



Li, Shuliang (2022), "the Metaverse: framework, quantum strategies, technologies and analytics". Keynote speech. The 8th International Conference on Information Management (ICIM 2022), Cambridge, England, UK. 25-27 March 2022.



ICIM2022 Keynote on the Metaverse Shuliang Li University of Westminster



Overview

- Framework/paradigm & applications
- Supporting technologies
- Strategies & quantum
 - strategies
- Analytics

The **Metaverse** is an Internet and computer-based, and socially connected networking space of three-dimensional virtual-reality worlds (Li, 2022)



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Facebook gives a glimpse of metaverse, its planned virtual reality world

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The Metaverse: Framework/paradigm & applications

- Mark Zuckerberg Meta
- Immersive
- Digital avatar engagement dynamics
- □ 3D interactions with haptics
- Sustainability
- **D** Entrepreneur
- Open innovation
- The Metaverse for business, finance, games, music, events, showcase and more
- □ Branding in the Metaverse
- Brand virality
- The Metaverse for education

A simplified illustration example of random user engagement simulation for a branded content is shown in Figure 1. Persons in green color are engaged across the social networks, while the white ones are the disengaged and the yellow icons are the reached. Netlogo software tool and multiple software agents, called Turtles, are coded and created to produce the illustration and simulation with graphical animation.





Brand virality over social media By Jim Zheng Li & Shuliang Li, United Kingdom

Figure 2. The screenshot for simulation of the brand virality

V. THE USE OF FUZZY LOGIC IN ASSESSING THE EFFECTIVENESS AND EFFICIENCY OF BRAND VIRALITY

A. Fuzzy logic and the space of the variables affecting brand virality in social media

'A fuzzy set is a class of objects with a continuum of grades of membership' [12, page 338]. Let U be a universe of discourse, a collection of objects $\{u\}$. A fuzzy set A in U is characterized by a membership or compatibility function μ_A taking values in the interval [0, 1]. A in U is represented as [13, 15]:

$$A = \{ (u, \mu_A(u)) | u \in U \}$$
 (2)

Based upon Fung et al [16]'s work, the set of

An example of brand virality (Li et al., 2015)

Supporting technologies ✓ Intelligent digital avatars ✓Augmented virtual reality ✓ Machine learning, artificial intelligence \checkmark AI & technologies for haptics, emotion, etc. ✓VR glasses etc. ✓ Blockchain – secured, decentralized, internetenabled, electronic leger ✓Cryptocurrency, bitcoin Mark Zuckerberg's meta Al Elon Musk's neuralink chips connected to the Metaverse?

Strategies

- Mintzberg: Innovation perspective
- Porter: Differentiation, uniqueness
- Social networking strategies
- Metaverse 4Ps marketing strategies
- Branding strategies
- Sustainability strategies
- Big data strategies
- Quantum entanglement strategies
- Quantum superposition strategies
- Quantum computing strategies

Superposed quantum strategies By Shuliang Li, University of Westminster **Examples**



Quantum entanglement strategies for Metaverse interactions By Shuliang Li, University of Westminster



Calculate the initial state

The quantum formulation evolves by assigning the output of the classical strategies *D* and *C* to two vectors, $|C\rangle = \begin{pmatrix} 1 \\ 0 \end{pmatrix}, |D\rangle = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$, where $|C\rangle$ and $|D\rangle$ are in the Hilbert space. In each case, the state of the game is denoted by a vector in tensor product space that is crossed by the classical game basis $|CC\rangle$, $|CD\rangle$, $|DC\rangle$, $|DD\rangle$. Here it is supposed that suppliers and beneficiaries started with $|CC\rangle$. Consequently, qubits $|C\rangle \otimes |C\rangle$ go through an entangling gate $\hat{J} = \exp(i\gamma \hat{D} \otimes \hat{D}/2)$, which is a reversible two-bit gate with $\gamma \in [0, \pi/2]$.

Quantum entaglement & entangling gate

$$\hat{J} = \exp\left(i\gamma \ \hat{D} \otimes \hat{D}/2\right) = \exp\left(i\frac{\gamma}{2}\begin{pmatrix} 0 & 1\\ -1 & 0 \end{pmatrix} \otimes \begin{pmatrix} 0 & 1\\ -1 & 0 \end{pmatrix}\right) = \begin{pmatrix}\cos\left(\frac{\gamma}{2}\right) & 0 & 0 & i\sin\left(\frac{\gamma}{2}\right) \\ 0 & \cos\left(\frac{\gamma}{2}\right) & -i\sin\left(\frac{\gamma}{2}\right) & 0 \\ 0 & -i\sin\left(\frac{\gamma}{2}\right) & \cos\left(\frac{\gamma}{2}\right) & 0 \\ i\sin\left(\frac{\gamma}{2}\right) & 0 & 0 & \cos\left(\frac{\gamma}{2}\right) \end{pmatrix}$$

Source:

Li, Shuliang and D. Huang, 2017. Hybrid Quantum Games. Working paper, the University of Westminster, London, UK. October 2017. Westminster Research Repository.

Interactions and the equilibrium point



Source:

Huang, D. & Li, S., 2017. Hybrid Quantum Games. Working paper, the University of Westminster, London, UK. October 2017. Westminster Research Repository. The numbers of different actors in the scenario with a constant or varying gamma between the suppliers/vendors and the beneficiaries/digital avatars/customers



Source:

Huang, D. & Li, S., 2017. Hybrid Quantum Games. Working paper, the University of Westminster, London, UK. October 2017. Westminster Research Repository.

Analytics

Shuliang Li (2022)'s definition on Metaverse analytics: Aiming at analysing what occurred, what is ocurring and what will or may occur or happen, Metaverse Analytics is about the use of relevant strategies, procedures, methods and software tools for tracking, gathering, reporting, visualising, interpreting, reviewing, mining, exploring and reviewing the users and digital avatars' behaviour, activities, interactions and associated data in an Internetenabled, computer-created and socially connected networking space of three-dimensional virtual-reality worlds, called Metaverse or meta universe. Metaverse analytics transforms data and big data into information, knowledge, decisions and strategies. (Li, 2022). Copyright reserved ©

Source:

Li, Shuliang (2022), Keynote speech on the Metaverse, the 8th International Conference on Information Management (ICIM 2022), Cambridge, England, UK. 25-27 March 2022. The University of Westminster Research Repository.

Metaverse analytics



Metaverse analytics for business

Element	Function	Software tools for Metaverse analytics
Metaverse SN space	Answers: reach, communication, interactions, engagement, etc.	Software tools, e.g. WeMeta, for Metaverse analytics for this element
Avatar behaviour, clickstream or touch stream & metrics	Answers the what: Intelligent/smart digital avatars' behaviour, online visitor behaviour, traffic, bounce rate, referrals, conversions	
Multiple outcomes	Answers the how much: Sales, revenue, profit margin, costs, avatar/customer retention & loyalty,	
Customer churn; Digital avatar churn	Contribute to the why: comments, feedback from customers and intelligent or smart digital avatars	
Competitive intelligence	Answers the what else: Digital avatars' behaviour, monitoring competitors,	
Insights	Help achieve understanding, identifying, discovering new opportunities, useful patterns, hidden relationships	
Strategies, decisions, innovation, competition	Aims/goals to achieve; the means; courses of actions, different types & levels of decision making; digital innovation; open innovation; analysis of competitors	

Adapted, extended and modified by Shuliang Li on the basis of Av i n a s h K a u s h i k (2010)'s work

Example: WeMeta Open Metaverse of multiple worlds, dashboard, metrics (unique buyers, sales, etc.), Comparison, and more





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Source: analytics.wemeta.world