SECURITY REQUIREMENTS OF CONVENTIONAL (MANUAL) ELECTION SYSTEMS

Gunasekara C.M   200193U
Muaad M.N.M   200401J
Muthuthanthrige N.R 200406E

Introduction

Overview of Election Systems

Conventional (manual) election systems involve a physical, paper-based voting process where voters cast their ballots in designated polling stations. These ballots are often marked by hand and deposited into a secure ballot box, after which they are counted manually or using machines that tally paper votes. This system has been widely used for centuries in democratic processes, with variations in the way votes are recorded and counted, such as:

- **In-Person Voting:** Voters physically go to polling stations, identify themselves, and receive a paper ballot to mark their choices.
- **Postal Voting:** Some voters may mail in ballots, which are processed and counted manually.
- **Polling Station Supervision:** Election officials oversee the process, ensuring that only eligible voters participate and that votes are cast in secret to maintain privacy.
- **Vote Counting:** Once the voting process is complete, ballots are collected and counted, either by hand or using ballot-scanning machines.

The manual election system, while relatively straightforward, is still the foundation of many electoral processes worldwide due to its transparency and perceived security.

The security of any election is paramount to ensuring its integrity, fairness, and legitimacy. In a democratic society, the election process must reflect the will of the people, free from manipulation, fraud, or coercion. A secure election system—whether manual or electronic— ensures public trust in governance and political stability.

Purpose of the Study

The purpose of this study is to analyze the security requirements and objectives of conventional (manual) election systems, with a specific focus on ensuring the integrity, fairness, and transparency of the voting process. By examining key security principles such as "one person, one vote," voter eligibility verification, vote integrity, anonymity, and verifiability, the study aims to:

1. **Identify Critical Security Objectives**: Understand the core security goals that manual election systems must achieve to ensure that elections are free from manipulation, fraud, or external influence.
2. **Evaluate Security Mechanisms**: Investigate the mechanisms and processes that are used to safeguard elections, such as ballot protection, voter identification methods, and transparent vote-counting procedures.
3. **Highlight Vulnerabilities and Challenges**: Examine potential vulnerabilities in manual election systems, including risks like fraud, human error, and tampering, and assess the limitations in addressing these challenges.

4. **Provide Comparative Insights**: Offer insights into how manual election systems compare with modern e-voting solutions, specifically looking at security, practicality, and the implementation of verification mechanisms.

Security Objectives

One Person – One Vote

The principle of "One Person, One Vote" ensures that each individual's vote in an election is counted equally and no individual can cast more than one vote. It is a cornerstone of democratic systems, aiming to provide equal representation and uphold fairness in elections. The main objective is to ensure that:

1. **Equal Representation:** Every voter has an equal say in the outcome of the election, preventing any group from gaining disproportionate power by manipulating the voting system.
2. **Fairness:** No voter has more influence than another by casting multiple votes or tampering with the system.
3. **Integrity of the Electoral Process:** Trust in the electoral system is maintained, which is vital for the legitimacy of government institutions and the rule of law.

Security Measures to Ensure No Individual Votes More Than Once:

1. **Voter Registration Verification:**
   ○ Voters must be registered before voting, and their identity should be verified during this process. This ensures that only eligible citizens can participate in the election.
   ○ Registration lists are regularly updated to remove duplicates, deceased individuals, or ineligible voters.
2. **Voter Identification:**
   ○ Requiring government-issued ID or biometric verification (fingerprints, facial recognition) ensures that the person casting the vote is a registered voter. This prevents impersonation.
3. **Biometric Systems:**
   ○ In some countries, biometric data (fingerprints or iris scans) are used to verify voter identity. These systems provide a high level of security as biometric features are unique to individuals.
4. **Unique Voter ID or Code:**
   ○ Each voter may be assigned a unique code or voter ID to be used when voting. The system can track whether the ID has been used, ensuring that no one votes more than once.
5. **Voter Ink (Indelible Ink):**
   ○ Some countries use indelible ink applied to voters' fingers after they vote. This ink cannot be washed off easily and serves as a simple, visible way to prevent multiple voting.

6. **Penalties for Voter Fraud:**
    ○ Clear legal consequences for anyone attempting to vote more than once serve as a deterrent. Strict penalties ensure the integrity of the election.

By implementing these security measures, the election system can prevent fraudulent voting and ensure that the "One Person, One Vote" principle is upheld.

Eligible Voter Verification

The purpose of eligible voter verification is to ensure that only individuals who meet the legal requirements to vote can participate in an election. This involves confirming that voters are of the correct age, are citizens (where applicable), and are not otherwise barred from voting (e.g., due to legal restrictions or disenfranchisement). This process is essential for maintaining the integrity of elections by preventing ineligible individuals from casting ballots.

Ensuring Only Eligible Voters Can Participate:

1. **Voter Registration Process:**
    ○ Before an election, individuals must register to vote by providing information that verifies their eligibility, such as proof of age, citizenship, and residency within a particular electoral district.
    ○ Registration processes may involve submitting documents like birth certificates, passports, utility bills, or proof of residency.
2. **Age Verification:**
    ○ Ensuring that voters meet the minimum legal age requirement (typically 18) is crucial. This can be verified using identification documents such as birth certificates, national ID cards, or passports.
3. **Citizenship Verification:**
    ○ Voting is often restricted to citizens of a country or region. Citizenship can be confirmed through a passport, national identification card, or other government-issued documents that prove citizenship.
4. **Residency Requirements:**
    ○ Many elections require that voters reside in the jurisdiction they are voting in for a specified period. Residency can be verified through utility bills, driver's licenses, or other forms of proof of address.
5. **Elimination of Duplicate Registrations:**
    ○ Cross-referencing registration lists with national databases (such as Social Security or immigration records) can help remove duplicate entries, ensuring no one is registered in multiple locations.
6. **Removal of Ineligible Voters:**
    ○ Voter rolls should be regularly updated to remove individuals who are no longer eligible to vote, such as deceased persons, those who have moved out of the district, or those who are legally disenfranchised.

Methods for Independent Verification of Voter Eligibility:

1. **Voter ID Checks:**
   - Requiring voters to present a government-issued photo ID, such as a driver's license, passport, or national identification card, is a common method for verifying eligibility at the polls.
   - In some cases, biometric voter ID systems are used, such as fingerprint or iris scanning, to verify the identity of registered voters.

2. **Voter Registration Lists:**
   - Election officials maintain voter registration lists, which contain the names and information of all eligible voters. These lists are checked at polling stations before an individual is allowed to vote.
   - Voter registration lists can be made accessible to election observers, political parties, or independent auditing bodies for further verification.

3. **Online Voter Verification Portals:**
   - In some jurisdictions, voters can verify their registration status online through government portals. This allows individuals to check if they are registered, ensuring transparency and reducing errors in the voter rolls.
   - These portals can also be used by election officials to cross-check and update registration data.

4. **Biometric Verification:**
   - In countries where biometric data is collected during voter registration, election officials can use fingerprints, iris scans, or facial recognition to confirm the identity of voters at the polls, ensuring that only eligible individuals can vote.

5. **National Identity Systems:**
   - Some countries have national identity card systems where citizens are required to obtain an official government-issued ID. These cards are often linked to databases containing voter information and can be used to independently verify a voter's eligibility.

6. **Third-Party Audits and Observers:**
   - Independent organizations, including international observers or civil society groups, can verify the accuracy of voter lists and monitor the registration process to ensure that it complies with legal and fairness standards.
   - These organizations can also investigate claims of fraud or improper removal of eligible voters from registration lists.

7. **Cross-Checking with National Databases:**
   - Election authorities can cross-check voter rolls against national databases like immigration records, social security systems, or national censuses. This ensures that only eligible citizens are included and that non-citizens or those who have lost voting rights are excluded.

8. **Voter Verification via Mail:**
   - For absentee or mail-in voting, election officials can require voters to provide a signature or copy of an ID with their ballot. These are then matched to the voter's registration records to verify eligibility.

Vote Integrity

In a manual election system, ensuring vote integrity means guaranteeing that each vote is cast by an eligible voter, recorded correctly as cast, and remains secure through the counting process to the final result. This process must be transparent and resistant to tampering, fraud, or human error.

Requirement for the Vote to Be Recorded as Cast:

1. **Correct Marking of Ballots:**
   - Voters are provided with paper ballots that they mark by hand, selecting their preferred candidates or choices.
   - Ballots are designed to be simple and easy to mark, reducing the possibility of errors such as spoiled or ambiguous votes.
2. **Secrecy of the Ballot:**
   - The principle of a secret ballot ensures that voters can cast their votes without fear of coercion or intimidation. This is achieved by providing private voting booths and ensuring that no one can link a ballot to a specific voter.
3. **Physical Collection of Ballots:**
   - Once marked, voters place their paper ballots in sealed ballot boxes. These boxes are closely monitored and secured throughout the day to prevent unauthorized access or tampering.
4. **Voter Verification at Polling Stations:**
   - Voters present proof of identity and are checked against voter registration lists to ensure they are eligible to vote.
   - After verification, each voter's name is marked off the list to prevent multiple voting.

Steps to Ensure the Vote is Not Altered After Casting:

1. **Secure Ballot Boxes:**
   - Ballot boxes are sealed and monitored throughout election day. They are often transparent so that anyone can see the number of ballots inside without opening the box.
   - Polling station officials, often accompanied by party representatives or observers, are responsible for ensuring the integrity of the ballot boxes.
   - Boxes are sealed with tamper-evident seals, and the number of ballots cast is logged to ensure the count is accurate when the box is opened.

2. **Chain of Custody for Ballots:**
   - A strict chain of custody is followed from the moment the ballot is cast until it is counted. This includes documented handovers when transporting ballot boxes from polling stations to counting centers.
   - In many systems, party representatives or election observers can accompany the ballot boxes to ensure no tampering occurs during transportation.

3. **Cross-Verification of Ballots and Voter Lists:**
   ○ At the end of the voting day, election officials verify that the number of ballots in the box matches the number of voters who were marked off the voter list.
   ○ Any discrepancies must be reported and investigated immediately to prevent fraud or mistakes.
4. **Supervised and Transparent Counting Process:**
   ○ Ballots are counted by hand in the presence of election officials, party representatives, and independent observers to ensure transparency.
   ○ Counting takes place in a public or semi-public location, where observers can see the process. This prevents any attempts at altering or discarding votes during the count.
   ○ Each ballot is reviewed, and valid votes are tallied. Spoiled or invalid votes are set aside but are still part of the record for transparency.
5. **Reconciliation and Audit:**
   ○ The vote-counting process involves reconciling the number of ballots cast with the number of voters marked on the registration list. This step ensures that no extra ballots have been added or legitimate ballots removed.
   ○ Election officials also verify that no ballots are missing or unaccounted for. If there is any discrepancy, it must be resolved before the count is finalized.
6. **Public Posting of Results:**
   ○ After the count is completed at each polling station, the results are posted publicly at the polling site. This allows for immediate transparency and provides an opportunity for observers to compare the polling station results with the final tally.
7. **Storage of Ballots for Audits and Recounts:**
   ○ After the count, all paper ballots are securely stored and retained for a set period, often mandated by law, to allow for audits or recounts if disputes arise.
   ○ Ballots must be stored in tamper-proof, sealed containers, often under guard or surveillance, until the election results are certified or until any challenges have been resolved.
8. **Independent Election Observers:**
   ○ Independent observers, often from domestic or international organizations, oversee the entire process, from the opening of the polls to the counting of votes. Their presence helps ensure that no tampering or fraud occurs at any stage.
   ○ Observers can report any irregularities they see during the election, ensuring transparency and accountability.

9. **Audits and Recounts:**
   ○ If necessary, audits or recounts can be conducted to verify the results. Since the election is conducted manually with paper ballots, a physical recount of the ballots can be performed.
   ○ Audits may involve randomly selecting a sample of ballots or polling stations to ensure that the results match the original count.
10. **Penalties for Tampering or Fraud:**
   ○ Election laws often include severe penalties for tampering with ballots, ballot boxes, or the voting process. These penalties act as a deterrent for anyone attempting to alter the election outcome.

Anonymity of Voter

Voter anonymity, also known as the **secret ballot**, is a fundamental principle in democratic elections designed to protect voters' privacy and freedom of choice. Anonymity ensures that voters can cast their ballots without fear of retribution, coercion, or influence, thus fostering a free and fair election process.

Importance of Maintaining Anonymity to Protect the Voter's Privacy:

1. **Freedom from Coercion and Intimidation:**
   - Anonymity prevents external forces such as employers, government authorities, or political parties from pressuring voters to vote in a certain way.
   - By ensuring that no one knows how a specific individual votes, voters can express their true preferences without fear of retaliation or negative consequences.
2. **Preserving Democratic Freedom:**
   - Democracy relies on the free will of its citizens to elect representatives or make decisions on governance. Anonymity ensures that voters are not constrained by societal pressures, making the election process more genuine and reflective of the people's true will.
3. **Protection Against Vote Buying:**
   - Anonymity breaks the connection between the voter and their vote, making it impossible for corrupt actors to verify if a voter complied with a deal for financial or other gains. This prevents vote buying or selling from being effective.
4. **Encouraging Voter Participation:**
   - Voters are more likely to participate in elections when they are confident their privacy will be protected. Without anonymity, many individuals might be discouraged from voting out of fear of repercussions.
5. **Maintaining Electoral Integrity:**
   - Ensuring that votes remain anonymous helps prevent interference in the voting process. If ballots were linked to voters, it could lead to fraud, manipulation, or breaches of confidentiality.

Mechanisms That Prevent Linking Voters to Their Ballots:

1. **Secret Ballot (Voting in Private Booths):**
   - **Private Voting Booths** are provided at polling stations so that voters can mark their ballots without anyone seeing their choices.
   - This setup ensures that the act of voting is conducted in complete privacy, and no one else, including election officials or observers, can determine how the voter voted.

2. **Anonymous Ballot Design:**
   - Paper ballots are designed without any identifying information about the voter (e.g., name, address, ID number). Once cast, the ballot is indistinguishable from others in the ballot box.
   - This makes it impossible to link a specific ballot back to the voter after it is deposited in the ballot box.
3. **Uniform Ballot Handling Procedures:**
   - Once cast, all ballots are treated identically, mixed together, and counted in bulk to prevent tracking or linking a specific ballot to an individual.
   - Ballots are never handled or inspected in ways that could reveal the identity of the voter.
4. **Ballot Boxes and Mixing of Ballots:**
   - Voters place their completed ballots into a sealed ballot box along with other voters' ballots. This physical mixing of ballots makes it impossible to determine which voter cast which ballot.
   - The ballot box is only opened once voting is complete, and the ballots are counted in groups, further ensuring anonymity.
5. **Separation of Voter Identity from Ballot:**
   - During voter check-in, voters are verified against the registration list. However, after they are given a ballot and cast their vote, there is no further connection between their identity and the specific ballot they submitted.
   - In some manual systems, ballot stubs may be used for tracking, but they are separated from the actual ballot before it is cast, ensuring anonymity.
6. **Double-Envelope Voting Systems (for Absentee Voting):**
   - For mail-in or absentee voting, some systems use a **double-envelope method**. The voter marks the ballot and places it in an inner envelope without any identifying marks.
   - This inner envelope is then placed inside an outer envelope with the voter's details for verification. Once verified, the inner envelope is separated from the outer one, maintaining the anonymity of the vote during the counting process.
7. **Prohibiting the Display of Ballots:**
   - In many countries, laws prohibit voters from taking photographs or publicly displaying their marked ballots to prevent vote selling or coercion. This reinforces the principle of the secret ballot.
   - Similarly, voters are not allowed to show their marked ballot to others before casting it.
8. **Strict Oversight and Legal Safeguards:**
   - Election laws and regulations enforce the secrecy of the ballot by penalizing attempts to reveal a voter's choice or link voters to specific ballots.
   - In some countries, legal frameworks also include strict penalties for election officials or others who attempt to compromise voter anonymity.
9. **Independent Observers and Monitors:**
   - Observers from various parties or independent organizations monitor polling stations to ensure that voters are not being coerced and that the principle of a secret ballot is upheld.
   - They also ensure that election officials follow procedures to prevent any possible identification of a voter's ballot

Verifiability of Vote

Verifiability in a voting system ensures that voters can confirm their vote was recorded and counted accurately while maintaining the anonymity of their vote. This is crucial for maintaining public confidence in the election process and ensuring that the final result reflects the true will of the voters.

How Voters Can Confirm That Their Vote Was Recorded and Counted Accurately:

1. **Voter Participation Records:**
   - **Voter Lists:** After casting their vote, voters can verify that they were properly checked off the voter registration list, confirming that their participation in the election was recorded.
   - Some systems allow voters to confirm post-election that their name was marked off in the official register of those who voted, without revealing how they voted.

2. **Ballot Tracking Numbers (in Absentee or Mail-In Voting):**
   - For mail-in or absentee voting, some jurisdictions provide voters with a **tracking number** on their ballot envelope. This allows voters to verify that their ballot was received by election officials and processed for counting.
   - However, the tracking number is separated from the ballot once it is opened to maintain anonymity, so voters cannot see how their individual vote was counted.

3. **Receipt of Confirmation in Some Voting Systems:**
   - In some manual voting systems, particularly in smaller elections, voters may receive a receipt that confirms their vote was cast and recorded, though this is rare in large national elections due to the importance of anonymity.
   - While these receipts confirm the act of voting, they do not link to specific voting choices, preserving voter secrecy.

4. **Voter-Verified Paper Ballots:**
   - When using paper ballots, voters directly mark their choices, making the ballot a physical record of their vote. The voter can personally inspect the ballot before placing it in the ballot box to ensure that it accurately reflects their intended choices.
   - This simple form of verifiability ensures that the vote recorded is what the voter intended.

Mechanisms to Verify Votes:

1. **Public Counting of Votes:**
   - **Transparency of the Counting Process:** In many manual election systems, the counting of votes is conducted publicly. After the polls close, ballots are often counted in the presence of election officials, party representatives, and sometimes independent observers.
   - This **public counting** ensures that the tally is conducted transparently, allowing any interested party to observe and verify that the counting process is accurate and fair.
2. **Cross-Checks and Reconciliation Procedures:**
   - **Reconciliation of Voter and Ballot Counts:** After the election, a cross-check is done to ensure the number of ballots matches the number of voters who were marked on the registration list. Any discrepancy between the number of voters and ballots must be resolved before the count is finalized.
   - This prevents the introduction of extra ballots or the loss of valid votes and ensures that all cast votes are accounted for.
3. **Post-Election Audits:**
   - **Manual Audits:** In manual voting systems, post-election audits are conducted to verify the accuracy of the vote count. This often involves randomly selecting a sample of ballots to manually recount and compare against the official results.
   - **Risk-Limiting Audits (RLAs):** These audits use statistical methods to verify the accuracy of the election results by randomly selecting and checking a small number of ballots. If the sample matches the reported results, it confirms that the election was accurate. If discrepancies are found, a larger audit or full recount may be triggered.
4. **Chain of Custody of Ballots:**
   - The **chain of custody** ensures that ballots are handled securely from the time they are cast to when they are counted. Every step in the handling process is documented, including the transfer of ballot boxes and the storage of ballots, to prevent tampering or unauthorized access.
   - Observers and party representatives can monitor the chain of custody to verify that ballots are secure throughout the election process.
5. **Open Access for Independent Observers:**
   - **Election Monitoring:** Independent observers, including representatives from political parties, civil society, and international organizations, are often allowed to observe both the voting and counting process. Their role is to ensure transparency and to verify that procedures are followed correctly.
   - Observers also help verify that votes are counted accurately and that no irregularities occur during the election.
6. **Ballot Box Security:**
   - Ballot boxes are often designed to be transparent and are locked and sealed with tamper-evident seals after voting ends. This ensures that no ballots can be added or removed without detection.
   - When ballot boxes are opened for counting, the seals are inspected and verified in the presence of observers, ensuring that the ballots inside have not been tampered with.

7. **Access to Election Results Data:**
   ○ In some systems, detailed election results are published at the precinct or polling station level. This allows political parties, candidates, and interested citizens to compare the publicized results with the numbers they observed during the vote count, ensuring that the reported results are accurate.
   ○ **Public Posting of Results:** After the vote count at each polling station, the results are posted publicly at the polling place. This ensures that everyone, including voters and observers, can see the results for their specific polling station before they are sent to central election authorities.
8. **Ballot Recounts:**
   ○ In close or contested elections, candidates or parties can request a recount of the votes. Since manual voting systems use paper ballots, recounts are feasible and can be done by hand to ensure accuracy.
   ○ The ability to manually recount physical ballots is one of the most reliable ways to verify that the election results are correct.
9. **Election Result Certification:**
   ○ **Official Certification:** Before the final results are declared, election authorities conduct a certification process to verify the results. This often includes reviewing audit logs, reconciling ballot counts, and ensuring that all steps of the election process are followed.
   ○ Certification ensures that the results are reviewed by independent election officials, providing an additional layer of verification.

Tamper Resistance

The goal of tamper resistance in election systems is to safeguard the integrity of the election process by preventing unauthorized interference with ballots, ballot boxes, and other election materials. These safeguards ensure that votes are cast, stored, transported, and counted securely, without the risk of fraud or manipulation.

Measures to Prevent Tampering with Ballots, Ballot Boxes, or Election Materials:

1. **Tamper-Evident Ballot Boxes:**
   ○ **Secure Construction:** Ballot boxes are designed with tamper-proof features such as locks and seals. Once voting begins, ballot boxes are sealed, and any unauthorized opening or tampering with the box can be easily detected.
   ○ **Seals and Numbering:** Ballot boxes are typically sealed with tamper-evident seals, which have unique serial numbers. These seals are recorded and checked by election officials, ensuring that if the seal is broken or altered, it is immediately noticeable.
   ○ **Transparent Boxes:** In some cases, ballot boxes are made of transparent materials to allow observers to see the contents without opening the box, reducing the chance of tampering during the voting process.

2. **Ballot Design to Prevent Fraud:**
   ○ **Unique Features:** Official ballots are designed with unique markings such as watermarks, serial numbers, or security ink to prevent unauthorized duplication or alteration.
   ○ **Pre-Printed Ballots:** Only official ballots pre-printed and distributed by the election authorities are used during voting. This ensures that no counterfeit ballots can be introduced into the process.

3. **Strict Control Over Election Materials:**
   ○ **Limited Access to Ballots:** Before and during the election, access to blank ballots is restricted to authorized election officials. Extra ballots are kept under lock and key, and any spoiled ballots are recorded and securely disposed of.
   ○ **Monitoring of Election Supplies:** Election materials such as stamps, envelopes, and ink pads are closely monitored to prevent tampering or unauthorized use.

4. **Voter Verification and Registration:**
   ○ **Voter Identification:** Voters must verify their identity at the polling station by providing a government-issued ID or other forms of verification. This ensures that each ballot is issued to an eligible voter.
   ○ **Marking Voter Lists:** After receiving a ballot, voters are checked off the voter roll to prevent anyone from voting more than once. This record-keeping prevents fraudulent voting attempts and ensures accountability.

5. **Monitoring by Observers:**
   ○ **Independent Election Observers:** Representatives from political parties, independent organizations, and international monitors are often allowed to observe polling stations and the entire election process. Their presence helps deter any attempts at tampering with ballots or ballot boxes.
   ○ **Transparency in Election Operations:** Observers can witness the opening of sealed ballot boxes, the casting of votes, and the vote count to ensure transparency and discourage fraud.

6. **Public Posting of Results:**
   ○ **Local Poll Results:** After ballots are counted at each polling station, the results are posted publicly at the location. This allows the public, observers, and party representatives to verify the count and ensures transparency before the results are transported for central tabulation.

Securing Storage and Transport of Ballots:

1. **Sealing Ballot Boxes After Voting:**
   ○ **Sealed and Secure Boxes:** At the close of voting, ballot boxes are sealed securely using tamper-evident seals, which are verified and recorded by election officials and observers. This prevents any unauthorized access before the ballots are transported to counting centers.
   ○ **Witnessed Sealing:** Party representatives or independent observers are often present to witness and confirm that the ballot boxes are sealed properly, providing additional accountability.

2. **Chain of Custody Documentation:**
   ○ **Tracked Movement:** Every movement of the ballot boxes is documented, with officials recording the time and the individuals responsible for handling the boxes at each step. This chain of custody is maintained throughout the entire process, making any unauthorized handling of the boxes immediately identifiable.
   ○ **Signed Transfers:** Election officials sign off on ballot transfers to ensure accountability. Both the sender and the receiver are required to sign documents that detail the transfer, further reinforcing the integrity of the process.

3. **Secure Transport of Ballots:**
   ○ **Escorted Transportation:** After voting, ballot boxes are often transported to central counting centers under escort. This can include police or security personnel to ensure the ballots remain secure during transportation.
   ○ **Sealed Containers:** Ballot boxes or containers are placed in sealed, tamper-evident bags or containers, which are only opened at the counting center under strict supervision.
   ○ **Dedicated Transport Vehicles:** Ballots are transported in specially designated vehicles that may have security escorts or GPS tracking to monitor their movement.

4. **Secure Storage Facilities:**
   ○ **Locked and Guarded Storage:** If ballots need to be stored overnight or before counting begins, they are placed in secure, locked facilities that are monitored by election officials and sometimes by security personnel or police.
   ○ **Limited Access:** Only authorized individuals are permitted access to ballot storage areas. This prevents tampering and unauthorized entry into ballot storage facilities.
   ○ **Video Surveillance:** Many storage facilities use continuous video surveillance to monitor ballot boxes, ensuring that any unauthorized access attempts can be detected and investigated.

5. **Supervised Vote Counting:**
   - **Open Counting:** Ballots are counted in open, supervised environments, often with observers from political parties, independent organizations, and international bodies present. This transparency prevents tampering during the counting process.
   - **Reconciliation Procedures:** During the counting process, election officials cross-check the number of ballots with the number of voters who were recorded as having voted. This ensures no extra or missing ballots, making it difficult for tampering to go unnoticed.
6. **Audits and Recounts:**
   - **Post-Election Audits:** Random audits may be conducted after the election to ensure the integrity of the vote count. Auditors verify that the number of ballots matches the official voter turnout, and any irregularities are flagged for further investigation.
   - **Recounts:** In close elections, recounts may be ordered. Since the process is manual, recounts are feasible and serve as an additional check against tampering or counting errors. All ballots are securely stored until the final results are certified.

Transparency

Transparency is critical in election processes to build trust and ensure that the public has confidence in the results. A transparent election process means that every stage, from voting to counting and reporting, is open and observable by election officials, political parties, independent observers, and sometimes the general public. This openness helps to deter fraud, detect irregularities, and confirm that the process is fair and impartial.

Ensuring the Election Process is Open and Observable:

1. **Open Access to Polling Stations:**
   - **Public Polling:** Polling stations are accessible to voters, accredited observers, and political party representatives. This ensures that the entire process of casting votes is transparent and can be observed in real-time.
   - **Polling Station Observers:** Representatives from political parties and independent observer groups can observe the activities inside polling stations to ensure voters are properly identified, ballots are issued correctly, and the overall process adheres to electoral laws.
2. **Clear Voting Procedures:**
   - **Voter Education:** The procedures for voting should be well-communicated to the public, making it clear how to vote, where to vote, and how the results will be tallied. This promotes transparency and reduces confusion or misunderstandings about the process.
   - **Clear Guidelines for Election Officials:** Election officials are trained and guided by clear procedures that outline how ballots should be handled, how voters should be verified, and how any issues, such as spoiled ballots, should be resolved.

3. **Transparency in Vote Counting:**
   - **Public Counting Process:** After the close of voting, ballots are often counted transparently, either at the polling station or at a central location. Observers, party representatives, and sometimes members of the media or public are allowed to watch the counting process.
   - **Real-Time Vote Reporting:** In many cases, results from individual polling stations are publicly posted as soon as they are counted. This allows the public and interested parties to follow the tallying process and ensures that any discrepancies between reported and actual results can be immediately flagged.

4. **Sealed and Secure Ballot Boxes:**
   - **Sealing Ballot Boxes in Full View:** Once voting has finished, ballot boxes are sealed in front of election officials, observers, and party representatives. This ensures that everyone can see the process, and tampering with the ballots becomes highly unlikely.
   - **Chain of Custody Documentation:** Ballot boxes are tracked as they are transported from polling stations to counting centers. Every movement is documented and observed by accredited individuals, which adds another layer of transparency.

5. **Public Posting of Results:**
   - **Display of Polling Station Results:** At the end of the vote count at each polling station, the results are publicly posted at the polling location. This allows voters and observers to see the results immediately after counting, reducing the chance of tampering between counting and reporting.
   - **Access to Final Results:** Once all votes are counted, election authorities typically provide open access to the final certified results. In some cases, detailed results are broken down by region, polling station, or precinct, allowing for easy cross-verification with independently observed results.

6. **Voter List Verification:**
   - **Access to Voter Rolls:** In many electoral systems, voter rolls are publicly accessible before and after the election. This allows parties and observers to verify who is eligible to vote and to confirm that the number of votes cast matches the number of registered voters.
   - **Real-Time Marking of Voter Rolls:** In some systems, voter rolls are marked in real-time as individuals cast their votes, preventing double voting or impersonation.

Public Oversight and Independent Observers to Ensure Integrity:

1. **Accredited Election Observers:**
   - **Domestic Observers:** Accredited domestic observers from civil society groups, non-governmental organizations, and political parties can monitor the election process. Their role is to ensure that the election is conducted fairly and that any irregularities are reported.
   - **International Observers:** In some elections, international organizations such as the United Nations, the Organization for Security and Cooperation in Europe (OSCE), or the Carter Center may send teams of observers to ensure that the election meets global standards for fairness and transparency.
   - **Observer Guidelines:** Observers are typically provided with guidelines and are required to follow certain rules to avoid interfering with the election process while still ensuring they have full access to observe and report any potential issues.

2. **Independent Election Commissions:**
   - **Non-Partisan Election Commissions:** Independent election commissions, often established by law, oversee the administration of elections to ensure neutrality and integrity. These commissions are responsible for organizing elections, training officials, and certifying the final results.
   - **Oversight of Election Processes:** The election commission monitors the entire election process, from voter registration to vote counting. It ensures that electoral rules are followed and has the authority to address complaints or irregularities that may arise.

3. **Reporting Mechanisms for Irregularities:**
   - **Hotlines and Complaint Systems:** Many election systems have mechanisms in place for voters, observers, or officials to report suspicious activities, such as fraud or voter intimidation. These reports are often investigated by election commissions or law enforcement.
   - **Independent Election Tribunals:** If significant complaints arise, some countries have independent tribunals or courts specifically tasked with handling election-related disputes, ensuring that complaints are resolved transparently and impartially.

4. **Audits and Recounts:**
   - **Post-Election Audits:** To ensure the accuracy of the election results, audits are conducted by independent auditors or election authorities. These audits verify that the number of votes cast matches the results reported, ensuring that no tampering occurred during the count.
   - **Recounts in Disputed Elections:** In close or contested elections, recounts are often initiated. These recounts are typically conducted in the presence of observers to ensure accuracy and transparency.

5. **Media and Public Access:**
   - **Media Coverage:** Independent media coverage of elections, including reporting from polling stations and counting centers, provides an additional layer of transparency. Media reports help expose any irregularities and keep the public informed about the election process.
   - **Public Participation:** In some jurisdictions, members of the public are allowed to observe the counting of ballots or attend public hearings related to election disputes, further increasing transparency.
6. **Publishing Detailed Election Data:**
   - **Public Availability of Results:** After elections, detailed results from each polling station or precinct are often published online or in official government publications. This data can be reviewed and cross-verified by political parties, analysts, and the public.
   - **Post-Election Reports by Observers:** Independent observer groups often publish reports detailing their findings, including any irregularities they witnessed during the election process. These reports provide transparency and can lead to improvements in future elections.

Accountability

Accountability in election systems ensures that election officials and authorities are responsible for conducting free, fair, and transparent elections. Mechanisms to hold election officials accountable provide a safeguard against misconduct, negligence, or manipulation, ensuring that every step of the process is secure, reliable, and open to scrutiny.

Mechanisms to Hold Election Officials Accountable for Their Role in Securing the Process:

1. **Clear Legal Framework and Duties for Election Officials:**
   - **Defined Responsibilities:** Election laws or regulations clearly define the duties and responsibilities of election officials, from voter registration to vote counting and reporting. This ensures that each step of the process is conducted according to established rules and standards.
   - **Oath of Office:** In many countries, election officials are required to take an oath of office, pledging to act impartially and in accordance with the law. This serves as a formal commitment to uphold election integrity.
2. **Training and Certification of Election Officials:**
   - **Pre-Election Training:** Election officials are typically required to undergo training to ensure they understand their roles, legal obligations, and the procedures they must follow. This includes training on preventing voter fraud, handling ballots securely, and managing polling stations.
   - **Certification:** In some systems, officials must be certified before serving, ensuring they have the necessary qualifications and understanding of the election process. Failing to follow procedures can lead to suspension or removal from their position.
3. **Code of Conduct for Election Officials:**

- **Adherence to Ethical Standards:** Election officials are often bound by a code of conduct that requires them to act impartially, avoid conflicts of interest, and report any irregularities. This code serves as a guideline for maintaining the integrity of the election.
- **Penalties for Misconduct:** Failure to adhere to the code of conduct can result in penalties, including fines, suspension, dismissal, or criminal charges, depending on the severity of the misconduct.
4. **Observer and Public Oversight:**
   - **Independent Observers:** Independent observers, both domestic and international, monitor the actions of election officials throughout the election process, providing an external layer of accountability. They report any irregularities, mismanagement, or misconduct.
   - **Public Access and Transparency:** Public access to polling stations, counting centers, and election results ensure that the election process is open to scrutiny. This transparency holds election officials accountable for ensuring that procedures are followed correctly.
5. **Complaint and Dispute Resolution Mechanisms:**
   - **Voter and Candidate Complaints:** If voters, political parties, or candidates believe that election officials have acted improperly or violated procedures, they can file complaints with the election commission or an independent electoral tribunal.
   - **Election Tribunals or Courts:** Special election tribunals or courts are often established to handle disputes, investigate complaints, and, if necessary, overturn results or order recounts. Election officials found responsible for irregularities can be held accountable through legal channels.

Use of Logs, Audit Trails, and Official Reports:

1. **Election Logs and Record-Keeping:**
   - **Polling Station Logs:** Election officials are required to keep detailed logs throughout Election Day. These logs record key activities, such as when polling stations open and close, how many ballots were issued, and any incidents or irregularities that occur.
   - **Incident Reports:** If any unusual events take place, such as voter intimidation, equipment malfunctions, or challenges to voter eligibility, election officials must document these in official incident reports. These reports provide a record that can be reviewed by oversight bodies or during audits.
2. **Audit Trails:**
   - **Ballot Handling Records:** From the moment a ballot is issued to a voter, there is often a paper or digital trail documenting its movement. This includes logs of how ballots are distributed, stored, transported, and counted. These audit trails are critical for verifying that ballots were handled securely and that no tampering occurred.
   - **Chain of Custody Documentation:** For physical ballots, chain-of-custody logs are maintained to track the handling of ballots as they move from polling stations to central counting centers or storage facilities. This documentation ensures that ballots are not tampered with during transport or storage.

- ○ **Electronic Voting Systems (if used):** For systems that incorporate electronic elements (e.g., voter registration databases), audit trails track every interaction with the system, including login times, actions taken by officials, and any changes made to voter or election data.

3. **Post-Election Audits and Reviews:**
   - ○ **Mandatory Audits:** After the election, mandatory audits are conducted to verify that the election results match the ballots cast. Election officials are responsible for ensuring that all ballots are accounted for and that no discrepancies exist. These audits provide a detailed check on the integrity of the process.
   - ○ **Risk-Limiting Audits:** In some systems, a random sample of ballots is selected for review, and the results are compared to the official tally. If significant discrepancies are found, the sample size may be increased, or a full recount may be ordered.

4. **Certification of Results:**
   - ○ **Certification Process:** Before election results are finalized, they must be certified by the election commission or relevant authority. This process includes a review of the logs, audit trails, and any reports of irregularities. Election officials are responsible for providing accurate documentation during the certification process.
   - ○ **Public Reporting:** Election authorities typically publish reports summarizing the results and any issues that occurred during the election. These reports may include details about the number of ballots cast, invalid ballots, and any incidents or complaints raised during the election.

5. **Independent Audits and External Reviews:**
   - ○ **Third-Party Audits:** Some election systems allow for independent, third-party audits of the election process, conducted by external organizations or civil society groups. These audits hold election officials accountable for their actions and provide an impartial review of the election's integrity.
   - ○ **Election Commission Reports:** Election commissions often publish detailed post-election reports, which include assessments of how well election officials adhered to legal requirements, followed procedures, and addressed any irregularities. These reports provide transparency and accountability.
   - ○

6. **Penalties and Legal Consequences for Misconduct:**
   - ○ **Legal Accountability:** Election officials who violate procedures, engage in fraud, or fail to secure the election process can face legal consequences, including fines, criminal charges, and imprisonment. Laws governing elections typically include provisions for prosecuting individuals who attempt to manipulate or undermine the process.
   - ○ **Administrative Penalties:** In cases of negligence or mismanagement, election officials can face administrative penalties such as suspension, dismissal, or being barred from future election-related roles.

Challenges in Conventional Election Systems

Conventional election systems heavily rely on manual processes such as voter registration, voter identification, voter verification, ballot casting, and vote counting. Traditionally most of these processes are performed by people (officials). Because of that, it introduced unique challenges, which undermine the fairness, integrity, and efficiency of the electoral process if not addressed properly.

Fraud Prevention

Prevention of fraud is one of the hardest parts to address in conventional election systems. Although strict regulations and checks are put in place to prevent such manipulations, fraudulent activities do still occur due the human nature. Although there are security measures such as voter ID laws and security protocols to prevent issues like voter impersonation and ballot box stuffing, with good planning and by use of power, these protocols can get bypassed. Frauds like voter bribery and coercion are nearly impossible to address in traditional election systems.

Human Error

When performing tasks manually by people, there's a higher chance of human error which can affect the overall outcome. Although there are redundant mechanisms and oversight committees to prevent such errors, these methods require more human resources and assets, it's proven to be more costly and time-consuming. For example, in the case of incorrect counting of ballots, the usual procedure is to start counting from the beginning. This tends to be time-consuming and people get tired there's a chance for more human error to occur.

Resource Intensity

Conventional election systems tend to be resource-intensive, requiring significant financial and human resources for the successful implementation of the system. Key areas of resource intensity include:
1. **Staffing**: As many operations are performed manually, it requires a massive amount of human resources and training to support the structure of conventional election systems.
2. **Infrastructure**: Staring from buildings to use as polling stations, counting centers and vehicles are essential in conventional election systems.
3. **Stationary:** As conventional election systems rely on boxes are papers (to use as ballots and other documentation purposes), it adds to the cost of having an election.

Other than the above-mentioned resources, there are direct and indirect resources used in traditional election systems and all of them add up and increase the total cost.

Logistical and Administrative Challenges

When it comes to managing nationwide conventional elections, coordination tends to be a complex and tiring process. Some of the primary logistical and administrative issues include:

1. **Polling Station Setup and Accessibility**: The administration needs to ensure all the polling and counting stations are set up on time and are accessible for voters and relevant personnel.
2. **Voter Registration and Verification:** Maintaining updated and accurate voter lists is a challenging task in a conventional election system.

Voter Access and Participation

Conventional voting systems require voters to come to an established polling station in order to cast their votes. This can be problematic for certain voters like voters having certain disabilities. These are some issues faced by voters in the conventional election system:

1. **Long queues:** In most cases, long waiting times discourage voters from participating, especially in densely populated urban areas.
2. **Transportation Barriers**: In conventional elections, transportation can be a huge problem as public transportation isn't as effective as on other days. Voters in ruler areas may struggle to reach their polling center.

Delayed Results and Political Uncertainty

As traditional voting systems are prone to delays in counting and verification of results, there is a prolonged period of uncertainty. In highly competitive elections this can fuel suspicions of manipulation and create political instability. Slow manual counting processes and dispute resolution can be taken as examples of events which contribute to delays in results.

Comparative Discussion: Manual vs. Electronic Voting Systems

Overview of the Key Differences in Security Objectives

1. **Data Integrity and authenticity**
   - In conventional voting systems, physical ballots are used and in order to protect their integrity and authenticity, security measures like tamper-evident ballot boxes, secure storage, and documented chain of custody are used.
   - In electronic voting systems, integrity and the authenticity of the votes are ensured by the implementation of security mechanisms like cryptographic measures, secure communication protocols, and data redundancy tactics.

2. **Vote Verification**
   - Manual systems depend on in-person identity verification methods. In most cases, they use government-issued ID to perform the verification. In this case, the officials have the authority to decide whether the person is eligible for voting.
   - When it comes to electronic voting, it can use biometric data, MFA, and digital certificates. With digitalisation, these methods are susceptible to phishing attacks and hacking.

3. **Vote Privacy and Anonymity**
   - In conventional election systems, privacy is established by having covered voting booths and by separating the identity of the voter from their ballot.
   - Electronic voting uses cryptographic techniques to provide privacy and anonymity to the voter.

Areas Where Manual Systems Are More Secure

1. **Transparency and Auditability**
   - Manual systems have the advantage of having physical paper tails and it can be observed visually to verify each step.
   - When it comes to electronic voting systems, it is easy to perform audits and recounts if needed. But in some cases, if a technical difficulty arises, a person with specialised knowledge is required to backtrace the logs to find the issue.

2. **Resistance to Cyber Threats**
   - Traditional voting systems inherit cyber resilience by default. Therefore, threats like DDOS don't disrupt the voting process.
   - Electronic voting systems require robust cybersecurity measures against digital threats.

Areas Where Electronic Systems Are More Secure

1. **Error Reduction and Efficiency**
   - Electronic voting systems are more efficient than traditional voting systems because the effects of human errors are less. By automating processes, it can efficiently deliver the results.

2. **Scalability and Accessibility**
   - Electronic voting systems can be easily scaled up as the requirement. One of the major advantages is, that voters with disabilities and the ones living abroad (if eligible) can access the voting system.

Conclusion

Summary of the Security Objectives

The primary security objectives of both manual and electronic voting systems are to ensure:

1. **Integrity:** Every vote must be recorded, stored, and counted accurately
2. **Confidentiality**: Ensure voter privacy and unlikability
3. **Authenticity and Voter Eligibility:** Only eligible voters should be able to vote, and no one should be able to vote more than once.
4. **Availability of the Voting System:** The voting system must be available for voting in the declared time period and every voter must be able to access it with ease.
5. **Transparency and Verifiability:** The entire voting process must be transparent and auditable.

Meeting the above requirements is a crucial aspect of every election because any violation of the above requirement will result in losing trust in the voting process. Therefore, the implementation of robust security measures in both systems is a necessity. Implementing robust policies and procedures prevents manipulations, fraud, and coercion. It ensures the election results are true and it reflects the voters' will.