



Public Safety Firearms: Users' Perceptions and Quality Evaluation of the Beretta APX

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ABSTRACT

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The quality of equipment used in public security is a significant concern in Brazil. This research aimed to evaluate the quality of pistols used by Brazilian institutions based on technical requirements and to compare these findings with the expectations of the product users. Through a groundbreaking study involving public security professionals from across Brazil, it was possible to analyze perceptions of quality in terms of the technical, physical, mechanical, and safety requirements of pistol-type products. The study employed an adapted version of the ServQual method, along with both qualitative and quantitative data analysis techniques. The results indicate that the evaluated product met or exceeded user expectations in 96% of the observations. However, it fell short in one performance requirement related to functional failures – a critical control point for users and public security agencies. The results of this study provide robust empirical evidence that can support and enhance decision-making practices in public procurement, contributing to more efficient acquisitions with higher quality standards and operational safety for public security.

1. INTRODUCTION

It is widely acknowledged in academic circles that quality, from a historical perspective, is a challenging concept to define. The understanding of its meaning has been limited, leading to ambiguities in its application. This ambiguity arises, in part, from the subjective nature often attributed to the concept of quality, as well as from the widespread use of the term to refer to elements or phenomena that can, at times, be substantially distinct.

Based on the definition of quality from various perspectives, and the understanding of a product as a combination of different attributes – quality being one of them – it becomes evident that there is an urgent need for technical and scientific studies to assess the quality of items introduced for consumption in society.

In this context, the dubious quality of equipment used by public security forces has been a recurring issue reported in the Brazilian media for some time. According to Apple [1], “the lack of technical criteria and the ultimate inadequacy of public security products, equipment, and technologies have led to numerous reports of serious and significant non-conformities in their application.” This concern is further substantiated by various inquiries and legal proceedings initiated on the subject in the country [2-4].

Similarly, Souza [5] stated in one of his publications about the non-conformity of military equipment manufactured by a national company that “only in August 2016 did the company admit that the pistols could fire on their own when dropped and included this information in its instruction manuals.”

It is important to note, however, that such findings are also observed in other countries. In a study conducted in the United Kingdom titled *Munition Incidents and Defects*, it was found that between January 3 and December 31, 2007, 1,158 unintentional gunshots occurred; 4% of these incidents resulted in 55 injuries, including one fatality, as reported by Maia et al. [6]. The authors also highlight that firearms are the primary mechanism for self-inflicted injuries among public security professionals.

A study carried out by Plani et al. [7] about deaths and injuries of police officers in South Africa shows that among 92 police officers treated for gunshot wounds, 80 cases occurred during service, of which 9 were accidental shots.

Thus, analyzing the quality of equipment acquired by the Public Administration not only contributes to the gradual improvement of public procurement efficiency but also provides an opportunity to identify control points and enhance the technical requirements used to specify the products purchased.

Given the recurring reports of functional failures and the growing need for technically reliable equipment in Brazilian public security forces, this study seeks to answer the following research question: Does the quality of pistols acquired through public procurement processes meet the technical requirements and expectations of their users? Addressing this question is crucial, as ensuring the conformity and reliability of firearms directly impacts the effectiveness and safety of public security operations. Therefore, this research is highly relevant for improving procurement practices, enhancing the performance and safety of public security agents, and contributing to the

development of evidence-based policies in the field of public security equipment acquisition.

This study examines aspects of product quality, drawing on the concepts outlined in its theoretical framework and considering consumer satisfaction from the perspective of the end user. Specifically, it analyzed perceptions of the quality of the technical requirements of pistols used by Brazilian institutions, comparing them with the expectations of their users.

2. EVOLUTIONARY AND CONCEPTUAL ASPECTS OF QUALITY

2.1 Conceptual aspects of quality

The pursuit of quality transcends centuries and civilizations. According to Dias [8], in ancient Egypt, there was strict adherence to the practice of standardization. One notable consequence of this technical standardization was the severe punishment for those who failed to comply with the standardized dimensions required for the construction of ceramic blocks. This standardization was essential to ensure the precise fittings necessary for building the tombs of the great pharaohs, with the ultimate sanction being the sacrifice of life for noncompliance.

In a similar vein, more than 5,000 years ago in China, people sought to ensure accurate measurements as a means of minimizing quality failures. They developed what can be considered the first system for standardizing instruments for length, volume, and mass, which also required periodic verification to ensure their accuracy [9]. In ancient Egypt, this same calibration of instruments used in the manufacture of stone blocks was performed with "punctual periodicity, at each full moon" [10].

Based on this historical preamble, it is possible to contextualize that modernizing equipment and processes used in State activities, particularly in essential services, is crucial for improving the quality of public services provided to society.

In this regard, the evolution of quality involves a significant transformation in its approach, as the focus has gradually expanded over time from solely the product to include processes, services, and customer needs, as highlighted by Blodorn and Soares [11].

Although quality is often considered an attribute inherent to objects or people, it is crucial to understand that it cannot be directly identified or observed. According to Almeida and Toledo [12], what can be directly identified and observed are the characteristics of these objects or people. In other words, quality is perceived through the interpretation of one or more characteristics or requirements associated with them.

The definition of a product, in turn, depends on the perspective of the observer, whether it is a designer, a production manager, or a consumer. While designers and production managers focus on the technical aspects of the product, consumers tend to prioritize the satisfaction they derive from the product in its intended use [12].

Quality, therefore, was traditionally conceptualized as "perfection in the production process and in the product, encompassing variables such as value, durability, and technical performance, all of which aligned with the attributes of a product" [13]. However, this concept has evolved and is now more focused on consumer satisfaction and the product's suitability for its intended use [13].

It is evident, then, that organizations have undergone significant social and political changes over the years, "forcing them, in order to standardize processes, eliminate waste, qualify their professionals, and satisfy their customers, to adopt programs or practices aimed at improving quality" [11].

It can therefore be understood that the ongoing pursuit of quality provides benefits from social, scientific, technological, and economic perspectives, among others, contributing to the reduction of risks faced by consumers and enabling the improvement of goods available to society [14-16].

In this context, Sato [17] argues that the definition of quality is an endogenous process that arises from economic activity itself, shaped by a social consensus that may or may not be explicitly expressed in standards.

Seleme and Stadler [18], addressing this issue, assert that it is essential for products and services to embody characteristics that meet desirable standards in terms of quality, environmental impact, safety, efficiency, reliability, and the ability to be replaced at an economically appropriate cost.

The quality of products made available to society for consumption, therefore, represents a balance between user needs, technological possibilities, production costs, and the minimum technical requirements established by the government for the general benefit of society [19], particularly as it relates to public services, especially those concerning public safety.

In this context, the literature identifies three major aspects in the definition of quality, as outlined by Almeida and Toledo [12]: (i) quality as suitability for use; (ii) quality as conformity to specifications; and (iii) quality associated with the losses a product imposes on society after its sale. In this research, the evaluation of product quality focused primarily on the first two aspects, aiming to gather participants' perceptions regarding the suitability and conformity of the analyzed product's technical requirements to user expectations.

Thus, considering the above, it is evident that the pursuit of quality in products, processes, and services offered to society is both ongoing and highly relevant today, with studies on the subject serving as drivers of tangible change aimed at improving the equipment and services made available to society.

2.2 Quality as a criterion for public tenders in Brazil

The purpose of bidding is to enable the Public Administration to select contractors with the necessary qualifications to serve the public interest. This process specifically considers aspects such as the technical and economic-financial capacity of the bidding company, the quality of the product offered, and the value of the contracted item, as outlined by the Federal Court of Auditors (TCU) [20].

From a more modern perspective, aligned with the new legal principles introduced by the updated legislation, bidding is understood as an administrative process adopted by both direct and indirect Public Administration. Its objective is to ensure equality, select the most advantageous proposal – considering, among other factors, the life cycle of the object – avoid price disparities, and foster innovation and sustainable national development. This process aims to promote efficiency, effectiveness, and efficacy in public procurement, as established in Article 11 of Law N° 14,133, dated April 1, 2021 [21].

In this context, Niebuhr [22] argues that efficiency in public procurement relies on three essential aspects: price, quality,

and speed. Similarly, the TCU, in several decisions [23-25], has consistently emphasized the importance of quality in public procurement, with particular attention to the evaluation of the quality of products acquired and services contracted by the Administration.

According to the TCU, it is essential for the bidding notice to clearly establish the evaluation criteria for the products offered. These criteria must take into account aspects such as quality, durability, functionality, and performance, in addition to other factors deemed necessary [20].

In this regard, the proof of concept, frequently used in the proposal or bid evaluation phase of public tenders, constitutes a recommended administrative practice aimed at verifying whether the proposed solution meets the requirements established in the call for bids. This verification includes aspects such as technical characteristics, quality, expected functionality, and product performance [20]. Therefore, assessing product conformity is a crucial tool in ensuring quality assurance, safety, and performance in acquisitions made by the Public Administration.

Furthermore, several provisions of the new 2021 procurement law, in full effect since January 2024, address aspects related to quality in the pursuit of advantageous public procurement, as outlined in Articles 11 and 18; Article 17, §6; Article 18, §3; Article 29; Article 34; Article 40, §1, item I and §2, item II; Article 42; Article 46; Article 80; Article 144; and Article 337-L [21].

In line with this perspective, the conformity assessment, outlined in the technical standards established since 2020 by the Ministry of Justice and Public Security (MJSP), emerges as another recommended administrative practice to ensure quality in the acquisition of products, processes, or services aimed at public security. These standards must be observed by public security institutions when utilizing federal resources, as stipulated in Article 7 of Ordinance MJSP N° 104/2020 [4].

In this context, an emblematic example of compliance with these sub-legal standards and the adoption of good administrative practices was the acquisition of pistols by the National Secretariat of Public Security (SENASP) of the MJSP. Initiated in 2019 and completed in 2021, this purchase marked the first public acquisition of security equipment in Brazil to be finalized based on the minimum technical requirements and conformity assessment procedures established in a technical standard of the MJSP [26].

The acquisition was carried out through the Price Registration System [27] via Electronic Auction N° 06/2019, with the MJSP as the managing body and 35 other participating bodies (Managing Units), totaling a potential purchase of 159,451 (one hundred fifty-nine thousand, four hundred fifty-one) pistols. The winning bid was awarded to the manufacturer Beretta, which offered the APX model.

Of the total registered, the National Public Security Force acquired 3,681 (three thousand six hundred eighty-one) pistols in 2021. This was the first agency to receive and evaluate the products in accordance with the conformity assessment process established in the technical standards for public security products [26].

Thus, the acquisition of these weapons marks the beginning of the conformity assessment process for public safety products in Brazil, having been carried out based on SENASP Technical Standard N° 001/2020, which specifies the requirements for 9 × 19 mm and .40 S&W caliber pistols [28].

Therefore, it is crucial that the Administration adopts good practices not only to comply with legal and regulatory

requirements but also to actively seek improvements in the quality of products, processes, and services used in public safety. The standardization promoted by the MJSP public policy represents a significant management effort and an important step toward assessing compliance and encouraging improvements in the quality of products regulated for public safety.

3. METHODOLOGY

This research employed a mixed-methods approach, constructed in a dialectical manner, with an exploratory and descriptive nature, using the case study strategy [29, 30]. The qualitative foundation of the research was developed through bibliographic research to better understand the topic addressed [29, 30], documentary research to describe and characterize the object of study [30], and content analysis to analyze the information [31].

In turn, the quantitative approach was employed to examine the relationships between the variables studied, which are fundamental for answering the research questions and testing the hypotheses through surveys and experiments conducted with a sample of public security professionals [29]. For these quantitative studies, ordinal data extracted from the electronic questionnaire were analyzed using specific methodologies, as will be detailed.

3.1 Sample and methodology used for primary data collection

Data collection from primary sources was conducted through an electronic questionnaire created using the digital tool Google Forms. The questionnaire included both closed and open-ended questions, designed to capture perceptions of the degree of importance and quality expectations of the variables and dimensions studied, relating them to the perceived quality of the products analyzed in the study. Prior to its application, the research questionnaire was validated [29] by 10 public security professionals from the states of Bahia, Piauí, Goiás, Distrito Federal, Acre, Amazonas, Santa Catarina, Rio Grande do Sul, São Paulo, and Rio de Janeiro. The feedback provided by these participants was used to refine the data collection instrument.

The data collection instrument was applied between 08/31/2023 and 10/31/2023 to the general public of public security. It was sent institutionally via the Fala.Br (e-SIC) platform [32] and email to all Public Security Secretariats in Brazil, and was also disseminated through the WhatsApp application to members of public security.

Thus, the target population consisted of public security officers who had received training and were using the pistols that were the subject of the research, as members of the country's public security institutions.

Thus, the sample group involved in the research was randomly selected from a finite and multivariate population of representatives from the Military Police, Civil Police, Military Fire Department, Penal Police, Forensic Experts, Municipal Guards, and other agencies that acquired the same product and voluntarily participated in the research.

To calculate the sample estimate required for the research and assess the representativeness of the results obtained, information was collected on the quantity of weapons of the same model analyzed in the study, acquired by public security

agencies as managing, participating, or adhering (free-riding) entities during the period from 2020 until the expiration of the Price Registration Record in 2022, resulting from the acquisition made by the MJSP [26, 33].

Thus, based on the survey of the number of weapons covered by this study that were sold and used in Brazil by public institutions [33], it was possible to approximately determine the maximum size of the population and the minimum representativeness required for the research sample. To statistically calculate the sample size needed for the research, the maximum known number of Beretta APX pistols sold in Brazil (77,309) was considered as the population.

To this end, the method used to determine the sample size was based on the estimate of the proportion for a finite population of 77,309 (seventy-seven thousand three hundred and nine) potential participants, with a 95% confidence level, an admitted sampling error of 5%, an estimated proportion of 20% in the population, and an assumed element loss of 20% for the research, as will be described in the research results.

3.2 Product suitability analysis

During the collection of primary data for the study, participants were asked to assign a grade to the quality expectations they had for a series of technical requirements, including functional, physical, mechanical, and safety parameters listed for pistol-type products used in public safety.

They then answered a similar question, assigning a score to the same technical requirements related to the product purchased by the MJSP and subjected to the conformity assessment process (Beretta brand, APX model pistol) during the contest. This made it possible to compare the scores of their responses, calculated using the median, in order to understand the levels of user satisfaction and identify gaps in the quality of the evaluated product.

The result of this comparison indicated the perceived quality of the product from the users' perspective, compared to the importance placed on the evaluated requirements. Positive results indicate that the quality exceeds user expectations, negative results indicate that the product falls short of what was expected for the evaluated requirement, and neutral results demonstrate compliance with the requirement [34].

The calculation formula can be expressed through the following equation: $AV - EX = QUAL$. Therefore: AV = Customer evaluation of the product; EX = User expectation of the product, and $QUAL$ = Perceived quality of the product.

The evaluation described above was adapted from the SERVQUAL model [34], a quality measurement methodology designed to assess customer expectations in contrast to their perception of the service received. In this research, the method's guidelines were applied to the quality assessment of the analyzed product, without implementing the method in its entirety, but rather using the logic of its measurement as proposed by the authors, yielding important results for evaluating potential improvements to the product studied.

The use of the ServQual model in this study is justified by its capacity to systematically compare users' expectations with their perceptions of the product's actual performance. Although traditionally applied in the evaluation of service quality, the ServQual model's conceptual framework is highly adaptable to the analysis of tangible products, particularly those whose performance and reliability are directly linked to users' subjective perceptions of quality, such as firearms.

In the context of public security, where the operational

effectiveness and safety of pistols are paramount, it is essential to evaluate not only the technical specifications of the product but also the degree to which these specifications align with the expectations and needs of the professionals who use them in high-risk environments. The ServQual model facilitates this by enabling the identification of specific quality gaps in functional, mechanical, and safety aspects, which are critical for both procurement decisions and operational reliability.

The evaluation was conducted using a semantic differential scale with a range from 1 (one) to 7 (seven), where the lowest score represented a low degree of quality and the highest score represented a high degree of quality for the product requirements, according to the same user [35].

4. RESULTS AND DISCUSSION

4.1 Sample size estimation

In calculating the sample, the minimum representative sample size was 246 (two hundred and forty-six) participants. However, considering the assumed 20% loss of elements for the research, the minimum expected number was 307 (three hundred and seven).

At the end of data collection, 1,513 (one thousand five hundred and thirteen) participants were recorded. However, after tabulating and processing the data, the final sample consisted of 1,496 (one thousand four hundred and ninety-six) valid responses.

After analyzing the obtained sample size, it was determined that it has statistical representativeness for the study. The 1,496 (one thousand four hundred and ninety-six) valid responses in the sample correspond to a 99% confidence level for the calculated proportion's confidence interval, maintaining the same calculation parameters. This considers an estimated population proportion of 20% and allows for a sampling error of less than 3%, thereby ensuring the representativeness and statistical reliability of the sample.

4.2 Sample composition

As explained, the primary data collection conducted in this research resulted in a sample of 1,496 (one thousand four hundred and ninety-six) valid responses. These responses were provided by public security officials from all 27 (twenty-seven) states of the Federation, with the highest number of responses coming from Mato Grosso do Sul (MS), followed by Alagoas (AL) and Paraíba (PB). In all other states, the number of respondents varied, ranging from 88 (eighty-eight) in Santa Catarina (SC) to a minimum of 8 (eight) responses collected in Acre (AC) and Tocantins (TO). These data indicate that the sample reflects the reality of public security across all states within the five regions of the country, suggesting a representative scope of their circumstances.

For this sample, the respondents' length of service was initially assessed, showing a fairly even distribution across the five-time categories defined in the research. However, there was a slightly higher representation of employees with more than 20 (twenty) years of service, as illustrated in Figure 1.

It is observed that the majority of participants in the research phase (63.8%) have between 11 (eleven) and 20 (twenty) or more years of service in public security, while approximately one-third (36.2%) have between 0 (zero) and 10 (ten) years of service. This distribution reflects a heterogeneous sample of professional experience.

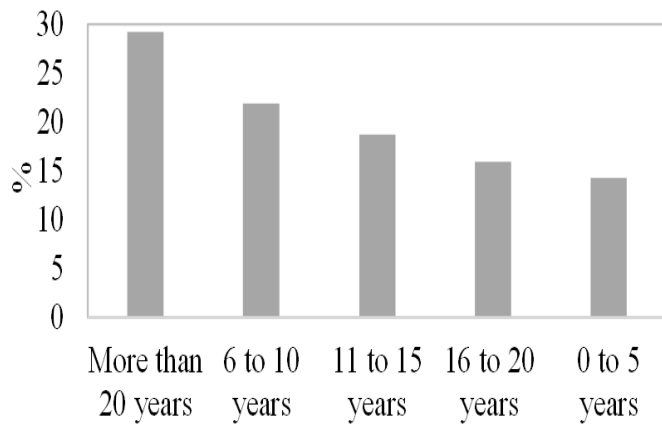


Figure 1. Length of service in public safety

When asked about their experience and/or specialization with firearms (e.g., shooting courses, instructor certification, gunsmithing, war material management, etc.), 57.3% of survey participants reported having no experience in this area. Meanwhile, 18.6% stated they had 10 (ten) or more years of experience and/or specialization, while the remaining 24.1% reported having between 0 (zero) and 10 (ten) years. These results suggest a diverse population in terms of technical expertise with firearms.

Thus, following the initial analysis of the population involved in the research, we proceeded to analyze the comparative perception of these professionals' expectations as users of the Beretta APX pistol, acquired through the competition held by the MJSP, as previously explained.

4.3 Comparative quality assessment of the product analyzed against user expectations

According to Carpinetti [13], “customer satisfaction regarding the quality of a product also depends on the relationship between the expectation of the product at the time of acquisition and the perception of the product at the time of consumption,” as stated in the theoretical framework. Thus, the author adds that this relationship defines the perceived quality of the product, with satisfaction occurring when perception exceeds expectations and dissatisfaction arising when it does not.

From this perspective, through the applied electronic questionnaire, research participants were asked about their quality expectations regarding 28 (twenty-eight) variables, divided into Physical and Mechanical parameters, as well as Security and Functional parameters. This approach highlights the importance of these technical requirements, which are commonly found in pistol-type products.

After collecting users' expectations regarding the requirements of the evaluated product, respondents were asked to assign a score, using the same scale, to each of the technical requirements present in the Beretta APX pistol, acquired by public security institutions in Brazil.

In this sense, regarding the evaluated physical and mechanical parameters and considering the median of the assessments, it was observed that users stated the Beretta APX pistol exceeds expectations for requirement 1 (external and internal finish resistant to weather, oxidation, abrasion, shock, etc.) and meets expectations for the other evaluated items, as Table 1.

Table 1. Perception of the physical and mechanical requirements of Beretta APX pistols

Item	Physical and Mechanical Parameters	Users' Expectations	Product Review	Gap	General Public Indicator
1	Weatherproof, oxidation, abrasion, shock-resistant exterior and interior finish, etc.	6	7	1	It meets expectations
2	Barrel with hardness and resistance to abrasion, oxidation, heat, corrosive agents, and external mechanical shock.	7	7	0	It meets expectations
3	Weatherproof, oxidation-resistant, abrasion-resistant, and shock-resistant bolt assembly, etc.	7	7	0	It meets expectations
4	Bolt featuring grooves, knurling, or ridges.	7	7	0	It meets expectations
5	Weatherproof, oxidation-resistant, abrasion-resistant, and shock-resistant frame, etc.	7	7	0	It meets expectations
6	Magazine with hardness and resistance to abrasion, oxidation, heat, corrosive agents, and external mechanical impact.	7	7	0	It meets expectations
7	Prohibition of trigger and moving parts play.	7	7	0	It meets expectations
8	Ergonomic grip.	7	7	0	It meets expectations
9	Ambidextrous external controls.	7	7	0	It meets expectations

It is noted that item 1 reflects a high-quality expectation (median of 6) from users regarding this requirement. Similarly, the Beretta APX pistol received a score of 7 (seven) for this requirement, indicating a positive gap compared to users' expectations. This suggests that the product exceeds the average user expectation for this parameter. Regarding the other evaluated physical and mechanical requirements, the product meets expectations, as it received the same score as the expectations expressed by respondents.

A similar assessment is observed when analyzing the scores assigned to the safety parameters of pistol-type products. In

users' view, the Beretta APX pistol exceeds expectations in three safety requirements and meets professional expectations for all other requirements, as shown in Table 2.

It should be noted that requirement 1 (Grip Safety) and requirement 2 (External Safety) are not present in Beretta APX pistols. However, based on the evaluation, it can be concluded that users assign a lower level of importance and quality expectation to these two requirements compared to the other components of the pistols.

This may be related to the modernization and changes in platforms and models of this type of weapon worldwide. The

External Safety Lock, whose function is to prevent firing and bolt movement [36], has been replaced in current pistol models by the Trigger Safety System. A clear trend in recent years has been the adoption of pistols without an External Safety Lock by Western security forces, such as those used by the

Federal Bureau of Investigation (FBI), the New York Police Department (NYPD), the Federal Police, the Federal Highway Police, the Federal Prison Police, the Brazilian Intelligence Agency, and numerous Civil and Military Police forces throughout Brazil [36].

Table 2. Perception of the safety requirements of Beretta APX pistols

Item	Physical and Mechanical Parameters	Users' Expectations	Product Review	Gap	General Public Indicator
1	Grip Safety	4	Does not apply	---	Does not apply to the product
2	External Safety	5	Does not apply	---	Does not apply to the product
3	Trigger Safety	6	7	1	Beyond expectations
4	Firing Pin Safety System	7	7	0	Beyond expectations
5	Bolt Locking System	7	7	0	Beyond expectations
6	Bolt Hold-Open/Release	7	7	0	Beyond expectations
7	Magazine Release	7	7	0	Beyond expectations
8	Trigger Guard	7	7	0	Beyond expectations
9	Loaded Chamber Indicator	7	7	0	Beyond expectations

Thus, it is observed that although they still appear on many pistol models worldwide, in user analyses, External Safety Locks do not have the same level of importance or quality expectation as other weapon safety requirements. This result aligns with Cunha Neto's findings [36], which state that the current focus of modernizing weapon safety systems is preventing accidental discharges (those occurring without pulling the trigger) and not unintentional discharges (involuntary pressing of the trigger), which must be prevented through adequate operator training.

The Grip Safety, in turn, is rarely used in more modern firearms and is also considered less important for the safety of this type of product compared to the other requirements studied. In this regard, according to Cunha Neto [36], only one striker-fired pistol model currently known in Brazil features this type of solution: the Springfield XD, used by the São Paulo State Scientific and Forensic Police. We are unaware of any other model in use in Brazilian public security, as of yet, that utilizes this safety technology.

This analysis shows that safety is a decisive factor for users, and safety features that directly impact firing, such as the Trigger Safety (requirement 3), were considered highly important. The Beretta APX pistol, studied in the research,

exceeded user expectations regarding this requirement.

Other requirements, such as the Firing Pin Safety System (item 4) and the Bolt Locking System (item 5), as well as those related to the safe handling of the weapon – such as the Bolt and Magazine Release Retainer and Key (items 6 and 7), the Trigger Guard (item 8), commonly known as the Trigger Guard, and the Ammunition Chamber Indicator (item 9) – were also considered extremely important (median 7) when establishing safety requirements for weapons of this nature. The evaluated pistol obtained a score of 7 (seven) for all these requirements, meeting users' expectations regarding product safety.

Thus, the weapon was considered to exceed the expectations of public safety professionals regarding the Trigger Safety Lock (requirement 3), meeting the users' expectations regarding all other items evaluated, indicating that it is a reliable product regarding its safety requirements.

Furthermore, in the analysis of the functional parameters of the pistols, it was observed that this aspect of the research yielded the highest evaluations for the analyzed product compared to the median of user expectations. It was verified that 7 (seven) out of the 10 (ten) evaluated requirements were considered above users' expectations, as shown in Table 3.

Table 3. Perception of the functional requirements of Beretta APX pistols

Item	Functional Parameters	Users' Expectations	Product Review	Gap	General Public Indicator
1	Type of action (single-action, double-action, hybrid)	5	7	2	Beyond expectations
2	Adjustable sighting system	5	7	2	Beyond expectations
3	Nominal caliber	6	7	1	Beyond expectations
4	Magazine type/capacity	6	7	1	Beyond expectations
5	Striker-fired operating system	6	7	1	Beyond expectations
6	Hammer-fired operating system (double-action or hybrid)	5	Does not apply	---	Does not apply to the Product
7	Impossibility of fragment ejection in case of barrel obstruction	6	7	1	Beyond expectations
8	Trigger pull weight	6	6	0	It meets expectations
9	Interchangeability of parts	6	6	0	It meets expectations
10	Lower number of functional failures during use	7	6	-1	Falls below expectations

Two other requirements, Trigger Pull Force (item 8) and Parts Interchangeability (item 9), were considered to be of high quality and importance for pistols (median 6), meeting the expectations of Beretta APX users with an equally high product evaluation.

On the other hand, it was observed that for the variable related to the functional parameter of the Lowest Number of Functional Failures during use (item 10), there was a significant divergence between the product evaluation and users' expectations.

The assessment of this requirement reveals that the public security personnel evaluated the Beretta APX pistol as having High Quality (median 6) in terms of the number of functional failures. However, their expectations were for a product with Very High Quality (median 7) in this regard – that is, one that experienced minimal or no failures during use.

This suggests that the product has High Quality in terms of functional failures, meaning it exhibits very few failures during use. However, likely due to the weapon's modern design and high-quality standards, as well as the conformity assessment it underwent during the competition, users expected a product with no functional failures.

Thus, this assessment point remained controversial regarding the perception of the research participants. In line with the obtained data, the qualitative analysis revealed that public security personnel repeatedly noted functional failures in their justifications when describing shots fired with the weapon.

This condition is highlighted by numerous respondents, who consistently reported that the excessive stiffness of the recoil spring increases handling difficulty and contributes to malfunctions, particularly when using training ammunition with lower propellant charges. Many participants emphasized that this rigidity can cause failures to eject, feeding issues, and cycling malfunctions, especially affecting operators with lower muscle strength. There was also a recurrent suggestion that the design modifications introduced to meet endurance test requirements may have unintentionally compromised the firearm's adaptability to a broader range of ammunition. Furthermore, some respondents pointed out that functional failures are not solely attributable to the firearm itself, but also to the combined effect of equipment configuration, ammunition characteristics, and the shooter's technical proficiency.

This qualitative information, gathered from the survey of the general public in the field of public security, is also highlighted in the Technical Report on the Operation of 9 × 19 mm Ammunition – Operational and Training – in the Beretta APX Pistol, issued by Brazilian Cartridge Company [37]. The report includes evaluations conducted by the company's product engineering team in collaboration with the National Penitentiary Department (DEPEN).

According to Companhia Brasileira de Cartuchos (CBC) [37]: “DEPEN representatives visited the CBC factory for technical collaboration, aiming to gain a better understanding of the malfunctions that occurred during training conducted by DEPEN Armament and Shooting Instructors in Brasília. The training involved 9 mm NTA EOOG 124 gr ammunition from manufacturing batch (LF) N° 234/20, fired from the Beretta APX pistol”.

Next, the test report identifies the possible technical cause of the functional failures, based on the relationship between the spring's movement and its elastic force, as observed [37]: “The amount of movement generated by the shot causes the weapon to cycle correctly. Therefore, if, due to the weapon's characteristics (such as the weight of the bolt assembly or a stiffer spring), a greater amount of movement is required for proper cycling, and this is combined with ammunition that produces less movement than necessary, improper cycling of the weapon may occur”.

In this regard, it is observed that the aforementioned spring was supplied by the Beretta factory as a component part of the equipment and was accepted as meeting the requirements of the bidding notice for the purchase made by the MJSP [26].

This spring was intended to guarantee the product's high resistance. The following conclusions were observed in the aforementioned report [37]:

- “Considering the characteristics of the notice and the coincidences with CBC ammunition's speed recommended by SAAMI, the conclusion shared by DEPEN and CBC technical representatives is that Beretta offered/presented a weapon with military specifications to meet the bid's requirements. These specifications require ammunition that produces a greater amount of movement for proper functioning”.
- “Considering the results of tests conducted at CBC and based on the specifications of the auction for the 9 mm TREINAMENTO pistols (NTA and TREINA ETOG), we believe the APX pistols supplied by Beretta to the contracting agencies were manufactured with different characteristics. We further believe that a condition for the weapon's full functioning is 9 mm ammunition with a 124 g projectile having a speed of 350 m/s or more – that is, an energy value close to military ammunition specifications – to provide the minimum movement necessary for proper operation”.

Based on the data and qualitative information collected in the research, as well as the technical information from the referenced report – even without rigorously proven scientific methodology – it can be inferred that the recoil spring's mechanical condition, combined with the shooters' motor variables and the use of training and operational ammunition below military cartridge specifications, has been causing functional failures of the product during use. This inference aligns with the general public safety perception identified during the study.

To this end, considering this information, the MJSP was contacted via the aforementioned Fala.Br platform to comment on any recalls of the weaponry or reported failures related to the product acquired by the agency. The agency responded that no recall had been conducted on the acquired weapons and that it had no official information regarding functional failures of the product [38].

The effectiveness of using firearms, especially handguns, depends on a harmonious interaction between the equipment, the ammunition, and the shooter, with these elements needing to be properly aligned to ensure the weapon's optimal performance. Thus, despite the numerous concerns regarding the recoil spring of the Beretta APX supplied through the MJSP acquisition, it is essential to look beyond isolating the spring as the sole cause of malfunctions and instead consider technical adjustments that enhance the overall compatibility and adaptability of the system. Modifications such as adopting modular recoil spring systems, redesigning the recoil mechanism, and expanding component tolerances to accommodate different types of ammunition can contribute to optimizing the firearm's operation. Conversely, ensuring that ammunition complies with military normative standards when sold to such institutions can decisively help reduce malfunctions and increase the operator's safety and confidence, thereby ensuring the effectiveness of firearms in a variety of operational scenarios.

Therefore, despite the product receiving a high median evaluation (6) for this weapon performance requirement, it is advisable that this parameter be considered a control point by the MJSP and other institutions purchasing the product in future acquisitions. It should also be considered by the manufacturer in any adaptations of the product to meet user

expectations, and by testing laboratories and certifying bodies during equipment conformity evaluations.

Furthermore, it is important to alert public security institutions, users, and similar agencies that, as indicated in the aforementioned technical report, the Beretta APX model weapons currently in use in Brazil, acquired through the MJSP bidding process [26], require careful attention to the ammunition used – both live and training rounds. This ammunition must ensure the weapon's complete functional cycle. According to Companhia Brasileira de Cartuchos (CBC) [37], a "condition for the full functioning of the weapon" is that "9 × 19 mm caliber ammunition with a projectile weight of 124 g has a speed of 350 m/s or more" to provide the minimum movement necessary for proper operation, which is approximately 2,852 g.m/s [37].

The issue of functional failures in the Beretta APX pistol represents a critical challenge for public security operations in Brazil, directly impacting the effectiveness and safety of professionals on duty. The recurrence of functional failures, as reported in the research, severely compromises the reliability of the equipment in scenarios of confrontation and high stress, where the proper functioning of the firearm is paramount. This inconsistency not only diminishes the operator's confidence in the equipment but also exposes agents to unnecessary risks, turning a protective tool into a potential threat. Furthermore, the possible cause of these failures—an excessively stiff recoil spring—affects ergonomics and ease of handling, especially for operators with lower muscle strength, raising concerns about the suitability of the firearm for all professional profiles. The need for ammunition with very restrictive specifications to ensure the weapon's full functionality adds a logistical and financial complication, limiting training with more affordable ammunition and adaptability to different operational scenarios, which directly affects its ability to guarantee public safety.

However, these results from tests conducted by CBC and DEPEN require further technical and confirmatory analysis. They represent a point of study for the MJSP, the product manufacturer, and interested organizations, with a view to issuing an official government report. This report should employ robust, previously validated methodological criteria to investigate the potential causes of the functional failures reported in this research. This is an urgent need for the State to ensure the safety of public security operators using this product.

4.4 Comparative overview of the quality of the analyzed product with user expectations

In summary, the evaluated product – a Beretta APX pistol – generally received comparative evaluations meeting user expectations. This suggests the equipment satisfies user expectations in 57% of the analyzed variables and exceeds expectations in 39% of the evaluated requirements. However, it falls below acceptable levels for public security professionals participating in the research in one requirement, representing 4% of the 28 items studied, as shown in Figure 2.

This analysis revealed that functional parameters received the highest user evaluations, with seven evaluations exceeding expectations. However, this area of the research also revealed a concern regarding product use, despite being evaluated as a high-quality requirement, as it fell below the expectations of public security professionals.

Thus, in general, the Beretta APX pistol meets or exceeds user expectations in 96% of the evaluations. However, it exhibits a control point regarding the Lowest Number of

Functional Failures requirement (item 10 of the functional parameters), which warrants further in-depth study.

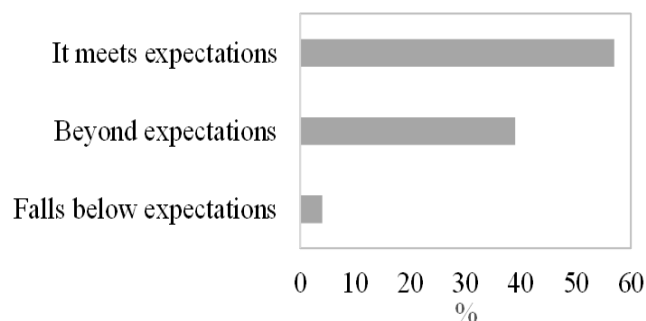


Figure 2. Overall evaluation of the analyzed product in relation to user expectations

5. CONCLUSIONS

This previously unprecedented research in Public Administration analyzed the perceptions of public security professionals regarding the quality of pistols acquired by the MJSP in 2021 for Brazilian public security institutions, comparing those perceptions with user expectations.

For this research, the ServQual model, commonly used to evaluate services, was adapted and applied to public security professionals from all 27 federal units. This resulted in 1,496 valid responses, which formed the basis for the research results.

The results showed that, in general, users of pistol-type products indicated that the equipment used as a case study (the Beretta APX pistol) met or exceeded their expectations in 96% of the evaluations.

However, regarding the performance requirement related to the Lowest Number of Functional Failures (item 10 of the functional parameters), the product was evaluated as below user expectations, despite receiving a median evaluation of 6. This indicates that while the Beretta APX pistol is generally considered to be of high quality with respect to the number of functional failures, user reports of such failures exist.

Respondents indicated that a possible cause of the reported functional failures is the high elastic force of the recoil spring, which implies increased resistance. This was corroborated by a technical report issued by the CBC, based on tests conducted in partnership with DEPEN/MJSP. The report also concluded that a condition for the full functioning of the weapon is that 9 × 19 mm caliber ammunition with a projectile weight of 124 g has a speed of 350 m/s or more to provide the minimum movement necessary for proper operation, approximately 2,852 g.m/s. This issue requires further in-depth study.

Based on the results obtained, it is recommended that public security institutions adopt more rigorous conformity assessment procedures and require standardized testing protocols to verify product reliability prior to procurement. Manufacturers should consider adjustments to the recoil spring specifications in order to mitigate the functional failures identified by users, ensuring compatibility with a broader range of ammunition types commonly used in training and operational contexts. Furthermore, purchasing agencies should incorporate systematic user feedback mechanisms to continuously monitor product performance in both operational use and training, enabling timely adjustments to technical specifications and contributing to the acquisition of safer and more effective equipment for public security forces.

This research, unprecedented in Public Administration, has proven to be of utmost importance for building scientific knowledge in Public Security. Given the current findings, future research could explore other public security products and user groups to analyze their perceptions and information. Such research should emphasize the pursuit of high-quality equipment for public security personnel to ensure effective public service delivery.

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