The Metaverse University

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The metaverse that is being created is starting from games but is not limited to games. There are scant educational programs to support this growing field. In this article, we propose the founding of The Metaverse University.

I n 2005, I founded the Computer Science Games Program at the University of Southern California (USC) (the USC GamePipe Laboratory), and the purpose of that program was to provide a stream of engineers, artists, and gameplay designers to the rapidly growing games industry. Since 2005, the games industry has grown by a factor of five in size, and the program I created at USC has graduated some 4,000+ students into positions in the game and computing industries.

We are now in a rapidly changing environment where major efforts are being placed on creating the metaverse—technologies are quickly being created to support the metaverse and its application. The metaverse that is being created is starting from games but is not limited to games; there are applications—medical, engineering, and others—that are also demanding a place in the metaverse. There is not much university focus on the metaverse, and there are scant educational programs to support this growing field. Without an educational program focused on metaverse technologies and their application, this new field will not be able to grow.

THE METAVERSE UNIVERSITY

We propose the creation of a new educational entity called *The Metaverse University*, an educational university that will graduate engineers, artists, designers, and producers who can design and build our future metaverse technologies and applications. We plan on creating a university without departmental boundaries to eliminate the stove-piping issues we discovered in the stand-up of various games programs. Our model will be similar to that of Rockefeller University, where all faculty and students are just members of the university, not departments. Students will follow educational tracks—metaverse design, development, art, audio, and production. The last year for each student will be a year-long, team-based metaverse

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development project capstone course followed by a demo day for presentation of the developed technologies and applications.

WHAT DOES THE EDUCATIONAL PROGRAM LOOK LIKE?

The metaverse educational program has three major parts: metaverse development, metaverse design, and metaverse art and design (Figure 1). Each of these parts is briefly described in the following sections.

Metaverse development

Metaverse development is the engineering part of building the applications that allow users to move through and interact with the developed 3D graphics world. Until recently, building a 3D environment for a metaverse required strong, relatively low-level game engine programming. The programmer would decide to use the Epic Unreal or Unity engine and, typically, would find that the engine required significant software development before it could properly be used. Engines are typically not yet ready for much nonprogrammer development. The metaverse industry has created a number of platforms—platforms are typically built on top of a game or similar engine, and the purpose of having a platform is to reduce the complexity of metaverse application development. Some of the platforms available include Nvidia's Omniverse, Unity's Metaverse Toolkit, Intel's Metaverse Toolkit, Microsoft's Metaverse Toolkit, Epic's Fortnite Creator, and Roblox. To be able to graduate strong metaverse developers, we put the following courses into the metaverse development degree program:

- Metaverse Design Workshop
- 3D Computer Graphics and Rendering

- Metaverse Platforms and Tools
- Metaverse Modeling and Simulation
- Metaverse Networking Infrastructures
- Machine Learning for the Metaverse
- Building the Human-Intelligent Metaverse.

The Metaverse Design Workshop class is taken by all students in all degree tracks at the Metaverse University. The purpose of the class is to teach our students how to think in 3D for metaverse development and how to generate an appropriate metaverse design document (MDD) before cutting code. This class has the students develop a runnable prototype using one of the available industry platforms once their MDD has been completed and approved. The MDD is not unlike the game design document used in the games industry except that designing an application that will be in 3D—with a 3D interface and all of its digital art in 3D—is somewhat more difficult than the 2D side-scroller usually found in games programs.

In the metaverse development program, we have to make a decision as to what appropriate foundational courses should be required. One such course is a solid course: 3D Computer Graphics and Rendering. Most university computer science departments have this course in some fashion. Universities that are hopelessly out of date will have the students in this course turn lines and triangles into pixels in an in-memory frame buffer. This is out of date, as this is all done in graphics hardware today—it might have been appropriate, say, in a 1979 version of this course. Today, for the metaverse development realm, there is probably high-level viewing and matrix transformation functionality, so students who will be building at that level

should understand such mathematics at the symbolic level as presented in text, such as that by Hughes et al.[1] Additionally, students who come out of this course should thoroughly understand shaders and rendering pipelines as are provided by today's graphics hardware.

The Metaverse Platforms and Tools course (Figure 2) starts out by covering the Open Metaverse standard toolsets and definitional files that should be utilized in constructing your metaverse application. The next part of the course is to learn about game engines—say, the Epic Unreal and Unity engines—to understand how those engines reach out efficiently to the graphics pipeline for the proposed hardware. This course then moves on to the various available industry metaverse platforms that may be of interest to the student. Nvidia's Omniverse is an outstanding choice for the student interested in creating a metaverse that requires high-performance GPUs, as
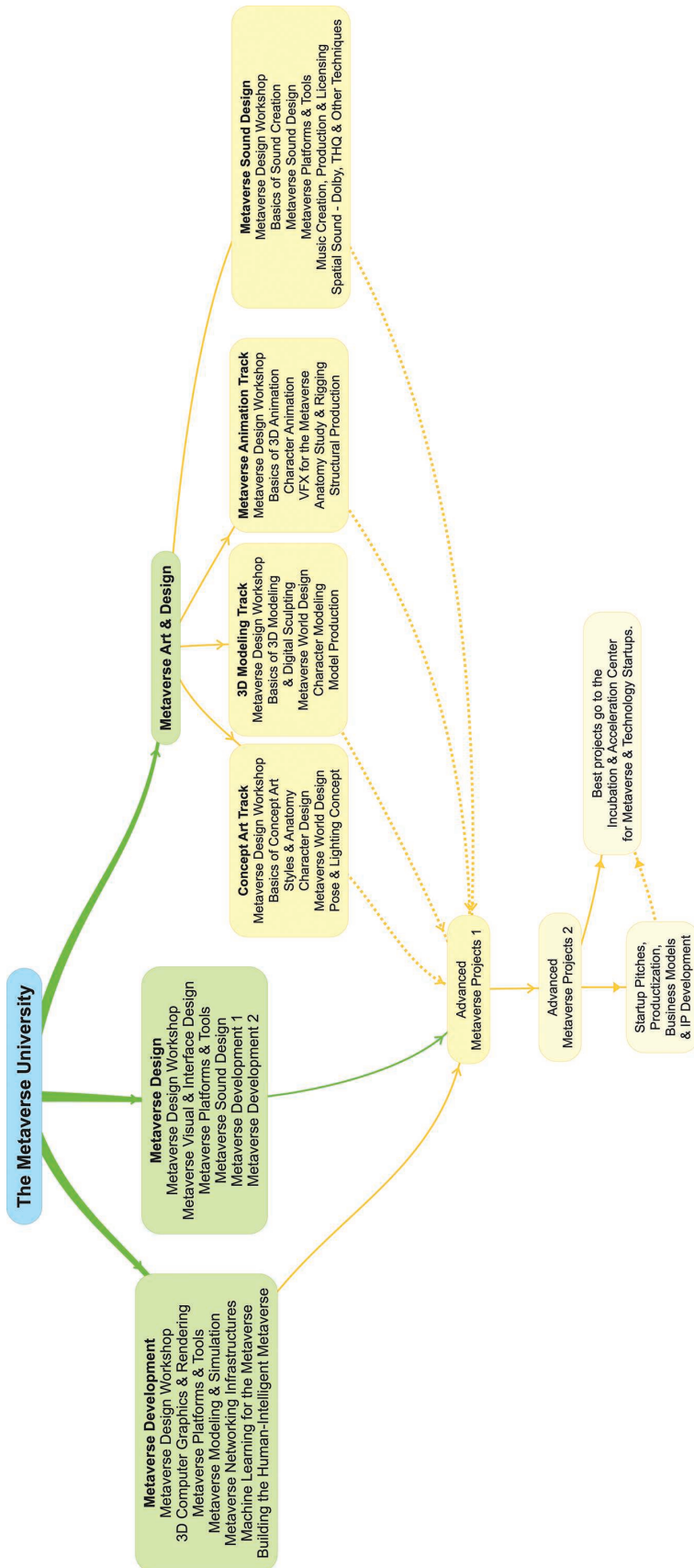
FIGURE 1. The Metaverse University.

are manufactured by Nvidia. If the student is interested in a platform that works on pretty much any hardware, then the Microsoft/Intel/Unity metaverse toolkits are the way to go. At an even higher level of functionality that is less complex programmatically, the Epic Fortnite Creator and Roblox platforms are what to utilize. Therefore, the purpose of this class for the student is to understand how to utilize a modern metaverse platform as well as how to use a game engine that may be under that platform—the engineer may have to add code at the engine level for a special feature not in the higher level platform.

The Metaverse Modeling and Simulation course (Figure 3) begins with time management in real-time simulation—a complete integrated model of how time operates in the individual metaverse is essential. A classic article on this is Time, Clocks, and the Ordering of Events in a Distributed System.[2] We cover discrete event simulation. We then move on to physics engines and real-time collision detection. The end, nonsmall topic for this course is digital twins—real-time virtual representations of real-world physical systems or processes.

The Metaverse Networking Infrastructures course (Figure 4) is fundamental in that the expectation for all metaverses is that there will be multiple people in each metaverse as well as standards and methods for moving your virtual character from one metaverse to another. Since those standards and interoperability do not yet exist, this course covers everything the engineer requires understanding in, including latency, reliability, bandwidth, protocols, communications architectures, managing shared states, designing for latency reduction, scalability and performance, complex infrastructures, Open Metaverse architectures, communication modeling, and securing the online metaverse. The information from this course is critical to the secure and performant operation of every metaverse and is
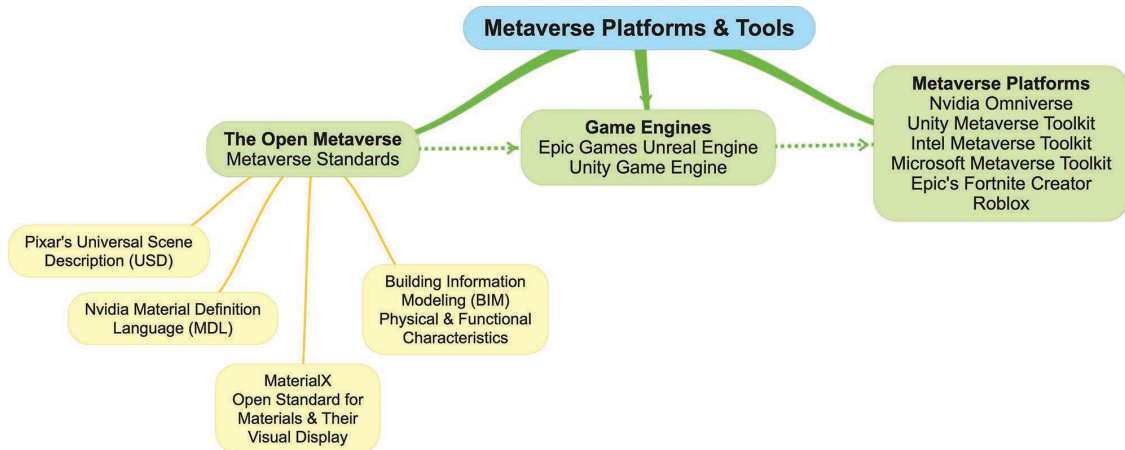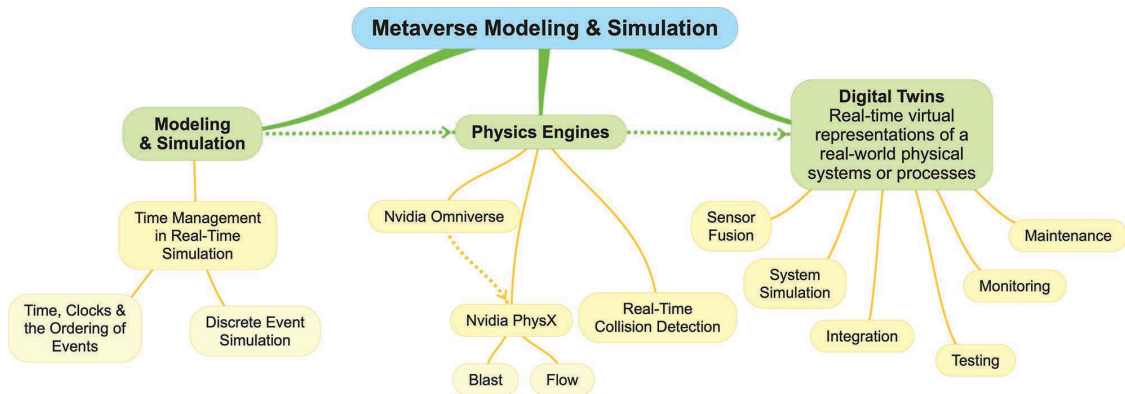
FIGURE 2. The Metaverse Platforms and Tools course.

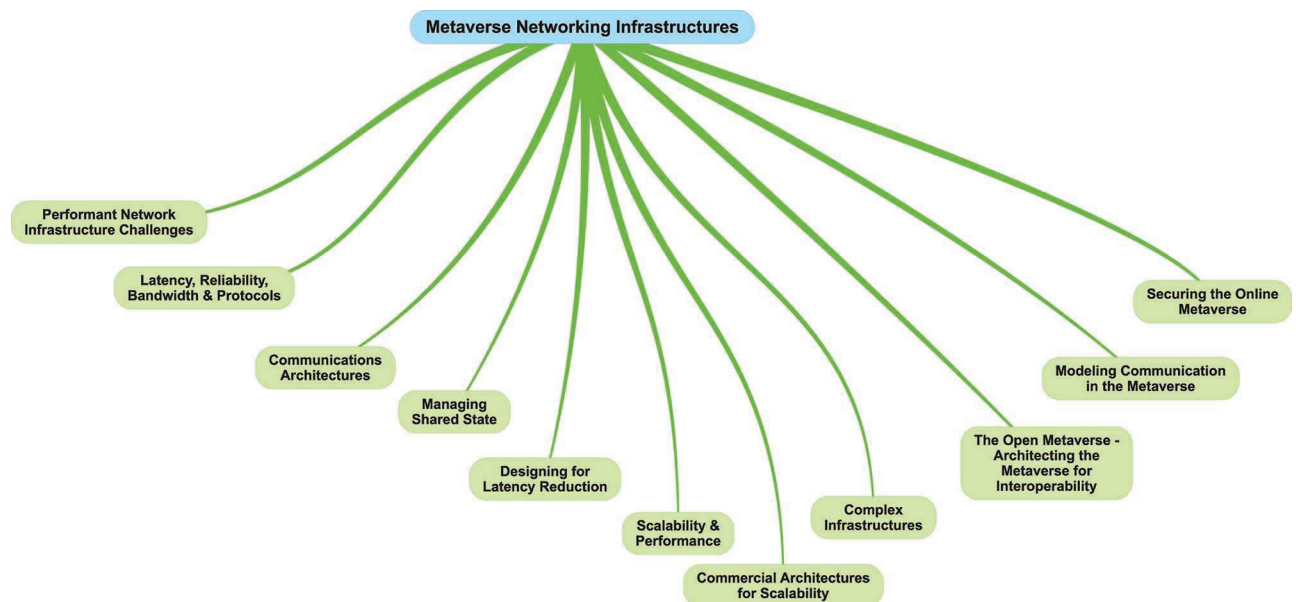**FIGURE 3.** The Metaverse Modeling and Simulation course.

FIGURE 4. The Metaverse Networking Infrastructures course.

not just something, at the moment, that "comes with the game engine." These issues were well discussed in a previous edition of this column, and the interested reader is pointed toward that article.[3]

The Machine Learning for the Metaverse course is conducted at the application level as opposed to the mathematical fundamentals of machine learning (ML). The application of ML to metaverse development is an important focus for the metaverse industry. This course covers the use of ML for artificial intelligence bot creation, metaverse interaction analysis, and real-time metaverse user understanding. As metaverse platforms move beyond their game engine origins, embedded ML for the operation, analysis, and understanding of metaverse interaction will become a prominent and important component.

The Building the Human-Intelligent Metaverse course provides an understanding of the available biosignals generated by humans, sensors that can read those biosignals, and human modalities that can be computed from biosignals. Topics covered include human-generated biosignals; emotion states; emotion sensors and computational models for interpretation; emotional state vectors; detected emotions and probabilities; sensor bandwidth, power, and computation requirements; physical state sensors and their computational models; mental state sensors and their computational models; sensor fusion; ML for computing human states and modalities from sensed biosignals; and computed human modalities.[4]

Metaverse design

Metaverse design is the degree program that teaches creatives how to draft an MDD, a document that is written before code is developed describing how the metaverse app goes together, how its user interface works, and any other important design features. The courses taken by students in the metaverse design program are the following:

- Metaverse Design Workshop
- Metaverse Visual and Interface Design
- Metaverse Platforms and Tools
- Metaverse Sound Design
- Metaverse Development 1
- Metaverse Development 2.

We already defined the Metaverse Design Workshop class earlier in the "Metaverse Development" section and will not repeat that material here. Remember, everyone in each track at The Metaverse University takes the Metaverse Design Workshop course.

The Metaverse Visual and Interface Design course is one of the most important. In this course, design students are taught how to think conceptually in 3D such that a coherent, unified 3D interface for the metaverse app can be specified. This course also teaches how to think about software architecturally such that the overall 3D interface defined is used in the same way for all parts of the specified app and, in fact, for all apps of the series expected to be developed.

The Metaverse Platforms and Tools course we discussed earlier in the Metaverse Development section.

The Metaverse Sound Design course is a tool- and software-level course that teaches the designer how to create sounds and utilize them in a metaverse platform such that we "see a sound and hear a sound," as sound designers are wont to say. This course additionally covers music integration into the metaverse platform. Again, sound integration into a 3D metaverse means that it is the metaverse user's expectation that sounds will be appropriate to their spatial location and to the characteristics of the 3D virtual materials in that part of the metaverse.

The Metaverse Development 1 and 2 courses are courses where the students form small teams for the creation, over the course of a semester, of a prototype metaverse implementation selected by each student team. The idea is to get the students used to building rapid prototypes of metaverse apps

with high-level platforms. These two courses must be completed before the students move into the Advanced Metaverse Projects course.

Metaverse art and design

The metaverse art and design degree program focuses on the creation of art and sound assets for use in the development of metaverse apps. There are four tracks in the metaverse art and design program: concept art, 3D modeling, metaverse animation and visual effects (VFX), and metaverse sound design.

Concept art track. The concept art track focuses on teaching the student how to make concept art that properly communicates to the developers of the metaverse application what that particular metaverse should, in the end, look like. It is always nice to know expectations before software and 3D assets are cut.

The concept art track student, then, takes the following courses:

- Metaverse Design Workshop
- Basics of Concept Art
- Styles and Anatomy
- Character Design
- Metaverse World Design
- Pose and Lighting Concept.

Basics of Concept Art is exactly that. This course teaches the student how to create concept art that visually displays the vision as expressed in writing by the metaverse designer. The Styles and Anatomy course teaches the student how to create a coherent style for the concept art as well as the appropriate anatomy of human and other figures to be shown in the concept art. Character Design is the course for building the concept art of prominent characters in the metaverse. Metaverse World Design is the course that teaches how to create the 3D worlds where your metaverse app takes place. A concept art student in that course will focus on concepts for such 3D worlds. Pose and Lighting Concept is the course that teaches the artist how to pose and light characters and the world model.

3D modeling track. The 3D modeling track focuses on teaching students how to build all of the 3D parts of the metaverse app to be developed. The courses in this track are the following:

- Metaverse Design Workshop
- Basics of 3D Modeling and Digital Sculpting
- Metaverse World Design
- Character Modeling
- Model Production.

The Basics of 3D Modeling and Digital Sculpting course is exactly that, using appropriate digital tools. The Metaverse World Design course we detailed earlier. Character Modeling is how the 3D characters are designed and built for our metaverse. Model Production is a course on how to create a pipeline process for 3D art production for a metaverse development project.

Metaverse animation and VFX track. The metaverse animation and VFX track is how we give life to the characters and the world we have developed for our metaverse. The courses in that track are the following:

- Metaverse Design Workshop
- Basics of 3D Animation
- Character Animation
- VFX for the Metaverse
- Anatomy Study and Rigging
- Structural Production.

Basics of 3D Animation teaches the student classical animation methods for getting the characters and the world in motion. Character Animation is how we bring our characters to life and provide their visage with emotion. VFX for the Metaverse is how we use special effects to animate the world and make it have a particular ambient emotion. Anatomy Study and Rigging is how we create a framework inside of our 3D characters that we can manipulate via our available user interface. Structural Production is how we create a pipeline of 3D modeling, animation, and VFX for all of the characters/

worlds and all of the artists working on our production.

Metaverse sound design track. The metaverse sound design track is how we create artists who can develop and integrate sound into our metaverse productions. The courses in that track are the following:

- Metaverse Design Workshop
- Basics of Sound Creation

> Building sound and music for use in the metaverse is critical for creating the illusion of life in that world.

- Metaverse Sound Design
- Metaverse Platforms and Tools
- Music Creation, Production and Licensing
- Spatial Sound: Dolby, THQ, and Other Techniques

The course titles are accurate as to our expectation as to what will be covered. Building sound and music for use in the metaverse is critical for creating the illusion of life in that world.

ADVANCED METAVERSE PROJECTS

All students in our program take the Advanced Metaverse 1 and 2 courses. These courses are the team-based production of a significant metaverse application or technology over the course of two semesters. The spring semester before this year-long project is where the students pitch their proposed plan as to what they would like to build over the course of a year. University faculty and staff watch those pitches and develop a greenlight list as to what is approved for production.

Start-up pitches, productization, business models, and intellectual property development
One of the final courses all of our students must take covers how to

create a successful start-up pitch, how to productize developed prototypes, business models for marketing your prototype, and intellectual property development and protection. We plan on teaching our students to fish.

Incubation and Acceleration Center
The best projects from our students in the Advanced Metaverse Projects course have the potential to be accepted into the Incubation and Acceleration Center.

In that center, we provide space and resources for student teams to advance or complete their metaverse application. We additionally provide them guidance toward potential investment partners.

WEB3 AND NFTs ...
Whenever I mention to people that I am planning the creation of a new university, The Metaverse University, either I get great understanding from real-tech people who have been in the 3D virtual environment space for some time, or I get the blockchain/Web3/NFT fanboys/fangirls telling me that the metaverse is just about Web3, describing how they will soon become rich beyond their wildest dreams, and asking me what I think about crypto. I usually delete any person who chats with me about crypto online, but I do believe we should perhaps study the whole blockchain/Web3/NFT space to see if there is some nugget that is not fully and foolishly useless.

Some comments from game industry greats are aligned with me on this—the following two are from Gabe Newell, CEO of Valve:

- *Gabe Newell on blockchain and NFTs*:

  "The things that were being done were super sketchy.

And there was some illegal shit that was going on behind the scenes, and you're just like, yeah, this is bad. Blockchains as a technology are a great technology, that the ways in which has been utilized are currently are all pretty sketchy. And you sort of want to stay away from that. … The people who are currently active in that space are not usually good actors."[5]

- *Gabe Newell on the metaverse*:

"There's a bunch of get rich quick schemes around metaverse. Most of the people who are talking about metaverse have absolutely no idea what they're talking about. And they've apparently never played an MMO. They're like, "Oh, you'll have this customizable avatar." And it's like, well … go into La Noscea in *Final Fantasy 14* and tell me that this isn't a solved problem from a decade ago, not some fabulous thing that you're, you know, inventing."[5]

Another article, "The Boom and the Bust: How NFTs Went the Way of Beanie Babies," is also worth reading:

"In early 2021, NFTs were pitched as a way for artists to make life-changing money. All you needed was a token! So artists raced out to buy ether so they could mint NFTs of their work. Only, the money didn't pour in—unless your name was Beeple.

"Now all that is left of the once overly hyped NFT market is dust in the wind. NFTs are becoming an unattractive piece of history. People aren't trading them, and the only ones

talking about them are those trying to sell them."[6]

On one of my presentations to Nvidia on founding this new university, I had a slide on our proposed adjacent research university, and Nvidia's comment was that they all thought blockchain/Web3/NFTs was all just a big scam and that I should take that off my research slide. I think I am going to leave it on my research slide so that it reminds me that perhaps I ought to take a closer look—just in case there is a winning lottery ticket inside.[7]

All of this is a proposal to build The Metaverse University. We have developed the course plan for the educational program and have had initial discussions with potential faculty. We have developed an operating budget for the first three years. We are looking at various sites for the stand-up of The Metaverse University (Los Angeles, Seoul, and Dubai) and are looking at acquiring the first space, a space that can educate students in Los Angeles.

We are looking for a key sponsor partner for the first three years of operation for The Metaverse University. We believe that, by the start of the fourth year of operation, tuition and fees will be able to cover this university's operating costs. **C**

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