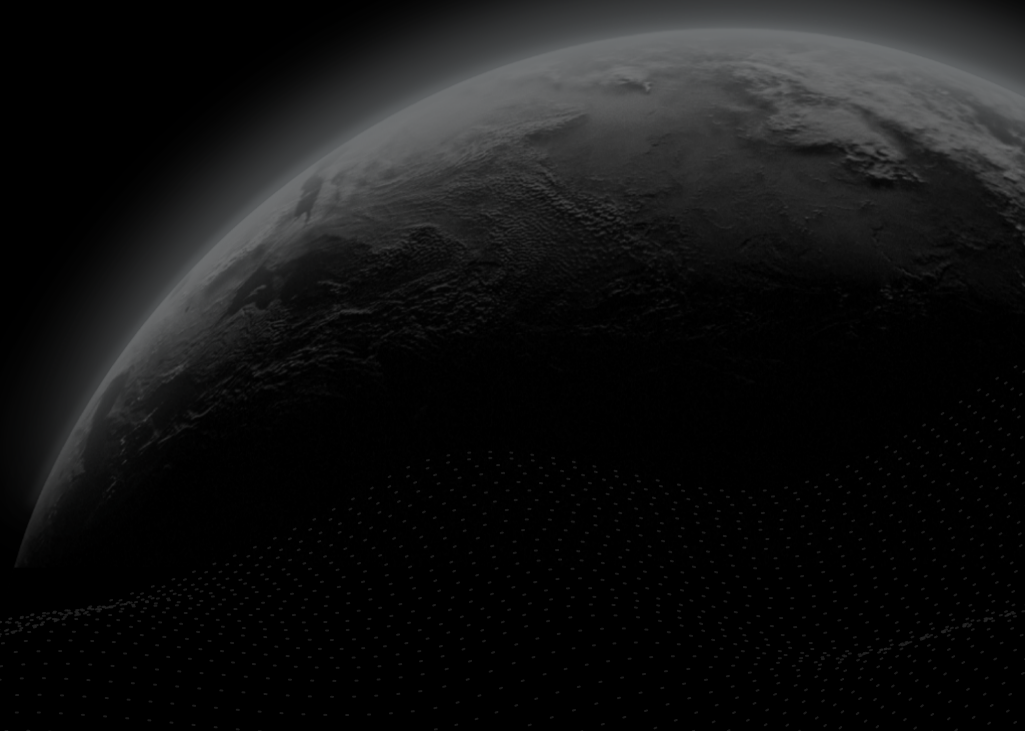
CERTIK

Security Assessment

Carrieverse - audit

CertiK Verified on Oct 28th, 2022



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The security assessment was prepared by CertiK, the leader in Web3.0 security.

Executive Summary

TYPES	ECOSYSTEM	METHODS
ERC-20	EVM Compatible	Manual Review, Static Analysis

LANGUAGE	TIMELINE	KEY COMPONENTS
Solidity	Delivered on 10/28/2022	N/A

CODEBASE

https://github.com/imantisco/CarrieVerseToken

...View All

COMMITS

166629c54fcb0987a5c00c57748c71aefb650aee

ca991c39ca1b255cec9f6a9a286f494bcf7f7717

...View All

Vulnerability Summary

6	4	0	0	2	0	0
Total Findings	Resolved	Mitigated	Partially Resolved	Acknowledged	Declined	Unresolved

0	Critical		Critical risks are those that impact the safe functioning of a platform and must be addressed before launch. Users should not invest in any project with outstanding critical risks.
2	Major	2 Acknowledged	Major risks can include centralization issues and logical errors. Under specific circumstances, these major risks can lead to loss of funds and/or control of the project.
0	Medium		Medium risks may not pose a direct risk to users' funds, but they can affect the overall functioning of a platform.
1	Minor	1 Resolved	Minor risks can be any of the above, but on a smaller scale. They generally do not compromise the overall integrity of the project, but they may be less efficient than other solutions.
3	Informational	3 Resolved	Informational errors are often recommendations to improve the style of the code or certain operations to fall within industry best practices. They usually do not affect the overall functioning of the code.

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CODEBASE | CARRIEVERSE - AUDIT

Repository

https://github.com/imantisco/CarrieVerseToken

Commit

166629c54fcb0987a5c00c57748c71aefb650aee

ca991c39ca1b255cec9f6a9a286f494bcf7f7717

AUDIT SCOPE | CARRIEVERSE - AUDIT

11 files audited ● 4 files with Acknowledged findings ● 7 files without findings

ID	File	SHA256 Checksum
OCV	contracts/access/Ownable.sol	96a3b09372173d7174fcb0080a97c0cd9abb51cd31e71ecd597d62e0942cb7c4
CVC	contracts/CarrieVerseToken.sol	cfa67d111944f3d36363d47ee7797637b2f669a36f880e1ae568f6330ab9decb
ETL	contracts/EmployeeTokenLock.sol	b311a631bb03636f36a12dbff27a77821ebbf6e616c6d8e99d8b26d605f844e6
TLC	contracts/TokenLock.sol	ca9540453634d1fce9ef120b6c9f2a44ba89b6726619c7dc9eb809a0db2debb0
IER	contracts/interfaces/IERC20.sol	96a25403069ea471908ea170788dda67c756a240d8e75d5d48351f6bc20e3d0d
IEM	contracts/token/ERC20/extensions/IERC20Metadata.sol	af5c8a77965cc82c33b7ff844deb9826166689e55dc037a7f2f790d057811990
SER	contracts/token/ERC20/utils/SafeERC20.sol	b5a1340c5232f387b15592574f27eef78f6017bdc66542a1cea512ad4f78a0d2
ERE	contracts/token/ERC20/ERC20.sol	94eae31eacf3fadc080674b151d99a86c74edcbcf84a4627c4ef88cc4aa3f4b3
IEC	contracts/token/ERC20/IERC20.sol	94f23e4af51a18c2269b355b8c7cf4db8003d075c9c541019eb8dcf4122864d5
ACV	contracts/utils/Address.sol	aafa8f3e41700a8353aabcdf020e06735753e6bc4b615279b43de53cfbb4f2cd
CCV	contracts/utils/Context.sol	1458c260d010a08e4c20a4a517882259a23a4baa0b5bd9add9fb6d6a1549814a

APPROACH & METHODS | CARRIEVERSE - AUDIT

This report has been prepared for Carrieverse to discover issues and vulnerabilities in the source code of the Carrieverse - audit project as well as any contract dependencies that were not part of an officially recognized library. A comprehensive examination has been performed, utilizing Manual Review and Static Analysis techniques.

The auditing process pays special attention to the following considerations:

- Testing the smart contracts against both common and uncommon attack vectors.
- Assessing the codebase to ensure compliance with current best practices and industry standards.
- Ensuring contract logic meets the specifications and intentions of the client.
- Cross referencing contract structure and implementation against similar smart contracts produced by industry leaders.
- Thorough line-by-line manual review of the entire codebase by industry experts.

The security assessment resulted in findings that ranged from critical to informational. We recommend addressing these findings to ensure a high level of security standards and industry practices. We suggest recommendations that could better serve the project from the security perspective:

- Testing the smart contracts against both common and uncommon attack vectors;
- Enhance general coding practices for better structures of source codes;
- Add enough unit tests to cover the possible use cases;
- Provide more comments per each function for readability, especially contracts that are verified in public;
- Provide more transparency on privileged activities once the protocol is live.

FINDINGS | CARRIEVERSE - AUDIT

6	0	2	0	1	3
Total Findings	Critical	Major	Medium	Minor	Informational

This report has been prepared to discover issues and vulnerabilities for Carrieverse - audit. Through this audit, we have uncovered 6 issues ranging from different severity levels. Utilizing the techniques of Manual Review & Static Analysis to complement rigorous manual code reviews, we discovered the following findings:

ID	Title	Category	Severity	Status
CVC-01	**Initial Token Distribution**	**Centralization / Privilege**	**Major**	**Acknowledged**
CVT-01	**Centralization Risks**	**Centralization / Privilege**	**Major**	**Acknowledged**
CVT-02	Check Effect Interaction Pattern Violated	Logical Issue	Minor	Resolved
CVT-04	Missing Zero Address Validation	Volatile Code	Informational	Resolved
CVT-05	Missing Error Messages	Coding Style	Informational	Resolved
CVT-06	Lack Of Input Validation	Volatile Code	Informational	Resolved

CVC-01 | INITIAL TOKEN DISTRIBUTION

Category	Severity	Location	Status
Centralization / Privilege	**Major**	**contracts/CarrieVerseToken.sol: 14**	**Acknowledged**

Description

```
13      constructor() ERC20("CarrieVerse Token", "CVTX") {
14          _mint(msg.sender, (10 ** 9) * (10 ** 18));
15      }
```

All of the CVTX tokens are sent to the contract deployer when deploying the contract. This could be a centralization risk as the deployer can distribute these tokens without obtaining the consensus of the community.

Recommendation

We recommend the team to be transparent regarding the initial token distribution process, and the team shall make enough efforts to restrict the access of the private key.

Alleviation

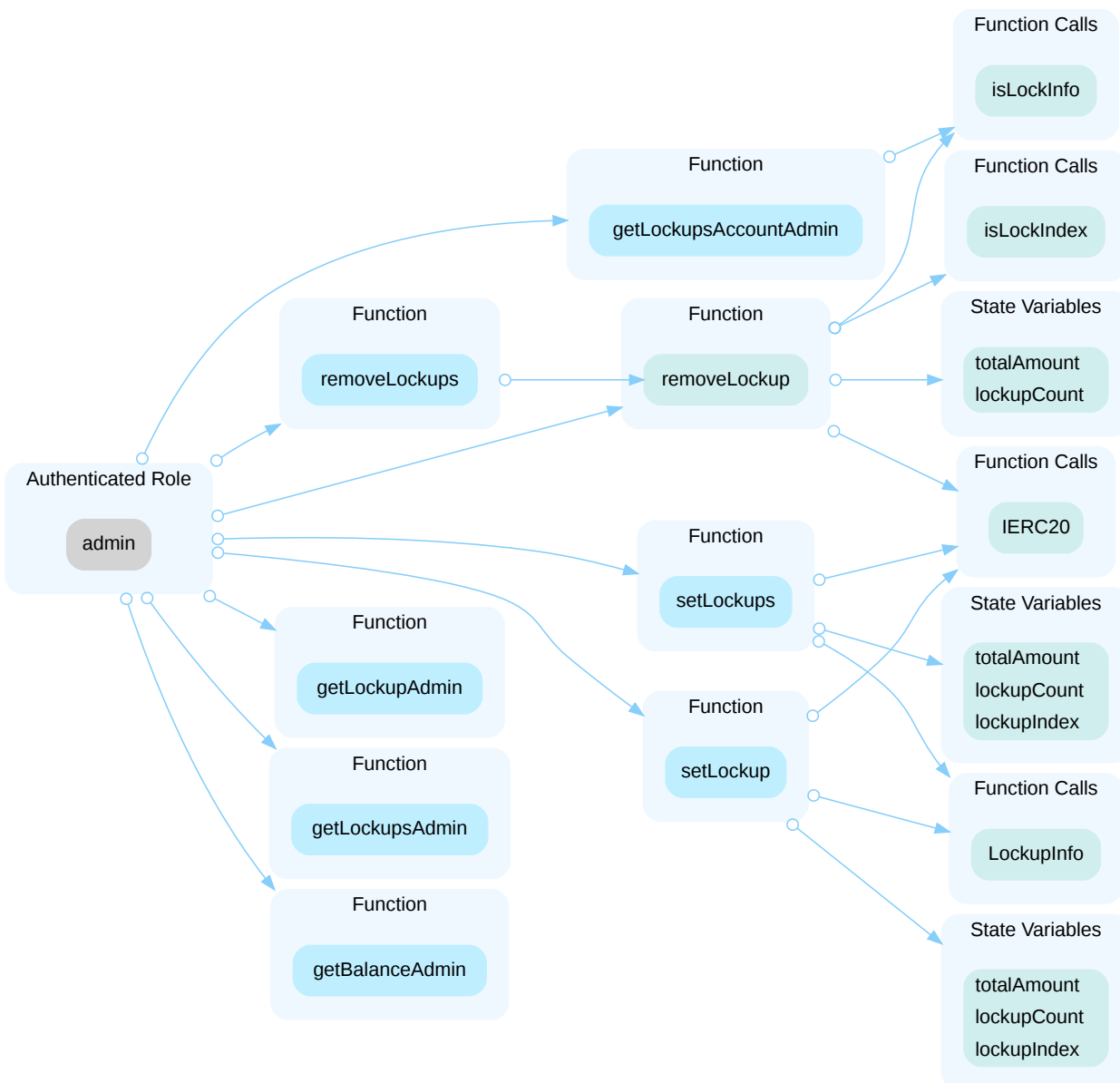
Carrieverse team: CVTX token is not being stored in early version of token contract. Tokens have been distribued to separate cold wallet according to token distribution plan. Team portion of CVTX is locked up and under vesting for long term success.

CVT-01 | CENTRALIZATION RISKS

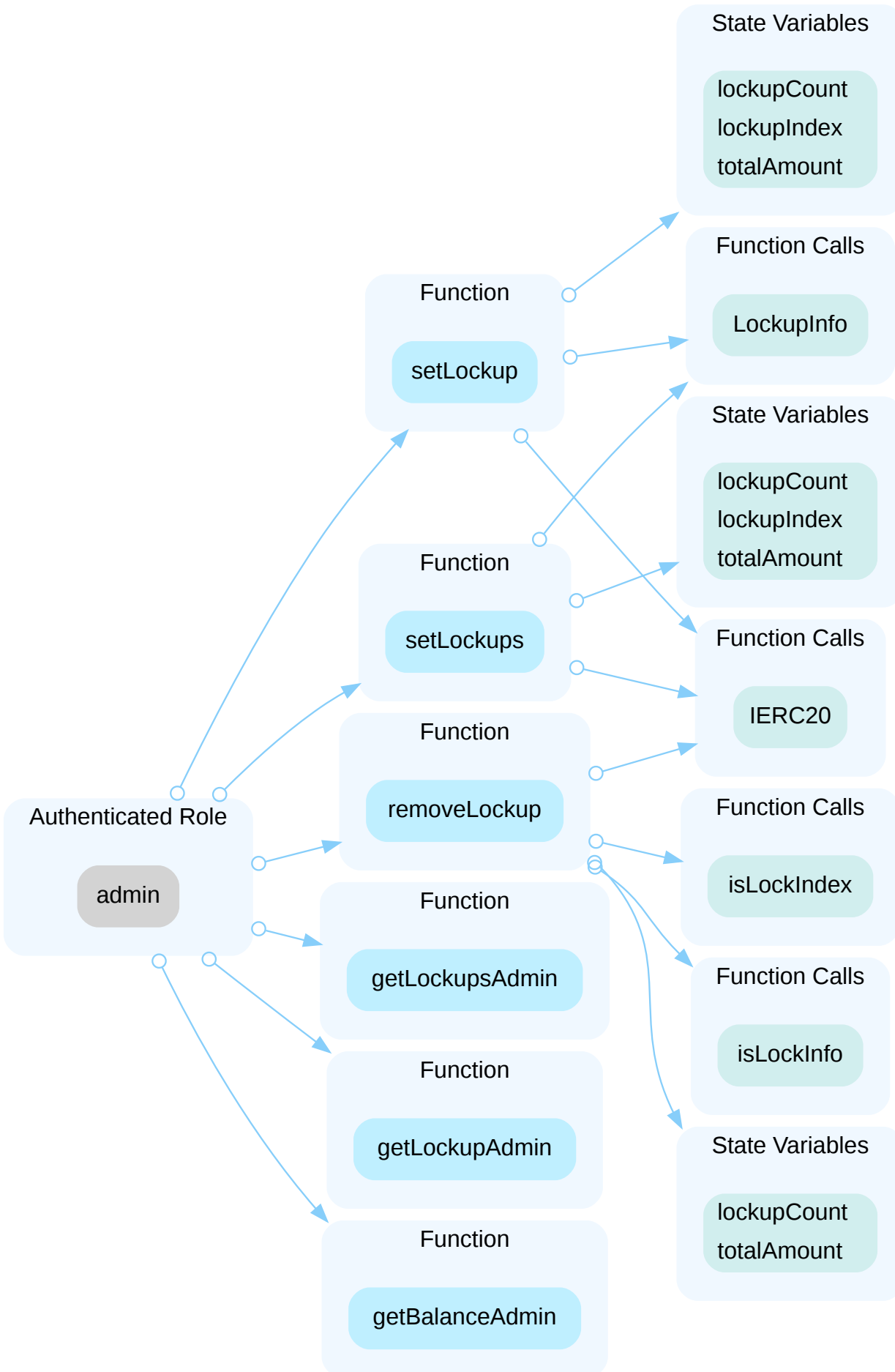
Category	Severity	Location	Status
Centralization / Privilege	Major	contracts/CarrieVerseToken.sol: 17; contracts/EmployeeTokenLock.sol: 67, 93, 119, 144, 167, 185, 201, 212; contracts/TokenLock.sol: 62, 86, 110, 149, 167, 177; contracts/access/Ownable.sol: 61, 69	Acknowledged

Description

In the contract `EmployeeTokenLock` the role `admin` has authority over the functions shown in the diagram below. Any compromise to the `admin` account may allow the hacker to take advantage of this authority and distribute tokens, sweep out locked tokens, or get all locked tokens' information.



In the contract `TokenLock` the role `admin` has authority over the functions shown in the diagram below. Any compromise to the `admin` account may allow the hacker to take advantage of this authority and distribute tokens, sweep out locked tokens, or get all `lockups` information.


State Variables
lockupCount
lockupIndex
totalAmount
Function Calls
LockupInfo
Function
setLockup
State Variables
lockupCount
lockupIndex
totalAmount
Function
setLockups
Function Calls
IERC20
Function
removeLockup
Function Calls
isLockIndex
Authenticated Role
admin
Function
getLockupsAdmin
Function Calls
isLockInfo
Function
getLockupAdmin
State Variables
lockupCount
totalAmount
Function
getBalanceAdmin

Recommendation

The risk describes the current project design and potentially makes iterations to improve in the security operation and level of decentralization, which in most cases cannot be resolved entirely at the present stage. We advise the client to carefully manage the privileged account's private key to avoid any potential risks of being hacked. In general, we strongly recommend centralized privileges or roles in the protocol be improved via a decentralized mechanism or smart-contract-based accounts with enhanced security practices, e.g., multisignature wallets. Indicatively, here are some feasible suggestions that would also mitigate the potential risk at a different level in terms of short-term, long-term and permanent:

Short Term:

Timelock and Multi sign (⅔, ⅗) combination *mitigate* by delaying the sensitive operation and avoiding a single point of key management failure.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Assignment of privileged roles to multi-signature wallets to prevent a single point of failure due to the private key compromised;
  AND
- A medium/blog link for sharing the timelock contract and multi-signers addresses information with the public audience.

Long Term:

Timelock and DAO, the combination, *mitigate* by applying decentralization and transparency.

- Time-lock with reasonable latency, e.g., 48 hours, for awareness on privileged operations;
  AND
- Introduction of a DAO/governance/voting module to increase transparency and user involvement.
  AND
- A medium/blog link for sharing the timelock contract, multi-signers addresses, and DAO information with the public audience.

Permanent:

Renouncing the ownership or removing the function can be considered *fully resolved*.

- Renounce the ownership and never claim back the privileged roles.
  OR
- Remove the risky functionality.

Alleviation

Carrieverse Team: Admin account verification and authentication are under corporate process for operation and maintenance according to team wallet management process.

CVT-02 | CHECK EFFECT INTERACTION PATTERN VIOLATED

Category	Severity	Location	Status
Logical Issue	Minor	contracts/EmployeeTokenLock.sol: 253, 291; contracts/TokenLock.sol: 218, 256	Resolved

Description

In the function `EmployeeTokenLock.withdraw()`, `lockupInfo[_lockupIndex]` is deleted after transferring the tokens, which violates the check-effect-interaction pattern. If the token has a hook, it can reenter the same function and drain token balance.

Functions `EmployeeTokenLock.withdraws()`, `TokenLock.withdraw()`, and `TokenLock.withdraws()` share the same issue.

```
249     function withdraw(uint256 _lockupIndex) public onlyLock(_lockupIndex)
returns(uint256 withdrawBalance){
250         uint256 balance = getBalance(_lockupIndex);
251
252         require(balance > 0, "EmployeeTokenLock: NOT_AMOUNT");
253         require(IERC20(token).transferFrom(address(this), msg.sender,
balance));
254
255         delete lockupInfo[_lockupIndex];
256
257         uint256 index = 0;
258         for( index; index < accountToLockupIndex[msg.sender].length; index++ ){
259             if( accountToLockupIndex[msg.sender][index] == _lockupIndex ){
260                 break;
261             }
262         }
263
264         if( accountToLockupIndex[msg.sender].length > 0 ){
265             accountToLockupIndex[msg.sender][index] =
accountToLockupIndex[msg.sender][accountToLockupIndex[msg.sender].length-1];
266             accountToLockupIndex[msg.sender].pop();
267         }
268
269         totalAmount -= balance;
270         lockupCount--;
271         withdrawBalance = balance;
272
273         emit withdrawEvent(msg.sender, _lockupIndex, balance);
274     }
```

Recommendation

We recommend using the Checks-Effects-Interactions Pattern to avoid the risk of unexpected errors and reentrancy.

Alleviation

The team heeded the advice and resolved the finding in the commit hash ca991c39ca1b255cec9f6a9a286f494bcf7f7717.

CVT-04 | MISSING ZERO ADDRESS VALIDATION

Category	Severity	Location	Status
Volatile Code	Informational	contracts/EmployeeTokenLock.sol: 49, 50; contracts/TokenLock.sol: 44, 45	Resolved

Description

The following addresses should be checked before assignment to make sure they are not zero addresses.

In contract `EmployeeTokenLock` :

```
49          admin = _admin;
50          token = _token;
```

In contract `TokenLock` :

```
44          admin = _admin;
45          token = _token;
```

Recommendation

We advise adding zero-checks for the passed-in address values to prevent unexpected errors.

Alleviation

The team heeded the advice and resolved the finding in the commit hash ca991c39ca1b255cec9f6a9a286f494bcf7f7717.

CVT-05 | MISSING ERROR MESSAGES

Category	Severity	Location	Status
Coding Style	Informational	contracts/EmployeeTokenLock.sol: 253, 291; contracts/TokenLock.sol: 218, 256	Resolved

Description

The **require** can be used to check for conditions and throw an exception if the condition is not met. It is better to provide a string message containing details about the error that will be passed back to the caller.

Recommendation

We advise adding error messages to the linked **require** statements.

Alleviation

The team heeded the advice and resolved the finding in the commit hash ca991c39ca1b255cec9f6a9a286f494bcf7f7717.

CVT-06 | LACK OF INPUT VALIDATION

Category	Severity	Location	Status
Volatile Code	Informational	contracts/EmployeeTokenLock.sol: 67; contracts/TokenLock.sol: 62	Resolved

Description

In contract `TokenLock`, the `setLockup()` function checks for address, amount and duration as following, but the `setLockups()` function does not contain these checks.

```
87        require( _account != address(0), "TokenLock: NOT_ADDRESS");
88        require( _amount > 0, "TokenLock: NOT_AMOUNT");
89        require( _duration > 0, "TokenLock: NOT_DURATION");
```

This also applies to contract `EmployeeTokenLock`.

Recommendation

We recommend including the checks in functions `EmployeeTokenLock.setLockups()` and `TokenLock.setLockups()`.

Alleviation

The team heeded the advice and resolved the finding in the commit hash ca991c39ca1b255cec9f6a9a286f494bcf7f7717.

OPTIMIZATIONS | CARRIEVERSE - AUDIT

ID	Title	Category	Severity	Status
CVT-03	Variables That Could Be Declared As Immutable	Gas Optimization	Optimization	Resolved

CVT-03 | VARIABLES THAT COULD BE DECLARED AS IMMUTABLE

Category	Severity	Location	Status
Gas Optimization	Optimization	contracts/EmployeeTokenLock.sol: 7, 8; contracts/TokenLock.sol: 7, 8	Resolved

Description

The linked variables assigned in the constructor can be declared as `immutable`. Immutable state variables can be assigned during contract creation but will remain constant throughout the lifetime of a deployed contract. A big advantage of immutable variables is that reading them is significantly cheaper than reading from regular state variables since they will not be stored in storage.

Recommendation

We recommend declaring these variables as immutable.

Alleviation

The team heeded the advice and resolved the finding in the commit hash ca991c39ca1b255cec9f6a9a286f494bcf7f7717.

FORMAL VERIFICATION | CARRIEVERSE - AUDIT

Formal guarantees about the behavior of smart contracts can be obtained by reasoning about properties relating to the entire contract (e.g. contract invariants) or to specific functions of the contract. Once such properties are proven to be valid, they guarantee that the contract behaves as specified by the property. As part of this audit, we applied automated formal verification (symbolic model checking) to prove that well-known functions in the smart contracts adhere to their expected behavior.

Considered Functions And Scope

Verification of ERC-20 compliance

We verified properties of the public interface of those token contracts that implement the ERC-20 interface. This covers

- Functions `transfer` and `transferFrom` that are widely used for token transfers,
- functions `approve` and `allowance` that enable the owner of an account to delegate a certain subset of her tokens to another account (i.e. to grant an allowance), and
- the functions `balanceOf` and `totalSupply`, which are verified to correctly reflect the internal state of the contract.

The properties that were considered within the scope of this audit are as follows:

Property Name	Title
erc20-transfer-revert-zero	Function `transfer` Prevents Transfers to the Zero Address
erc20-transfer-correct-amount	Function `transfer` Transfers the Correct Amount in Non-self Transfers
erc20-transfer-succeed-normal	Function `transfer` Succeeds on Admissible Non-self Transfers
erc20-transfer-succeed-self	Function `transfer` Succeeds on Admissible Self Transfers
erc20-transfer-correct-amount-self	Function `transfer` Transfers the Correct Amount in Self Transfers
erc20-transfer-exceed-balance	Function `transfer` Fails if Requested Amount Exceeds Available Balance
erc20-transfer-recipient-overflow	Function `transfer` Prevents Overflows in the Recipient's Balance
erc20-transfer-change-state	Function `transfer` Has No Unexpected State Changes
erc20-transfer-never-return-false	Function `transfer` Never Returns `false`
erc20-transfer-false	If Function `transfer` Returns `false`, the Contract State Has Not Been Changed

Property Name	Title
erc20-transferfrom-revert-from-zero	Function `transferFrom` Fails for Transfers From the Zero Address
erc20-transferfrom-revert-to-zero	Function `transferFrom` Fails for Transfers To the Zero Address
erc20-transferfrom-correct-amount	Function `transferFrom` Transfers the Correct Amount in Non-self Transfers
erc20-transferfrom-correct-amount-self	Function `transferFrom` Performs Self Transfers Correctly
erc20-transferfrom-succeed-normal	Function `transferFrom` Succeeds on Admissible Non-self Transfers
erc20-transferfrom-succeed-self	Function `transferFrom` Succeeds on Admissible Self Transfers
erc20-transferfrom-fail-exceed-balance	Function `transferFrom` Fails if the Requested Amount Exceeds the Available Balance
erc20-transferfrom-correct-allowance	Function `transferFrom` Updated the Allowance Correctly
erc20-transferfrom-change-state	Function `transferFrom` Has No Unexpected State Changes
erc20-transferfrom-fail-exceed-allowance	Function `transferFrom` Fails if the Requested Amount Exceeds the Available Allowance
erc20-transferfrom-false	If Function `transferFrom` Returns `false`, the Contract's State Has Not Been Changed
erc20-totalsupply-succeed-always	Function `totalSupply` Always Succeeds
erc20-totalsupply-correct-value	Function `totalSupply` Returns the Value of the Corresponding State Variable
erc20-transferfrom-never-return-false	Function `transferFrom` Never Returns `false`
erc20-transferfrom-fail-recipient-overflow	Function `transferFrom` Prevents Overflows in the Recipient's Balance
erc20-totalsupply-change-state	Function `totalSupply` Does Not Change the Contract's State
erc20-balanceof-succeed-always	Function `balanceOf` Always Succeeds
erc20-balanceof-correct-value	Function `balanceOf` Returns the Correct Value
erc20-balanceof-change-state	Function `balanceOf` Does Not Change the Contract's State
erc20-allowance-succeed-always	Function `allowance` Always Succeeds
erc20-allowance-correct-value	Function `allowance` Returns Correct Value

Property Name	Title
erc20-allowance-change-state	Function `allowance` Does Not Change the Contract's State
erc20-approve-revert-zero	Function `approve` Prevents Giving Approvals For the Zero Address
erc20-approve-correct-amount	Function `approve` Updates the Approval Mapping Correctly
erc20-approve-succeed-normal	Function `approve` Succeeds for Admissible Inputs
erc20-approve-change-state	Function `approve` Has No Unexpected State Changes
erc20-approve-false	If Function `approve` Returns `false`, the Contract's State Has Not Been Changed
erc20-approve-never-return-false	Function `approve` Never Returns `false`

Verification Results

For the following contracts, model checking established that each of the 38 properties that were in scope of this audit (see scope) are valid:

Contract CarrieVerseToken (Source File contracts/CarrieVerseToken.sol)

Detailed results for function `transfer`

Property Name	Final Result	Remarks
erc20-transfer-revert-zero	True	
erc20-transfer-correct-amount	True	
erc20-transfer-succeed-normal	True	
erc20-transfer-succeed-self	True	
erc20-transfer-correct-amount-self	True	
erc20-transfer-exceed-balance	True	
erc20-transfer-recipient-overflow	True	
erc20-transfer-change-state	True	
erc20-transfer-never-return-false	True	
erc20-transfer-false	True	

Detailed results for function `transferFrom`

Property Name	Final Result	Remarks
erc20-transferfrom-revert-from-zero	True	
erc20-transferfrom-revert-to-zero	True	
erc20-transferfrom-correct-amount	True	
erc20-transferfrom-correct-amount-self	True	
erc20-transferfrom-succeed-normal	True	
erc20-transferfrom-succeed-self	True	
erc20-transferfrom-fail-exceed-balance	True	
erc20-transferfrom-correct-allowance	True	
erc20-transferfrom-change-state	True	
erc20-transferfrom-fail-exceed-allowance	True	
erc20-transferfrom-false	True	
erc20-transferfrom-never-return-false	True	
erc20-transferfrom-fail-recipient-overflow	True	

Detailed results for function `totalSupply`

Property Name	Final Result	Remarks
erc20-totalsupply-succeed-always	True	
erc20-totalsupply-correct-value	True	
erc20-totalsupply-change-state	True	

Detailed results for function `balanceOf`

Property Name	Final Result	Remarks
erc20-balanceof-succeed-always	True	
erc20-balanceof-correct-value	True	
erc20-balanceof-change-state	True	

Detailed results for function `allowance`

Property Name	Final Result	Remarks
erc20-allowance-succeed-always	True	
erc20-allowance-correct-value	True	
erc20-allowance-change-state	True	

Detailed results for function `approve`

Property Name	Final Result	Remarks
erc20-approve-revert-zero	True	
erc20-approve-correct-amount	True	
erc20-approve-succeed-normal	True	
erc20-approve-change-state	True	
erc20-approve-false	True	
erc20-approve-never-return-false	True	

Contract ERC20 (Source File contracts/token/ERC20/ERC20.sol)

Detailed results for function `transfer`

Property Name	Final Result	Remarks
erc20-transfer-revert-zero	True	
erc20-transfer-succeed-normal	True	
erc20-transfer-succeed-self	True	
erc20-transfer-correct-amount	True	
erc20-transfer-correct-amount-self	True	
erc20-transfer-change-state	True	
erc20-transfer-exceed-balance	True	
erc20-transfer-recipient-overflow	True	
erc20-transfer-false	True	
erc20-transfer-never-return-false	True	

Detailed results for function `transferFrom`

Property Name	Final Result	Remarks
erc20-transferfrom-revert-from-zero	True	
erc20-transferfrom-revert-to-zero	True	
erc20-transferfrom-correct-amount	True	
erc20-transferfrom-correct-amount-self	True	
erc20-transferfrom-succeed-normal	True	
erc20-transferfrom-succeed-self	True	
erc20-transferfrom-fail-exceed-balance	True	
erc20-transferfrom-correct-allowance	True	
erc20-transferfrom-change-state	True	
erc20-transferfrom-fail-exceed-allowance	True	
erc20-transferfrom-false	True	
erc20-transferfrom-fail-recipient-overflow	True	
erc20-transferfrom-never-return-false	True	

Detailed results for function `totalSupply`

Property Name	Final Result	Remarks
erc20-totalsupply-succeed-always	True	
erc20-totalsupply-correct-value	True	
erc20-totalsupply-change-state	True	

Detailed results for function `balanceOf`

Property Name	Final Result	Remarks
erc20-balanceof-succeed-always	True	
erc20-balanceof-correct-value	True	
erc20-balanceof-change-state	True	

Detailed results for function `allowance`

Property Name	Final Result	Remarks
erc20-allowance-succeed-always	True	
erc20-allowance-change-state	True	
erc20-allowance-correct-value	True	

Detailed results for function `approve`

Property Name	Final Result	Remarks
erc20-approve-revert-zero	True	
erc20-approve-succeed-normal	True	
erc20-approve-correct-amount	True	
erc20-approve-change-state	True	
erc20-approve-false	True	
erc20-approve-never-return-false	True	

APPENDIX | CARRIEVERSE - AUDIT

Finding Categories

Categories	Description
Centralization / Privilege	Centralization / Privilege findings refer to either feature logic or implementation of components that act against the nature of decentralization, such as explicit ownership or specialized access roles in combination with a mechanism to relocate funds.
Gas Optimization	Gas Optimization findings do not affect the functionality of the code but generate different, more optimal EVM opcodes resulting in a reduction on the total gas cost of a transaction.
Logical Issue	Logical Issue findings detail a fault in the logic of the linked code, such as an incorrect notion on how block.timestamp works.
Volatile Code	Volatile Code findings refer to segments of code that behave unexpectedly on certain edge cases that may result in a vulnerability.
Coding Style	Coding Style findings usually do not affect the generated byte-code but rather comment on how to make the codebase more legible and, as a result, easily maintainable.

Checksum Calculation Method

The "Checksum" field in the "Audit Scope" section is calculated as the SHA-256 (Secure Hash Algorithm 2 with digest size of 256 bits) digest of the content of each file hosted in the listed source repository under the specified commit.

The result is hexadecimal encoded and is the same as the output of the Linux "sha256sum" command against the target file.

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