Applying Multi-Criteria Decision Making to Prioritization of Web 3.0 Development Factors

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Abstract—— In more recent times, blockchain and Web 3.0 have taken the world by storm. Conversations have been sparked with regards to its use cases as such web developers are beginning to integrate these solutions into web-based systems. Most important of all, it is easy to consider blockchain as a distributed world computer that will change the way we look at the internet. In this paper, we present analytic hierarchy process (AHP) as a tool for ranking Web 3.0 factors and which of those are pertinent for consideration by developers and specialists in the area. We apply the multi-criteria decision making to prioritization of Web 3.0 development factors. Policy recommendations are indicated in the study.

Keywords - blockchain, Web 3.0, AHP, multi-criteria decision making, web development, software engineering

I. INTRODUCTION

A paradigm shift towards decentralization within numerous sectors of the innovative industry and society has taken the world by storm. Proponents of this concept believe that Web 3.0 has the potential to transform the internet, the experience of individuals, provide security in the FinTech world, as well as handing back ownership of data to those who create it [1], [2]. In spite of the growing conversations, and quest to understand this paradigm (as seen in Figure 1, highlighting the Google search trends for the keyword "Web 3.0" over time), some scholars believe the theme is yet to take off [3].

Fig. 1. Google Search Trends (Web 3.0) – 2004 - 2023

As per the Gartner Hype Cycle, which is a visual representation of the disillusionment with respect to emerging technologies and to describe the life cycle of such technologies [4], [5], a comparative overview of 2021 and 2022 (figures 2 and 3 respectively) reveals the presence of concepts related to the Web 3.0 world which were classified under the Peak of Inflated Expectations. It can be observed that the hype around Web 3.0 peaked during 2022 and this phenomena according to researchers has been linked to the decentralized nature of the innovative technology [6].

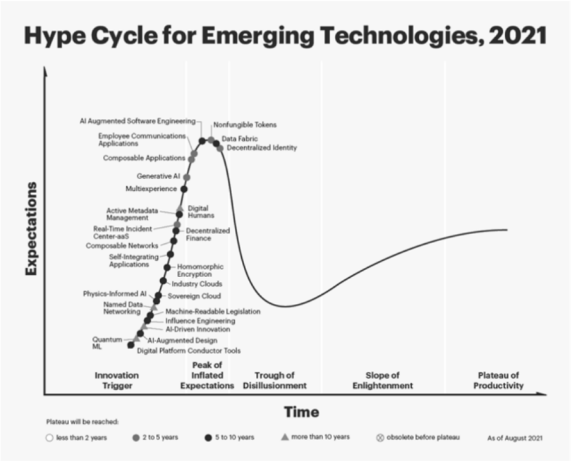

Fig. 2. Gartner Hype Cycle for Emerging Technologies 2021 – (Source: Gartner Inc.[1])

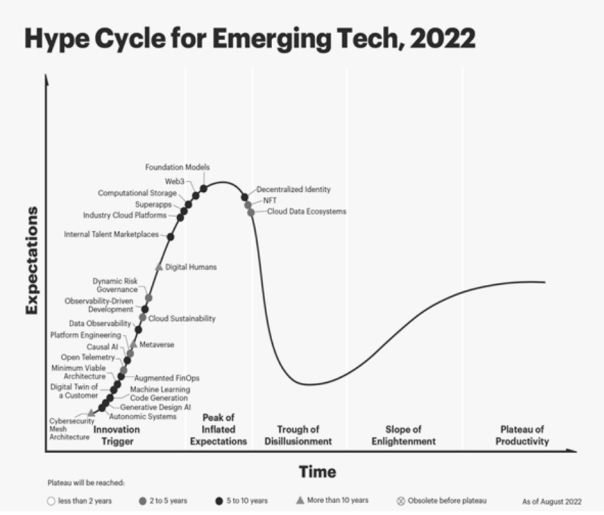

Fig. 3. Gartner Hype Cycle for Emerging Technologies 2022 – (Source: Gartner Inc. [2])

The rise of Web 3.0, with blockchain technology as its backbone has created avenues for developing areas such

[1] Gartner Inc. (n.d.), 3 Themes Surface in the 2021 Hype Cycle for Emerging Technologies, https://www.gartner.com/smarterwithgartner/3-themes-surface-in-the-2021-hype-cycle-for-emerging-technologies

[2] Gartner Inc. (n.d.), What's New in the 2022 Gartner Hype Cycle for Emerging Technologies, https://www.gartner.com/en/articles/what-s-new-in-the-2022-gartner-hype-cycle-for-emerging-technologies

as the Metaverse, decentralized applications (dApps), decentralized exchange (DEX), decentralized autonomous organizations (DAO) or decentralized autonomous corporations (DAC) built on blockchain architectures such as Ethereum, WAX, Hive, BNB Chain, Polygon, EOS, Solana, Thundercore, Arbitrum, Flow, Ronin, Cardano, Tezos, and many others. Tools (high level languages) such as Vyper, Solidity are used by developers for writing smart-contracts and these are interfaced with popular programming languages like JavaScript, Python, and PHP to create these decentralized applications [7], [8]. Developers applications based on Web 3.0 strive to develop trustless solutions that improve and optimize business processes [9], [10]. The process of developing such applications come with challenges such as choosing the right architecture, as well as the ease in combining separate services to create a seamless user experience. Thus, prioritization of all the relevant driving factors is an essential component in any project management workflow or business process. In light of the rate of development, the gradual integration of Web 3.0 and the need for prioritizing the development process, this research asks the question: What are the key factors to be considered by developers when building a Web 3.0 applications and of what order of importance are they to developers?

II. BLOCKCHAIN AND WEB 3.0

Many hope it will arrive as an announced messiah that will save us from cookies, trackers, advertising, and data theft by large centralized companies. However, Web 3.0 is still in its infancy, and it's hard to know if whatever has been said and promised will become true. Web 3.0 is developing exponentially, which additionally provides to the cybersecurity issues it imposes. There is a non-stop shift withinside the Internet architecture, from a read/write version to a more modern version called Web 3.0. Global organizations are exploring Web 3.0 possibilities of their enterprise processes [11]. New internet technology are required for assembly the growing human wishes. Web is used now no longer simplest for human wishes, however additionally for communique among humans or machines. The essential homes of current internet technology are integrated, person orientated and offering wealthy content. However, swiftly changing human wishes and technology are because of faster, greater interactive and smart internet technology [12].

There currently exist numerous usability techniques that has been used successfully over the years to determine how Web 3.0 Popular usability attributes include satisfaction, efficiency, and effectiveness amongst others. It is realized some of these attributes are quantitative while others are subjective (qualitative) in nature such as satisfaction and attractiveness attributes. A study claimed that most times quantitative attributes are usually based on user performance while subjective attributes are based on the way users view the app [13]. Usability researchers have always had difficulty when making decisions on which technique to apply during usability evaluation purposes out of the numerous techniques that exist. It is realized that most of these techniques consume resources in terms of time and money. The problem is on how to evaluate numerous usability attributes at once, saving resources and also getting better results.

This work tends to approach usability evaluation from a wider perspective, taking numerous attributes into consideration as well as the quantitative and qualitative aspects simultaneously using Multi Criteria Decision Making techniques. The usability evaluation issue had been identified to be a Multi-Criteria Decision Making (MCDM) problem, which is a subset of the general Operational Research (OR) models that are used for solving problems involving high uncertainty and different ideas, data and information [14].

In this paper the Consensus Mechanism, Carbon Neutrality, Market Capitalization (in USD), Ubiquity of the Metaverse, Blockchain Network Latency, Programming Language Ease, Access to Developer Community, Comprehensible Documentation, Cross-Blockchain Interoperability, Vision and Goals of Blockchain of Choice are the different types of factors of Blockchain where these has got prioritized. The MCDM problem aimed at choosing or deciding on suitable measurable usability constructs from various substitutes and criteria. The focus of this study is to rank all the criteria and criteria identified in the usability hierarchical model by using the Analytic Hierarchy Process (AHP), a decision-making technique which allows important ranking and prioritization to be done based on sets of multi-level criteria [15]. It is worth noting that the use of blockchain technology in conjunction with the AHP is still in the early stages of development and is not yet widely adopted. Further research and development will be necessary to fully realize the potential benefits of this combination.

III. METHOD

Analytic Hierarchical Process (AHP) is a relevant mathematical technique that is used to solve MCDM problems, where a choice has to be made from a number of alternatives based on their relative importance [15]. It was developed by Saaty in the 1970's from mathematical and psychological principles. It relies on the judgments of experts to derive priority scales through pairwise comparison of decision elements at each level as shown

This study utilized a multi-criteria decision-making (MCDM) method, specifically the Analytic Hierarchy Process (AHP), to prioritize and rank Web 3.0 development factors. The study population consisted of experts in Web 3.0 development or related fields, who were knowledgeable about the various factors that impact the development of Web 3.0 applications.

Data for this study was collected using a survey questionnaire, which contained a list of Web 3.0 development factors that respondents were asked to compare and pri-

oritize the various factors in the questionnaire. The study data was obtain from 11 respondents. Respondents were university students that were into blockchain development. As per the AHP method, pairwise comparison matrices were used to assess the relative importance of Web 3.0 development factors. Pairwise comparison results that did not meet the Saaty Consistency Index were eliminated. The geometric mean of the consistent pairwise comparisons was determined for all factors to generate a unified weight for ranking.

Based on the analysis of the survey data, a prioritized list of Web 3.0 development factors was obtained. The factors were ranked in order of importance as per the experts, based on the weights assigned to them in the AHP analysis. The prioritized list was used to provide guidance for developers and specialists in the area.

The study demonstrated the effectiveness of using the AHP method as a tool for prioritizing and ranking Web 3.0 development factors. The prioritized list of factors can be used by developers and specialists to guide their decision-making process and ensure that they focus on the most important factors in the development of Web 3.0 applications.

IV. RESULTS

The results of the study indicates that the most important factor for Web 3.0 development is the consensus mechanism, which had a weight of 20.0% (as seen in Table I). This suggests that experts in the field consider the underlying technology that enables blockchain to be a decentralized and trustless system as the most critical aspect of Web 3.0. This can be linked to the consideration of gas fees during transactions be it with proof-of-stake (PoS) or proof-of-work (PoW) consensus frameworks [16], [17]. Blockchain consensus mechanisms are important to programmers since they influence the functionality, shared maintenance as well as control of the blockchain. Programming language ease had the second-highest priority with a weight of 14.4%, indicating that developers and specialists value the ease of use and accessibility of the programming languages used to build Web 3.0 systems. Solidity is known to be the most popular and well-used smart contract language due to factors such as its object-oriented nature [18], [19]. Other languages used by developers include Obsidian, Python, PHP, Go, JavaScript, Java [20], [21].

Blockchain network latency had a weight of 13.8% and was ranked third in importance, highlighting the importance of the speed and reliability of blockchain networks. As such, network latency plays a crucial role in the success of any Web 3.0 deployment [22]. Access to developer communities was also considered crucial, with a weight of 13.6%, as it provides opportunities for collaboration, knowledge sharing, and innovation. Cross-blockchain interoperability was given a weight of 9.1%, suggesting that developers and specialists recognize the importance of building blockchain systems that can work seamlessly with other blockchain networks.

Comprehensible documentation had a weight of 8.4% and was ranked sixth in importance, emphasizing the need for clear and concise documentation to facilitate the development and adoption of Web 3.0 systems. Vision and goals of blockchain of choice were also considered essential, with a weight of 7.8%, as it helps to ensure that the blockchain system aligns with the objectives of the organization or community. Ubiquity of the metaverse had a weight of 5.5%, highlighting the importance of building Web 3.0 systems that are accessible across different platforms and devices.

Factors related to environmental sustainability, such as carbon neutrality, had a weight of 4.2%, indicating that they were given a lower priority in this study. Market capitalization had the lowest priority with a weight of 3.2%, suggesting that experts in Web 3.0 development do not consider it a crucial factor for the development of blockchain-based systems.

Table I. Pairwise comparison

Construct	***Weight***	***Rank***
Consensus Mechanism	20.00%	1
Programming Language Ease	14.40%	2
Blockchain Network Latency	13.80%	3
Access to Developer Community	13.60%	4
Cross-Blockchain Interoperability	9.10%	5
Comprehensible Documentation	8.40%	6
Vision and Goals of Blockchain of Choice	7.80%	7
Ubiquity of the Metaverse	5.50%	8
Carbon Neutrality	4.20%	9
Market Capitalization	3.20%	10

Overall, these results provide valuable insights into the factors that developers and specialists consider essential for the development of Web 3.0 systems. They can be used to guide decision-making processes, prioritize resources, and allocate funding for the development of Web 3.0 systems.

V. CONCLUSION

The study ranked the criteria and sub-criteria in a usability hierarchical model using AHP, a technique based on mathematical and psychological principles. This approach was used as a result of the complex nature involved in evaluating both the quantitative and qualitative usability attributes simultaneously. Opinions were elicited from decision makers which comprised of Web 3.0 developers and the users. Consistency ratio for all participants were computed to get reliable and valid opinions. Based on results of analysis, efficiency had the highest rank with 20% which is Consensus mechanism followed by effectiveness with 14.4%, 13.8%, 13.6% and so on ranked lowest with 3.2%

which is Market capitalization.

The AHP methodology was found to be more efficient than the traditional methods of usability since numerous attributes were evaluated at the same time thereby saving cost, time and other resources. It was also realized that based on the findings of this study, the AHP was a helpful tool in enabling effective and efficient decisions to be made by users and developers and their prioritization about the multi criterion decision making to prioritization of Web 3.0 factors.

However, it is important to consider the potential trade-offs and limitations of using blockchain technology in conjunction with the AHP. For example, the setup and maintenance of a blockchain-based AHP system could require significant resources and expertise, which may not be practical or cost-effective in all situations. In addition, the use of blockchain technology may introduce additional complexity and potential points of failure into the decision-making process. It may also be necessary to carefully consider issues related to data privacy and security when using blockchain technology in conjunction with the AHP, involve more decision makers in the opinion elicitation process both from the Industry and the Academia. The data analysis can be done by using AHP tool for organizing and analyzing complex problems, so using it with Web 3.0 and blockchain technologies would require a person to be adept at analyzing and interpreting data.

Web 3.0 and blockchain technologies would require the developers to be adept at identifying and analyzing problems, developing and evaluating potential solutions, and implementing effective solutions. This study can be extended by considering other usability attributes or factors that are essential during and after system development. More respondents can also be involved in the opinion gathering process to get judgements from a larger group of decision makers to make more valid judgements. More so, involves creating a hierarchy of factors and evaluating their relative importance, so its use with Web 3.0 and blockchain technologies may require a person to be able to communicate and collaborate effectively with others in order to reach consensus on a hierarchy of factors. Future research will extend the research to compare various cryptocurrencies as per the factors indicated in the study.

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