

Development of a Methodology and an Optimization Model for the Performance Evaluation of the Employees in the Public Economic Management and Procurement Systems: The Case Study of the Spanish Air Force

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Abstract—The economic administration and procurement system of public sector structures are composed of a series of management units whose staff assigned to them needs to be optimized. In order to achieve this, the work analyzes the concept of performance evaluation presented in the Spanish Public Administration, similar to other countries of the EU and Latin America. A methodology has been designed to evaluate performance using systemic analysis and organizational behavior, taking as a case study the Spanish Air Force. Traditional performance evaluation models are based on the psycho-sociological research of workers, which are static and require a lot of management effort. Faced with these limitations, a new dynamic and interdisciplinary model has been designed and implemented to evaluate performance and measure workload that can be used with high periodicity and requires little management effort. The model in question focuses mainly on the generation of strategic intelligence through the exploitation of the databases of the economic management information system. This strategic intelligence serves to guide decision-making regarding the reallocation of jobs and personnel to identify training needs and the necessary changes in organizational culture and leadership. In general, this model allows an improvement in the effectiveness, efficiency, economy and service level of the system, and can be applied to other Spanish military organizations or those belonging to other countries of the international community as well as other structures of the public administration dedicated to economic management and procurement.

Keywords—Public Sector Management; Public Performance Evaluation; Workload Measurement; Human Resources Optimization.

I. INTRODUCTION

During the last decades, there has been an astounding and continuous transformation of management models in the private sector, which have searched for permanent improvements in the competitiveness and productivity of available resources through the optimization of work processes, methods as well as costs. The strong and growing competition experienced due to globalization has forced us to identify new alternatives to reinvent strategic solutions in productive organizations, generating the development of new, flexible and innovative management tools. On the contrary, the management of public organizations, including publicly owned companies, is quite different. Usually, these organizations do not have any sort of competition in their

fields of activity but have a guaranteed sustainability in their public budgets.

Thus, they have maintained a continuous position while retaining a very bureaucratic model with inadequate management procedures that in many cases have failed to meet the demands of economicity, effectiveness and efficiency, especially in closed and non-permeable structures such as the armed forces.

In April 2019, the work entitled *Employee Performance Evaluation within the Economic Management System of the Spanish Air Force: Development of a Methodology and an Optimization Model* was presented at the 7th World Conference on Information System and Technologies and has also been published in *New Knowledge in Information Systems and Technologies - Advances in Intelligent Systems and Computing - of Springer* [1]. In this work, a synthesis of the research carried out for the development of a methodology for performance evaluation and an optimization model of human resources allocation within the economic management and procurement system of the Spanish Air Force was presented. As a continuation of this work, the present work considers its conceptual and scope extension, in order to facilitate its possible generalization to other international military structures and, therefore, to other public bodies.

A. A case study: The Spanish Air Force

The Spanish Air Force (SAF) is one of the three armed forces designated to defend Spanish airspace, as well as contributing to the maintenance of international security through its participation in peace operations and humanitarian aid.

The dimension of the SAF is conditioned by increasing operational and logistical needs derived from a modern fleet composed of 415 aircraft. Among them, include the most avant-garde weapons systems such as the Eurofighter Typhoon, the Airbus A400M, the EADS CASA C-295, the Canadair CL415, or the Eurocopter AS 532 COUGAR, which allow it to operate with high capacities at a global level.

At present, the human resources available amount to some 23,000 employees. In recent years, there has been a reduction of about 4,000, with a growing tendency to continue reducing this figure by another 3,000 during the next 3 years. This significant reduction, which contrasts with the increase in

demand for operational activity and training, logistics and administration, has led to personnel becoming an increasingly scarce resource as well as its optimization becoming an essential initiative.

About 500 employees are directly assigned to the organic elements that make up the economic management and procurement system of the SAF, a collective that includes another 500 who work part-time in the operational, training and logistic support Units, Centres and Organizations (UCOs). The sum of both groups should be significantly reduced over the next few years, without adversely affecting the functioning of the aforementioned system of economic administration and procurement.

This system is currently made up of the Directorate of Economic Affairs and the Procurement Directorate, 14 Management Units called Economic-Administrative Sections (SEAs), 7 Economic Support Organs (OAEs) in national deployment and 4 more in international deployment, and 218 Units that correspond to the UCOs of the SAF that configure their national deployment.

B. Research Methodology and Contents

The research was initially developed through an exploratory or interpretive methodology, trying to better understand the problem posed but without obtaining conclusive results, through a systemic conception through a systematized deductive process (from top to bottom) guided by empirical evidence obtained from the author's experience and qualitative interaction with different organizational structures (Bottom-Up). The literature review has been used to synthesize the essential concepts and approaches on the problem investigated, reviewing all this with a level of detail that is considered sufficient, seeking its original aspects to ensure objectivity and avoid interpretative biases.

On the conceptual basis obtained, a model of the performance evaluation of the economic management and procurement system of the Spanish Air Force has been subsequently developed, with data from the 2017 financial year, which concentrated the approach as a "pilot study", whose approaches and procedures are explained throughout the work.

The work has been structured in two sections, after which the conclusions are presented. First, a conceptual review of performance evaluation systems and alternative references in Public Administration is studied, within a systemic and organizational behaviour approach. Secondly, the case of the Economic Management and Procurement System of the Spanish Air Force is analyzed, within the performance evaluation procedures of the Spanish Public Administration. A specific methodology and model is developed and is applied with the economic management data for 2017, within a "pilot experience". Finally, the synthesis of the results obtained that allow validating the effectiveness of the methodology and the model developed is exposed. The methodology and model developed is possible to be applied internationally to other military forces and other civil organs of the public sector.

II. BACKGROUND AND LITERATURE REVIEW

A. Performance evaluation: Alternative reference approaches and its application in Public Administration

Despite the growing importance that most public and private organizations have been giving to both the management of human resources and the evaluation of their performance, the more frequent ones are those that continue to maintain traditional approaches and whose evaluative activities mainly focus on the simple unilateral judgment of the boss regarding the work of his subordinate [2].

However, regardless of this non-evolved way of operating, the last decades have been very prolix as to the conceptual development of increasingly sophisticated and interdisciplinary evaluation models. For example, for Chiavenato [3] the evaluation of performance is a systematic evaluation carried out by each individual in his job or from the potential of its future development. Each evaluation is a process targeted to stimulate or judge the value, excellence and qualities of the workers. Griffin & Ebert [4] state that the formal evaluation of an employee's job performance must determine the degree to which this employee is effectively performing his job. For Sastre & Aguilar [5], performance evaluation is a systematic and structured process for monitoring the professional work of the employee, and assesses their work and the results achieved in the performance of their job. Ployhart, Schneider & Schmitt [6] consider that the evaluation represents the conceptualization, measurement and analysis of the level at which employees do their work and the satisfaction they feel in regarding their work situation. According to Dolan, Valle, Jackson & Schuler [7], performance evaluation is defined as a structural and systematic procedure that measures, evaluates and influences the attributes, behaviours and results related to work, in order to discover to what extent the employee is productive, and if he is able to improve his future performance. Finally, Sánchez & Bustamante [8] point out that those organizations need to know how employees are performing their tasks, in order to identify who effectively adds value and who does not.

Consequently, as can be seen from the above, there is a shared approach among the relevant authors, both in relation to the purposes that the concept of performance evaluation raises, as well as in the need to measure the contribution of each worker as to their achievements regarding the objectives of the organization.

However, there is no homogeneity in terms of how to evaluate this, or on the effects that can or could derive from the selected evaluation system selected, which has therefore resulted in a multiplicity of disparate methodologies and different applications.

Perhaps for this reason, new disruptive tendencies in the evaluation of performance based on the global analysis of management data and continuous evaluation are being imposed in the business world. These new approaches reduce the use of complicated traditional methods and make a final qualification prevail, without relying on voluminous audit reports [9].

These evaluations are developed around a continuous dialogue between bosses and subordinates, where the centre of the permanent evaluation is the person, not with the idea of

measuring but rather promoting their continuous improvement. It is about stimulating a culture based on merit and high performance, focused on individual development, emphasizing strengths and correcting weaknesses. Teamwork and collaboration, organizational and individual learning, and the alignment of workers with the values and corporate culture of the organization prevail as the most important elements. Finally, transparency becomes a fundamental value, giving full visibility as well as sharing the assessments and criteria for decision making, supported at all times by digital tools.

In relation to the Public Sector in Spain, Law 7/2007, 12 of April, of the Basic Law of Public Employees, the concept of performance evaluation was introduced, stating in its Article 20 the obligation for those Administrations to establish systems that would allow performance evaluation of their employees. However, until now this Law has not been applied and deployed, and only some training initiatives and "pilot projects" between 2008 and 2012 have been proposed in the General State Administration, to which the Ministry of Defence and the SAF belong [10] [11].

B. Systemic Analysis and Organizational Behavior

The general systems theory formulated by Bertalanffy [12] determined that the systems were among other aspects, characterized by the interactions of their component subsystems as well as the non-linearity of those interactions and their environment.

This approach, which for decades has been greatly used in the field of study of organizational development, has forced the studies in this discipline to conceive organizations as open systems that interact with their environment.

The change, seen as a permanent and necessary phenomenon of open social systems and organizations, is often induced by previous changes in the conditions. Consequently, the planning of social and organizational change with the intention of solving a problem or developing a view, should predict and keep in mind the changes in the circumstances that will predictably occur, and when they will take place. It is necessary to bear in mind that every change that is generated in an organization will affect various variables of its internal social system. The detailed knowledge of the nonlinear relationships between the variables that explain it offers those responsible for the planning process the possibility of achieving great changes in a desired variable, through relatively small changes in another one.

In this sense, interdisciplinary field studies of organizational behaviour are very useful, and allow us to know the impact that individuals, groups and structures have on human behaviour within the organizational scope. Organizational behaviour complements the studies on human resources and organizational theory, investigating the way in which individuals interact within social groups, by creating more effective and efficient organizations, thus optimizing personal and group work performance. So, it is an interdisciplinary field that involves sociology, psychology, communication and management, which focuses on organizational and intra-organizational issues, and

complements human resource studies, which are focused more on everyday business practices. Normally, this study is applied in an attempt to create more efficient business organizations. The main idea of the study of organisational behaviour is that a scientific approach can be applied to the administration of workers. Organizational behaviour theories are used for human resource goals to maximize the performance of individual group members [13].

The problems addressed by studies on the behaviour of the micro organization include decision-making, cognition and organizational and individual learning, motivation, negotiation, perception, group development, as well as power and influence. Those related to the behaviour of the macro organization include the study of organizations as social systems, the dynamics of change, the relationships between organizations and their environments, aspects of organizational personality and identity, social movements, as well as the power caused by communication. The functional areas under investigation include workload analysis and staff sizing, productivity increase and job satisfaction, innovation promotion changes of dysfunctional corporate cultures and management, and participatory leadership encouragement, as objectives.

The application of the theories and methodologies of organizational behaviour to the field of study of this work, allows the approaches to be enhanced, provides references on the dimensions which is necessary to take into account, and makes the guidelines to be followed more visible [14] [15].

To begin with, the specific corporate culture of each management unit plays an important role in the way in which individuals interact with each other, they also set up formal and informal groups and develop their work activities. In addition, success through achieving a high level of professional satisfaction requires the existence of an intrinsic and extrinsic rewards system, which should be felt as being fair by the majority. Likewise, the development of adequate labour standards, the existence of an appropriate style of management and supervision, as well as satisfactory working conditions, a leadership that is totally aligned with the approach of the implemented management system, all of which should promote a participative, effectiveness, efficient and service-oriented style. Finally, power and authority, which should operate in an interdependent manner with ethical and legal guidelines proper to the functioning of the Public Administration, through which these elements are exhibited and used, and represent key components to manage a cohesive and sound workplace.

III. THE PROBLEM CASE: THE STRATEGIC CONCEPT AND DESIGN OF THE SPECIFIC MODEL USED

The aim of this work has been to analyse the problem as well as develop and implement a dynamic model that allows group performance evaluation and workload measurement of each of the management units of the economic administration system and acquisitions of the SAF. The management of this model only requires a reduced consumption of resources, essentially making use of the data of the computerized management system, thus making it possible to guide decision-making regarding staff and personnel reallocation,

training and changes in culture organizational and leadership, and moving towards the improvement of the effectiveness, efficiency, economic viability and service to the UCOS.

A. The Computer System of Economic Management and Administration of the Spanish Ministry of Defence (SIDAE)

The Computer System of Economic Management and Administration of the Spanish Ministry of Defence (SIDAE) manages all financial resources and management activities thereof, including the SAF: budget, contracting and procurement, accounting, financial management and treasury processing service commissions, as well as B2B electronic management with various suppliers. Different types of users undertake the tasks of this management.

The SIDAE is a system developed in three layers. The Database layer is located in a SUPERDOM (UNIX) managed by an Oracle database engine. The Application layer, where the business logic of the SIDAE is implemented, comprises more than one and a half million lines of code, developed in both JAVA and NET programming languages and run in different virtual machines with balanced Apache servers against TOMCAT servers. Finally, different layers of WEB services which, depending on multiple configuration elements, directly serve users who connect to the system through WEB browsers, both inside and outside the corporate network of the Ministry of Defence. It also has Control Tables developed with IBM COGNOS BI.

B. Reference performance evaluation models in the Spanish Public Administration

Three generic performance evaluation models have been preferentially used in Spanish Public Administrations:

1) The contextual performance model by Borman & Motowidlo [16] is based on both individual and group analysis and the persistence of extra effort and enthusiasm to successfully complete the activities required by the tasks, the voluntarism in the individual tasks, support and cooperation, alignment of the rules, procedures and organizational policies, and ongoing support to fulfill the objectives of the organization.

2) The performance techniques and core tasks model by Campbell, Gasser & Oswald [17] include generic tasks of similar posts as well as specific ones of particular posts. Additionally it also includes tasks that need verbal and written communication to variable sized audiences, maintaining personal discipline, facilitating team tasks, monitoring activities regarding influence, the management and monitoring of workers as well as management tasks related to the organization in addition to its implementation and resourcing.

3) The task productivity model of Viswesvaran & Ones [18], which is based on their analysis of the behaviours that are considered constituent of the central tasks of the positions, interpersonal competence, leadership, effort, knowledge of the position and the counterproductive conducts.

The specificity of the problem under study recommended the creation of an ad hoc dynamic model that would integrate the main aspects of the previous three, and that would be

oriented towards the generation of strategic intelligence produced by a monitor of quantitative indicators of exploitation of the SIDAE related to the SAF [19]. This would be completed with a monitor of qualitative indicators on objective quality regarding management and productivity of the assigned resources, as well as on subjective quality and satisfaction of the users of the services provided.

C. The specific model used: Empirical analysis

The analyses has been developed with a multidisciplinary approach. This approach integrates the creation of a matrix of the four functional areas of activity. These include global management, contracting and procurement, accounting and finance, and treasury management, with the three types of continuous improvement established for performance evaluation: EFFICIENCY, objective quality of the management and productivity of the resources allocated; ECONOMICITY, internal control of the management activities; and EFFECTIVENESS, subjective quality and user satisfaction of the services provided.

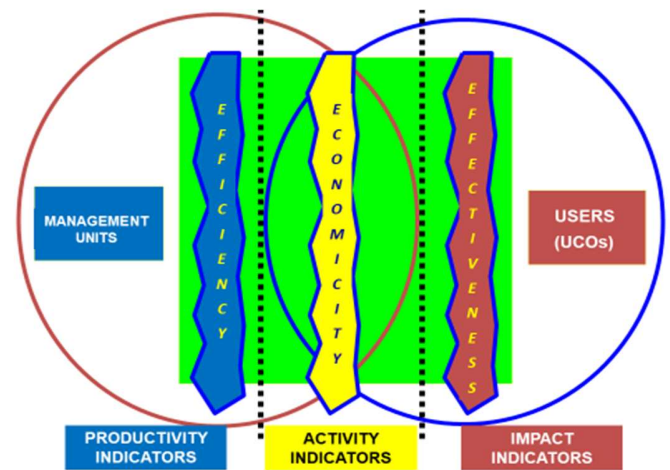


Figure 1: Types of indicators for the performance evaluation of the economic management and procurement system of the SAF.

The specific model proposed incorporates an approach of evaluation and continuous improvement, with a vocation to export "best practices" and avoid "inappropriate practices" to the general management units, and concentrating the effort on the most important aspects of the four functional areas, depending on their deviation from the standard or their variability and risk.

For this purpose, an integrated monitor of quantitative and qualitative indicators was developed, for which a classification of their values was proposed in conditions of "normality", of "insignificant abnormality" and of "very significant abnormality", as well as their objective values.

It was decided that the studies should begin by evaluating the performance of the 14 SEAs, which are regulated by the same regulations, managed by similar procedures that have a similar deployment of the SIDAE.

In relation to the ACTIVITY - ECONOMICITY indicators and part of the PRODUCTIVITY - EFFICIENCY indicators, 21 KPIs were defined within the possibilities offered by the SIDAE for the integration and monitoring of quantitative

information related to the four established functional areas. It was necessary to integrate them, by deliberating the ones that were most adjusted to the average reality of the set of SEAs, even though there was proof that there were differences in the actual procedures that apply to each of them.

A Bottom-Up study was carried out estimating from an "IT-technical" approach, a first determination of such weight only taking into account the average efforts made in the management of the SIDAE information processes. However, it was considered necessary in order to complement this result with a Top-Down study, from a "user manager" approach, to integrate in each indicator the comprehensive effort of the managers, that is, in addition to the computer processes, of other processes, documentaries and cognitive activities, coordination, archiving processes, etc. of both management personnel and support staff.

In order to do this, starting from a total activity of 100%, and through qualitative analysis, the aim was to determine the percentage of integral effort that involved the development of activities linked to each chosen indicator. An average estimation of all of the weights of the 14 SEAs was taken, and the variability of the weights was studied, measuring their variances to determine the congruence of the results obtained, both in comparative terms of what is proposed by the rest of the SEAs, as in relation to the weights obtained from the previous Bottom-Up approximation.

The information on PRODUCTIVITY - EFFICIENCY was complemented by qualitative research, through a survey carried out on all of the staff from each of the selected SEAs as a statistically significant sample, by means of questions whose answers were tabulated with Likert scales, in relation to the main attributes of leadership, motivation, training and corporate culture.

Finally, in relation to the IMPACT – EFFECTIVENESS indicators, the main aspects of the quality perceived by the users of the services provided by the SEAs to the UCOs were studied. A survey evaluated statistically representative samples, and likewise, with a Likert scale, evaluated the importance, assessment and diversity of the satisfaction attributes. These included, advice and use of clear and transparent information; knowledge of the needs of the UCO; professionalism, efficiency and reliability in meeting the needs of the UCO; availability, speed, efficiency and flexibility in management responses; loyalty and treatment in the personal interaction regarding services provision; and an overall level of satisfaction.

A variety of tools have been used to extract and process the SIDAE data. Most of the extraction has been done through Query String, directly made against the Database in SQL language (Structured Query Language) through the Oracle SQL Developer tool. These queries have been downloaded to Excel files for processing in the Microsoft Excel Tool through macros and programming in Visual Basic for Applications (VBA).

The final presentation of the data has been set up by generating dynamic and fixed tables, with cross references within the Excel Book itself, thus maintaining the interconnection of the data. The model is synthesized in Figure 2, which is summarized below:

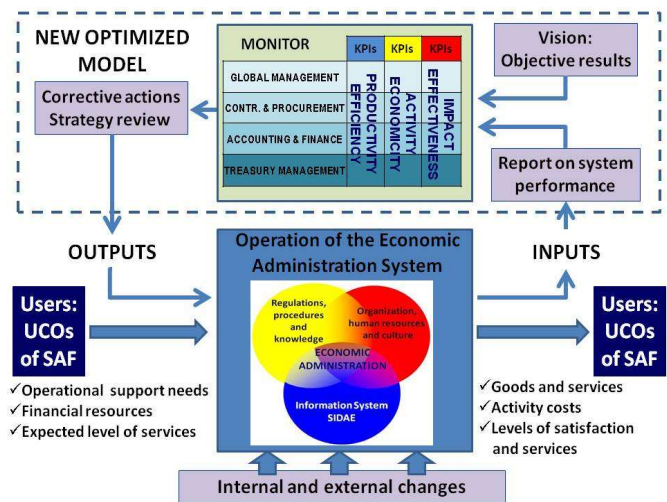


Figure 2: Synthesis of the dynamic model developed for the performance evaluation of the economic management and procurement system of the SAF.

IV. RESULTS OBTAINED

The performance evaluation with data from the 2017 financial year, which concentrated the focus exclusively on the 14 SEAs as a "pilot study", provided information on the effectiveness, economy and efficiency of the system.

Regarding qualitative aspects of overall satisfaction, the study resulted in average values higher than 4 (valuing 1 as minimum and 5 as maximum), both in importance and in the assessment of all its attributes, with very low diversity of opinions. Likewise, the levels of personnel motivation and the exercising of leadership among the intermediate commanders, gave average result levels regarding valuation superior to 3.5 but, on the other hand, identifying a lack of training in more than 80% of the employees, both in the procedures and in the management of the SIDAE.

Regarding the quantitative aspects of workload, as shown in Figure 3, there is a great divergence in the workload levels supported in absolute terms by each of the SEAs. These were estimated according to the result obtained from the integration of the KPIs used, which is especially significant in terms of the unit levels of workload of jobs in the existing workplaces, for each job covered and each employee allocated.

SEA	NUMBER OF PEOPLE SEA	TOTAL JOB POSITIONS SEA	OCCUPIED JOBS SEA	WORKLOAD SEA	WORKLOAD / PEOPLE	WORKLOAD / OCCUPIED JOBS	WORKLOAD / TOTAL JOB POSITIONS
EA26 - SEA	23	24	24	231.637	10.071	9.652	9.652
EA14 - SEA	15	18	16	189.486	12.632	11.843	10.527
EA41 - SEA	24	26	24	182.076	7.586	7.586	7.003
EA22 - SEA	23	24	24	173.887	7.560	7.245	7.245
EA27 - SEA	25	32	25	167.759	6.710	6.710	5.242
EA15 - SEA	18	19	18	144.261	8.014	8.014	7.593
EA24 - SEA	21	24	22	135.227	6.439	6.147	5.634
EA12 - SEA	25	28	25	118.369	4.735	4.735	4.227
EA46 - SEA	17	18	18	117.307	6.900	6.517	6.517
EA62 - SEA	22	28	23	79.153	3.598	3.441	2.827
EA61 - SEA	14	19	14	77.128	5.509	5.509	4.059
EA45 - SEA	16	19	17	76.766	4.798	4.516	4.040
EA23 - SEA	21	21	21	75.388	3.590	3.590	3.590
EA16 - SEA	8	16	12	45.369	5.671	3.781	2.836
TOTAL	272	316	283	1.813.812	6.668	6.409	5.740

Figure 3: Number of personnel, total work positions and occupied work positions of the SAF SEAs - Workload indexes.

V. CONCLUSION

This dynamic model has turned out to be sufficiently effective and explanatory. The functioning of the model, essentially provided by the SIDAE data, also allows it to be qualified as efficient, given that the effort necessary regarding its management is minimal and the possibility of it being implemented with high periodicity is absolute. After verifying the significantly high satisfaction levels of the UCOs, it has been possible to confirm the existence of a distribution of jobs whose load is very unbalanced. Therefore, it is necessary to adjust the demand and supply of labour, promoting a reallocation of personnel, or reassigning the UCOs that are managed by each SEA.

Following the generalization of the analysis to each element that make up the economic management and procurement system of the SAF, and with a view to addressing digital transformation processes that will modify the procedures, the strategy used as well as the organization itself, it is necessary to develop standardized actions and intensify the deployment of the SIDAE in the aforementioned system, thus promoting a more homogeneous corporate culture based on participative leadership. For this reason, it is essential to reform the internal operating regulations, by reviewing the functions and tasks of each organic element of the system as well as providing a higher level of integration to it.

The feasibility and effectiveness of the methodology and the developed model have been established, and they can be applied to other Spanish military organizations or those belonging to other countries of the international community, especially the EU and Latin America due to the similarity of their applicable regulations, as well as other structures of the public administration of these countries dedicated to economic management and procurement.

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