

Appendix A: Comprehensive Cognitive Toolkit (Methods M)

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Introduction

This appendix provides concise descriptions for the methods constituting the "Comprehensive Cognitive Toolkit" (M) referenced within the WTF 6.0 Framework. Each method is presented with its core concept and any key associated mathematical formalism. Ethical considerations (E) are integral to the application of every method. Selection and application depend on context (problem X, KIQs, data, rigor required, WTF 6.0 step).

1. Enhanced 5W+1H Analysis

Extends the basic Who, What, Where, When, Why, How questions into a deeper, multi-faceted inquiry to thoroughly explore a problem's context, actors, timelines, causes, and mechanisms during initial observation (WTF 6.0 Step 1). It aims to distinguish facts from interpretations, symptoms from causes, and map stakeholders, consequences, and processes to build a rich understanding.

Mathematical/Formal Representation

Predominantly qualitative. May involve ordered sets for timelines $T = \{t_1, \dots, t_n\}$, graph theory $G = (V, E)$ for stakeholder relationships or virtual spaces, or subjective scoring matrices for influence ($\text{Influence}(\text{Actor}_i) = f(\text{attributes})$).

2. Trigger Moment Identification & Analysis

Focuses on pinpointing and documenting the specific event, data point, question, or observation that initiated the analysis ("WTF is X?" moment in Step 1). It involves recording the trigger, its source, the initial perception/reaction, immediate context, and preliminary scope/urgency assessment to ground the analysis and check initial framing biases.

Mathematical/Formal Representation

Primarily qualitative. The trigger itself might be quantitative (e.g., value $v > \tau$).

3. Issue Trees / Logic Trees

A structured method to break down a complex problem or question into smaller, mutually exclusive and collectively exhaustive (MECE) components, arranged hierarchically. It helps organize thinking, ensure comprehensive coverage, identify root causes or key drivers, and map areas for investigation. Used in Steps 1, 2, 3, 5.

Mathematical/Formal Representation

Represents decomposition as a hierarchical graph $G = (V, E)$. Can embed algebraic relationships (e.g., Profit = Revenue – Cost) or probabilities ($\sum P(\text{Branch}_i) = 1$) at nodes.

4. Mind Mapping

A visual thinking tool using a non-linear, radiant structure starting from a central idea with branches for related concepts, keywords, and images. Aims to enhance creative brainstorming, memory, and understanding of associative relationships, especially in Steps 1, 3, 6.

Mathematical/Formal Representation

Represents structure as a graph $G = (V, E)$, but emphasis is visual and qualitative, not typically involving formal graph metrics. MECE is not required.

5. Concept Mapping

A graphical technique representing knowledge by visualizing relationships between concepts (nodes) using directed arrows labeled with linking phrases (edges) to form meaningful propositions. Aims to structure understanding, facilitate learning, and identify knowledge connections or gaps. Useful in Steps 1, 5, 7.

Mathematical/Formal Representation

Represents knowledge as a directed graph $G = (V, E)$ where nodes V are concepts and edges E have labels $L(e)$ forming a semantic network. Analysis is primarily qualitative/structural.

6. Problem Restatement / Reframing

A critical thinking technique involving deliberately generating multiple alternative definitions or perspectives of a problem to challenge initial framing, uncover hidden assumptions, and reveal different solution pathways. Aims to ensure the right problem is being addressed (Step 1, shaping Step 2).

Mathematical/Formal Representation

Entirely qualitative and conceptual. Transforms an initial problem statement P_{initial} into a set of alternatives $\{P_1, \dots, P_n\}$.

7. Context Mapping

A technique to explore and visualize the broader environment (e.g., using PESTLE categories) surrounding a problem (X), identifying external trends, forces, and actors that influence or constrain X (Step 1 Environmental Scanning). Aims for a systemic understanding of the landscape.

Mathematical/Formal Representation

Primarily qualitative visualization. Can be viewed as a conceptual graph, potentially annotating trends with quantitative data if available, but formal metrics are not typically used.

8. Stakeholder Analysis & Mapping

Identifies individuals/groups affected by or affecting a situation (X), analyzes their interests, influence, and perspectives, and maps these using tools like Power/Interest Grids or network diagrams (Step 1). Aims to understand the human/organizational landscape and inform engagement strategies (Method 120).

Mathematical/Formal Representation

Qualitative analysis supported by quantitative elements: scoring power/interest (e.g., 1-5 scale), matrix representations (Power/Interest grid), Network Analysis metrics (C_D , C_B , etc. via Method 68) if relationships are mapped.

9. CATWOE Analysis (Checkland)

A mnemonic checklist (Customers, Actors, Transformation, Weltanschauung/Worldview, Owners, Environmental constraints) from Soft Systems Methodology used to define the core elements, purpose, perspectives, and constraints of a human activity system or problem situation (Step 1). Aids in creating rich system definitions (Root Definitions).

Mathematical/Formal Representation

Qualitative framework for structuring definitions and perspectives. No inherent mathematical formalism.

10. Scope Definition (In/Out Frame)

Clearly defining the boundaries of an analysis or project by specifying what elements (data, questions, activities) are included ("In Scope") and excluded ("Out of Scope") based on criteria like relevance, feasibility, and priority (Step 1). Aims to prevent scope creep and focus resources.

Mathematical/Formal Representation

Primarily qualitative boundary setting. Can be represented using set notation: partitioning a universe U into disjoint sets S_{IN} and S_{OUT} .

11. Initial Assumption Listing

Explicitly identifying and documenting beliefs taken as true without proof at the start of an analysis (factual, causal, value assumptions) (Step 1). Aims to surface hidden premises for later examination, challenge (Method 103), or validation.

Mathematical/Formal Representation

Qualitative listing. Preliminary assessment can involve quasi-quantitative scoring (1-5) for Likelihood/Validity and Impact, potentially plotted on a risk matrix. Bayesian priors $P(\text{Assumption})$ represent subjective confidence.

12. Information Requirements (IR) / Knowledge Gap Identification

Systematically identifying specific pieces of information currently lacking but needed to understand the problem, answer key questions, or test hypotheses (output of Step 1, input to Step 2). Translates uncertainties into concrete, prioritized needs, guiding collection efforts (Step 4).

Mathematical/Formal Representation

Qualitative articulation of knowledge deficits ($K_{\text{gap}} = K_{\text{required}} \setminus K_{\text{known}}$). Prioritization can use scoring (Impact I , Urgency U) to calculate priority $S = w_1I + w_2U$.

13. Question Formulation Technique (QFT)

A structured process (QFocus → Produce → Improve → Prioritize → Next Steps → Reflect) for individuals/groups to generate, refine, and prioritize their own questions about a topic (Step 2). Aims to stimulate inquiry, deepen comprehension, and identify knowledge gaps (IRs).

Mathematical/Formal Representation

Qualitative, procedural method. Output is lists of questions, categorization (Open/Closed), and prioritized subsets.

14. OSINT Search Strategies

Techniques for effectively finding, filtering, and retrieving relevant information from publicly available sources (web, databases) using structured queries (keywords, Boolean operators, field searching, advanced operators like 'site:', 'filetype:') to answer IRs (Step 4).

Mathematical/Formal Representation

Based on Boolean logic ($A \cap B$, $A \cup B$, A^c). Underlying search engine ranking uses Information Retrieval models (e.g., $\text{TF-IDF} = \text{TF}(t, d) \times \log(N/N_t)$, Vector Space Model).

15. Source Vetting Frameworks

Structured methods (e.g., Admiralty Code A-F, 1-6; CARS checklist) to systematically evaluate source credibility, reliability, expertise, access, bias, and corroboration (Step 4). Aims to assess information quality before use in analysis (Step 5).

Mathematical/Formal Representation

Largely qualitative judgment against criteria. Output often uses ordinal rating scales (A-F, 1-6). Scoring models ($\sum w_i C_i$) or Bayesian approaches ($P(\text{True}|\text{Report})$) possible but less common than coded ratings.

16. Lateral Reading

A source vetting technique for unfamiliar online sources (Step 4): instead of reading the source deeply (vertically), open new tabs to search *about* the source (reputation, bias, funding) on other websites before deciding credibility or investing time. Quick assessment via external context.

Mathematical/Formal Representation

Qualitative heuristic procedure based on triangulation across external sources. No direct mathematical calculation.

17. Metadata Analysis

Examining "data about data" (e.g., file properties, EXIF data in images, email headers) to extract contextual clues about origin, history, authenticity, location, or relationships not apparent from the primary content alone (Step 4). Supports vetting (Method 15) and analysis (Step 5).

Mathematical/Formal Representation

Analysis involves parsing key-value pairs $M = \{(k_i, v_i)\}$, time conversions (Δt), coordinate geometry (GPS (lat, lon)), potentially network analysis ($G = (V, E)$) on communication metadata, or statistical analysis across many objects.

18. Data Cleansing Techniques

Detecting, diagnosing, and correcting/removing corrupt, inaccurate, inconsistent, irrelevant, duplicate, or incomplete data (Step 4). Aims to improve data quality and reliability for analysis (Step 5), addressing GIGO. Involves profiling, handling missing values (deletion, imputation), correcting errors, standardizing, deduplication.

Mathematical/Formal Representation

Uses descriptive statistics ($\bar{x}, M, s, IQR$) for profiling. Outlier detection via Z-score $(x_i - \bar{x})/s$ or IQR method ($Q1 - 1.5 \times IQR$). Imputation uses mean/median or models (regression $\hat{x}_i = \beta_0 + \dots$, Multiple Imputation). String distance metrics (Levenshtein) for fuzzy duplicate detection.

19. Devil's Advocacy

A technique where an individual or subgroup is assigned the role of critically challenging a proposed plan, hypothesis, or consensus view (Steps 3, 5, 6). They deliberately seek out flaws, weaknesses, counter-arguments, and inconsistencies to ensure robust vetting and avoid groupthink (Method 97).

Mathematical/Formal Representation

Qualitative critical thinking technique. Focuses on logical challenge and identifying counter-evidence.

20. Team A / Team B Analysis

Two independent teams analyze the same problem/data (Step 5) using potentially different methods or perspectives. Their findings are then compared to identify areas of agreement (increasing confidence) and disagreement (highlighting uncertainties, biases, or alternative interpretations requiring further investigation).

Mathematical/Formal Representation

Procedural technique for comparative analysis. May involve statistical comparison of results if quantitative, but primarily focused on comparing qualitative judgments and analytical pathways.

21. Red Team Analysis / Alternative Futures Analysis

Red Teaming involves simulating an adversary's perspective to challenge plans, assumptions, or security from the outside-in (Steps 5, 6). Alternative Futures Analysis (Method 74) explores multiple plausible future scenarios based on key uncertainties and driving forces, rather than predicting a single outcome (Steps 3, 5, 6). Both aim to stress-test plans/hypotheses against unexpected or adversarial conditions.

Mathematical/Formal Representation

Primarily qualitative, simulation/scenario-based. May use game theory (Method 113) for Red Teaming or scenario matrices/probability assignments for Alternative Futures (Method 74).

22. Timeline Analysis

Organizing events chronologically to understand sequences, durations, concurrencies, and potential cause-effect relationships (Steps 1, 5). Involves gathering dated events, plotting them visually, and analyzing patterns or critical paths.

Mathematical/Formal Representation

Represents events as an ordered set $T = \{t_1, \dots, t_n\}$ with associated events $E = \{e_1, \dots, e_n\}$. Can calculate durations ($d_i = t_{i+1} - t_i$) and frequencies. Related to Critical Path Method in project management (Method 79).

23. Pattern Analysis

Identifying recurring regularities, trends, structures, or relationships within data (quantitative or qualitative) (Steps 1, 5). Can involve visual inspection, statistical methods (time series, clustering), sequence analysis, or machine learning techniques to discover non-random structures. Goal is finding meaningful order in complexity.

Mathematical/Formal Representation

Highly diverse mathematically. Includes Time Series Analysis (Method 73 - identifying seasonality, trend), Cluster Analysis (Method 77 - grouping similar data points), sequence mining algorithms, statistical tests for randomness, machine learning pattern recognition models.

24. Brainstorming (Osborn)

A group creativity technique aiming to generate numerous ideas quickly (Steps 1, 3, 6) by encouraging free association and suspending judgment. Key rules: Defer judgment, Encourage wild ideas, Build on others' ideas, Stay focused, One conversation at a time, Be visual, Go for quantity.

Mathematical/Formal Representation

Qualitative idea generation technique. Focuses on quantity N of ideas initially.

25. Brainwriting / 6-3-5 Method

Silent idea generation techniques (Steps 1, 3, 6). 6-3-5 Method: 6 participants write 3 ideas in 5 mins, pass worksheets, build on previous ideas for 6 rounds. Aims for high volume, equal participation, cross-fertilization.

Mathematical/Formal Representation

Procedural/qualitative. Potential idea volume $N = P \times I \times R = 6 \times 3 \times 6 = 108$ for 6-3-5.

26. SCAMPER

A creative thinking checklist using action verbs (Substitute, Combine, Adapt, Modify/Magnify/Minify, Put to another use, Eliminate, Reverse/Rearrange) to prompt new ideas for changing an existing product/process/problem (Steps 1, 3, 6). Systematically provokes different perspectives.

Mathematical/Formal Representation

Qualitative heuristic checklist. Applies transformation operators O to subject X generating $X' = O(X)$.

27. Lateral Thinking (De Bono)

Techniques/mindset for moving "sideways" from established thought patterns to explore multiple possibilities, challenge assumptions (Method 103), use provocation, and generate novel ideas (Steps 1, 3, 5, 6), contrasting with linear "vertical" thinking.

Mathematical/Formal Representation

Cognitive approach, set of qualitative heuristics. Intentionally disrupts logical sequences.

28. Random Word Input

A lateral thinking technique (Method 27) using a randomly chosen word to force connections to the problem focus, sparking new perspectives and ideas by introducing an external stimulus (Steps 1, 3, 6).

Mathematical/Formal Representation

Qualitative heuristic based on random stimulus $Word_{\text{random}}$ and forced association Problem $\leftarrow$ Connect(Attributes($Word_{\text{random}}$)).

29. Morphological Analysis

Systematically explores all possible solutions/configurations by breaking a problem into essential parameters, listing variations for each, and combining variations in a matrix ("morphological box") (Steps 1, 3, 6). Aims for comprehensive exploration, uncovering novel combinations.

Mathematical/Formal Representation

Total combinations $N = \prod_{i=1}^k n_i$, where n_i = variations for parameter P_i . Configuration $C = (V_{1,j_1}, \dots, V_{k,j_k})$. Consistency assessment $f(C) \rightarrow \{\text{Consistent, Inconsistent}\}$ filters combinations.

30. TRIZ (Theory of Inventive Problem Solving)

Systematic methodology (contradiction matrix, 40 principles, Su-Field analysis, laws of evolution) based on patterns in patents to solve inventive problems, primarily by resolving technical/physical contradictions (Steps 1, 3, 6).

Mathematical/Formal Representation

Algorithmic/heuristic. Contradiction matrix $M : P_{\text{improve}} \times P_{\text{worsen}} \rightarrow \{\text{Principles}\}$. Su-Field uses symbolic models. Logic: Map Specific Problem $\rightarrow$ Generic Problem $\rightarrow$ Generic Solution $\rightarrow$ Specific Solution.

31. Attribute Listing

Creative thinking technique identifying key attributes (physical, functional, abstract) of a subject and then brainstorming modifications for each attribute individually to generate improvement ideas (Steps 1, 3, 6).

Mathematical/Formal Representation

Qualitative decomposition. Subject X has attributes $A = \{a_i\}$. Generate modifications $M(a_i)$. Less systematic combination than Morphological Analysis (Method 29).

32. Reverse Brainstorming

Brainstorming how to *cause* a problem or achieve the *opposite* goal (P_{rev}). Ideas generated ($I(P_{\text{rev}})$) are then "reversed" ($s = R(i)$) to identify solutions/preventative measures for the original problem (P) (Steps 1, 3, 6). Overcomes blocks by inverting perspective.

Mathematical/Formal Representation

Qualitative, procedural, using logical inversion heuristic R .

33. Starbursting

Brainstorming technique focused solely on generating *questions* about a topic, using the 5W+1H categories as prompts around a central idea (Steps 1, 2, 3, 5). Aims for comprehensive exploration and identification of knowledge gaps (IRs).

Mathematical/Formal Representation

Qualitative question generation. Output is structured set of questions $Q = \cup Q_{\text{category}}$.

34. Storyboarding

Visual technique using sequence of images/sketches with brief text to pre-visualize a process, narrative, or user experience over time (Steps 1, 3, 5, 6). Helps plan, communicate, identify issues in dynamic sequences.

Mathematical/Formal Representation

Primarily qualitative/visual. Sequence is ordered list/graph $P_1 \rightarrow \dots \rightarrow P_n$. Can add timings (Δt_i) or qualitative state ratings (E_i).

35. Six Thinking Hats (De Bono)

Framework for structured group discussion using six colored "hats" representing different thinking modes (White=Facts, Red=Emotion, Black=Caution, Yellow=Benefits, Green=Creativity, Blue=Process). Enables parallel thinking (Steps 1, 3, 5, 6), ensuring all perspectives considered without argument.

Mathematical/Formal Representation

Qualitative framework for managing cognitive focus. Sequence $(H_1, \dots, H_n)$.

36. Analogical Reasoning

Cognitive process identifying similarities between a familiar source domain and unfamiliar target domain to transfer knowledge, generate hypotheses, or solve problems by mapping relational structures (Steps 1, 3, 5, 6).

Mathematical/Formal Representation

Qualitative heuristic. Formal models exist (Structure Mapping Theory - SMT, predicate logic, graph matching) but complex. $\text{Target} \leftarrow \text{Map}(\text{Source})$.

37. Root Cause Analysis (RCA)

Class of methods (including 5 Whys - Method 39, Fishbone - Method 38) aiming to identify the *fundamental* cause(s) of a problem (Step 5), not just symptoms, by tracing causal chains backward. Goal is preventing recurrence by addressing root issues.

Mathematical/Formal Representation

Logical investigation. May use Boolean logic (FTA - Method 40), probability (quantitative FTA/ETA), causal graphs (DAGs - Method 43), but core process is logical deduction/induction.

38. Fishbone Diagram (Ishikawa / Cause-and-Effect)

Visual brainstorming tool (part of RCA - Method 37) categorizing potential causes (bones) contributing to an effect (head) using predefined (e.g., 6Ms) or custom categories (Steps 1, 3, 5). Structures search for root causes.

Mathematical/Formal Representation

Qualitative visualization representing hierarchical categorization of potential causes. Graph structure, but value is visual organization.

39. 5 Whys

Simple iterative technique (part of RCA - Method 37) exploring cause-effect relationships by repeatedly asking "Why?" starting from a problem statement (Steps 1, 5), until a fundamental, actionable root cause is identified (often around 5 iterations).

Mathematical/Formal Representation

Qualitative heuristic tracing a linear causal chain: Problem $\xrightarrow{\text{Why?}}$ Cause₁ $\xrightarrow{\text{Why?}}$... $\rightarrow$ Root Cause.

40. Fault Tree Analysis (FTA)

Top-down, deductive failure analysis (Step 5) starting with an undesired top event and using Boolean logic gates (AND, OR) to trace backward to identify combinations of basic events (component failures, errors) that could cause it. Identifies failure modes, calculates probability if inputs known.

Mathematical/Formal Representation

Based on Boolean logic (Output = $A \cup B$ for OR, Output = $A \cap B$ for AND). Probability calculation uses $P(A \cup B) = P(A) + P(B) - P(A)P(B)$ and $P(A \cap B) = P(A)P(B)$ (assuming independence) applied recursively. Identifies Minimal Cut Sets (MCS).

41. Event Tree Analysis (ETA)

Forward, inductive logic technique (Step 5) starting with an initiating event and branching chronologically based on success/failure of subsequent pivotal events (safety functions) to map all possible outcome sequences and calculate their frequencies/probabilities.

Mathematical/Formal Representation

Binary tree structure. Sequence probability calculated using conditional probabilities along path (chain rule): $P(\text{Seq}_k) = P(IE) \times \prod P(\text{Branch}_i | \text{Preceding})$. Outcome probability $P(\text{Outcome}_X) = \sum_{k \rightarrow X} P(\text{Seq}_k)$.

42. Causal Loop Diagrams (CLDs)

Visual tools from systems thinking (Method 75) mapping cause-effect links between variables with polarity (+/-) to identify feedback loops (Reinforcing 'R' / Balancing 'B') driving system behavior (Steps 1, 5). Captures underlying dynamic structure qualitatively.

Mathematical/Formal Representation

Directed graph $G = (V, E)$ with edge polarity $p(e) \in \{+, -\}$. Loop polarity (R/B) determined by count/parity of negative links $N_{\text{neg}}(L)$. Maps qualitatively to System Dynamics differential equations $dV_i/dt = f(V_j)$.

43. Directed Acyclic Graphs (DAGs - Causal Inference)

Visual representations of assumed causal relationships (nodes=variables, arrows=direct causes, no cycles) used to determine if a causal effect (X on Y) is identifiable from observational data (Step 5) by identifying confounding paths and necessary adjustment sets (Z) using criteria like d-separation or back-door criterion.

Mathematical/Formal Representation

DAG $G = (V, E)$. Identifiability via back-door criterion (Z blocks non-causal paths into X, Z not descendant of X). Allows estimation via adjustment formula: $P(Y|\text{do}(X = x)) = \sum_z P(Y|X = x, Z = z)P(Z = z)$. d-separation links graph structure to conditional independence $X \perp\!\!\!\perp Y|Z$.

44. Process Mapping / Flowcharting

Creating a visual representation of a process using standardized symbols (ovals, rectangles, diamonds) connected by arrows to depict sequence of steps, decisions, inputs/outputs, and flow (Steps 1, 5, 6). Used to understand, document, analyze, and improve workflows.

Mathematical/Formal Representation

Represents workflow as directed graph $G = (V, E)$. Nodes are steps/decisions. Can be augmented with quantitative data (cycle times T_i , costs C_i) for analysis (e.g., critical path, simulation).

45. Contribution Analysis

Structured approach (primarily for program evaluation) assessing plausible contribution of an intervention to observed outcomes in complex settings where RCTs are infeasible (Step 5). Builds an evidence-based "contribution story" along a Theory of Change, considering alternative explanations.

Mathematical/Formal Representation

Primarily qualitative, logic-based evaluation of evidence against ToC links. Uses quantitative evidence (p -values, effect sizes) but synthesis is qualitative judgment of plausibility, not mathematical aggregation.

46. Multiple Hypotheses Generation

Actively developing several distinct, plausible, testable competing explanations (hypotheses H_i) for an observation/question (Step 3), rather than focusing on just one. Counteracts cognitive biases and provides framework for objective evaluation (e.g., via Method 47).

Mathematical/Formal Representation

Logical process generating set $H = \{H_1, \dots, H_n\}$. Aims for MECE ($P(\cup H_i) \approx 1, P(H_i \cap H_j) \approx 0$). Bayesian framework uses priors $P(H_i)$ s.t. $\sum P(H_i) = 1$.

47. Analysis of Competing Hypotheses (ACH - Heuer)

Structured technique evaluating multiple competing hypotheses (H_i) against evidence (E_j) using a matrix (Step 5). Focuses on assessing consistency ('+/-') of each evidence piece against *all* hypotheses to identify the hypothesis with fewest inconsistencies (emphasizing disconfirmation).

Mathematical/Formal Representation

Structured logic; simple '+/-' scoring is heuristic. Approximates Bayesian inference where cells relate to likelihoods $P(E_j|H_i)$ and working across rows assesses diagnosticity (Likelihood Ratios). Bayesian ACH tools add priors/formal updates.

48. Hypothesis Testing (Statistical)

Formal statistical framework using sample data to make decisions about population parameters (Step 5) by evaluating evidence against a null hypothesis (H_0) in favor of an alternative (H_a). Uses test statistics and significance level (α) / p-value for decision rule.

Mathematical/Formal Representation

Formulate $H_0 : \theta = \theta_0$ vs H_a . Choose α . Calculate test statistic (e.g., $z = (\bar{x} - \mu_0)/(\sigma/\sqrt{n})$). Calculate p-value. Reject H_0 if p-value $\leq \alpha$. Consider Type I error (α) and Type II error (β).

49. Indicator / Signpost Development & Monitoring

Identifying specific, observable events/data points (indicators) whose occurrence/non-occurrence would support or refute competing hypotheses (developed in Step 3). Involves defining diagnostic indicators, planning how to monitor them (Step 4), and using observations to update hypothesis likelihoods over time (Steps 5, 7).

Mathematical/Formal Representation

Relates to Bayesian likelihoods $P(I_j|H_i)$. Diagnostic indicators have high Likelihood Ratios $LR = P(I_j|H_1)/P(I_j|H_2)$. Monitoring updates prior odds via Posterior Odds = $LR \times$ Prior Odds.

50. Falsifiability Principle Check (Popper)

Criterion for evaluating if a hypothesis is empirically testable (Step 3): there must be some conceivable observation that could prove it false. Used to distinguish scientific/testable claims from non-falsifiable ones (tautological, vague, metaphysical).

Mathematical/Formal Representation

Logical criterion: Hypothesis H is falsifiable if $\exists O$ such that $O \implies \neg H$. Non-falsifiable if for all O , $O \wedge H$ is logically possible.

51. Diagnostic Reasoning

Cognitive process of identifying the cause/explanation of a situation based on observed signs/evidence. Involves generating hypotheses (causes - Step 3), gathering information (Step 4), and evaluating evidence fit (Step 5) to arrive at the most likely diagnosis. Core process underpinning WTF 6.0.

Mathematical/Formal Representation

Often formalized using Bayesian Inference (Method 1): $P(H_i|E) \propto P(E|H_i)P(H_i)$. Choose H_i maximizing posterior probability. Also related to Likelihood Ratios, decision trees.

52. Abductive Reasoning (Inference to Best Explanation)

Inference starting with observations (O) and seeking the simplest, most likely hypothesis (H) that, if true, would best explain O (Step 3). Generates plausible hypotheses based on explanatory power, simplicity, coherence.

Mathematical/Formal Representation

Closely related to Bayesian inference: seeks H_i maximizing $P(H_i|O)$, often driven by high likelihood $P(O|H_i)$ combined with prior $P(H_i)$ reflecting simplicity/coherence. Logical form: O observed; If H were true, O follows; Hence, suspect H.

53. Consistency Checking (Internal Logic)

Systematically examining a set of statements/beliefs/hypotheses (Steps 3, 5, 6) to ensure freedom from internal contradictions according to rules of logic. Identifies logical flaws undermining coherence.

Mathematical/Formal Representation

Uses Propositional/Predicate Logic. Set $\{S_i\}$ is consistent if $S_1 \wedge \dots \wedge S_n$ is satisfiable (not a contradiction $P \wedge \neg P$). Checked via truth tables, semantic tableaux, or proof systems.

54. Plausibility Assessment

Judging the initial likelihood or reasonableness of a hypothesis/claim (Step 3) based on existing background knowledge, expertise, common sense, and preliminary evidence (Step 1), before rigorous testing (Step 5). Used for initial screening/prioritization.

Mathematical/Formal Representation

Corresponds to assigning subjective Bayesian Prior Probabilities $P(H|K)$ based on background knowledge K . Incorporates base rates, simplicity (Occam's Razor). Qualitative judgment scale (High/Medium/Low plausibility).

55. Deductive Reasoning

Inference moving from general premises (assumed true) to a specific conclusion that necessarily follows if the argument form is valid (Steps 5, 6). Aims for logical certainty.

Mathematical/Formal Representation

Based on Propositional/Predicate Logic rules of inference (Modus Ponens $((P \rightarrow Q) \wedge P) \rightarrow Q$, Modus Tollens, Syllogisms). Valid inferences are tautologies. Soundness = Validity + True Premises.

56. Inductive Reasoning

Inference moving from specific observations/patterns to broader generalizations or principles (Steps 1, 3, 5). Conclusions are probable but not certain. Generates new knowledge/hypotheses from empirical evidence.

Mathematical/Formal Representation

Deals with probability/statistics. Bayesian inference $P(H|E)$ updates belief based on observations. Statistical inference uses samples to estimate population parameters, test hypotheses (p -values). Machine learning uses induction.

57. Argument Mapping

Visually displays logical structure of arguments using boxes (statements) and arrows (relationships - support, attack) to show conclusions, premises, co-premises, objections, rebuttals (Steps 5, 6). Clarifies reasoning for critical evaluation or structuring reports.

Mathematical/Formal Representation

Represents structure as directed graph $G = (V, E)$ with typed edges. Co-premises model conjunctive support ($P_1 \wedge P_2 \rightarrow C$). Relates to Abstract Argumentation Frameworks $AF = \langle Arg, Att \rangle$.

58. Toulmin Model of Argumentation

Analyzes practical argument structure by identifying components: Claim (conclusion), Data/Grounds (evidence), Warrant (linking principle), Backing (support for warrant), Qualifier (certainty), Rebuttal (exceptions) (Steps 5, 6). Aids nuanced analysis of justification.

Mathematical/Formal Representation

Conceptual framework enriching basic logic. Qualifier relates to probability $P(C|D, W)$. Rebuttal relates to non-monotonic logic $(D \wedge W \wedge \neg R) \rightarrow C$.

59. Logical Fallacy Identification

Recognizing common errors in reasoning (flawed patterns in logic, relevance, sufficiency) that undermine an argument's validity or soundness, despite often being persuasive (Steps 1, 5, 6). Aids critical evaluation.

Mathematical/Formal Representation

Formal fallacies violate rules of Propositional/Predicate Logic (e.g., Affirming Consequent). Informal fallacies violate principles of relevance, sufficiency (related to probability/statistics), presumption, clarity.

60. Critical Discourse Analysis (CDA)

Studies language use in social/political context to analyze how it constructs meaning, represents reality, enacts relationships, and relates to power, ideology, and inequality (Steps 1, 4, 5). Aims to uncover hidden meanings/assumptions through linguistic/structural analysis linked to social theory.

Mathematical/Formal Representation

Predominantly qualitative, interpretive. May use quantitative Corpus Linguistics (frequencies, collocations) or Content Analysis (Method 61) codes as supporting evidence, but core is critical interpretation.

61. Content Analysis (Qualitative & Quantitative)

Systematically identifies characteristics (codes, themes) in texts/media, coding them to make replicable inferences (Step 4 input to Step 5). Quantitative counts frequencies/relationships; Qualitative interprets meaning/context of themes. Objectively describes communication content.

Mathematical/Formal Representation

Quantitative uses frequency counts f_i , percentages p_i . Inter-coder reliability uses Kappa $\kappa = (P_o - P_e)/(1 - P_e)$ or Krippendorff's Alpha. Statistical tests (χ^2) compare frequencies. Qualitative is interpretive.

62. Narrative Analysis

Qualitative approach interpreting stories people tell to understand sense-making, identity construction, and communication of meaning (Steps 4, 5). Examines narrative structure (plot, characters, sequence) and function as a whole.

Mathematical/Formal Representation

Predominantly qualitative/interpretive. Structural analysis might use plot diagrams or character network graphs. Frequency counts of narrative elements possible but secondary.

63. Thematic Analysis

Foundational qualitative method for identifying, analyzing, reporting patterns (themes) in qualitative data (Step 5). Involves data familiarization, coding, searching for themes across codes, reviewing/refining/defining themes, and reporting based on these patterns.

Mathematical/Formal Representation

Fundamentally qualitative. May use descriptive frequencies of themes or network diagrams showing code co-occurrence, but focus is rich interpretation.

64. Comparative Analysis / Benchmarking

Systematically comparing two+ entities based on predefined criteria to identify similarities/differences/patterns (Steps 1, 5). Benchmarking specifically compares against leaders/standards to find improvement opportunities (performance gaps) (Step 6).

Mathematical/Formal Representation

Uses descriptive statistics for comparison. Statistical tests (t-tests, χ^2) check significance of differences. Indexing/Scoring ($\sum w_i \times \text{Metric}_i$) for overall ranking. Gap Analysis: Gap = Benchmark – Own. Qualitative Comparative Analysis (QCA) uses Boolean algebra.

65. Historical Analysis / Comparison

Systematically examining/interpreting past events, trends, contexts using primary/secondary sources to understand causes, consequences, relevance (Steps 1, 3, 5). Comparison identifies similarities/differences across historical cases/periods. Aims for perspective, understanding origins/patterns.

Mathematical/Formal Representation

Primarily qualitative/interpretive. Quantitative History (Cliometrics) uses statistics (time series, regression) on historical data. Timelines are ordered sets. Comparative may use descriptive stats or QCA.

66. Case Study Method

In-depth empirical inquiry investigating a contemporary phenomenon ("case") within its real-life context using multiple evidence sources (qualitative/quantitative) (Steps 4, 5). Aims for holistic understanding, exploration, explanation, or theory building/testing related to the specific instance. Can be the subject (X) itself.

Mathematical/Formal Representation

Primarily qualitative. May include quantitative data analysis (descriptive stats, time series) *within* the case. Cross-case synthesis might use matrices or QCA (Method 64). Core logic is pattern matching/explanation building.

67. Link Analysis

Visual technique evaluating connections between entities (nodes) using network diagrams (links=edges) (Steps 1, 4, 5). Aims to uncover patterns, key entities/connections, network structures from disparate data. Leads into SNA (Method 68).

Mathematical/Formal Representation

Based on Graph Theory $G = (V, E)$. Uses adjacency matrices A . Often applies Social Network Analysis (SNA - Method 68) metrics (C_D, C_B, C_C , etc.) and pathfinding/community detection algorithms.

68. Social Network Analysis (SNA)

Investigates social structures using network/graph theories, modeling relationships (ties) between social entities (actors/nodes) (Step 5). Applies formal mathematical metrics (centrality, density, clustering) and sociological theory to understand network structure influence. Builds on Link Analysis (Method 67).

Mathematical/Formal Representation

Uses Graph Theory/Linear Algebra. Calculates Network metrics (Density, Path Length, Clustering C_i), Node centrality metrics ($C_D(i) = \sum_j A_{ij}$, $C_B(i) = \sum_{j < k} \sigma_{jk}(i)/\sigma_{jk}$, $C_C(i) = 1/\sum_j d(i, j)$, Eigenvector $x_i = \frac{1}{\lambda} \sum_j A_{ij}x_j$). Community detection via Modularity Q .

69. Geospatial Analysis

Examines phenomena based on geographic location/spatial relationships using GIS (Steps 1, 4, 5, 6). Integrates geo-referenced data (vector points/lines/polygons, raster grids) to identify spatial patterns, concentrations, proximity effects via mapping, buffering, overlay, spatial statistics.

Mathematical/Formal Representation

Uses Coordinate Geometry (distances $d = \sqrt{\Delta x^2 + \Delta y^2}$, areas), Raster Algebra (cell-by-cell operations), Spatial Statistics (Moran's I for autocorrelation, Getis-Ord G_i^* for hotspots, Kernel Density Estimation $\hat{f}(x)$). Network algorithms (Dijkstra) on spatial networks.

70. Statistical Analysis (Descriptive)

Methods for organizing, summarizing, presenting data informatively to describe its main features (central tendency, dispersion, shape) without generalizing to a population (Steps 1, 4, 5, 6). Includes calculations and visualizations.

Mathematical/Formal Representation

Calculates measures like Mean $\bar{x} = \frac{1}{n} \sum x_i$, Median M , Mode, Range, IQR, Variance $s^2 = \frac{1}{n-1} \sum (x_i - \bar{x})^2$, Standard Deviation s , Percentiles, Skewness, Kurtosis. Uses visualizations (Histogram, Box Plot).

71. Correlation Analysis

Statistical method measuring strength/direction of *linear* relationship between two quantitative variables (X, Y) (Steps 1, 5). Quantifies how closely they move together but does not imply causation.

Mathematical/Formal Representation

Calculates Pearson's $r = \frac{s_{xy}}{s_x s_y}$, ranging from -1 to +1. Coefficient of Determination r^2 = proportion of shared variance. Hypothesis test ($H_0 : \rho = 0$) uses t-statistic $t = r\sqrt{(n-2)/(1-r^2)}$. Check scatter plot for linearity/outliers.

72. Regression Analysis

Statistical technique modeling relationship between a dependent variable (Y) and one or more independent variables (X) (Step 5). Estimates how changes in X are associated with changes in Y, allowing prediction or inference (cautiously) about influence. Assesses model fit (R^2) and coefficient significance.

Mathematical/Formal Representation

Linear Regression Model: $Y = \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k + \epsilon$. Estimates coefficients $\hat{\beta}_i$ (usually via Ordinary Least Squares - OLS). Evaluates model fit (R^2 , Adjusted R^2), significance of coefficients (t-tests on $\hat{\beta}_i$), overall model significance (F-test). Checks assumptions (linearity, independence, homoscedasticity, normality of residuals ϵ).

73. Time Series Analysis

Statistical methods analyzing time-ordered data points (Step 5) to identify patterns (trend, seasonality, cycles, autocorrelation) and make forecasts (Step 6). Models account for temporal dependencies.

Mathematical/Formal Representation

Involves decomposition (Trend T , Seasonality S , Cycle C , Irregular I), autocorrelation function (ACF), partial autocorrelation function (PACF). Models include Moving Averages, Exponential Smoothing (e.g., Holt-Winters), ARIMA ((p, d, q) orders for Autoregressive, Integrated, Moving Average components), GARCH (for volatility). Evaluated by forecast accuracy metrics (MAPE, RMSE).

74. Scenario Analysis / Alternative Futures

Developing multiple plausible, internally consistent descriptions of potential future states ("scenarios") based on identifying key driving forces and critical uncertainties (Steps 3, 5, 6). Used to explore possibilities, test strategy robustness, and identify warning indicators, rather than predicting a single future. (Related to Method 21).

Mathematical/Formal Representation

Primarily qualitative narrative construction. May use matrices (Key Uncertainties x Drivers) to define scenario logics. Probabilities sometimes assigned subjectively to scenarios or driving forces, but focus is often on exploring plausible range. Input from simulation models possible.

75. Systems Thinking Concepts

A holistic approach analyzing complex problems by focusing on the interconnectedness of components, feedback loops (Method 42), delays, non-linear relationships, and emergent properties of the system as a whole (Steps 1, 5), rather than just isolated parts. Aims to understand dynamic behavior and identify leverage points.

Mathematical/Formal Representation

Conceptual framework supported by tools like CLDs (Method 42), System Dynamics (Method 76), Agent-Based Modeling (Method 77), Network Analysis (Method 68). Focuses on relational structure and dynamic behavior patterns over time.

76. System Dynamics Modeling (SD)

Computer simulation methodology (Step 5) modeling dynamic behavior of complex systems over time using stocks (accumulations), flows (rates of change between stocks), feedback loops (Method 42), and time delays, based on underlying causal structure. Used to understand dynamics, test policies, explore scenarios.

Mathematical/Formal Representation

Uses systems of coupled, non-linear differential or difference equations. Stock S changes based on inflow I and outflow O : $dS/dt = I(t) - O(t)$ or $S(t) = S(t - \Delta t) + (I(t) - O(t))\Delta t$. Flows are functions of stocks and parameters. Solved numerically over time using simulation software (Vensim, Stella).

77. Agent-Based Modeling (ABM)

Computational modeling approach (Step 5) simulating actions and interactions of autonomous agents (individuals, organizations) with heterogeneous characteristics and simple rules, observing emergent macro-level patterns from micro-level behavior. Useful for systems with adaptive agents and local interactions.

Mathematical/Formal Representation

Defines agent attributes, behavioral rules (often conditional logic, sometimes utility functions), interaction topology (network, grid), environment. No closed-form solution; results obtained via computer simulation runs. Statistical analysis performed on simulation outputs.

78. Design Thinking

Human-centered, iterative approach to innovation emphasizing Empathy (understand users - Step 1), Define (frame problem based on needs - Step 1), Ideate (generate solutions - Step 3/6), Prototype (build tangible representations - Step 4/6), and Test (get user feedback - Step 5/7). Integrates desirability, feasibility, viability.

Mathematical/Formal Representation

Qualitative, human-centered methodology. May use quantitative data in Empathize or Test phases, but core process is iterative design based on qualitative insights.

79. Project Management Body of Knowledge (PMBOK® Guide) Concepts

Framework describing project management process groups (Initiating, Planning, Executing, Monitoring & Controlling, Closing) and knowledge areas (Scope, Schedule, Cost, Quality, etc.) providing structured approach to managing projects (including analytical projects like WTF 6.0).

Mathematical/Formal Representation

Utilizes quantitative tools: Scheduling (CPM, PERT $t_{\text{exp}} = (t_o + 4t_m + t_p)/6$), Costing (Budgeting, EVM: $\text{CPI} = \text{EV}/\text{AC}$, $\text{SPI} = \text{EV}/\text{PV}$), Risk Analysis (Monte Carlo - Method 84, decision trees - Method 109).

80. Knowledge Creation Spiral (SECI Model - Nonaka & Takeuchi)

Model describing organizational knowledge creation via interplay between tacit/explicit knowledge through four conversion modes (Socialization Tacit→Tacit, Externalization Tacit→Explicit, Combination Explicit→Explicit, Internalization Explicit→Tacit) in a continuous spiral. Informs Step 7 learning.

Mathematical/Formal Representation

Conceptual framework of socio-cognitive processes. Not typically represented mathematically, though aspects relate to network analysis, information theory, learning curves.

81. Experiential Learning Cycle (Kolb)

Model describing learning as a cycle transforming experience: Concrete Experience (CE-Doing) → Reflective Observation (RO-Reviewing) → Abstract Conceptualization (AC-Theorizing) → Active Experimentation (AE-Planning/Trying). Emphasizes learning through reflection on action, aligning with WTF 6.0's Step 7.

Mathematical/Formal Representation

Qualitative conceptual model. Associated Learning Style Inventory (LSI) uses scoring to place individuals on AC-CE and AE-RO axes.

82. Organizational Learning (Argyris & Schön)

Theories distinguishing single-loop learning (correcting errors within existing norms/assumptions) from double-loop learning (questioning/modifying underlying norms/assumptions). Highlights defensive routines inhibiting deeper learning and gaps between espoused theory vs. theory-in-use. Informs Step 7.

Mathematical/Formal Representation

Conceptual models of organizational behavior. Relates conceptually to control theory (single-loop = error correction, double-loop = changing setpoint/structure) or potentially game theory for defensive routines.

83. Mindset (Dweck)

Psychological concept distinguishing Fixed Mindset (belief abilities are fixed) from Growth Mindset (belief abilities can be developed). Influences response to challenge, effort, feedback, impacting learning and achievement throughout WTF 6.0, especially Step 7. Goal is fostering growth mindset.

Mathematical/Formal Representation

Qualitative psychological construct. Effects on performance/learning measured quantitatively in research (e.g., linking mindset questionnaire scores to outcomes via regression/ANOVA).

84. Visual Display of Quantitative Information (Tufte)

Principles for designing clear, efficient, accurate data graphics by maximizing data-ink ratio, avoiding chartjunk, ensuring graphical integrity (Lie Factor=1), using appropriate forms, maximizing density, facilitating comparisons (Steps 1, 4, 5, 6). Goal: graphical excellence supporting clear thinking.

Mathematical/Formal Representation

Design principles. Quantifiable concepts include Data-Ink Ratio = $\text{Data-Ink} / \text{Total Ink}$, Lie Factor = $(\text{Size effect in graphic}) / (\text{Size effect in data})$, Data Density = $(\# \text{ entries}) / (\text{Area})$.

85. Information Dashboard Design (Few)

Principles for designing visual displays consolidating critical metrics (KPIs) on a single screen for rapid monitoring and situation awareness (Step 6, 7). Emphasizes clear purpose/audience, key metrics with context (comparisons, targets), logical organization, appropriate simple visualizations (bullet graphs, sparklines).

Mathematical/Formal Representation

Design discipline. Math relates to displayed metrics: KPI formulas, comparison calculations (Δ , $\% \Delta$). May incorporate SPC control charts ($\mu \pm 3\sigma$).

86. Functional Art (Cairo)

Approach to information graphics balancing Truthfulness (accuracy), Functionality (fitness for purpose/audience), Beauty (aesthetics/elegance), and Insightfulness (revealing patterns) (Steps 5, 6). Emphasizes designing visualizations to help audiences understand information effectively. Integrates design, stats, cognition.

Mathematical/Formal Representation

Qualitative design principles integrating cognitive/aesthetic aspects with accurate data representation (Method 84 principles apply). Focus is effective communication.

87. Data and Goliath (Schneier - Privacy/Surveillance Context)

Critical analysis of pervasive data collection (corporate/government) and implications for privacy, security, power. Emphasizes awareness of surveillance, data as power, privacy harms, data security risks, metadata significance. Guides ethical considerations (E) in data handling throughout WTF 6.0.

Mathematical/Formal Representation

Ethical/critical perspective. Related technical fields use math: Differential Privacy ((ϵ, δ) -DP bounds privacy loss), Anonymization metrics (k-anonymity), Security Risk ($P \times I$).

88. Understanding Privacy (Solove)

Pragmatic taxonomy classifying privacy harms into four categories (Information Collection - surveillance/interrogation; Processing - aggregation/insecurity/secondary use; Dissemination - disclosure/distortion/breach; Invasion - intrusion/decisional interference). Aids structured analysis of specific privacy problems under Ethical Consciousness (E).

Mathematical/Formal Representation

Qualitative classification system. Risk assessment might assign Likelihood/Impact scores to harms. Formal privacy models (k-anonymity, DP) aim to mathematically limit risk of specific harms (Identification, Disclosure).

89. Security Engineering (Anderson)

Discipline of building dependable systems resilient to malice/error/mischance. Integrates technical controls (crypto, access control) with economics, psychology, usability, threat analysis, failure modes, lifecycle approach. Aims for risk management. Informs Ethical Considerations (E) and analysis/solutions (Steps 1, 5, 6).

Mathematical/Formal Representation

Draws on Cryptography (number/complexity theory), Formal Methods (logic, proofs), Risk Analysis ($P \times I$), Game Theory (Method 113), Information Theory (entropy H).

90. Threat Landscape Reports (e.g., ENISA)

Periodic reports summarizing prevalent cybersecurity threats, vectors, actors, vulnerabilities based on aggregated incident/research data. Provide situational awareness for risk assessment and resource allocation (Input to Steps 1, 3, 4, 5, 6).

Mathematical/Formal Representation

Present descriptive statistics (frequencies f_i , percentages p_i of threat types), time series trends. May use risk matrices (Likelihood x Impact). Often reference structured TTP knowledge bases (MITRE ATT&CK®).

91. Universal Declaration of Human Rights (UDHR) Concepts

Using the foundational UDHR principles (listing civil, political, economic, social, cultural rights) as a framework for ethical analysis (E). Involves assessing potential impacts of problem X, analysis process, or solutions on fundamental human rights (privacy, expression, assembly, non-discrimination, etc.) throughout WTF 6.0.

Mathematical/Formal Representation

Normative ethical framework, primarily qualitative. May use quantitative indicators to measure state of specific rights, or risk matrices for assessing potential harms, but rights are principles.

92. Critical Questions for Big Data (boyd & Crawford)

Critical framework questioning epistemological, methodological, ethical assumptions of Big Data analysis. Prompts reflection on data bias, algorithmic objectivity, context loss, digital divides, ethical implications (E) vs. claims of objective truth from large datasets (relevant throughout WTF 6.0).

Mathematical/Formal Representation

Qualitative critique questioning assumptions behind quantitative analysis (e.g., statistical significance vs practical, sampling bias in $N=\text{all}$, algorithmic bias $f(\text{Data})$). Relates to fairness metrics attempting quantification.

93. Privacy in Context (Nissenbaum)

Theory of "Privacy as Contextual Integrity" arguing privacy is about ensuring information flows conform to context-specific norms (actors, attributes, transmission principles). Violations occur when norms are breached. Evaluates privacy based on appropriateness of flow within social context (informs E throughout WTF 6.0).

Mathematical/Formal Representation

Qualitative normative framework. Formal logic attempts exist (e.g., deontic logic for permissions $\text{Permitted}(\text{Flow}|\text{Context}, \text{Principle})$). Core application is qualitative analysis of norms.

94. Homo Deus (Harari - Future Context/Ethics)

Using Harari's analysis of potential future human agendas (immortality, happiness, divinity via tech), rise of AI/algorithms, Dataism ideology, and resulting ethical challenges/inequalities as a tool for long-term foresight and deeper ethical reflection (E) on current trends/analyses (Steps 1, 5, 6).

Mathematical/Formal Representation

Philosophical speculation, historical synthesis. Qualitative framework for long-term ethical/contextual consideration.

95. Enlightenment Now (Pinker - Progress Context)

Using Pinker's data-driven argument that reason, science, humanism have driven long-term progress (health, wealth, safety) to contextualize problems (Step 1, 5), counter negativity bias, and inform solutions (Step 6) based on empirically successful principles. Informs E.

Mathematical/Formal Representation

Relies heavily on Descriptive Statistics (Method 70) and Time Series Analysis (Method 73) of historical data (often visualized with line graphs, log scales). Core argument interprets these quantitative trends qualitatively.

96. Blink / Thinking Without Thinking (Gladwell)

Exploring rapid cognition ("thin-slicing", intuition, adaptive unconscious). Acknowledges potential accuracy (esp. experts in domain) but highlights risks of error/bias (stereotypes, irrelevant cues, stress). Goal is understanding when to trust vs. distrust intuitive judgments within WTF 6.0 (esp. Step 1 trigger vs. Step 5 rigor).

Mathematical/Formal Representation

Qualitative description of psychological phenomena. Relates to Heuristics/Biases research (Method 1/related), Pattern Recognition (ML), Signal Detection Theory.

97. Victims of Groupthink (Janis)

Theory describing how cohesive in-groups seeking unanimity can override realistic appraisal, leading to flawed decisions. Identifies antecedent conditions, symptoms (overestimation, closed-mindedness, uniformity pressure), and prevention strategies. Informs collaborative aspects of WTF 6.0 (esp. Steps 5, 6, 7).

Mathematical/Formal Representation

Qualitative social psychological theory. Game theory might model conformity aspects, but core model is conceptual.

98. Making Social Science Matter (Flyvbjerg)

Advocates for social science embracing *phronesis* (practical wisdom, context-dependent judgment) over emulating natural science's predictive theory (episteme). Emphasizes context, values, power analysis, case studies, and producing input for public deliberation to make inquiry relevant. Informs WTF 6.0 ethos (context, E, actionable outcomes).

Mathematical/Formal Representation

Qualitative, philosophical critique of over-reliance on predictive mathematical models in social science. Prioritizes qualitative methods (case study, ethnography). Quantitative data used contextually.

99. Creating the Corporate Future (Ackoff - Interactive Planning)

Proactive systems approach (Interactive Planning) where organization designs desirable future (Idealized Design based on Ends) and invents ways (Means) to bring it about, dissolving systemic problems ("the mess"). Emphasizes participation, continuity, holism, learning/adaptation. Frames application of WTF 6.0 to systemic problems.

Mathematical/Formal Representation

Systems methodology, primarily conceptual/procedural. May use math models within phases: CLDs/SD/ABM (Mess), optimization/decision analysis (Means), budgeting (Resources), control metrics (Control), but philosophy is key.

100. Value Sensitive Design (VSD)

Methodology proactively integrating human values (privacy, fairness, autonomy) throughout technology design via iterative conceptual (identify values/stakeholders), empirical (understand user perspectives/context), and technical (analyze tech properties, design value-supporting mechanisms) investigations. Operationalizes E in WTF 6.0.

Mathematical/Formal Representation

Primarily qualitative methodology. Empirical phase may use quantitative methods. Technical phase may use formal methods to verify value properties (e.g., privacy) or optimization/MCDA to balance values (requires quantification).

101. AI: Its Nature and Future (Boden)

Philosophical/historical perspective on AI exploring different paradigms (Symbolic, Connectionist, Bio-inspired), creativity types (Combinational, Exploratory, Transformational), capabilities vs. understanding, limitations (bias, explainability), future trajectories. Promotes nuanced view of AI informing AI Augmentation (A) in WTF 6.0.

Mathematical/Formal Representation

Philosophical/conceptual. Math relates to specific AI techniques discussed: Formal Logic (Symbolic), Linear Algebra/Calculus/Probability (Connectionism), Evolutionary Algorithms math.

102. Bias in Computer Systems (Friedman & Nissenbaum)

Taxonomy categorizing bias sources in computer systems: Preexisting (individual/societal biases in data/assumptions), Technical (hardware/software constraints, formalization choices), Emergent (arising from use, context mismatch, feedback loops). Aids systematic bias identification/mitigation for E and A in WTF 6.0.

Mathematical/Formal Representation

Conceptual categorization. Quantifying bias uses Fairness Metrics (Demographic Parity $P(\hat{Y} = 1|A = a) = P(\hat{Y} = 1|A = b)$, Equalized Odds, etc.) or statistical analysis of data bias.

103. Assumption Challenging (Listing/Smashing)

Critical thinking technique explicitly identifying underlying assumptions (Method 11) and systematically questioning/negating ("smashing") them to explore alternatives, uncover vulnerabilities, break conventions, and generate robust analyses or creative solutions (Throughout WTF 6.0).

Mathematical/Formal Representation

Logical/critical thinking process. Formal logic: Assess truth of premise P , explore implications of $\neg P$. Bayesian: Re-evaluate prior $P(\text{Assumption})$. Modeling: Sensitivity analysis on parameters (θ) or structure.

104. Decision Matrix Analysis (Weighted Criteria)

Systematically evaluates multiple options (O_j) against predefined criteria (C_i) by scoring each option against each criterion (S_{ij}), weighting scores by criterion importance (W_i), and summing to find the best alternative based on total weighted score (Steps 2, 3, 5, 6).

Mathematical/Formal Representation

Total Score $TS_j = \sum_{i=1}^n (S_{ij} \times W_i)$. Choose option maximizing TS_j . Form of MAUT/MCDA using weighted sum model.

105. Paired Comparison Analysis

Determines relative priority/preference of items by comparing them head-to-head in pairs based on a specific criterion. Tallying wins or preference scores creates a ranked order. Useful when direct ranking is hard (Steps 2, 3, 5, 6). Can derive weights for Method 104.

Mathematical/Formal Representation

Tally Score = $\sum_{j \neq k} \mathbb{I}(I_k > I_j)$ or sum preference scores. Rank based on score. Related to ranking algorithms, preference modeling (AHP, Thurstone).

106. SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats)

Strategic planning framework identifying entity's Strengths (Internal+), Weaknesses (Internal-), Opportunities (External+), Threats (External-) relative to objectives/environment (Steps 1, 5). TOWS matrix analyzes intersections (S-O, S-T, W-O, W-T) to form strategies (Step 6). Provides structured situational overview.

Mathematical/Formal Representation

Primarily qualitative. Can involve scoring factors or using MCDA methods to prioritize TOWS strategies.

107. Porter's Five Forces Analysis

Analyzes industry competitive structure and attractiveness based on five forces: Threat of New Entrants, Bargaining Power of Buyers, Bargaining Power of Suppliers, Threat of Substitutes, Intensity of Rivalry (Steps 1, 5). Assessing force strength informs strategy (Step 6).

Mathematical/Formal Representation

Qualitative framework assessing force strength (H/M/L). Econometrics might link structure variables (concentration) to profitability (ROI). Game theory (Method 113) can model specific rivalries.

108. Cost-Benefit Analysis (CBA)

Systematically compares total expected costs against total expected benefits of a project/policy/decision (Step 6), usually monetized and discounted to present value (PV). Assesses economic efficiency (NPV > 0? BCR > 1?) to support rational resource allocation / choices.

Mathematical/Formal Representation

Present Value $PV = \sum_{t=0}^T \frac{FV_t}{(1+r)^t}$. Net Present Value $NPV = \sum_{t=0}^T \frac{B_t - C_t}{(1+r)^t}$. Benefit-Cost Ratio $BCR = PV_B / PV_C$. Internal Rate of Return (IRR) finds r^* where NPV=0.

109. Decision Tree Analysis (Quantitative)

Graphically models/evaluates sequential decisions (squares) under uncertainty (circles with probabilities) leading to consequences (end nodes with payoffs) (Steps 5, 6). Uses rollback (backward pass) calculating expected value (EV) to identify optimal decision strategy maximizing EV/utility.

Mathematical/Formal Representation

Rollback calculates Expected Value/Utility $EU(v)$. At Chance Node: $EU(v) = \sum P(o_i) \times EU(v_i)$. At Decision Node: $EU(v) = \max_j \{EU(v_j)\}$. Finds $EU(v_{\text{root}})$ and optimal path.

110. Pareto Analysis (80/20 Rule)

Technique based on Pareto Principle (80

Mathematical/Formal Representation

Rank items by impact $I_{(i)}$. Calculate Cumulative % = $(\sum_{i=1}^k I_{(i)} / I_{\text{total}}) \times 100\%$. Identify smallest k^* s.t. Cumulative % $\geq 80\%$. Pareto chart visualizes $I_{(i)}$ and Cumulative %.

111. MoSCoW Method

Prioritization technique categorizing requirements/features as Must have (critical), Should have (important), Could have (desirable), Won't have (out of scope for now) (Steps 2, 3, 4, 6). Manages scope/expectations in projects.

Mathematical/Formal Representation

Qualitative prioritization into ranked categories: Must > Should > Could > Won't.

112. Force Field Analysis (Lewin)

Framework diagnosing change situations (Steps 1, 5, 6) by identifying Driving Forces (pushing for change) and Restraining Forces (resisting change). Assesses relative strengths (often scored 1-5) to understand equilibrium and identify strategies (strengthen drivers, weaken restrainers) for enacting change.

Mathematical/Formal Representation

Primarily qualitative diagnosis. Uses subjective strength scores S_i . Change requires $\sum S_{\text{driving}} > \sum S_{\text{restraining}}$. Visual diagram shows force balance.

113. Game Theory Concepts

Mathematical framework analyzing strategic interactions between rational players where outcomes depend on interdependent actions (Step 5). Models games (players, strategies, payoffs) using normal form (matrix) or extensive form (tree) to predict behavior via solution concepts (Dominant Strategy, Nash Equilibrium).

Mathematical/Formal Representation

Defines game $(N, \{S_i\}, \{u_i\})$. Nash Equilibrium s^* if $u_i(s_i^*, s_{-i}^*) \geq u_i(s_i, s_{-i}^*)$ for all i, s_i . Calculates expected utility for mixed strategies. Uses concepts like backward induction.

114. Real Options Analysis

Applies financial option valuation techniques (Black-Scholes, Binomial Lattices, Monte Carlo) to decisions on real assets/projects under uncertainty (Steps 5, 6). Explicitly values managerial flexibility (options to defer, expand, abandon) often missed by static NPV (Method 108 related).

Mathematical/Formal Representation

Calculates Option Value (OV) using methods like Binomial Lattices ($f = e^{-r\Delta t}[pf_u + (1-p)f_d]$ rollback) or modified Black-Scholes. Expanded NPV = Static NPV + OV.

115. BLUF (Bottom Line Up Front)

Communication principle starting documents/briefings with the main conclusion/recommendation before details (Step 6). Ensures core message received immediately by busy audiences.

Mathematical/Formal Representation

Qualitative communication structure principle.

116. Executive Summary Writing

Crafting a concise, standalone overview of a longer document (Step 6 output), highlighting purpose, key findings, conclusions, recommendations for busy stakeholders. Written after main document. Incorporates BLUF (Method 115).

Mathematical/Formal Representation

Qualitative communication skill summarizing potentially quantitative findings.

117. Structured Reporting Templates

Predefined formats/outlines specifying standard sections, headings, information order for reports (intelligence, project status, etc.) (Step 6 output). Ensures consistency, completeness, clarity, efficiency across multiple reports.

Mathematical/Formal Representation

Qualitative organizational tool defining report structure. Aids consistency for potential later meta-analysis.

118. Narrative Analysis / Storytelling with Data

Combines Narrative Analysis (Method 62 - understanding story structure) with constructing compelling narratives *around* data findings (Step 6) using story elements (setup, conflict, resolution), effective visuals (Methods 84-86, 119), and clear explanations to communicate insights memorably and persuasively.

Mathematical/Formal Representation

Communication methodology using qualitative narrative structures supported by (potentially quantitative) data visualization adhering to accuracy principles (Method 84).

119. Data Visualization Best Practices (Tufte, Few, Cairo)

Synthesized principles (from Tufte - Method 84, Few - Method 85, Cairo - Method 86) for creating effective data visualizations (throughout WTF 6.0): choosing appropriate chart types based on purpose/audience, designing for clarity/accuracy (high data-ink, no chartjunk, integrity), leveraging perception, enabling comparisons, integrating text.

Mathematical/Formal Representation

Design principles ensuring accurate data representation (Lie Factor = 1, proper scales) and leveraging perceptual understanding (Gestalt, preattentive attributes).

120. Stakeholder Communication Strategy

Planned approach for interacting/sharing information with identified stakeholders (Method 8). Involves determining who needs what info, when, how (channel/method), and by whom, documented in a communication plan (guides Step 6 delivery and feedback in Step 7). Manages expectations, ensures alignment, gathers input.

Mathematical/Formal Representation

Primarily qualitative strategic planning process. Input (Stakeholder Analysis) may involve scores, but output plan focuses on non-mathematical elements (channel, frequency, message, responsibility).