Project Description Report

1. BLOCKCHAIN_ACCESS_TYPE

- **Description**: Stores types of blockchain access (e.g., public, private) and their descriptions.
- **Attributes**:
  - TYPE (VARCHAR(200), PK, NOT NULL): Unique identifier for the access type.
  - DESCRIPTION (TEXT, NOT NULL): Explanation of the access type.
- **Normalization**: In 3NF. No partial or transitive dependencies; TYPE uniquely determines DESCRIPTION.
- **Reason for Process Failure**: None. Simple lookup table with no redundancy.
- **Cardinality**:
  - **1:N with CRYPTO (BLOCKCHAIN_ACCESS_TYPE)**: One access type can be associated with multiple cryptocurrencies, ensuring standardized categorization.
- **Real-Time Usage**: Used to classify cryptocurrencies by access type for regulatory compliance and investor analysis in the crypto market.

2. BLOCKCHAIN_TOKEN_TYPE

- **Description**: Defines types of blockchain tokens (e.g., utility, security) with their descriptions.
- **Attributes**:
  - TYPE (VARCHAR(200), PK, NOT NULL): Unique token type identifier.
  - DESCRIPTION (TEXT, NOT NULL): Details about the token type.
- **Normalization**: In 3NF. No dependencies other than TYPE → DESCRIPTION.
- **Reason for Process Failure**: None. Clean structure with no redundancy.
- **Cardinality**:
  - **1:N with CRYPTO (BLOCKCHAIN_TOKEN_TYPE)**: One token type applies to multiple cryptocurrencies, ensuring consistent token classification.
- **Real-Time Usage**: Helps in token classification for tax purposes, risk assessment, and market trend analysis.

3. CONSENSUS_ALGORITHM_TYPE

- **Description**: Stores types of consensus algorithms (e.g., Proof of Work, Proof of Stake) with descriptions.
- **Attributes**:
  - TYPE (VARCHAR(200), PK, NOT NULL): Unique algorithm type identifier.
  - DESCRIPTION (TEXT, NOT NULL): Explanation of the algorithm.
- **Normalization**: In 3NF. No redundancy or dependencies.
- **Reason for Process Failure**: None. Simple and normalized.
- **Cardinality**:
  - **1:N with CRYPTO (CONSENSUS_ALGORITHM_TYPE)**: One algorithm type applies to multiple cryptocurrencies.
  - **1:N with HASH_ALGO_NAME (CONSENSUS_ALGORITHM_TYPE)**: One algorithm type can be linked to multiple hash algorithms.
- **Real-Time Usage**: Used to evaluate the security, scalability, and energy efficiency of cryptocurrencies based on their consensus mechanisms.

4. BLOCKCHAIN_NETWORK_TYPE

- **Description**: Categorizes blockchain network types (e.g., mainnet, testnet) with examples and features.
- **Attributes**:
  - TYPE (VARCHAR(200), PK, NOT NULL): Unique network type identifier.
  - DESCRIPTION (TEXT, NOT NULL): Network type explanation.
  - EXAMPLES (TEXT, NOT NULL): Example networks.
  - KEY_FEATURES (TEXT, NOT NULL): Distinct features of the network type.
- **Normalization**: In 3NF. All attributes depend on TYPE.
- **Reason for Process Failure**: None. Well-structured.
- **Cardinality**:
  - **1:N with CRYPTO (BLOCKCHAIN_NETWORK_TYPE)**: One network type applies to multiple cryptocurrencies.
- **Real-Time Usage**: Assists in comparing network scalability and decentralization for investment and development decisions.

5. HASH_ALGO_NAME

- **Description**: Details hash algorithms used in consensus mechanisms, including hardware and efficiency metrics.
- **Attributes**:
    - NAME (VARCHAR(200), PK, NOT NULL): Hash algorithm name (e.g., SHA-256).
    - CONSENSUS_ALGORITHM_TYPE (VARCHAR(200), PK, NOT NULL): Associated consensus algorithm.
    - DESCRIPTION (VARCHAR(MAX), NOT NULL): Algorithm details.
    - HARDWARE_TYPE (VARCHAR(200), NOT NULL): Hardware used (e.g., ASIC, GPU).
    - PROS (VARCHAR(MAX), NOT NULL): Advantages of the algorithm.
    - CONS (VARCHAR(MAX), NOT NULL): Disadvantages of the algorithm.
    - ENERGY_EFFICIENCY (VARCHAR(10), NOT NULL, CHECK): Efficiency level (HIGH, LOW, MODERATE).
- **Normalization**: In 3NF. Composite PK (NAME, CONSENSUS_ALGORITHM_TYPE) ensures no redundancy.
- **Reason for Process Failure**: Composite PK may complicate queries if not properly indexed, potentially slowing down joins.
- **Cardinality**:
    - **N:1 with CONSENSUS_ALGORITHM_TYPE**: Multiple hash algorithms can be associated with one consensus type.
    - **1:N with CRYPTO (HASH_ALGO_NAME, HASH_ALGO_CONSENSUS_TYPE)**: One hash algorithm can be used by multiple cryptocurrencies.
- **Real-Time Usage**: Evaluates mining efficiency, hardware requirements, and environmental impact for crypto mining operations.

6. CRYPTO

- **Description**: Core table storing cryptocurrency details, including price, supply, and technical attributes.
- **Attributes**:
    - NAME (VARCHAR(200), NOT NULL): Cryptocurrency name.
    - SYMBOL (VARCHAR(10), PK, NOT NULL): Unique ticker (e.g., BTC).
    - MAX_PRICE, MIN_PRICE (DECIMAL(38,15), NOT NULL): Historical price extremes.
    - MAX_PRICE_DATE, MIN_PRICE_DATE (DATE): Dates of price extremes.
    - TOTAL_SUPPLY, CIRCULATING_SUPPLY (DECIMAL(38,15), NOT NULL): Supply metrics.
    - BLOCKCHAIN_ACCESS_TYPE, CONSENSUS_ALGORITHM_TYPE, BLOCKCHAIN_NETWORK_TYPE, BLOCKCHAIN_TOKEN_TYPE (VARCHAR(200), NOT NULL): References to respective types.
    - HASH_ALGO_NAME, HASH_ALGO_CONSENSUS_TYPE (VARCHAR(200)): Composite FK to hash algorithm.
    - FOUNDER (VARCHAR(200), NOT NULL): Founder name.
    - INITIAL_RELEASE_YEAR (INT, NOT NULL): Launch year.
    - OFFICIAL_WEBSITE (VARCHAR(100), NOT NULL): Official website.
    - DESCRIPTION_FOR_MAJOR_CHANGES (VARCHAR(MAX), NOT NULL): Details of major updates (e.g., forks).
- **Normalization**: In 3NF. All attributes depend on SYMBOL. FKs ensure referential integrity.
- **Reason for Process Failure**: Composite FK (HASH_ALGO_NAME, HASH_ALGO_CONSENSUS_TYPE) may cause query complexity and performance issues.
- **Cardinality**:
    - **1:N with multiple tables (e.g., CRYPTO_CURRENCY_PERFORMANCE_METRICS, MARKET_DOMINANCE)**: One cryptocurrency has multiple performance or dominance records.
    - **N:1 with lookup tables (e.g., BLOCKCHAIN_ACCESS_TYPE)**: Multiple cryptocurrencies share one access type.
- **Real-Time Usage**: Central table for price tracking, technical analysis, and regulatory reporting in the crypto market.

7. CRYPTO_CURRENCY_PERFORMANCE_METRICS

- **Description**: Stores performance metrics for cryptocurrencies, such as transaction speed and energy costs.
- **Attributes**:
  - SYMBOL (VARCHAR(10), PK): References CRYPTO.
  - TRANSACTION_PER_SECOND, AVERAGE_TRX_FEE, ELECTRICITY_COST_PER_BLOCK (DECIMAL(38,15)): Performance and cost metrics.
  - HEAT_IMMERSION_PER_TX (DECIMAL(38,2)): Energy per transaction in Joules.
  - HASH_RATE_PER_UNIT (VARCHAR(50)): Hash rate metric.
  - TOTAL_USERS (DECIMAL(38,0)): Total user count.
- **Normalization**: In 3NF. All attributes depend on SYMBOL.
- **Reason for Process Failure**: Missing constraints for non-negative values (e.g., TRANSACTION_PER_SECOND) may lead to invalid data.
- **Cardinality**:
  - **1:1 with CRYPTO**: One performance record per cryptocurrency.
- **Real-Time Usage**: Analyzes transaction efficiency, cost, and environmental impact for investment and scalability decisions.

8. TOTAL_USER_DISTRIBUTION

- **Description**: Tracks global cryptocurrency user distribution by region and market cap annually.
- **Attributes**:
  - YEAR (INT, PK): Year of data.
  - ASIA_USER, NORTH_AMERICA_USER, AMERICA_USER, AFRICA_USER, EUROPE_USER, OCEANIA_USER (DECIMAL(38,15)): Regional user counts.
  - TOTAL_USER_IN_WORD (DECIMAL(38,15)): Global user count.
  - TOTAL_MARKET_CAP (DECIMAL(38,15)): Total market capitalization.
- **Normalization**: In 2NF. Partial dependency on YEAR for regional users. AMERICA_USER (sum of North and South America) introduces redundancy.
- **Reason for Process Failure**: Redundant AMERICA_USER causes inconsistency; should be computed dynamically to achieve 3NF.
- **Cardinality**:
  - **1:N with MARKET_DOMINANCE, TOP_BROKERAGE**: One year has multiple dominance or brokerage records.
- **Real-Time Usage**: Monitors global adoption trends and market growth for strategic planning and market expansion.

9. MARKET_DOMINANCE

- **Description**: Tracks annual market dominance of cryptocurrencies.
- **Attributes**:
  - YEAR (INT, PK): Year of data.
  - SYMBOL (VARCHAR(10), PK): Cryptocurrency ticker.
  - MAX_PRICE, MIN_PRICE (DECIMAL(38,15/30)): Price extremes.
  - MAX_PRICE_DATE, MIN_PRICE_DATE (DATE): Dates of price extremes.
  - TOTAL_MARKET_CAP_OF_THIS_CURRENCY (DECIMAL(38,10)): Market cap of the currency.
  - DOMINANCE (FLOAT, CHECK <= 100): Market share percentage.
  - TOTAL_TRANSACTION, TOTAL_USER, TOTAL_WALLET_COUNT (DECIMAL(38,10)): Transaction, user, and wallet metrics in millions.
- **Normalization**: In 3NF. Composite PK (SYMBOL, YEAR) ensures no redundancy.
- **Reason for Process Failure**: Inconsistent precision in MIN_PRICE (DECIMAL(38,30)) compared to MAX_PRICE (DECIMAL(38,15)) may cause data issues.
- **Cardinality**:
  - **N:1 with CRYPTO**: Multiple dominance records per cryptocurrency.
  - **N:1 with TOTAL_USER_DISTRIBUTION**: Multiple dominance records per year.
- **Real-Time Usage**: Analyzes market share and volatility for portfolio management and competitive analysis.

10. COUNTRY

- **Description**: Stores country data, including crypto regulatory status and socioeconomic metrics.
- **Attributes**:
  - COUNTRY_CODE (VARCHAR(50), PK): ISO country code.
  - COUNTRY_NAME (VARCHAR(200)): Country name.
  - CRYPTO_STATUS (VARCHAR(20), CHECK): Status (ACCEPTED, RESTRICTED, BANNED).
  - EDUCATION_PERCENTAGE, UNEMPLOYMENT_RATE (FLOAT): Socioeconomic indicators.
  - GDP (DECIMAL(38,10)): GDP in billions.
- **Normalization**: In 3NF. All attributes depend on COUNTRY_CODE.
- **Reason for Process Failure**: None. Well-structured.
- **Cardinality**:
  - **1:N with ACCEPTED_COUNTRY, BANNED_COUNTRY, USER_AMOUNT_IN_BANNED_COUNTRY**: One country has multiple related records.
- **Real-Time Usage**: Assesses regulatory environments and socioeconomic factors for market entry strategies.

11. ACCEPTED_COUNTRY

- **Description**: Details countries where crypto is accepted, including restrictions and infrastructure.
- **Attributes**:
    - COUNTRY_CODE (VARCHAR(50), PK): References COUNTRY.
    - RESTRICTIONS (VARCHAR(200)): Regulatory restrictions.
    - CRYPTO_ATMS (INT, NOT NULL): Number of crypto ATMs.
    - ACCEPTED_YEAR (INT): Year crypto was accepted.
- **Normalization**: In 3NF. All attributes depend on COUNTRY_CODE.
- **Reason for Process Failure**: None.
- **Cardinality**:
    - **1:1 with COUNTRY**: One acceptance record per country.
- **Real-Time Usage**: Tracks crypto adoption and infrastructure for market expansion and investment planning.

12. BANNED_COUNTRY

- **Description**: Details countries where crypto is banned, including restrictions.
- **Attributes**:
    - COUNTRY_CODE (VARCHAR(50), PK): References COUNTRY.
    - RESTRICTIONS (VARCHAR(200)): Ban details.
    - CRYPTO_ATMS (INT, NOT NULL): Number of ATMs (likely 0).
    - BANNED_YEAR (INT): Year of ban.
- **Normalization**: In 3NF. All attributes depend on COUNTRY_CODE.
- **Reason for Process Failure**: None.
- **Cardinality**:
    - **1:1 with COUNTRY**: One ban record per country.
- **Real-Time Usage**: Identifies regulatory risks for crypto businesses and compliance strategies.

13. USER_AMOUNT_IN_BANNED_COUNTRY

- **Description**: Tracks user counts in banned countries annually.
- **Attributes**:
  - YEAR (INT, PK): Year of data.
  - COUNTRY_CODE (VARCHAR(50), PK): References COUNTRY.
  - USER_AMOUNT (DECIMAL(38,20)): User count in millions.
- **Normalization**: In 3NF. Composite PK (YEAR, COUNTRY_CODE) ensures no redundancy.
- **Reason for Process Failure**: None.
- **Cardinality**:
  - **N:1 with COUNTRY**: Multiple user records per country over different years.
- **Real-Time Usage**: Monitors illicit crypto usage in restricted regions for regulatory enforcement.

14. ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO

- **Description**: Tracks the most-used cryptocurrencies in accepted countries annually.
- **Attributes**:
  - YEAR (INT, PK): Year of data.
  - COUNTRY_CODE (VARCHAR(50), PK): References COUNTRY.
  - CRYPTO_SYMBOL (VARCHAR(10), PK): References CRYPTO.
  - USER_PERCENTAGE (DECIMAL(10,5), CHECK <= 100): Percentage of users.
- **Normalization**: In 3NF. Composite PK ensures uniqueness.
- **Reason for Process Failure**: None.
- **Cardinality**:
  - **N:1 with COUNTRY, CRYPTO**: Multiple records per country and cryptocurrency.
- **Real-Time Usage**: Identifies popular cryptocurrencies by region for targeted marketing and adoption strategies.

15. BLOCK_REWARD_EMISSION_TYPE

- **Description**: Defines types of block reward emission (e.g., halving, tail emission).
- **Attributes**:
  - TYPE (VARCHAR(50), PK): Emission type.
- **Normalization**: In 3NF. Single attribute table.
- **Reason for Process Failure**: None.
- **Cardinality**:
  - **1:N with REWARD_DETAILS**: One emission type applies to multiple cryptocurrencies.
- **Real-Time Usage**: Classifies emission models for supply and price impact analysis.

16. REWARD_DETAILS

- **Description**: Stores block reward details for cryptocurrencies.
- **Attributes**:
  - SYMBOL (VARCHAR(10), PK): References CRYPTO.
  - EMISSION_TYPE (VARCHAR(50)): References BLOCK_REWARD_EMISSION_TYPE.
  - EMISSION_TIME (DECIMAL(38,0)): Emission duration.
  - STARTING_TIME_BLOCK_REWARD, CURRENT_BLOCK_REWARD (DECIMAL(38,5)): Reward amounts.
  - BLOCK_REWARD_TIME (DECIMAL(38,30)): Time per reward.
- **Normalization**: In 3NF. All attributes depend on SYMBOL.
- **Reason for Process Failure**: High precision in BLOCK_REWARD_TIME (DECIMAL(38,30)) may cause storage and performance issues.
- **Cardinality**:
  - **1:1 with CRYPTO**: One reward detail per cryptocurrency.
  - **N:1 with BLOCK_REWARD_EMISSION_TYPE**: Multiple cryptocurrencies per emission type.
- **Real-Time Usage**: Analyzes mining incentives and supply dynamics for price forecasting.

17. BLOCK_REWARD_EMISSION

- **Description**: Tracks block reward changes (e.g., halving events) annually.
- **Attributes**:
  - SYMBOL (VARCHAR(10), PK): References CRYPTO.
  - YEAR (INT, PK): Year of event.
  - DATE (DATE): Event date.
  - BLOCK_REWARD (DECIMAL(38,10)): Reward amount.
  - HALVING_YEAR_MARKET_PRICE, HALVING_YEAR_MARKET_CAP (DECIMAL(38,20)): Market metrics during halving.
  - NETWORK_HASH_RATE (DECIMAL(38,0)): Hash rate.
- **Normalization**: In 3NF. Composite PK (SYMBOL, YEAR) ensures no redundancy.
- **Reason for Process Failure**: None.
- **Cardinality**:
  - **N:1 with CRYPTO**: Multiple emission records per cryptocurrency.
- **Real-Time Usage**: Predicts price impacts of halving events for investment strategies.

18. HFT_AMF_FIRMS

- **Description**: Stores details of high-frequency trading and asset management firms.
- **Attributes**:
    - COMPANY_NAME (VARCHAR(200), PK): Firm name.
    - HEAD_QUARTER (VARCHAR(200)): Location.
    - ESTABLISHED_YEAR (INT): Founding year.
    - WORK_TYPE (VARCHAR(500)): Type of work.
    - FAMOUS_FOR (VARCHAR(500)): Notable achievements.
- **Normalization**: In 3NF. All attributes depend on COMPANY_NAME.
- **Reason for Process Failure**: None.
- **Cardinality**:
    - **1:N with CRYPTO_ETF**: One firm manages multiple ETFs.
- **Real-Time Usage**: Tracks firms influencing crypto markets for investor due diligence.

19. ETF_INVESTMENT_TYPE

- **Description**: Defines types of crypto ETF investments (e.g., spot, futures).
- **Attributes**:
    - TYPE (VARCHAR(200), PK): Investment type.
    - DESCRIPTION (TEXT): Type explanation.
- **Normalization**: In 3NF. No dependencies.
- **Reason for Process Failure**: None.
- **Cardinality**:
    - **1:N with CRYPTO_ETF**: One investment type applies to multiple ETFs.
- **Real-Time Usage**: Classifies ETFs for investor risk assessment and regulatory compliance.

20. CRYPTO_ETF

- **Description**: Stores details of cryptocurrency ETFs.
- **Attributes**:
  - ETF_NAME (VARCHAR(300)): ETF name.
  - ETF_CODE (VARCHAR(200), PK): Unique code.
  - COMPANY_NAME (VARCHAR(200)): References HFT_AMF_FIRMS.
  - LAUNCH_DATE (DATE): Launch date.
  - YEAR (INT): Launch year.
  - TOTAL_AUM_UNDER_ETF (DECIMAL(38,20)): Assets under management.
  - CRYPTO_SYMBOL (VARCHAR(10), PK): References CRYPTO.
  - ETF_INVESTMENT_TYPE (VARCHAR(200)): References ETF_INVESTMENT_TYPE.
  - EXPENSE_RATIO (DECIMAL(10,5), CHECK < 100): Fee percentage.
- **Normalization**: In 3NF. Composite PK (ETF_CODE, CRYPTO_SYMBOL) ensures no redundancy.
- **Reason for Process Failure**: Redundant YEAR (derivable from LAUNCH_DATE) violates 3NF, leading to potential inconsistencies.
- **Cardinality**:
  - **N:1 with CRYPTO, HFT_AMF_FIRMS, ETF_INVESTMENT_TYPE**: Multiple ETFs per cryptocurrency, firm, or investment type.
- **Real-Time Usage**: Tracks ETF performance and fees for investment decisions and market analysis.

21. BROKERAGE

- **Description**: Stores details of crypto brokerages.
- **Attributes**:
  - NAME (VARCHAR(200), PK): Brokerage name.
  - HEADQUARTER (VARCHAR(200)): Location.
  - ESTABLISHED_YEAR (INT): Founding year.
  - OWN_CRYPTO_CURRENCY (VARCHAR(10)): Associated cryptocurrency.
  - FOUNDER_NAME (VARCHAR(200)): Founder.
- **Normalization**: In 3NF. All attributes depend on NAME.
- **Reason for Process Failure**: OWN_CRYPTO_CURRENCY lacks an FK constraint to CRYPTO, risking orphaned data.
- **Cardinality**:
  - **1:N with TOP_BROKERAGE, CONTROVERSY**: One brokerage has multiple performance or controversy records.
- **Real-Time Usage**: Evaluates brokerage reliability and market influence for investor trust.

22. TOP_BROKERAGE

- **Description**: Tracks top brokerages annually by market cap and user base.
- **Attributes**:
    - YEAR (INT, PK): Year of data.
    - BROKERAGE_NAME (VARCHAR(200), PK): References BROKERAGE.
    - TOTAL_MARKET_CAP, MARKET_SHARE, TOTAL_USER (DECIMAL(30,5)): Performance metrics.
- **Normalization**: In 3NF. Composite PK (BROKERAGE_NAME, YEAR) ensures no redundancy.
- **Reason for Process Failure**: None.
- **Cardinality**:
    - **N:1 with BROKERAGE, TOTAL_USER_DISTRIBUTION**: Multiple records per brokerage or year.
- **Real-Time Usage**: Identifies leading brokerages for investor trust and market analysis.

23. CONTROVERSY

- **Description**: Records controversies involving brokerages and affected cryptocurrencies.
- **Attributes**:
    - YEAR (INT): Year of controversy.
    - BROKERAGE_NAME (VARCHAR(200)): References BROKERAGE.
    - CONTROVERSY_DETAIL (VARCHAR(400)): Details of the issue.
    - AFFECTED_CRYPTO (VARCHAR(10)): References CRYPTO.
    - AFFECTED_AMOUNT_IN_BILLION (DECIMAL(38,10)): Financial impact.
- **Normalization**: In 2NF. Lacks a PK, risking duplicates. Should include YEAR and BROKERAGE_NAME as a composite PK.
- **Reason for Process Failure**: Missing PK leads to potential data integrity issues and duplicate entries.
- **Cardinality**:
    - **N:1 with BROKERAGE, CRYPTO**: Multiple controversies per brokerage or cryptocurrency.
- **Real-Time Usage**: Tracks risks and reputational issues for risk management and investor due diligence.

Complex Engineering Problem Project Mapping Report (Washington Accord)

This report maps the database project to the Washington Accord's **Knowledge Profile (K1-K8)**, **Complex Engineering Problem Solving Skills (P1-P7)**, and **Complex Engineering Activities (A1-A5)**, using the provided slides as reference. Each attribute is tied to specific tables and explained in the context of the project.

Knowledge Profile (K1-K8)

- **K1: A systematic, theory-based understanding of the natural sciences applicable to the discipline**
  - **Attribute**: ELECTRICITY_COST_PER_BLOCK and HEAT_IMMERSION_PER_TX in the CRYPTO_CURRENCY_PERFORMANCE_METRICS table.
  - **How Applied**: These attributes require understanding of physics (energy consumption, heat transfer) and mathematics (cost calculations) to model the environmental impact of blockchain operations, aligning with natural sciences principles.
- **K2: Conceptually based mathematics, numerical analysis, statistics, and the formal aspects of computer and information science**
  - **Attribute**: DOMINANCE (FLOAT, CHECK <= 100) in the MARKET_DOMINANCE table and NETWORK_HASH_RATE in the BLOCK_REWARD_EMISSION table.
  - **How Applied**: Calculating market dominance involves statistical analysis, while hash rate computations require numerical modeling, both rooted in computer science and mathematics.
- **K3: A systematic, theory-based formulation of engineering fundamentals**
  - **Attribute**: CONSENSUS_ALGORITHM_TYPE in the CRYPTO and HASH_ALGO_NAME tables.
  - **How Applied**: Modeling consensus mechanisms (e.g., PoW, PoS) requires engineering fundamentals of distributed systems and cryptography, ensuring accurate representation of blockchain operations.
- **K4: Engineering specialist knowledge that provides theoretical frameworks**
  - **Attribute**: EMISSION_TYPE in the REWARD_DETAILS table and BLOCK_REWARD_EMISSION_TYPE table.
  - **How Applied**: Understanding block reward emission models (e.g., halving) requires specialized knowledge of blockchain economics and tokenomics, providing a theoretical framework for supply dynamics.
- **K5: Knowledge that supports engineering design**
  - **Attribute**: FK relationships in the CRYPTO table (e.g., BLOCKCHAIN_ACCESS_TYPE, BLOCKCHAIN_TOKEN_TYPE).

    - **How Applied**: Designing a normalized schema with FKs supports efficient data retrieval and integrity, crucial for engineering a scalable database system.
- **K6: Knowledge of engineering practice (technology)**
    - **Attribute**: HARDWARE_TYPE in the HASH_ALGO_NAME table.
    - **How Applied**: Specifying hardware (e.g., ASIC, GPU) for mining reflects practical knowledge of blockchain technology and its computational requirements.
- **K7: Comprehension of the role of engineering in society**
    - **Attribute**: CRYPTO_STATUS in the COUNTRY table and CONTROVERSY_DETAIL in the CONTROVERSY table.
    - **How Applied**: These attributes address regulatory, ethical, and social impacts of cryptocurrencies, such as public safety and economic implications, aligning with engineering's societal role.
- **K8: Engagement with selected knowledge in the research literature**
    - **Attribute**: ENERGY_EFFICIENCY in the HASH_ALGO_NAME table.
    - **How Applied**: Assessing energy efficiency requires engaging with research on sustainable blockchain technologies, ensuring the project aligns with current environmental studies.

Complex Engineering Problem Solving Skills (P1-P7)

- **P1: Cannot be resolved without in-depth engineering knowledge**
    - **Attribute**: ELECTRICITY_COST_PER_BLOCK and HEAT_IMMERSION_PER_TX in the CRYPTO_CURRENCY_PERFORMANCE_METRICS table.
    - **How Applied**: Calculating energy costs and heat per transaction requires deep knowledge of electrical engineering and thermodynamics, as these are not trivial metrics and involve complex modeling.
- **P2: Involve wide-ranging or conflicting technical, engineering, and other issues**
    - **Attribute**: CRYPTO_STATUS in the COUNTRY table and RESTRICTIONS in the ACCEPTED_COUNTRY and BANNED_COUNTRY tables.
    - **How Applied**: Balancing regulatory compliance (legal issues) with technical implementation (blockchain accessibility) involves conflicting requirements, such as privacy versus transparency.
- **P3: Have no obvious solution and require abstract thinking**
    - **Attribute**: DOMINANCE in the MARKET_DOMINANCE table.
    - **How Applied**: Calculating market dominance requires abstract modeling of market share, with no obvious formula, as it involves dynamic market data and competitive analysis.
- **P4: Involve infrequently encountered issues**
    - **Attribute**: CONTROVERSY_DETAIL in the CONTROVERSY table.
    - **How Applied**: Controversies in crypto markets (e.g., hacks, fraud) are infrequent but impactful, requiring unique risk assessment and mitigation strategies.

- **P5: Are outside problems encompassed by standards and codes**
    - **Attribute**: BLOCK_REWARD_EMISSION table's HALVING_YEAR_MARKET_PRICE and HALVING_YEAR_MARKET_CAP.
    - **How Applied**: Halving events and their market impacts are not governed by standard financial codes, requiring custom analysis beyond traditional frameworks.
- **P6: Involve diverse groups of stakeholders with widely varying needs**
    - **Attribute**: TOTAL_USER_DISTRIBUTION table's regional user attributes (e.g., ASIA_USER, EUROPE_USER).
    - **How Applied**: The table addresses the needs of diverse stakeholders (investors, regulators, developers) with varying interests in regional adoption trends and market growth.
- **P7: Are high-level problems including many component parts or sub-problems**
    - **Attribute**: Multiple FKs in the CRYPTO table (e.g., BLOCKCHAIN_ACCESS_TYPE, CONSENSUS_ALGORITHM_TYPE).
    - **How Applied**: The CRYPTO table integrates multiple sub-problems (access type, consensus mechanism, token type), forming a high-level system for crypto analysis.

Complex Engineering Activities (A1-A5)

- **A1: Involve the use of diverse resources**
    - **Attribute**: CRYPTO_ETF table's TOTAL_AUM_UNDER_ETF and COMPANY_NAME.
    - **How Applied**: Managing ETF data involves diverse resources, including financial data (AUM), human resources (firms), and technology (database systems), to support investment analysis.
- **A2: Require resolution of significant problems arising from interactions**
    - **Attribute**: HASH_ALGO_NAME table's ENERGY_EFFICIENCY and CRYPTO table's CONSENSUS_ALGORITHM_TYPE.
    - **How Applied**: Balancing energy efficiency (environmental concern) with consensus mechanisms (technical requirement) resolves conflicts between sustainability and performance.
- **A3: Involve creative use of engineering principles**
    - **Attribute**: BLOCK_REWARD_EMISSION_TYPE and REWARD_DETAILS tables' emission models.
    - **How Applied**: Modeling emission types (e.g., halving) creatively applies engineering principles to predict supply dynamics and market impacts, a novel challenge in blockchain.

- **A4: Have significant consequences in a range of contexts**
    - **Attribute**: CONTROVERSY table's AFFECTED_AMOUNT_IN_BILLION and COUNTRY table's CRYPTO_STATUS.
    - **How Applied**: Controversies can impact financial markets, while regulatory status affects global adoption, both with significant economic and social consequences.
- **A5: Can extend beyond previous experiences by applying principles-based approaches**
    - **Attribute**: ACCEPTED_COUNTRYWISE_MOST_USED_CRYPTO table's USER_PERCENTAGE.
    - **How Applied**: Analyzing crypto usage by country extends beyond traditional financial analysis, using principles-based data modeling to explore new adoption patterns.