Exploring the potential of Distributed Ledger Technology in publication industry – A technological review

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Abstract

Distributed ledger technology has shown enormous growth since 2015. More than 2000 articles, and proceedings paper have been published in Web of Science. These publications have the diversity from the leading field of Computer Science with 1626 publications in last 5 years, followed by the field of Engineering. Different organizations and funding agencies have also supported the research work done in this field with the approval of almost 1260 block chain based ideas. Countries like China, and USA together have published almost 922 publications in this field, followed by India and England. Different authors have tried to experiment blockchain in areas like IOT, Healthcare, Smart contracts and supply chain management. Among all IOT has received 304 publications in last 5 years. Various journals have also supported the publications of blockchain based applications with IEEE Access at the top with 169 publications, followed by its peers. Chinese academy of science has published 54 publications in this technology followed by CSIRO and Nanyang Technol University with 33 and 32 contributions. IOT has received 2905 citations followed by Healthcare which shows the real potential of this technology. Such results have given us the benchmark to explore the potential of this technology in the field of publication industry associated with different entities like authors, academicians publishing their work in different indexing databases like Scopus and Web of Science. This study presents the current evolution and scope of distributed ledger technology in the field of citations analysis and academic publishing.

Keywords 1

Blockchain, Applications, Publication Industry

1. Introduction

Appreciation always encourages an author to contribute more for the society. A qualitative research can lead to generations for taking an enormous benefit of the work done. An author as an individual has the responsibility to maintain the quality, systematic phenomena and a clear purpose while doing research in his field. A good research can attract various stakeholders like academic organizations, government bodies, funding, accreditation and ranking agencies to appreciate and further explore the future trends based on the performed research. A dynamic and novel research can engage these stakeholders to define, expand and develop possible outcomes for the betterment of science and society.

To determine the quality of the research, various informetrics exists like h-index [1], cite-score, journal impact-factor, eigen-factor etc. [2][3]. To verify the published work of an author, various indexing databases like Scopus (https://www.scopus.com/dashboard.uri), Web of Science (https://clarivate.com/webofsciencegroup/solutions/web-of-science/), Microsoft Academic (https://www.microsoft.com/en-us/research/project/academic/) and Google Scholar (https://scholar.google.com/) can be used [4]. These indexing databases use their own concept of

indexing which results into different informetrics for same author across different indexing databases. To combine these indexing databases and deliver a unified informetrics system, we can explore the feasibility of distributed ledger technology in the publication industry.

Ledgers are the core of trade from early times and are utilized to store many transactions, most ordinarily belongings such as property and currency. They were stimulated to log on clay tablets to paper, vellum and papyrus. However, the merely prominent novelty is observed in computerization, which originally was an assignment from manuscript to bytes. Systems assist concerted formation of digital ledgers with features and abilities that goes beyond from customary manual ledgers. A distributed ledger is basically a data bank that can be accessed across a system of multiple layouts or organizations. All members within a linkage may carry identical copy of the ledger personally. Any update to ledger is reflected everywhere in seconds. The entities can be monetary, lawful, or physical [5].

Different applications of distributed ledger technology may include enhancement of government services, providing benefits like passports and recording property deeds, improving healthcare through enhancement of services and protected distribution of medical histories as well as records, refining facilities that trust greatly on transactions where such dealings are slow, exclusive and dependent upon mediators, using 'smart contracts' to expand many divisions like nourishment, liveliness, pharmaceuticals, aeronautics, communications, transportation etc., facilitating fair compensation in fashion industries, improving business and expertise replicas in the Internet of Things, improving personality administration, where identity is safe and portable, applications in economic services, efficient business structure, and hazard management and promising the truthfulness of arrangements and mechanisms in composite organizations [6].

A distributed ledger is a data bank believed and accessed autonomously by every contributor involved in a huge system. The allotment is exclusive and records are held and autonomously constructed by each node [7]. A block acts as a page of a register or record book. It is thus a stable collection of records which, once engraved, cannot be reformed or removed. The blocks are supplemented to the chain in a direct, sequential order. Chain structure permanently timestamp's and stores exchange of value, preventing anyone from altering the ledger [8]. Each block's record indicates at minimum one transaction; however, many effective transactions can be characterized in a single block. Every transaction record (ledger entry) is connected to preceding transactions and is consistent for every contributing node. Every ledger entry is retraceable through its complete antiquity and can be remodeled [9].

In this paper we would like to explore the potential of distributed ledger technology to propose a system which can help its stakeholders to record the actual research potential of the associated author. Proposed system will use the concept of citation analysis with distributed ledger technology to improvise the existing system [10]. Citation analysis will provide a system to analyse the importance of the research work of an author so that the research credibility of the author may be measured. During citation analysis, citations received by the author may be analysed for the final citation count required to calculate unified informetrics. Citation analysis helps to identify the similarities between the research work done by different authors, it also helps to identify self citations or repeated citations in the research work, an impact of author in his discipline and field can also be evaluated accordingly.

The complete work has been divided into three research-based questions as follows:

1. What is the evolution of blockchain-based applications over time?
2. How are blockchain-enabled technologies have emerged in various sectors of society?
3. How do we evaluate the blockchain applicability in publication industry?

2. Data Selection

To provide a comprehensive literature review of blockchain-based applications, we have used Web of Science as a main scientific database. We searched the term "blockchain based applications in the month of Oct, 2020 and the executed query returns 2598 results. These results have the publication year range from 2015 to 2020. Out of 2598 results, we have analyzed that 376 papers are review papers on blockchain, whereas 95 papers are not directly linked with blockchain. Rest of 2127 papers were based on blockchain based applications. We analyzed those papers on the basis of their type, year, country, affiliation, journal, research area, funding, and technical area of publication.

We have used 2127 papers to frame 3 primary research questions of our work. These questions were answered with the analysis of identified papers and the 7 patent documents downloaded from https://patents.google.com/, and https://worldwide.espacenet.com/.

Figure 1 shows the data selection and filtration process as follows:
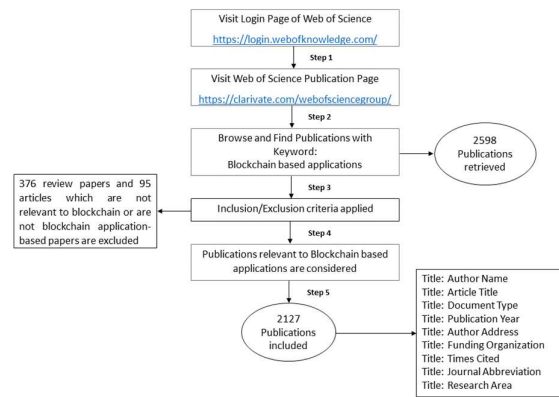
Figure 1: shows the data selection and filtration process of 2127 publication from 2015 to 2020.

3. Results
## 3.1. Number of documents – Year and type wise

Figure 2 shows the year wise publication details of the blockchain based applications. In 2015, we can see the existence of blockchain based applications with a very low publication count of 4, but from 2016 onwards we can observe a continuous hike in the publications. In 2016, it was 36, in 2017, it was 179, in 2018, it was jumped to 627 and reaching the milestone of 1000+ publications in 2019. 2020 has seen a bit of downward flow with publication count of 685 as well. These publications were from different categories like articles, book review, editorial material, letters, meeting abstracts, proceedings paper and review. The major contribution year wise can be seen from proceedings papers which is 47.8% followed by articles contributing to 43.9% of the total publications from the year 2015 to 2020.
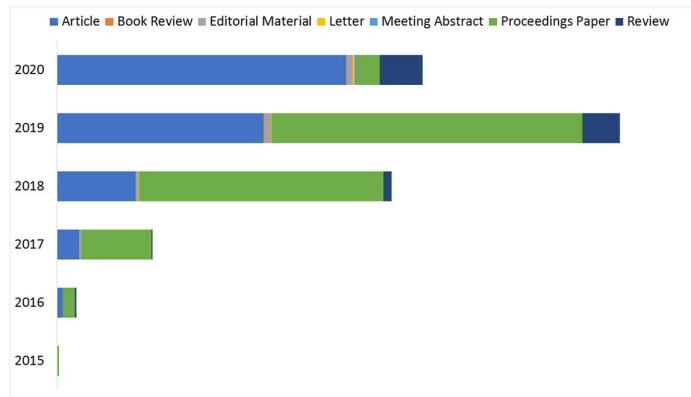
Figure 2: shows the number of documents published from 2015 to 2020. Documents are of different types like article, book review, editorial material, letter, meeting abstract, proceedings paper and reviews. Different categories of documents are presented with year wise detail of publication.

Number of documents – Country wise – Top 10

Figure 3 shows the country wise contribution of authors contributed in blockchain based applications. In total authors from 93 countries worldwide have contributed with China at the top with maximum publications of 500+. Followed by USA with 400+ publications, India, England, Australia, Germany, and Korea with 100+ publications. Italy, Canada, Russia, Spain, Taiwan, and Japan with 50+ publications. France, Singapore, Brazil, Netherlands, Pakistan, Switzerland, Portugal, Romania, Greece, Arabia, Ireland, Austria, Emirates, Malaysia with 20+ publications. Denmark, Turkey, Norway, Poland, Thailand, Finland, Sweden, Scotland, Qatar, Slovenia, Croatia, Vietnam, Egypt, Israel, Bulgaria, Colombia, Estonia with 10+ publications. Indonesia, Cyprus, Ukraine, South Korea, Belgium, Bangladesh, Slovakia, Malta, Hungary, Lebanon, Wales, Morocco, Jordan, Latvia, Mexico, Philippines, Iran, Africa, Tunisia, Zealand, Lithuania, Luxembourg, Republic, Serbia, Macedonia, Ecuador, Kenya, Kazakhstan, Algeria, Ghana, Herceg, Oman, Nigeria, Lanka, Peru, Venezuela, Cambodia, Chile, Iceland, Czech Republic, Namibia, Iraq, Leone, Mauritius, Liechtenstein, Bolivia, Belarus, Tobago, Faso with less than 10 publications each.
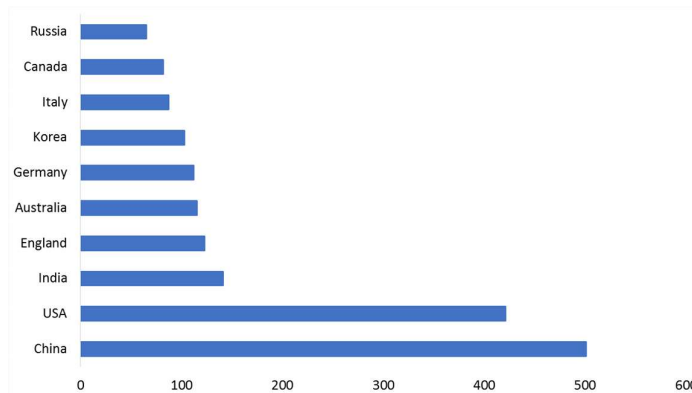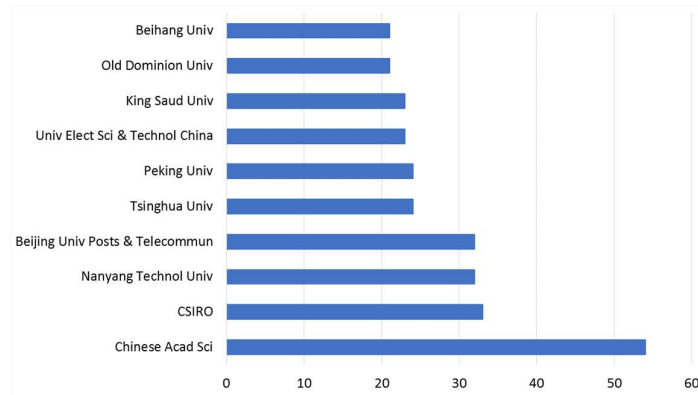

Figure 3: shows the number of documents contributed by different countries. In total 93, countries have contributed and we have presented the data of Top 10 countries worldwide with the number of documents published – country wise.

Number of documents – Organization wise – Top 10

Figure 4 shows the contribution of Top 10 organizations working on the blockchain based applications. In total 2668 organizations worldwide are contributing in blockchain based applications. Out of which Chinese Academy Science is leading with 50+ contributions, followed by CSIRO, Nanyang Technol University, and Beijing Univ Posts & Telecommun with 30+ contributions. Tsinghua

Univ, Peking Univ, Univ Elect Sci & Technol China, King Saud Univ, Old Dominion Univ, Beihang Univ, Wuhan Univ, Univ Texas San Antonio, and Shanghai Jiao Tong Univ with 20+ contributions.

Figure 4: shows the number of documents based on different organizations participated in the publication under block chain application based category. In total 2668 organizations are involved worldwide and we have presented Top 10 organizations from the list.

3.2.   Number of documents – Journal wise

Figure 5 shows the journal wise contribution for blockchain based applications. In total 696 journals have published the blockchain applications-based work from 2015 to 2020. With IEEE Access at the top, it has 150+ publications, followed by Lect Notes Comput Sc with 50+ publications, Sensors-Basel with 40+ publications, Future Gener Comp Sy, and Ieee Internet Things with 30+ publications. Sustainability-Basel With 20+ publications and Appl Sci-Basel, Int J Adv Comput Sc, Electronics-Switz, Future Internet, Adv Comput, Energies, Adv Intell Syst, Ieee T Veh Technol, Int C Par Distrib Sy, Ieee Trans Comput So, Comm Com Inf Sc, Int Con Distr Comp S, Ieee Network, Procedia Comput Sci, J Phys Conf Ser, Lect Notes Bus Inf P, J Netw Comput Appl, Ieee Icc, Ieee T Ind Inform, Ieee Commun Surv Tut, J Med Internet Res, Ieee Glob Comm Conf, Comput Commun with 10+ publications.
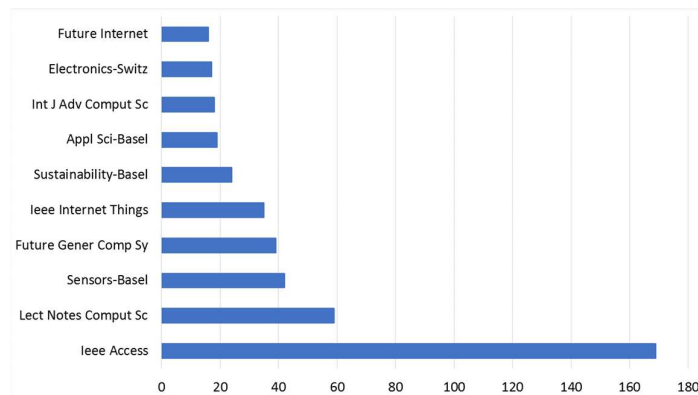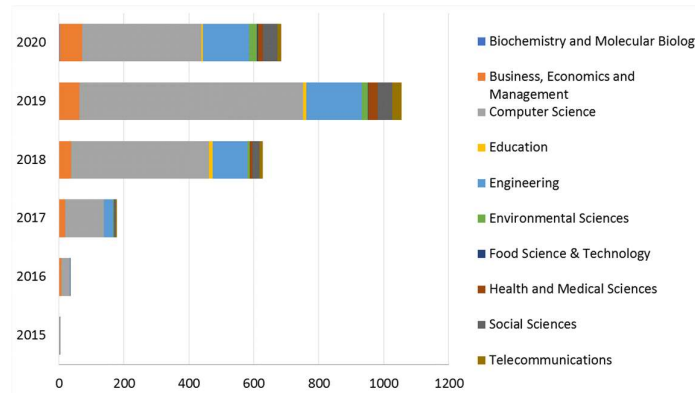

Figure 5: shows the number of documents published by different journals. We have presented Top 10 journals who have rigorously published the work based on block chain based applications. In total 696 journals have published the work based on block chain applications.

Number of documents – research area wise

Figure 6 shows the impact of blockchain in 10 research areas. Primarily all documents have been divided into 10 categories such as Biochemistry and Molecular Biology, Business, Economics and Management, Computer Science, Education, Engineering, Environmental Sciences, Food Science & Technology,   Health and Medical Sciences, Social Sciences, Telecommunications.

Biochemistry and Molecular Biology and Food Science & Technology has received minimum publications across 5 years as compared to other disciplines. Education, Environmental Sciences, Health and Medical Sciences and Telecommunications have shown the average 9, 13, 13, and 11 publications from year 2015 to 2020. Social Sciences and Business, Economics and Management have received 100+ contributions as compared to other research areas. Computer Science is at top with 1500+ contributions followed by 400+ contributions in Engineering. Computer science is the only field which has received contributions in all the years starting from 2015 to 2020 with an average of 233 contributions per year.

Figure 6: shows the number of documents published research area wise. Complete dataset is categorized into 10 different research areas and based on the categories of Web of Science, all publications have been segregated.

3.3.   Number of documents – funding agency wise

Figure 7 shows the number of documents which have received funding from different agencies. Out of 2127 publications, 1266 have received funding from different agencies which is almost 50% of the total contribution. 50% funding also depicts that there is an extensive support by different agencies for the evolution and growth of blockchain based applications. 2019 is the most successful year with almost 500 contributions receiving funding from the agencies, followed by 300+ in 2020 and 200+ in 2018.
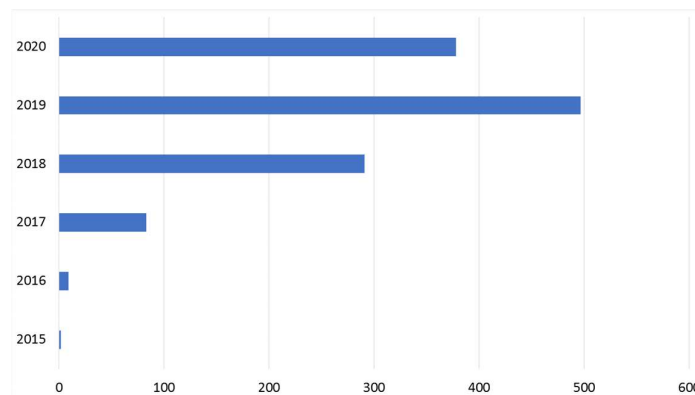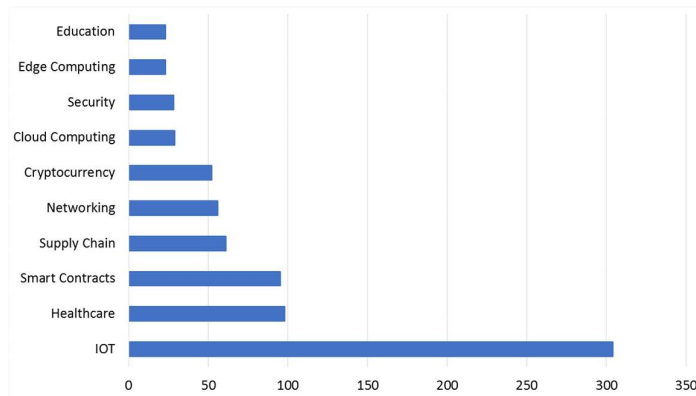

Figure 7: shows the number of documents received funding from year 2015 to 2020. Almost 50% have received the funding from different sources which signifies that agencies are looking forward towards research based on block chain based applications.

3.4.   Number of documents – technical area wise

Figure 8 shows the technical areas which are emerged with the boom of blockchain. IOT has received maximum contributions with the overall count of 300+ out of 2127 contributions. Followed by Healthcare, Smart Contracts, Supply chain, Networking, Cryptocurrency, Cloud Computing,

Security, Edge Computing, Education, Business Applications, Finance, and Medical Records with 20+ contributions at least. E-voting, Energy systems, Mobile Environment, Cybersecurity, 5G, Artificial intelligence, Privacy Issues, Digital signature, Privacy Management, and Fog computing have received 10+ contributions each.

Figure 8: shows the number of documents segregated into different technical areas wise. Although we have observed the block chain based work into number of research areas, we have plotted the Top 10 areas who have received significant response in context with block chain. IOT has received the top contributions from 2015 to 2020.

3.5. Number of citations – technical area wise

Figure 9 shows the number of citations received by the different technical areas. Review based papers have received almost 3900+ citations, followed by IOT with 2900+ citations, Healthcare with 900+ citations, Smart Contracts with 400+ citations, Cryptography with 400+ citations, Supply chain and Decentralized Digital Currencies with 300+ citations, Cloud Computing and Edge Computing with 200+ citations. Chemical Industry, Networking, Cloud Environment, Mobile Edge Computing, Automotive Security and Privacy, Cryptocurrency, Distributed ledger technology, Cybersecurity, Smart City, Transportation Systems, Smart Cities Applications, Energy systems, Privacy policies, Architecture Design, Banking Industry, and Information sharing with 100+ citations each. Among top 10 with number of contributions received technical area wise, we can see that Cryptocurrency and Security technical areas are in the top 10 when we compile the results – with number of publications but when we sort the results citations wise – we can see that both have received less number of citations as compared to peer technical areas.
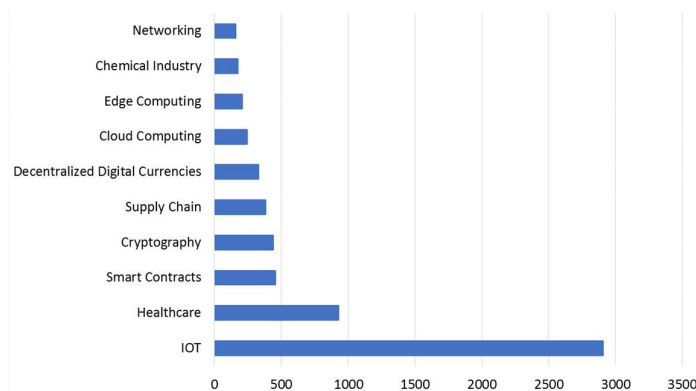
Figure 9: shows the number of citations received by different technical areas. Block chain has shown his emergence in almost all the areas worldwide. We have plotted the Top 10 areas who have received the significant number of citations as compared with overall data.

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3.6.   Relevant work and encouragement

In the work titled as "Contribution of multiparty data aggregation using distributed ledger technology ", authors have presented the framework to identify the items of information with the record of entity requesting the information. This is proposed with the concept of distributed ledger technology. Multiparty data signifies the contribution and segregation of data from multiple sources. After studying the research work done by the authors, we can conclude that there is a good prospective of using distributed ledger technology in publication industry. Presented work does not directly supports the publication industry but it definitely resembles to the framework which is required to be built on the concept of acknowledging the contribution of multiple indexing databases [11]. In the prospects of blockchain and distributed ledger technologies for open science and academic publishing, authors have used the concept of blockchain and smart contracts in academic publishing. They have identified concrete use cases to prepare an informal model for required setup. This research work is directly contributing and supporting the need of using distributed ledger technology in the publication industry. Authors have significantly explored the prospects of DLT in academic publishing. A unique idea is also provided with the concept of possible use cases while integrating the DLT in academic publishing [12]. In one of the works related to Intellectual property asset management system using distributed ledger technology, authors have presented the system to manage different assets associated with Intellectual Property. Authors have used the concept of distributed ledger technology to generate DLT based records. In this study of intellectual property asset management, we have found that we can manage different indexing databases just as a routine of intellectual property assets. This idea supports our pattern of using the concept of taking the research inputs of author from multiple assets like Scopus and Web of Science [13]. In the paper titled as "Systems, devices, and methods for Dlt-based data management platforms and data products", authors have tried to preserve the benefits of distributed ledger technology which can be used to handle and manage the private sharing of the data. This study in the field of distributed ledger technology also supports our work. We also have systems which are connected across multiple indexing databases. We also want to provide a unified system based on distributed ledger technology to provide a composite data product [14]. In "Unified identification protocol in training and health", authors have presented an idea for the unique identification of entities with the help of distributed ledger technology. Uniquely identified data may be stored in one or more devices or on cloud services with the help of distributed ledger or blockchain technologies. This study supports our idea of using distributed ledger technology in academic publishing industry directly. Authors have integrated the concept of training and health whereas we are trying to integrate the concept of publications and citations [15]. In "Scholarly publishing on the blockchain – from smart papers to smart informetrics", authors have used the concept of smart papers in publication industry. They have proposed the mechanism of decentralized publishing and the calculation of informetrics on the basis of citations counts. This work directly supports our idea of using distributed ledger technology in academic publishing. Authors have used their own concept of consideration of scholarly publishing of articles. They have tried to convert smart papers into smart informetrics. In similar way, we are also trying to utilize smart informetrics rather smart unified informetrics based on article and citation count of an author [16].

4. Conclusion

This study provides insight and meaningful implications regarding use of distributed ledger technology in the academic publishing industry. We have studied the trend of distributed ledger technology in last 5 years. How this technology is being encouraged by different countries, different organizations, and different journals. How blockchain is being mashed up with the key technical areas of these days. Such results have shown the significant impact of this technology in the society and has also increased the societal value of the key technical areas like IOT after being merged with distributed ledger technology. Few patent ideas and few implementations in academic publishing have also given us the boom to experiment with this technology in the field of research publication industry. Calculated results have shown us the significant scope of this technology to prove its potential in different key technical areas in the current trend.

We further recommend to explore the capabilities and limitations of distributed ledger technology in the different key technical areas and to explore the concept of Gamification in the academic publishing industry as well.

5. Acknowledgements

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