Business Intelligence in Public Management

Javier Benavides-Redhead, Jenny Gutiérrez-Flores*
Facultad De Ciencias Empresariales, Universidad Científica Del Sur, Lima, Peru

***Abstract*—The present research seeks to demonstrate the improvement of the visualization of indicators applying Business Intelligence in the district municipality of Lince. The entity has among its different institutional objectives to strengthen the modernization of the administrative and functional systems of institutional management. The research was proposed as an applied type, with a pre-experimental and quantitative design. A sample of 10 users belonging to Tax Administration Management was available, applying the questionnaire technique and the survey-type instrument. From the data collected by the instrument in the Pre-Test and Post- Test, the results were obtained that allowed us to determine a positive relationship in relation to decision-making for tax collection. For the Pre-Test tests, a score of 50% was obtained, in the low-level score as opposed to the Post Test tests, which obtained a 50% general level. The investigation allowed, in its interpretation, the meaningful change for decision-making supported by indicators generated by Business Intelligence, when evaluating the results and finding changes among the respondents on time, productivity and presentation of information in relation to the use of Business Intelligence. On the other hand, decision-making was positively affected from the direction, control, and evaluation organization, from the perception of the respondents in the changes represented by the use of a business tool to obtain information capable of responding to the needs of the institution for decision-making, focused on tax collection. The research is structured in six sections. The first section details the problematic situation and the justification of the study in relation to the research objectives. The second explains the background and previous research that supports the problematic situation based on the key constructs of the work. The third mentions the methodology used, through the quantitative approach, and the fourth shows the results obtained. The fifth section makes a comparison of what the study achieved compared to other previous studies and finally, the conclusions provide the final scopes on the achievement of the objectives and the contribution to future research.**

***Keywords*—Business intelligence; municipality; taxation; decision making; indicators; public management; information presentation; technology tool; modernization; productivity**

I. Introduction

The District Municipality of Lince in Lima seeks to provide quality services to citizens within its district. Accurate decision-making is essential to meet the needs of citizens and improve their quality of life. For managers, having timely information is crucial to analyzing problems and proposing valuable solutions. In this sense, the ability to listen to the perspectives of the areas involved, based on real data, is key to making the right decisions. However, the Tax Administration Management that supervises the collection of municipal revenues has been operating through a manual, daily process and with data from various sources, which has affected the timely generation of collection reports, essential for efficient decisions, to the extent that the Information Technology sub-management is in charge of the Tax Information System, essential for tax collection reports. Because of this problem, there are limitations of information due to the delay in the creation of indicators as they have been executed manually, causing dissatisfaction among users. The objective of this research is to determine how the improvement in the visualization of indicators by applying Business Intelligence is related to decision-making for tax collection. It will make it possible to analyze the real situation of the processes that are aligned with the institutional objectives and the supervision of compliance with the goals executed by the organic units under its responsibility. Obtaining data from various sources of information can be collected and transformed into useful information for public management and therefore in better decision making.

To achieve this objective, Business Intelligence has been established as an independent variable, [1] which is defined as the technological tool that allows generating profits at all levels of management, especially in decision-making processes, through the integration and analysis of an organization's data resources. They also [2] state that BI is a generic term that groups together technologies and management processes aimed at collecting, storing, organizing, and managing data with the aim of improving the competitiveness of companies.

Among the dimensions selected for the study we have the following: Time, related to speed, the tool is intended to deliver the information required by the user in the shortest possible time. This is crucial as the value of information can change depending on the moment. Productivity is related to reliability, ensuring the quality of information to avoid incorrect decisions. Trust in the data is achieved through transparency and traceability, ensuring that the results provided by the BI tool are based on reliable data. Presentation of information, which seeks to make interpretation easy for the user with minimal effort. Beyond the appearance of the reports, it is important to have an intuitive structure that facilitates the interpretation of the data.[3]

In relation to the dependent variable, decision-making, [4] they define it as a habitual and common act of choice between different alternatives linked to management because it is a human activity. Therefore, the study focuses on detecting problems and opportunities, verifying objective deviations, and taking the necessary actions to resolve the situation. The explanation of their relationship and impact has been explored using technological tools to support effective decision-making in administrative management. To this end, the following dimensions have been proposed: Organization, this aspect helps to establish the activities of the organization, focusing on establishing the appropriate hierarchies to accelerate the execution of tasks and make the right decisions. Management, which is based on communication within the organization as an

essential element for an ideal work environment and for the effective resolution of conflicts. Business strategies that benefit stakeholders are studied and the visualization of indicators through Business Intelligence tools is used to help. Control and Evaluation, where the performance of the operations conducted is compared with what was originally proposed. The aim is to demonstrate the reality of performance and opportunities for improvement. Business Intelligence helps to analyze variations and find the cause of non-compliance with the established provisions. [5]

II. Related Work

Among the international precedents, [6] it formulated a Business Intelligence proposal that favored decision-making, specifically Tax Management, with the aim of improving the tax reporting process. He concluded that the use of a Business Intelligence proposal facilitated the visualization of consolidated information on dashboards. For [7], in the municipality of Cartagena del Cheara they defined a project based on the development of an artificial model aimed at helping the management of a service company in decision-making to improve the efficiency, productivity and competitiveness of its organization.

At the national level, [8] it proposed a Business Intelligence solution for the dynamization of decision-making in tax management, focused on debt control and SUNAT collection. Among its results, it identified that the reporting time with the use of the Business Intelligence tool was reduced by a total of 8.7 seconds compared to 116.05 seconds without the tool. For the costs of the preparation of management reports, a reduction was found from S/ 0.56 to S/ 0.04, and for the level of user satisfaction, greater acceptance was identified with 2.65 points against 1.9 points without the tool. Based on the evidence, it was concluded that the activation of Business Intelligence helped to reduce times and costs, as well as increase the level of user satisfaction. In the same sense, [9] they proposed that, to improve the decision-making process in the Revenue Area, Business Intelligence was necessary. The objective of the research focused on reducing time, minimizing the cost of person-hours and increasing user satisfaction with the proposed solution for reporting. Their results showed that user satisfaction increased by 32.56%, reporting time was reduced by 69.12%, and labor time costs associated with reporting were reduced by 69%. The deduction was reached that the development of Business Intelligence made it possible to speed up decision-making, specifically in tax revenues of the District Municipality of Moche. [10] , prepared a study on the development of a DataMart for the analysis of tax delinquencies and traffic offenders. Its main objective was to analyze the tax debts and traffic infractions, of the Tax Administration Service of Piura, through multivariate analysis with the Hefesto methodology. To this end, quantitative study was developed, with a descriptive scope and a non-experimental design. The units of analysis of the study and the records of the tax debts stored in the database were used. With a population between 2013 and 2017, all population records were considered for the sample, and the observation card was used as a tool for data collection. Among its conclusions, it validated the confirmation of hypotheses by describing in tabular and graphical form their respective interpretations of the main indicators of the research variable. On the other hand, [11] it conducted a study, in the collection area of the Municipality of Los Olivos, for the development and deployment of Business Intelligence. It identified problems in the efficiency of information, producing user satisfaction related to the receipt of reports. For the solution, SCRUM was used as a methodology in the development of the project, and for the construction of the Business Intelligence tools, the Ralph Kimball methodology. Among its results, it was identified that the implementation of Business Intelligence improved the efficiency index by 53.36% and an increase of 1.90% in the user satisfaction index was achieved. As conclusions, a significant improvement in the decision-making process was evidenced thanks to the introduction of Business Intelligence.

This study will help to analyze the real situation of the processes that are aligned with the institutional objectives and monitoring compliance with the goals executed by the organic units under their responsibility. The obtaining of data from various sources of information can be collected and transformed into useful information for public management, developing better decision-making for public management. In addition, it will allow the institution to work in a more efficient way, providing the inhabitants of Lince with better services, increasing the speed of processes and response times, exploring the different solutions provided by the implementation of Business Intelligence. As demonstrated by the work [12] of seeking to use a system for both the public and private environments, it was possible to provide confidence by making use of a tool that complies with being accurate, reliable, efficient, dynamic and agile, generating the best result in the execution of the care processes. For his part, [13] he argues that the choice of the method to be used for data storage applying Business Intelligence will depend on the number of steps necessary to build it, such as the methods of Kimball, Hephaestus and SAS, which help in the agile identification of the business objective and the quick results of the project, to validate its performance in decision-making. Finally, it can be replicated in any local government institution and as they point out, [14] the Data Warehouse model allows to have centralized information available for later analysis at a high speed, which is reliable and supports decision-making, becoming a fundamental part of the organization in which it is implemented.

However, the study presents as a limitation the availability of the personnel involved in the process for the generation of indicators by tax collection, in order to measure the quality of the visualization of indicators in terms of time, cost and user satisfaction at the end of the process.

III. Materials and Methods

The pre-experimental design was considered. As mentioned, [15] , the pre-experimental design is based on the test and post-test of a single sample group, which consists of the application of the test prior to experimental treatment, which will later be compared with the result of the subsequent tests. In view of this, the research conducted a before and after analysis in the visualization of indicators applying Business Intelligence and was validated in the hypotheses raised on tax collection decision-making. Likewise, the data were obtained from the instruments selected for the dimensions of the proposed independent and dependent variable. The type of research

applied, as defined [16], to the entire process of relationship between theory and product was considered defined as: a need for an industry or social sector that allows the creation of a theoretical concept if the properties of the concept are useful to the end user. The approach was quantitative, [17] we are told that the quantitative research approach establishes the experimental method, which is more common than is believed. And its objective is to discover new knowledge that allows them to know reality in the purest way possible, collecting and analyzing data through concepts and measurable variables. The scope was correlational, where [18] it is defined as the need for the approach where a relationship between 2 or more variables in relation to a hypothesis is proposed. From the quantitative approach, inferential statistical processes are applied with the purpose of extrapolating the results of the research to benefit the entire population.

The population and the study sample were made up of the same number of workers, that is, 10 people, with profiles of administrative employees of the Tax Administration Management in the District Municipal of Lince. Hernández quoted in [19], commented that the population will be equal to the sample if the study population is less than the number of fifty (50) individuals. The survey was used for the collection of primary data, applying the questionnaire as an instrument to measure the implementation of Business Intelligence in the visualization of indicators.

The questionnaire included questions with the application of the Likert scale where each statement of the questionnaire could be measured with 5 items and each one was assigned a numerical value. For [20], he specifies that the survey technique is commonly applied in the research procedure, which allows us to obtain the data more quickly. The advantage lies in obtaining information on a wide range of issues at the same time. In reference to the questionnaire, Sierra cited in [21] it tells us that the questionnaire as an instrument is applied to many individuals through a list of questions focused on a certain problem that the research tries to identify. Likewise, this instrument can be applied in writing, verbally and even in digital format.

A. *Reliability Analysis – Pre – Test*

In Cronbach's alpha, the closer it is to its maximum value, the greater the reliability of the scale. As can be seen in Table I, the value of 0.762 is obtained, which can guarantee the reliability of the scale for the instrument in pre-Test.

TABLE I. RELIABILITY ANALYSIS - PRE-TEST

Cronbach's alpha	N° Elements
.762	20

B. *Reliability Analysis – Post Test*

In Cronbach's alpha, the closer it is to its maximum value, the greater the reliability of the scale. As can be seen in Table II, the value of 0.785 is obtained, which can guarantee the reliability of the scale for the instrument in post-Test.

TABLE II. RELIABILITY ANALYSIS - POST-TEST

Cronbach's alpha	N° Elements
.785	20

For the implementation of Business Intelligence, a solution consistent with the development of a Datawarehouse was proposed, that is, a repository or data warehouse where the data generated by the entire organization is located, which is characterized by being stable, coherent, dependable, and supported by historical information. For its elaboration we based ourselves on Ralph Kimball's methodology that indicates that to build a DataWarehouse, it must have the following characteristics: 1) Focus on the business and its needs. 2) Have an infrastructure designed to solve business problems. 3) It can be delivered in relatively short times of 6 to 12 months. 4) Provides a complete solution, database, reports, documentation, etc. Likewise, to achieve the processing of the data we require the generation of the ETL, which is defined as the process by which the data that is going to be used to build the DataWarehouse is identified, this data comes mainly from the transactions and the history of the organization, this information must go through filters to determine which is the one that will be of greatest importance to solve our problems, In addition, modifications will have to be made before entering it to adapt it to the structure that our data warehouse will have, so that it can be used by users and obtain the required information effectively. To finally generate the dimensional data model and its visualization of indicators through dashboards tailored to the needs of the organization.

The limitations of the study are associated with the limited accessibility of the income systems for the exploitation of information from the process of extraction, transformation and loading of data for the Business Intelligence tool. Likewise, the lack of availability of the personnel involved in the process for the generation of indicators for tax collection, to measure the quality of the visualization of indicators in time, productivity, and presentation of information at the end of the process.

IV. RESULTS

For the Pre-Test type of test, the process of generating indicators was considered before the implementation of Business Intelligence, as can be seen in Fig. 1.

Fig. 1. Indicator generation process – Pre Test scenario.

For the type of Post-Test test, the process of generating indicators was taken into consideration, after the implementation of Business Intelligence, which can be seen in Fig. 2.

Fig. 2. Indicator generation process – Post Test scenario.

A. Independent Variable: Improvement of the Visualization of Indicators by Applying Business Intelligence

According to the results in Table III, on the Improvement of the visualization of Indicators by applying Business Intelligence, for the Pre-Test a low level of 50.0% and an elevated level of 0% were obtained. For the type of test in the Post Test, 50.0% had an elevated level and 0% had a low level.

1) Dimension time: According to the results in Table IV, on the Improvement of the visualization of Indicators applying Business Intelligence over Time, for the Pre-Test a low level of 50.0% was obtained with a medium and elevated level of 0%. For the type of test in the Post-Test, 35.0% have an elevated level, 15% have a medium level and 0% have a low level.

2) Dimension productivity: According to the results in Table V, on the Improvement of the visualization of Indicators applying Business Intelligence in Productivity, for the Pre-Test a low level of 45.0% was obtained with a medium level of 5.0% and an elevated level of 0%. For the type of test in the Post-Test, 15.0% have an elevated level, 35% have a medium level and 0% have a low level.

3) Dimension presentation of information: According to the results in Table VI, on the Improvement of the visualization of Indicators by applying Business Intelligence in the Presentation of Information, for the Pre-Test a low level of 35.0% was obtained with a medium level of 15.0% and an elevated level of 0%. For the type of test in the Post-Test, 15.0% have an elevated level, 35.0% have a medium level and 0% have a low level.

TABLE III. CROSS-ACROSS TABLE - TEST TYPE * IMPROVED VISUALIZATION OF INDICATORS BY APPLYING BUSINESS INTELLIGENCE

			Improvement of the Visualization of Indicators by applying Business Intelligence		Total
			Low Level	High Level	
Test Type	Pre-Test	Recount	10	0	10
		% Of Total	50.0%	0%	50.0%
	Post-Test	Recount	0	10	10
		% Of Total	0%	50.0%	50.0%
Total		Recount	10	10	20
		% Of Total	50.0%	50.0%	100.0%

TABLE IV. CROSS-ACROSS TABLE - TEST TYPE * IMPROVEMENT OF THE VISUALIZATION OF INDICATORS BY APPLYING BUSINESS INTELLIGENCE OVER TIME

			D01: Time			Total
			Low Level	Intermediate level	High Level	
Test Type	pre-test	Recount	10	0	0	10
		% of total	50.0%	0%	0%	50.0%
	post-test	Recount	0	3	7	10
		% of total	0%	15.0%	35.0%	50.0%
Total		Recount	10	3	7	20
		% of total	50.0%	15.0%	35.0%	100.0%

TABLE V. CROSS TABLE - TEST TYPE * IMPROVEMENT OF THE VISUALIZATION OF INDICATORS BY APPLYING BUSINESS INTELLIGENCE IN PRODUCTIVITY

			D02: Productivity			Total
			Low Level	Intermediate level	High Level	
Test Type	pre-test	Recount	9	1	0	10
		% of total	45.0%	5.0%	0%	50.0%
	post-test	Recount	0	7	3	10
		% of total	0%	35.0%	15.0%	50.0%
Total		Recount	9	8	3	20
		% of total	45.0%	40.0%	15.0%	100.0%

TABLE VI. CROSS TABLE - TEST TYPE * IMPROVEMENT OF THE VISUALIZATION OF INDICATORS BY APPLYING BUSINESS INTELLIGENCE IN THE PRESENTATION OF INFORMATION

			D03: Presentation of Information			Total
			Low Level	Intermediate level	High Level	
Test Type	pre-test	Recount	7	3	0	10
		% of total	35.0%	15.0%	0%	50.0%
	post-test	Recount	0	7	3	10
		% of total	0%	35.0%	15.0%	50.0%
Total		Recount	7	10	3	20
		% of total	35.0%	50.0%	15.0%	100.0%

B. Dependent Variable: Decision-making for tax collection

According to the results in Table VII, on Decision-making for tax collection, for the Pre-Test a low level of 50.0% and an elevated level of 0% were obtained. For the type of test in the Post-Test, 50.0% had an elevated level and 0% had a low level.

1) Dimension organization: According to the results in Table VIII, on Decision-making for tax collection in the organization, for the Pre-Test a low level of 40.0%, a medium level of 10.0% and an elevated level of 0% were obtained. For the type of test in the Post-Test, 50.0% had an elevated level and 0% had medium and low levels.

2) Dimension address: According to the results in Table IX, on Decision-making for tax collection in the directorate, for the Pre-Test a low level of 45.0% was obtained, a medium level of 5.0% and an elevated level of 0%. For the type of test in the Post-Test, 50.0% had an elevated level and 0% had medium and low levels.

3) Dimension control: According to the results in Table X, on Decision-making by tax collection in the control, for the Pre-Test a low level of 45.0% was obtained, a medium level of 5.0% and an elevated level of 0%. For the type of test in the Post-Test, 50.0% had an elevated level and 0% had medium and low levels.

4) Dimension evaluation: According to the results in Table XI, on Decision-making by tax collection in the evaluation, for the Pre-Test a low level of 45.0%, a medium level of 5.0% and an elevated level of 0% were obtained. For the type of test in the Post-Test, 50.0% had an elevated level and 0% had medium and low levels.

TABLE VII. CROSS-LINKED TABLE - TYPE OF EVIDENCE * DECISION-MAKING BY TAX COLLECTION

			VD: Decision-making for tax collection		Total
			Low Level	High Level	
Test Type	pre-test	Recount	10	0	10
		% of total	50.0%	0%	50.0%
	post-test	Recount	0	10	10
		% of total	0%	50.0%	50.0%
Total		Recount	10	10	20
		% of total	50.0%	50.0%	100.0%

TABLE VIII. CROSS-LINKED TABLE - TYPE OF EVIDENCE * DECISION-MAKING FOR TAX COLLECTION IN THE ORGANIZATION

			D04: Organization			Total
			Low Level	Intermediate level	High Level	
Test Type	pre-test	Recount	8	2	0	10
		% of total	40.0%	10.0%	0%	50.0%
	post-test	Recount	0	0	10	10
		% of total	0%	0%	50.0%	50.0%
Total		Recount	8	2	10	20
		% of total	40.0%	10.0%	50.0%	100.0%

TABLE IX. CROSS-LINKED TABLE - TYPE OF EVIDENCE * DECISION-MAKING BY TAX COLLECTION IN THE DIRECTORATE

			D05: Address			Total
			Low Level	Intermediate level	High Level	
Test Type	pre-test	Recount	9	1	0	10
		% of total	45.0%	5.0%	0%	50.0%
	post-test	Recount	0	0	10	10
		% of total	0%	0%	50.0%	50.0%
Total		Recount	9	1	10	20
		% of total	45.0%	5.0%	50.0%	100.0%

TABLE X. CROSS TABLE - TYPE OF TEST * DECISION MAKING BY TAX COLLECTION IN CONTROL

			D06: Control			Total
			Low Level	Intermediate level	High Level	
Test Type	pre-test	Recount	9	1	0	10
		% of total	45.0%	5.0%	0%	50.0%
	post-test	Recount	0	0	10	10
		% of total	0%	0%	50.0%	50.0%
Total		Recount	9	1	10	20
		% of total	45.0%	5.0%	50.0%	100.0%

TABLE XI. CROSS-LINKED TABLE - TYPE OF TEST * DECISION MAKING BY TAX COLLECTION IN THE EVALUATION

			D07: Evaluation			Total
			Low Level	Intermediate level	High Level	
Test Type	pre-test	Recount	9	1	0	10
		% of total	45.0%	5.0%	0%	50.0%
	post-test	Recount	0	0	10	10
		% of total	0%	0%	50.0%	50.0%
Total		Recount	9	1	10	20
		% of total	45.0%	5.0%	50.0%	100.0%

V. DISCUSSION

For the tests conducted, an interpretation classification was established in relation to the questions answered by the survey. This included the classification in three levels: Low to identify a negative or no impact on the decision-making process, Medium to recognize a neutral effect in which it can be interpreted as minimal changes in the decision-making process and High to indicate a significant improvement in the evaluation of the results for decision-making. From the results obtained in the research, a relationship could be observed between the improvement in the visualization of indicators applying Business Intelligence with decision-making for tax collection, with an elevated level of acceptance in the Post-Test type of test, differentiating it from the Pre-Test test, as shown in Table VII.

For the first hypothesis, it could be observed in the results for the Pre-Test test, that the high level was 0% and the low level was 50.0%, while the Post-Test, the high level was 50.0% and the low level was 0% which represents the decrease in the time used to generate the indicators with the support of Business Intelligence. It can be interpreted that the time spent searching, analyzing, and generating reports improved satisfactorily because of the POST-TEST, which can be seen in Fig. 3. where a total of 10 users expressed their level of dissatisfaction before the implementation of the BI tool through 10 responses and Low Level. After its implementation, 3 responses were placed at the Medium Level and the other 7 responses were positioned at a High Level. From these results, a positive change in the perception of users is perceived.

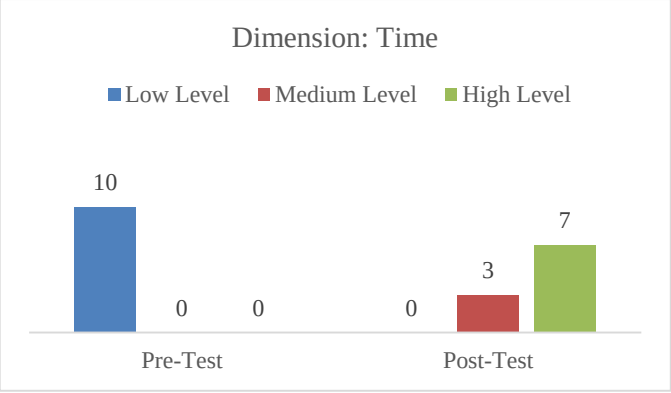

Fig. 3. Comparative pre test vs. post test results dimension: Productivity.

The change is since before the implementation of the BI tool, the delay in obtaining the information from the Tax Information System represented an estimated time of 4 hours (240 minutes). After the implementation of the BI tool, the time obtained was 5 minutes for collection information, which represents a reduction of 98%. In addition, for the analysis of the information before the implementation of the BI tool, it was verified that the time spent was 60 minutes. After the implementation of the BI tool, a time of 15 minutes was obtained, which represented a reduction of 75%. Finally, for the generation of reports based on the information before the implementation of the BI tool, a time spent of 40 minutes was obtained. After the implementation of the BI tool, a time of 20 minutes was obtained, which represented a reduction of 50%.

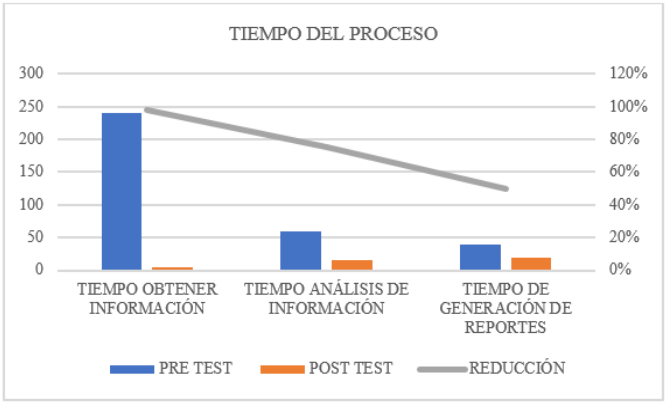

Fig. 4. Process time - comparison of indicators.

This indicates that the participants recognize the change in the perception of the time spent on this task, and a trend towards a greater acceptance of the change from a medium level to an elevated level was observed. The reduction in time generated a higher quality of the information presented, which positively affected decision-making to improve tax collection. This finding is supported by what was mentioned by Salazar (2020), where it is considered that the time dimension represents an improvement for the visualization of indicators through Business Intelligence, through the speed and ability to offer information in real time, creating a positive impact on tax collection decision-making in a municipality.

Regarding the second hypothesis, it was observed in the results that the Pre-Test presented 0% at the elevated level, while for the medium level it was 5.0% and the low level was 45.0%. In the Post-Test test, the elevated level was 15.0%, the medium level was 35.0%, and the low level was 0%. This can be interpreted as improved productivity because of the POST-TEST test, compared to the perception obtained in the PRE-TEST test, which can be seen in Fig. 5. Prior to the implementation of the BI tool, a total of 9 responses with Low Level and 1 response with Medium Level. After the implementation of the BI tool, the results where 7 responses were located at the Medium Level and the rest of 3 responses

were positioned at a High Level. In relation to these results, a positive change in user perception is perceived after the application of the BI tool.

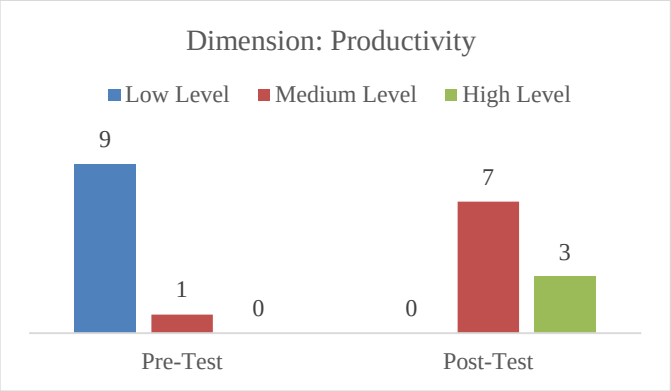

Fig. 5. Comparative pre test vs. post test results dimension: productivity.

In the same way, it was possible to implement better strategies that contributed to productivity. Among them we have: The management of e-mailing, which allows the notification of information on tax debts and benefits to taxpayers by email registered in the Tax Computer System. This was achieved thanks to the information provided by the BI tool, allowing the possibility of classifying taxpayers by segmentation in debt range, facilitating the implementation of these notifications. On the other hand, the management of telephone collection made it possible to select the taxpayers with the highest delinquencies to raise awareness and provide the payment facilities available by the institution, through the information obtained from the BI tool. In addition, the taxpayer orientation process was strengthened from the face-to-face tax service platform, which aims to provide all the information available to comply with their obligations, as well as the land registry and the purchase declaration, known as alcabala. Finally, the possibility of better collection through punctuality incentives makes it possible to offer benefit programs to the neighbor, providing the taxpayer with benefits in other institutions.

Therefore, greater productivity in improving data visualization allowed for faster implementation of strategies that enabled the improvement in tax collection, as well as generated greater efficiency in the collection process. By automating much of the activity in data collection, Business Intelligence can reduce repetitive tasks and allow users to focus on data analysis. In addition, by providing a clear and easy-to-understand visualization of data, business intelligence can increase visibility and understanding of key indicators, enabling more informed and effective decision-making.

This hypothesis can be supported (Gálvez, 2016, as cited in Salazar, 2020), where the importance of the analytical capabilities of Business Intelligence tools for decision-making is recognized. Increased productivity through the visualization of metrics allows for improved analytical capabilities and demonstrates a positive impact on municipal tax collection decisions.

Finally, the third hypothesis, the results indicate that 15.0% of the respondents perceived a significant improvement in the presentation of information, while 35.0% noticed a medium level of improvement in the Post Test. In general, these results proved that the implementation of Business Intelligence to improve the visualization of the indicators contributed to the presentation of the information in a dynamic way of the different management reports, making it simpler for the use of any user interested in tax collection information.

This hypothesis is related to the previous article by [3] in which he specifies that presenting clear and concise information can increase the analytical capacity of decision-makers to understand and analyze data, improving the presentation of information, suggesting that doing so can have a positive impact on a municipality's tax collection.

VI. Conclusions

In relation to the general hypothesis, it was concluded that the improvement in the visualization of indicators by implementing Business Intelligence significantly affects decision-making for tax collection.

Regarding the first specific hypothesis, the results show that the execution of Business Intelligence reduced the time spent on the information processing task and generated a higher quality of the data presented, resulting in greater capacity on the part of those responsible for making more effective decisions.

In reference to the second hypothesis, the results show that the application of Business Intelligence improves efficiency and transparency in tax collection by allowing the analysis of enormous amounts of data, identifying patterns of behavior and trends in payments made by taxpayers, detecting possible deviations in collection and improving tax strategies. In addition, information can be obtained in real time to detect and generate timely solutions, which enhances efficiency and transparency in tax management.

Finally, for the third hypothesis, the results show that the implementation of Business Intelligence contributed to the presentation of information in a dynamic way from the different management reports, making it simpler for the use of any user interested in tax collection information. This opens the possibility of continuous improvement in the presentation of information, according to the nature of the business logic and the needs of users that change over time.

It is worth mentioning that, although improvements in the application of Business Intelligence in Public Management are evident, this is also aligned with maintaining adequate and available personnel to develop and monitor indicators that make possible the execution of these improvements.

On the other hand, this study constitutes a contribution for the public sector not only at the local level, but also at the regional level or of greater scope to the extent that such improvements in management indicators through the use of BI for decision making, will allow analyzing the real situation of the processes that are aligned to the institutional objectives and the monitoring of the fulfillment of the goals executed by the organizational units in charge. Obtaining data from different sources of information can be compiled and transformed into useful information for public management, which makes the best business practices its own.

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