Addressing the Limitations of the Futures Cone: Introducing the Adaptive Futures Mesh

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Abstract

This paper aims to address the limitations of traditional strategic foresight methodologies, specifically the Futures Cone (FC), by introducing and evaluating a novel framework called the Adaptive Futures Mesh (AFM). The study employs a conceptual analysis, drawing on systems thinking, complexity science, and participatory design principles to develop the AFM. The AFM is structured around key components including a dynamic mesh network, uncertainty gradients, adaptive feedback loops, and an emergence engine. The analysis finds that the AFM offers a more robust approach to navigating uncertainty by explicitly incorporating unknown unknowns (dark matter nodes). It visualizes cascading impacts, emphasizing human agency, and enables continuous adaptation through feedback loops. Research limitations include the lack of empirical validation and potential challenges in implementing the AFM across diverse contexts. However, the AFM offers significant practical implications for strategic planning. It enables organizations to move beyond prediction and cultivate futures-readiness. Socially, the AFM promotes more inclusive and equitable futures by democratizing foresight and empowering stakeholders to shape their own destinies. The originality and value of this paper lie in its articulation of a novel, adaptive framework that enhances strategic resilience in facing complexity and multiple crises.

Keywords: Adaptive Futures Mesh (AFM), Futures Cone (FC), strategy development; resilience, strategic foresight; uncertainty; philosophy; cognitive psychology; quantum physics; history and philosophy of science; complex adaptive systems (CAS)

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Introduction

The Futures Cone (FC) has long been a conceptual framework in the field of Futures Studies (FS) (Gall et al., 2022). It provides a visual representation of various potential futures that can emerge from the present. It has helped individuals and organizations think about the future and explore different scenarios. However, as foresight practitioners continue to evolve in their understanding of time, complexity, and uncertainty, it is essential to gently re-evaluate this framework to ensure it remains relevant and effective in addressing emergent challenges.

This analysis acknowledges that the FC is a simple visual and adjusts desired expectations accordingly. It is not intended to undervalue or downplay the significant contributions that previous studies based on the FC have made. Many practitioners have utilized this model to stimulate discussions about future possibilities and guide strategic planning (Mao, Liu, 2023; Migone, Howlett, 2024; Park, Shin, 2024). Instead, the study aims to facilitate a constructive dialogue about how to enhance contemporary approaches to FS. This analysis recognizes the limitations of the FC, such as its linear assumptions and susceptibility to cognitive biases. It opens up new perspectives that may better capture the complexities of time and future developments.

Considering the changes and uncertainties organizations encounter today, it feels timely to think about alternative frameworks that embrace a more interconnected and dynamic understanding of time and future possibilities. In this way, the study builds upon the foundation laid by previous work and adapts to new insights from philosophy, quantum physics, and cognitive psychology.

Based on that premise, this study analyzes the FC as a two-dimensional or three-dimensional shape expanding in one direction to visually represent a range of alternative potential futures (Migone, Howlett, 2024). Characterized by its cone-like shape, this framework illustrates how various futures branch out from the present. It originated from the work of Henchey (1977) who proposed four categories of future scenarios: possible (any future that could happen), plausible (a future that makes logical sense), probable (a highly likely future based on current trends), and preferable (the best possible future). These categories were later visualized by Hancock and Bezold (1994), and reinterpreted by Voros (2003) to illustrate the expanding range of potential futures as one moves forward in time. As demonstrated by Figure 1, this model encourages the exploration of alternative scenarios. It stimulates thinking about complex problems and dynamics.

However, the FC is not without limitations. While useful for visualizing potential futures, it is essential to examine its underlying assumptions and potential shortcomings. This analysis will evaluate the FC from philosophical, scientific, and cognitive perspectives to identify areas where the framework may oversimplify or misrepresent the nature of time and future possibilities. This examination will consider challenges to the cone's assumed linear progression of time, its handling of uncertainty, and its susceptibility to cognitive biases. It offers recommendations for improving the process of envisioning future possibilities.

In light of the comprehensive critique, this analysis will propose an alternative framework. It is a groundbreaking framework that addresses the limitations inherent in the FC. The Adaptive Futures Mesh (AFM) integrates dynamic systems thinking, participatory agency, and uncertainty absorption to model futures more effectively and responsively. Figure 2 represents an overview of the AFM in which its core components—emergence engine, adaptive feedback loops, and uncertainty gradients—are highlighted. Thus, this analysis aims to provide a more reliable and robust framework for understanding potential futures.

The current study sets the stage for a thorough evaluation of the FC and the proposition of an alternative framework that addresses its limitations. This exploration will contribute to the ongoing dialogue in FS. It enhances the tools and approaches used to envision and prepare for the future. This critical review also serves as an invitation for reflection and growth within the field of FS. As practitioners continue to learn from one another, it will be critically important to remain open-minded and supportive in joint efforts to envision futures that are not only possible but also preferable for all.

The subsequent sections outline the methodology, theoretical framework, problems with the FC framework, an interdisciplinary analysis, and the alternative framework. Finally, the need for adopting the proposed framework to better conduct foresight studies will be noted in light of acknowledging the study's limits and recommending further research.

Method

The methodology utilized in this study involves a structured and interdisciplinary approach (Hvidtfeldt, 2018). It integrates insights from philosophy, quantum physics, and cognitive psychology. A key question drove this study: How can foresight practitioners develop more adaptive frameworks for envisioning the future? This question was raised by acknowledging the complexities of uncertainty and the interconnectedness of potential outcomes. It was aimed at going beyond the limitations of traditional models like the FC. It encouraged the exploration of innovative approaches for FS.

This study examines the philosophical, scientific, and cognitive foundations of the FC to determine if an alternative framework is warranted. Then, the study develops a methodology for an alternative framework. It also assesses its feasibility and utility in supporting strategic decision-making within complex domains such as AI-driven and climate-related strategies.

The study is both epistemological and ontological in its approach. It is epistemological as it focuses on how future possibilities are considered through the FC. It questions how knowledge about potential futures is constructed and validated. It investigates the assumptions underlying the FC and how these assumptions affect the epistemological stance toward envisioning futures. It also explores how different disciplines like philosophy, quantum physics, and cognitive psychology contribute to practitioners' understanding of future possibilities.

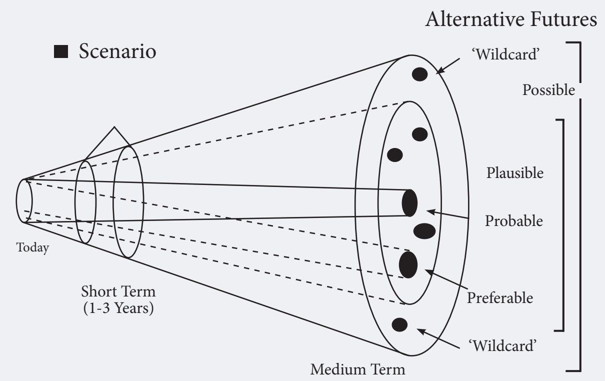
It is ontological as it deals with the nature of time and reality. The study explores what can exist in terms of future possibilities. It considers whether the FC reliably represents the potential realities that could emerge. It examines whether the concept of "possible" futures in the FC aligns with the current understanding of physical laws and cognitive limitations. Ontologically, it proposes an alternative framework concerned with how a different model may better capture the essence of future realities. This involves exploring how quantum physics offers insights into the nature of reality that could inform new ways of conceptualizing future possibilities and how cognitive psychology reveals biases in the perception of future scenarios.

The analysis process began with a review of the literature that created a foundational understanding of the FC and its application. The review involved examining primary sources on the FC, including its origins and adaptations over time, as well as exploring philosophical theories of time. Key works by Hancock and Bezold (1994) provided essential insights into the framework's development, while philosophical texts by Eliade (2018) and Hawking (2011) offered critical perspectives on the nature of time as they challenged the linear assumptions that underpin the cone.

Figure 3 represents the research flow briefly. Following the literature review, a philosophical analysis was conducted to scrutinize the underlying assumptions about time within the FC framework. The analysis highlighted how the assumption of linear time fails to account for cyclical and complex views that emphasize the interconnectedness of past, present, and future. Insights from Eastern philosophies, which view time as a repeating cycle, alongside modern physics concepts such as loop quantum gravity (Rovelli, 2007) revealed that the FC's linear model is limited in its ability to reflect the intricate relationships that shape future possibilities.

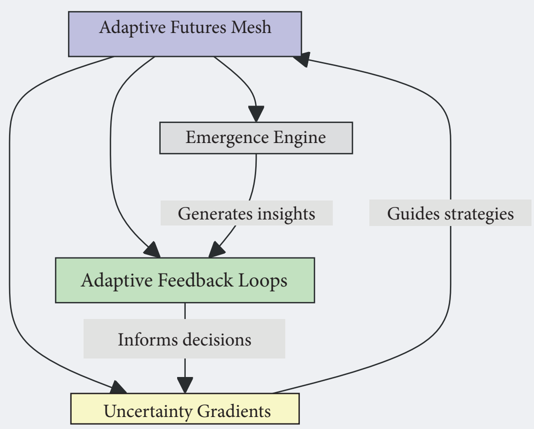
The next phase involved a scientific critique of the FC's treatment of uncertainty and predictability. This critique drew on principles from quantum physics and complex systems theory to illustrate how these fields introduce concepts of uncertainty that challenge traditional models. Quantum mechanics reveals that outcomes are probabilistic rather than predetermined (Bohr, 2011; Heisenberg, 2013), while complex systems theory emphasizes emergent phenomena and non-linear dynamics (Érdi, 2008; Sterman, 2000). The analysis underscored how the FC's static categorization of futures into "probable," "plausible," "possible," and "preferable" oversimplifies the complexities inherent in anticipating future developments.

Figure 1. **The Futures Cone**



Source: (Hancock, Bezold, 1994).

Figure 2. **An Overview of Adaptive Futures Framework**

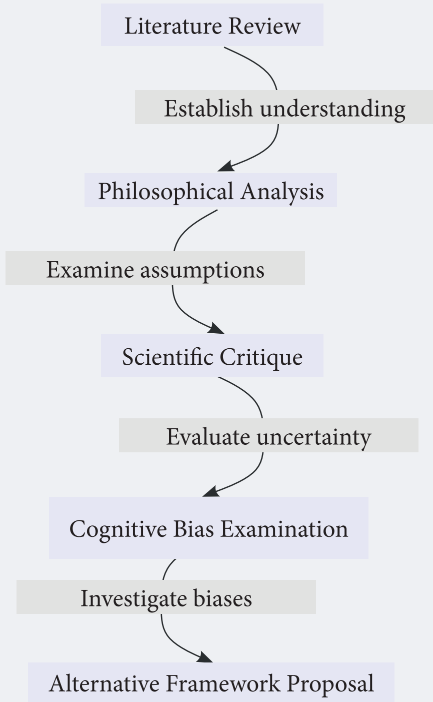


Source: author.

In addition to philosophical and scientific perspectives, cognitive biases were examined to understand their influence on how individuals interpret and apply the cone. The analysis identified common biases such as confirmation bias and anchoring bias that can distort futures thinking. The recognition of these biases revealed that decision-makers might prioritize specific outcomes while neglecting alternative scenarios (Ramos, 2019). This insight led to a discussion of strategies for mitigating these biases through diverse perspectives and inclusive decision-making processes.

Building upon these critiques, an alternative framework was proposed. This approach emphasizes the interconnectedness of past, present, and future while acknowledging uncertainty and complexity. It advocates for incorporating multiple perspectives to mitigate cognitive biases and recognizes the dynamic nature of time and potential futures. Adopting an interdisciplinary approach offers a more reliable model for understanding uncertainty and complexity.

Figure 3. **The Research Flow**



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Theoretical Framework

The networked perception of the future aligns with several theories and approaches, including networked foresight, systems thinking, and concepts related to social-ecological systems. These theories emphasize interconnectedness, dynamic interactions, and the importance of multiple perspectives, which are central to the networked perception framework.

Systems Thinking

Systems thinking is a holistic approach that focuses on understanding the relationships among parts of a system rather than analyzing the individual components in isolation. It emphasizes that the interactions and feedback loops between its elements determine the behavior of a system (Meadows, Wright, 2008). In the context of FS, systems thinking encourages practitioners to consider the broader social, technological, economic, environmental, and political factors that shape future outcomes (Hynes et al., 2020). Systems thinking analyzes these interdependencies and helps to reveal potential leverage points and unintended consequences that linear approaches likely overlook.

Interdisciplinary Approach

Including multiple perspectives is an essential component of a networked or complex perception. Taking such an approach requires practitioners to go beyond the conventional borders of the foresight field and embrace views from other disciplines, including cognitive psychology. For instance, cognitive biases can significantly distort human understanding of the future, leading to narrow and inaccurate predictions.

Similarly, modern physics has introduced theories such as loop quantum gravity, which imply that spacetime itself may be fundamentally non-linear (Rovelli, 2007). These insights highlight the limitations of viewing time through a linear lens and underscore the need for a wider understanding of how time operates. For example, quantum physics challenges the FC's assumptions by introducing concepts of uncertainty and non-linearity. At the quantum level, particles exist in superpositions of states until they are measured. This indicates that outcomes are not predetermined but probabilistic (Heisenberg, 2013). The inherent uncertainty suggests that the future cannot be envisioned or anticipated based solely on present conditions.

Practitioners may seek out diverse viewpoints and challenging assumptions to mitigate the impact of these biases and gain a more comprehensive understanding of the range of possible futures. This approach also aligns with creating environments where all voices are heard and collective intelligence is harnessed (van den Ende et al., 2022). Perceived societal anomie, as a negative perception of the present, can shape imagined futures. Again, this further emphasizes the need for diverse perspectives.

Dynamic Perspective

A networked perception emphasizes the dynamic and evolving nature of the future. Unlike the FC, which presents a static view of potential outcomes, this approach recognizes that a multitude of interacting factors shape the future constantly. If decision-makers embrace such a dynamic perspective, they can remain agile and responsive to changing conditions and adapt their strategies as new information emerges. This approach aligns with networked thinking. It encourages unbounded exploration and embraces the chaotic nature of the journey (Stechert, 2006). Network analysis can reveal structural linkages between trends and emerging issues, and thereby enrich foresight analysis.

Social-Ecological Outlook

The concept of social-ecological systems (SES) recognizes that human societies and natural ecosystems are intertwined and co-evolve (Walker et al., 2004). Understanding SES dynamics is critical for sustainable futures. It highlights the reciprocal relationships between human actions and environmental impacts (Partelow, 2018). In FS, an SES perspective encourages practitioners to consider how social and ecological systems interact and influence each other over time (Drees et al., 2022).

This approach often involves engaging diverse stakeholders, including scientists, business owners, government officials, landowners, and nonprofit representatives, to develop integrated plans for managing resources and building resilience in the face of uncertainty. The SES concept also highlights the importance of considering outcomes where advanced technologies or large-scale systems result in immense suffering. Addressing these risks involves ethical foresight and robust frameworks to prevent scenarios where suffering could persist or multiply across vast scales.

Futures Literacy

Futures literacy involves the ability to imagine and shape the future, i.e., how the future influences perception and actions, and learning to apply strategies to build resilience and opportunities for the futures (Miller, 2018). This capacity has been recognized as an important skill for education today. It can enhance the exploration of new ways of engaging with what is happening in the world. From the perspective of educational technology, it provides learners with a method to anticipate the ethical, social, and economic challenges that may arise in the new educational landscape and to design policies and practices that promote equity and inclusion in an increasingly digital world (Mangnus et al., 2021). Futures literacy aligns with the network perception of the future.

The networked perception framework integrates these concepts, theories, and approaches to provide a more holistic and adaptive approach to FS. It aligns with the interdisciplinary and systematic study of technological and social advancement. This theoretical foundation makes the exploration of potential futures possible and facilitates the development of robust strategies for navigating complexities and interconnections.

Main Problems with the FC

The FC framework, while a valuable tool in strategic planning, presents significant limitations when confronted with the complexities of real-world scenarios. Its primary deficiency lies in its inability to adequately account for unknown unknowns, those unpredictable and unforeseen events that can drastically alter the course of future outcomes, as well as the inherent dynamic, non-linear nature of reality (Heisenberg, 2013). These shortcomings can lead to strategic plans that are ultimately rigid and ill-prepared for the challenges of uncertain futures. An overview of the main problems with the FC framework is offered below.

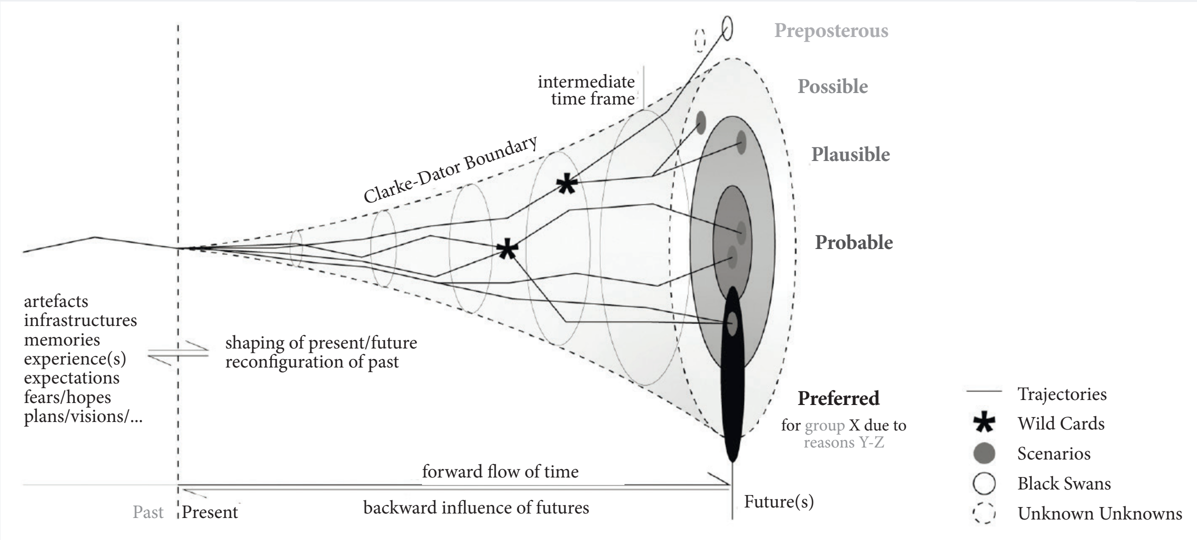
Linear Conception

The FC inherently presumes a linear progression of time. It is an assumption that faces considerable scrutiny from philosophical and physical science perspectives. This linear model suggests that the future unfolds sequentially from the present and branches out into a range of possibilities. The FC operates under static and linear assumptions that do not reflect the intricate dynamics of reality (Migone, Howlett, 2024). The framework implies a linear progression from the present to various potential futures. It neglects the complex interdependencies, feedback loops, and emergent phenomena that constantly reshape the world.

Furthermore, it cannot often dynamically adapt as new information emerges. It offers strategies that can quickly become outdated and irrelevant. Constant change and interconnectedness characterize the world. Thus, a linear and static model can prove inadequate. As depicted by Figure 4, even later representations of the FC framework that attempted to optimize its structure amplified that concept of linearity (Gall et al., 2022).

However, a significant body of philosophical thought challenges this notion. They argue that time is not necessarily a straight line but may exhibit cyclical patterns (Overton, 1994), complex interdependencies (Hawking, Penrose, 2015), or

Figure 4. **The Revised FC**



Source: (Gall et al., 2022).

even be an illusion altogether (Jaffe, 2018). This issue will be discussed further in the upcoming section.

Illusion of Comprehensiveness

One of the most significant drawbacks of the FC is the false sense of comprehensiveness it can engender. The framework categorizes potential futures into discrete segments such as "probable," "plausible," "possible," and "preferable." It creates an illusion that all critical scenarios have been accounted for. However, practitioners' current knowledge base inherently limits this categorization. The FC struggles to address blind spots or so-called black swan events, unpredictable, high-impact developments that fall outside existing frameworks of understanding (Taleb, 2010). Because it relies on what is already known or anticipated, it inherently fails to account for what decision-makers cannot know.

Overlooking Human Agency and Interaction

Another key limitation of the FC is that it overlooks the critical role of human agency and interaction in shaping future outcomes. The cone tends to treat futures as passive results rather than recognizing the influence of proactive decisions, innovation, and the complex interplay between different scenarios and stakeholder actions. The framework is merely a simplified representation of an assumption that does not adequately model the multifaceted interactions that can significantly alter the course of events. Thus, it diminishes the impact of human actors.

Underestimating Uncertainty

The FC runs the risk of underestimating the true extent of uncertainty as it structures the future into distinct categories. This categorization can create a sense of overconfidence in strategic plans. It may lead organizations to prioritize "probable" or "plausible" paths and neglect the potential for radical disruption. This can leave them vulnerable to unanticipated challenges and ill-prepared to navigate the complexities of a changing environment. When uncertainty is downplayed, resilience is compromised.

There is a growing need for adaptability and agility in making future-focused decisions. Strategic plans that rely solely on the FC framework may prove rigid, incomplete, and ultimately ineffective. To develop truly resilient strategies, decision-makers must embrace adaptability, scenario agility, and a sense of humility in the face of the unknown. Effective strategy requires acknowledging the limitations of anticipatory models and cultivating the capacity to respond effectively to unforeseen events—elements that the FC does not inherently address.

Analysis

To propose an alternative framework to the FC, it was necessary to integrate insights from several disciplines, including philosophy, quantum physics, and cognitive psychology. In this way, a comprehensive understanding of how humans envision potential futures could be achieved. Therefore, the limitations of the FC were examined through an interdisciplinary lens. This analytical framework aims to highlight the complexities of time, uncertainty, and human cognition in shaping perceptions of future possibilities.

Philosophical Perspective

Philosophical viewpoints on time vary widely. Some, like Aristotle, define it as a "measure of movement" and inextricably linked to change (Hutton, 1977). Others, such as Newton, posited the existence of "absolute time," flowing uniformly and independently of external events (Schliesser, 2013). In contrast, relationists like Leibniz argued that time is not independent of events but rather a series of moments defined by the relations of "earlier-than" and "simultaneous-with" among co-existing events (Futch, 2008). These contrasting views highlight a fundamental debate about whether time is an objective reality or a construct dependent on perception and the events that unfold within it.

The concept of cyclical time (Oosterling, Tiemersma, 1996), prevalent in many early cultures and religions like Hinduism, Buddhism, and Jainism, further undermines the linear assumption of the FC. These traditions perceive time as consisting of repeating ages and periods. They suggest that the future may echo patterns from the past (Bendor et al., 2021). This cyclical view contrasts sharply with the FC's unidirectional projection, where the future is seen as a divergence from the present rather than a recurrence of past trends.

Modern philosophical perspectives also challenge the traditional understanding of time. Some philosophers propose that time might be an illusion, with everything happening simultaneously, and that the perception of sequential events is merely a construct of mind (Merleau-Ponty, 2004). Others focus on subjective time. They emphasize how consciousness and changing perceptions shape the human experience of time (Varela, Depraz, 2005). Kant suggested that time and space are forms that the mind projects (Copenhaver, 2019). They influence how humans perceive the external world. These ideas suggest that human's understanding of time is not a direct reflection of an objective reality but is filtered through cognitive processes (Nozick, 2001).

Consequently, the FC's depiction of the future as a set of possibilities branching out from the present may be an oversimplification. Influenced by past patterns, present conditions, and the subjective experiences of individuals, a more reliable approach might envision the future as a complex web of interconnected events. This perspective aligns with complex systems theory (Estrada, 2024), where small changes can lead to significant and unpredictable outcomes. This view emphasizes the interconnectedness and emergent properties of the future.

Scientific Perspective

Quantum physics fundamentally alters the assumption of determinism. At the quantum level, particles do not have definite states until they are observed. Instead, they exist in a superposition of states (Colosi, Rovelli, 2009). This principle suggests that the future is not merely a linear extension of the present but is influenced by probabilistic outcomes that are not predetermined. As a physicist, Niels Bohr famously stated, "We must be clear that when it comes to atoms, language can be used only as in poetry" (Anderson, 1971). This highlights the limitations of classical deterministic models in anticipating future events. The FC's reliance on probability overlooks this quantum uncertainty and presents a misleadingly simplistic view of how future events may unfold.

Moreover, complex systems theory further complicates the linear notion of time. In complex systems, small changes can lead to disproportionately large effects—a phenomenon known as the butterfly effect. This unpredictability means that while certain trends may appear probable based on current data, they can be disrupted by unforeseen variables or interactions within the system. As noted by physicist Edward Lorenz, "The flapping of a butterfly's wings in Brazil can set off a tornado in Texas" (Érdi, 2008). Thus, the structure of the FC may imply a false sense of security regarding the ability to predict future outcomes based solely on present conditions.

On the other hand, deterministic assumptions in complex systems often hold only within specific spacetime scales. For instance, while short-term anticipations may yield reasonable accuracy due to more stable conditions, long-term forecasts become increasingly unreliable as more variables and uncertainties come into play. This limitation is crucial for understanding how the FC might misrepresent the fluidity and complexity of future scenarios. As noted by researchers like Sterman (2000), neglecting these dynamics can lead to oversimplified models that fail to capture the intricate interdependencies present in real-world situations.

In light of these scientific insights, it becomes evident that the FC framework requires re-evaluation. Rather than viewing the future as a series of branching paths emerging from a fixed present moment, it may be more productive to conceptualize it as a dynamic network of interconnected possibilities influenced by a myriad of factors, both predictable and unpredictable, namely, a mesh. If practitioners embrace the inherent complexity and uncertainty of the future as described by quantum mechanics and complex systems theory, they may develop more robust models that reflect the true nature of time and future outcomes.

Cognitive Perspective

The FC is inherently susceptible to cognitive biases that can significantly distort foresight and anticipatory thinking. Cognitive biases are systematic patterns of deviation from the norm or rationality in judgment. They arise from the way the human brain processes information (Muntwiler, 2023). These biases can affect how individuals perceive the present, interpret signals, and imagine future possibilities. They may lead to errors in judgment and decision-making.

One of the primary cognitive pitfalls of the FC is the tendency for individuals to focus on a particular image of the future and neglect alternative scenarios. This often results from confirmation bias, where people selectively seek out and interpret information that confirms their pre-existing beliefs or hypotheses (Nickerson, 1998). For instance, if someone believes that renewable energy will dominate the future, they might overemphasize trends supporting this view and dismiss evidence that suggests otherwise. This narrow focus can lead to a skewed and incomplete understanding of the range of possible futures. It can limit the effectiveness of strategic planning and risk assessment (Cristofaro et al., 2021).

The structure of the FC itself can inadvertently reinforce confirmation bias. By categorizing futures into "possible," "plausible," "probable," and "preferable," the cone may create a cognitive framework that encourages individuals to prioritize scenarios that align with their current expectations or desires. This can result in a self-fulfilling prophecy and drive efforts that are concentrated on realizing a specific future while neglecting the exploration of alternative paths that may be more beneficial or resilient in the face of unanticipated events.

Anchoring bias also poses a significant challenge when using the FC. This bias refers to the tendency to rely too heavily on the first piece of information encountered when making decisions (Chapman, Johnson, 1994). In the context of futures thinking, the initial assumptions or trends considered can disproportionately influence the subsequent analysis and scenario development. This can limit the ability to see beyond the probable spectrum. It may eliminate chances of finding plausible or possible alternatives.

To mitigate the impact of cognitive biases, decision-makers must be aware of these tendencies and actively employ strategies to overcome them (Winkler, Moser, 2016). This includes seeking diverse perspectives, challenging assumptions, and using structured decision-making processes to ensure that a wide range of possibilities is considered. Additionally, scanning the environment for weak signals and emerging trends can help to identify potential disruptions that might be overlooked due to cognitive biases (Tabatabaei, 2011).

Recognizing that worldviews are tacit, with practitioners participating in future exercises unaware of their biases, it becomes essential to expand the FC (Kunseler et al., 2015). This requires considering the past and present to ensure a more effective and inclusive supervisory style of foresight. Consideration of likelihood, interdependence, and power dynamics can enrich future scenario planning and ensure that the range of possible futures is captured.

Adaptive Futures Mesh

Instead of the FC's linear approach, an alternative perspective, particularly a networked one can offer a more robust and adaptable framework for understanding the nature of time and the future. The Adaptive Futures Mesh framework, AFM, is designed to handle unexpected events through several key components. Its components work together to provide a more comprehensive and reliable understanding of the future. This approach recognizes the intricate interconnectedness of the past, present, and future. It acknowledges the inherent uncertainty and complexity that characterizes future outcomes. This approach integrates multiple perspectives and actively mitigates cognitive biases. It emphasizes the dynamic and evolving nature of the future and leads practitioners toward a better foresight practice.

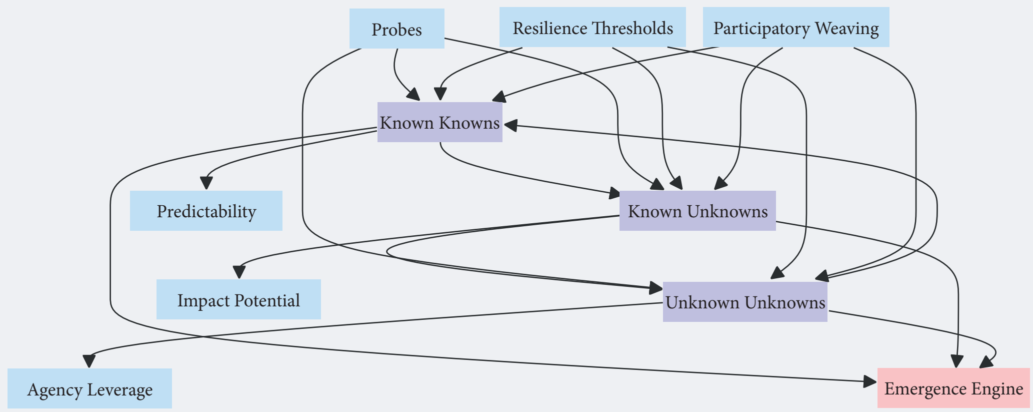
Principles

At the heart of the AFM are several core principles that redefine how it conceptualizes futures. Firstly, it emphasizes the 'non-linear interconnectedness' of futures. It replaces the linearity of cones with a dynamic network that reflects the complexity of real-world interactions. Secondly, it treats uncertainty as a core variable rather than an afterthought. This creates a more realistic representation of future scenarios. Thirdly, the concept of participatory emergence is introduced. In this sense, futures are co-created by both human and non-human actors. Lastly, the framework promotes continuous adaptation. It utilizes feedback loops that replace static scenarios with evolving strategies.

Components

One of the fundamental aspects of the AFM is its mesh structure. Instead of visualizing futures as a simple cone, this framework models them as a three-dimensional network composed of interconnected nodes. These nodes represent various categories: known knowns, which include established

Figure 5. **The Key Components of Adaptive Futures Mesh**



Source: author.

trends and data; known unknowns, encompassing identified risks; and unknown unknowns. Inspired by astrophysics, the AFM represents them as "dark matter nodes" that absorb ambiguity (Choudhury, 2023).

In the fields of space science and astrophysics, dark matter is believed to make up more than 80 percent of the universe's matter, but it remains invisible to scientists. Since it emits neither light nor energy, it cannot be detected using traditional methods. Dark matter appears to be dispersed throughout the universe in a web-like structure, with galaxy clusters forming at the intersections of these cosmic fibers (Garrett, Duda, 2011). Likewise, the nodes within the AFM dynamically adjust in size and position based on real-time data, stakeholder actions, and external shocks. Figure 5 represents the key components of this mesh.

Drawing from cognitive science, another significant element is the concept of "uncertainty gradients" (Skov, Nadal, 2023). Each node is evaluated based on three distinct gradients: "predictability," which assesses how well we understand it; "impact potential," which gauges the magnitude of potential disruption; and "agency leverage," which measures how much influence stakeholders can exert over it. Together, these gradients create a heat map that guides strategic resource allocation as represented by Figure 6.

The AFM also incorporates adaptive feedback loops (Zavala Rodríguez et al., 2019). This involves small-scale experiments known as probes, which test assumptions and generate signals to update the mesh accordingly. Resilience thresholds are established to define critical tipping points where strategies must pivot in response to significant changes. Moreover, participatory weaving allows stakeholders to collaboratively add or remove nodes, ensuring that emerging risks are flagged by those closest to them. Figure 7 shows how feedback loops contribute to updating the mesh.

Lastly, an "emergence engine" serves as a layer for emergent futures that arise from interactions between nodes (Maltarich, Havrylyshyn, 2023). For instance, debates on artificial intelligence (AI) ethics combined with climate migration can lead to new governance models. This engine leverages generative AI or crowdsourcing techniques to simulate various combinatorial possibilities. Figure 8 models these components and flows.

Dealing with the FC's Problems

The AFM effectively addresses several shortcomings of the traditional FC. It incorporates the "dark matter nodes" metaphor and acknowledges the existence of unknown unknowns. In this way, it encourages humility in foresight by explicitly reserving space for unimaginable scenarios. The nonlinear structure visualizes cascading impacts. For example, if a supply chain node collapses, it may significantly alter geopolitical dynamics. Furthermore, human agency is emphasized. Stakeholders have the power to rewire the mesh through their decisions and actions. Finally, adaptive feedback loops ensure that strategies evolve more swiftly than disruptions can occur.

Superiority

The AFM promotes an resilient approach that thrives on volatility by viewing uncertainty as a catalyst for innovation rather than an obstacle. It democratizes foresight by involving diverse voices in shaping future trajectories through collaborative weaving. Most importantly, it shapes a living strat-

Figure 6. **Uncertainty Gradients**

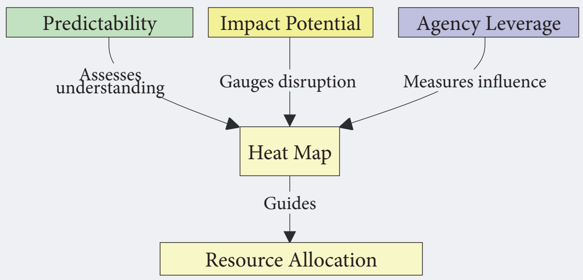


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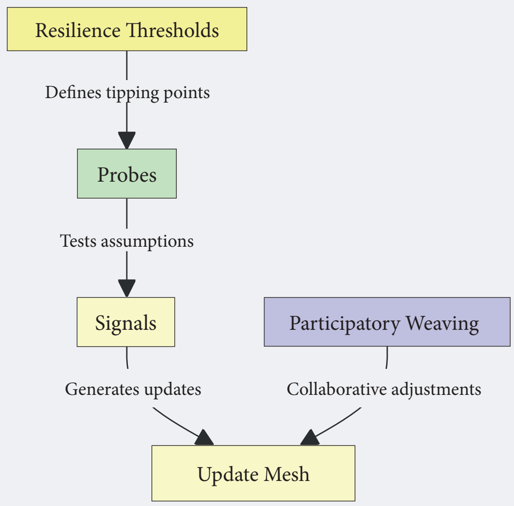
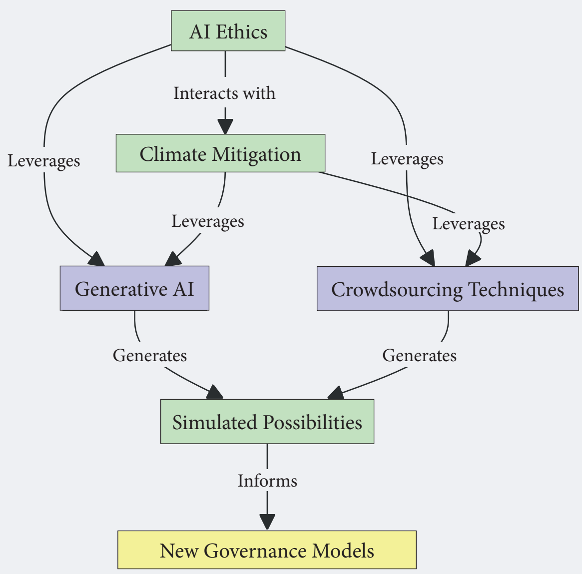
Figure 7. **Adaptive Feedback Loops**



Source: author.

Figure 8. **An Emergence Engine Model**



Source: author.

egy where plans are never final but evolve organically in response to changing circumstances. This framework represents a crucial shift from merely anticipating futures to actively cultivating futures-readiness. This is an essential capability in today's era characterized by poly-crisis challenges (Raczkowski, Komorowski, 2025). Organizations interested in operationalizing this approach can explore tailored applications specific to their industries.

Example

Consider a company that strategizes for climate-related initiatives by 2030. A traditional FC approach might focus narrowly on plausible carbon taxes. However, applying the AFM allows for a broader perspective. The company could map nodes such as "geoengineering start-ups," "water conflicts," and "unknown climate feedback loops." Through this comprehensive modeling, they might identify a dark matter node—like permafrost methane release—that poses significant risks to other elements within their strategy. If they invest in innovative methane-capture prototypes while continuously monitoring Arctic conditions, they can adapt their strategy as new nodes emerge — such as youth-led climate litigation.

Conclusion

This analysis has critically examined the FC, a prominent framework in futures studies that categorizes potential futures into probable, plausible, possible, and preferable types. While the FC serves as a useful tool for visualizing alternative futures and stimulating strategic thinking, it is not without limitations. The reliance upon a linear progression of time oversimplifies the complexities and uncertainties inherent in forecasting future developments. Philosophical critiques challenge the notion of linear time, suggesting instead that time may be cyclical or complex, where past, present, and future are interconnected. Furthermore, scientific insights from quantum physics and complex systems theory highlight the unpredictability of future outcomes, emphasizing that they are influenced by chance and new conditions rather than deterministic pathways.

Additionally, cognitive biases play a crucial role in shaping how individuals interpret and engage with the FC. Confirmation bias and anchoring bias can lead to a narrow focus on specific futures while neglecting alternative scenarios. This underscores the importance of incorporating diverse perspectives and challenging assumptions to mitigate these biases. If decision-makers recognize these limitations, they can avoid complacency and develop a more comprehensive understanding of potential futures.

To address the shortcomings of the FC, this analysis proposed the AFM alternative framework. This approach emphasizes the interconnectedness of past, present, and future while acknowledging uncertainty and complexity. This framework incorporates multiple perspectives and recognizes the dynamic nature of future developments. It offers a more reliable understanding that can better inform strategic planning and decision-making. Embracing this complexity allows organizations to remain agile in the face of uncertainty and adapt their strategies as new information emerges.

The exploration of alternative frameworks like networked perception is essential for enhancing practitioners' ability to envision and prepare for the future. As organizations navigate an increasingly complex world characterized by change and uncertainty, adopting comprehensive approaches to futures thinking will be crucial for empowering resilience and adaptability. The AFM moves beyond the limitations of the FC. It embraces a more holistic view of potential futures that better equip decision-makers to respond effectively to emerging challenges and opportunities.

While this study introduces and details the AFM as a novel framework for strategic foresight, it is inherently limited by its primarily theoretical and conceptual nature. The proposed framework requires extensive empirical validation across diverse real-world scenarios and organizational contexts. Furthermore, the effectiveness of specific components, such as the dark matter nodes and the emergence engine, requires rigorous testing to determine their practical contribution to improved decision-making. The study also acknowledges the potential challenges in implementing the AFM, including the need for cross-functional collaboration, data availability, and stakeholder engagement, which may vary significantly depending on the specific context.

Future research should focus on empirically validating the AFM framework through case studies and experimental designs. This includes developing quantifiable metrics to assess the performance of the AFM in comparison to traditional strategic foresight methods like the FC. Investigating the optimal methods for identifying and managing dark matter nodes, as well as exploring the ethical implications of using AI and crowdsourcing in the emergence engine, are critical areas for future research. Furthermore, studies should address the practical challenges of implementing the AFM in various organizational settings, including developing best practices for team composition, data governance, and stakeholder engagement to maximize the framework's effectiveness and impact.

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