

في هذا العدد:

- علاج الأخطاء الشائعة المتعلقة بالصلاة في ضوء مقاصد سورة البقرة: دراسة تحليلية
عتيق الله مهران فقير خان، والسيد سيد أحمد محمد نجم، ويوسف محمد عبده محمد العواضي
- العرض المقارن المقيّد بالمصدر: منهجية لتوظيف الذكاء الاصطناعي في التفسير المقارن وتطبيق تجريبي على جزء عم
محمود حمود، وعبد الغني قمر جمعة جاد الله
- Definiteness and Indefiniteness in Recurring Qur'anic Vocabulary: A Semantic and Contextual Study
Mohammed Minhaj Uddin
- Knowledge and the Foundations of Scientific Methodology in the Noble Quran
Souad Ouhab; Nacera Mamache
- نعمة معرفة الخالق وهدايتها التربوية في ضوء القرآن الكريم: دراسة موضوعية
مروة سلطان عديل الجابري، وعبد العالي باي زكوب، ويوسف محمد عبده محمد
- الصبر في مواجهة الاختلاف عند الأنبياء في القرآن الكريم: دراسة موضوعية
هرشي بولندي، والسيد سيد أحمد محمد نجم
- الأحاديث الحسنة التي أخرجها ابن حبان في صحيحه من بداية باب العفو من كتاب البر والإحسان- إلى نهاية باب الجار: جمعاً ودراسة
أروى حسن حمزة مشرف، ومهدي عبدالعزيز
- منهج الصحابة في اختيار الخليفة: دراسة تحليلية
جواد أحمد أحمد القاضي، وإبراهيم محمد البيومي
- الخواء الروحي ودوره في نزعة الانتحار: دراسة عقديّة
شداد بن خالد محمد عطية
- الدين والصحة النفسية: دراسة تأصيلية في أثر العقيدة والعبادة والأخلاق في تحقيق الاتزان النفسي
محمد خير حسن محمد العمري
- دعاوى المشركين الواردة في القرآن الكريم المتضمنة القدح في الإيمان بالله تعالى، ومنهج القرآن في الرد عليها: جمعاً ودراسة
سلطان عالي علي السفياني
- سجود الكون وتسبيحه لله عز وجل بين الوحي والمعطيات العلمية
أسماء عبد المجيد الزنادي
- الآثار القضائية لتأجيل الحكم في الفقه الإسلامي والقانون الغامبي: دراسة مقارنة
عبدالله محمد حالي، ومجدي عبد العظيم إبراهيم فرج
- تأصيل نظرية الضمان الذكي في المسؤولية المدنية عن أضرار أنظمة الذكاء الاصطناعي: دراسة فقهية تطبيقية
سعيد محمد عزيز برون
- الإمام الشوبري ومنهجه في حاشيته على تحفة الطلاب شرح التحرير للأتصاري
حسين علي جبر معيوف، ونادي قبضي
- المآلات وعلاقتها بالعلل والأسباب والشروط عند ابن تيمية: دراسة أصولية تحليلية
هشام برزنجي، وصلاح عبدالنواب
- آراء الإمام النسائي الفقهية المتعلقة بأحكام الأسرة: دراسة تحليلية
نجاة حسين عبدالرحمن باجمال، وصلاح عبدالنواب
- منهج الشيخ الإتيوبي في الترجيح بين الأدلة الشرعية المتعارضة
حسن محمد خلاوي، وصلاح عبدالنواب
- UVIF as a Computational Framework Compatible with Islamic Epistemology and Decision Philosophy
Habib Hamam
- الإدارة التنظيمية في مرحلة التمكين: قراءة تحليلية في نموذج موسي (عليه السلام) من خلال سورة يونس (الآية 87)
نجم عبد الودود نعمة الجزائري



UVIF as a Computational Framework Compatible with Islamic Epistemology and Decision Philosophy

[إطار UVIF الحاسوبي ومدى توافقه مع نظرية المعرفة الإسلامية وفلسفة اتخاذ القرار]

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Abstract

Contemporary artificial intelligence systems increasingly operate in environments characterized by irreducible uncertainty, partial observability, and value-laden trade-offs. Deterministic and certainty-seeking paradigms have proven insufficient for these challenges. This article introduces the Unified Variational Intelligence Framework (UVIF) as a computationally grounded, epistemically humble approach to machine reasoning and decision-making. UVIF is characterized by variational equilibrium principles, bounded rationality, and iterative policy commitment under residual uncertainty. We demonstrate that UVIF's core architectural commitments epistemic exploration before action, residual uncertainty acknowledgment, and human-centered ethical alignment bear remarkable structural and philosophical congruence with foundational principles of Islamic epistemology and decision philosophy. Specifically, we examine correspondences between UVIF's variational equilibrium and the Islamic concept of Tawakkul (trust and commitment after exhausting available means), between variational inference and the Islamic epistemological hierarchy of Yaqin, Zann, and Shakk, and between bounded rationality and the Quranic recognition of the inherent limitations of human knowledge. This alignment is not merely metaphorical. We argue it reflects a strong structural correspondence a shared functional architecture of reasoning and action under uncertainty between principled probabilistic reasoning and the Islamic jurisprudential tradition of Ijtihad, which proceeds from incomplete evidence toward actionable, revisable judgments. Applications to jurisprudential decision support, ethical AI for Islamic communities, explainable cultural AI, and autonomous systems operating under moral constraints are discussed. The article contributes to the emerging interdisciplinary dialogue between Islamic intellectual tradition and the theoretical foundations of trustworthy artificial intelligence.

Keywords: Variational Intelligence (UVIF); Islamic Epistemology; Tawakkul; Decision-Making Under Uncertainty; Ethical AI

الملخص

شهدت السنوات الأخيرة اهتمامًا متزايدًا بالذكاء الاصطناعي القادر على التعامل مع عدم اليقين، والقيود المعرفية، واتخاذ القرار في البيئات المعقدة. وفي الوقت نفسه، طوّرت الحضارة الإسلامية عبر قرون طويلة منظومة معرفية وأخلاقية متكاملة لمعالجة المشكلات المرتبطة بالمعرفة المحدودة، والاجتهاد، والموازنة بين المصالح والمفاسد، واتخاذ القرار في ظل غياب اليقين الكامل. تهدف هذه الدراسة إلى استكشاف أوجه التوافق الفلسفي والمعرفي بين الإطار الموحد للذكاء التغييري (UVIF) وبعض المفاهيم المركزية في نظرية المعرفة الإسلامية وفلسفة اتخاذ القرار. ولا تدّعي الدراسة أن UVIF إطار إسلامي في أصله أو في بنيته الرياضية، بل تسعى إلى إظهار أن العديد من مبادئه الأساسية تتوافق مع مفاهيم راسخة في التراث الإسلامي، مثل الأخذ بالأسباب، والتوكل، والاجتهاد، والشورى، والعقلانية المقيدة، والاعتراف بمحدودية المعرفة البشرية. وتبيّن الدراسة أن الفكر الإسلامي ينظر إلى اتخاذ القرار بوصفه عملية تتم في ظل معلومات غير مكتملة وقيود متعددة ومتعارضة أحيانًا، وأن المطلوب ليس الوصول إلى يقين مطلق، بل تحقيق توازن مسؤول بين الأدلة والقيود والنتائج المتوقعة. كما توضح الدراسة أن العديد من الآيات القرآنية والمفاهيم الفقهية يمكن فهمها باعتبارها نماذج لاتخاذ القرار القائم على التوازن بين أهداف متنافسة، وهو ما ينسجم مع فلسفة UVIF القائمة على البحث عن حالة توازن تغييري بين الاستكشاف المعرفي، والمنفعة المتوقعة، والقيود الأخلاقية، وعدم اليقين المتبقي. وتقترح الدراسة عددًا من التطبيقات المحتملة لهذا التوافق، من بينها أنظمة دعم القرار الفقهية، والمساعدات الذكية المتوافقة مع القيم الإسلامية، واتخاذ القرار الاجتماعي والأخلاقي، وتطوير أطر جديدة للذكاء الاصطناعي الجدير بالثقة. وتخلص الدراسة إلى أن التراث الإسلامي يمكن أن يقدم مساهمة فلسفية ذات قيمة في النقاشات المعاصرة المتعلقة بالذكاء الاصطناعي وعدم اليقين واتخاذ القرار المسؤول.

الكلمات المفتاحية: الذكاء التغييري، UVIF، نظرية المعرفة الإسلامية، التوكل، الأخذ بالأسباب، الاجتهاد، اتخاذ القرار، عدم اليقين، الذكاء الاصطناعي الأخلاقي.

1. INTRODUCTION

1.1 Context and Motivation

The proliferation of artificial intelligence across high-stakes domains — from clinical medicine and autonomous transportation to public policy and judicial support — has intensified scrutiny of the epistemic and ethical foundations of AI systems. A growing consensus in the AI research community holds that classical deterministic architectures, which seek point-estimate solutions under assumptions of complete information, are fundamentally misaligned with the complexity of real-world reasoning [32, 56]. Such paradigms tend toward overconfidence, produce brittle behavior under distribution shift, and lack the interpretive flexibility required for morally sensitive domains.

Concurrently, Islamic intellectual traditions have, across fourteen centuries, developed sophisticated frameworks for reasoning under uncertainty, acknowledging epistemic limitations, and grounding action in principled commitment despite irreducible unknowns. The Quranic discourse on knowledge — distinguishing between divine omniscience (Al-Ilm al-Mutlaq) and human bounded knowledge (Al-Ilm al-Muqayyad) — and the jurisprudential tradition of Ijtihad represent intellectual achievements that resonate deeply with modern challenges in AI epistemology [22, 6].

This article contends that the Unified Variational Intelligence Framework (UVIF), a decision-theoretic architecture built upon variational Bayesian principles and free energy minimization, constitutes a computational framework whose structural commitments are philosophically aligned with — and may be enriched by — Islamic epistemology and decision philosophy. This is not a claim of historical derivation but of conceptual isomorphism: both frameworks grapple with the same fundamental problem of rational action under irreducible uncertainty, and both arrive at structurally similar solutions. Throughout this article, the expression “structural isomorphism” is used in a deliberately restricted, non-formal sense: it denotes a correspondence of functional roles — the role a concept plays within the overall architecture of reasoning and action under uncertainty — rather than a formally demonstrated mathematical isomorphism between two axiomatized systems. Where a correspondence remains primarily conceptual rather than functionally demonstrated, we describe it as a conceptual correspondence, and Table 3 makes the nature and the limits of each analogy explicit.

1.2 Problem Statement

The dominant paradigm in AI system design remains rooted in expected utility maximization under deterministic or weakly stochastic assumptions. While powerful in narrow domains, this paradigm struggles with three interrelated challenges: epistemic overconfidence (producing incorrect decisions with high stated certainty), ethical opacity (inability to represent and balance competing values), and cultural non-transferability (frameworks calibrated to Western rationalist assumptions that do not translate to diverse epistemological communities). These limitations are well-documented in the AI ethics literature [19, 14, 37].

Islamic communities represent approximately 1.8 billion people whose intellectual, legal, and ethical frameworks derive from a distinct epistemological tradition. The design, deployment, and governance of AI systems in contexts informed by Islamic values requires

not merely superficial localization but deep architectural alignment with the epistemic and ethical commitments of that tradition [12, 18]. UVIF, we argue, provides a promising computational architecture for this purpose.

1.3 Research Hypothesis

The central hypothesis of this article is threefold. First, UVIF's variational equilibrium — the process of minimizing free energy across a space of possible world-models before committing to action — is structurally isomorphic to the Islamic principle of Tawakkul, understood as complete commitment to action after exhausting available causal means. Second, UVIF's treatment of bounded rationality and epistemic uncertainty is aligned with the Islamic epistemological tradition's nuanced hierarchy of knowledge states. Third, this alignment is plausibly not coincidental but reflects a broader convergence: principled reasoning under uncertainty in any domain tends, insofar as it is coherent, to converge on similar architectures. This third claim is advanced as a philosophical conjecture supported by the correspondences documented in this article, not as a formally demonstrated theorem.

1.4 Main Contributions

This article makes four primary contributions. First, it provides a systematic conceptual mapping between UVIF's architectural principles and core concepts in Islamic epistemology and decision philosophy. As illustrated in Fig. 1, the proposed framework positions UVIF as an interdisciplinary bridge connecting artificial intelligence, decision theory, variational intelligence, ethical reasoning, and Islamic epistemology through a common architecture of uncertainty-aware and bounded rational decision-making. The figure further highlights the structural relationships between UVIF and concepts such as bounded rationality, uncertainty-aware AI, Tawakkul, Al-Akhḍ bi'l-Asbāb, jurisprudential reasoning, and ethical AI.

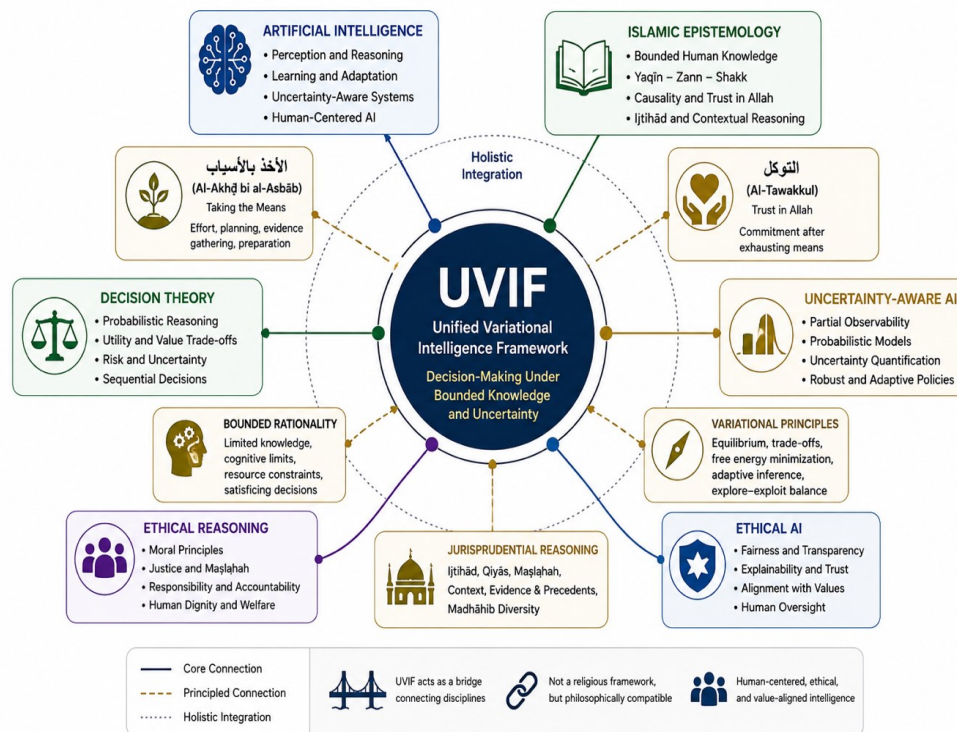


Figure 1: Interdisciplinary positioning of the Unified Variational Intelligence Framework (UVIF) as a computational bridge between artificial intelligence, decision theory, Islamic epistemology, ethical reasoning, and variational intelligence. The figure illustrates how UVIF integrates bounded rationality, uncertainty-aware reasoning, epistemic exploration, الأخذ بالأسباب, التوكل, jurisprudential reasoning, and ethical AI within a unified framework for decision-making under limited knowledge and residual uncertainty.

Second, the article develops a formal account of Tawakkul as decision commitment under residual uncertainty, rendering this theological concept tractable within modern decision theory and uncertainty-aware intelligent systems. Rather than interpreting Tawakkul as passive fatalism, the framework conceptualizes it as a rational commitment mechanism emerging after the exhaustion of available epistemic and practical means.

Third, the article demonstrates the practical applicability of this alignment through multiple application domains spanning jurisprudential support, ethical social decision-making, autonomous systems, culturally sensitive AI, and intelligent Islamic knowledge assistance. These applications illustrate that the UVIF framework is not proposed as a religious AI architecture, but rather as a computational framework whose epistemic structure exhibits strong compatibility with Islamic reasoning traditions.

Fourth, the article advances a broader theoretical argument concerning the value of Islamic intellectual tradition in addressing foundational challenges in trustworthy AI research. In particular, the paper argues that concepts such as bounded human knowledge, calibrated uncertainty, contextual reasoning, causality, consultation, and ethical accountability provide philosophically rich foundations for the development of human-centered and uncertainty-aware intelligent systems.

1.5 Methodological Approach

This article is a structured conceptual study rather than a purely interpretive essay, and its method can be stated explicitly. The Islamic concepts examined were selected according to three criteria: (i) centrality in classical Islamic epistemology and *usul al-fiqh*, as attested in the primary and secondary literature cited throughout Section 2; (ii) direct relevance to reasoning and decision-making under uncertainty, the problem domain UVIF addresses; and (iii) broad acceptance across the major Sunni and, where applicable, wider Islamic intellectual traditions, so that the analysis does not depend on the doctrine of a single school.

The interpretation of each concept follows the mainstream classical understanding — for example, Tawakkul as trust and commitment after the responsible exhaustion of available means, rather than passive fatalism — and is documented against the cited scholarly literature rather than constructed ad hoc for the comparison. The comparative analysis then proceeds in four steps: each Islamic concept is first characterized on its own terms; the candidate UVIF analogue is characterized independently in computational terms; the nature of the correspondence is classified (conceptual, functional, or structural) according to whether the two elements merely share a theme, play the same role in their respective architectures, or exhibit a parallel internal organization; and finally the limits of the analogy are stated. Table 3 summarizes the outcome of this procedure for every correspondence claimed in the article.

This procedure deliberately separates the descriptive task (what each tradition holds) from the comparative task (how the elements correspond), so that each claimed correspondence can be individually examined, criticized, and, where necessary, rejected without undermining the framework as a whole.

1.6 Structure of the Article

The article is organized as follows. Section 2 provides a systematic review of Islamic epistemology and decision philosophy, with particular attention to principles directly relevant to AI design. Section 3 presents UVIF's theoretical foundations, including variational equilibrium, active inference, and bounded rationality. Section 4 develops the conceptual compatibility framework, including formal correspondences and careful delineation of the framework's limits. Section 5 presents five application domains. Section 6 offers philosophical, interdisciplinary, and comparative discussion. Section 7 concludes.

2. FOUNDATIONS OF ISLAMIC EPISTEMOLOGY AND DECISION PHILOSOPHY

2.1 Knowledge and Human Limitation in Islamic Thought

2.1.1 *According to Islamic Thought*

Islamic epistemology represents one of the most philosophically sophisticated systems of knowledge theory in world intellectual history. Its architecture rests on a fundamental ontological distinction: the absolute, complete, and infallible knowledge of God (Al-Ilm al-Mutlaq) stands in categorical contrast to the necessarily limited, perspectival, and fallible knowledge accessible to human beings. This distinction is not merely theological; it has profound epistemological and ethical implications [27, 43].

The Quranic statement that human beings have been given only a limited share of knowledge provides a foundational epistemic orientation for Islamic reasoning. It rejects the illusion of total human certainty and invites a disciplined form of intellectual humility. Within the context of artificial intelligence, this principle is particularly significant because modern intelligent systems also operate under partial observability, incomplete evidence, noisy measurements, and probabilistic inference. Thus, the Islamic recognition of bounded human knowledge offers a meaningful philosophical analogue to uncertainty-aware AI, where the objective is not to claim absolute certainty but to reason responsibly within limited knowledge.

The Islamic knowledge hierarchy recognizes five principal epistemic categories: *Yaqin* (certainty), *Zann* (strong probable belief), *Shakk* (doubt or balanced uncertainty), *Wahm* (weak surmise), and *Muhal* (logical impossibility). As illustrated in Fig. 2, these categories may be interpreted as a graded epistemological spectrum that ranges from near-certainty to impossibility and can be meaningfully compared with modern probabilistic reasoning in AI. This hierarchy, elaborated extensively in classical jurisprudential literature, constitutes a sophisticated probabilistic ontology that anticipates in conceptual form many of the distinctions later formalized in Bayesian epistemology [6]. Crucially, Islamic jurisprudence permits — and often requires — action based on *Zann* when certainty is unattainable, thereby legitimizing decision-making under irreducible uncertainty as not merely permissible but sometimes necessary.

This graded view of knowledge is directly relevant to UVIF because the framework does not require the agent to possess complete knowledge before acting. Rather, UVIF encourages the agent to distinguish between strong evidence, weak evidence, unresolved doubt, and impossible or contradictory assumptions. In this sense, the Islamic hierarchy of

Yaqin–Zann–Shakk–Wahm–Muhāl provides a culturally and philosophically meaningful vocabulary for explaining why uncertainty-aware systems should calibrate their confidence instead of producing overconfident conclusions. A UVIF-compatible system should therefore avoid presenting Zann as Yaqin, avoid acting on Wahm as if it were reliable evidence, and explicitly identify situations of Shakk where further consultation, evidence gathering, or human judgment is required.

Classical Islamic philosophers — al-Ghazali, Ibn Sina, al-Farabi, and Ibn Rushd — further articulated three complementary epistemological methods: Bayani (textual-hermeneutical reasoning), Burhani (demonstrative rational reasoning), and Irfani (intuitive-mystical knowledge). Together, these constitute an integrative epistemology that bridges revelation, reason, and experience [8, 3]. The contemporary relevance of this tripartite framework lies in its insistence that legitimate knowledge may arise from multiple sources, none of which is by itself complete — a position structurally analogous to modern multi-source Bayesian inference.

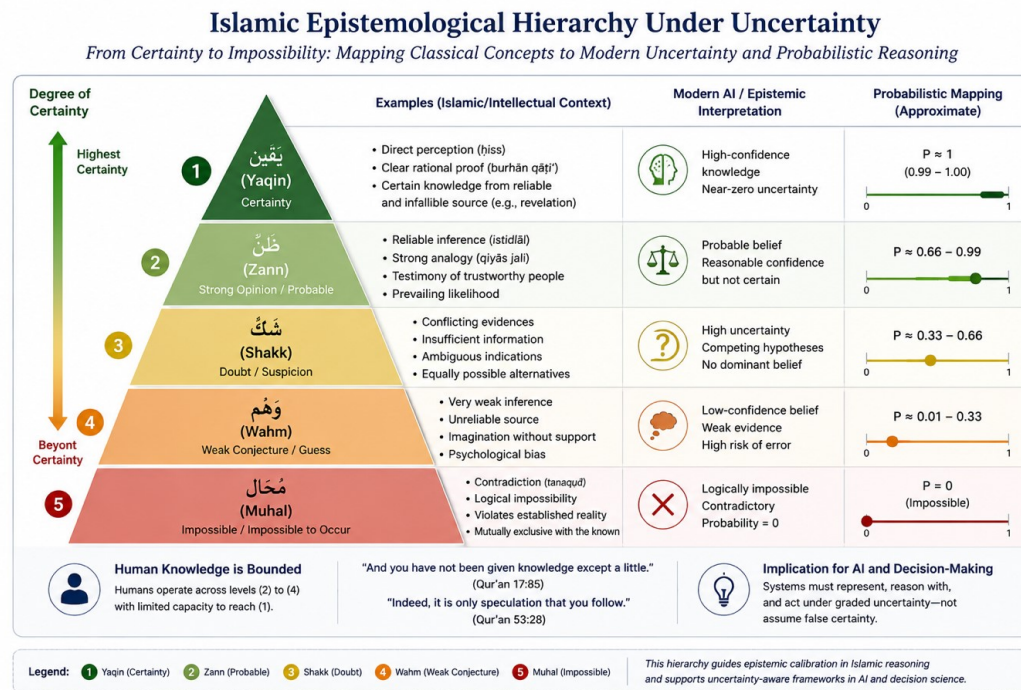


Figure 2: Islamic epistemological hierarchy under uncertainty. The figure maps the classical categories of Yaqin, Zann, Shakk, Wahm, and Muhāl onto a graded uncertainty spectrum and compares them with modern AI interpretations such as high-confidence knowledge, probable belief, competing hypotheses, weak evidence, and logical impossibility. This hierarchy supports the UVIF argument that intelligent systems should reason with calibrated uncertainty rather than assume false certainty.

2.1.2 According to Modern Science

Modern science has progressively revealed that uncertainty and limitation are not merely practical inconveniences arising from insufficient technology or incomplete datasets. Rather, many scientific disciplines now recognize that bounded observation and incomplete knowledge are intrinsic structural features of physical reality itself. This recognition is particularly visible in modern physics, information theory, complexity science, and probabilistic artificial intelligence, all of which acknowledge that complete certainty is

fundamentally unattainable for finite observers operating within time, measurement, and computational constraints.

One of the most influential examples is the Heisenberg uncertainty principle in quantum mechanics, which demonstrates that certain physical properties cannot be simultaneously measured with arbitrary precision. The principle does not merely reflect imperfect instruments; it establishes a structural limitation on observation itself. In simplified form, the relationship may be expressed as:

$$\Delta x \Delta p \geq \frac{\hbar}{\gamma} \quad (1)$$

where:

- Δx represents uncertainty in position,
- Δp represents uncertainty in momentum,
- and $\hbar$ denotes the reduced Planck constant.

The philosophical significance of this principle extends beyond physics. It suggests that uncertainty is not always removable through additional observation or increased computational power. Modern scientific thought therefore increasingly accepts that all observational systems possess epistemic horizons beyond which certainty cannot be fully extended. Similar limitations emerge in chaos theory, where small perturbations generate unpredictable long-term behavior; in information theory, where finite information constrains inference quality; and in machine learning, where noisy data, incomplete sampling, and distribution shifts limit predictive reliability.

As illustrated in Fig. 3, modern science therefore converges toward a view of human knowledge as probabilistic, incomplete, observer-limited, temporally constrained, and model-dependent. Human reasoning operates through partial observation, approximation, statistical inference, and bounded computational capacity. Even highly advanced intelligent systems remain dependent on sensors, data quality, assumptions, models, and contextual interpretation. Consequently, scientific prediction is frequently expressed in probabilistic rather than absolute terms.



Figure 3. Human knowledge versus absolute divine knowledge. The figure contrasts bounded human knowledge with the concept of unrestricted divine knowledge while emphasizing that modern science itself recognizes intrinsic limitations in observation, prediction, and measurement. The left side illustrates human knowledge as probabilistic, incomplete, observer-limited, temporally constrained, and affected by irreducible uncertainty. The central section presents the Heisenberg uncertainty principle as an example of structural observational limitation within physics. The right side illustrates the theological concept of absolute divine knowledge as complete, unrestricted, and not subject to epistemic horizons. The figure does not equate theology with physics; rather, it highlights a philosophical convergence concerning the limits of finite observation and the importance of epistemic humility.

Importantly, the figure does not propose a theological interpretation of physics nor an equivalence between scientific uncertainty and divine attributes. Rather, it illustrates a philosophical convergence: modern science itself acknowledges intrinsic limits in measurement, prediction, and observation. Within Islamic epistemology, these limitations resonate with the principle that complete and unrestricted knowledge belongs only to God, while human knowledge remains necessarily partial and bounded.

This distinction is highly relevant to UVIF because the framework explicitly rejects the assumption of perfect rationality or omniscient intelligence. Instead, UVIF treats uncertainty, partial observability, and bounded inference as foundational conditions of intelligent decision-making. The objective is therefore not to eliminate uncertainty entirely, but to organize reasoning responsibly under incomplete knowledge while continuously updating beliefs through evidence, contextual adaptation, and iterative learning.

From this perspective, modern scientific epistemology and Islamic epistemology converge on a shared recognition of epistemic humility. Both acknowledge that finite observers cannot fully capture the complexity of reality. The resulting challenge is not to attain impossible certainty, but to develop principled mechanisms for acting responsibly despite irreducible

uncertainty. This convergence forms one of the central philosophical foundations of the UVIF framework.

2.2 The Principle of *Al-Akhdh bi'l-Asbab* (الأخذ بالأسباب)

A cornerstone of Islamic decision philosophy is the principle of *Al-Akhdh bi'l-Asbab* — the active utilization of all available causal means before entrusting outcomes to divine will. This principle, grounded in prophetic tradition and elaborated in classical jurisprudence, establishes that reliance on God does not preclude — but rather presupposes — the exhaustive exercise of human agency and practical reason.

The principle has three operational dimensions. First, it mandates epistemic due diligence: the decision-maker must gather all accessible information and apply available analytical tools before acting. Second, it requires practical deployment: available physical, social, and institutional means must be employed. Third, it establishes causal humility: even after exhausting available means, outcomes are understood as contingent on factors beyond human control. This three-phase structure — gather information, deploy means, accept residual uncertainty — maps with remarkable precision onto the UVIF action cycle of epistemic exploration, policy selection, and variational commitment [29, 55].

2.3 The Principle of *Tawakkul* (التوكل)

2.3.1 *Tawakkul after Finding an Equilibrium*

Tawakkul is among the most theologically rich and practically significant concepts in Islamic ethics. Frequently rendered in English as “trust in God” or “reliance on God,” this translation captures only the surface of a concept whose depth encompasses a complete philosophy of action under uncertainty [17, 2].

A systematic thematic analysis of Quranic verses on *Tawakkul* reveals seven core dimensions: (1) the necessity of *Tawakkul* in the lives of prophets; (2) *Tawakkul* as the cornerstone of faith; (3) optimism and fearlessness under uncertainty; (4) *Tawakkul* as an exclusive right of God to whom outcomes belong; (5) *Tawakkul* as a distinguishing quality of true believers; (6) the essential role of maximal human effort before entrusting outcomes to God; and (7) unconditional acceptance of divine will regardless of outcome [2].

Critically, Islamic scholars from al-Ghazali onward have insisted that *Tawakkul* is not passivity but a form of active commitment: it is the mental and volitional state achieved after—and only after—exhausting available epistemic and practical resources [34]. This understanding directly parallels the decision-theoretic notion of policy commitment under residual uncertainty: the rational agent commits to action not when certainty is achieved (which may be impossible) but when further deliberation yields diminishing marginal returns. *Tawakkul*, on this account, is the psychological and ethical dimension of this commitment.

As illustrated in Fig. 4, the process begins with **taking the available means (*Al-Akhdh bi'l-Asbab*)**, including information gathering, consultation, planning, and the responsible deployment of available resources. These efforts are followed by careful deliberation and assessment of the remaining uncertainty. Once the decision-maker reaches a state of **bounded certainty**—where further investigation is unlikely to produce substantial additional benefit—the appropriate course is to commit to a decision and act. *Tawakkul* therefore follows, rather than replaces, rational inquiry and practical effort.

Figure 4 also emphasizes one of the central theses of this article: **Tawakkul is not passive surrender or fatalism**. Instead, it represents informed and ethically grounded decision commitment after reasonable investigation has been completed. In modern computational language, it corresponds to the transition from epistemic exploration to action execution under residual uncertainty. This interpretation is highly consistent with the UVIF philosophy, where intelligent agents continuously reduce uncertainty but eventually commit to action despite the impossibility of achieving complete knowledge.

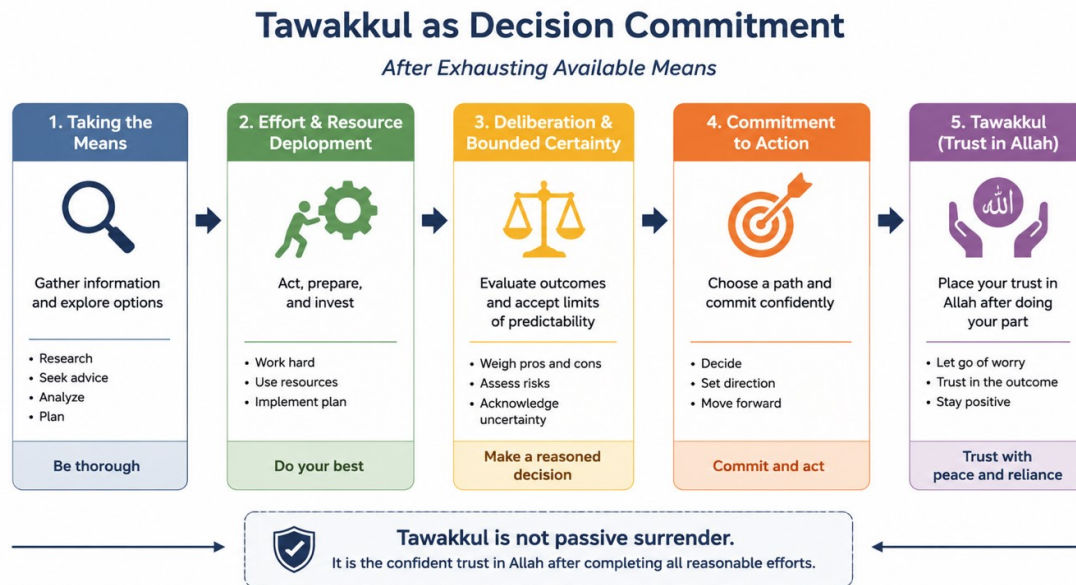


Figure 4. *Tawakkul* as decision commitment after exhausting available means. The figure illustrates a simple progression from taking the available means (*Al-Akhdh bi'l-Asbab*) through information gathering, effort, resource deployment, and deliberation toward bounded certainty, followed by commitment to action and finally *Tawakkul*. It highlights that *Tawakkul* does not replace reasoning or preparation but succeeds them, reflecting trust in God after responsible investigation and action have been undertaken.

2.3.2 *Tawakkul* and the Principle of *Taysir* (Facilitation Through Obstacles)

An important dimension of *Tawakkul* is closely connected with the Quranic and prophetic notion of *taysir* (facilitation or making a path easier). This idea is beautifully reflected in the supplication of Prophet Musa (Moses):

"My Lord, expand my chest for me, ease my task for me, and untie the knot from my tongue so that they may understand my speech." (Quran 20:25–28)

From the perspective of decision theory, it is striking that Prophet Musa did not ask for the removal of Pharaoh, the disappearance of opposition, or the elimination of obstacles. Instead, he asked for the ability to proceed effectively despite those obstacles: clarity of mind, ease in accomplishing the mission, and effective communication.

This distinction has profound implications. Human life is inherently characterized by constraints, uncertainty, illness, risk, scarcity, disagreement, and unforeseen events. These realities are not anomalies to be eradicated but structural features of existence. *Taysir* therefore should not be interpreted as the disappearance of difficulties but rather as the capacity to find a feasible path through them.

A useful analogy is that of climbing a mountain covered with thorny bushes. A rational traveler does not attempt to uproot every thorn along the mountainside before advancing. Such an

objective would be impossible and would prevent any progress. Instead, the traveler gently moves the branches aside, identifies a narrow but traversable passage, and continues climbing. The thorns remain in place after the traveler has passed; what changes is the path that enables successful navigation.

This metaphor closely resembles the philosophy underlying UVIF. The framework does not assume that uncertainty, conflicting constraints, or competing objectives can be completely removed. Rather, it seeks an equilibrium that allows intelligent progress through a complex decision landscape. Ethical obligations, resource limitations, social expectations, risks, and incomplete information remain present, but the decision-maker identifies a balanced trajectory that satisfies them sufficiently to permit responsible action.

Accordingly, *Tawakkul* should not be understood merely as trust after effort but as trust following the identification of a viable path through unavoidable constraints. The emphasis shifts from obstacle elimination to obstacle navigation. In computational terms, UVIF performs a similar function by balancing multiple competing pressures until a feasible policy emerges, without requiring the impossible condition of perfect certainty or the complete disappearance of risk.

Viewed in this way, the prayer of Prophet Musa embodies a philosophy of bounded rationality and adaptive decision-making: not “remove the mountain,” but “enable me to cross it wisely.” This interpretation reinforces the central thesis of this article that Islamic decision philosophy and UVIF share a common appreciation for acting responsibly under persistent uncertainty and irreducible constraints.

2.4 Decision-Making Under Uncertainty in Islamic Tradition

Islamic jurisprudential tradition has developed, over more than a millennium, one of the most sophisticated practical frameworks for decision-making under uncertainty in any intellectual tradition. The concept of *Ijtihad* — independent reasoning by a qualified jurist to derive legal rulings for novel situations — represents a principled system for reaching actionable conclusions from incomplete textual and empirical evidence [21].

Al-Zarqa (2025) provides a particularly illuminating interdisciplinary analysis, demonstrating that Islamic jurisprudential epistemic categories parallel statistical significance thresholds. The *Fiqh* concept of *hadd al-tawahhum* (the threshold of acceptable conjecture below which action is impermissible) corresponds to the minimum probability threshold in frequentist hypothesis testing. This mapping suggests that classical Islamic decision theory was, in effect, developing a contextually grounded probabilistic decision framework centuries before the formal development of probability theory.

Suliswanto (2021) further demonstrates that the Islamic perspective does not regard uncertainty or risk as inherently forbidden; rather, *gharar* (excessive uncertainty that distorts consent) is prohibited, while calibrated uncertainty — that which can be reasonably bounded and managed — is not only permissible but may be the very domain within which human moral agency is exercised. This position aligns precisely with the UVIF framework's treatment of uncertainty as not an obstacle to be eliminated but a structural feature to be modeled and managed.

As illustrated in Fig. 5, Islamic decision-making under uncertainty may be interpreted as a structured and iterative reasoning pipeline involving evidence gathering, contextual interpretation, balancing of harms and benefits, uncertainty assessment, *ijtihad*, and finally the derivation of an actionable ruling. Importantly, this process is neither purely deterministic nor rigidly linear. Instead, it contains feedback loops and revisability mechanisms through which

new evidence, contextual changes, or deeper understanding may lead to reassessment and refinement of the ruling.

The first stage involves the collection of evidences (al-adillah) from primary and secondary sources, including the Quran, Sunnah, consensus (ijma'), analogy (qiyas), juristic preference (istihsan), custom ('urf), and empirical observations. The second stage concerns contextual interpretation, where the jurist evaluates the meaning, intent, applicability, and situational relevance of the evidence. This phase reflects the Islamic recognition that legal and ethical judgments cannot be separated from temporal, geographical, social, and practical realities.

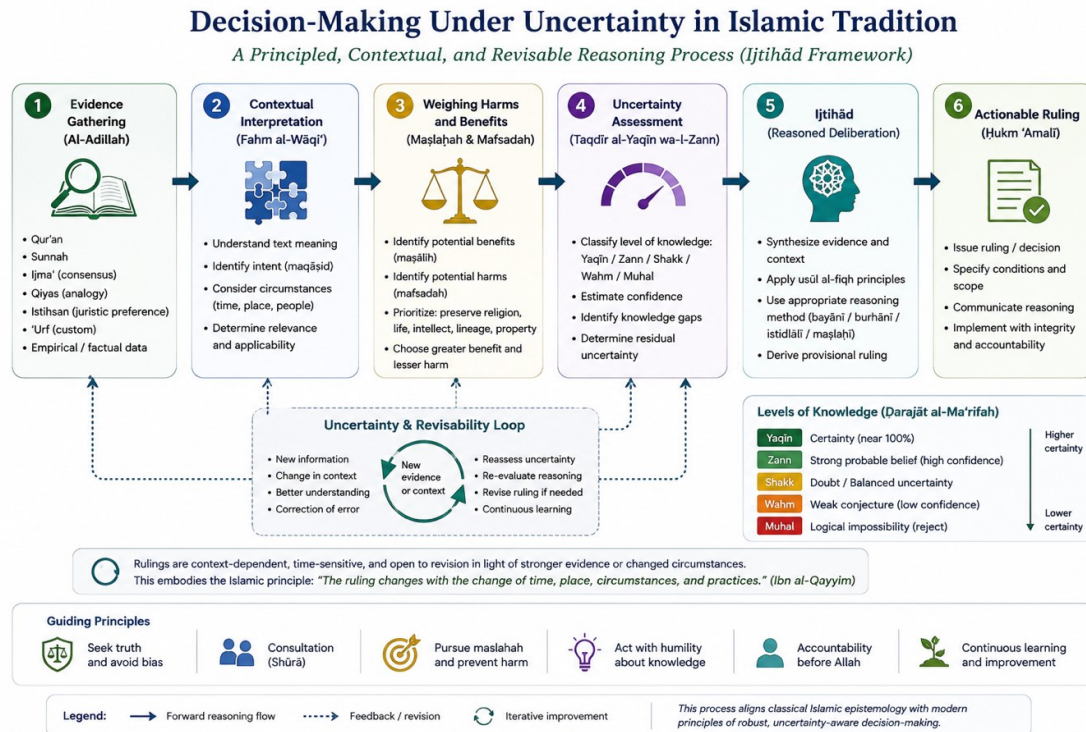


Figure 5: Decision-making under uncertainty in Islamic tradition. The figure illustrates a revisable and context-sensitive reasoning workflow involving evidence gathering, contextual interpretation, balancing harms and benefits, uncertainty assessment, ijtihad, and actionable ruling generation. The framework incorporates iterative feedback loops, epistemic calibration, and ethical deliberation, reflecting strong conceptual alignment with modern uncertainty-aware and variational decision-making architectures such as UVIF.

The third stage consists of weighing harms and benefits (maslahah and mafsadah), a process closely related to multi-objective optimization in decision theory. Rather than maximizing a single utility metric, Islamic reasoning often seeks equilibrium between competing ethical priorities, such as preserving life, religion, intellect, dignity, family, and economic stability. This balancing process is conceptually aligned with UVIF's variational equilibrium framework, where competing constraints and objectives must be jointly considered before action commitment.

The fourth stage involves explicit uncertainty assessment through epistemic calibration using categories such as Yaqin, Zann, Shakk, and Wahm. Unlike deterministic systems that attempt to suppress uncertainty, Islamic jurisprudence recognizes uncertainty as an intrinsic feature of human reasoning. This stage therefore resembles modern uncertainty-aware AI

systems that quantify confidence levels, identify knowledge gaps, and distinguish between reliable and weak evidence.

Following uncertainty assessment, the process enters the stage of *ijtihad*, where evidence, context, ethical principles, and probabilistic judgments are synthesized into a reasoned deliberative conclusion. The resulting ruling is then translated into an actionable decision while preserving accountability, transparency, and ethical responsibility. Importantly, Islamic jurisprudential reasoning recognizes that rulings may remain provisional and revisable rather than absolutely final, particularly when new evidence or changing circumstances emerge.

From the perspective of UVIF, this jurisprudential architecture represents a remarkably advanced form of uncertainty-aware decision intelligence. It demonstrates that Islamic tradition historically embraced bounded rationality, calibrated confidence, contextual adaptation, and revisable reasoning long before these concepts were formally developed in modern AI, Bayesian inference, and probabilistic decision theory.

2.5 Ethical and Social Dimensions

Islamic epistemology is not a purely theoretical enterprise; it is deeply integrated with ethical and social dimensions. The concept of *Maslaha Mursalah* (public good not explicitly specified in primary sources) provides a mechanism for deriving ethical imperatives from broad principles, enabling Islamic jurisprudence to address novel situations including those involving modern technology [12].

The concept of *Shura* (consultation) establishes that consequential decisions should be made through deliberative collective processes, not imposed unilaterally — a principle with direct implications for AI governance. *Amanah* (trustworthiness) and *Adalah* (justice) function as meta-ethical constraints on all forms of human agency, including technological agency. These principles collectively constitute an Islamic framework for what contemporary AI ethics calls "human-centered AI" — systems designed primarily to serve human flourishing, dignity, and justice [23].

2.6 Making Decisions within the Framework of Equilibrium

Islamic reasoning frequently presents human life as a field of decision-making under constraints. The objective is not to remove all constraints, nor to pursue one value without limit, but to establish a balanced path between competing pressures. This equilibrium-oriented logic appears repeatedly in the Quran: between permission and prohibition, spending and saving, worldly life and the Hereafter, firmness and facilitation, consultation and commitment. In UVIF terms, these Quranic examples may be interpreted as forms of decision-making under bounded knowledge, competing objectives, ethical constraints, and residual uncertainty (Table 1).

Table 1: Some Quranic examples on making decisions within the framework of equilibrium

Quranic verse	English meaning	Competing objectives	Required equilibrium	UVIF interpretation
﴿وَكُلَا مِنْهَا رَغَدًا حَيْثُ شِئْتُمَا وَلَا تَقْرَبَا هَذِهِ الشَّجَرَةَ﴾ البقرة 2:35	“Eat freely from it wherever you wish, but do not approach this tree.”	Permissible abundance vs. prohibited boundary	Benefit from what is allowed while respecting constraints	Constrained decision-making within feasible and infeasible zones
﴿وَالَّذِينَ إِذَا أَنْفَقُوا لَمْ يُسْرِفُوا وَلَمْ يَقْتُرُوا وَكَانَ بَيْنَ ذَلِكَ قَوَامًا﴾ الفرقان	“When they spend, they are neither extravagant nor	Extravagance vs. miserliness	Balanced spending	Resource-allocation equilibrium

25:67	miserly, but maintain a balance between that.”			
﴿وَلَا تَجْعَلْ يَدَكَ مَغْلُولَةً إِلَىٰ عُنُقِكَ وَلَا تَبْسُطْهَا كُلَّ الْبَسْطِ﴾ الإسراء 17:29	“Do not keep your hand chained to your neck, nor extend it completely.”	Excessive restriction vs. excessive spending	Sustainable use of resources	Avoiding extreme policies; bounded optimization
﴿فَإِذَا عَزَمْتَ فَتَوَكَّلْ عَلَى اللَّهِ﴾ آل عمران 3:159	“Then, when you have decided, put your trust in Allah.”	Endless deliberation vs. premature action	Consultation and reasoning followed by commitment	Explore–then–commit under residual uncertainty
﴿فَخُذْهَا بِقُوَّةٍ وَأْمُرْ قَوْمَكَ يَأْخُذُوا بِأَحْسَنِهَا﴾ الأعراف 7:145	“Take them firmly, and command your people to take the best of them.”	Normative firmness vs. practical implementation	Serious commitment with wise application	Context-sensitive policy selection
﴿وَابْتَغِ فِيمَا آتَاكَ اللَّهُ الدَّارَ الْآخِرَةَ وَلَا تَنْسَ نَصِيبَكَ مِنَ الدُّنْيَا﴾ القصص 28:77	“Seek, through what Allah has given you, the Hereafter, and do not forget your share of this world.”	Hereafter vs. worldly life	Spiritual purpose with legitimate worldly benefit	Multi-objective equilibrium
﴿رَبِّ اشْرَحْ لِي صَدْرِي﴾ وَيَسِّرْ لِي أَمْرِي طه 26–20:25	“My Lord, expand my chest for me, and ease my task for me.”	Mission difficulty vs. capacity to proceed	Facilitation through obstacles, not removal of all obstacles	Finding a feasible path through constraints

The story of Adam and Eve may be read as the first symbolic decision environment given to humanity. The garden was not a world without constraints. It contained vast permissible space and one explicit prohibition. This structure reflects the general condition of human life: freedom exists, but it is not absolute. Decision-making therefore consists in identifying the feasible path that maximizes benefit while respecting ethical boundaries.

The verses on spending provide another clear equilibrium model. The believer is not asked to spend without limit, nor to preserve wealth with excessive rigidity. The Quranic word **قَوَامًا** expresses balance, stability, and proportionality. This is close to UVIF’s logic: a decision is not produced by maximizing a single variable, but by balancing benefit, risk, future need, social duty, and moral responsibility.

The verse on *Tawakkul* adds the transition from deliberation to commitment. After consultation, reasoning, and decision, trust in God becomes meaningful. In UVIF language, this corresponds to the moment when further exploration no longer provides sufficient value, and action must be taken despite residual uncertainty.

The verse concerning worldly life and the Hereafter is especially important because it shows that Islamic reasoning is not anti-worldly. The believer is directed toward the Hereafter without forgetting his or her share of this life. This is a multi-objective equilibrium: spiritual, ethical, family, social, economic, and personal dimensions must be coordinated rather than separated.

The verse “My Lord, expand my chest for me, and ease my task for me.” Has been treated in subsection 2.3.2.

Overall, these verses support the idea that Islamic decision philosophy is deeply equilibrium-oriented. Human beings live among constraints, opportunities, obligations, risks, and uncertainties. UVIF offers a computational vocabulary for this structure: it formalizes how an

agent may search for a balanced, responsible, and context-sensitive decision under bounded knowledge.

3. UVIF: UNIFIED VARIATIONAL INTELLIGENCE FRAMEWORK

3.1 Overview of UVIF

The Unified Variational Intelligence Framework (UVIF) is a decision-theoretic architecture for intelligent systems operating in partially observable, stochastic environments. Unlike classical AI paradigms that seek point-estimate solutions under simplifying assumptions of completeness and stationarity, UVIF maintains explicit probabilistic representations of epistemic and aleatoric uncertainty throughout the perception-action cycle [32, 42].

UVIF integrates three theoretical lineages: (1) variational Bayesian inference, which provides the mathematical framework for updating beliefs given evidence while managing computational tractability [9, 56]; (2) the free energy principle (FEP) from theoretical neuroscience, which provides a unifying account of perception, learning, and action as processes minimizing a common variational objective [15, 31]; and (3) bounded rationality theory from cognitive science and economics, which acknowledges that optimal decision-making must be defined relative to the agent's computational and informational resources [13, 30].

For readers outside computational neuroscience and Bayesian machine learning, UVIF can be understood in simple terms as a disciplined way of deciding when knowledge is sufficient for responsible action. The framework assumes that an intelligent agent never has complete access to reality. Instead, it has observations, prior experience, ethical preferences, limited resources, and a set of possible actions. UVIF asks the agent to reduce avoidable ignorance, represent remaining uncertainty honestly, compare possible actions, and then commit to the action whose expected consequences are most coherent with evidence, values, and constraints.

This makes UVIF different from a purely predictive AI model. A conventional model may answer the question: "What is most likely to happen?" UVIF asks a broader decision question: "Given what is known, what remains unknown, what values must be protected, what costs are imposed by delay, and what action should now be responsibly taken?" In this sense, UVIF is not merely an accuracy-oriented method; it is a decision architecture that links perception, uncertainty, value alignment, and action commitment.

3.2 Variational Equilibrium Principles

The core computational objective of UVIF is the minimization of variational free energy — a quantity that upper-bounds the agent's surprise (negative log-evidence) given its generative model of the environment. Formally, for an agent with internal states μ , sensory observations o , and a generative model $p(o, s)$ over hidden states s , the variational free energy is defined as:

$$F = \mathbb{E}_{q(s)}[\log q(s) - \log p(o, s)] = D_{\text{KL}}[q(s) \parallel p(s | o)] - \log p(o) \quad (7)$$

where:

- F denotes the variational free energy,

- $q(\mathbf{s})$ is the approximate posterior distribution over hidden states,
- $p(\mathbf{o}, \mathbf{s})$ is the generative model over observations $\mathbf{o}$ and hidden states $\mathbf{s}$,
- $D_{\text{KL}}(\cdot)$ denotes the Kullback–Leibler divergence,

and $p(\mathbf{s} | \mathbf{o})$ is the true posterior distribution conditioned on observations.

This objective captures a fundamental trade-off between accuracy (how well the model explains observations) and complexity (how much the posterior beliefs diverge from the prior). Minimizing free energy therefore implements a principled form of Occam’s razor, penalizing unnecessarily complex belief updates [15, 11]. Crucially, this minimization does not seek to eliminate uncertainty but rather to represent it optimally — an epistemically humble stance that distinguishes UVIF from certainty-seeking paradigms.

Within the UVIF framework, intelligent behavior emerges from the dynamic balancing of several competing forces operating simultaneously during decision-making. As illustrated in Fig. 6, these forces include epistemic exploration, uncertainty reduction, computational cost, ethical constraints, action utility, and risk exposure. Rather than maximizing a single objective function in isolation, UVIF conceptualizes intelligence as a variational equilibrium process in which competing pressures continuously interact until a stable and contextually acceptable policy emerges.

The first force corresponds to epistemic exploration, which drives the agent toward information acquisition and uncertainty reduction. Exploration increases situational awareness and improves posterior belief quality, but it also consumes time, computational resources, and practical effort. A second force concerns direct uncertainty reduction through inference and evidence integration. However, additional evidence gathering eventually produces diminishing returns, especially when residual uncertainty becomes structurally irreducible.

A third force arises from computational and cognitive cost. Real-world agents — whether biological, social, or artificial — possess finite processing capabilities, limited memory, bounded time, and restricted observational access. Consequently, exhaustive optimization is rarely feasible. UVIF therefore explicitly incorporates bounded rationality through computational regularization and constrained inference.

Simultaneously, ethical constraints act as normative boundaries restricting the space of acceptable actions. In the Islamic-compatible interpretation proposed in this article, these constraints may include fairness, consultation, avoidance of harm, responsibility, honesty, and social accountability. Ethical principles therefore influence not only the desirability of outcomes but also the admissibility of the decision process itself.

The framework additionally includes action utility and risk exposure as competing pragmatic forces. Utility attracts the agent toward actions associated with expected benefit or goal achievement, while risk exposure discourages actions associated with severe uncertainty, instability, or harmful consequences. The resulting equilibrium therefore reflects neither pure optimization nor pure conservatism, but rather a calibrated balance between opportunity, uncertainty, ethics, and bounded computational feasibility.

From an Islamic epistemological perspective, this equilibrium-oriented architecture resonates strongly with the principle that human reasoning should pursue responsible action without claiming absolute certainty (Fig. 6). The framework does not assume omniscient intelligence. Instead, it accepts bounded observation, incomplete evidence, and residual

uncertainty as permanent features of finite decision-making systems. UVIF therefore operationalizes a form of structured epistemic humility that aligns naturally with Islamic conceptions of limited human knowledge and responsible action under uncertainty.

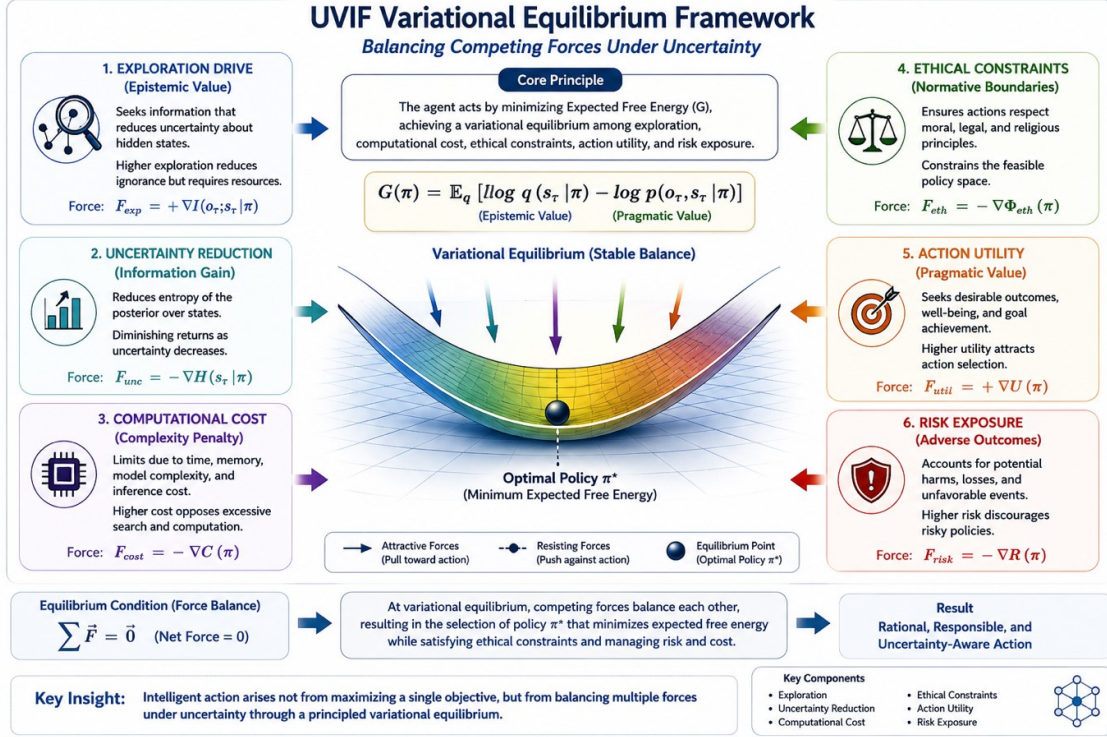


Figure 6. UVIF variational equilibrium framework. The figure illustrates how intelligent decision-making emerges from the dynamic balancing of multiple competing forces under uncertainty, including epistemic exploration, uncertainty reduction, computational cost, ethical constraints, action utility, and risk exposure. The central equilibrium landscape represents the search for an optimal policy π^* that minimizes expected free energy while satisfying practical, ethical, and computational constraints. The framework emphasizes that intelligent action does not arise from maximizing a single objective, but from achieving a stable variational equilibrium under bounded knowledge and partial observability.

3.3 Epistemic Exploration and Action Commitment

UVIF instantiates a two-phase decision cycle that can be characterized as explore-then-commit. In the exploration phase, the agent actively seeks information that reduces uncertainty about the relevant aspects of its environment, guided by epistemic value (expected information gain). In the commitment phase, the agent selects and executes a policy based on the most accurate posterior beliefs currently available, accepting residual uncertainty as irreducible [25, 47].

This architecture has a natural analogy in human decision-making under uncertainty: the agent that continues deliberating indefinitely is no more rational than the agent that acts precipitously. The optimal stopping rule — the point at which the expected value of additional information no longer justifies the cost of delay — is formalized within UVIF through the concept of expected free energy, which balances goal-directed (exploitative) and uncertainty-reducing (exploratory) action [31].

As illustrated in Fig. 7, the UVIF decision process can be understood as a cyclic sequence of perception, evidence gathering, uncertainty estimation, policy evaluation,

commitment to action, feedback acquisition, and adaptive learning. The cycle begins with perception, during which the agent observes its environment and acquires contextual information. These observations are subsequently enriched through evidence gathering, where additional information is actively sought to reduce uncertainty and improve situational understanding.

The acquired evidence is then incorporated into the agent's internal belief structure through uncertainty estimation and posterior updating. Rather than treating uncertainty as a binary condition, UVIF explicitly quantifies confidence levels and evaluates the remaining ambiguity associated with alternative interpretations of the observed situation. This updated belief state serves as the basis for policy evaluation, during which competing actions are assessed according to expected utility, ethical constraints, risk exposure, computational cost, and expected information gain.

A critical transition occurs when the process moves from exploration to commitment. At this stage, the agent determines that the expected benefit of further information acquisition no longer justifies its associated costs. The selected policy is then executed in the real world, transforming inference into action. Importantly, action is not delayed until uncertainty disappears entirely; rather, action occurs once uncertainty has been reduced to a level compatible with responsible decision-making.

The consequences of the selected action generate new observations that enter the feedback and review stage. The agent compares expected and actual outcomes, identifies discrepancies, and updates its internal models accordingly. Through repeated interaction with the environment, the learning and adaptation stage progressively refines the generative model, improves future predictions, and enhances decision quality. The resulting architecture therefore constitutes a continuous cycle of exploration, action, feedback, and learning rather than a single isolated decision event.

From the perspective of Islamic-compatible decision philosophy, this cycle closely resembles the progression from *Al-Akhdh bi'l-Asbab* (taking the means through investigation, consultation, and preparation) to *Tawakkul* (commitment under residual uncertainty), followed by reflection and learning from outcomes. The framework therefore provides a computational interpretation of responsible action under bounded knowledge while preserving the principle that complete certainty remains unattainable for finite agents.

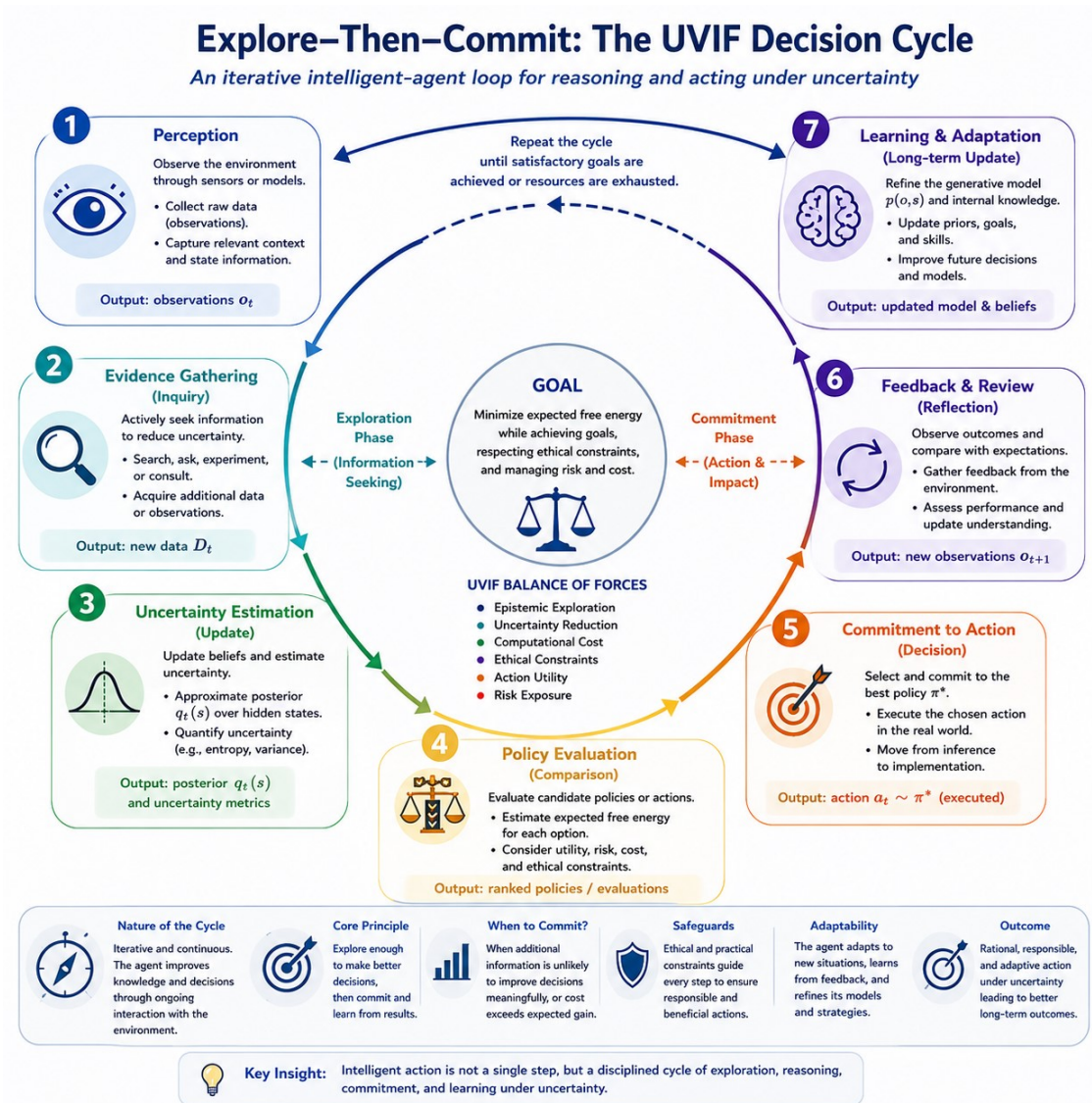


Figure 7: Explore–Then–Commit UVIF decision cycle. The figure illustrates the iterative decision-making process underlying UVIF, consisting of perception, evidence gathering, uncertainty estimation, policy evaluation, commitment to action, feedback acquisition, and adaptive learning. The left side of the cycle represents epistemic exploration aimed at reducing uncertainty and improving situational awareness, whereas the right side represents commitment and action execution under bounded knowledge. The feedback and adaptation stages continuously refine the agent's beliefs and decision policies, enabling intelligent behavior through repeated interaction with the environment. The framework emphasizes that rational action emerges not from perfect certainty, but from a disciplined balance between exploration, commitment, and learning under uncertainty.

3.4 UVIF and Bounded Rationality

Herbert Simon's concept of bounded rationality — the recognition that real decision-makers operate under constraints of time, attention, and computational capacity — is formally incorporated into UVIF through the information-theoretic framework. The agent's posterior beliefs are constrained by available computation (controlling the tightness of variational

approximation) and available information (limiting the accuracy of the likelihood model) [30, 20].

This has an important implication: UVIF agents do not seek globally optimal solutions but satisficing solutions that are good enough given resource constraints. The KL-divergence term in the free energy objective explicitly penalizes overly precise beliefs (beliefs that deviate far from the prior without sufficient evidential support), thereby implementing a form of epistemic humility [13, 10]. This is directly analogous to the Islamic prohibition on claiming certainty where only probability exists — the jurisprudential doctrine that one should not affirm knowledge (Ilm) where one possesses only conjecture (Zann).

3.5 Conceptual Mathematical Representation

The UVIF decision cycle can be compactly represented as a four-stage iterative process.

Stage 1 — Prior Formation

The agent maintains a generative model encoding prior beliefs about observations (o), hidden states (s), and policies (π), derived from past experience and domain knowledge: $p(o, s, \pi)$

This probabilistic structure represents the agent's internal model of the environment and its expected behavioral dynamics.

Stage 2 — Epistemic Updating

Upon receiving a new observation (o_t), the agent updates its beliefs by approximating the posterior distribution over hidden states through variational inference:

$$q(s_t) \approx p(s_t | o_t) \quad (3)$$

The updating process is achieved through the minimization of variational free energy:

$$F = \mathbb{E}_{q(s)} [\log q(s) - \log p(o, s)] = D_{\text{KL}} [q(s) || p(s | o)] - \log p(o) \quad (4)$$

where:

- F denotes the variational free energy,
- $q(s)$ is the approximate posterior distribution,
- $p(o, s)$ is the generative model,
- and D_{KL} denotes the Kullback–Leibler divergence.

This formulation enables the agent to continuously integrate new evidence with prior beliefs while reducing epistemic inconsistency.

Stage 3 — Policy Evaluation

The agent evaluates candidate policies by minimizing expected free energy over future time steps ($\tau > t$):

$$G(\pi) = \mathbb{E}_q [\log q(s_\tau | \pi) - \log p(o_\tau, s_\tau | \pi)] \quad (5)$$

This quantity jointly captures:

- pragmatic value (goal-directed utility),
- and epistemic value (expected information gain).

Consequently, UVIF balances exploitation and exploration within a unified decision-theoretic framework.

Stage 4 — Action Commitment

The agent commits to the policy that minimizes expected free energy:

$$\pi^* = \arg \min_{\pi} G(\pi) \quad (6)$$

Importantly, action commitment occurs despite residual uncertainty, which is treated as epistemically irreducible rather than fully eliminable. After action execution, new observations are received and the decision cycle repeats adaptively.

Information-Theoretic Bounded Rationality

The UVIF framework further incorporates computational boundedness through an information-theoretic regularization mechanism:

$$F_{\text{total}} = F_{\text{perception}} + \lambda D_{\text{KL}} [q(\pi) \| p_0(\pi)] \quad (7)$$

where:

- $F_{\text{perception}}$ represents perceptual inference cost,
- $p_0(\pi)$ denotes prior policy preferences,
- $q(\pi)$ represents the updated policy distribution,
- and λ controls the precision–cost trade-off.

This formulation constrains computational expenditure during policy search and formalizes bounded rationality within the UVIF framework [30].

3.6 Civil-Life Illustration: Marriage and Family Formation

A useful civil-life example is the decision to marry and establish a new family. This decision is not reducible to emotion, financial calculation, or social convention alone. It involves incomplete knowledge about the prospective spouse, family compatibility, religious and ethical expectations, housing options, employment constraints, relocation, future children, social support, and long-term emotional stability. No person can obtain one hundred percent certainty about all these dimensions before marriage. At the same time, acting without inquiry, consultation, and preparation would be irresponsible.

In UVIF terms, the individual begins with prior beliefs formed by personal values, family expectations, religious commitments, and life experience. He or she then performs epistemic

exploration: asking about character, compatibility, work conditions, financial capacity, housing possibilities, and the practical consequences of relocation. Each new piece of evidence updates the decision state. Some evidence may reduce uncertainty, such as stable employment or shared ethical values. Other evidence may reveal new uncertainty, such as whether the future wife should leave her job, whether an alternative city is possible, or whether both families can support the transition.

UVIF in Civil Life: Marriage and Family Formation

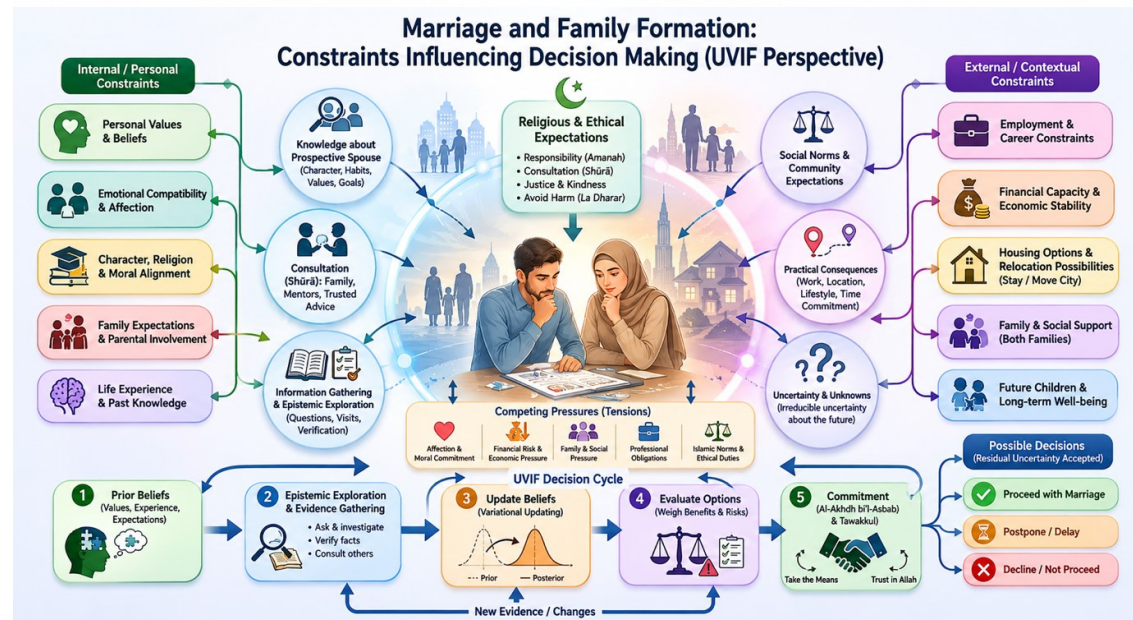
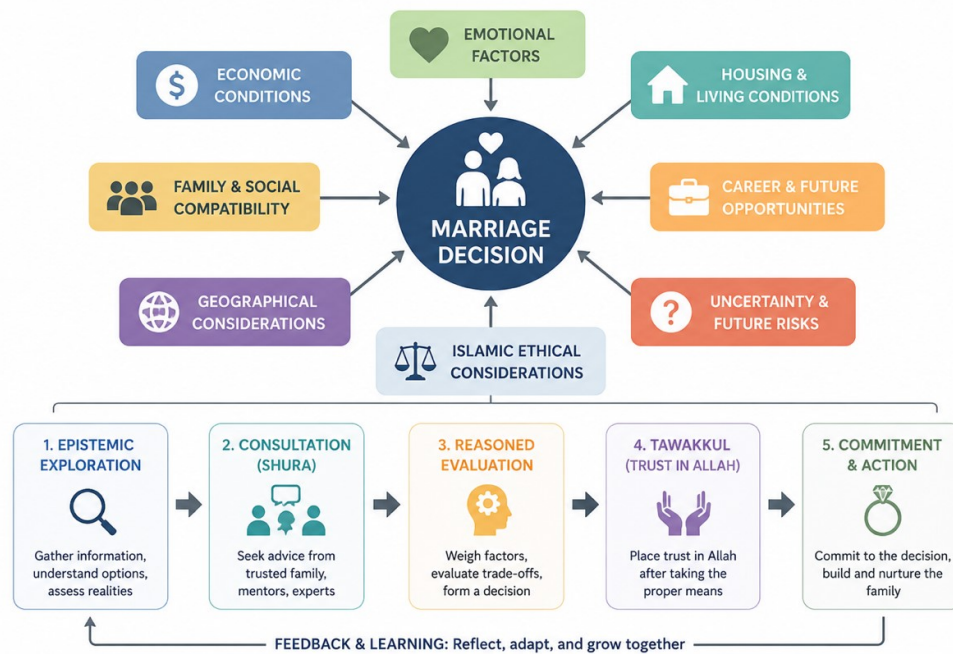


Figure 8: Civil-life illustration of marriage and family formation as a UVIF-compatible decision process. The figure shows how a marriage decision emerges from the interaction of personal values, emotional compatibility,

family expectations, religious and ethical commitments, financial capacity, housing options, employment constraints, relocation possibilities, social support, future children, and residual uncertainty. It illustrates how UVIF organizes these pressures through prior beliefs, epistemic exploration, belief updating, option evaluation, and action commitment, while linking responsible preparation with *Al-Akhdh bi'l-Asbab* and decision commitment under remaining uncertainty with *Tawakkul*.

As illustrated in Fig. 8, the marriage decision can be represented as a multi-constraint decision environment in which internal, social, practical, ethical, and future-oriented factors interact dynamically. The figure shows that personal values, emotional compatibility, family expectations, religious commitments, financial capacity, housing possibilities, work obligations, relocation constraints, and long-term family planning do not act independently. Rather, they create competing pressures that must be interpreted together. This makes the decision inherently variational: the decision-maker must continuously update beliefs, reassess options, and evaluate whether the available evidence is sufficient for responsible commitment.

The decision therefore becomes variational rather than deterministic. Several pressures act simultaneously: affection and moral commitment pull toward marriage; financial risk may push toward delay; family expectations may create social pressure; professional obligations may constrain relocation; Islamic norms require responsibility, consultation, fairness, and avoidance of harm. UVIF does not eliminate these tensions. It organizes them into a structured equilibrium in which additional inquiry continues only while it has meaningful value. When further inquiry becomes repetitive, costly, or unable to remove irreducible uncertainty, the decision-maker must move from exploration to commitment.

This is precisely where the Islamic concepts of *Al-Akhdh bi'l-Asbab* and *Tawakkul* become philosophically significant. The person should take the means: investigate, consult, plan, secure housing as far as possible, evaluate financial obligations, and discuss professional alternatives with honesty. Yet the person must also recognize that absolute certainty belongs only to God and that human knowledge remains limited. *Tawakkul*, in this setting, is not passive fatalism. It is the decision to proceed, postpone, or decline after responsible reasoning, while accepting that residual uncertainty cannot be fully removed. The civil-life example therefore shows how UVIF can serve as a computational vocabulary for a form of practical wisdom already present in Islamic decision philosophy [2, 6, 12, 18, 30, 34].

3.7 An Islamic-Compatible Variational Objective

Section 3.5 presented the four-stage UVIF cycle and the perception-level free energy (Eq. 4). The competing forces depicted in Fig. 6 — epistemic exploration, uncertainty reduction, computational cost, ethical constraints, action utility, and risk exposure — were described qualitatively but were not combined into a single objective. We now make Fig. 6 precise by proposing an Islamic-compatible policy objective: an expected free energy functional augmented with an explicit ethical-constraint term. For a candidate policy π evaluated against a committed evidence set and a context C that encodes the agent's preferences, the objective is given by Eq. 8.

$$J(\pi) = -\mathbb{E}_q[\ln p(o_\tau | C)] - \mathbb{E}_q[D_{\text{KL}}[q(s_\tau | o_\tau, \pi) \| q(s_\tau | \pi)]] + \lambda_C \Phi_{\text{ethic}}(\pi) + \lambda_K D_{\text{KL}}[q(\pi) \| p_0(\pi)] + \lambda_R \mathcal{R}(\pi) \quad (8)$$

The first term is the pragmatic value (goal-directed utility), which rewards policies expected to realize the preferred observations encoded in C . The second term is the epistemic value

(expected information gain), which rewards policies that resolve uncertainty about hidden states; together these two terms constitute the standard expected free energy of active inference [25, 31, 11]. The remaining three terms encode the additional pressures of Fig. 6. The term weighted by λ_C is an ethical-admissibility penalty grounded in the Maqasid al-Shariah; the term weighted by λ_K is the information-theoretic cost of deviating from prior policy preferences, formalizing bounded rationality exactly as in Eq. 7 [30]; and the term weighted by λ_R penalizes risk exposure, for example through a tail-risk functional that discourages policies with severe downside even when their expected value is favorable. The agent selects the optimal policy by minimizing this objective.

The ethical term deserves explicit definition. Following the doctrine that the higher objectives of Islamic law — preservation of religion (din), life (nafs), intellect ('aql), lineage (nasl), and property (mal) — act as constitutional constraints on admissible reasoning [12, 24], we define a weighted penalty over the five objectives, as in Eq. 9.

$$\Phi_{\text{ethic}}(\pi) = \sum_{k=1}^5 w_k \ell_k(\pi), \quad \ell_{\text{nafs}}(\pi) = \infty \text{ if } \pi \text{ violates } \textit{hifz al-nafs} \text{ (La Darar)} \quad (9)$$

Two regimes are useful. In the soft regime, each component penalty is finite and differentiable, and the weights express the relative priority of the objectives, so that ethically costly policies are discouraged but not categorically forbidden. In the hard regime, violations of the most basic objectives are assigned infinite penalty, rendering the corresponding policies inadmissible; the preservation of life under the prophetic principle La Darar wa La Dirar (“no harm shall be inflicted or reciprocated”) is naturally expressed this way. This construction makes ethical principles constitutive of the objective rather than an external filter applied to its output — precisely the position argued on philosophical grounds in Section 6.1.

3.8 Tawakkul as an Optimal Stopping Rule

The abstract of this article promised to render Tawakkul tractable within modern decision theory. Sections 2.3 and 4.2 argue informally that Tawakkul is the commitment that follows once further inquiry no longer repays its cost. We now state this as a formal stopping rule, which is the central formal contribution of the paper.

Consider the exploration phase of the UVIF cycle as a sequential process. At step t the agent holds a committed evidence set and can compute the best achievable objective value by minimizing Eq. 8 over policies. Acquiring one additional unit of evidence — one more consultation, measurement, or act among the asbab — is expected to lower this value, but it carries a marginal cost reflecting the time, resources, and opportunity forgone by delay. The expected marginal value of further inquiry is the anticipated reduction in the objective, defined in Eq. 10.

$$\text{VoI}_t = G_t^* - \mathbb{E}[G_{t+1}^* | \mathcal{D}_t], \quad G_t^* = \min_{\pi} J(\pi | \mathcal{D}_t) \quad (10)$$

This quantity is the value of information of the next observation. Early in the exploration phase it is large, because evidence is scarce and each new datum sharply reduces uncertainty; as inquiry proceeds it declines, because the agent approaches the irreducible residual uncertainty that no further means can remove. The Tawakkul commitment is the first moment at which the marginal value of inquiry falls to or below its marginal cost, after which the agent commits to the policy that minimizes the objective, as in Eq. 11.

$$\tau^* = \min\{t \geq 0 : \text{VoI}_t \leq c_t\}, \quad \pi^* = \arg \min_{\pi} J(\pi | \mathcal{D}_{\tau^*}) \quad \text{s. t.} \quad \max_h q(h) \geq \theta_Z \quad (11)$$

The side condition enforces a calibration floor: the agent commits only if the most probable hypothesis attains at least the threshold θ_Z of probable belief. This threshold is the formal counterpart of the jurisprudential notion of hadd al-tawahhum, the level of conjecture below which action is impermissible, which Al-Zarqa (2025) has shown to behave like a statistical significance threshold [6]. If the floor is not met, the agent does not act; it suspends judgment (tawaqquf) and refers the matter to further inquiry or to human authority — the computational analogue of refusing to affirm knowledge where only weak surmise exists.

Figure 9 illustrates the rule. The blue curve is the best achievable objective, decreasing with diminishing returns toward the irreducible floor. The red curve is the marginal value of inquiry, and the dashed line is the marginal cost. To the left of the crossing point the agent remains in the exploration phase — the domain of Al-Akhdh bi'l-Asbab, the active taking of means — because additional inquiry still repays its cost. At the crossing point the agent commits: this is Tawakkul, not as the abandonment of reason but as its completion. Crucially, commitment occurs while the objective still lies strictly above its floor, formalizing the central thesis that responsible action is taken under residual uncertainty rather than after its elimination.

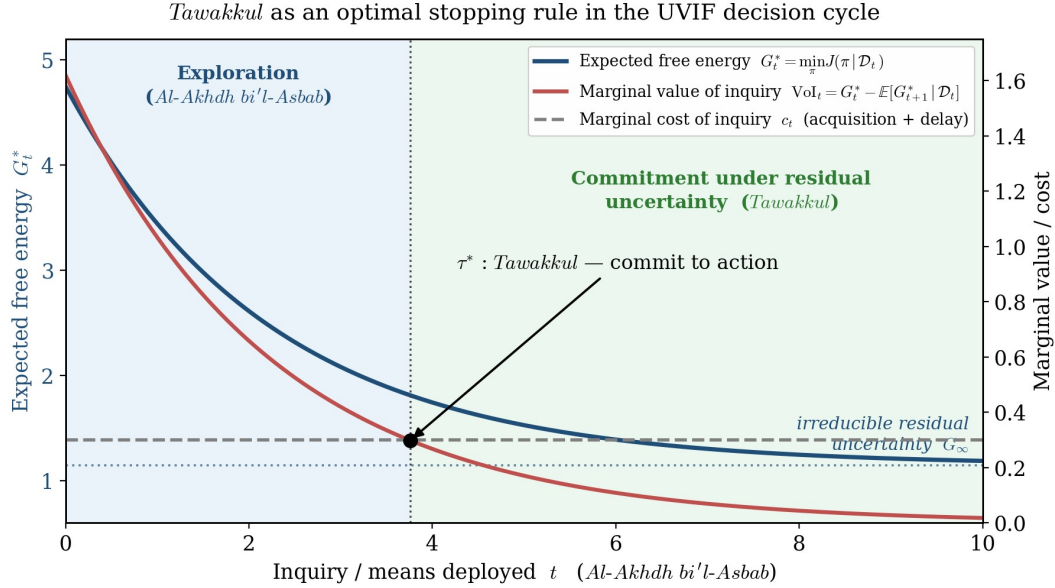


Figure 9. Tawakkul as an optimal stopping rule in the UVIF decision cycle. The horizontal axis represents the amount of inquiry or means deployed (Al-Akhdh bi'l-Asbab). The decreasing curve is the best achievable expected free energy, which approaches an irreducible residual-uncertainty floor that no further inquiry can remove. The marginal value of inquiry declines as evidence accumulates, while the marginal cost of continued inquiry remains roughly constant. Their crossing point defines the stopping time at which the agent transitions from exploration to commitment. The figure formalizes Tawakkul as a principled interior stopping point: the agent neither acts prematurely on weak surmise nor defers indefinitely in pursuit of unattainable certainty, but commits to action under residual uncertainty once further means cease to repay their cost.

Three properties of the rule align with the classical understanding of Tawakkul reconstructed in Section 4.2. First, it is non-trivial: it neither commits immediately (the error of the agent who acts on Wahm) nor defers indefinitely (the error of the agent paralyzed by the pursuit of

impossible Yaqin), but stops at a principled interior point. Second, it is adaptive: the stopping time is later when stakes are high, raising the effective value of accuracy, and earlier when delay is costly, which matches the jurisprudential sensitivity of required certainty to the gravity of the matter. Third, it is revisable: after commitment, the outcome enters as new evidence and a new cycle begins, mirroring the acceptance of the result (rida) and the resumption of effort that complete the Tawakkul disposition [29, 55].

3.9 Calibrated Epistemic Bands and Action Thresholds

The stopping rule's calibration floor invites a fuller formalization of the Islamic epistemic hierarchy introduced in Section 2.1. The classical categories Yaqin, Zann, Shakk, Wahm, and Muhal can be read as bands of the posterior probability assigned to the most probable hypothesis, each licensing a distinct class of action. Table 2 makes this correspondence explicit and ties it to the thresholds that appear in Eqs. 8–11.

Table 2: Calibrated Epistemic Bands and Their Licensed Action Classes

Epistemic category	Posterior band (most probable hypothesis)	Decision-theoretic status	Licensed action class
Yaqin (certainty)	$p^* \approx 1$ ($p^* \geq 1 - \varepsilon$)	Near-deterministic belief	Grounds obligation (wujub)
Zann / Ghalabat al-Zann (probable belief)	$\theta_Z \leq p^* < 1 - \varepsilon$	Actionable conjecture above hadd al-tawahhum	Grounds permissible action (jawaz)
Shakk (doubt / equipoise)	$p^* \approx \frac{1}{2}$	Indecision; value of information high	Counsels suspension (tawaqquf), further inquiry
Wahm (weak surmise)	$0 < p^* < \theta_W$	Below the conjecture threshold	Inadmissible as a basis for action
Muhal (impossibility)	$p^* = 0$	Logically excluded	Pruned from the policy space

The table is not a numerical claim: the band edges are context-dependent and, in jurisprudential settings, are properly set by qualified scholars rather than by the system. Its purpose is structural. It shows that the graded vocabulary of classical Islamic epistemology maps onto calibrated posterior probabilities and onto the action-licensing thresholds of a principled decision procedure, so that a UVIF-compatible system can be required to avoid the characteristic failures the hierarchy names — presenting Zann as Yaqin (overconfidence), or acting on Wahm as though it were reliable evidence [6, 44].

3.10 The UVIF–Tawakkul Decision Procedure

The preceding components combine into a single procedure. Algorithm 1 summarizes the UVIF–Tawakkul cycle: it takes the means by acquiring evidence and updating beliefs until the value of further inquiry falls below its cost (Al-Akhdh bi'l-Asbab), commits to the ethically admissible policy that minimizes the objective provided the calibration floor is met (Tawakkul), and otherwise suspends judgment (tawaqquf), finally accepting the outcome as new evidence for the next cycle.

Algorithm 1. UVIF–Tawakkul Decision Procedure

Input : generative model $p(o,s,\pi)$; preference context C ; Maqasid weights $\{w_k\}$;

```

    marginal cost  $c_t$ ; thresholds  $\theta_Z$  (hadd al-tawahhum),  $\epsilon$ 
1:  $D \leftarrow \emptyset$ ;  $t \leftarrow 0$                                 ▷ Stage 1: prior formation
2: repeat                                                    ▷ Al-Akhdh bi'l-Asbab
   (taking the means)
3:   acquire observation  $o_t$ ;  $D \leftarrow D \cup \{o_t\}$ 
4:   update  $q(s)$  by minimizing free energy  $F$               (Eq. 4)
5:    $G_t^* \leftarrow \min_{\pi} J(\pi \mid D)$                     (Eq. 8)
6:    $VoI_t \leftarrow G_t^* - E[ G_{t+1}^* \mid D ]$               (Eq. 10)
7:    $t \leftarrow t + 1$ 
8: until  $VoI_t \leq c_t$                                        ▷ Tawakkul stopping
   criterion (Eq. 11)
9:  $\pi^* \leftarrow \operatorname{argmin}_{\pi} J(\pi \mid D)$  subject to ethical admissibility (Eq. 9)
10: if  $\max_h q(h) < \theta_Z$  then                               ▷ below hadd al-tawahhum
11:   return tawaqquf (suspend; defer to qualified human authority)
12: else commit and execute  $\pi^*$                                ▷ Tawakkul: act under
   residual uncertainty
13: observe outcome; accept the result (rida); go to 1       ▷ next adaptive cycle

```

The procedure is deliberately architecture-agnostic: the generative model, the variational inference routine in line 4, and the policy space may be realized by any uncertainty-aware method, from variational Bayesian networks to active-inference agents. What the procedure contributes is the explicit coupling of an ethically constrained objective (Eq. 8) with an Islamically motivated stopping criterion (Eq. 11) and calibration floor (Table 2). In this form, the abstract correspondence argued throughout the article becomes an executable specification: a checklist against which a system intended for ethically sensitive deployment in Muslim communities can be designed and audited.

4. COMPATIBILITY BETWEEN UVIF AND ISLAMIC DECISION PHILOSOPHY

4.1 Conceptual Correspondence Framework

The correspondences between UVIF and Islamic decision philosophy can be organized along four structural axes: epistemic stance, action dynamics, ethical constraints, and governance architecture. Table 3 synthesizes, for each Islamic concept, its UVIF analogue, the nature of the correspondence, its computational implication, and the limits of the analogy:

Table 3: Synthesis of Correspondences Between Islamic Concepts and UVIF Principles

Islamic Concept	UVIF Analogue	Nature of Correspondence	Computational Implication	Limits of the Analogy
Tawakkul	Variational equilibrium and	Functional	Commitment to the current optimal policy once further	Tawakkul includes a spiritual dimension of trust

Islamic Concept	UVIF Analogue	Nature of Correspondence	Computational Implication	Limits of the Analogy
	policy commitment		inquiry yields negligible expected information gain (optimal stopping rule, Eq. 11)	in God that has no computational counterpart
Al-Akhdh bi'l-Asbab	Epistemic exploration	Functional	Active information gathering to reduce expected free energy before action; value-of-information criteria	The Islamic principle is a moral and religious obligation, not merely an informational strategy
Limitation of human knowledge (Al-Ilm al-Muqayyad)	Bounded rationality	Conceptual	Explicit uncertainty quantification, calibrated confidence, and resource-bounded inference	Quranic epistemic humility is theological in origin, not a computational resource constraint
Epistemic hierarchy: Yaqin, Zann, Shakk, Wahm	Graded posterior confidence in variational inference	Structural	Action thresholds mapped to calibrated epistemic bands (Table 2)	Classical categories are qualitative and context-sensitive, not fixed probability intervals
Ijtihad	Policy selection under incomplete information	Functional	Iterative, revisable inference producing actionable yet corrigible judgments	Ijtihad presupposes qualified human scholarly authority and accountability, which cannot be delegated to a system
Bayani / Burhani epistemology	Free-energy minimization over belief space	Conceptual	Optimization of internal models against available evidence	The analogy does not extend to the status of revealed sources, which are not data among other data
Maslaha Mursalah	Human-centered ethical objective (Maqasid penalty term, Eq. 8)	Functional	Ethical constraints and public-interest considerations encoded as penalty terms in the objective	The determination of maslaha remains a scholarly judgment; the penalty term encodes, but does not derive, it

This mapping reveals a systematic rather than superficial alignment. Each UVIF architectural commitment has a corresponding Islamic principle that serves an analogous functional role in reasoning and action. The correspondences are at the level of *functional architecture* — the role each element plays in the overall system of rational decision-making — rather than at the level of surface metaphor.

4.2 Tawakkul as Decision Commitment Under Residual Uncertainty

The most philosophically significant correspondence is between UVIF's policy commitment mechanism and the Islamic concept of Tawakkul. To appreciate this correspondence requires moving beyond popular misunderstandings of Tawakkul as passive fatalism and engaging with its classical theological articulation.

Al-Ghazali's analysis, reconstructed and applied by Rayan (2018), positions Tawakkul within a causal ontology: human agents are understood as secondary causes (asbab) whose actions participate in a causal order ultimately governed by divine will. This understanding neither eliminates human agency nor renders it fully autonomous. The agent who practices Tawakkul correctly: (1) identifies all available means (asbab) relevant to achieving a

legitimate goal; (2) deploys those means with full effort (Ikhtiyar); (3) makes a decision and acts without being paralyzed by uncertainty about outcomes; and (4) accepts the resulting outcome, whatever it may be, as part of a larger order beyond human comprehension [34, 2].

This four-stage process maps onto the UVIF action cycle with remarkable precision. Step (1) corresponds to the prior formation and epistemic exploration phase; step (2) to the variational posterior update and policy evaluation; step (3) to action commitment (the selection of the policy minimizing expected free energy); and step (4) to the acceptance of environmental feedback as new observations, initiating the next cycle. Tawakkul, on this account, is the *normative description* of the decision-theoretic state achieved when an agent has performed optimal policy selection given available information and now commits to action despite residual uncertainty — not because certainty has been achieved, but because further delay has negative expected value.

4.3 Islamic Epistemology and Variational Intelligence

The Islamic epistemological hierarchy — from Yaqin (certainty) through Zann (strong probability) and Shakk (equipoise) to Wahm (weak surmise) — constitutes an informal analogue of a probability distribution over epistemic states. Islamic jurisprudence has developed sophisticated rules for how each epistemic state should influence action: certainty grounds obligation; strong probability grounds permissibility; doubt counsels caution; and near-impossibility grounds prohibition [6, 44].

The variational Bayesian framework in UVIF provides a formal realization of this epistemological architecture. The posterior distribution $q(s)$ represents the agent's graded epistemic state across hypotheses about the world, analogous to the Islamic epistemic hierarchy. The free energy objective ensures that beliefs are updated proportionally to evidence — assigning higher probability to states better supported by evidence, analogous to the move from Shakk toward Zann as evidence accumulates [56, 9].

More specifically, the Bayani, Burhani, and Irfani epistemological methods of Islamic philosophy correspond to three components of the UVIF generative model: Bayani (textual reasoning from authoritative sources) maps onto the prior $p(s)$ (background knowledge encoded in the model); Burhani (rational demonstration) maps onto the likelihood function $p(o|s)$ (logical inference from observations to states); and Irfani (intuitive knowledge) may correspond to the generative model's capacity for abductive inference — leaping to the best explanation when deductive derivation is incomplete [8, 3].

4.4 Human-Centered and Ethical Intelligence

Both UVIF and Islamic decision philosophy are fundamentally human-centered frameworks — frameworks in which the purpose of rational deliberation is not efficiency for its own sake but the flourishing and welfare of human beings and communities. In Islamic jurisprudence, the Maqasid al-Shariah (the higher objectives of Islamic law) — protection of religion, life, intellect, lineage, and property — function as constitutional constraints on legal reasoning, ensuring that technical jurisprudential conclusions serve substantive human goods [12, 24].

In the UVIF framework, preference priors $p(o)$ — the agent's beliefs about desirable observations — play an analogous structural role. These priors encode the agent's values and can be designed to reflect human welfare objectives, ethical constraints, and cultural commitments. The human-centered AI literature has converged on similar architectures,

emphasizing the need for AI systems that reflect human values, support human oversight, and are transparent in their reasoning [16, 51, 48].

4.5 Avoiding Misinterpretations

Several potential misinterpretations of our compatibility argument require explicit correction.

First: We do not claim that UVIF was historically derived from Islamic thought. The alignment we identify is structural and functional, arising from convergent solutions to the universal problem of rational action under uncertainty.

Second: We do not claim that UVIF is sufficient for Islamic AI. Islamic jurisprudence involves dimensions of religious authority, textual interpretation, and spiritual depth that are not reducible to computational models. UVIF can support but never replace qualified human scholarly judgment in Islamic legal and ethical contexts [49, 4].

Third: The structural correspondences we identify do not constitute divine endorsement of any particular AI architecture. We are making a philosophical and technical argument about conceptual alignment, not a theological claim.

Fourth: Not all AI applications in Islamic contexts require UVIF-style architectures. The framework is specifically relevant for domains characterized by irreducible uncertainty, value trade-offs, and high ethical stakes.

5. APPLICATIONS AND CASE STUDIES

5.1 Jurisprudential Decision Support

The application of AI to Islamic jurisprudence represents one of the most demanding and practically significant use cases for UVIF-compatible architectures. Islamic legal reasoning is characterized precisely by the features UVIF is designed to handle: incomplete and sometimes conflicting textual evidence, multiple competing methodological traditions, uncertainty about the applicability of historical precedents to contemporary cases, and the necessity of reaching actionable conclusions despite irreducible uncertainty [45, 7].

Current AI approaches to Fiqh face well-documented limitations. Chatbot systems that provide Islamic guidance exhibit high rates of misattribution of Quranic verses, oversimplification of complex jurisprudential debates, and inconsistency across similar queries [52]. These failures are directly attributable to the certainty-seeking architecture of standard language models, which produce point-estimate responses without representing or communicating epistemic uncertainty.

A UVIF-compatible jurisprudential decision support system would differ architecturally in three key respects. First, it would maintain explicit probabilistic representations of the evidence base by encoding the relative strength of support for competing interpretations across different *madhabs* (legal schools). Second, it would provide calibrated uncertainty estimates alongside its outputs, distinguishing cases of broad scholarly consensus from cases involving genuine disagreement or insufficient evidence. Third, and most importantly, it would be designed from the outset as a **scholar-in-the-loop** system, providing structured analytical assistance to qualified jurists rather than claiming autonomous legal authority [1, 39].

As illustrated in **Fig. 10**, the proposed workflow begins with a user's legal question expressed in natural language. The system then retrieves relevant evidence from the Quran, authentic Hadith collections, classical jurisprudential sources, and principles of *Usul al-Fiqh*. This evidence undergoes structured legal analysis and uncertainty estimation within the UVIF framework, where competing interpretations are evaluated according to their evidential support and contextual applicability. The reasoning engine remains aware of differences among legal schools

and therefore produces *madhhab*-sensitive analyses instead of forcing a single deterministic answer.

The resulting candidate opinions are subsequently ranked according to evidential strength, methodological consistency, and confidence estimates. However, the workflow deliberately stops short of autonomous legal judgment. A qualified human scholar reviews the retrieved evidence, the reasoning process, and the proposed recommendations before issuing the final ruling. In this architecture, artificial intelligence functions as an epistemic assistant that enhances retrieval, organization, comparison, and uncertainty quantification, while responsibility for interpretation and *fatwa* issuance remains entirely with the human expert.

Figure 10 therefore highlights one of the central principles of this article: **AI assists, scholars decide**. The role of UVIF is not to replace Islamic jurists but to augment their analytical capabilities by systematically organizing evidence, making uncertainty explicit, supporting comparative jurisprudential reasoning, and presenting transparent recommendation rankings. Such a framework preserves scholarly accountability while leveraging modern computational methods to improve consistency, traceability, and decision support in complex jurisprudential settings [49].

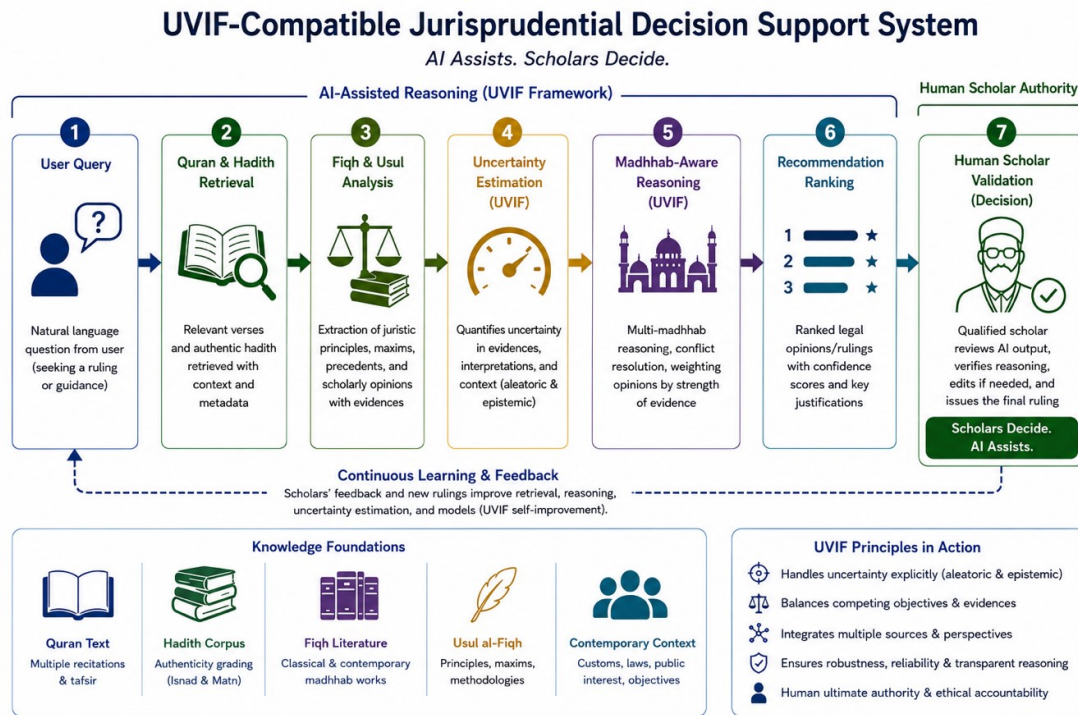


Figure 10. UVIF-compatible jurisprudential decision support system. The figure illustrates a scholar-in-the-loop workflow in which a user's query triggers retrieval of relevant Quranic verses, Hadith, and jurisprudential sources, followed by fiqh analysis, uncertainty estimation, *madhhab*-aware reasoning, and recommendation ranking within the UVIF framework. The generated analyses are then reviewed and validated by a qualified human scholar, who alone retains the authority to issue the final legal opinion. The architecture emphasizes that artificial intelligence serves as a decision-support instrument rather than an autonomous religious authority.

A categorical distinction must therefore be maintained between two classes of systems. Systems that support scholarly reasoning — by retrieving sources, structuring evidence, quantifying uncertainty, and presenting *madhhab*-aware analyses to a qualified scholar — are the intended application of the framework developed here. Systems that appear to issue religious judgments directly to end users, by presenting ranked conclusions as authoritative

rulings without scholarly review, fall outside the scope of what this article endorses and raise distinct dangers of misplaced authority, decontextualized rulings, and the erosion of the scholarly accountability that Islamic jurisprudence requires. In UVIF terms, the human scholar is not an optional verification stage but a constitutive component of the decision architecture: the system's outputs are epistemic inputs to Ijtihad, never substitutes for it, and responsibility for any religious judgment remains entirely with the accountable human scholar.

5.2 Ethical Social Decision-Making

Islamic social ethics operates on principles — justice (Adalah), consultation (Shura), public good (Maslaha), and avoidance of harm (La Darar wa La Dirar) — that are structurally well-suited to expression as preference priors in a UVIF generative model. A social decision-support system designed for Muslim communities could encode these principles as constitutional constraints on the preference distribution $p(o)$, ensuring that policy recommendations systematically favor outcomes consistent with Islamic ethical commitments [12, 18].

Consider the application of such a system to resource allocation under uncertainty — a recurrent challenge in contexts ranging from humanitarian response to zakat distribution to healthcare triage. A UVIF-based allocation system would: (a) model uncertainty about needs, resources, and outcomes; (b) encode Islamic distributive justice principles as preference priors; (c) generate allocation policies that maximize expected alignment with these principles under uncertainty; and (d) present recommendations with explicit uncertainty quantification to human decision-makers. Recent work on digital zakat distribution systems in Malaysia and Indonesia demonstrates the practical feasibility and social value of such approaches [18, 28].

5.3 Autonomous Systems and Responsible Action

Autonomous systems — robots, self-driving vehicles, unmanned platforms — operating in environments with Muslim populations or under Islamic governance frameworks face a distinctive challenge: their action selection mechanisms must be explicable in terms that are meaningful within Islamic ethical frameworks. The Tawakkul-as-decision-commitment framework offers a conceptual bridge.

Consider an autonomous vehicle operating in dense urban traffic. From a standard decision-theoretic perspective, the vehicle must continuously select actions (steering, acceleration, braking) under uncertainty about the intentions and future positions of other road users. From an Islamic ethical perspective, this vehicle is acting as a khalifah (steward/agent) on behalf of human passengers, with obligations to protect their lives (hifz al-nafs) and the lives of others. A UVIF-based autonomous system can be designed to embody both dimensions: it exercises maximal epistemic diligence (modeling all available cues about the environment) before committing to action, and it accepts residual uncertainty as irreducible rather than pretending to certainty it does not possess [53, 35].

This architectural alignment has practical implications for Islamic governance of autonomous systems: Muslim communities can evaluate the ethical acceptability of an autonomous system not merely by its outcomes but by the quality of its epistemic and deliberative process — a criterion that the Tawakkul framework makes operationalizable.

5.4 Explainable and Culturally Compatible AI

The demand for explainability in AI systems — increasingly codified in regulatory frameworks and ethical guidelines — aligns naturally with both UVIF's architecture and Islamic epistemic norms. UVIF systems produce explanations that are structurally aligned with the Islamic requirement of tabayyun (critical verification): they present the evidence

base, the inference process, and the resulting belief distribution, allowing the human interlocutor to evaluate the reasoning rather than merely accepting the conclusion [26].

The human-centered explainable AI literature converges on requirements that closely parallel Islamic epistemic norms: transparency of reasoning, calibrated confidence, acknowledgment of limitations, and support for human oversight [36, 51]. UVIF's free energy framework provides a principled basis for all four: the variational objective makes the reasoning transparent; the posterior distribution provides calibrated confidence; the free energy value communicates the adequacy of the explanation; and the human-in-the-loop architecture institutionalizes oversight.

The ethical challenges of XAI with respect to cultural bias are also directly relevant here. Current XAI systems have been criticized for reflecting predominantly Western cultural assumptions in their explanation formats, evaluation criteria, and knowledge representations [46]. A UVIF system designed for Islamic cultural contexts can incorporate culturally appropriate prior knowledge, evaluation criteria aligned with Islamic values, and explanation formats resonant with Islamic intellectual traditions.

5.5 Intelligent Systems for Islamic Knowledge Assistance

The digitalization of Islamic knowledge — Quranic text databases, hadith repositories, classical fiqh libraries, and contemporary fatwa archives — creates both opportunities and risks for AI-assisted Islamic knowledge management. The risks, extensively documented in the literature, include misattribution of sources, oversimplification of complex debates, erosion of scholarly authority, and cultural homogenization of regionally diverse traditions [33, 40].

A UVIF-compatible architecture for Islamic knowledge assistance would address these risks through several design principles. First, by maintaining explicit uncertainty about textual attribution and scholarly consensus, the system would never present contested interpretations as settled fact. Second, by encoding the methodology of *isnad* (chain of transmission) as a prior that discounts unverified sources, the system would respect the epistemic norms of the hadith sciences. Third, by representing the scholarly diversity of the *madhab* tradition as a legitimate distribution over interpretations rather than a problem to be resolved, the system would preserve intellectual plurality. Fourth, by operating under strict human scholarly supervision, the system would institutionalize the principle that *ijtihad* is a human prerogative [1, 49, 45].

6. DISCUSSION

6.1 Philosophical Implications

The alignment between UVIF and Islamic epistemology carries significant philosophical implications beyond the technical and applied dimensions explored above. Most fundamentally, it suggests that the problem of rational action under uncertainty — how a finite agent with limited knowledge should reason toward action in an uncertain world — admits of structural solutions that appear across intellectual traditions developed in very different historical, cultural, and theological contexts.

This convergence is not merely curious; it has implications for the foundations of AI ethics. The dominant approach in AI ethics treats ethical principles as constraints on AI systems — external impositions that limit what would otherwise be purely performance-maximizing behavior. The UVIF-Islamic alignment suggests an alternative: ethical principles, properly understood, are constitutive of rational agency under uncertainty, not merely constraints on it. Epistemic humility, acknowledgment of limitations, calibrated confidence,

and human-centered design are not external limitations on rational AI but expressions of what rationality, properly understood, actually requires [37, 50].

The Islamic philosophical tradition has long maintained that reason (aql) and revelation (wahy) are, when properly understood, harmonious rather than conflicting sources of knowledge. The UVIF-Islamic alignment provides a contemporary illustration of this harmony: what Islamic jurisprudence learned through centuries of practical wisdom about reasoning under uncertainty, modern AI research has rediscovered through mathematical formalization [22, 54].

6.2 Interdisciplinary Contributions

This article contributes to several interdisciplinary conversations. To the AI research community, it offers a principled engagement with Islamic intellectual tradition that goes beyond superficial localization and identifies genuine structural correspondences that may inform architectural design choices. To Islamic studies scholars, it offers a demonstration that modern AI theory provides formal tools for analyzing and extending classical Islamic epistemological and decision-theoretic concepts.

To the AI ethics community, it offers an example of how engagement with non-Western intellectual traditions can enrich — not merely diversify — the field's foundational concepts. Islamic epistemology's sophisticated treatment of uncertainty, its principled architecture for knowledge hierarchies, and its integration of epistemic and ethical norms provide resources for addressing genuine lacunae in current AI ethics frameworks [23, 38].

6.3 Comparative Positioning

The following table situates UVIF-Islamic aligned AI against conventional deterministic AI along the dimensions most relevant to our analysis:

Table 4: Comparison of Deterministic AI and UVIF-Based Approaches from an Islamic Perspective

Dimension	Deterministic AI	UVIF / Uncertainty-Aware AI	Islamic Alignment
Epistemic Stance	Certainty-seeking	Uncertainty-embracing	Zann and bounded ilm
Action Policy	Rule-based, fixed	Variational, adaptive	Ijtihad and discretion
Knowledge Source	Training data only	Prior + data (Bayesian)	Revelation + reason + experience
Human Oversight	Optional	Integral (human-in-loop)	Shura and scholarly authority
Ethical Framework	Performance metrics	Value-aligned objectives	Maqasid al-Shariah
Failure Mode	Overconfident errors	Calibrated uncertainty	Humility before the unknown (ghayb)

This comparison reveals that UVIF-based approaches are not merely more technically sophisticated than deterministic alternatives — they are more deeply aligned with the epistemological and ethical commitments of the Islamic tradition. Deterministic AI's combination of certainty-seeking, fixed rules, and optional oversight conflicts with Islamic epistemic norms on multiple dimensions. UVIF's uncertainty-embracing, adaptive, and oversight-integral architecture is a much closer fit [41, 5].

6.4 Limitations

This article has several important limitations that must be acknowledged.

Conceptual translation: The correspondences we identify between UVIF concepts and Islamic principles involve conceptual translation across very different intellectual frameworks. We have been careful to note functional rather than semantic equivalences, but the risk of inappropriate mapping cannot be entirely eliminated. Future work should subject these correspondences to scrutiny by scholars deeply grounded in both traditions.

Formalization limits: Islamic jurisprudence involves dimensions of intentionality, spiritual state, and relational context that resist formal computational modeling. We do not claim that UVIF can capture the full richness of Islamic decision philosophy — only that it can model its structural-epistemic components.

Implementation gap: The architectural alignment we describe remains primarily theoretical. Practical implementation of UVIF-based systems for Islamic applications faces substantial challenges of knowledge engineering, data quality, scholarly acceptance, and governance design that require extensive future work.

Diversity within Islamic tradition: Islamic jurisprudence encompasses significant internal diversity across schools, regions, and historical periods. Our analysis necessarily abstracts from this diversity and should be understood as identifying correspondences with classical mainstream positions rather than any specific contemporary tradition. It must be stated plainly that no single computational mapping can represent all schools, methodologies, or interpretive approaches within the Islamic tradition; concepts such as Zann, Maslaha, and the conditions of valid Ijtihad are themselves understood differently across madhahib and theological schools. Any implemented system would therefore need to be explicitly parameterized by the interpretive tradition it serves, and reviewed by scholars of that tradition, rather than presented as a universal model of Islamic reasoning.

6.5 Future Research Directions

Several high-priority future research directions emerge from this analysis.

Formal Tawakkul models: Development of formal decision-theoretic models of Tawakkul that can be operationalized in UVIF architectures, potentially drawing on stopping rule theory and optimal information acquisition frameworks.

Empirical studies: Empirical investigation of how Muslim scholars and communities evaluate and interact with uncertainty-aware AI systems, and whether UVIF-aligned architectures are perceived as more epistemically appropriate than certainty-seeking alternatives.

Multi-tradition analysis: Extension of the comparative framework to examine structural alignments between UVIF and other non-Western intellectual traditions — including Buddhist epistemology, Confucian practical reason, and African Ubuntu ethics — with the goal of identifying universal principles of rational agency under uncertainty.

Governance frameworks: Development of Islamic governance frameworks for UVIF-based AI systems, drawing on principles of Shura, Maslaha, and scholarly authority to specify appropriate human oversight mechanisms.

Prototype development: Construction and evaluation of prototype UVIF-based jurisprudential decision support systems, in collaboration with qualified Islamic scholars, as proofs-of-concept for the practical realization of the theoretical framework developed here.

7. CONCLUSION

7.1 Recapitulation

This article has argued for a systematic conceptual alignment between the Unified Variational Intelligence Framework (UVIF) and the epistemological and decision-philosophical foundations of Islamic thought. Beginning from an analysis of Islamic epistemology's sophisticated treatment of knowledge, uncertainty, and action, and proceeding

through a detailed exposition of UVIF's variational equilibrium and bounded rationality architectures, we identified structural correspondences — in the restricted, functional sense defined in Section 1.1 — that are not superficial metaphors but substantive functional parallels.

The central correspondence — between UVIF's policy commitment under residual uncertainty and the Islamic concept of *Tawakkul* — was shown to be particularly deep. Both frameworks address the universal problem of how a finite, epistemically limited agent should act in an uncertain world: both arrive at the solution of maximal epistemic due diligence followed by wholehearted commitment, neither premature nor indefinitely deferred. The Islamic contribution is to embed this decision-theoretic architecture within an ethical and spiritual framework that gives it meaning; UVIF's contribution is to formalize it mathematically in a way that enables computational implementation.

7.2 Final Perspective

The broader significance of this work lies in its contribution to what might be called *epistemological AI ethics* — an approach to AI ethics grounded not merely in outcome-based principles (avoid harm, promote welfare) but in the epistemic architecture of AI systems themselves. We have argued that epistemic humility, calibrated uncertainty, and human-centered design are not merely ethically desirable features of AI systems but expressions of what rational intelligence, properly understood, actually is.

Islamic intellectual tradition, with its fourteen centuries of sophisticated engagement with knowledge, uncertainty, and the ethics of action, offers profound resources for this project. The UVIF-Islamic alignment explored in this article represents one instantiation of the broader insight that the development of trustworthy, ethically aligned AI can benefit enormously from genuine engagement with the full range of human intellectual traditions — not as window-dressing for already-determined technical architectures, but as sources of conceptual insight that can reshape those architectures from the ground up.

As artificial intelligence systems become ever more deeply embedded in the social, legal, and spiritual lives of Muslim communities worldwide, the need for AI architectures that are not merely *compatible with* but *conceptually grounded in* Islamic epistemological and ethical commitments will only intensify. This article represents a contribution toward meeting that need.

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TRANSLITERATION

a. Consonant

Arabic	Latin	Example	
		Arabic	Latin
ء	‘	فَأْرُ	faʿrun
أ	(a,i,u)	أَحْكَام	aḥkāṁ
ب	b	بَابُ	bābun
ت	t	تَمْرٌ	tamr
ث	th	ثَلَاثُ	thalātha
ج	j	جَبَلٌ	Jabal
ح	ḥ	حَدِيثٌ	ḥadīth
خ	kh	خَالِدٌ	khālīd
د	d	دِينٌ	dīn
ذ	dh	مَذْهَبٌ	madhhab
ر	r	رَاهِبٌ	rāhib
ز	z	زَكِيٌّ	zakī
س	s	سَلَامٌ	salām
ش	sh	شَرَبٌ	sharaba
ص	ṣ	صَدْرٌ	ṣodrun
ض	ḍ	ضَارٌ	ḍār
ط	ṭ	طَهْرٌ	ṭahura
ظ	ẓ	ظَهْرٌ	ẓhohr
ع	‘	عَبْدٌ	‘abdun
غ	gh	غَيْبٌ	ghayb
ف	f	فَاتِحَةٌ	Fātihah
ق	q	قَبَسٌ	qabas
ك	k	كِتَابٌ	kitāb

ل	l	لَيْلٍ	layl
م	m	مُنِيرٍ	munīr
ن	n	نِقَابٍ	niqāb
و	w	وَعَدٍ	wa ^c ada
هـ	h	هَدَفٍ	hadaf
ي	y	يُوسُفَ	Yūsuf

b. Short Vowel

Arabic	Latin	Example	
		Arabic	Latin
اَ	a	كَتَبَ	kataba
اِ	i	عَلِمَ	°alima
اُ	u	غَلِبَ	ghuliba

c. Long Vowel

Arabic	Latin	Example	
		Arabic	Latin
اَ ، اِ ، اُ	ā	عَالَمَ ، فَتَى	°ālam , fatā
يِ	ī	عَلِيمَ ، دَاعِي	°alīm , dā°ī
وِ	ū	عُلُومَ ، اُدْعُو	°ulūm , 'ud°ū

d. Diphthong

Arabic	Latin	Example	
		Arabic	Latin
أَوْ	aw	أَوْلَادَ	aulād
أَيَّ	ay	أَيَّامَ	ayyam
إِيَّ	iy	إِيَّاهُ	iyyāka