stress the importance of always being aware of all changes and unforeseen events that may arise during the company operations. On the one hand, the authors demonstrate that APS systems will support the S&OP process and help meet its objectives, especially in complex planning environments. [14] However, it is not appropriate to provide APS systems for supporting processes characterized by low technology readiness. By this typology, we propose rethinking of an S&OP process with a flexible planning horizon due to the constant changes faced by companies. [15]

However, the contributions of the authors mentioned have shown the effectiveness of S&OP implementation only in the manufacturing sector and not in the services sector. As it is known, the services sector has different characteristics, which have not been considered in previous research. Moreover, the above-mentioned S&OP studies are carried out and applied in large companies but not in SMEs, which tend to have fewer resources, different processes, but the same desire to improve their inventory management. Finally, the above studies do not demonstrate how S&OP can be scaled up in the process of developing and implementing S&OP, which would help companies to see their current situation and what they need to develop to improve their inventory management by means of S&OP.

III. PROPOSED MODEL

III.I. Proposal design

III.I.I. Benchmarking

There are currently several models for improving inventory management based on S&OP, but these models are focused on the manufacturing sector. Furthermore, these models are applicable to large companies but not to SMEs. Therefore, the authors propose a model for managing and developing the inventories of service companies focused on SMEs . Below is a table comparing the existing models with the model proposed by the authors.

Table 1: Criteria Considered in S&OO Models

CRITERIA	S&OP MODELS					
	AUTHOR'S MODEL	S&OP EFFECTIVENESS MODEL	QUANTITATIVE PLANNING MODEL	PERFORMANCE MODEL	S&OP MANAGEMENT MODEL	S&OP HEURISTIC
Data quality	X				X	X
Determination of demand	X				X	X
Available resources	X				X	X
S&OP process	X	X	X	X		
Data	X	X	X	X		
Processes	X	X	X	X		
People	X	X	X			
Organization	X		X			

As can be seen, S&OP models found consider some criteria necessary to achieve the tool success. However, the model proposed by the authors covers all the relevant criteria for inventory improvement as studied.

III.I.II. Proposal

As mentioned, the authors propose a model for managing and developing the inventories of service companies in the industrial machinery rental sector based on the S&OP tool. This tool allows an appropriate demand and supply planning for efficient inventories, thus avoiding overstock or lack of supplies in the company maintenance process. This model has three components: S&OP Effectiveness, S&OP Processes, and S&OP Efficiency.

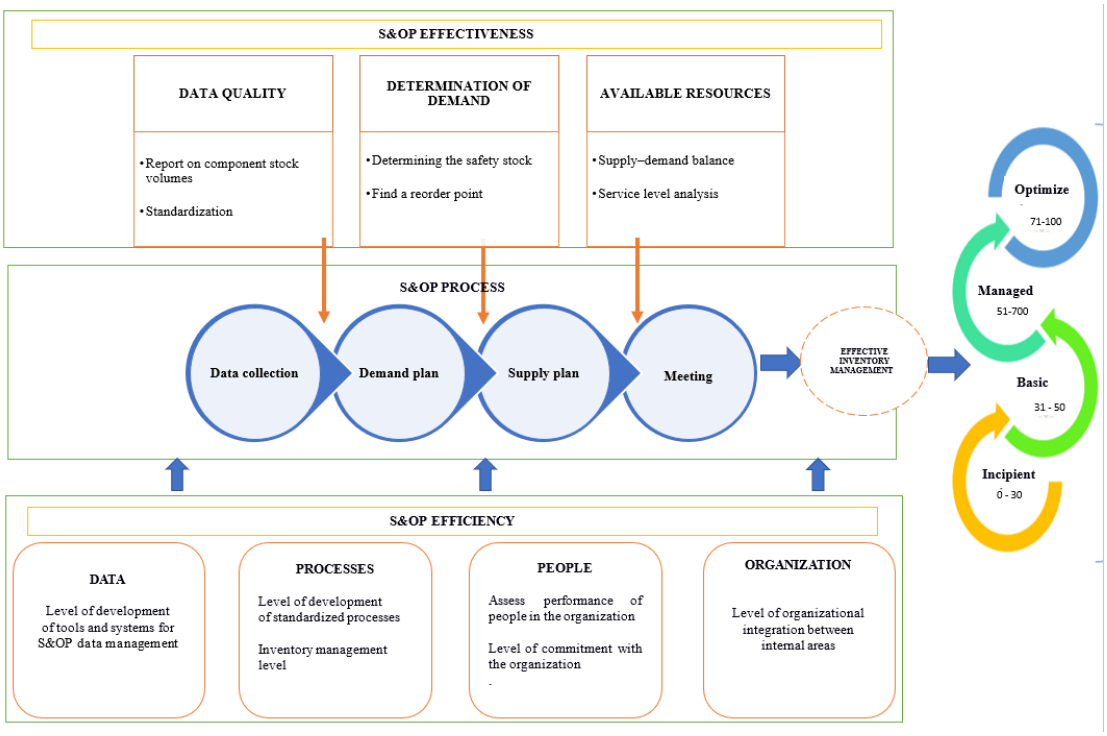

Figure 1: Proposal S&OP Model based on Hana Hulthen (2016)

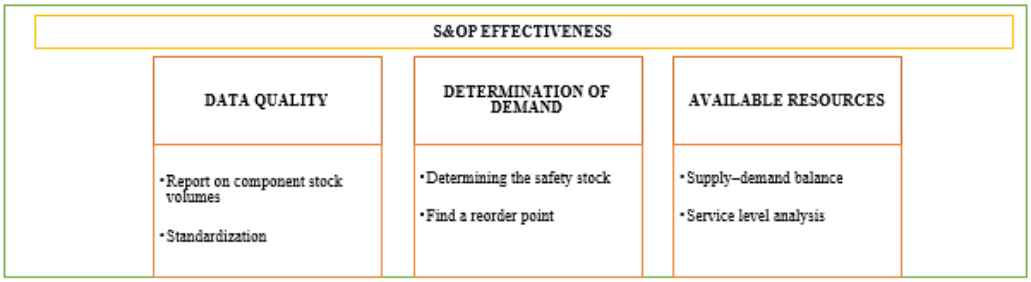

Figure 2: Dimensions to achieve S&OP Effectiveness

III.I.II.I. Component 1

S&OP EFFECTIVENESS: The first component is defined as S&OP effectiveness, which encompasses the different dimensions that must be added to each step of S&OP. Each criterion of the above-mentioned component will be detailed below.

III.I.II.I.I. Data quality

This is the first dimension to consider, as it will be added to the first step of the S&OP process. In this dimension, the report on component stock volumes can be executed, which will serve as a support for the corresponding analysis in subsequent processes. Furthermore, the processes will be standardized to align the operation with the organization objectives and improve inventory management. The purpose of data quality is to measure and analyze the information collected in order to optimally enter the data into the S&OP process. For such purpose, the Checklist tool will be used, for a good audit of all the necessary data to take into account and keep track thereof. This should be measured by means of the following:

Table 2: Data Quality Criteria

DATA INDICATOR	DEFINITION
Completeness	The information acquired consists of all the elements required for data quality.
Conformity	The data should be in a standard format for better understanding.
Consistency	Cross-checking the information in various processes to avoid contradiction.
Accuracy	Determine whether the data is accurate to be used.
Integrity	Know if a record contains all relevant information to be used.

Table 3: Data Quality Interpretation Interpretation:

STATUS	MEASUREMENT	DEFINITION	SCORE
Incipient	1–2 indicators	Meets only one indicator.	1
Moderate	3 indicators	Meets two indicators.	2
Good	4 indicators	Records three indicators and is in the course of improvement**.**	3
Advanced	5 indicators	Records five indicators and can be said to have data quality.	4

III.I.II.I.II. Determination of Demand

The safety stock and reorder point of spare parts will be determined based on this criterion in order to meet demand variability. In addition, the demand forecasting tool will be used to determine the optimal inventory needed to meet demand. On the other hand, we will make use of the ABC classification to determine which spare parts should be further purchased and which should not.

Table 4: Demand and Inventory level to determine the demand

INDICATOR	DEFINITION	SCORE
DEMAND > INVENTORY LEVEL	Higher demand and lower inventory means that demand cannot be met. This causes losses to the company.	1
DEMAND < INVENTORY LEVEL	A demand lower than the inventory level can result in overstock.	2
DEMAND = INVENTORY LEVEL	A demand equal to the inventory level will satisfy customers and generate profit.	3

The results of the ABC Analysis will be interpreted as follows.

Table 5: ABC Analysis

STATUS	DEFINITION	SCORE
C Inventory < ABC	Group C inventory is less than that suggested by the ABC tool	3
C Inventory = ABC	Group C inventory is the same as that suggested by the ABC tool	2
C Inventory > ABC − C	Group C inventory exceeds that suggested by the ABC tool	1

III.I.II.I.III. Available resources

At this point, the supply–demand balance will be established for optimizing the spare parts inventory management. In addition, a service level analysis will be carried out to determine the response capacity. The following formula will be used for the application thereof.

$$\textit{Service level (in \%)} = \frac{\textit{No. of rentals fulfilled}}{\textit{No. of rentals fulfilled} + \textit{No. of rentals unfulfilled}} \quad (1)$$

Table 6: Resources analysis

INDICATOR STATUS		DEFINITION	SCORE
NS > 0.7	Appropriate	They have an optimal service level, since they have the necessary spare parts and machinery to meet the demand.	3
0.5 < NS <= 0.7	Acceptable	Requires basic modifications in order to make correct use of the service level.	2
0 < NS <= 0.5	Inappropriate	Requires serious changes, as the service level is not used properly.	1

III.I.II.II. Component 3

S&OP EFFICIENCY: The third component of the model consists of four dimensions that will serve as the basis thereof and are indispensable for achieving efficiency during S&OP development.

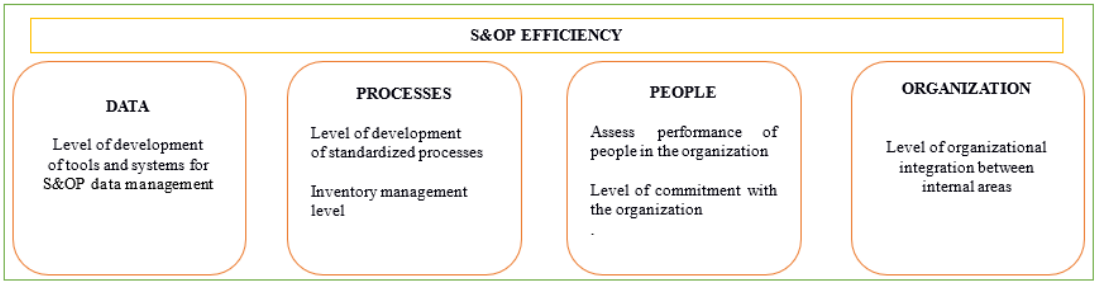

Figure 3: Dimensions to achieve S&OP Efficiency

III.I.II.II.I. Data

This dimension will focus on recognizing the development level of S&OP tools. A checklist will be used to evaluate the tool scale. Author Kjellsdotter Line was taken as a reference for the development of this tool in order to define the criteria thereof. The above mentioned will be presented below.

Table 7: Development level of S&OP tools

Tool Scale	**Definition**	**Score**
Basic tools	Spreadsheet tools such as Microsoft Excel	1
Functional tools	ERP tools	2
Integrated tools	Integrated tools or systems	3
Complex tools	Complex systems or simulation	4

III.I.II.II.II. Processes

The inventory turnover indicator will be used for measuring the inventory management. For this purpose, we have taken as a reference the standard formula thereof, which is presented below.

$$Inventory\ Turnover = \frac{AnnualOutputs}{AverageStock} \qquad (2)$$

This will be interpreted as follows.

Table 8: Inventory Turnover Analysis

Measurement	**Interpretation**	**Score**
R.I < 5	Poor development of the Inventory Management process	1
5<= R.I <8	Moderate development of the Inventory management process	2
R.I >8	Advanced development of the Inventory management process	3

III.I.II.II.III. People

This dimension will be measured by means of using two different tools. The first is Gallup Q12 developed by the author George Gallup.

This tool allows to quantitatively determine the commitment of company's employees. As shown in the following table.

Table 9: Commitment of company's employees analysis

STATUS	**DEFINITION**	**SCALE**	**SCORE**
Disengaged	The employee has no interest in meeting the individual and organizational objectives.	1 and 2	1
Neutral	The employee meets the individual objectives but not the organizational objectives and goals.	3	2
Engaged	The employee identifies with the organization and is aligned with the organizational goals.	4 and 5	3

The second will evaluate employee performance using the 360 tool developed by the author Rafael Bisquerra. The totals of these two tools are calculated by the average of all the competencies assessed by the three levels. The totals are calculated by the average of all the competencies assessed by the three levels. Thus, if the assessed employee obtains a score of 1 to 3, it is considered poor performance. the other hand, a score of 3 to 4 is considered average performance and a score of 4 to 5 is considered outstanding performance.

In this way, the rating of the "Employee" dimension will be the sum of Q12 and 360 evaluation results.

III.I.II.II.IV. Organization

This dimension will focus on defining the areas level of integration in the S&OP process. A questionnaire of ten questions related to integration and collaboration in the company was used to achieve this objective. The following image shows the definition of each scale and the corresponding score according to the company's status.

Table 10: Level of integration in the S&OP process

TOOL SCALE	DEFINITION	SCALE	SCORE
Basic Integration	Measures the good relationship between all areas of the company	Higher "disagree" score	1
Defined Integration	The areas share and meet their organizational objectives	Higher "neither agree nor disagree" score	2
Improved integration	All areas together manage to align their individual objectives with the organization's objectives	Higher "agree" score	3

Once each dimension has been determined, the level of importance will be defined as a percentage of the two components of the proposed model:

Table 11: Percentages of the proposed model components

COMPONENT	WEIGHT	DIMENSIONS	WEIGHT
COMPONENT 1	50%	DATA QUALITY	30%
		DETERMINATION OF DEMAND	35%
		AVAILABLE RESOURCES	35%
COMPONENT 3	50%	DATA	30%
		PROCESSES	26%
		PEOPLE	23%
		DATA QUALITY	21%

After obtaining the percentage of each dimension, a standard formula is defined in order to know the current status of the company after implementing the model. This formula is shown below.

$$\textit{Effectiveness dimension score} = \Sigma W * N$$

$$\textit{Efficacy dimension score} = \Sigma Q * N \quad (3)$$

$$\textit{Model score} = C\ (\textit{effectiveness dimension score} + \textit{efficiency dimension score})$$

W: Weight of the effectiveness dimension

Q: Weight of the efficiency dimension

N: Criteria score for a dimension

C: Weight of the component

Furthermore, a maturity model was implemented as an evaluation tool. This model will allow the company to know its S&OP status according the score obtained from the previous formula. Once the level of the company has been determined, the necessary requirements can be identified to scale to the next level in order to optimize inventory management, as shown in the table below.

Table 12: Characteristics of model dimensions

DIMENSIONS	INCIPIENT	BASIC	MANAGED	OPTIMIZED
DATA QUALITY	Meets a single indicator of everything that determines total quality.	Meets two indicators of everything that determines total quality.	Meets three indicators of everything that determines total quality.	Meets four or five indicators of everything that determines total quality.
DEMAND FORECAST	Group C inventory is more than 20% higher than that suggested by the ABC tool.	Group C inventory is less than 20% higher than that suggested by the ABC tool.	Group C inventory is the same as that suggested by the ABC tool.	Group C inventory is less than suggested by the ABC tool.
	The company has a demand greater than the inventory level.	The company has an inventory level higher than the demand.	The company has a demand equal to the inventory level.	The company has a demand equal to the inventory level.
AVAILABLE RESOURCES	The service level is not used properly, since less than 50% of it is used.	The service level is used in more than 50% and less than 70%.	They have an adequate level of service since they make use of more than 70% and less than 85%.	Develops a service level of over 85%.
DATA	Spreadsheet tools such as Microsoft Excel	ERP tools	Integrated tools or systems	Complex systems or simulation
PROCESSES	Inventory turnover rate is less than 50%.	Inventory turnover rate is greater than 50% and less than 80%.	Inventory turnover rate is greater than 80% and less than 90%.	Inventory turnover rate is greater than 90%.
PEOPLE	The employee has no interest in meeting the individual and organizational objectives.	The employee meets the individual objectives but not the organizational objectives and goals.	The employee identifies with the organization and is aligned with the organizational goals.	The employee identifies with the organization and maintains an outstanding performance.
ORGANIZATION	Poor relationship between the employees of each area of the company subject to the study	Defined integration is reflected between the employees of each area of the company	Improved integration is reflected, since the areas manage to align individual objectives with organizational objectives	Optimal integration is reflected where the areas manage to align individual objectives with organizational objectives

This table determines the company's level of maturity as shown in the proposal design.

III.I.III. Implementation guide

The flow chart below shows how the model proposed by the authors is implemented.

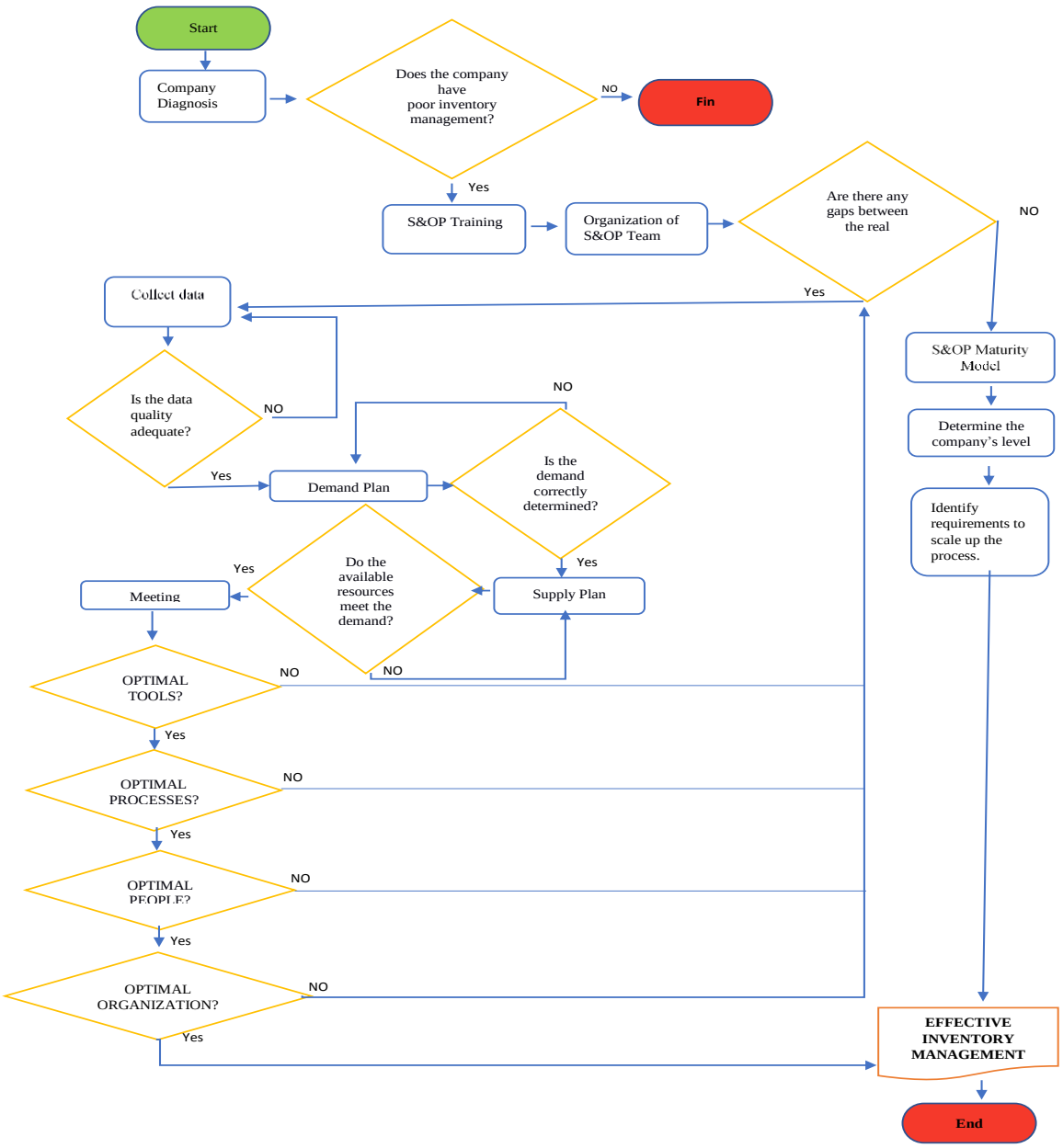

Figure 4: Implementation Guide

III.II. Case study

In this section the proposed model is implemented following the proposed flow chart as a guide. The selected company is an industrial machinery company that offers rental services of different equipment to other companies in various fields such as industrial, mining, and construction. In recent years, this company had problems in the logistics area, since there is a spare parts overstock in the storage area, which has generated stock and financial losses. The model implementation is described below.

III.II.I. STEP 1 Company diagnosis

We went to RD Rental Company and talked to the heads of the different areas. First, we took a tour of the Logistics area, which has the greatest impact on the model development. We took some pictures thereof showing poor inventory management.

Afterwards, we interviewed the managers of the area subject to the study and through these interviews, questionnaires, and data collection, we found that the company was facing inefficient inventory management in the maintenance process. We took samples to demonstrate the model efficiency.

III.II.II. STEP 2 S&OP Training

Consequently, the heads of Logistics, Sales, Directors, and Supervisors were trained as shown in the following image. The main topic of training was the S&OP process, which unfolded in conceptualization, S&OP steps, and implementation of the proposed model. They were also provided with physical guidance on treaties in implementation.

III.II.III. STEP3 S&OP Team organization

To carry out the appropriate S&OP development, we needed a team covering important roles and responsibilities in this regard. Thus, we designated the team after training, based on their skills and knowledge. These people also provided quantitative data on the processes necessary for model execution.

Table 13: S&OP Team organization

S&OP POSITION	NAME	JOB TITLE	RESPONSABILITIES
S&OP Leader	Anibal Rivera	Administrative Manager	• Ensure the execution of the S&OP process. • Report process inconsistencies • Leader in S&OP meetings • Ensure the supply–demand balance
Demand Planner	Rafael Ticona	Head of Logistics	• Make forecasts • Controls demand planning indicators • Ensures forecast accuracy
Supply Planner	Miguel Pastor	Head of Services	• Consolidate service capacity with inventory level • Controls supply planning indicators • Controls inventory classification
Service Planner	Tonny Cajacuri	Spare Parts Supervisor	• Generate purchase requirements • Communicate and align planning needs with the commercial area

III.II.IV. STEP 4 Collect data

We asked the Logistics area for information about the reports on spare parts inputs and outputs. They also provided information on the management of spare parts purchases and stock volume reports.

They stated that the company only counted on a Kardex as sole inventory control tool. This only shows the inputs and outputs of all the spare parts they have.

On the other hand, they stated that the person in charge of managing purchases was the storekeeper. This person placed orders for spare parts based on their work experience and according to spare parts movement.

III.II.IV.I. Data quality

Based on the information provided by the company such as Kardex tool, we organized the data required for S&OP implementation. Thus, we were able to classify information such as spare parts outputs, inputs, stock level, and spare parts turnover by means of Kardex.

Table 14: Data collection

Description	brand	annual outputs (dollars)	Maximum probability (month)	Indicator	storage time	current stock (pieces)	price in dollars/ piece
OIL							
VDS-4 ENGINE							
(19 LITRES LARGE	VOLVO	60,111.21	866	69.4 0 months	0	6.18	
CANS)							
VOLVO							
(23068344							

III.II.V. STEP 5 Demand plan

First of all, we classified all the spare parts according to the ABC method. This will allow the company to know the products with the greatest and least economic impact.

Table 15: ABC Classification

CLASIFICATION		SOLES	%	UNITS	%
A	YELLOW	S/l,110,792.84	80	426	17
B	GREEN	S/208,271.72	15	661	27
C	RED	S/70,058.70	5	1384	56
		S/1,389,123.26		2,471	

As mentioned above, the company does not have any kind of demand calculation, which is evidenced by the way in which the spare parts orders were placed. Therefore, the forecasts of each spare part were made with the information collected from Kardex. We calculated them using Minitap, as it was more convenient to apply the statistical calculation. The results obtained are shown in the following image.

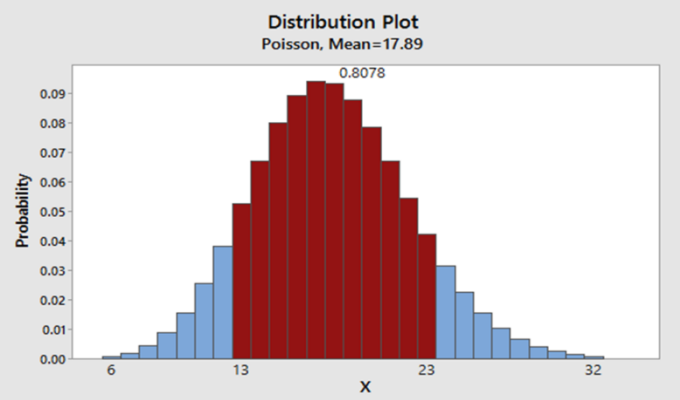

Figure 5: Distribution Plot

As shown in the chart, the 80.78% probability of demand is between the mentioned values. The average demand thereof is shown, thus we considered using the average and adding a unit without stock-outs.

As indicated above, the average demand for each spare part was calculated.

III.II.V.I. Safety stock determination

In order to determine the safety stock, we use the following formula:

$$Safety\ stock = Lead\ time * monthly\ demand \quad (4)$$

Table 16: Safety stock determination

Spare Part Name	Current Stock	Lead Time	Monthly demand	Minimum Stock	Reorder point (MONTH)	Maximum Stock
PERKINS AIR FILTER	15	0.25	10	3	1.5	18

III.II.V.II. Reorder point

The reorder point was established through policies based on the criteria of the spare parts buyer and the chief service officer related to their experiences in product movement. On the other hand, the maximum stock level was calculated using the data obtained.

$$Reorder\ point = \frac{Maximumstock - Minimumstock}{Monthlydemand} \quad (5)$$

III.II.VI. STEP 6 SUPPLY PLAN

Therefore, the company service level is calculated in order to determine whether the demand can be met.

Table 17: Capacity Analysis

CAPACITY ANALYSIS			
COMPANY:	RD RENTAL	AREA:	LOGISTICS
POSITION	Chief Services Officer – Miguel Pastor		
DATE	May 06th, 2018		
Service level (in %) = $\frac{No.\ of\ rentals\ fulfilled}{No.\ of\ rentals\ fulfilled + No.\ of\ rentals\ unfulfilled}$ x 100 No. of rentals fulfilled = 600 x month No. of rentals unfulfilled= 150 x month Service level = 0.8			
Service level	0.8		

III.II.VII. STEP 7 Meeting

A board of directors meeting was held with all those involved in the project to analyze the results obtained and establish actions for further improvement.

III.II.VII.I. Actions to further improve s&op

- Increase the level of service in order to increase the company's profits.
- Perform spare parts sales that exceed the suggested maximum stock level.
- The maturity model should be considered to improve the implemented processes, since it allows the process results to be scaled up and improved at the same time.

STEP 8 S&OP Efficiency

The next step is to assess whether the company meets the necessary minimum criteria to achieve S&OP tool efficiency.

III.II.VII.II. Data

In this dimension we verified that the company now has two of the necessary tools for S&OP inventory management process, as shown in the following picture.

Table 18: Verification of S&OP tools

DATA		
COMPANY:	RD RENTAL	LOGISTICS
POSITION	Administrative Manager (S&OP Leader)	
DATE	May 05th, 2018	
TOOLS	**YES**	**NO**
SPREADSHEETS	X	
ERP	X	
INTEGRATED SYSTEMS		X
COMPLEX SIMULATION		X

III.II.VII.III. Processes

In this dimension we measured the product turnover level and the results obtained determined that the company has an acceptable index in the S&OP process.

Table 19: Product Turnovrt Analysis

PROCESSES			
COMPANY:	RD RENTAL	AREA:	LOGISTICS
POSITION	Spare Parts Supervisor (Service Planner)		
DATE	May 05th, 2018		

$$ANNUAL\ INVENTORY\ TURNOVER = \frac{Annualoutputs}{averagemonthlystock}$$

Annual outputs = 2,778,246.52
Average monthly stock = 451549

ANNUAL INVENTORY TURNOVER = $\frac{}{6.15}$

III.II.VII.IV. People

For this dimension we checked whether the organization has an appropriate commitment and performance level to achieve the desired results in the S&OP process.

Table 20: Commitment level analysis

GALLUP Q12					
COMPANY:	RD RENTAL	**POSITION**	Tony Cajacuri		
AREA	LOGISTICS	**DATE**	May 05th, 2018		
QUESTIONS	**STRONGLY AGREE**	**AGREE**	**NEITHER AGREE NOR DISAGREE**	**DISAGREE**	**STRONGLY DISAGREE**
Do I know what is expected from me at work?	X				
Do I have the materials and equipment needed to do my work?				X	
At work, do I have the opportunity to do what I do best every day?					X
In the last seven days, have I received recognition or praise for doing good work?		X			
Does my supervisor, or someone at work, seem to care about me as a person?			X		
Is there someone at work who encourages my development?		X			
At work, do my opinions seem to count?			X		
Does the mission/purpose of my company make me feel my job is important?					X
Are my coworkers committed to doing quality work?				X	
Do I have a best friend at work?		X			
In the last six months, has someone at work talked to me about my progress?			X		
This last year, have I had opportunities at work to learn and grow?			X		
SUM	1	3	4	2	2
SCORE	5	4	3	2	1

CONCLUSION		
RESULT	**OBSERVATION**	**SCORE**
360 EVALUATION	The result of the 360 evaluation is that the company's personnel are considered to have an average performance.	3.6

III.II.VII.V. Organization

The company has a basic integration due to the full integration of the logistics area but has not yet achieved full integration between all areas. While not optimal, it is within the acceptable range of the S&OP.

Table 21: Organization integration analysis

ORGANIZATION				
COMPANY:	RD RENTAL	**AREA:**	LOGISTICS	
POSITION:	S&OP team			
DATE:	May 05th, 2018			
INTEGRATION		**AGREE**	**NEITHER AGREE NOR DISAGREE**	**DISAGREE**
Do I provide information to other areas or people who need it in the organization?				X
Do other areas or people give me information when I need it?				X
Do I maintain good communication with people in other areas?		X		
Can I participate in the company's decision making?			X	
Do managers interact with people from all areas?				X
Are there people in the company who motivate me?				X
Are there integration activities in the company?			X	
Do you have knowledge of the company's organizational objectives?				X
Do you consider that there is effective communication in the company?			X	
Is truthfulness and respect promoted in the company?		X		
RESULTS		2	3	5
SCORE		3	2	1

III.II.VIII. STEP 9 Maturity model

Therefore, the score of each dimension was determined after the implementation of the model as shown in the following table.

Table 22: Current state of S&OP in the case companie

DIMENSION	**RESULTS**	
DATA QUALITY	**Test**	**Score**
	4 indicators	3
DETERMINATION OF DEMAND	**Demand**	**Score**
	DEMAND < INVENTORY LEVEL	2
	ABC	**Score**
	C Inventory = ABC − C	2
AVAILABLE RESOURCES	**Indicator**	**Score**
	0.5 < N.S <= 0.7	2
DATA	**Scale**	**Score**
	Functional tools	2
PROCESSES	**Scale**	**Score**
	5 <= R.I < 8	2
PEOPLE	**Gallup Q12**	**Score**
	3	2
	360 evaluation	**Score**
	3 4	2
ORGANIZATION	**Test**	**Score**
	Higher “disagree” score	1

After obtaining the scores for each model dimension, the established formula was developed:

Effectiveness dimension score = 0.3(3) + 0.35(2 + 2) + 0.35(2) = 3

Efficiency dimension score = 0.3(2) + 0.26(2) + 0.23(2) + 0.21(1) = 1.79

Model score = 0.5(3) + 0.5(1.79)

Model score = 2.39 = 57.31

The equation result establishes through the maturity model that the company falls under Level III: Managed.

IV. VALIDATION

IV.I. Assesment

In order to compare the actual result with what the specialists wanted to achieve in terms of Sales and Operation Planning development, we proposed an assessment. It consists of nineteen questions that focus on the level of importance of proposed model dimensions and criteria thereof from S&OP experts’ perspective.

Figure 6: Optimized, Managed, Basic, Incipient

Table 23: Proposed assessment to know the ideal level of S & OP for the company

ASSESSMENT							
				Key			
Name				1	Not important		
Position				2	Slightly important		
S&OP member				3	Important		
				4	Very important		
DIMENSIONS				1	2	3	4
Data quality	What is the data quality level you consider the organization should have?						
	How important do you consider the stock volume report to be as S&OP process input?						
	What degree of standardization do you consider the organization should have?						
Determination of demand	What level of demand determination development do you consider the company should have?						
	How important do you consider the safety stock determination to the inventory management process?						
	How important do you consider the reorder point determination?						
Resources available	How important do you think it is for the company to have resources available to meet demand?						
	How important do you consider the supply–demand balance in the inventory management process?						
	What level of service do you think the company should have to meet the demand?						
Data	How important do you consider the level of development of data management tools?						
Processes	How important do you consider the inventory management processes in the organization?						
	What degree of standardization do you think processes should have in inventory management?						
	What level of management do you consider the most optimal in spare parts inventories?						
People	How important should employees be to the company?						
	What level of organizational commitment do you think employees should have in the company?						
	What level of performance do you think employees should have in the company?						
Organization	How important should the company's S&OP process be to you?						
	What level of integration do you consider should exist across the areas of the company?						
	How involved should senior management be in the S&OP process?						

To complete this assessment, we invited S&OP team members to develop it. The selection thereof was based on their level of knowledge of the subject matter and their mastery and experience in the area in which they worked, as shown in the table below.

Table 24: Characteristics of the selected experts

EXPERTS	
Number	3 to 5 experts
Experience	6 to 10 years of experience in areas related to demand, supply, purchase, and/or inventory management
Knowledge required	Intermediate or advanced level knowledge of Sales and Operation Planning development processes

IV.II. Assesment vs maturity

Therefore, the results obtained were tabulated using the following format:

Table 25: Assesment maturity results

ASSESSMENT RESULTS				
ASSESSED DIMENSIONS	**S&OP MEMBERS**			
	S&OP LEADER	**DEMAND PLANNER**	**SUPPLY PLANNER**	**SERVICE PLANNER**
Data quality	12	10	12	11
Determination of demand	12	12	11	11
Available resources	12	11	12	11
Data	4	4	4	3
Processes	12	12	12	12
People	12	12	12	12
Organization	12	11	12	9
Score	76	72	75	69
Total score	73			
Interpretation	The ideal level for the company is the optimized one			

As can be seen in the table above, the results obtained show a score of 73. Comparing this result with the maturity level, we found that the ideal level for the company would be the optimized one. Therefore, they should follow the actions recommended by the model to scale from managed to optimized level, as shown in the table below.

Table 26: Recommended actions to scale from one level to another

IMPROVEMENT MEASURES	
INCIPIENT	* Ensure that the information provided is real * Have the necessary data to determine the current situation of the company * Senior management and organization staff commitment * Motivate staff with small incentives.
BASIC	* Creation of templates for collected data standardization * Follow up with areas to determine if organizational objectives have been met * Control group C inventories until reaching the ABC level.
MANAGED	* Receive feedback from all the company's employees * Count on 5% of safety stock * Process mapping * Determine weekly cyclic inventories.
OPTIMIZED	*Continuous improvement to ensure effective compliance with S&OP process.

Table 27: Actual vs. Model

INDICATOR	BEFORE	AFTER	PERCENTAGE DIFFERENCE
Inventory turnover	50%	25%	−25%
Demand forecasting errors	84%	10%	−74%
Percentage cost of spare parts on total rentals	S/. 13,462.25	S/. 6,410.60	−52%
Overstock	56.41%	8.74%	−47.67%

IV.III. Actual vs model

To determine the improvement of inventory management in the case study, we took into account the following indicators, which were measured before and after the implementation of the proposed model. We have selected these indicators because the criteria they consider are found in the S&OP process.

$$Inventory\ turnover\ = \frac{annualoutputs}{Maximummonthlyprobability}$$

$$Demand\ forecasting\ errors = \frac{Demandforecast - ActualDemand}{ActualDemand}$$

$$Percentage\ cost\ of\ spare\ parts\ on\ total\ rentals = \frac{Sparepartsexpenses}{Rentals}\ x\ 100$$

$$Overstock\ percentage\ = \frac{Overstock * 100}{Totalinventories}$$

The results of this comparison are shown in the above table (table 27).

As can be seen, the improvements achieved were very significant for the company. Among them, demand forecasting errors and overstock were two indicators that were significantly reduced, since they are related to each other and the model focused directly on them.

On the other hand, the model also generated other positive impacts on the organizational environment. First, by implementing and validating the proposed model, the environmental impact was reduced, since only the spare parts necessary for business operation will be requested and thus, suppliers will reduce the pollution level upon manufacturing. Secondly, there is the social impact. This is generated by the great impact on the organization employees' quality of life, since it reduced tensions and achieved efficiency by allocating the necessary resources and approving modifications in capabilities. Moreover, S&OP allowed for improved resource distribution and thus greater profitability for the company. Finally, the company may propose security policies through the improvement actions identified during the process.

V. CONCLUSION

S&OP model was easily accessible for SMEs in the industrial machinery rental sector, as it helped to optimize inventory management. As shown by the results, the main problem, namely the Overstock was reduced by 47.67%, which proves that the proposed model is effective and efficient. In the same manner, demand forecasting errors were reduced by 74%, as they were related to the main problem and the process was significantly improved as shown in the result.

Furthermore, the S&OP model implementation allowed the company to improve the work climate and the integration between areas, since the tools proposed by the model can improve those aspects that are not understood and generate organizational chaos.

On the other hand, the maturity model allows the organization to know its level and what actions needs to be taken to scale to another level in order to improve the inventory management process in the organization. Finally, the result of the assessment allows for generation of the improvement plan through the proposed actions in order to bring the company up to the desired level of the maturity model.

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