EasyChair Preprint

№ 8933

Global Corporate Performance Measurement Model Through the Integration of Six Sigma and Balanced Scorecard. Application in the Poultry Industry

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October 3, 2022

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Abstract. In recent decades, a competitive landscape, informed customers, and stringent regulations have forced goods and services industries to focus on evaluating performance and improving productivity. The purpose of this research is to develop a model for measuring overall corporate performance through the alignment of strategic objectives (Balanced Scorecard) and productivity improvement tools (Six Sigma) for multi-response processes that is robust enough for application in the poultry industry. The article's contributions focus on the development of a model called the Multivariate Performance Measurement System (MPMS) that shows how a scorecard should be implemented in order to go beyond the DMAIC, or performance monitoring of financial and non-financial measures. The model postulates how indicators integrate and relate to each other to optimize a company's overall performance.

Keywords: Balanced Scorecard (BSC), Six Sigma, Multivariate Statistics, Organizational Performance.

1 Introduction

In recent years, as a result of globalization, organizations must face rapid changes in their competitive environments and only those that are able to implement an effective strategy will be able to obtain above-average performance [1], [2]. In this sense, different concepts of improvement initiative have emerged, whosZe results promise to lead to superior performance and effective value creation in organizations [3], [4]. For this reason, there has been an increased interest in studying in more depth the process of implementing efficient strategic tools for these purposes [5], [6].

Consequently, Ritter & Pedersen [7] state that the needs of organizations to obtain performance measures have led to the investment of scientific human capital, materials and time to obtain useful models to reflect corporate performance; however, their applicability is not very widespread or scarcely studied. In this sense, a change of methodological approach that contrasts the difference would be useful for the organizational dynamics of underdeveloped countries, since it would directly affect the way of managing, creating motivating work environments [8], [9].

Research shows that companies located in developing countries such as Ecuador analyze their performance indicators, individually and independently, rarely converted to useful metrics in the assessment of the results of the strategies implemented, there are very few organizations that perform or implement integrated actions to make decisions, generally foreign [10]–[13]. Despite this fact, negative at first glance, there is concern and interest on the part of Ecuadorian companies to implement strategies within this area [14]. Hidalgo-Proaño [15]; Boza-Valle & Manjarez-Fuentes [16]; Zamora [17]; Pontarollo & Mendieta [18]; Jiménez et al., [19] externalize that entrepreneurship in Ecuador is growing to a great extent and the training of true entrepreneurs is becoming increasingly important, however, there are scenarios that are out of the hands of entrepreneurs and that often make their best performance impossible, especially for those who wish to start a business.

According to Hedman et al., [20]; Muyulema-Allaica et al., [21] this aspect does not go unnoticed in the Ecuadorian poultry industry, which is made up of a chain of links that begins with the cultivation and marketing of raw materials, followed by the production of balanced feed, poultry breeding, processing, distribution, transportation,

marketing, value added, and especially for the poultry business in Chimborazo, as shown in the applicability manual of good poultry practices, a project developed together with technical manuals. However, despite the above, the literature review does not show any research that leads to the design of an instrument that comprehensively and strategically assesses the performance of an organization for evaluation and subsequent control within the Ecuadorian poultry industry.

The above shows the urgent need for scientific resources, which translate into useful models, which in turn, provide a management tool that allows integrating business performance within the mission and vision in order to generate added value to entities through the effective performance of labor and behavioral commitments, in order to go beyond monitoring the performance of financial and non-financial measures which allows determining, effectively, how the indicators are related to each other to improve the overall performance of a company.

Under these circumstances, the present work reports the results of a research focused on developing a model for measuring the global corporate performance through the alignment of strategic objectives (Balanced Scorecard) and productivity improvement tools (Six Sigma) for processes with multiple responses, which is robust enough for its application in the poultry industry, with the purpose of contributing to fill the gap that currently exists within the industry under analysis, taking into account that until now there has not been any type of instrument with these characteristics that comprehensively and strategically assesses the performance of an organization.

The integration of Six Sigma (6σ) with the Balanced Scorecard (BSC) today called Multivariate Performance Measurement System (MPMS), shows how a control panel should be implemented with the purpose of going beyond the DMAIC, or performance monitoring of financial and non-financial measures; with this it can be determined, in an effective way, how the indicators are integrated and related to each other to improve the overall performance of a company. This is where the importance of using multivariate techniques to identify, quantify and model such relationships can be highlighted.

The MPMS is a new model for measuring global corporate performance. Specifically, it is a system that requires the full participation and commitment of the organization at all levels through leaders who inspire, managers who improve, and human capital who create and innovate in joint and integrated efforts, all of which pursue the purpose of achieving the optimum level of profitability and growth. The model is based on scientific principles in five phases, improvement practices proven through numerous research and multivariate statistical techniques, within a framework of principles and values that guide the different trajectories of the organization.

The objective of the MPMS is, on the one hand, to identify and quantify the indicators related to the key processes of the industry in any dimension and integrate them into a model that assesses the overall performance of the corporate process, in order to achieve an adequate level of profitability and, on the other hand, to identify, design and implement the corresponding improvement processes, in order to meet customer needs by breaking their expectations, generating loyalty and positioning in the market.

2 Methodology

This work is framed within the mixed approach, which according to Kowalewski & Bartłomiejski (2020); Yang (2022) is a process that collects, analyzes and links quantitative and qualitative data in a single study or a series of investigations to respond to a problem statement. Subsequently, the determination method was proposed, consisting of two stages: diagnosis and comprehensive impact analysis. This led to the formulation of the proposed model for measuring global corporate performance.

The chosen sector of analysis fell on the province of Chimborazo, one of the 24 provinces that make up the Republic of Ecuador, and is made up of 10 cantons, from which are derived their respective 61 urban and rural parishes, located in the south-central part of the country, in the geographical area known as the inter-Andean region or highlands. Its city is the largest and most populated of the country since it occupies a territory of about 5,287 km². Agriculture and livestock are the most important resources and sources of employment in the province. Poultry production and management in the province account for 6% of national production in terms of broiler production [21]. Poultry production in Chimborazo is carried out through an integrated system. This chain is interdependent, generating employment and income for small-scale producers of corn and soybeans, which are the raw materials most used in poultry feed. Therefore, the determination of production costs in a technical way is of great importance for a farm operating under an integrated poultry system, in order to improve its profitability.

The companies were selected on the basis of data from the Community Statistical Program of the Andean Community of Nations (CAN), adopted by Decision 488, which defines the basic precepts for preparing community statistics on SMEs, under four assumptions. The first: 1) Being a small enterprise (considered small if it has between 10 and 49 employees); 2) Having an e-mail address and telephone; 3) That the enterprise needs support in the production area; and 4) Accepting to participate in the project, with accurate and updated information on the situation of the enterprise.

Under the general context previously studied, the target population was composed of 53 poultry industries, located within the 10 cantons of the province of Chimborazo (Table 1).

Table 1. Population

Poultry farms in the province of Chimborazo (Cantons)		**Frequency**	**%**
1	Canton Riobamba	4	8%
2	Canton Alausí	2	4%
3	Canton Chambo	2	4%
4	Canton Chunchi	1	2%
5	Canton Colta	2	4%
6	Canton Cumandá	8	15%
7	Canton Guamote	1	2%
8	Canton Guano	2	4%
9	Canton Pallatanga	30	57%
10	Canton Penipe	1	2%
TOTAL		**53**	**100%**

To identify the level of overall corporate performance in the poultry industry in the province of Chimborazo, a compliance checklist was used based on the points of

ISO 9001:2015, an international certifiable standard that regulates quality management systems, which combines a process approach with risk-based thinking at all levels of the companies evaluated. The reference level taken to measure the level of global corporate performance by means of a Checklist, three criteria were chosen: Compliance (C); Partial Compliance (PC) and Non-Compliance (NC). By external agents and using a discard method, the Checklist was carried out in 50 poultry companies in the province of Chimborazo, applied during the months of June - August 2019 and replicated for readjustment of the valuation parameter in June - August 2020 to the same managers or administrators of the poultry farms first evaluated, since they are the ones who know the situation of these companies best, they constituted a valid source of information.

3 Results and discussion

Once the target population had been defined, the data derived from the levels of compliance achieved were processed (Figure 1). The points of the standard were divided into: mandatory and non-mandatory documents and records, to be subsequently considered as sub-treatments by applying statistical tools based on an ANOVA analysis of variance using a completely randomized block design (CRBD).

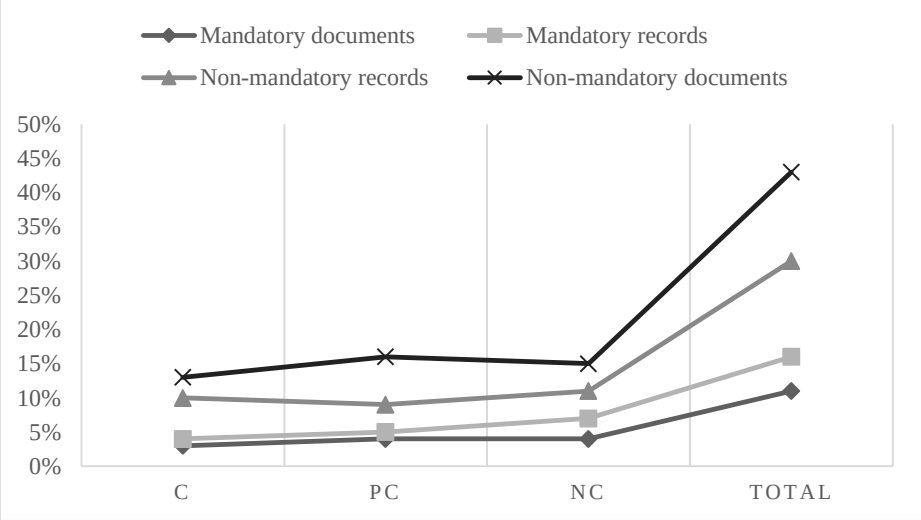

Fig. 1. Levels of compliance of basic documentation

In mandatory documents; there are 30% of these C with adequate documentation in the poultry industry, and 34% PC with the aforementioned documentation, and 36% NC with mandatory documents. This means that most of the entities lack the necessary documentation for an adequate control within their usual production, causing an inefficient management, loss of time and unnecessary expenses that reduce competitiveness.

In the mandatory records; there are 25.3% of these C with adequate records in the poultry industry, and 31.7% PC with the aforementioned records, and 43.0% NC with the records declared mandatory. This means that the entities of the sector evaluated do not have a structured base of minimum records that serve as documented evidence

to which the process or processes can be subsequently audited, which would allow adequate and timely control for decision making, in order to set objectives, goals and strategies for continuous improvement.

In the non-mandatory records; there are 32.4% of these C with adequate records in the poultry industry, and 30.9% PC with the mentioned records, and 36.7% NC with records declared as non-mandatory. Data that show that within the entities there is no innovation in the treatment of the information integrated to the technical and managerial procedures, to guide the actions of the organization in a practical and coordinated way and to ensure customer satisfaction and low costs for quality.

In the non-mandatory documents; there are 29.4% of these C with adequate documentation in the poultry industry, and 36.8% PC with the mentioned documentation, and 33.9% NC with documents mentioned as non-mandatory. Data that evidences that within the entities there is a lack of motivation towards increasing the reduction of investment risk, or in turn improve the exchange of documentation, or manage the daily work efficiently, the main problems that the companies had for not making these improvements with the processes were the lack of time and lack of resources.

It should be taken into account that the new ISO 9001:2015 standard has reduced the level of documentary obligations of the system, even so, there are a series of documents and records that are mandatory, as an essential requirement for certification of the system, which requires at least 80% compliance with documents and records.

Based on the above results, two study hypotheses were formulated: alternative (Ha) and Null (Ho). The Ha sought to statistically contrast whether a global corporate performance measurement model, based on the integration of the 6σ and BSC, would have a significant impact on the improvement of key processes in the poultry industry. While Ho seeks the opposite.

For the verification of the hypothesis, an analysis of variance was performed by means of an ANOVA using a CRBD, taking as:

- *Treatment.* - ISO 9001:2015 items, which were: Mandatory documents, Mandatory records, Non-mandatory records and Non-mandatory documents.
- *Block.* - the answer options such as C, PC and NC.

a. Decision rule

- The null hypothesis is accepted if the calculated Fisher value **(Fc)** is equal to or less than the tabulated Fisher **(FT).**
- The **alternative hypothesis** is accepted if the calculated Fisher value **(Fc)** is equal to or greater than the tabulated Fisher **(FT)**

The following statistical model is presented in a completely randomized block design:

$$y_e = \mu + r_i + в_j + E_{ij} \quad (1)$$

Where: μ: Overall average
r_i: Treatment effect
$в_j$: Block effect
E_{ij}: Effect of the i-th error (ij)

The Hypothesis testing model for a CRBD is summarized in Table 2 below:

Table 2. Modelo de diseño experimental

Source of variation	Sum of squares	Degrees of freedom	Mean square (MS)	F_0	F_0 Critical
Treatments	$SS_{\text{Treatment}}$	a-1	$\frac{SS_{\text{Treatment}}}{a-1}$	$\frac{MS_{\text{Treatment}}}{MS_E}$	Tabla F al 5%
Block	SS_{Block}	b-1	$\frac{SS_{Block}}{b-1}$		
Error	SS_E	(a-1) (b-1)	$\frac{SS_E}{(a-1)(b-1)}$		
Total	SS_T	N-1			

Table 3 contains the general contingency matrix for subsequent application of formulas for the respective calculation.

Table 3. General contingency matrix for the sum of the assessment

Documents and records required by ISO 9001:2015	C	PC	NC	Total (Y_i)
Mandatory documents	60.00	68.00	72.00	200.00
Mandatory records	76.00	95.00	129.00	300.00
Non-mandatory records	178.00	170.00	202.00	550.00
Non-mandatory documents	235.00	294.00	271.00	800.00
Total (Y_j)	549.00	627.00	674.00	1,850.00 (Y)

b. Sum of total squares

$$SS_T = \sum_{i=1}^{a}\sum_{j=1}^{b} {Y_{ij}}^2 - \frac{y^2}{N} \quad (2)$$

$$SS_T = (60.00^2 + 68.00^2 + 72.00^2 + \cdots 271.00^2 - \frac{(1\,850.00)^2}{(3)(4)}$$

$$SS_T = 361\,340.00 - 285\,208.33$$

$$SS_T = 76\,131.67$$

c. Sum of squares of treatments

$$SS_{Treatments} = \frac{1}{N_t}\sum_{i=1}^{a} {Y_i}^2 - \frac{y^2}{N} \quad (3)$$

$$SS_{Treatments} = \frac{1}{3}(200.00^2 + 300.00^2 + 550.00^2 + 800.00^2) - \frac{(1\,850.00)^2}{(3)(4)}$$

$$SS_{Treatments} = 357\,500.00 - 285\,208.33$$

$$SS_{Treatments} = 72\,291.67$$

d. Sum of the squares of the blocks

$$SS_{Block} = \frac{1}{N_t}\sum_{i=1}^{a} {Y_i}^2 - \frac{y^2}{N} \quad (4)$$

$$SS_{Block} = \frac{1}{4}(549.00^2 + 627.00^2 + 674.00^2) - \frac{(1\,850.00)^2}{(3)(4)}$$

$$SS_{Block} = 287\,201.50 - 285\,208.33$$

$$SS_{Block} = 1\,993.17$$

e. Sum of squares of the error

$$SS_E = SS_T - SS_{Treatment} - SS_{Block} \quad (5)$$

$$SS_E = 76\,131.67 - 72\,291.67 - 1\,993.17$$

$$SS_E = 1\,846.83$$

The results of the sum of squares and mean squares analysis to determine the F_0, or calculated F, are summarized in Table 4 below.

Table 4. ANOVA of the calculated Fo determination

Source of variation	Sum of squares	Degrees of freedom	Mean square (MS)	F_0	F_0 Critical
Treatments	72 291.67	3.00	24 097.22	78.29	19.164
Block	1 993.17	2.00	996.58		
Error	1 846.83	6.00	307.81		
Total	76 131.67	11.00			

By virtue of the results observed in the table above, the value of the calculated F-Fisher Statistic Fc =78.29 > F from the table Ft = 19.164, we reject H0) and accept H1, which indicates that: "*A global corporate performance measurement model, through the integration of 6σ and BSC has a significant impact on the improvement of key processes in the poultry industry*".

3.1 Construction of the MPMS model

The remarkable thing about the above metrics is that they can be quickly associated with sigma quality levels, an expression that is easy to handle and understand in relation to the appreciation of the quality of a product or service. This result is of utmost importance, since it shows that performance evaluation criteria at all levels of the poultry industry can be irreproachably aligned with the corporate strategic process, through quantitative criteria that are objective and consistent.

In this sense, the MPMS model is presented, which plans to define the requirements to be fulfilled and to describe the general dispositions to assure the procedures to be followed, to assure the integration of the Integral Multivariate Six Sigma with the Balanced Scorecard, evidencing the commitment of the company in front of the basic requirements proposed and the processes of the system.

MPMS, consists of 6 chapters and 5 faces of Global Corporate Performance Measurement, which explain the different methodologies and tools that can be used in the application of a long, medium and short term integration plan, within a variety of operational and strategic situations with the systematic approach shown in Figure 2.

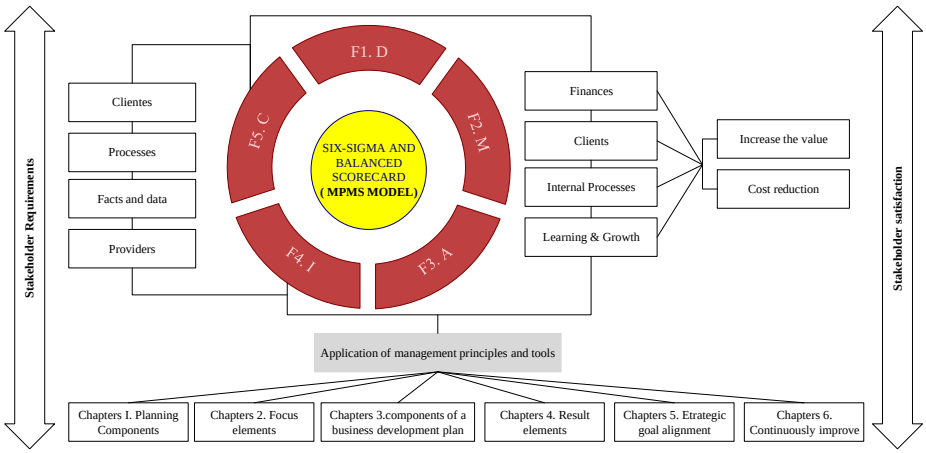

Fig. 2. MPMS model

Starting initially from the application of strategic tools of continuous improvement through the application of the 5 phases of 6σ, in the search to improve the performance of processes and reduce their variation, the Balanced Scorecard methodology is integrated as an additional control system taken from an internal and financial perspective to a balanced perspective in several senses: financial and non-financial information. Internal information and external information. Information on current and future results for the poultry industry in the province of Chimborazo. Figure 3 shows the different applicable tools of the MPMS model.

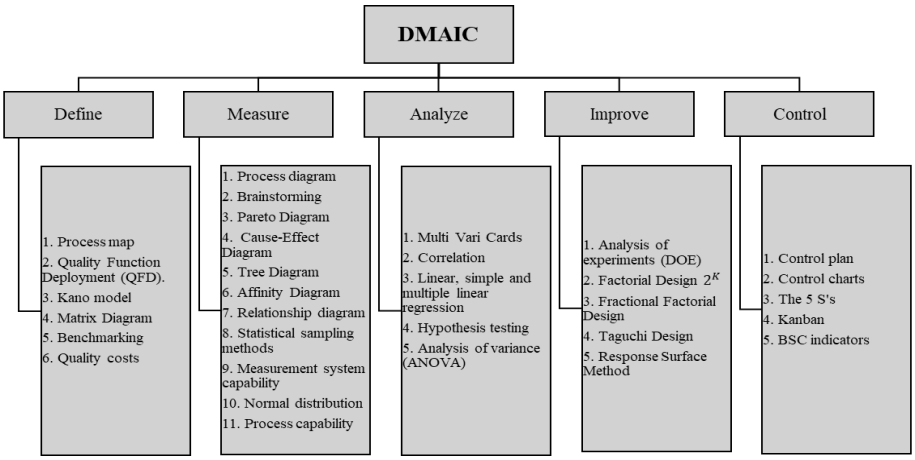

Fig. 3. MPMS model tools

Table 5 shows strategically a description of the tools of the MPMS model, comprised in the 6 chapters and 5 faces of integration of the Integral Multivariate Six Sigma with the Balanced Scorecard.

Table 5. MPMS model tools

6σ/BSC	Chapter	Phase	Feature
1	Chapter 1	Definition Phase	This phase identifies the problem to be solved, stratifying as much as possible, for example: customer complaint due to failure, identify the product family by importance using the Pareto diagram, then identify the product, the line where it is made, the specific equipment, among others. At this point you can define the problem and the opportunity for improvement.
2	Chapter 2	Measurement Phase	It focuses on selecting one or more characteristics to be measured, defining how they will be measured. This phase is important as it ensures that data relating to customer requirements and actual process performance are accurate, clear, and reliable.
3	Chapter 3	Analysis Phase	In this phase, the analysis of the data derived in the measurement stage is carried out, with the intention of finding out the causal relationships or root causes of the problem. The information from this analysis will provide evidence of the sources of variation and unsatisfactory performance, which is very useful for process improvement.

4	Chapter 4	Improvement Phase	In the analysis phase, the team selects the product performance characteristics that need to be improved to achieve the improvement goal by identifying the major sources of process variation. In this phase the design of experiments (DOE) will be used to choose the causes that most affect our Critical to Quality (CTQ) and investigate these causes to understand the behavior of the process.
5	Chapter 5	Control Phase	Once the process improvements have been implemented, it must be ensured that the implementations are maintained, continuously improved and in permanent control, the outputs will be: control plan and control methods implemented, training in the new methods, complete documentation and communication of results, lessons learned and recommendations.
	Chapter 6		Establishment of indicators based on BSC: Considering that the objectives and goals must be subject to management controls to determine an evolution in the implementation of the corporate global performance measurement model, through the integration of the 6σ with BSC. Feedback is mandatory in order to take the respective corrective measures to align the objectives and comply with the plan.

3.2 Strategic indicators by objectives of the MPMS model

Taking into account that the indicators are tools that allow in the measurement in the fulfillment of objectives which implants long term goals, these are useful to be able to measure with clarity the results obtained with the application of programs, processes or specific actions, in order to obtain the diagnosis of a situation or to evaluate the variations of an event. Therefore, based on the above, we propose indicators that show the way to reach the fulfillment of the corporate global strategic objectives; by means of these indicators we can conclude if the company is going in the right direction or what changes should be made.

Figure 4 illustrates the strategy map for each Balanced Scorecard phase based on the data collection of the 4 BSC phases.

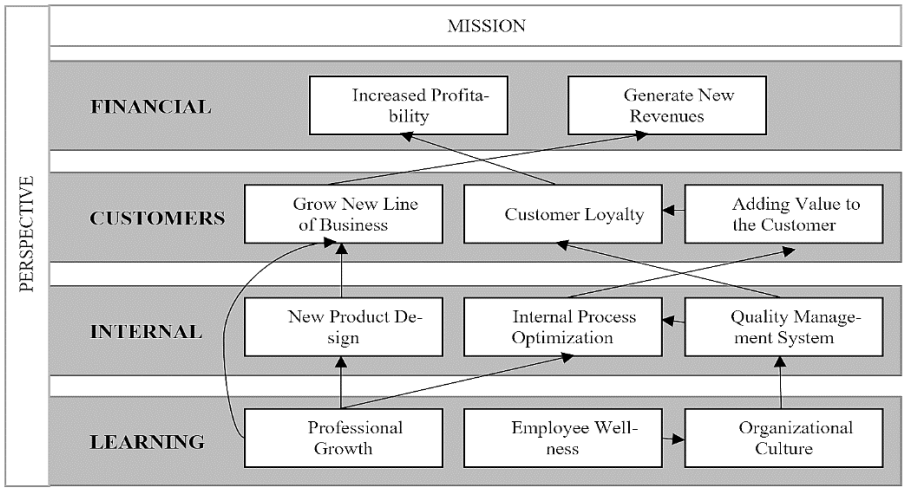

Fig. 4. Strategy Map

Table 6 contains the selected indicators for each strategic objective, designed to improve the performance of the processes and reduce their variation, extracted from the

analysis of data, tables and graphs generated with the application of the 5 phases of DMAIC.

Table 6. Strategic indicators by objectives of the MPMS model

Bsc	Strategic Objectives	Indicators
Financial Perspective	1. To generate new income in the poultry company.	1. Rate of return on invested capital
	2. Minimize the use of third-party capital in the operation of the company.	2. Financial autonomy index
	3. Improve the profitability of funds invested in the poultry industry.	3. Return on equity ratio.
Customer Perspective	1. Entering a new line of business Index Customer on-boarding	4. Index Customer onboarding.
	2. To expand the company in the search for new customers and to build customer loyalty among those customers who have little involvement in the company	5. Market share index.
	3. Increasing customer value and satisfying customer needs	6. User satisfaction level 7. Sales efficiency
Internal Process Perspective	1. Improve the efficiency and effectiveness of the company's logistic and operational processes.	8. Compliance in total production deliveries (TP) 9. Quality of the logistics process 10. Purchasing volume vs. sales volume 11. Operator efficiency 12. Machinery Utilization 13. TP failure rate 14. Documentation without problem
	2. Propose a cleaning policy to avoid disorder in the different areas of the company in order to avoid accidents (Quality Management System).)	15. Level of compliance with O.S. activities 16. Percentage of waste
	3. New product design	17. Level of compliance with programmed activities
Learning and Growth Perspective	1. Generate an organizational culture that manages to provide added value to our products (Employee Well-being)	18. Recognized employees
	2. Adapt a human capital recognition policy to develop the skills of our personnel (Organizational Culture).	19. Employee satisfaction
	3. Empower our salespeople to create a culture focused on customer satisfaction. (Professional Growth.)	20. Customer loyalty 21. Training hours

The MPMS model employs global corporate performance measurement indicators over a variety of operational and strategic situations which makes it applicable to a variety of organizations.

Table 7, 8, 9 and 10 below shows a breakdown of the indicators designed for each of the phases of BSC integration.

Table 7. Strategic integration indicators of the MPMS - Financial Model

BSC	Indicators	Threshold	Formula
Financial Perspective	1. Return on Invested Capital Ratio	In this indicator the qualification will be given by the company so that the level of capital invested in the development of the new product does not exceed the value of amortizations, and the value of the capital is higher.	$\text{R. C. I} = \frac{T.A}{B.N + A} * 100$ **Where:** R.C.I= Recovery of invested capital T.A = Total Assets B.N = Net Profits A = Amortizations
	2. Index Level of financial autonomy	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\text{N. A. F} = \frac{F.P}{T.A} * 100$ **Where:** N.A.F = Financial autonomy level F.P = Proprietary Fund T.A = Total Assets
	3. Return on equity index	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\text{R. F. P} = \frac{B.N}{F.P} * 100$ **Where:** R.F.P = Return on Equity B.N = Net Profits F.P = Proprietary Funds

Table 8. Strategic indicators of integration of the MPMS - Customer model

BSC	Indicators	Threshold	Formula
Customer Perspective	4. Index Customer onboarding	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\text{C. I} = \frac{F.C - I.C}{I.C} * 100$ **Where:** C.I= Customer Incorporation F.C= Final Customers I.C= Initial Customers
	5. Market Share Index	It is determined with the demand that the company has determined, ideally it should be a higher number than the current demand.	$\text{M. S} = \frac{N.C.C}{S.P}$ **Where:** M.S= Market Share N.C.C = Number of Current Customers S.P= Segment Population
	6. User satisfaction level	0% - 54% Very Bad 55% - 64% Bad 65% - 74% Regular 75% - 84% Good 85% - 100% Excellent	$\text{N. C. S} = \frac{(A*0)+(B*25)*(C*50)+(D*75)*(E*100)}{N}$ **Where:** N.C.S= Net customer satisfaction indicator. A= Number of responses for very dissatisfied. B= Number of unsatisfied responses. C= Number of responses for neutral. D= Number of responses for satisfied. E= Number of responses for very satisfied. N= Sum of all the above (A+B+C+D+E).
	7. Sales efficiency	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\text{E} = \frac{C.P}{T.C.T} * 100$ **Where:** E= Efficiency C.P= Customers Portfolio T.C.T= Total Clients Target Market

Table 9. Strategic indicators of integration of the MPMS model - Internal

BSC	Indicators	Threshold	Formula
Internal Process Perspective	8. Compliance in TP deliveries	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\text{C. TP. D} = \frac{N.OT.D}{T.D} * 100$ **Where:** C.TP. D= Compliance in TP deliveries N.OT.D= Number of on-time deliveries T.D= Total dispatches
	9. Quality of the logistic process	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\%\text{ L. P. Q} = \frac{N.I}{T.O} * 100$ **Where:** L.P.Q= Logistics process quality N.I= Number of incidents in TP deliveries T.O= Total orders
	10. Volume purchases vs. sales	In this indicator the qualification will be given by the company so that the level of purchases does not exceed the value of sales depending on the objectives it wants to achieve.	$\text{V} = 1 - \frac{V.p}{T.S} * 100$ **Where:** V= Purchasing volume V.p = Value of purchases T.S= Total sales
	11. Operator efficiency	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$O.P = \frac{N.U.P}{M.N.P} * 100$ **Where:** O.P = Operator performance N.U.P= Number of units produced M.N.P= Maximum number of units produced.
	12. Use of machinery	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\text{M. P} = \frac{N.U.P}{P.C} * 100$ **Where:** M.P= Machine performance N.U.P = Number of units produced P.C= Machinery production capacity.
	13. Failure rate of TPs	0% - 50 % Deficient 51% - 90 % Insufficient 91% - 94% Acceptable 95% - 100 % Ideal	$\text{F. TP. I} = \frac{T.U.R}{T.UP} * 100$ **Where:** F.TP.I=Faulty TP Index T.U.R= Total units returned T.U.P= Total units produced
	14. Documentation without problem	0% - 50 % Deficient 51% - 90 % Insufficient 91% - 94% Acceptable 95% - 100 % Ideal	$\text{V} = \frac{DWP}{T.D} * 100$ **Where:** V= Value D.W.P=Documentation without problems T.D= Total documents
	15. Level of compliance with O.S. activities.	0% - 50 % Deficient 51% - 90 % Insufficient 91% - 94% Acceptable 95% - 100 % Ideal	$\text{L. C} = \frac{N.A.C}{T.N.P.A} * 100$ **Where:** L.C= Level of compliance N.A.C= Number of activities carried out T.N.P.A= Total number of programmed activities.
	16. Percentage of waste	0% - 50 % Deficient 51% - 90 % Insufficient 91% - 94% Acceptable 95% - 100 % Ideal	$\%\text{W} = \frac{T.W}{T.RM} * 100$ **Where:** %W= Percentage of waste T.W= Total waste T.RM= Total raw material used
	17. Level of compliance with programmed activities	0% - 50 % Deficient 51% - 90 % Insufficient 91% - 94% Acceptable 95% - 100 % Ideal	$\text{L. C} = \frac{C.T}{E.C.T} * 100$ **Where:** L.C= Level of compliance C.T= Changeover time E.C.T= Estimated changeover time.

Table 10. Strategic indicators of integration of the MPMS model - Learning

BSC	INDICATORS	Threshold	Formula
Learning and Growth Perspective	18. Recognized employees	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\text{L. R} = \frac{N.E.R}{T.E} * 100$ **Where:** L.R= Level of recognition N.E.R= Number of employees recognized month T.E= Total number of employees
	19. Employee satisfaction	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\text{L. S} = \frac{N.c}{T.E} * 100$ **Where:** L.S= Level of satisfaction N.c= Number of monthly complaints T.E= Total number of employees
	20. Customer loyalty 21. Training hours	0% - 50 % Deficient 51% - 70 % Insufficient 71% - 85% Acceptable 86% - 100 % Ideal	$\text{L. L} = (N.C.C - N.C)$ **Where:** L.L= Loyalty level N.C.C= Number of current customers N.C= Number of customers previous year

With the exposed results it can be identified that 6σ is a quality management methodology that focuses on reducing the existing variation in the production processes of goods or services, the drastic reduction of defects and the improvement of the quality of products, processes and services. On the other hand, the BSC is a strategic management tool and performance measurement system designed to translate the organization's strategies into focused action plans. The MPMS model proposes that if strategy, performance and customer satisfaction are aligned, the organization will benefit from the strong relationship between process performance and strategic initiatives. These changes can be measured by productivity and process metrics, such as cycle time, production rates, production efficiency, and rework rate, among others. The present work reported the results of a research integrated by the analysis, development of a Corporate Global Measurement Model through the integration of 6σ with the BSC today called Multivariate Performance Measurement System (MPMS), which integrates multiple evaluation and control proposals. Systematically structured model based on DMAIC methodologies, BSC and advanced statistical techniques, with the purpose of contributing to fill the gap that currently exists due to the lack of an instrument with these characteristics that comprehensively and strategically assesses the performance of an organization..

4 Conclusions

A performance measurement model is a structural and systematic procedure to measure, evaluate and influence work-related attributes, behaviors and results, as well as the degree of absenteeism, in order to declare the extent to which the process is productive within the company, in order to make decisions related to improving its future performance.

A Global Corporate Measurement Model was proposed through the integration of Six Sigma (6σ) with the Balanced Scorecard (BSC) today called Multivariate Performance Measurement System (MPMS), which integrates multiple evaluation and control proposals. Systematically structured model based on the DMAIC and BSC methodologies, thus forming common scenarios in which the poultry industry of the province of Chimborazo is exposed, designed to take corrective and preventive actions towards translating the organization's strategies into action plans oriented to a continuous improvement.

The MPMS was able to identify the aspects with the greatest impact within the evolutionary process of the poultry industry and thus control and make the right decisions considering the goals proposed for the current year, developed with the objective of maximizing the effectiveness of equipment, processes and facilities, through organized work, trained personnel and methodologies that focus on continuous improvement, ensuring the quality characteristics established for the product.

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