Beyond Entertainment:
Academic Approaches to Gamedev Industry
ISBN 978-83-969444-4-3, AVANT Anthologies

Towards a Cybernetic Game Design Framework

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Received 2025-07-27; accepted 2025-12-18; published Online First 2025-12-31.

Abstract

Established game design frameworks, often adapted from linear engineering disciplines, are fundamentally misaligned with the non-linear, unpredictable, and collaborative reality of game development. This paper diagnoses this misalignment by framing game design as a "wicked problem," a class of challenges that resist traditional, top-down planning. It argues that a more robust foundation can be found in the principles of second-order cybernetics. The paper's contribution is not a rigid new framework, but a foundational rubric of five core principles intended to guide the creation of future design tools. These principles: Systemic Legibility, Emergence Cultivation, Conversational Framing, Authorial Intent as a First-Class Constraint, and Designing for the Player-as-System. Aimed at changing the conceptual understanding of a designer's role from a director of experience to a cultivator of a possibility space. By introducing design concepts rooted in cybernetics and systems thinking, this paper lays the theoretical groundwork for tools that can better support the discovery-driven and emergent nature of game design.

Keywords: Game Design, Game Design Frameworks, Game Development, Design Cybernetics, Design Frameworks, Player Experience, Interaction Design, Emergence

1. Introduction

Video games industry has emerged as one of the dominant cultural and economic forces in 21st century. In the recent years it has grown to become a massive powerhouse with the total industry-wise revenue projected to reach US$522.46bn in 2025 [1]. Yet, despite this commercial success, the creative process at the heart of the industry remains notoriously difficult to formalize and

manage. Video games are complex, costly sociotechnical products (Tschang, 2007), and empirical studies consistently reveal their development to be a non-linear, unpredictable, and highly collaborative process that resists traditional, top-down planning (Marklund et al., 2019). The final design is often *discovered* through iteration and playtesting, rather than being executed from an initial blueprint.

In an attempt to manage this complexity, numerous game design frameworks have been proposed. However, these frameworks, often adapted from more linear engineering disciplines, are frequently deemed not suitable in real-life scenarios. They attempt to impose a systematic, goal-oriented structure onto what is fundamentally an emergent and discovery-driven practice. By treating game design as a conventional, solvable problem, they often fail to adequately address its inherent "wickedness" (Rittel & Webber, 1973; Buchanan, 1992), creating a tension that can stifle the very creativity they are meant to support.

This paper argues that a more robust foundation for game design frameworks can be found in the principles of second-order cybernetics. By reframing game design not as a linear process of problem-solving but as a conversational and constraint-oriented practice of navigating complexity (Fischer & Richards, 2017; Dubberly & Pangaro, 2019), we can synthesize a new set of guiding principles for the creation of design tools. These principles, including systemic legibility, emergence cultivation, and the preservation of authorial intent, can lay the groundwork for a future generation of frameworks that empower, rather than confine, the designer's creative act. To build this argument, this paper will first establish the wicked nature of the game design problem space, then introduce key concepts from cybernetics, before finally synthesizing these insights into a set of foundational principles.

2. The Wicked Nature of Game Design

Prior to attempting to propose a new framework for game design, it is essential to define the nature of the activity it aims to support. A common approach in many design frameworks is to treat the process as a systematic, phased progression from idea to product, focusing on the structured development of components. (Maxim & Arnedo, 2025) However, a deep look into the empirical reality of game development reveals a process that is fundamentally at odds with such linear and predictive models. This chapter will argue that game design is not a conventional engineering task but a "wicked problem", a class of challenges that cannot be solved by traditional, systematic means. This inherent wickedness explains the limitations of current frameworks and establishes the necessary criteria for any new approach.

Empirical research into the daily practices of game development paints a picture of a process that is non-linear, highly iterative, and discovery oriented.

Marklund et al. (2019), in a comprehensive review of 48 papers on the topic, found that it is "almost impossible to plan a development project in detail". And this is not due to a lack of discipline but is seemingly inherent to the creative act itself. Creativity in game development is described not as the top-down vision of a single *auteur* but as a "subtle alchemy" emerging from the collaboration between diverse communities of scriptwriters, artists, programmers, and testers.

This collaborative and creative process is fundamentally non-linear. Ideas are not confined to an initial "ideation" phase but can appear at all stages and originate from any of the involved actors. (Marklund et al., 2019) The process is driven by continuous testing and refinement. As one developer noted: "You can plan for a large number of things, but ultimately the final decision is made when actual players try out the idea" (Kasurinen et al., (2014), as cited in Marklund et al., (2019)). The common four-stage structure: ideation, pre-production, production, and post-production, serves more as a loose guide than a rigid process, as the results from testing can have a major impact irrespective of the stage. The game is, in effect, *discovered* during its own creation.

Given this dynamic and unpredictable process, the tools used for design and communication become critically important. The traditional central artifact of game design, the Game Design Document (GDD), is a static, textual blueprint. However, its utility in a fluid development environment is highly questionable. Almeida & da Silva (2013) note that the static nature of the GDD creates a "gap between the conception of game ideas and the experimentation process" (Almeida & da Silva, 2013). They found that production teams, in real circumstances, are often unmotivated to read long, rapidly outdated documents. This finding is reinforced by Marklund et al. (2019), who observed a consistently low focus on formal documentation in favor of a strong focus on playable prototypes.

This inadequacy has led to a recognized need for more expressive and compact visual languages. (Almeida & da Silva, 2013) Designers have intuitively turned to tools like mind maps, flowcharts, UML diagrams, and other visual models to communicate the systemic and dynamic relationships within their designs that a linear document cannot adequately capture. The failure of the GDD is a clear symptom of a deeper misalignment: the tools of a predictable, linear process are being applied to an unpredictable, systemic one.

This collection of characteristics, the unpredictability, the co-evolution of problem and solution, the focus on subjective values, and the inadequacy of linear methods, has been identified and described before. It is the definitive signature of what design theorists Horst Rittel and Richard Buchanan have named a "**wicked problem**" (Rittel & Webber, 1973; Buchanan, 1992). Applying the ten attributes of wicked problems, as refined over decades of research (Chan & Xiang, 2022), reveals a near-perfect mapping to the challenges inherent in game design:

1. **No definitive formulation**. The formulation of the problem is inseparable from the formulation of the solution. This is clearly represented in the findings of Marklund et al. (2019) that the final design of a game is discovered during the development process. The initial design brief is only a hypothesis. The true problem of "what this game should be" is only defined through the iterative creation and testing of its solution.

2. **No stopping rule.** This manifests in game design as the constant need for balancing, patching, and the ever-present risk of "feature creep". The design process does not have a natural, logical endpoint where the game is definitively "solved" or "finished". It stops when external constraints (running out of budget, hitting a market deadline, etc.) are imposed. For modern "live service" games, the process seemingly never stops at all.

3. **Solutions are good-or-bad, not true-or-false.** This is evident in the industry's focus on subjective, "soft values" such as "user experience" and "fun" over objective metrics like "efficiency" (Marklund et al., 2019). There is no "correct" solution in game design, only solutions that are judged by various stakeholders (players, designers, publishers) as being more or less satisfying, engaging, or profitable.

4. **No immediate and no ultimate test of a solution.** While playtesting is essential, it cannot provide definitive proof of a solution's quality. Each playtest is a data point, an observation of a complex interaction at a single moment in time. Designers can only use this information to form better hypotheses about how the final design will be perceived by a much larger and more diverse audience over a longer period.

5. **Solutions trigger ripple effects.** Every significant game design decision has cascading consequences that affect the entire system. A seemingly minor change to a character's movement speed can impact level design, combat balance, the viability of certain strategies, and the overall "feel" of play. Once implemented and experienced, these decisions become part of the project's history and the team's collective memory. They are also not easily reversible, as the design is a path-dependent process.

6. **No clear solution or set of solutions.** As research by Kultima (2010) indicates, ideas in game design transform, evolve, and can originate from any source at any time. It is difficult to imagine a significant design problem, such as "the combat feels stale", that could be solved by a single definitive change. The solution is almost always a complex interplay of adjustments to animations, sound design, control responsiveness, enemy AI, and player feedback.

7. **Every wicked problem is essentially unique.** While genres provide conventions, every game development project is unique. The specific combination of creative vision, team dynamics, chosen technology, target audience, and market timing creates a unique context for every problem that arises.

A solution that worked for one game may be entirely inappropriate for another, even within the same genre.

8. **Every wicked problem can Be a symptom of another.** Due to the deep interconnectivity of a game's systems, the most elegant design solutions often address problems indirectly by treating them as symptoms of a deeper issue. For example, the problem “players are not using the crafting system” might not be a failure of the crafting UI, but a symptom of a flawed game economy that makes buying items easier than crafting them.

9. **The choice of explanation determines the nature of the resolution.** This principle highlights the power of framing. A designer who frames a problem as “players are bored” will seek solutions that add more content or spectacle. A designer who frames the same problem as “players don't understand the core mechanic” will seek solutions that improve tutorials and feedback. The way the problem is explained defines the entire space of possible solutions.

10. **The designer has no right to be wrong.** Game design is not a purely theoretical exercise. It results in the production of a cultural and commercial artifact. A flawed design decision is not a hypothetical “what if”, it is an intervention with real-world consequences, impacting the player experience, the team's morale, and the financial viability of the project. Every solution implemented in the final game will be experienced and judged by its players.

Recognizing game design as a wicked problem is not a critique, it is a crucial diagnosis. It explains why traditional frameworks fail and clarifies that what is needed is not a more rigid process, but a fundamentally different way of thinking about the design process itself.

3. A Cybernetic Language for Design

As I have previously established that game design is not a tame, structured process but a wicked problem, characterized by ambiguity, emergence, and subjectivity. Traditional design frameworks, with their linear and goal-oriented assumptions, are therefore less suitable for this reality. If game design is a problem of navigating complex, dynamic systems with unpredictable outcomes, then we must turn to a discipline that specializes in these very concepts. This chapter introduces cybernetics not as a rigid methodology, but as a foundational language for understanding and engaging with the wicked nature of game design.

At its core, cybernetics is the science of “goals, feedback, and learning” in any system (Dubberly & Pangaro, 2007; Dubberly & Pangaro, 2019). Its principles offer a powerful lens for describing the fundamental interactions of gameplay. A digital game is not simply a piece of software, it is a **complex regulatory system of communication** bounded by rules (Hollins, 2011). The player

and the game software together form a single, dynamic system where actions and reactions flow continuously. The core mechanism of this system is the **feedback loop**.

Feedback loops are the engine of play. They come in two primary forms:

Negative (Balancing) Feedback: This type of loop seeks stability and equilibrium. It works to close a gap between a current state and a desired state. In game terms, losing health is a balancing loop. The system signals a deviation from the desired state of "full health", prompting the player to disengage and take corrective action (seek cover, use a med-kit, etc.) to stabilize their condition.

Positive (Reinforcing) Feedback: This type of loop amplifies change, leading to exponential growth or collapse. In a game, a "snowballing" effect, where a player who gets an early advantage can leverage it to become exponentially more powerful, is a classic reinforcing loop.

A key cybernetic principle for designers is Ashby's Law of **Requisite Variety**. In essence, for a system to be stable, the number of states its control mechanism can adopt must be at least as great as the number of states in the system it is controlling (Ashby, 1956). In game design terms, this means the game's systems must have enough interesting responses (mechanics, AI behaviors, content variations) to match the variety of actions and strategies a player might try. A game with low variety feels brittle, "solvable", and quickly becomes boring. It cannot adequately regulate the player's experience.

While this first-order view of games as systems of feedback and variety is useful, it is insufficient. It still frames the designer as an objective engineer standing outside the system, tuning its loops and variables. However, as established in the context of wicked problems, the designer's own values, biases, and framing of the problem are inextricably part of the process itself.

This is the domain of **second-order cybernetics**, the "cybernetics of observing systems" (von Foerster, 2003). It recognizes that the designer is not a detached operator but a subjective participant in the conversation of creation. As Dubberly and Pangaro (2019) argue, this shifts the understanding of design from an act of engineering to an act of conversation. Design becomes a process of argumentation, negotiation, and the co-creation of meaning among the design team, stakeholders, and ultimately, the players.

This second-order perspective provides the necessary epistemology for wicked problems. It acknowledges that the designer's *Weltanschauung* (their worldview and explanation for the problem) is a central, not peripheral, element of the design process. The act of designing is an act of framing, and that framing is an inherently political and rhetorical act of persuasion (Buchanan, 1992; Dubberly & Pangaro, 2019).

If design is a second-order, conversational practice for navigating wicked problems, what does that mean for the designer's day-to-day actions? A purely goal-oriented approach becomes highly problematic. When the problem itself is misdiagnosed, a rigidly defined goal is often a fiction that locks the designer into a solution space that may be entirely wrong.

Fischer and Richards (2017) propose a powerful alternative: a shift from **goal-oriented to constraint-oriented design**.

> **Goal-Oriented Design** treats constraints as obstacles, the barriers to be overcome on the path to a predetermined goal. It seeks to narrow possibilities to find the "one right path".
>
> **Constraint-Oriented Design**, conversely, treats constraints as the primary creative tool. Constraints are not obstacles, they are the very elements that define the boundaries of the possibility space, giving it shape and direction.

This cybernetic approach is perfectly suited to the empirical reality of game development. Instead of defining the goal of "fun" directly, a designer defines the constraints of the system: the rules of the world, the scarcity of resources, the limitations of the player's abilities. Desirable, emergent gameplay, the "fun", arises from the player's creative exploration of the possibility space defined by those constraints. This approach embraces the non-linearity and unpredictability of the design process, making it a tool for discovery rather than a plan for execution. It is the practical, operational consequence of adopting a second-order cybernetic stance.

4. Defining the Principles for a Future Cybernetic Game Design Framework

I have now established two fundamental points: first, that game design is a wicked problem, incompatible with linear, predictive frameworks, and second, that second-order cybernetics provides a language and a conceptual lens for understanding and navigating this complexity. The critical questions remain: What does this mean in practice? If we reject the traditional model of a framework as a rigid, step-by-step process, what should take its place?

This chapter synthesizes these insights into a set of five core principles. These principles are not a blueprint for a specific tool but rather a foundational rubric, a set of criteria that any future cybernetic game design framework must embody to be effective. They shift the purpose of a framework from a tool for managing production to a tool for facilitating *conversation* and cultivating *emergence*.

Principle 1: Systemic Legibility. A cybernetic game design framework must make the systemic structure of the game legible and manipulable. As the empirical evidence shows, static, linear documents like the GDD fail because they

cannot represent the dynamic, interconnected nature of a game's systems (Almeida & da Silva, 2013; Marklund et al., 2019). A cybernetic framework must therefore favor visual and interactive representations that make explicit the "invisible" structures of gameplay, the feedback loops, resource flows, and causal relationships. By modeling the game as a network of interacting components rather than a list of features, the framework allows designers to reason about the system as a whole and understand the potential ripple effects of their decisions.

Principle 2: Emergence Cultivation. A cybernetic framework must shift the designer's focus from authoring specific, predetermined outcomes to cultivating the conditions for emergent behavior. The wicked nature of game design means the final experience is discovered, not created (Marklund et al., 2019). Therefore, the framework should operationalize a constraint-oriented approach (Fischer & Richards, 2017). Instead of defining a goal like "fun", the designer should be encouraged to define the system's core constraints: its rules, the scarcity of its resources, the limits of its agents' abilities. The framework's role is to help the designer understand how these simple, interconnected constraints can generate complex, surprising, and meaningful gameplay. It is a tool for designing the seeds of the system, not for engineering the entire forest.

Principle 3: Conversational Framing. A cybernetic framework must be a tool for conversation, not just for documentation. Second-order cybernetics teaches us that the designer is not a detached observer but a subjective participant whose framing of the problem defines the solution space (Dubberly & Pangaro, 2019). A framework must support this conversational and argumentative process. It should act as a Socratic partner, a "Cybernetic Compass and Sketchbook", that prompts designers to make their assumptions explicit, to question their own framing of the problem, and to facilitate a shared understanding within a multidisciplinary team. It should be an environment for asking "what if?" rather than a repository for declaring "what is".

Principle 4: Authorial Intent as a First-Class Constraint. Because solutions to wicked problems are judged as "good-or-bad" based on values, not "true-or-false" (Rittel & Webber, 1973), a cybernetic framework must treat the designer's artistic and thematic goals as first-class constraints. A game is not just a product to be optimized for engagement, it is a piece of art, an expression of ideas (Tschang, 2007). A framework must provide an explicit mechanism for designers to define these "irrational" but essential goals (such as "the player should feel a sense of dread" or "the mechanics should be intentionally frustrating to serve the narrative"). By treating these intentions as primary constraints, the framework can help protect the artistic vision from being eroded by purely utilitarian or market-driven pressures, ensuring that even "bad" design decisions can be made intentionally and for good reason.

Principle 5: Designing for the Player-as-System. Finally, a cybernetic framework must explicitly model the game and the player as two distinct but co-evolving systems within a broader environment. It must move beyond simple player personas to a systemic view of the player. This means providing tools to reason about the player's feedback loops of learning, their capacity for adaptation, and the requisite variety of their motivations (Hollins, 2011). The framework should constantly prompt the designer to consider the interaction between the two systems: How does this game mechanic afford learning? How does this feedback loop shape player behavior over time? How do the systems of the game and the systems of the player interact to co-create the experience?

5. Conclusion and Future Directions

These five principles, taken together, form a coherent foundation for a new approach to game design tools. They reject the notion of a framework as a rigid, prescriptive process and instead propose it as an interactive, reflective, and systemic environment for thought. They provide a language that is native to the wicked, complex, and creative reality of game development.

This study is, by design, theoretical. It lays the conceptual groundwork, but it does not provide the finished artifact. The principles outlined here are not an endpoint, but a beginning, a call to action for a new research agenda focused on creating tools that are as dynamic, adaptive, and reflective as the designers who will use them.

Future work must now move from the theoretical to the practical. The most direct and exciting path forward is the design and prototyping of an interactive tool that explicitly embodies these principles. I envision a Cybernetic Design Engine (CDE): a visual, interactive environment where designers can cultivate their game systems. Such a tool would not be a mere documentation aid, but an active collaborator that asks Socratic questions about player choice, visualizes the feedback loops that lead to emergence, and helps teams maintain thematic coherence by treating artistic goals as inviolable constraints. The development of the CDE would be a major research undertaking, blending human-computer interaction, systems modeling, and potentially AI-driven conversational agents.

References

Almeida, M.S.O., da Silva, F.S.C. (2013). A Systematic Review of Game Design Methods and Tools. In: Anacleto, J.C., Clua, E.W.G., da Silva, F.S.C., Fels, S., Yang, H.S. (eds) Entertainment Computing—ICEC 2013. ICEC 2013. Lecture Notes in Computer Science, vol 8215. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-41106-9_3

Ashby, W. R. (1956). An Introduction to Cybernetics. Chapman & Hall.

Buchanan, R. (1992). Wicked Problems in Design Thinking. Design Issues, 8(2), 5–21. https://doi.org/10.2307/1511637

Chan, J.K.H., Xiang, WN. (2022). Fifty years after the wicked-problems conception: its practical and theoretical impacts on planning and design. Socio Ecol Pract Res 4, 1–6. https://doi.org/10.1007/s42532-022-00106-w

Dubberly, Hugh & Pangaro, Paul. (2007). Cybernetics and service-craft: Language for behavior-focused design. Kybernetes. 36. 1301-1317. https://doi.org/10.1108/03684920710827319

Dubberly, Hugh & Pangaro, Paul. (2019). Cybernetics and Design: Conversations for Action. https://doi.org/10.1007/978-3-030-18557-2_4

Fscher, T., & Richards, L. D. (2017). From Goal-Oriented to Constraint-Oriented Design: The Cybernetic Intersection of Design Theory and Systems Theory. Leonardo, 50(1), 36–41. https://www.jstor.org/stable/26808353

Freese, M., & Lukosch, H. (2024). The Funnel of Game Design—An Adaptive Game Design Approach for Complex Systems. Simulation & Gaming, 55(2), 323–341. https://doi.org/10.1177/10468781231222524

Hollins, P. (2011). Recognition of variety: considering learning with digital games as cybernetic systems. International Journal of Technology Enhanced Learning, 3(5), 456–467. https://doi.org/10.1504/IJTEL.2011.042098

Kasurinen, J., Maglyas, A., Smolander, K. (2014). Is Requirements Engineering Useless in Game Development?. In: Salinesi, C., van de Weerd, I. (eds) Requirements Engineering: Foundation for Software Quality. REFSQ 2014. Lecture Notes in Computer Science, vol 8396. Springer, Cham. https://doi.org/10.1007/978-3-319-05843-6_1

Kultima, A. (2010). The organic nature of game ideation: game ideas arise from solitude and mature by bouncing. In Proceedings of the International Academic Conference on the Future of Game Design and Technology (Futureplay '10). Association for Computing Machinery, New York, NY, USA, 33–39. https://doi.org/10.1145/1920778.1920784

Marklund, B., Engström, H., Hellkvist, M., Backlund, P. (2019). What Empirically Based Research Tells Us About Game Development. The Computer Games Journal. 8. 1-20. https://doi.org/10.1007/s40869-019-00085-1.

Maxim, R. I., & Arnedo-Moreno, J. (2025). Identifying Key Principles and Commonalities in Digital Serious Game Design Frameworks: Scoping Review. JMIR Serious Games, 13, e54075. https://games.jmir.org/2025/1/e54075

Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. Policy Sciences, 4(2), 155–169. https://doi.org/10.1007/BF01405730

Tschang, F. T. (2007). Balancing the Tensions between Rationalization and Creativity in the Video Games Industry. Organization Science, 18(6), 989–1005. http://www.jstor.org/stable/25146154

von Foerster, H. (2003). Ethics and Second-Order Cybernetics. In: Understanding Understanding. Springer, New York, NY. https://doi.org/10.1007/0-387-21722-3_14

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