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The metaverse, but not the way you think: game engines and automation beyond game development

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ABSTRACT

The production of videogames routinely uses automated techniques to generate content, rig animations, map light, and script behaviors. The automation of programming and artistic functions is increasingly baked into game engines that work with other software applications in 3D production ecosystems, which are laying the foundations for what is being pitched by platform companies as the future metaverse. Platform studies has analyzed automated decision-making through the politics of classification. Game studies has investigated engines such as Unreal and Unity as platform tools that consolidate power through asymmetries of interconnectivity and interoperability. This commentary discusses the automaticity of game engines as platform tools for designing and simulating interactive 3D worlds within and beyond games. Outlining the structuring force of game engines from game development and entertainment media to architecture, engineering, construction, and manufacturing, I speculate on the implications of engines for game workers and game studies.

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The prefix "meta" refers to something going beyond or above its original (OED Online, 2021). This promise of surpassing an original is evoked in recent computing technologies based in game engines. Epic Games' MetaHuman Creator is a browser-based tool with preset components for game developers and 3D graphic designers to more efficiently craft characters that are fully rigged and ready for animation and rendering in Unreal Engine (Epic Games, 2021a). Unity Metacast is a platform for volumetrically capturing sports performances in 3D, allowing sports broadcasters and fans to view athletic action rendered in the Unity engine from any angle in real-time (Unity Technologies, 2021a). Producing "high-fidelity humans in minutes" (Epic Games, 2021a), MetaHuman characters are pitched as going beyond usual standards of 3D character modeling. Insisting that "This is not video" (Unity Technologies, 2021a), Metacast promises to capture more than the conventional visual medium. A recent champion of this brand of metaness is Facebook. For example, CEO Mark Zuckerberg recently announced plans to transition from a social media company to a "metaverse company" by building an embodied

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internet where people can connect, socialize, and work together in virtual spaces using Facebook's Oculus headsets (Venema, 2021). Facebook's prognostication trails behind game companies such as Epic Games' (Takahashi, 2021) and Roblox's (Cross, 2021) plans to leverage their game engines to build platforms for synchronous multi-user interaction. These game companies' vision of the metaverse goes *beyond* gaming services to encompass "an expansive network of persistent, real-time rendered 3D worlds and simulations that support continuity of identity, objects, history, payments, and entitlements" (Ball, 2021).

These meta- versions of universes, humans, and broadcasts are part of what Nick Montfort (2017) calls "future-making": acts of imagining a particular future—however absurd and exaggerated—to try to contribute to it by enlarging our imagination. By referencing Neal Stephenson's (1992) cyberpunk novel *Snow Crash* (Chayka, 2021), these metaverses speculate about the future through the "perspectival constraints" (Burton, 2022, p. 334) of nostalgia. The future-making of meta-imaginaries is a kind of performance through which power relations are tested and entrenched in the present (Powers, 2020; cited in Hong, 2021). This commentary grounds the futuristic hype of possible worlds in the "plumbing of the metaverse" (Bradshaw & Murphy, 2021): the physics simulation and real-time rendering of game engines that undergird the convergence of entertainment computing. Game engines such as Unreal and Unity are associated with the videogame industry but are increasingly used to build and render 3D animations in film, live performances, architectural models, product and training simulations (Nicoll & Keogh, 2019), and even maps for in-vehicle navigation systems (Walz, 2021). Positioning game engines as a kind of infrastructure for 3D rendered environments "enables companies to adopt platform strategies and gain a broader foothold in the digital economy" (Werning, 2021, p. 13).

My contribution to this special issue on the future of game studies pivots on the second meaning of the prefix "meta"—as transformation—to consider the metastasis of game engines as platforms for algorithmic cultural production across industries. Platform studies has analyzed automated decision-making through the politics of classification (Crawford, 2021; Gillespie, 2018). Game studies has investigated engines as platform tools that consolidate power through asymmetries of interconnectivity and interoperability (Foxman, 2019). In what follows, I speculate on the automaticity of game engines as platform tools for designing and simulating interactive 3D worlds within and beyond games and its implications for game workers and game studies. Future-making is less about prediction and more about suspension, as the future "performatively overwrites the present and its alternative paths" (Hong, 2021, p. 1942). As we anticipate the arrival of the metaverse, we risk overlooking its infrastructure that is currently being laid and the alternative configurations it can still take. By contemplating the future of engines beyond games, game studies can confront the formative present and its teleologies of action.

The pipeline and platform

Since the mid-2000s, a small handful of third-party engines such as Unreal and Unity have come to dominate videogame production. Engines provide professional and amateur developers with integrated software packages that include physics engines,

graphics rendering, and tools for building, lighting, and animating game assets. These commercial engines have accessible licensing structures and usable interfaces for non-programmers. James Malazita (2018, p. 43) explains that licensed engines are labor-saving: "The licensing of game engines offloads the labor hours required to develop core mechanical and behavioral code for new game properties," while ensuring compatibility and optimization of toolsets for hardware architectures. By taking "much of the drudgery out of game development," engines "allow developers to focus on innovation instead of mechanics." (Bogost, 2006, p. 60). This software framework provides building blocks for simulating the laws of physics such as gravity and collision, which frees developers from the task of constructing virtual spaces from the ground up. This gives developers time and space to focus on aspects that make their game distinctive. Game engines are the building blocks upon which design concepts, art assets, animations, and audio are assembled within production pipelines and made interoperable through the engine's underlying code framework (Nicoll & Keogh, 2019).

Game engines do not just lubricate production pipelines; they also act as platforms for cultural production in the videogame industry. Engines institute design standards, which streamline game-making ideas and techniques into common production workflows, default design methodologies, and accessible 3D toolsets (Chia et al., 2020). In the pipeline, engines like Unity integrate selectively with 3D graphics applications such as Maya and Blender, locking developers into specific formats and workflows (Foxman, 2019). Unreal also provides toolsets such as MetaHuman Creator that are only compatible with its own engine. In distribution, game engines such as Unity lock developers into specific distribution outlets (Nieborg, 2021) by being the broker for translating a single build for different app marketplaces. Because of their leverage of asymmetrical forms of interoperability that strategically position the engine as a bottleneck, Max Foxman (2019) calls game engines "platform tools" that consolidate power and equity in oligopolistic ways.

Developers are locked into technical configurations, economic relationships, as well as cultural tendencies that orient the creative process toward conventional and even conservative outcomes (Nicoll & Keogh, 2019). While cultural categories such as genre may constrain storytelling, game engines abstract these expectations into shared codebases, which "regulate individual videogames' artistic, cultural, and narrative expression" (Bogost, 2006, p. 56). Deriving its physics and control systems from the first-person shooter genre, Unreal Engine treats most environmental interactions as physical interactions. Games with playable characters may be narrated as defying rationalist, rule-based, and hierarchical ways of navigating environments; however, such characters' abilities are seldom translated by commercial engines into game mechanics. For example, Malazita (2018) describes how *BioShock Infinite: Burial at Sea* features a playable female character with magical realist abilities to traverse parallel realities and timelines; however, Unreal Engine's physics systems reduce this character to combat and stealth mechanics. This is a legacy of Unreal's alignment with the shooter genre's Newtonian calculations of power and force in gun-based combat, which have been long associated with masculinist videogame play styles (Malazita, 2018).

Tara McPherson (2013, p. 36) explains that "computers are themselves encoders of culture," structuring both representations and epistemologies by organizing the world and managing complexity according to the often-implicit worldview of their designers.

For example, Werning (2021) suggests that the way Unreal uses visual programming interfaces to represent the flow of information among in-game objects structures developers' mental model of their game. Commenting on the dominance of Unity and its casting of virtual reality applications in the mold of shooter genres, Foxman (2019, p. 9) encapsulates:

> cultural producers are encountering an increasingly rule-bound set of tools with which they must construct content. Those rules flow from the top down, rather than the bottom up, creating a path dependence for creativity.

Game workers automate

Game engines reconfigure power among game workers in circuitous ways. Commercial engines allow teams of artists, musicians, and designers to work in more modular arrangements within game development without relying on constant technical validation from programmers. Benjamin Nicoll and Brendan Keogh (2019) emphasize how this modularization of the pipeline decenters the authority of the programmer, which is replaced by the presiding influence of engines over all stages of game development. Citing Whitson (2018), Nicoll and Keogh (2019) add that the limitations imposed by engines are in turn wrangled into the creative visions of designers and artists by reenlisting the technical expertise of programmers. This tension between creative and programming functions is heightened by the myriad ways game engines automate the creation of art assets and the writing of code. On the one hand, licensed game engines economize the labor of programmers who are freed from writing code for core mechanics and behaviors. Writing code is also minimized through visual programming interfaces. For example, Unreal Engine and Unity both use visual scripting with node-based interfaces or drag-and-drop graphs to alleviate the need to write code from scratch. According to Unity, visual scripting is key to their mission of democratizing game development for creators at all levels of programming expertise (Nicoll & Keogh, 2019).

On the other hand, game engines also automate the creative labor of artists. For example, Unreal includes world building tools for procedurally generating natural environments such as mountains, valleys, grass, forests, and rocks. Procedural generation refers to the "algorithmic creation of game content with limited or indirect user input" (Shaker et al., 2016, p. 14). This means creating game content algorithmically rather than directly, by manipulating data through computational operations and parameters. Procedural generation is routinely used throughout the games industry—through licensed game engines, 3D animation software applications, as well as custom tools—to create content such as levels, maps, music, and even dialogue and animations. Across these production tools, procedural generation is often framed as a solution to a labor problem, especially in open-world games developed by AAA studios. For example, game AI researchers Georgios Yannakakis and Julian Togelius (2018, p. 152, original emphasis) offer that since game development generally requires more artists than programmers, if procedural generation techniques could replace some artists, "games could be produced *faster* and *cheaper* while preserving quality."

At the same time, these automation tools require artists' buy-in and have been promoted in ways that claim to empower artists. In a promotional panel for Unreal's MetaHuman Creator, which automates aspects of character creation, rigging, and animation, tool developer Vladimir Mastilovic reassured artists:

> People sometimes ask, you know, are we on a mission to remove the artist from the pipeline? And absolutely not. What we want to do is remove the work needed to match reality, one to one, and then allow the artist to intervene with that reality once it's captured and translated into the virtual world. So the challenge really is converting everything into a process and then making it automatic. (Epic Games, 2021b)

Similarly, at a Game Developers Conference talk on the "Future of Art Production in Games," Naughty Dog's technical art director Andrew Maximov (2017) celebrated the automation of specific tasks. These included creating level of detail (LOD) meshes, which designate the complexity of 3D models—and the efficiency of rendering them—relative to the scale they are being viewed. According to Maximov, certain tasks in the artist's pipeline "take you [a] stupidly long time to do by hand" and should be automated because they clearly "did not have any artistic values." Maximov's advice to game artists is to leave photorealistic recreations of art assets to automated physics simulations and focus instead on the human artistry of stylized and symbolic representations.

Within game development, technical artists are engineers and programmers who work with but should be distinguished from designers, artists, and management (O'Donnell, 2014). This is because technical artists are responsible for building or building on game engine tools used by artists. Technical artists such as Maximov and Mastilovic actively define which tasks in the pipeline are automatable and which should be reserved for human artistry. For example, procedural generation in Unreal's world building editor is commonly used for what are considered "unimportant parts of levels" (Smith, 2017, p. 1), such as transitional terrain that players cross to get from one quest to another. These game engine tools palpably create path dependence for creativity (Foxman, 2019). Whitson (2018) describes how engineers steer artists into patterns of desired use by building additional layers of tools, scripts for shortcuts, and simplified interfaces to obscure the underlying complexity of game engines like Unity.

The 3rd Annual Labor Innovation and Technology Summit (SAG-AFTRA, 2021) was organized by the Screen Actors Guild-American Federation of Television and Radio Artists (SAG-AFTRA) and American Federation of Labor and Congress of Industrial Organizations (AFL-CIO). This summit dedicated a session to the implications of digital humans on the future of work in the entertainment and media industries, including games. Digital humans are created and rendered by tools such as Unreal's MetaHuman Creator and the volumetric capture of human performers (e.g. in Unity Metacast) and are poised to be increasingly used in promotional, retail, and entertainment media. SAG-AFTRA leaders advocated for legal protections such as image rights for performers. They emphasized that fighting or avoiding new technology would not change what comes down the path; instead, dealing with automation requires understanding and adapting by putting structures in place to protect workers. Protections for workers facing automation in entertainment and media industries should be legal as well as technical. Werning (2021) maintains that game production tools shape the relationships

between stakeholders by framing how we understand the material they process and how we interpret the problem at hand. However, game workers have an asymmetrical understanding of game tools. Whitson (2018, p. 2328) explains that the "ability to make work visible is granted by engineering tools, but not art tools." Visual scripting systems and custom tools claim to democratize game development by simplifying how artists use game engines. However, these systems and tools also disempower artists most affected by automation by obscuring how engines work.

This everyday automation of game development is laying the infrastructure for metaverses of future content. The obvious threat game engines pose is to the livelihoods of performers and artists who are being replaced by the automation of digital humans and asset creation. However, the more insidious danger is the stratification of the game development pipeline where tools engineers set the benchmarks for automation that define the value of workers, content, and playstyles (Chia, 2022).[1] When artists are shielded from the inner workings of engines, they are locked out of discussions about the artistic value of different tasks in the pipeline, which informs how these tasks should be automated or handcrafted. As aforementioned, engines provide tools to automate content deemed unimportant by engineers, such as transitional terrain. Since engineering and artistic disciplines in AAA game development are highly stratified by gender, decisions about which kinds of game work and content are important will likely align with techno-masculine interests and values.

The future of engines beyond gaming

How engines work is important, not just for developing games. The relevance of game engines goes beyond digital humans in entertainment computing to affect how culture is produced and how materials are processed in industries such as architecture, engineering, construction (AEC), and manufacturing. Unity recently commissioned a report by Forrester Consulting (Blackborow, 2020) on these industries' use of Real-Time 3D (RT3D) tools, such as those offered by the Unity engine. The report found that more than half of leading companies in AEC and manufacturing industries plan to adopt RT3D tools in the next two years for interactive visualizations in design and prototyping, marketing, customer support, staff training, and more. The Unity engine is leveraging its gaming technology to build 3D worlds for interacting with digital versions of assets in the physical world. Just as Unity's ambitions as a platform tool exceed gaming, Unreal's aspirations to power the metaverse have also been described by its CEO Tim Sweeney as "a phenomenon that transcends gaming" (Bradshaw & Murphy, 2021, n.p.).

The enterprise needs of entertainment, AEC, and manufacturing industries may be converging in the Real-Time 3D technologies of game engines, but this is not the convergence culture of top-down corporate media and bottom-up participatory culture (Jenkins, 2006). Instead, the use of game engines in industries from sports broadcasting to architecture is part of the consolidation of market share that marks these tools as platforms. Marc Steinberg (2021) discusses the computer stack and multisided market as two models of how we understand platforms. The former highlights technical aspects of platforms' verticality and interoperability as layers in a computer stack, while the latter emphasizes the economic aspects of platforms' intermediary role for third-party transactions. As platforms tools, engines operate technically, economically, and culturally—

imposing design standards, priming mental models, shunting creativity, and designating automation—in game development, and increasingly, in AEC and manufacturing. Drawing from John Urry (2004), Steinberg (2021) compares the current dominance of platforms to the automobile's integration of different sectors of twentieth-century capitalism. Urry called this enduring influence of the car "automobility." This concept highlights how the car impacted the planning of cities, construction of buildings, ordering of space and time, and even the formulation of human subjectivity. Given the prospective influence of game engines on how media and material culture are rendered intelligible, manipulable, and functional, we could speculate about the future in terms of "enginicity."

Whatever form "enginicity" takes in 3D rendered environments, platform tools will support interoperable metaverses rather than walled gardens. In an interview with *VentureBeat*, Epic Games CEO and creator of Unreal Engine, Tim Sweeney, declared that the metaverse requires an open programming model with common standards and agreements for code to interact across worlds (Takahashi, 2021). As Foxman (2019) emphasizes, game engines as platform tools lock in developers and gain market dominance through asymmetrical forms of interoperability. However, platform tools such as Nvidia's new 3D production engine Omniverse are starting to shift towards the metaverse's open model by enabling universal interoperability across different applications and 3D ecosystem vendors (Nvidia Corporation, 2021). According to Sweeney and other proponents of an open metaverse, platforms must temper their oligopolistic ambitions with "enlightened self-interest" (Takahashi, 2021). Only then will companies profit from proprietary tools and assets without locking in users or complementers. The coevolution of platform strategies and promotional rhetoric of democratic tools and open protocols will be closely followed as the metaverse takes shape.

Game development requires engineering, artistic, and business disciplines, each with distinct sets of expertise and interests. Game engines are modular and customizable architectures that coordinate seemingly incommensurable understandings and goals of game development (Banks, 2013). Game studies emerged around a common object of inquiry across humanistic and scientific disciplines (Deterding, 2017). At the close of this commentary, it seems likely that the next stage in game engines' platformization will take the object of game scholarship beyond games. Game engines are not restricted to games. The field must follow its object to cognate material and ideological sites to interrogate how cultural production and practice are structured and stratified by computational and management techniques. The identity of the field will be negotiated in the specificities and generalities of its inquiry beyond games. The specificities of engines in videogames, broadcasting, AEC, and manufacturing matter. For example, the use-cases of Unity's RT3D technologies showcased in the Unity for Humanity Summit (Unity Technologies, 2021b) ranged from sustainable fashion to healthcare equity. As game studies follows its object into entertainment computing and product design, game studies must not be platformed—our lines of inquiry should not lock interlocutors into field-specific ways of understanding and critiquing engines.

In this next stage, the familiar lament that game studies lacks cohesion as a field and coherence in its methodology and epistemology will not be a weakness but a strength. Like its object of study, the disciplinary incommensurability coordinated by game studies positions its researchers to understand, critique, and shape gaming as a practice

and industry. In a future where the artifacts that united our field are unbound by text, platform, and culture—what is our field's common ground? This question will ignite a new baptism of fire that will consolidate the field of game studies across disciplinary affiliations.

As game engines evolve, they render people and materials according to technical protocols and cultural codes. These protocols and codes may have emerged from videogames, but they continually adapt to different cultural and industrial contexts. Tracing the history of computational images from academia to industry, Gaboury (2021, p. 9) argues that they "are not pictures of the things they represent; they are pictures of the world that produced them, and they execute a theory of that world in the world." The photorealistic and volumetric renderings by engines for manufacturing and entertainment execute a theory of the world—bodies, materials, forces, relationships—produced through game development. This is a theory steeped in (professional) disciplinary stratifications and differential valuations of labor according to race, gender, and orientation. As a critic of this theory since its inception, game studies has a vantage point to shape the future of engines by questioning its pursuit of fidelity in representation and futurity through automation.

Note

1. This study also discusses how automation in game development does not displace but stratifies humanity and artistry according to liberal humanism. This paradigm of human agency racializes creativity by naturalizing trade-offs where the autonomy of machines is contingent upon the automatism of outsourced and articulation workers.

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