Design and Implementation Proposal for Operational Process Efficiency: Lean Manufacturing, CRM and marketing segmentation at Intermet-2024

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***Abstract*– This work addresses the operational challenges faced by InterMet in event management, based in Perú, proposing the implementation of Lean Manufacturing, CRM (Customer Relationship Management) and marketing segmentation to improve efficiency and competitiveness. These strategies optimize internal processes and allow for a better understanding of customer needs, which is crucial in a competitive market.**

In the presentation of results to the board, it was highlighted that both Lean Manufacturing and CRM are feasible to implement according to the company's CEO. These initiatives will not only generate short-term benefits but also lay the foundation for sustainable growth and increased future profitability. The report uses industrial engineering tools to provide practical solutions to InterMet's specific challenges.

***Keywords*-- Efficiency, Competitiveness, Lean Manufacturing, Market Segmentation and CRM.**

I. Introduction

A consulting and training company in this field faces a series of problems that directly affect the quality of its services and, consequently, its competitiveness in the market. Among the main difficulties are the lack of standardized processes, the absence of a formal monitoring system, and the inherent complexity of the industry.

In this context, quality becomes essential for customer satisfaction and operational efficiency. InterMet, as a training and event management company in the mining sector, must strengthen both its internal and external practices. This need is aligned with the current priorities of the Ministry of Energy and Mines, which seeks to improve the global positioning of the Peruvian mining sector through the promotion of new projects and the sustainability of operations, with an emphasis on social and territorial responsibility. Under this framework, InterMet can play a crucial role by offering training programs that incorporate innovative technologies, sustainable practices, and corporate social responsibility. These efforts would allow mining companies to meet the required standards while contributing to more responsible and globally competitive development.

Despite this opportunity, InterMet faces critical challenges that affect its profitability and market reach. Inefficient registration processes generate long waits and participant frustration due to the lack of a clear credential management system. This has caused delays and highlighted the need to streamline and optimize registration activities.

Financial aspects also represent a major difficulty. Operational costs have exceeded profits, placing the company under financial pressure. This situation is aggravated by low attendance at events, which reduces revenues. Additionally, the strategy of offering excessive discounts, although initially attractive, has diminished the perceived value of the courses and conferences, further affecting profitability. These challenges demand urgent and strategic actions to reverse the trend and secure the company's sustainability within the mining and specialized events industry. Similar improvements may also be applicable to the metallurgical sector, which is currently experiencing growth in Peru.

Given this scenario, it is crucial for InterMet to adopt comprehensive strategies that address these issues. From process standardization to technological investment and improved resource management, the company must implement solutions that enhance both quality and efficiency across its operations.

Finally, although the proposal focuses on InterMet's context, the results obtained have a transferable character. With appropriate adaptations, the recommendations such as process standardization, strategic use of CRM, and the adoption of Lean tools can also be applied in other mining and metallurgical organizations, as well as in entities managing specialized technical events. In this way, the study offers practical guidelines to optimize operational management, strengthen customer relationships, and increase competitiveness in diverse scenarios.

II. Methods

Lean Manufacturing

According to Cesar (2021), Lean Manufacturing is a labor management method focused on optimizing the production system by eliminating tasks that do not add value to the process or to the customer. These unnecessary tasks, known as waste, can hinder production, cause service delays, generate overproduction, and create other negative effects.

To implement Lean Manufacturing, the following steps must be considered, taking into account the "5S" methodology:

- Identify Waste: Conduct a detailed analysis of business processes and registrations to detect activities that do not add value. Classify waste according to Lean Manufacturing principles, such as overproduction, excessive inventory, unnecessary transportation, waiting, unnecessary processes, unnecessary movements, and defects.
- Establish Standardized Processes: Develop clear, documented work standards for all business activities and

enrollment procedures. Ensure that all team members are aligned on how tasks should be performed.

• Eliminate Waste: Implement actions to reduce or eliminate identified waste, such as streamlining processes, reducing inventories, and optimizing workflows. Tools such as the Value Stream Map (VSM) can be used to visualize and analyze workflows and identify areas for improvement.

• Continuous Improvement: Promote a culture where teams are constantly looking for ways to optimize processes and eliminate waste. Apply improvement cycles such as PDCA (Plan, Do, Check, Act) to iterate and refine processes on an ongoing basis.

Table I. Problem to be solved by Lean Manufacturing (Own elaboration)

Problem: inefficient registry	ALTERNATIVE A: **"5 S": Numerical or alphabetical organization system**	ALTERNATIVA B **"DAP"**: Implementación de un sistema de flujo continuo de credenciales
Economy Implementation cost	S/. 774	S/. 893
Time Implementation time	8 days	10 días
Accesibility	70%	50%

NOTE OWN ELABORATION

Customer Relationship Management (CRM)

According to Augusto (2021), CRM is a strategy that leverages information technologies to establish and strengthen relationships with customers. Its main objective is to gain a detailed understanding of customers' needs, interests, and purchasing behaviors.

A CRM system centralizes customer data by consolidating sales interactions and registrations. This prevents duplication of effort and ensures that all team members have access to updated information about clients and related activities. Moreover, CRM systems usually provide automation tools such as follow-up reminders and automated workflows. These features contribute to standardizing and simplifying processes, reducing manual work, and minimizing errors or task duplications.

To implement CRM in InterMet, two steps are essential:

• Identify Needs: Determine the specific requirements of the commercial and enrollment areas and select a CRM system that can meet them, including lead management, customer tracking, and task automation.

• System Configuration: Adapt the CRM to reflect InterMet Peru's processes, customizing fields, workflows, and automations according to the company's needs.

Table II. Aspects to be considered

Aspect	Quantity	Cost	TOTAL
Licenses	3	$50.00 (Monthly)	$150.00
One-time Implementation cost	1	$1,000	$1,000
Customization & Configuration	1	$500.00 (Monthly)	$500.00 (Monthly)
Training Sessions	1	$500.00 (only time cost)	$500.00 (only time cost)
Monthly Technical Support	1	$100.00	$100.00

NOTE SOURCE INTERMET

Table III. Problem to be solved by crm

Problem Outdated database, preventing efficient customer outreach.	**Alternative A "TRELLO"** Project management software	**Alternative B "CRM"**: Customer Relationship Management
Maintainability Total cost of maintainability	$2 100.00	$1 350.00
Economics Total cost of implementation	$1 125.00	$1 085.00
Time time of implementation	7 meses	6 meses

NOTE OWN ELABORATION

1. Marketing Segmentation

InterMet primarily targets the mining market, which includes companies, industries, and professionals related to this sector. The main customer groups can be classified as follows:

• Mining Companies: Organizations engaged in the extraction and processing of minerals, both domestically and internationally. This includes metallic and non-metallic mining, as well as coal mining companies.

• Suppliers and Service Companies: Businesses that provide products, services, and technological solutions to the mining industry, such as machinery suppliers, safety equipment manufacturers, engineering consultants, and logistics providers.

• Sector Professionals: Engineers, geologists, metallurgists, mining technicians, operations personnel, managers, and directors of mining companies, as well as independent professionals linked to the sector.

• Educational and Research Institutions: Universities, research centers, and academic bodies that specialize in mining-related topics, offering training, research, and development programs.

• Government and Regulatory Bodies: Agencies, ministries, and regulatory entities responsible for creating policies, regulations, and standards for the mining industry.

• Investors and Financiers: Individuals and institutions interested in funding mining projects, such as investment funds, banks, and other financial entities.

2. Demographic Segmentation

InterMet focuses on countries with significant mining activity. Its events primarily attract male professionals and students between the ages of 30 and 50. This demographic approach allows the company to design activities aligned with participants' specific needs and preferences, ensuring relevant and engaging content.

3. Market Specialization

The company targets professionals and firms interested in specialized mining topics such as tailings processes, comminution, hydrometallurgy, and copper extraction. These clients usually aim to establish relationships with large mining companies or secure

business contracts. Their socioeconomic profile tends to be upper-middle class, which supports participation in events of this nature.

4. Developing Customer Profiles

Creating detailed customer profiles helps InterMet better understand its target audience, their motivations, and their purchasing behaviors. This information enables the company to design customized marketing and sales strategies aimed at attracting and retaining participants.

Table IV. Potential customer profile

Age	35 años	42 años
Gender	Male	Female
Major	Mining Engineer	Geologist
Country	Lima, Perú	Santiago, Chile
interests and values	Mining technology innovation, new extraction techniques	Environmental sustainability, responsible management of natural resources
Purchasing Behavior	Search for training and updating opportunities	Participation in events that address conservation and environmental impact reduction issues.

NOTE OWN ELABORATION

Table V. Market research costs

SPECIFICATION	VALUE
DESIGN	
Cost of survey design:	$150
SOFTWARE	
Cost of survey software	$300
AUDIENCE	
Cost of recruiting participants	$1,000
Cost of staff	$1,500
TOTAL COST:	**$2,750**

NOTE OWN ELABORATION

Table VI. Market research costs

Problem: Costs outweigh profits	ALTERNATIVE A: **Marketing segmentation**	ALTERNATIVE B **Positioning strategies**
Economics Total cost of implementation	$2750	$13000-
Time time of implementation	4 meses	8 meses

NOTE OWN ELABORATION

Considering the current economic context of the company, the selected alternative to implement lean manufacturing with a focus on operational efficiency using the 5s as a tool was taken as the selected alternative.

CURRENT SIMULATION

The code in VBA for Excel simulates the process of arrival and processing of guests at an event. It starts by setting the initial conditions necessary for the simulation. The total number of guests expected is defined, in this case, it is set to

200. In addition, the time of the event is set, ranging from 8:30 AM to 10:00 AM. These values are important because they determine the period during which the guests can arrive and be processed.

Before starting the simulation, the code performs a cleanup of the cells in the Excel workbook where the data will be recorded. This ensures that there is no previous information that could interfere with the new data generated during the simulation. The contents of cells A2 through I201 are deleted to start with a clean workbook ready to receive the generated data.

To simulate the arrival of guests, the code uses a nested loop. It iterates twice: once for each group of guests. Within

each iteration, it randomly generates the time at which each guest arrives at the event. This is done by calculating a random arrival time between the start time (8:30 AM) and the end time (10:00 AM) of the event. The "Rnd" function is used to obtain a random number and is set to represent a time within that time interval.

Once a guest's arrival is simulated, we proceed to simulate the processes that must be completed before they can enter the event. These processes include scanning their entry ticket, finding and receiving the welcome kit required for the event. Each of these processes has an associated time that is randomly generated. To ensure that the times are realistic but controlled, a "Do...Loop" loop is used that repeats the generation of times until the sum total of these processes does not exceed 10 minutes. This ensures that guests do not take too long at each stage before entering the event.

Once all the necessary times are generated for a guest, this data is recorded in the Excel workbook. Each row in the workbook corresponds to a specific guest and contains detailed information such as their ID number, the exact time they arrived at the event, the specific times for each stage of the process (scanning, searching and kit delivery), and the exact time they finally entered the event. This provides a clear and detailed view of each guest's arrival and processing flow.

At the end of the simulation for all guests, the Excel workbook shows a complete and organized record of how the actual event arrival and processing process would unfold. This allows us to efficiently analyze and plan logistics, identify possible areas for improvement and ensure a smooth and orderly experience for all event participants.

Table VII. Current simulation

IV. Discussion of Results

Guest number	Check In	End of scanning and verification	Search Home	End of Credential Search	Start of kit delivery	End of kit delivery	Event Entry Time
Invitado 1	08:30:23	08:34:47	08:34:47	08:37:25	08:37:25	08:38:18	08:38:18
Invitado 2	08:30:47	08:31:23	08:31:23	08:33:52	08:33:52	08:35:15	08:35:15
Invitado 3	08:30:48	08:31:34	08:31:34	08:33:55	08:33:55	08:41:48	08:41:48
Invitado 4	08:30:51	08:34:33	08:34:33	08:36:06	08:36:06	08:39:35	08:39:35
Invitado 5	08:31:42	08:33:07	08:33:07	08:36:25	08:36:25	08:39:14	08:39:14
Invitado 6	08:32:30	08:34:47	08:34:47	08:38:57	08:38:57	08:40:54	08:40:54
Invitado 7	08:32:42	08:33:33	08:33:33	08:35:21	08:35:21	08:42:10	08:42:10
Invitado 8	08:32:54	08:38:39	08:38:39	08:40:31	08:40:31	08:43:55	08:43:55
Invitado 9	08:33:01	08:33:35	08:33:35	08:34:07	08:34:07	08:36:45	08:36:45
Invitado 10	08:33:31	08:35:20	08:35:20	08:39:04	08:39:04	08:42:54	08:42:54
Invitado 11	08:34:05	08:37:31	08:37:31	08:42:55	08:42:55	08:43:50	08:43:50
Invitado 12	08:34:38	08:36:58	08:36:58	08:37:49	08:37:49	08:38:27	08:38:27
Invitado 13	08:35:07	08:38:50	08:38:50	08:40:01	08:40:01	08:44:56	08:44:56
Invitado 14	08:35:18	08:35:55	08:35:55	08:41:32	08:41:32	08:46:22	08:46:22
Invitado 15	08:35:34	08:44:29	08:44:29	08:45:09	08:45:09	08:46:34	08:46:34
Invitado 16	08:36:18	08:45:11	08:45:11	08:46:00	08:46:00	08:47:32	08:47:32
Invitado 17	08:37:26	08:46:21	08:46:21	08:48:42	08:48:42	08:49:24	08:49:24
Invitado 18	08:37:39	08:39:30	08:39:30	08:41:17	08:41:17	08:45:42	08:45:42
Invitado 19	08:38:15	08:41:26	08:41:26	08:43:28	08:43:28	08:48:04	08:48:04
Invitado 20	08:38:21	08:41:28	08:41:28	08:44:13	08:44:13	08:45:52	08:45:52
Invitado 21	08:39:07	08:44:34	08:44:34	08:46:44	08:46:44	08:50:14	08:50:14
Invitado 22	08:39:20	08:42:09	08:42:09	08:46:05	08:46:05	08:46:49	08:46:49
Invitado 23	08:40:15	08:45:16	08:45:16	08:48:24	08:48:24	08:52:09	08:52:09
Invitado 24	08:40:30	08:42:03	08:42:03	08:42:56	08:42:56	08:51:47	08:51:47
Invitado 25	08:41:25	08:48:11	08:48:11	08:51:10	08:51:10	08:52:14	08:52:14
Invitado 26	08:41:30	08:43:29	08:43:29	08:46:21	08:46:21	08:48:49	08:48:49
Invitado 27	08:41:36	08:45:11	08:45:11	08:48:26	08:48:26	08:50:45	08:50:45
Invitado 28	08:42:02	08:42:38	08:42:38	08:48:52	08:48:52	08:52:50	08:52:50
Invitado 29	08:42:09	08:43:38	08:43:38	08:44:11	08:44:11	08:48:35	08:48:35
Invitado 30	08:43:13	08:44:04	08:44:04	08:46:05	08:46:05	08:46:40	08:46:40
Invitado 31	08:43:16	08:47:25	08:47:25	08:49:01	08:49:01	08:49:42	08:49:42
Invitado 32	08:43:44	08:45:40	08:45:40	08:46:12	08:46:12	08:47:20	08:47:20
Invitado 33	08:43:45	08:49:38	08:49:38	08:51:04	08:51:04	08:55:02	08:55:02
Invitado 34	08:44:03	08:46:59	08:46:59	08:48:47	08:48:47	08:55:40	08:55:40
Invitado 35	08:44:20	08:45:16	08:45:16	08:51:54	08:51:54	08:54:06	08:54:06
Invitado 36	08:44:53	08:47:11	08:47:11	08:52:16	08:52:16	08:54:19	08:54:19
Invitado 37	08:45:27	08:47:22	08:47:22	08:48:39	08:48:39	08:55:22	08:55:22
Invitado 38	08:46:00	08:50:35	08:50:35	08:52:49	08:52:49	08:55:48	08:55:48
Invitado 39	08:46:06	08:51:28	08:51:28	08:52:28	08:52:28	08:56:30	08:56:30
Invitado 40	08:46:14	08:48:09	08:48:09	08:50:54	08:50:54	08:56:07	08:56:07
Invitado 41	08:46:33	08:48:56	08:48:56	08:55:02	08:55:02	08:57:28	08:57:28
Invitado 42	08:46:47	08:48:49	08:48:49	08:49:45	08:49:45	08:57:40	08:57:40
Invitado 43	08:46:59	08:50:45	08:50:45	08:54:31	08:54:31	08:57:51	08:57:51
Invitado 44	08:47:46	08:49:38	08:49:38	08:52:25	08:52:25	08:58:40	08:58:40
Invitado 45	08:47:50	08:53:31	08:53:31	08:58:47	08:58:47	08:59:34	08:59:34
Invitado 46	08:48:14	08:49:50	08:49:50	08:56:15	08:56:15	08:57:22	08:57:22
Invitado 47	08:48:22	08:53:56	08:53:56	08:56:08	08:56:08	08:59:02	08:59:02
Invitado 48	08:48:24	08:50:57	08:50:57	08:54:20	08:54:20	08:57:55	08:57:55
Invitado 49	08:48:29	08:56:13	08:56:13	08:56:49	08:56:49	08:57:46	08:57:46
Invitado 50	08:49:03	08:51:03	08:51:03	08:52:08	08:52:08	09:00:07	09:00:07

NOTE OWN ELABORATION

Once the simulation was done, we proceeded to calculate the process time for each of the guests, with the difference between the time of entry to the event and the time of arrival. This results in 200 simulated process times. And now we proceeded to take *the highest average time* of the simulation, which results *in 9 minutes and 25 seconds*. Comparing it with the average time displayed by the members of the group, it is very similar to that obtained in the simulator.

Now we proceeded to add to this simulator the improvement times that we propose using the different tools previously seen.

Simulation Improvement Proposal

The code begins by setting the variables and parameters needed for the simulation. numGuests is defined as 100, indicating that 200 guests in total will be simulated. starttime is set to 8:30 AM and endtime to 9:30 AM, which defines the time interval during which guests can arrive at the event.

Before starting the simulation, a cleanup of the cells in the range A2 of the Excel workbook to remove any previous data that may interfere with the new data generated during the simulation. In addition, columns B to I are formatted to display the data in time format (hh:mm:ss), facilitating the visualization of the recorded times.

To simulate the arrival of guests, the code uses two nested loops: one for each group and one for each guest within the group. This allows to simulate two groups of guests arriving at different times at the event.

Within each iteration of the loop, the arrival time (arrivalTime) of each guest is randomly generated using the Rnd function. This time is calculated within the time interval defined by StartTime and EndTime, ensuring that guests arrive at different times within the event window.

For each guest, three sequential processes are simulated that must be completed before they can enter the event: scanning their invitation (timeScanning), searching for and delivering their welcome kit (timeSearching and timeDelivering). Each of these times is randomly generated within specific ranges to simulate variability in the duration of these processes. The specific ranges were detailed in the enhancement proposal.

A Do...Loop is used to ensure that the sum total of these times (TotalTime) does not exceed 6.25 minutes (equivalent to 6 minutes and 15 seconds). This limit ensures that the simulated times are realistic but controlled, reflecting situations where processes may take different amounts of 9

Once the times for each guest have been calculated, these data are recorded in the Excel workbook. Each row in the range A2

represents one guest and contains detailed information such as guest number, arrival time, specific times for scanning, searching, kit delivery and event entry time. This provides a detailed representation of the guest arrival and processing flow during the simulated event.

Upon completion of the nested loops, the simulation is complete, and the Excel workbook contains a complete and organized record of how the guest arrival and processing process would unfold at a real event. This record is what is expected to be obtained when implementing the proposed tools to reduce processing times.

Table VIII. Simulation after implementation

Guest number	Check In	End of scanning and verification	Search Home	End of Credential Search	Start of kit delivery	End of kit delivery	Event Entry Time
Invitado 1	08:30:01	08:30:41	08:30:41	08:32:39	08:32:39	08:33:45	08:33:45
Invitado 2	08:30:14	08:30:46	08:30:46	08:31:38	08:31:38	08:33:09	08:33:09
Invitado 3	08:30:34	08:31:45	08:31:45	08:31:59	08:31:59	08:32:34	08:32:34
Invitado 4	08:30:37	08:30:48	08:30:48	08:31:56	08:31:56	08:32:19	08:32:19
Invitado 5	08:30:46	08:31:35	08:31:35	08:33:26	08:33:26	08:34:30	08:34:30
Invitado 6	08:30:51	08:31:13	08:31:13	08:34:10	08:34:10	08:35:42	08:35:42
Invitado 7	08:30:56	08:31:29	08:31:29	08:32:41	08:32:41	08:33:14	08:33:14
Invitado 8	08:31:01	08:31:27	08:31:27	08:33:31	08:33:31	08:33:44	08:33:44
Invitado 9	08:31:21	08:32:02	08:32:02	08:34:47	08:34:47	08:35:39	08:35:39
Invitado 10	08:31:44	08:32:10	08:32:10	08:33:48	08:33:48	08:35:39	08:35:39
Invitado 11	08:31:46	08:32:40	08:32:40	08:33:36	08:33:36	08:35:34	08:35:34
Invitado 12	08:32:17	08:33:06	08:33:06	08:35:48	08:35:48	08:36:29	08:36:29
Invitado 13	08:32:35	08:33:05	08:33:05	08:33:16	08:33:16	08:33:53	08:33:53
Invitado 14	08:32:36	08:33:10	08:33:10	08:35:23	08:35:23	08:36:54	08:36:54
Invitado 15	08:33:27	08:33:48	08:33:48	08:36:41	08:36:41	08:37:20	08:37:20
Invitado 16	08:34:26	08:34:34	08:34:34	08:35:34	08:35:34	08:35:49	08:35:49
Invitado 17	08:34:44	08:34:47	08:34:47	08:35:14	08:35:14	08:35:44	08:35:44
Invitado 18	08:34:51	08:35:25	08:35:25	08:38:08	08:38:08	08:38:39	08:38:39
Invitado 19	08:36:16	08:36:30	08:36:30	08:36:44	08:36:44	08:37:36	08:37:36
Invitado 20	08:36:23	08:37:38	08:37:38	08:39:40	08:39:40	08:39:41	08:39:41
Invitado 21	08:36:27	08:37:25	08:37:25	08:38:48	08:38:48	08:40:19	08:40:19
Invitado 22	08:36:35	08:36:57	08:36:57	08:38:09	08:38:09	08:39:16	08:39:16
Invitado 23	08:36:56	08:37:09	08:37:09	08:37:17	08:37:17	08:38:43	08:38:43
Invitado 24	08:37:02	08:37:34	08:37:34	08:39:53	08:39:53	08:40:36	08:40:36
Invitado 25	08:37:23	08:38:35	08:38:35	08:40:58	08:40:58	08:42:22	08:42:22
Invitado 26	08:38:42	08:39:01	08:39:01	08:39:06	08:39:06	08:40:46	08:40:46
Invitado 27	08:39:06	08:39:51	08:39:51	08:42:43	08:42:43	08:43:12	08:43:12
Invitado 28	08:39:24	08:40:12	08:40:12	08:42:02	08:42:02	08:43:45	08:43:45
Invitado 29	08:41:04	08:41:25	08:41:25	08:41:29	08:41:29	08:41:47	08:41:47
Invitado 30	08:41:14	08:41:51	08:41:51	08:44:46	08:44:46	08:46:18	08:46:18
Invitado 31	08:41:44	08:42:08	08:42:08	08:43:23	08:43:23	08:43:41	08:43:41
Invitado 32	08:41:53	08:42:21	08:42:21	08:42:38	08:42:38	08:43:52	08:43:52
Invitado 33	08:42:09	08:43:21	08:43:21	08:43:33	08:43:33	08:43:40	08:43:40
Invitado 34	08:42:22	08:43:27	08:43:27	08:45:12	08:45:12	08:46:43	08:46:43
Invitado 35	08:42:23	08:43:09	08:43:09	08:45:52	08:45:52	08:47:46	08:47:46
Invitado 36	08:42:27	08:42:55	08:42:55	08:44:38	08:44:38	08:45:19	08:45:19
Invitado 37	08:42:53	08:43:09	08:43:09	08:44:25	08:44:25	08:45:39	08:45:39
Invitado 38	08:43:04	08:43:33	08:43:33	08:44:44	08:44:44	08:45:18	08:45:18
Invitado 39	08:43:05	08:43:38	08:43:38	08:44:21	08:44:21	08:46:06	08:46:06
Invitado 40	08:43:24	08:44:08	08:44:08	08:45:13	08:45:13	08:46:58	08:46:58
Invitado 41	08:43:54	08:45:05	08:45:05	08:47:37	08:47:37	08:48:30	08:48:30
Invitado 42	08:44:29	08:45:21	08:45:21	08:47:07	08:47:07	08:48:19	08:48:19
Invitado 43	08:44:38	08:45:51	08:45:51	08:46:02	08:46:02	08:46:43	08:46:43
Invitado 44	08:44:44	08:45:13	08:45:13	08:46:24	08:46:24	08:47:28	08:47:28
Invitado 45	08:44:57	08:45:58	08:45:58	08:47:36	08:47:36	08:48:40	08:48:40
Invitado 46	08:45:03	08:45:15	08:45:15	08:47:11	08:47:11	08:43:09	08:43:09
Invitado 47	08:45:17	08:45:42	08:45:42	08:45:50	08:45:50	08:46:48	08:46:48
Invitado 48	08:45:24	08:45:31	08:45:31	08:45:36	08:45:36	08:46:15	08:46:15
Invitado 49	08:45:26	08:46:13	08:46:13	08:47:51	08:47:51	08:48:10	08:48:10
Invitado 50	08:45:29	08:46:10	08:46:10	08:47:42	08:47:42	08:48:50	08:48:50

NOTE OWN ELABORATION

Once the simulation was done, we proceeded to calculate the process time for each of the guests, with the difference between the time of entry to the event and the time of arrival. This results in 200 simulated process times. And now we proceeded to take the average time of the simulation, which results *in 3 minutes and 2 seconds.* Comparing it with the average time obtained in the current simulation of the company, we can see a considerable

optimization of the times, thus generating an increase in productivity and reducing the problems that had been causing this problem.

Table IX. Optimistic Simulation Results with 10,000 Guests

N°	ENTRADA	REGISTRO DE QR	APROBACIÓN DE DATOS	INICIO BUSQUEDA CREDENCIAL	ENTREGA DE CREDENCIAL	ENTREGA DE TICKET	INGRESO AL EVENTO	TIEMPO DE ESPERA	TIEMPO DE ATENCION	TIEMPO DE CICLO
Invitado 1	08:30:11 a. m.	08:30:12	08:30:12	08:30:21	08:30:21	08:30:40	08:30:40	00:00:01	00:00:28	00:00:29
Invitado 2	08:30:18 a. m.	08:30:22	08:30:22	08:30:27	08:30:27	08:30:46	08:30:46	00:00:04	00:00:24	00:00:28
Invitado 3	08:30:11 a. m.	08:30:40	08:30:40	08:30:42	08:30:42	08:31:09	08:31:09	00:00:29	00:00:29	00:00:58
Invitado 4	08:30:11 a. m.	08:30:58	08:30:58	08:31:13	08:31:13	08:31:31	08:31:31	00:00:47	00:00:32	00:01:20
Invitado 5	08:30:03 a. m.	08:30:19	08:30:19	08:31:18	08:31:18	08:31:37	08:31:37	00:00:16	00:01:18	00:01:34
Invitado 6	08:30:07 a. m.	08:30:51	08:30:51	08:31:03	08:31:03	08:31:45	08:31:45	00:00:44	00:00:53	00:01:38
Invitado 7	08:31:25 a. m.	08:31:34	08:31:34	08:31:38	08:31:38	08:31:45	08:31:45	00:00:09	00:00:11	00:00:20
Invitado 8	08:30:11 a. m.	08:30:38	08:30:38	08:31:19	08:31:19	08:31:46	08:31:46	00:00:27	00:01:09	00:01:35
Invitado 9	08:30:23 a. m.	08:30:42	08:30:42	08:31:39	08:31:39	08:31:52	08:31:52	00:00:19	00:01:10	00:01:29
Invitado 10	08:31:27 a. m.	08:31:33	08:31:33	08:31:40	08:31:40	08:31:53	08:31:53	00:00:06	00:00:20	00:00:26
Invitado 11	08:30:50 a. m.	08:31:15	08:31:15	08:31:23	08:31:23	08:31:56	08:31:56	00:00:25	00:00:40	00:01:06
Invitado 12	08:30:27 a. m.	08:30:36	08:30:36	08:31:48	08:31:48	08:32:01	08:32:01	00:00:09	00:01:25	00:01:34
Invitado 13	08:30:05 a. m.	08:30:43	08:30:43	08:31:48	08:31:48	08:32:03	08:32:03	00:00:38	00:01:20	00:01:58
Invitado 14	08:31:02 a. m.	08:31:55	08:31:55	08:32:08	08:32:08	08:32:12	08:32:12	00:00:53	00:00:17	00:01:10
Invitado 15	08:30:07 a. m.	08:30:35	08:30:35	08:31:02	08:31:02	08:32:12	08:32:12	00:00:28	00:01:37	00:02:05
Invitado 16	08:30:23 a. m.	08:30:46	08:30:46	08:30:49	08:30:49	08:32:14	08:32:14	00:00:17	00:01:28	00:01:45
Invitado 17	08:30:08 a. m.	08:30:25	08:30:25	08:31:08	08:31:08	08:32:16	08:32:16	00:00:17	00:01:51	00:02:08
Invitado 18	08:30:39 a. m.	08:31:09	08:31:09	08:31:46	08:31:46	08:32:18	08:32:18	00:00:30	00:01:10	00:01:39
Invitado 19	08:30:52 a. m.	08:31:14	08:31:14	08:32:09	08:32:09	08:32:21	08:32:21	00:00:22	00:01:07	00:01:29
Invitado 20	08:31:08 a. m.	08:31:30	08:31:30	08:31:41	08:31:41	08:32:22	08:32:22	00:00:22	00:00:52	00:01:14
Invitado 21	08:30:02 a. m.	08:30:41	08:30:41	08:31:34	08:31:34	08:32:24	08:32:24	00:00:39	00:01:44	00:02:22
Invitado 22	08:30:13 a. m.	08:30:37	08:30:37	08:31:07	08:31:07	08:32:25	08:32:25	00:00:24	00:01:47	00:02:12
Invitado 23	08:30:37 a. m.	08:30:50	08:30:50	08:30:57	08:30:57	08:32:30	08:32:30	00:00:13	00:01:40	00:01:53
Invitado 24	08:30:43 a. m.	08:31:16	08:31:16	08:31:44	08:31:44	08:32:30	08:32:30	00:00:33	00:01:14	00:01:47
Invitado 25	08:30:19 a. m.	08:30:50	08:30:50	08:32:01	08:32:01	08:32:32	08:32:32	00:00:31	00:01:42	00:02:13

NOTE OWN ELABORATION

Table X. Indicators of the Optimistic Scenario

PROMEDIO ESPERA	PROMEDIO ATENCION	PROMEDIO CICLO
00:00:37	00:02:30	00:03:07
INDICADORES DE LA MUESTRA DE 10000 DE INVITADOS		

NOTE OWN ELABORATION

In order to evaluate the maximum potential efficiency of the proposed improvements, a large-scale simulation was carried out with a sample of 10,000 guests. The results show an average waiting time of 00:00:37, an average service time of 00:02:30, and a total cycle time of 00:03:07. These indicators confirm that, under optimal conditions, the registration and check-in process can be optimized to achieve highly competitive service standards. Compared to the current process and the initial improvement scenario, this optimistic case highlights the scalability of the proposed methodology, demonstrating that even during high-demand events it is possible to maintain short processing times and offer a satisfactory experience to all attendees.

The implementation of the 5s is based on:

According to the starting point of the customer registration process in the events organized by InterMet, we must consider that the current flowchart of this process is as follows, which takes the highest average attention time of

10min 48sec, in which there is a bottleneck in the activity of "credential search" due to lack of organization and various internal reasons

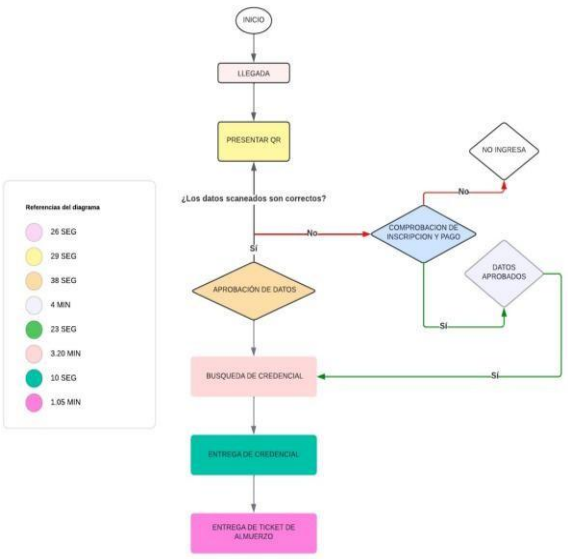

Fig. 1 flow chart in Spanish

Based on this, we propose to start the *implementation management as follows:*

For this purpose, it is recommended to highlight the incidences that may happen in the registration process.

Among them:

- Failure to register correctly via web
- Mixed credential types
- Failure to print badge for the client
- Manage pass for accompanying persons, if applicable.

Also conduct the respective training to the staff a week before the event, for a time study and to determine the results of the team.

Day 1: 5S Preparation and Execution

- 07:00 - 08:00: Kick-off Meeting
- Convening: All employees involved in the registration and credentialing process.

- Agenda: Explanation of the objective, benefits of 5S, and the plan of action for the day.
- Responsible: Project Manager (PM) and Team Leader (TL).

08:00 - 09:00: Seiri (Sort).

Actions:

- Materials Review: Quick review of all materials and tools used in the process.

Fig. 2 current place

- Sorting: Identification and separation of necessary and unnecessary items.
- Disposal: Removal of obsolete or unused materials.
- Responsible: All employees under the supervision of the LE.

09:00 - 10:00: Seiton (Sorting)

Actions:

- Assignment of locations: Designation of specific locations for each material and tool.
- Labeling: Clear labeling of all items and their locations. Area mapping: Creation of a visual map of the work area. Responsible: LE and registration team.

10:00 - 11:00: Seiso (Clean up)

Actions:

- Deep cleaning: Performing a thorough cleaning of the work area, removing dirt and clutter.
- Assignment of responsibilities: Assignment of specific cleaning tasks to each team member.
- Responsible: LE and registration team.

11:00 - 12:00: Seiketsu (Standardize) Actions:

- Training: Brief training to staff on standardized procedures.
- Creation of checklists: Development of checklists to ensure maintenance of standards.
- Responsible: GP, LE and documentation team. 12:00 - 13:00: Lunch.

13:00 - 14:00: Shitsuke (Sustain).

Actions:

Establishment of audits: Planning of periodic audits to verify 5S compliance.

- Follow-up meetings: Scheduling regular meetings to discuss improvements and solve problems.
- Culture of continuous improvement: Promotion of a culture of continuous improvement and accountability.
- Responsible: GP and LE.

14:00 - 16:00: Implementation of Best Practices.

Actions:

- Workflow optimization: Final adjustments to work area layout to maximize efficiency.
- Process Simulation: Perform a simulation of the registration and delivery process using the new practices.
- Responsible: LE and registration team.

16:00 - 17:00: Review and Closing.

Actions:

- Review of results: Initial evaluation of the implemented changes and discussion of observations.
- Team Feedback: Gather team comments for future improvements.
- Closing: Summary of the day's accomplishments and establishment of next steps.
- Responsible: GP and LE.

Although Lean Manufacturing, CRM, and market segmentation are well-established concepts in the literature, their integrated application in the management of mining events has received limited academic attention. This study contributes by demonstrating how the joint implementation of these tools can address specific challenges faced by InterMet such as inefficient registration processes, low event attendance, and financial imbalances while also incorporating customer satisfaction as a complementary service quality indicator. The reduction of registration time from 9:25 to 3:02 minutes is projected to significantly improve attendees' perception, thereby strengthening InterMet's reputation, enhancing customer loyalty, and providing a practical framework that can be replicated in similar organizations, particularly in Peru and other emerging mining economies.

V. SYNTHESIS

The implementation of Lean Manufacturing at InterMet has resulted in a significant improvement in operational efficiency. The adoption of this methodology allowed us to identify and eliminate waste in the processes, which led to significant cost reductions and increased productivity. Specific techniques such as 5S and Kaizen improved organization and daily efficiency. This process optimization is especially critical in the competitive event management market, where operational efficiency can be a key differentiator.

Market segmentation has enabled InterMet to better understand its customers' needs and preferences. By identifying different needs and tailoring marketing offers and strategies to specific segments, the company has achieved greater customer satisfaction and retention. Targeted marketing campaigns improved the relevance of messages and increased response and conversion rates, strengthening existing relationships and opening up new business opportunities.

The implementation of a CRM system has facilitated customer relationship management by providing a holistic view of all customer interactions and needs. This holistic view enabled InterMet to personalize service and respond more effectively to customer concerns, enhancing their experience and fostering stronger brand loyalty. With detailed, up-to-date customer information, the company was able to offer personalized services that increased customer satisfaction.

However, implementing these strategies was not without its challenges. Resistance to change on the part of some employees and the need for ongoing training were significant obstacles. The integration of new technologies and processes required considerable upfront investment, underscoring the importance of sound financial planning to ensure long-term success. Change management was crucial to overcoming these challenges, involving clear and continuous communication with employees and the implementation of training programs to facilitate the transition.

VI. Conclusions

Positive Results:

- The implementation of Lean Manufacturing, market segmentation and CRM has been highly beneficial, leading to increased operational efficiency, better understanding of customer needs and effective relationship management. These results validate the adopted strategy and provide a solid foundation for the company's sustainable growth.

Adaptability and Continuous Improvement:

- The ability to adapt and respond to changing market dynamics is essential to success in the event management industry. Organizational culture that favors continuous improvement and innovation is key to future implementations.

Future Recommendations:

- Continue to invest in employee training and advanced technologies that facilitate agility and efficiency.
- Maintain a customer-centric approach, using tools and strategies to proactively anticipate and meet customer needs.

Simulation Statistics and Results

Average Process Time:

- The average processing time for guests in the initial simulation was 9 minutes and 25 seconds.
- With the implementation of enhancements, the average process time was significantly reduced to 3 minutes and 2 seconds.

Simulations Performed:

- Simulations were conducted for 200 guests, with two groups of 100 guests each, arriving at different times at the event. The simulated processes included scanning invitations, finding and delivering the welcome kit.

Optimization and Productivity:

- The reduction in process times generated an increase in productivity and reduced previously identified problems, such as bottlenecks in the credential search.

Acknowledgment

We extend our heartfelt gratitude to our parents for their unwavering support and encouragement, and to our teachers for their invaluable guidance and wisdom. Their dedication and belief in us have been instrumental in our success.

VII. References

[1] (S/f). Gob.pe. Recuperado el 30 de mayo de 2024, de https://www.leyes.congreso.gob.pe/Documentos/Leyes/29337.pdf

[2] Arango Serna, M. D., Ruiz Moreno, S., Ortiz Vásquez, L. F., & Zapata Cortes, J. A. (2017). Indicadores de desempeño para empresas del sector logístico: Un enfoque desde el transporte de carga terrestre. Ingeniare. Revista chilena de ingeniería, 25(4), 707-720.https://www.scielo.cl/scielo.php?pid=s0718-33052017000400707&script=sci_arttext

[3] Alexander, G. G. J., & Tomás, U. S. (2024, 22 enero). Mejora en las estrategias de employer branding con herramientas six sigma para el area de recursos humanos en la empresa Sonavox– pasantía internacional. https://repository.usta.edu.co/handle/11634/54319

[4] Augusto, A. C. C. (2021, 22 enero). Gestión de relación con el cliente (CRM) en las empresas de Latinoamérica: una revisión sistemática de la literatura científica en los últimos 10 años, 2008 – 2018. https://repositorio.upn.edu.pe/handle/11537/25699?show=full

[5] Alvarado Ulloa, C. A. (2021). Implementación de la 5S para mejorar la gestión del almacén de una institución policial, La Libertad 2020. https://repositorio.upn.edu.pe/handle/11537/29032

[6] César, C. R. J. (2021, 14 diciembre). Implementación de herramientas de lean manufacturing en el área de producción para incrementar la productividad en la empresa Eurotubo S. A. C. https://repositorio.upn.edu.pe/handle/11537/29664

[7] Barrera, F., Segura, M., & Álvarez, C. M. (2024). Multiple criteria decision support system for customer segmentation using a sorting outranking method. Expert Systems With Applications, 238, 122310. https://doi.org/10.1016/j.eswa.2023.122310

[8] Bassi, A., Harkrit Chhatwal, Bhasin, N., Sharma, S., & Gupta, R. (2021). Optimization of Changeover Time in a Manufacturing Enterprise Using Single Minute Exchange of Dies (SMED): A Case Study. Lecture Notes on Multidisciplinary Industrial Engineering, 189–200. https://doi.org/10.1007/978-3-030-73495-4_13

[9] Carlier, S. I., Revuelto-Taboada, L., & Sandoval-Reyes, J. (2023). Política tecnológica e innovación. El rol de la dirección de recursos humanos desde una perspectiva dual de proceso y contenido. Revista Innovar Journal, 34(92). https://doi.org/10.15446/innovar.v34n92.102209

[10] Decreto Legislativo que aprueba la Ley General de mejora de la Calidad Regulatoria - DECRETO LEGISLATIVO - N° 1565 -. (s/f). Elperuano.pe. Recuperado el 30 de mayo de 2024, de https://busquedas.elperuano.pe/dispositivo/NL/2181939-3

[11] Disposiciones Generales, T. I. (s/f). CÓDIGO DE ÉTICA DEL COLEGIO DE INGENIEROS DEL PERÚ. Org.pe. Recuperado el 30 de mayo de 2024, de https://www.cip.org.pe/publicaciones/reglamentosCNCD2018/codigo_de_etica_del_cip.pdf

[12] Dorbessan, J. (2006). Las 5S, herramientas de cambio. Editorial Universitaria de la UTN.

[13] Ernesto, S. H., & Andres, O. C. V. (2023). Aplicación web para optimizar el proceso de generación de documentos que solicitan los empleados al área de recursos humanos dentro de las empresas. http://repositorio.uts.edu.co:8080/xmlui/handle/123456789/12841

[14] Galindo, E. V. (2023). Aplicabilidad de un sistema de automatización para la administración de bases de datos en billing de Tigo Honduras (Doctoral dissertation, Universidad Tecnológica Centroamericana UNITEC).

[15] Gloria Isabel Garcia-Chavez, Vanessa, Martin Fidel Collao-Diaz, & Juan Carlos Quiroz-Flores. (2022). Inventory management model based on Demand Forecasting, 5S, BPM and Max-Min to improve turnover in commercial enterprises. https://doi.org/10.1109/coniiti57704.2022.9953633

[16] Hernández Taborda, A. S. (2024) Optimización de la Actualización de Datos de los Clientes en el Área de Fidelidad Cencosud Colombia.

[17] Ibrahim S.(2023). Impacto de la implementación de un sistema de gestión de la relación con el cliente en las ventas de la empresa RESISOL NOR

PERÚ SRL. Cajamarca 2022-

[18] Industry resources. (2015, septiembre 16). UFI The Global Association of the Exhibition Industry. https://www.ufi.org/industry-resources/
[19] Información institucional. (s/f). Gob.pe. Recuperado el 30 de mayo de 2024, de https://www.gob.pe/institucion/inacal/institucional
[20] Institucional. (s/f). Colegio de Ingenieros del Perú. Recuperado el 30 de mayo de 2024, de https://www.cip.org.pe/institucional/
[21] Instituto Nacional de Calidad. (s/f). Gob.pe. Recuperado el 30 de mayo de 2024, de https://www.gob.pe/institucion/inacal/normas-legales/292131-30224
[22] ISO - Organización Internacional de Normalización. (2024). ISO. https://www.iso.org/es/home/
[23] ISO 20121:2024. (2024). ISO. https://www.iso.org/es/contents/data/standard/08/63/86389.html
[24] ISO 22301:2019/Amd 1:2024. (2024). ISO. https://www.iso.org/es/contents/data/standard/08/84/88412.html
[25] ISO 45001:2018/Amd 1:2024. (2024). ISO. https://www.iso.org/es/contents/data/standard/08/84/88428.html
[26] ISO 9000 family. (2023). ISO. https://www.iso.org/es/normas/mas-comunes/familia-iso-9000
[27] ISO/IEC 27001:2022/Amd 1:2024. (2024). ISO. https://www.iso.org/es/contents/data/standard/08/84/88435.html
[28] Kenneth. G, Luz.S. (2022). "IMPLEMENTACIÓN DE LA APLICACIÓN METODOLÓGICA 5S PARA LA MEJORA DEL PROCESO DE CONFECCIÓN DE LA EMPRESA CREACIONES SAYALU, AÑO 2021." Edu.pe. Recuperado el 1 de mayo de 2024, de https://repositorio.upn.edu.pe/bitstream/handle/11537/33203/Gonzaga%20Motta%2c%20Kenneth%20Christian%20-%20Sigue%c3%b1as%20Angeles%2c%20Luz%20Marita.pdf?sequence = 1
[29] Liberato-Arenas, A., & Collao-Diaz, M. (2022). Production Management Model Based on Lean Manufacturing and SPL to Increase Productivity in Clothing SMEs. 2022 8th International Engineering, Sciences and Technology Conference (IESTEC). https://doi.org/10.1109/iestec54539.2022.00022
[30] Mair, J. (2018). The motives and barriers of association conference attendance. Event Management, 22(6), 1017–1030. https://doi.org/10.1016/j.jhtm.2017.11.004
[31] Manzano Ramírez, M., & Gisbert Soler, V. (2016). Lean Manufacturing: implantación 5S. 3C Tecnología_Glosas de innovación aplicadas a la pyme, 5(4), 16–26. https://doi.org/10.17993/3ctecno.2016.v5n4e20.16-26
[32] Matosas-López, L. (2024). The Importance of Customer Relationship Management Systems to Business Management and Marketing Strategies. En Emerald Publishing Limited eBooks (pp. 131-145). https://doi.org/10.1108/978-1-83753-686-320241008
[33] Ministerio de la Producción. (s/f-a). Gob.pe. Recuperado el 30 de mayo de 2024, de https://www.produce.gob.pe/?id=0
[34] Ministerio de la Producción. (s/f-b). Gob.pe. Recuperado el 30 de mayo de 2024, de https://www.gob.pe/institucion/produce/normas-legales/4282955-006-2023-produce
[35] Ministerio de la Producción. (s/f-c). Gob.pe. Recuperado el 30 de mayo de 2024, de https://www.gob.pe/institucion/produce/normas-legales/5575666-0006-2024-produce
[36] Ministerio de la Producción. (s/f-d). Gob.pe. Recuperado el 30 de mayo de 2024, de https://www.gob.pe/institucion/produce/normas-legales/444490-003-2020-produce
[37] Montoya Cárdenas, G. A., Díaz Dumont, J. R., & Bravo Rojas, L.M. (2019). Aplicación del Value Stream Mapping en el Proceso del Acero en el Sector Construcción. TAYACAJA, https://revistas.unat.edu.pe/index.php/RevTaya/article/view/50/50
[38] Mortazavi, R., Mohammadi, M., & Pourtaheri, M. (2021). The relationship between visitor satisfaction, expectation and loyalty in event tourism. Event Management, 25(3), 257–270. https://doi.org/10.1016/j.iedeen.2020.10.002
[39] Presidencia del Consejo de Ministros. (s/f). Gob.pe. Recuperado el 30 de mayo de 2024, de https://www.gob.pe/institucion/pcm/normas-legales/2308431-046-2014-pcm
[40] Quispe Marreros, L. H. (2023). Propuesta de Mejora del Cuadro de Mando Integral del Área Recursos Humanos de la Empresa Metalmecánica FAMECT SR Ltda. Lima, 2022. https://repositorio.epnewman.edu.pe/handle/20 500.12892/686 2023".,https://repositorio.upn.edu.pe/bitstream/handle/11537/35903/Silva%20Narva%2c%20Gabriel%20Ibrahim.pdf?sequence=1&isAllowed=y
[41] Rodrigo Malta Meurer, Luis, J., & Matheus. (2022). Analysis of the market value of public service companies in Brazil, Argentina and Chile: An application using panel data. Contaduría Y Administración, 68(2), 383–383. https://doi.org/10.22201/fca.24488410e.2023.2867
[42] Roula Jabado, & Rim Jallouli. (2024). Impact of Data Analytics Capabilities on CRM Systems' Effectiveness and Business Profitability.
[43] Journal of Telecommunications and the Digital Economy, 12(1), 427–445. https://doi.org/10.18080/jtde.v12n1.845
[44] Szwejczewski, M., Lillis, B., Belvedere, V., & Grando, A. (2023). Sustaining lean changes: the influence and significance of different change sustainability factors in maturing lean change programmes. Journal Of Manufacturing Technology Management, 35(1), 54-73. https://doi.org/10.1108/jmtm-05-2023-0182
[45] Triche, J., Dong, T., Landon, J., & Baied, E. (2024). Teaching Tip Enhancing Student's Understanding of Enterprise Systems Using Salesforce. Journal of Information Systems Education, 25–36. https://doi.org/10.62273/lsvk6170
[46] UFI the Global Association of the exhibition industry. (2015, septiembre 16). UFI The Global Association of the Exhibition Industry. https://www.ufi.org/
[47] Zia, U., Zhang, J., Xiang, D., & Liu, J. (2024). Significance of knowledge management process and customer relationship management for stimulating innovation capability: empirical analysis, PLS-SEM approach. International Journal Of Knowledge Management Studies, 15(1), 17-37. https://doi.org/10.1504/ijkms.2024.138069