Use of DMAIC to Elaborate a Proposal to Improve the Purchase Processes of the Material Department of the Federal University of Amazonas: A Study on Public Procurement Management

Joice Ribeiro dos Santos, Marcelo Albuquerque de Oliveira, Raimundo Kennedy Vieira and Erika Souza de Melo

ABSTRACT

The public sector is a dynamic system composed of a web of tools and models for administrative and accounting management. In the midst of a tangle of processes, public procurement emerges as an important mechanism for the management, movement and application of financial resources destined to serve society. The purpose of this article is to present a proposal for a Manual of Procedures and Guidelines (MPG), aimed at promoting improvements to the public procurement process that is under the responsibility of the Material Department of the Federal University of Amazonas. The study methodology was developed from a bibliographic, documentary, and observational research, based on the application and analysis of the DMAIC tool. The study methodology was developed from a bibliographic, documentary, and observational research, based on the application and analysis of the DMAIC tool. The study presented as a result a viable proposal for improving procedures through the elaboration of a manual of rules and procedures for the optimization of public procurement management carried out by the materials department. The study presented as a result a viable proposal for improving procedures through the elaboration of a manual of rules and procedures for the optimization of public procurement management carried out by the materials department. It was concluded that greater efficiency in public procurement management is able to reduce expenses, allows the systematization of procedures and reduces the processing time of the purchase processes in their different phases until the purchase and availability of the purchased item to the requester.

Keywords: Public procurement, Improvement of procedures, DMAIC, Public service.

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Joice Ribeiro da Silva*

Technical-Administrative in Education. Master's student Production Engineering, Federal University Amazonas.

(e-mail: joicexume@hotmail.com)

Marcelo de Albuquerque de Oliveira

Professor, PhD, Master's Program in Production Engineering, University of Amazonas.

(e-mail: marcelooliveira@ufam.edu.br)

Raimundo Kennedy Vieira

Professor, PhD, Master's Program in Production Engineering, University of Amazonas.

(e-mail: kennedy71@gmail.com)

Erika Souza de Melo

PhD, Visitant Professor of Université du Québec à Trois-Rivières (UQTR).

(e-mail: Erika_SouzadeMelo@uqar.ca)

*Corresponding Author

I. INTRODUCTION

Public administration has in its historical origin, in the mideighteenth centuries, a character of managerial presence carried out by the State, that is, since the oldest periods in the history of mankind, the act of administering has already been applied to manage and coordinate actions: construction works, urban projects, industrial development, coordination of resources to subsidize the interests of the people [1].

In order to carry out the divestment process or to carry out any work, such as property acquisition or contracting services, the public sector needs legal support, to carry out the entire procedure. In the Public Administration, from the [2], new directions and procedures were determined to legally support the State in this process.

From that point on, according to [2], bidding started to be treated as a constitutional principle and the State was obliged to enter through the bidding process as the standard and legal form of contracting. Public agencies are frequently alienating and acquiring goods and services through bidding processes, in accordance with current legislation and based on Law 8,666 / 93, which is responsible for governing public tenders held by the State.

The Provisions of The Law have procedures and legal requirements that are supported by the Constitution, in which, in its broad scope, it demonstrates its public and legal relationship with all public spheres: Direct Public Administration, States and Municipalities. Throughout the public procurement process, the need to manage public resources in an organized, unblemished, lawful manner and with organizational quality is essential [2]. In this way, studies on intelligent management in public procurement are being increasingly deepened and disseminated in the technical environment of the academy, in view of its relevance for the improvement of the strategic planning of the

This article aims to present the procedures and guidelines manual as a viable proposal for improvement in the process of making public purchases in the material department of the Federal University of Amazonas. The study proposal followed with the following actions: Mapping the purchasing processes of the institution's materials department; Identification of obstacles that hinder efficiency in the execution of purchasing processes; Point-to-point analysis of the identified problems; Presentation of the improvement proposal through an action plan and preparation of the improvement action plan that originated the initial structure of the manual based on the application of the DMAIC tool.

II. LITERATURE REVIEW

A. Public Purchases

The public procurement process is due to the need that the public administration - direct and indirect - has to buy, dispose of, sell, assign or contract any goods or services, and it is then necessary to make these procedures legally and supported by the constitution [3].

Public purchases are made through legal instruments and are used to implement public policies. Thus, they are stimulated by the current legislation and serve as support measures for the public administration (State) to manage public resources efficiently and transparently [4].

The guiding principles that govern public procurement are aligned with the principles of reasonableness, transparency, efficiency, and sustainability [5].

The concept of "New Public Management" is being disseminated as a new sustainability model, also called "intelligent public procurement," based on a philosophy of sustainability and agility in its processes [5].

As noted in [2], the rules and legislation relevant to the public procurement process for the Union, States, Federal District and Municipalities (Direct and Indirect Public Administration) is carried out through public bidding. Bidding is an administrative instrument given to the public administration to proceed with the purchase of goods and services for the execution of the contracting of works and services from the managed public resources [6].

The concept of bidding as an administrative act is linked to an orderly succession of binding acts for the Public Administration [7].

Law 8.666 / 93, in its Article 3 (emphasis added) says: The bidding process is designed to guarantee the observance of the constitutional principle of isonomy, the selection of the most advantageous proposal for the administration and the promotion of sustainable national development and will be processed and judged in strict accordance with the basic principles of legality, impersonality, morality, equality, publicity, administrative probity, binding to the summoning instrument, objective judgment and those related to them [8].

The bidding is a contest that promotes the dispute between public entities for interested parties to provide services or offer goods by a purchase based on the presentation of more advantageous proposals and of interest to the public administration [9].

B. DMAIC

The DMAIC model was initially developed at Motorola as an evolution of the PDCA cycle and later adopted by General Electric as DMAIC, where D stands for Define.

This method became the operational base of the Six Sigma

rupture for these companies, being fundamental to the success they achieved [10]-[12].

The DMAIC methodology has been applied over the years in several areas, driving improvements in results, not only limited to industrial processes, but also in administrative processes, according to the work of different researchers, from project management to improvement of rates of quality, industrial processes, medication error reduction, quality costs, discrete event simulation, among other applications [13]-[20].

The DMAIC methodology has five phases, as shown in Fig. 1.

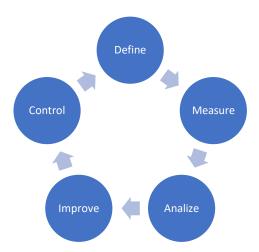


Fig. 1. DMAIC Cycle.

1. D (Define) - Define the critical processes and objectives in view of the business and the expectations and needs of customers. In this phase, a work team is defined that will organize and plan the project. People who know and master the process should be chosen. The objectives of the project are defined; that is, the boundary map is elaborated to clarify which sectors are interested in the project to be developed and the map of roles and responsibilities. This will show who of the team will be involved in each phase of the project. [21].

Still in phase D (Define), it is recommended to prepare a rational study for the project, through the use of the Project Charter, which enables a formal document to carry out the study [22].

- 2. M (Measure) In this phase, tools such as Histogram, Pareto Diagram, Cause and Effect Diagram, among others, are used. It is in the measurement that the process data is observed to actually understand the causes of the problem [21]. At that moment, it is necessary to determine the location and focuses on the problem [22].
- 3. A (Analyze) This phase is very important because the collected data are analyzed, where the causes of the problems must be analyzed and the objective of improving the process must be clearly defined [22].
- 4. I (Improve) Improve the process by eliminating problems, reducing costs, and adding value to customers. In this phase, tools such as Jidoka – autonomous, Poka Yoke – error-proof, just in time - are applied at the right time, among others [21].
- 5. C (Control) Control the performance of the process. In this phase, the critical items raised in the previous phases of the DMAIC methodology are monitored. A measurement and control system must be established and validated to

continuously monitoring the process, in order to ensure that its capacity is maintained. It is necessary to control so that the improvements obtained in the previous phase do not fall back [23].

The DMAIC is a structured method for solving problems. It is not only effective for reducing defects, but also for increasing productivity, reducing costs, improvements in general in the process such as in ergonomics, administration [12]. In this work, it was used to monitor the implementation of automation in the process.

III. METHODOLOGY

The methodology for this study was developed from a bibliographic, documentary, and observational research, based on the application and analysis of the DMAIC tool.

The feasible proposal for improving public procurement processes was developed and presents it based on a Manual of Procedures and Guidelines (MPG), which is a technicalinstitutional document with the function of organizing, in a systemic way, all procedures, rules, requisitions and command flows for making purchases and acquisitions of permanent or consumable materials for the department.

Bibliographical research is a fundamental step in the methodological and research process in a research, as it deals with a type of research that is based on theoretical foundation through bibliographical sources (books, theses, dissertations, scientific articles, among others) that serve to support a given

Documentary research is a type of study that is based on the analysis and collection of data in non-publishable bibliographies, that is, primary bibliographic sources with restricted access [24]. For the study, institutional documents were collected that served as a support base to elaborate the structure of the MPG.

The observational study is a type of study that is based on the researcher's on-site analysis, without interference in the processes, with the aim of collecting data in a given environment (object of study) [24].

Observational was carried out through the implementation of the DMAIC quality tool, which served as a parameter for the elaboration of the MPG model as a proposal for the management of public procurement in the institution's purchasing department.

The flow of steps in the study proceeded as follows:

- 1. Diagnosis of the DEMAT / UFAM purchases flow;
- 2. Presentation of proposals (solutions);
- 3. Application of the DMAIC quality tool;
- 4. Analysis and evaluation (prior).

IV. FINDINGS AND DISCUSSIONS

The Federal University of Amazonas is a federal institution of higher education based in Manaus. It was created under the terms of Law no. 4,069-A, of June 12, 1962, of Decree no. 53,699, of March 13, 1964, and is maintained by the Federal Government as an indirect administration entity in the form of the legislation in force. It has as its mission the production, dissemination of knowledge and the search for academic excellence to serve the community, as well as contributing to the formation of citizens and the development of the Amazon [25].

The Materials Department is responsible for making purchases of consumable and permanent materials, including equipment, services, and products in order to meet the needs of the Units that make up UFAM [26].

It is subordinate to the Rectorate of Administration and Finance, which is responsible for planning, organizing, directing, and controlling activities related to accounting, purchasing, wealth and establishing contracts and agreements within the University [25].

The study was applied at the Materials Department of the Institution based on the analysis of the stages of the public procurement processes for acquisition and contracting. In addition, we proceeded with the observation of the steps of the process and interview with the employees responsible for the procedural analysis.

After the initial analysis of the processes, DMAIC was applied to the process. In the measurement phase, a group was appointed to work with a focus on continuous improvement. The main objective defined is related to the fact that the Purchasing Department needs to reduce the slowness of processes and waste in duplicating purchases (permanent materials and consumables).

A Boundary Map was elaborated, in which it was possible to verify the percentage of interest of the department in this project. It made it possible to identify which opportunities for action within the Department were favorable to changes in the flow of processes and the proposal of the MPG. Table 1 shows the Map of Roles and Responsibilities designated at this stage of the study.

TABLE I: MAP OF ROLES AND RESPONSIBILITIES

-					
Main Stakeholders	D	M	A	I	С
Purchasing Coordination	X				X
Warehouse Division	X		X	X	X
Heritage Division	X	X			X
External collaborators	X	X			X

In the measurement phase, through the analysis of the purchasing management report (2012-2017), the slow processing of the process was identified, resulting in a very high cycle time for activity.

It was observed that the sluggish aspect of the process flow is due to the lack of systematization of the processes. It means, there is a great occurrence of duplication of purchase orders at the Institution, without any systemic control along with the demand from other sectors of the University, observing failed items in the trading sessions, decreasing the economies of scale and still causing fractional expenses.

In this context, the DMAIC methodology was applied to develop the proposal for the formulation of the MPG based on the preliminary diagnosis collected in the purchase management reports through the working groups. The DMAIC phases identified the problems and actions necessary to eliminate or mitigate bottlenecks.

The development of the DMAIC phases led to the structuring of the MPG, consisting of the following steps:

- i. Integration A (Processes): Receiving demands;
- ii. Integration B (Processes): Analysis of demands;
- iii.Integration C (Verification): Analysis of specifications (CATMAT, Description);

- iv. Integration D (Quotation): Market Research;
- v. Integration E (Processes): Elaboration of the Term of Reference;
- vi. Integration F (Process): Insertion in the IRP System;
- vii. Integration G (Process): Authorization of the Expense Authorizer;
- viii. Integration H (Process): Preparation of Public Notice and Purchase.

The structure built above for the MPG allowed to build the proposal according to the needs of Table II. It is a proposal that is based on the systemic structuring with branching in subsystems, which will be developed in a future system.

TARLE II. DMAIC ADDITION STEDS AND ACTIVITIES

Phases	Actions	TEPS AND ACTIVITIES Results		
Define	Identify the needs of the Purchasing Coordination and Material Department. Identification of critical processes.	Defining the problem, identifying the low flow of process turnover.		
Measure	Checking the flow of decision-making procedures. Identification of the main bottlenecks in the process.	Return of processes with the absence of technical specifications and necessary information, for analysis and procedures.		
Analyze	Identification of the main cause of the problem and activities.	Lack of standardization of processes, lack of organization of items by group, absence of market research, material code and others.		
Improve	Identify a solution to the problem in order to guarantee improvement by eliminating or preventing it.	Propose the creation of a procedure manual, in order to eliminate the bottleneck of returning the processes for adequacy, standardizing the processes. Development of the MPG structure.		
Control	Confirm the action found in the previous step and validate through the benefits achieved.	Implementation of the MPG manual, with clear and objective information on the instruction of bidding processes in their preparatory phase.		

The structure of the MPG is as follows, and its steps are detailed in Fig. 2.

Integration A – Requesting units forward their demands, within the pre-established period by the Administration, and according to guidelines on the instruction of the bidding processes in their preparatory phase in compliance with Normative Instruction No. 01/2019.

Integration B - Material Department compiles the demands, confirms the budget, and organizes the demands by similar groups, in order to elaborate a unique process for the groups, avoiding the loss in the economy of scale, failures of the items and avoiding the division of expenses.

Integration C – Purchasing Coordination analyzes the process by checking the CATMAT, technical description and quantities.

Integration D – Purchasing Coordination elaborates market research on the price panel on the Comprasnet portal (https://www.comprasgovernamental.gov.br) and on the platform of the Integrated General Services Administration System.

Integration E – Procurement Coordination prepares the reference document of an important document that serves as a basis for the preparation of the Bidding documents.

Integration F – Purchasing Coordination inserts the first phase of the Electronic Auction in the SIASG, Price Registration Intent – PRI.

Integration G – The Expense Coordinator approves the terms of reference.

Integration H - The Bidding Coordination receives the terms of reference, prepares the Notice, publishes, and purchases the materials.

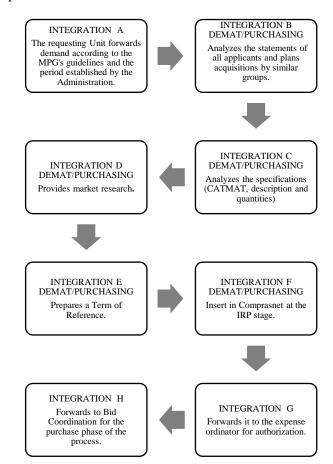


Fig. 2. Viable model of the Manual of Procedures and Guidelines in public procurement (MPG) of DEMAT / UFAM.

After analyzing each step in the flow of steps, a redesign of the flows was proposed based on a temporary action plan, which should be analyzed more effectively after the implementation of the Value Flow Map (MFV), which will be carried out in a further study, and is detailed in Fig. 3.

Fig. 3 below represents a previous model for structuring the MFV for DEMAT / UFAM, taking into account the proposed actions identified with the DMAIC. The idea of using the MFV will be to improve the process of management and control of acquisitions in the sector. Therefore:

1. Flow 1: Suppliers – Enabling demand processes to identify suppliers based on current legislation. The study of the needs and demands of the coordinators is important for the acquisition process.

- 2. Flow 2: Materials Market research is a step of identifying the necessary materials based on the mapping of demands. This is where the bidding process begins.
- 3. Flow 3: Flow control Consists of the process of monitoring the purchase materials and acquisitions of goods, mainly to adjust the demand policies in accordance with Normative Instruction No. 01/2019.
- 4. Flow 4: Evaluation It is the stage of reviewing the demands in accordance with the requests and with the degree of need established in the general procurement planning.
- 5. Flow 5: Reflux It is the feedback step of the flow mapping. In this phase, a new check of the purchase process is carried out in the Control System and the inclusion of the items in the Terms of Reference and other technical support documents.

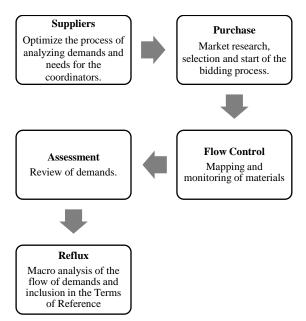


Fig. 3. Proposed DEMAT / UFAM Value Flow Analysis Model.

V. CONCLUSION

It is extremely important to understand that the management of public procurement in the public service needs to be developed based on the basic principles of public administration, especially with regard to transparency and economy. Thus, investment in strategies that enable this reconfiguration denotes tools that optimize processes and bring greater sustainability to public coffers.

The DMAIC tool made it possible to identify the needs for changes in the process, in order to optimize the expected results, avoiding wastes in terms of rework, reduction of failed items, economy of scale, optimization of acquisition

The purpose of preparing the MPG is to redefine the flow structure of the purchasing process at DEMAT / UFAM. In addition, it will make it possible, based on a more in-depth study, to be the basis for the elaboration of an integrated public procurement management system at UFAM, being an institutional product to corroborate the economic process of managing the institution's public resources.

As a suggestion for future research, it is advisable to deepen studies on the mapping of workflows in the sector based on the implementation of a Value Flow Map to improve

the quality of service provision, prioritizing efficiency and eliminating wasted time and of materials. The guiding document for this study will be Normative Instruction No. 01/2019, which deals with the Annual Contracting Plan (ACP) and the Contracting Planning and Management System (CPMS).

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Joice Ribeiro is a student in the master's Program in Production Engineering at Federal University of Amazonas. She is a Technical-Administrative in Education currently and serves as Head of Materials at the Federal University of Amazonas.



Marcelo Oliveira is an Adjunct Professor of Department of Production Engineering and member of Master Program in Production Engineering, Federal University of Amazonas. He has published several Research Papers related to Engineering area.



Raimundo Kennedy is a Head Professor of Department of Civil Engineering and member of Master Program in Production Engineering, Federal University of Amazonas. He has published several Research Papers related to Engineering



Erika Melo is a Visitant Professor of Université du Québec à Trois-Rivières (UQTR) and member contributor of Master Program in Production Engineering, Federal University of Amazonas. She has published Research Papers related to Engineering area and Aeronautical Project Management.