Implementation Project
Electronic Voting Azuay 2014 – Ecuador

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I. BACKGROUND

After the general elections held on February 17, 2013 , the National Electoral Council became committed to improve the electoral process through the introduction up-to-date voting and counting technologies .

A number of responsible and serious studies were carried out ever since in order to assess the feasibility of implementing the Electronic Voting by multidisciplinary teams. Given the current legislation in Ecuador and especially, the cultural reality found in Azuay province, a third-generation software solution was chosen, the same that incorporates a single ballot with an embedded chip and an electronic voting machine, all in one single system .

Generalities regarding the implementation electronic voting in the province of Azuay, local elections 2014

The project executory unit was embodied by the Provincial Delegation of Azuay. The overall objective was to implement a pilot electronic voting process in the voting and counting stages for the election of sectional authorities to be held in February 2014 in the province of Azuay.

The following specific objectives were set in order to attain this objective:

- To build knowledge base on the electronic voting in order to perform automated elections in the nation.

- To establish the regulatory framework for electronic voting and its implementation.

- To implement automatic processing in voting machines, producing results in a timely and reliable manner.

- To carry-out audits at all stages of the electronic voting.

The pilot plan was implemented in an entire province in order to measure and assess the impact of electronic voting within the voting, counting and totalization stages and to evaluate the overall results with regard to the authorities who are elected in a specific region (Prefect, vice-prefect, municipal mayors, urban and rural municipal councilors, and members of rural parish councils), It was decided to conduct the pilot project in the province of Azuay, based upon the following considerations:

- Azuay has 2.163 voting boards which is 5, 5% of the nation's total.

- The number of voters per each voting station has been kept in (300). One equipment shall be placed in each voting station (2163 equipments in total).

- Twenty per cent of the equipments were assigned to training exercises (440 equipments) whereas 10% were assigned for contingencies (220 equipments).

- The Electoral Province Delegation is skilled in the implementation of electronic voting processes.

- The mentioned Province Delegation has a high level of efficiency in the implementation of electoral processes.

- Staff in Azuay province is adequately trained for the implementation of this kind of projects.

- Adequate means of transportation (road and air) make it easy to transport the voting equipments and allow a good communication between the work teams and the CNE headquarters.

- There are good roads from Cuenca city to all the voting sites throughout the province.

TABLE I. POPULATION DATA

Population data
Azuay province presents the greatest percentage of young population: 46.7% between 15 and 44 years of age.
53.2% of the province young population are women
It is the third most densely inhabited province.

Fig. 1. Geographical location of Azuay province

Azuay is a province located south of Ecuador in the Southern Sierra Region (Andes). Its northern border meets the province of Canar, on the south the provinces of El Oro and Loja, on the east the provinces of Morona Santiago and Zamora Chinchipe, and the province of Guayas to the west. Its capital city is Cuenca, a city known as the "Athens of Ecuador" with some 330,000 inhabitants in the urban area.

II. ANALYSIS TO DETERMINE THE BEST TOOL

In order to decide which technology should be used to automate the voting and/or counting process, technological, legal and procedural aspects were taken into account, including the political culture in our country (both in terms of political parties and movements, and citizens in general). Within this framework (once the technology to be implemented was selected), it was possible to start making all necessary contacts throughout Latin American countries for their support with the techology solution that had been chosen. This, because variables such as language, technical support, transportation, among other aspects made it easier to locate the electronic voting method that was applied in our country.

Legal, procedural and technical aspects were taken into account in order to ensure the following conditions: *Universal Suffrage, Equal Suffrage, Free Suffrage, Suffrage Secrecy, Transparency, Verification, Reliability and Safety.* Additionally, all voting options were considered, including null and blank ballots.

As for the integral procedural standards, Calling for elections, Voters, Candidates, Voting process, Results, and Audit were taken into consideration. Also, the following technical standards were considered: Accessibility, Interoperability, Operating Systems, Security, Audit and Certification. Necessary recovery procedures were taken in case of a system failure so that the data would not be lost. The electronic voting system had restricted access levels according to the specific tasks performed by the different users.

Measures were adopted to ensure adequate system protection against intrusions from outside. Transmission of results was safeguarded through the utilization of safe transmission means that guaranteed data integrity and accuracy. The proposal was aimed at improving the quality of electoral processes in charge of the CNE by delivering accurate and verifiable results in the shortest possible time. The final objective is to improve the exercise of political rights of citizens through the implementation of automatic mechanisms within the voting and counting processes.

As per the above (as shown in the chart below), the electronic voting machine with smart ballot proved to be the most adequate for application within the Ecuadorian electoral system. Thus, it was suggested to the CNE Board that the technology that best fits the electoral process and that could deal with the number of candidates for the electoral process of February 23th, 2014, was the electronic voting equipment with smart paper ballot. However, the main problem with electronic voting is that it does not stick to Article 10 of the Organic Law of Elections and Political Organizations of the Republic of Ecuador which provides that popular voting must be publicly scrutinized.

TABLE II. COMPARISON OF VOTING TECHNOLOGY

Feature	Electronic Ballot Box	Styluz	Smart Ballot
Audit of voting at voting station	X	X	X
Voting secrecy	X	X	X
Counting celerity	X	X	X
Equipment portability		X	X
Electrical autonomy			X
Celerity and safety in the transmission of results gathered at each voting station	X		X
Displays candidate information on screen / ballot	X		X
Votes counted in public			X
MJRV-enabled suffrage process.	X	X	X
Accessibility for people with dissabilities.	X		X
Low propability of ballot loss (with votes /voting receipts)		X	X
Vote modifications are not possible during the counting process.	X		X
TOTAL *	8	6	12

III. COMPETITIVE ADVANTAGES OF ELECTRONIC VOTING COMPARED TO MANUAL VOTING

- Experiences in the region are favorable (in some provinces of the Republic of Argentina, this system has been used successfully in voting processeses. More than 900,000 voters from different social and cultural levels use it).

- Vote counting is public and can be observed and validated by different observers and representatives of political sectors.

- It allows to set-up the software according to the election type: It accepts blank and null ballots, votes per lists of candidates and different languages, including Quichua and Spanish. Interface designers made sure that all possibilities are available on the screen.

- 100% auditable throughout all process stages.

- The device where the vote is cast does not store any information; the choices are stored in an RFID chip on the ballot and are printed on it.

- It facilitates voting of people with disabilities including a module for the blind. One of the advantages is that the electronic equipment can be used in various voting processes, which implies an economic benefit.

- Fully portable equipment.

- It does not link the voting station with the equipment, voters can choose any free machine for your vote.

- The voter may request another ballot in case of noticing a mistake.

IV. IMPLEMENTATION OF THE ELECTRONIC VOTING PROJECT

The e-voting project was developed precisely in response to the need of obtaining agile, verifiable and transparent voting results, taking into account today's global demand for free and widespread citizen access to information, knowledge and networking, through the use of digital tools to reduce the technological gap. Moreover, the implementation of electronic voting generates a substantial change in all aspects, with politics and governance as two areas of great importance, leading to a rethinking on the proper relationship between candidates and voters as well as between representatives and citizens.

The proposal on which we based this proposal was a thorough improvement in the quality of electoral processes in charge of CNE and the generation of accurate and verifiable election results in the shortest possible time. The purpose is to improve the application of citizens' political rights by introducing automated mechanisms within voting and counting processes.

V. LEGAL FRAMEWORK

According to the constitutional mandate, the National Electoral Council shall ensure the exercise of people's political rights through their votes as provided for by the Organic Electoral and Political Organizations Law of the Republic of Ecuador, Code of Democracy, enforcing

principles of effectiveness, efficiency and quality that the public administration must observe.

Moreover, by implementing the electronic voting (which does not require the use of ballots), we will provide all aids and adequate safety levels in accordance with article 109 of the Code of Democracy. For instance, we will attain the participation of all voters and will provide the aid required by people with disabilities so that all of them will be able to vote.

The National Electoral Council may also decide to use electronic methods not only during the voting but also for the counting stage, for which purpose all rules can be modified if necessary (based upon Articles 113 and 115 of the Code of Democracy).

VI. ELECTRONIC VOTING. AN EFFECTIVE SOLUTION TO A BALLOT COUNTING PROCESS

Ecuador has been manually managing the processes of voting and counting of votes at polling stations and the recount in the Provincial Election Boards, with consequent problems that may arise in the manipulation of electoral kits and ballots, problems such as: ballot size, number of candidates to be elected, interpretation of some votes cast, errors in transcribing the data from vote registers, slowness in delivering results and the possibility of human errors in the counting of votes. Consequently to the above mentioned, the CNE decided that it was necessary to introduce automatic voting and counting processes. The implementation of a new computer voting system and the use of modern vote counting tools conveyed risks within the implementation and operation stages. Therefore, such implementation was programmed by stages with specialized area teams dully trained to take over project implementation.

The management team was formed with officials from the head office specialized in areas related to information, communication, finance, logistics, legal, administrative, training and electoral processes.

VII. PROJECT'S COMMUNICATIONAL DIMENSION

A population study was carried-out in Azuay province as part of a communicational strategy. It was found that over 60% of Azuay inhabitants did not have a clear idea regarding the Electronic Voting, reason why we started an aggressive informative and training program. The campaign included visits to local communication media to spread communication products such as written newsletters, informative reports including audio interviews on the main activities undertaken by the election authorities and a monthly press conference on the progress of the project.

A massive campaign was launched in order to reach a large segment of the population. The campaign included radio, television, and print media with highly informative and emotive contents to inform people from Azuay regarding the electronic voting process. Once people were

aware of the ELECTRONIC VOTING and its advantages, they rushed to the nearest training point in order to learn more about the new technology to be applied. They were also receptive to receive the training conducted at their workplaces.

The communication ELECTRONIC VOTE campaign was present on the main social networks used by people from Azuay, networks that spread positive messages on the project (always highlighting the benefits of using technology in favour of our democracy). The communications department received important feed back through this means, including many opinions issued by citizens. Additionally, the ELECTRONIC VOTE project included mobile training at a bus equipped with electronic voting machines that traveled all around the 15 cantons of the province of Azuay.

VIII. STRATEGIES EMPLOYED TO PROMOTE THE TRAINING PROCESS

It began with a socialization through two seminars on electoral processes that took place in the city of Cuenca with the participation of experts in the topic, experts such as Carlos María Ljubetic (Paraguay), Rui Santos (Portugal) and Amilcar Brunazo (Brazil). The workshops were aimed at the population in general and were attended by media, university representatives, representatives of the neighborhoods of Cuenca, provincial authorities and political organizations. These experts were able to share personal experiences in each of their countries.

Management of electronic voting developed the training plan that was launched in the province of Azuay. It is worth mentioning the training given to MJRV's (members of polling stations and actors involved in the event) on the management and operation of the Electronic Voting machine used in the electoral process of 23 February 2014.

Undoubtedly, we were aware on the importance of providing adequate training to voters (general public) on the voting machine.

Training started on October 1, 2013 with the first group of 100 trainers who received information about the e-voting process, voting machines, laws and hints on how to approach to people. Training to citizens started on October 15th with the 22 computers available at that time. Until 16th November 2013 a total of 100 equipments were available for the training events to citizens, including social, professional, corporate, institutional and the public in general.

In total we counted with the participation of some 200 trainers who toured throughout the province providing training at public and private companies, schools (to parents of students), universities, students from upper high school years, neighborhoods, rural communities, political organizations and at the most crowded places such as markets, parks, bus terminals, fairs and churches.

TABLE III.   TRAINING

Inhabitants	Voters	% of registered voters	Number of trained citizens	Percentage of trainees
609.007	459.303	75,42%	367.441	80 %

Source: Delegation of Azuay province.

IX. SYNERGY BETWEEN TECHNOLOGY AND ELECTORAL MANAGEMENT

The Electronic Voting Project provided tools that facilitated interaction with the voting process, tools such as is the voting introduced in Azuay province on 11 December 2013, a tool that was available to citizens and political organizations at www.cne.gob.ec and www.cnezona4.ec. This tool allowed practices from home.

Functioning of the "QR Code" was explained to political organizations for them to keep quick records on the results obtained at polling stations in the province of Azuay, including details on the operation of the software's source code to allow political organizations to carry-out their own ballot counting.

Network

200 transmission links were installed with a bandwidth of 1Mbps, featuring transmission of coded information. Transmission in nationwide links reached 150 Mbps with optic fiber, which guaranteed a fast delivery of information to the ballot counting hub. XDSL technology was used in copper-based networks at rural areas. Wireless links (Radio) were established in areas lacking wire networks, as well as mobile suppliers working on 3G APN technologies. VSAT-satellite technology links were installed in areas with difficult geographical access.

X. AUDITING PROCESS: A WARRANTY OF TRANSPARENCY AND RELIABILITY

Four electronic voting audits were conducted in Azuay project. There, voters and political organizations were able to verify the results of the election process.

Audit of installation, voting and counting software - In this audit software installation, voting and counting were validated through observation, review of the application and generation of a hash code that ensures the integrity of the software used in voting and counting processes.

Audit database - This audit was performed to review the databases used as a repository of the information generated at every voting site and was used o generate the final results.

Audit of the scrutiny made at the Poll Station - This audit was conducted by the Electoral Provincial Board of Azuay and consisted of performing manual counting every vote for prefect and Vice-Prefect , Mayors, Urban - Rural Councillors and Members of the Rural Parish Boards. Once the votes counted , were compared with the results of the electronic totalizing system .

Audit of the totalization system - This audit was conducted by the Electoral Provincial Board and involved the processing of ballots for Prefect, Vice-Prefect, Mayors, Rural Councillors and Members of the Rural Parish Boards. The results were totalized and compared with the results of the electronic totalization.

XI. MUTUALITY BETWEEN THE ELECTRONIC VOTING PROJECT AND THE INCLUSION PROJECTS CENTERED AROUND HISTORICALLY EXCLUDED GROUPS.

As for the "Voting at Home" project, the National Electoral Council (CNE) developed a plan that allowed people with disabilities and older adults to vote at home by leveraging the portability of the electronic voting equipment. A database of persons with disabilities requiring special attention was elaborated before the elections. Prisoners at state jails in Azuay province were also able to vote thanks to the electronic voting machines with intelligent ballot.

XII. VARIABLES OF A COMPREHENSIVE ASSESSMENT

The following was obtained on 23 February 2014 at the Sectional Elections 2014:

1) Result reporting in less than two hours upon voting closure;

2) Reduction of absenteeism from 31.38% in 2009 to 24.80% in 2014;

3) Training given to more than 525,000 people (standing for 78% of voters).

4) Audit of 100% of voting registers and technical audits on pre-election, election and post-election phases.

5) 39 people suffering from disabilities voted at home.

6) 241 jail prisoners were given the right to vote (those who had not been sentenced).

7) Inter-cultural voting of indigenous people (in their native language).

8) Signing of the "Agreement for our Democracy and Transparency" supporting the electronic voting process (signed by political organizations participating in the electoral event).

9) Positive acknowledgements from observing missions that deem e-voting as an emblematic electoral project.

10) Permanent support given by people who became empowered of the E-voting project held in Azuay 2014.

XIII.   COMPARATIVE ANALYSIS OF PARTICIPATION FROM 2009 TO 2014 (SAMPLE: PROVINCE PREFECT, MAYOR)

The elections held on February 2014 showed an increasing participation of citizens. Comparing with the elections held in 2009, absenteeism fell from 31.38% to 25.21% in 2013 at province level, ending at 24.54% in the last elections held in February 2014. If you want to compare the amount of blank and null votes that were obtained from one election to another, it is necessary to compare two similar elections, 2009 being the last electoral process in which sectional authorities were elected. It is noteworthy that the electronic voting itself eliminates unintentional errors made by voters. It also eliminates the subjective interpretation of votes by polling station officials. Considering the results obtained in 2009 for province Prefect we can see that the number of blank votes in 2014 was smaller. A different behavior occurs in null ballots... there were fewer nulled ballots in 2014 than in 2009. (See comparison chart).

TABLE IV.   NULLED BALLOTS 2009 – 2014 PREFECT

	Election April 2009 – Prefect	Election february 2014 – Prefect
Population	551.291	609.007
Voters	378.423	459.303
Polling stations	2.319	2.163
Blank	44.041	34.716
Nulle	28.553	30.662
Total Blank and Nulle votes	72.594	65.378
Absenteeism	31.38%	24,58%

Regarding blank and null ballots for mayors, an increase in the number of blank votes was seen in 2014 compared to 2009 and a decrease of null votes from 2009 to 2014. The increase of blank and null votes from 2009 to 2014 is just 10.35 % despite the number of voters grew in that period by 16.69 %.

The total percentage of blank and null votes for Mayor with regard to the number of voters is 16.45% in 2009, whereas in 2014 such percentage dropped to 15.31 %. Participation level has also grown in Cuenca canton during the last election, going from 70.60 % in 2009 to 76.48 % this year.

TABLE V.   NULLED BALLOTS 2009 – 2014 MAYOR

'	Election April 2009 – Mayor	Election february 2014 – Mayor
Voting sites	1.573	1.464
Voters	383.253	424.847
Persons who voted	270.682	324.918
Blank	16.044	27.016
Null	28.553	22.731
Total Blank and Nulle votes	44.597	49.747
Absenteeism	29.40%	23.52%

Methodology - The questionnaire was aimed at those voters who had just cast their electronic vote: A questionnaire was designed for the survey. The surveys were conducted at voting stations with the sample selected.

The questionnaire consisted of multiple choices (related to voters' socio-economic condition, variables concerning their confidence toward electronic voting, new voting technologies and scope of information campaigns and training conducted by the e-voting project weeks before the Election Day). Additionally, the questionnaire allowed respondent voters to recommend or suggest solutions to the problems derived from citizen's eagerness to know and improve the system for the next elections.

Sample design - The sample design was stratified, randomized and configured by county and urban area. Rural areas and voting sites according to the number of voters in the province of Azuay.

Results for Azuay Province

A total of 3,983 individuals were surveyed in Azuay province (distributed in 36 polling stations in urban and rural areas).
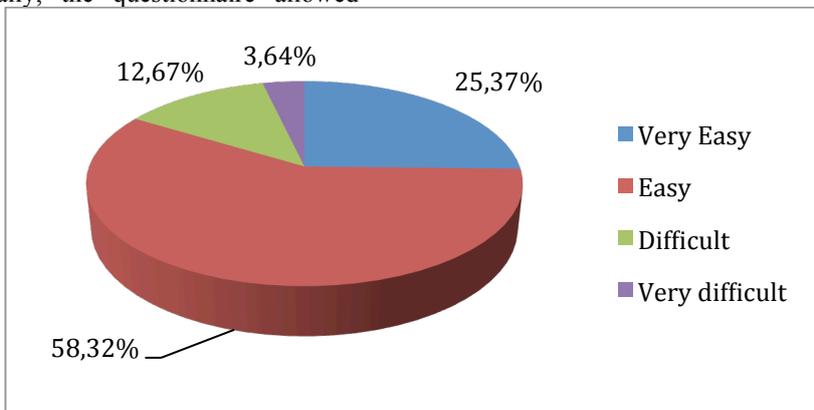

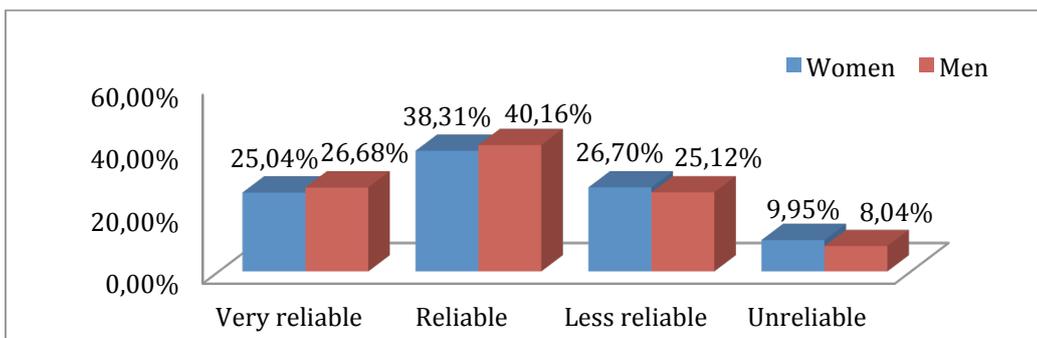Fig. 2. Rating of Experience of Electronic Voting

1. *How do you qualify the experience of electronic voting in Azuay?*

This first rating evidence that the majority of voters surveyed (more than 80 %) felt that their experience to vote electronically was very easy or easy, which indicates a certain way that the electronic voting project Azuay was successful. Certainly, it is necessary to check that the components that formed each of the projects require adjustments, so that we can improve these processes in future projects. Below are the voters' perceptions of women and men separately.

TABLE VI.   RATING OF THE EXPERIENCE OF ELECTRONIC VOTE BY SEX

AZUAY PROVINCE		
	Women	Men
Very reliable	25.04%	26.68%
Reliable	38.31%	40.16%
Less reliable	26.70%	25.12%
Unreliable	9.95%	8.04%

In conclusion it can be inferred that the fact of being a man or a woman does not affect the rating of the experience of the electronic vote; that is to say, the electronic vote was qualified in equal proportions by both voters and women voters by men.

Another key aspect of the research revolves around the voter confidence in front of the electronic voting system in Azuay. It is important to note that it is one thing that the voter has been found with a voting system friendly and easy to use; while another thing is that the voter qualifies as reliable or not the voting system as such. Hence the importance of understanding on the part of the voter, if despite having found an electronic voting system easy to use or not, the voter found reliable or not the voting system.
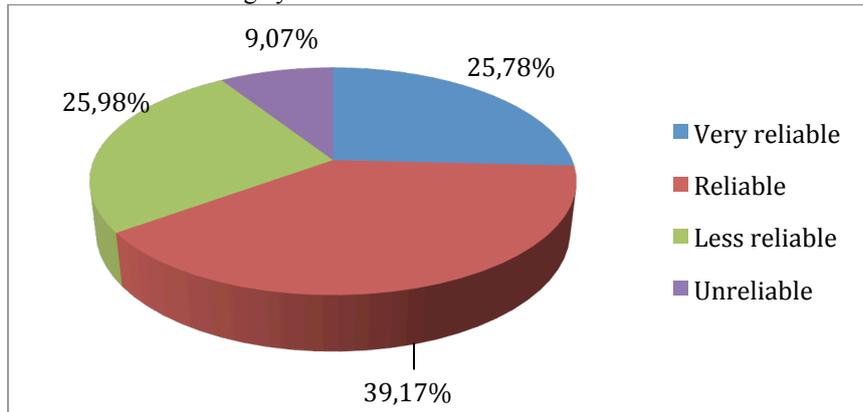

Fig. 3. Reliability in e-voting

At this point, the research i wanted to know the perception of voter with regard to this topic. The results reveal perceptions divided among voters who considered the system very reliable (25.78 %), reliable (no 39.17 %), unreliable (25.98 %) and nothing reliable (9.07 %).

TABLE VII.   RELIABILITY IN E-VOTING

AZUAY PROVINCE		
	Women	Men
Very reliable	25.04%	26.68%
Reliable	38.31%	40.16%
Less reliable	26.70%	25.12%
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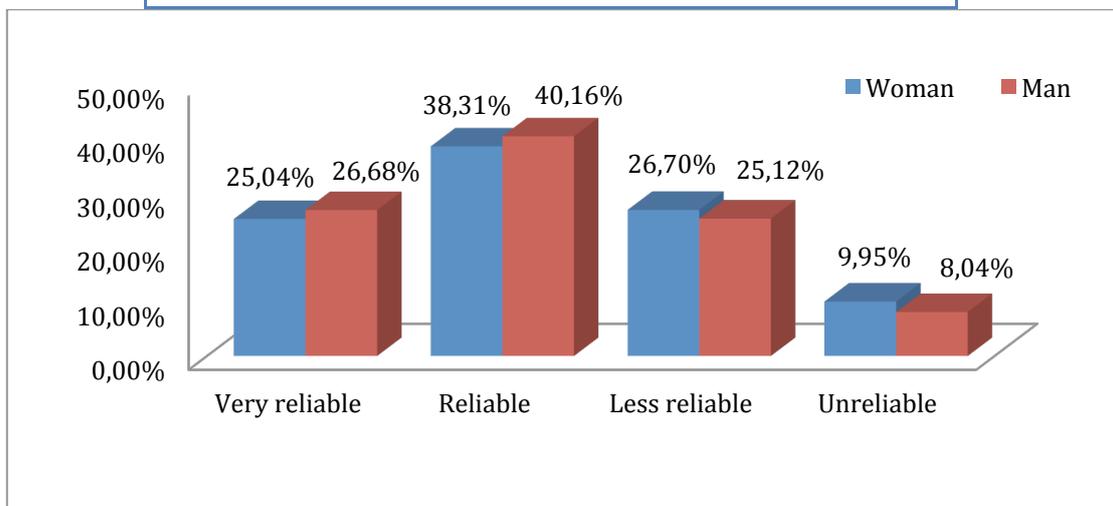
2. Are you willing to use this system for the upcoming elections?

For the National Electoral Council is essential to know the opinion of citizens on whether voters would be willing to use the electronic voting system that were used in their respective provinces for the coming elections or not. Below are the results of this question along with the sex variable.

In general, eight out of ten people would be willing to vote using the electronic voting system that used the day of the election in their respective provinces. Similar results when viewed from the sex variable are presented below.
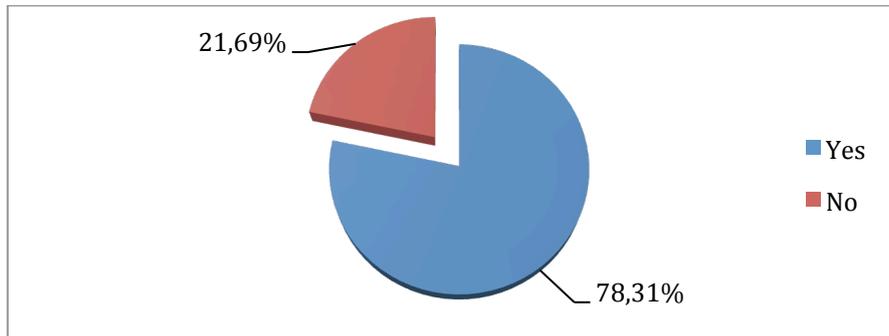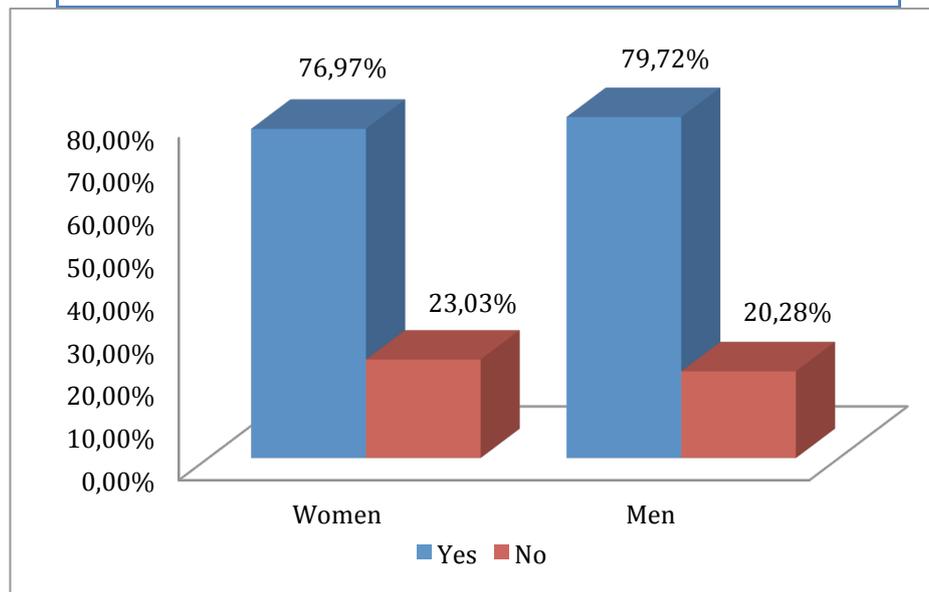

Fig. 4. Use or electronic voting in future electoral processes of the Azuay Province Reliability in electronic voting

TABLE VIII. USE OF ELECTRONIC VOTING IN THE UPCOMING ELECTIONS BY SEX

| AZUAY PROVINCE		
	Women	**Men**
Yes	76.97%	79.72%
No	23.03%	20.28%

3. Experience of electronic voting by level of education?

In the following graphic shows how the voters felt the ease or not on the use of the voting machine depending on their level of education. In this way there is for example that a higher level of education, the easier it is considered the use of the machine.

TABLE IX.   EXPERIENCE OF ELECTRONIC VOTING BY LEVEL OF EDUCATION

| AZUAY PROVINCE				
	Nothing	Primary	Secondary	Highger
Very easy	7,55%	10,55%	28,38%	45,70%
Easy	32,45%	63,78%	63,69%	51,37%
Difficult	41,13%	20,50%	6,69%	2,25%
Very difficult	18,87%	5,16%	1,24%	0,68%
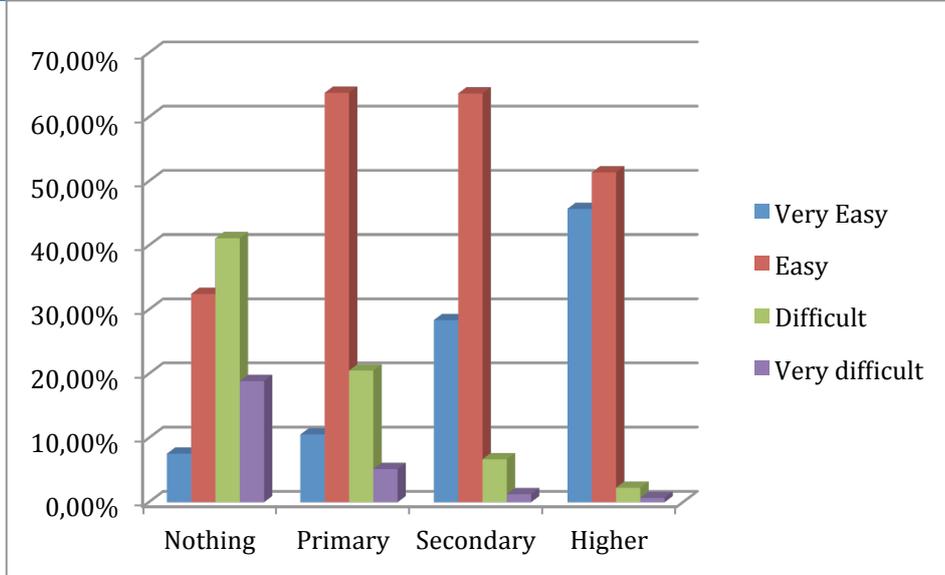
4.   *Confidence in the electronic voting systems by level of education?*

The following graphs shows that the digital divide in terms of confidence is tied to the level of education of the electorate: the higher the level of education, the greater the confidence to the system. For the province of Azuay, the 80.14 % of people with higher education rely on the system:

TABLE X.   CONFIDENCE TO THE SYSTEM ACCORDING TO LEVEL OF EDUCATION

| AZUAY PROVINCE				
	Nothing	Primary	Secondary	Higher
Yes	62,88%	76,29%	82,85%	80,14%
No	37,12%	23,71%	17,15%	19,86%
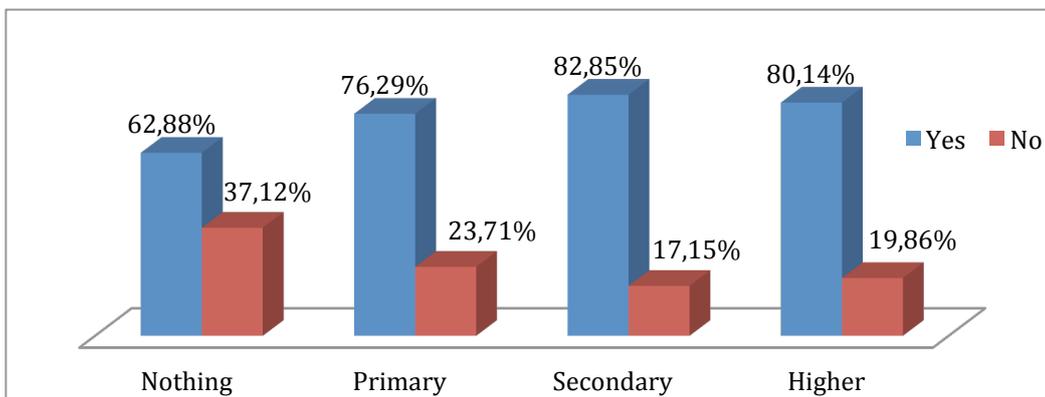
5. *Urban and rural behavior with regard to electronic voting in Azuay?*

It is important to know how the electorate of the urban and rural areas felt with regard to electronic voting. Below are results, considering primarily the variable ease of use of the machine and confidence to the system.

TABLE XI. RATING OF THE EXPERIENCE OF ELECTRONIC VOTING IN URBAN AND RURAL AREAS AZUAY

| AZUAY PROVINCE				
	Very easy	Easy	Difficult	Very difficult
Urban	28,66%	55,53%	12,59%	3,22%
Rural	18,00%	64,57%	12,85%	4,58%
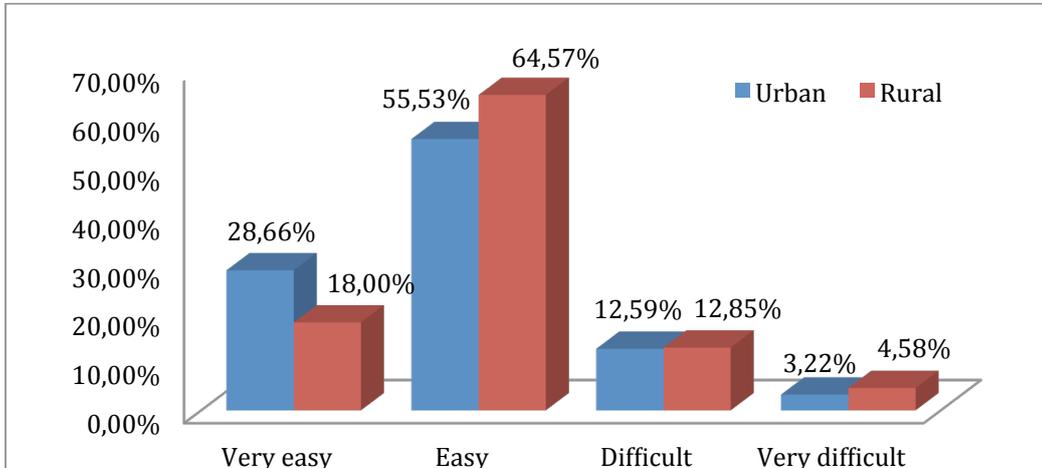
It can be seen that there is no significant relationship between urban or rural area and the qualification of the voter to the use of electronic voting machine. In other words, for both urban voters as to the rural was observed similar results. Below are the results based on the variable trust to the voting system.

TABLE XII. CONFIDENCE AS URBAN OR RURAL AREA

AZUAY PROVINCE				
	Very reliable	Reliable	Less Reliable	Unreliable
Urban	26,82%	39,64%	25,19%	8,35%
Rural	23,46%	38,15%	27,73%	10,66%
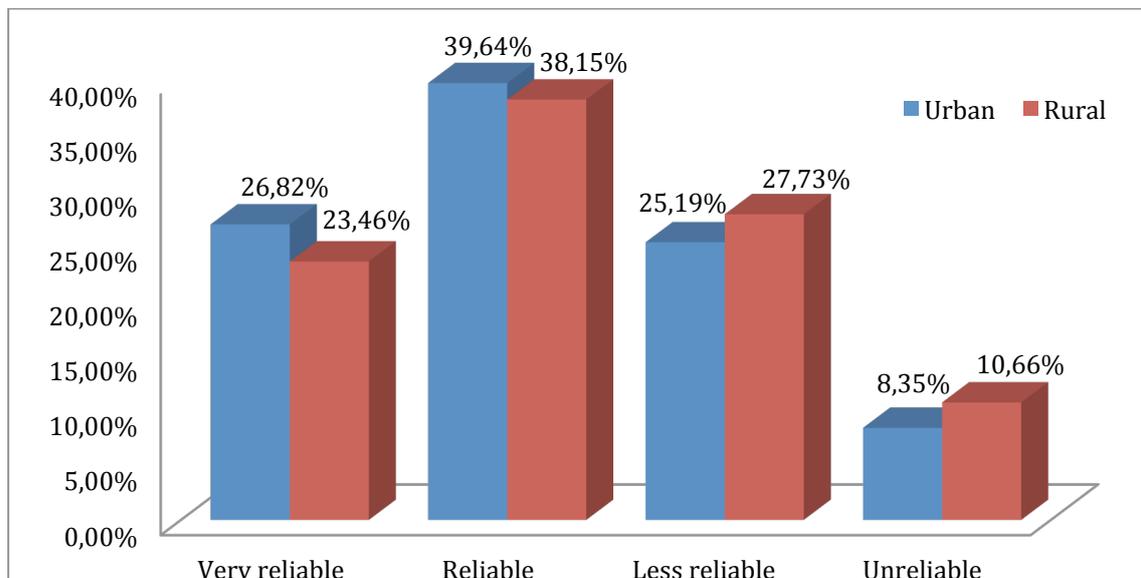
It should be noted that for both the variable ease of use of the machine as to the variable trust the electronic voting system, urban areas have a considerable increase on the rural areas with regard to the ease of use and the confidence to the system. On the other hand, rural areas manifested in greater numbers than urban areas, that the use of the machine is not easy and that the voting system is not reliable. These answers may have its origin in the level of education of the voters polled.