

TELECOM BUSINESS REVIEW

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1. Impact of Ultra-Reliable Low Latency 5G on Internet of Everything
Padma Panchapakesan 1
2. A Study of Collective-Work Approach on Perceived Creativity for Enhancing Leadership Qualities in IT Companies
Rahil Meymandpour, Zahra Bagheri, Prafulla Pawar 11
3. Layered Approximation for Deep Neural Networks
Utpal Chakraborty 18
4. Data Monetization Strategies for New Age Digital Communication Providers in India
Sohag Sarkar, Pooja Sarkar 23
5. Executing Strategies - A Bird's Eye View of the Future of the Communications Sector
Saibal Samaddar 35
6. Revolutionizing Healthcare With 5G
Pijush Gupta, Mahuya Ghosh 41
7. Big Data Analytics for Customer Lifetime Value Prediction
Aslekar Avinash, Piyali Sahu, Arunima Pahari 46
8. Moving Beyond Paperwork: Blockchain in Public Sector
Damle Pramod, Benjamin Zachariah, Tina Salim 50



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Editorial Message



It gives me immense pleasure in presenting to you the Twelfth issue of “Telecom Business Review” (TBR): A journal of Symbiosis Institute of Telecom Management. The TBR Research Journal has been a platform for scholars, teachers, professionals and students to contribute and showcase their knowledge, research, experience, study results and findings in the relevant areas of Technology, Business and Management. In the TBR September 2019 Issue, we have published articles on diverse topics such as , “Impact of Ultra Reliable Low Latency 5G on Internet of Everything”, “A Study of Collective-Work Approach on Perceived Creativity for Enhancing Leadership Qualities in IT Companies”, “Layered Approximation for Deep Neural Networks”, “Data Monetization Strategies for New Age Digital Communication Providers in India”, “Executing Strategies - A Bird’s Eye View of the Future of the Communications Sector”, “Revolutionising Healthcare With 5G”, “Moving Beyond Paperwork: Block Chain in Public Sector”, “Big Data Analytics for Customer’s Lifetime Value Prediction”.

I am sure the TBR Research Journal 2019 will help to trigger quality studies in the field of Telecom Business Management and enlighten and educate the Telecom fraternity.

At the release of the Twelfth issue, I thank all the contributors for their thought provoking articles. I also express my heartfelt gratitude to the members of the Editorial Review Board and all our esteemed reviewers. I also seek the support of the telecom fraternity in our efforts of making the TBR Journal global by contributing research papers that highlight global issues in telecom business.

Prof. Abhijit Chirputkar
Director SITM

Telecom Business Review

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Contents

- 1. Impact of Ultra-Reliable Low Latency 5G on Internet of Everything**
Padma Panchapakesan 1-10
- 2. A Study of Collective-Work Approach on Perceived Creativity for Enhancing Leadership Qualities in IT Companies**
Rahil Meymandpour, Zahra Bagheri, Prafulla Pawar 11-17
- 3. Layered Approximation for Deep Neural Networks**
Utpal Chakraborty 18-22
- 4. Data Monetization Strategies for New Age Digital Communication Providers in India**
Sohag Sarkar, Pooja Sarkar 23-34
- 5. Executing Strategies - A Bird's Eye View of the Future of the Communications Sector**
Saibal Samaddar 35-40
- 6. Revolutionizing Healthcare With 5G**
Pijush Gupta, Mahuya Ghosh 41-45
- 7. Big Data Analytics for Customer Lifetime Value Prediction**
Aslekar Avinash, Piyali Sahu, Arunima Pahari 46-49
- 8. Moving Beyond Paperwork: Blockchain in Public Sector**
Damle Pramod, Benjamin Zachariah, Tina Salim 50-55

Impact of Ultra-Reliable Low Latency 5G on Internet of Everything

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ABSTRACT

Wireless technology has continuously evolved to cater to new applications and services. Till now, this evolution was mainly driven by the demand for high data rates. However, requirement for next generation wireless technology is much more than just high data rates. It is estimated that by 2025 there will be 25 billion wireless connections connecting people and things. This Internet of Everything (IoE) will continuously capture and exchange data. It will also be highly intelligent to aid quick decision making and to deliver high quality services. To achieve this, the underlying communication technology will have to be extremely reliable and should provide very low latency.

3GPP is working towards 5G technology, which is expected to be launched in 2020. Apart from supporting high data rates, it will also enable large scale IoE connectivity and extremely low latency applications. With 5G as the communication technology, AI enabled platforms can collect, exchange and store relevant data and can deliver more efficient products and services. This interworking of 5G and AI has the potential to bring a new era of intelligent connectivity that can drastically change our lives.

In this study, we have done systematic literature review of ultra-reliability and low latency (uRLLC) feature of 5G. We present an overview of uRLLC and also discuss some use cases of how 5G, AI and IoE can interwork to improve the lives of rural and urban population especially in important areas like Agriculture, Healthcare, Education and Transport.

Keywords: 5G, AI, IoE, uRLLC

1. INTRODUCTION

Mobile broadband traffic is increasing rapidly. This traffic growth is driven by new applications, services and device capabilities. Hence, providing high data throughput was the primary motivation for the evolution of wireless technology from 2G to 3G and later to 4G.

However, now there are additional requirements apart from high data rates. Today we require a technology that can provide massive connectivity along with high data rates. This technology should interconnect everything that we see around - people and things. This network is called Internet of Everything (IoE). It is estimated that by 2025 there will be 25 billion connections (GSMA, 2018b). This network will also be extremely intelligent, will aid in quick decision-making, and will deliver high quality services and applications. To achieve this, the underlying communication technology should be extremely reliable and should be capable of providing very low end-to-end latency.

3GPP is working towards 5G technology, which is expected to be launched in 2020. Apart from supporting bandwidth intensive content, 5G will also enable large-scale IoE connectivity and lower latency applications compared to existing wireless technologies.

In this paper, we present an overview of Ultra-Reliable Low Latency Communication (URLLC) feature of 5G. We also discuss the techniques used in 5G to achieve URLLC requirements. We then present some use cases of how URLLC, AI and IoE can interwork to improve the effectiveness and efficiency of some important areas like Agriculture, Healthcare, Education and Transport.

2. LITERATURE REVIEW

5G supports three broad categories of services namely eMBB, URLLC, and mMTC (Fig. 1). In this paper we focus on URLLC which is a very challenging feature because high reliability and low latency are conflicting requirements. For example, to achieve high reliability,

additional coding bits are added and robust retransmission schemes are deployed. However, these methods increase latency. Similarly, to reduce latency, coding should be minimal and retransmissions should be reduced.

However, this can increase packet error rates thereby reducing reliability. Hence, it is necessary to come up with a different approach to achieve both high reliability and low latency simultaneously.

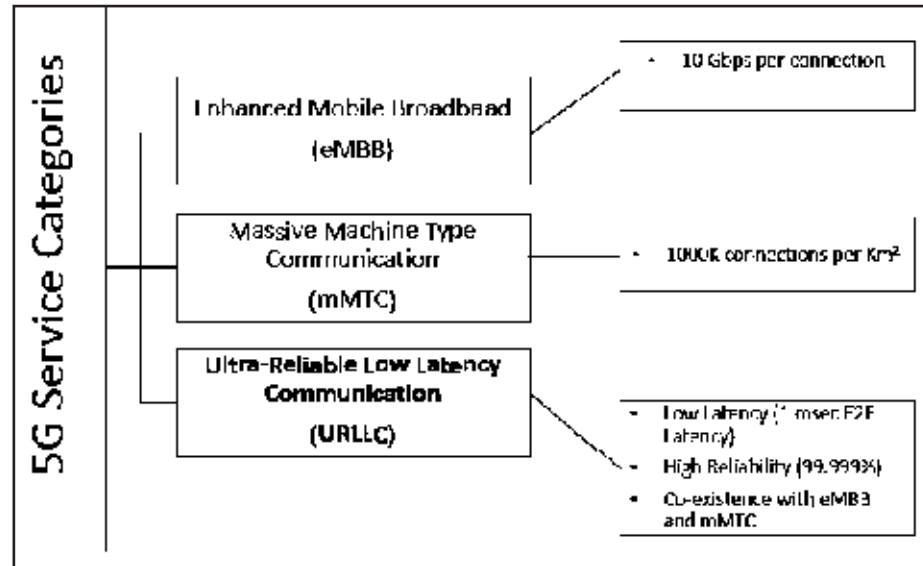


Fig. 1: 5G Service Categories

(Ji, et al., 2018) have explained URLLC Service requirements in detail. Physical layer enhancements required to achieve URLLC requirements are explained in (3GPP TR 38.824, 2018). In (Chen, et al., 2017) and (5G Americas, 2018), the authors discuss a few possible latency reduction measures. They also talk about emerging use cases, design challenges, and potential approaches in the design of URLLC communications.

Network operators and device manufacturers are accelerating the adoption of 5G URLLC for different use cases. Implementation of some interesting use cases in transportation and healthcare are detailed in (Qualcomm, 2019), (AUTO Connected Car News, 2019), (Enride, 2019) and (Donkin, 2019).

3. OBJECTIVE OF THE PAPER

We have done systematic study of URLLC and its technical requirements from existing literature. The purpose of this paper is to summarize the concept of URLLC and to highlight some methods that can help achieve URLLC requirements. We also discuss some implementation challenges of these methods. We then present a few use

cases of URLLC that have the potential to transform our lives.

4. ULTRA-RELIABLE LOW LATENCY COMMUNICATION

URLLC is a service category defined in 5G to support delay sensitive mission-critical services. These services require very high reliability or very low latency or both at the same time.

4.1 Latency Requirement

As per ITU recommendations (ITU, 2018), E2E latency for URLLC services should not exceed 1msec. To meet this requirement, 3GPP has set the average U-plane latency for URLLC services to be less than 0.5msec (3GPP TR 38.913, 2017). U-plane latency refers to the time from when application data enters Layer 2/Layer 3 in the transmitter to the time when the data reaches Layer 2/Layer 3 in the receiver successfully. The main contributors of U-plane latency are shown in Fig. 2.

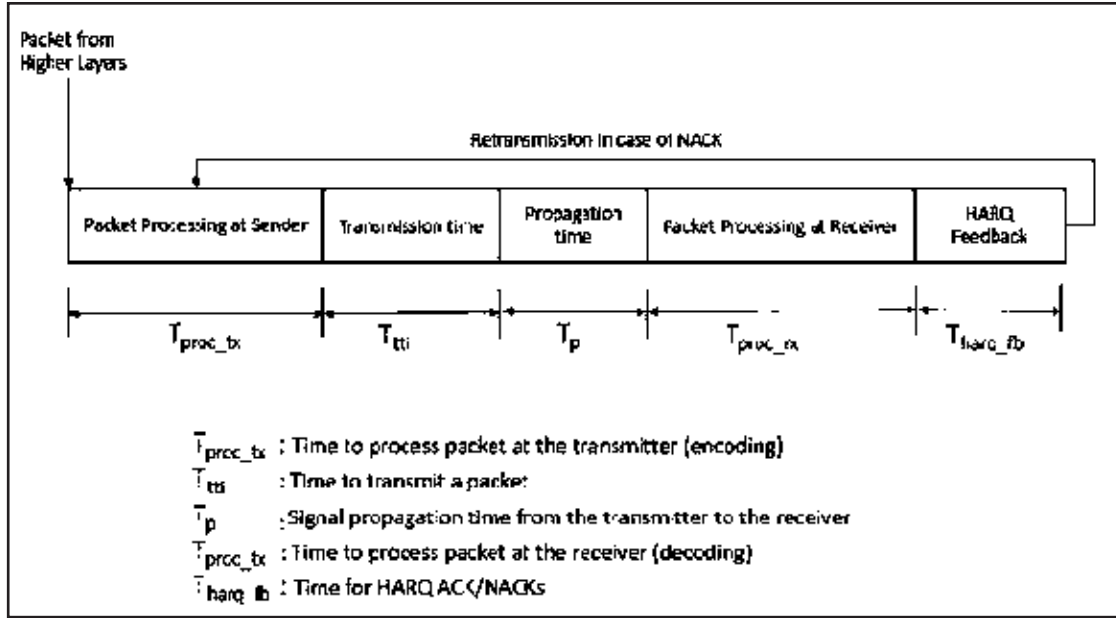


Fig. 2: U-Plane Latency

Apart from this, initial control message exchange (resource requests, grants) before data transmission also adds to delays. Some techniques used to reduce U-plane latency are explained in (3GPP TR 23.725, 2018) and (Bennis, Debbah, & Poor, 2018) and are listed below.

4.1.1 Advanced Channel Coding Schemes

5G uses LDPC coding for U-plane as against Turbo coding that is used in LTE (Khan & Roy, 2013). In both Turbo and LDPC, decoding is done iteratively. The accuracy of decoding improves with each iteration. However, the number of iterations in Turbo code is fixed which means the time spent in decoding is fixed irrespective of the probability of error. In LDPC, the decoder can stop the iterations when a legal code word is found. Hence, decoding time for LDPC is shorter when the channel conditions are good. When channel conditions are poor, number of iterations required will be higher and can be configured based on the latency requirement of the application. This provides a trade-off between the required bit error performance and latency. In addition, LDPC decoders are parallel in nature while Turbo decoders are serial in nature. This allows LDPC to support low latency applications in a better way than Turbo codes.

4.1.2 Shorter TTI

TTI is the periodicity at which a Transport Block is transferred by physical layer on the radio interface. In LTE each TTI is 1msec long corresponding to 14 OFDM symbols (normal cyclic prefix) with a subcarrier spacing of 15kHz.

In 5G, sub-carrier spacing can be 15kHz, 30kHz, 60kHz, 120kHz or 240kHz resulting in flexible symbol durations. Increasing sub-carrier spacing results in shorter symbol durations (Fig. 3). Short symbol durations work well with mmWave ($> 6\text{GHz}$) where cell sizes and delay spreads are small. However, in sub-6GHz frequencies, cell sizes will be large resulting in larger delay spreads. Using smaller symbol durations in large cells can result in excessive inter-symbol interference. Hence, short symbol durations corresponding to sub-carrier spacing of 120kHz and 240kHz are applicable only to mmWave and larger symbol durations corresponding to 15kHz, 30kHz are applicable only to sub-6GHz frequencies. 60kHz can be used in both cases. For sub-6GHz, solution for reduced TTI is to use mini-slot (2-3 symbols) and slot level (7 symbols) transmission. With this, TTI for each packet can be reduced to 142, 241, and 500 μs , respectively.

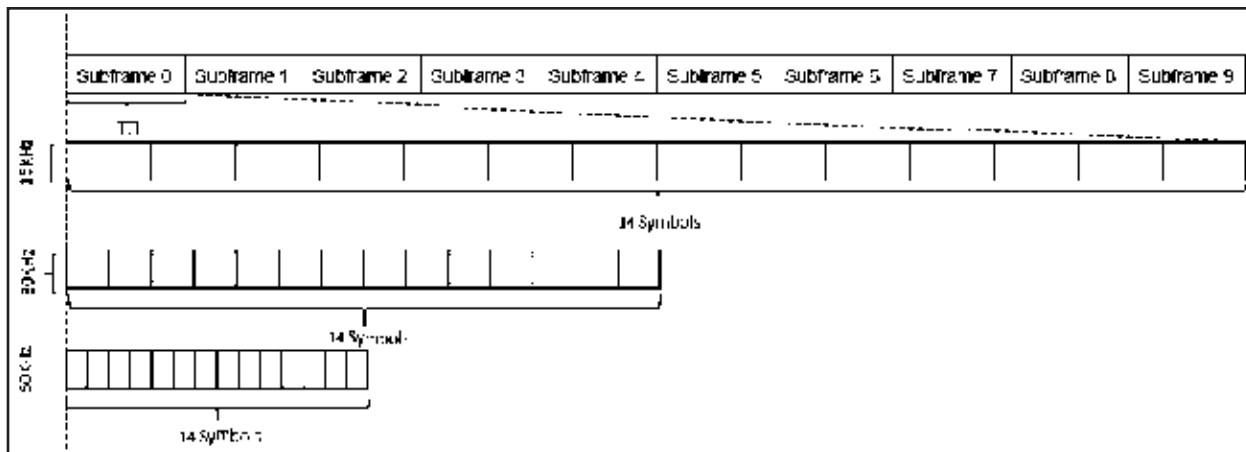


Fig. 3: Flexible Numerology

4.1.3 Faster HARQ Turn-Around Time

5G frame structure allows self-contained subframe for TDD where the DL transmission as well as the ACK/

NACK for that transmission are contained in the same subframe. In FDD also the turn-around time of HARQ ACK/NACKS and data retransmissions is made shorter (Fig. 4).

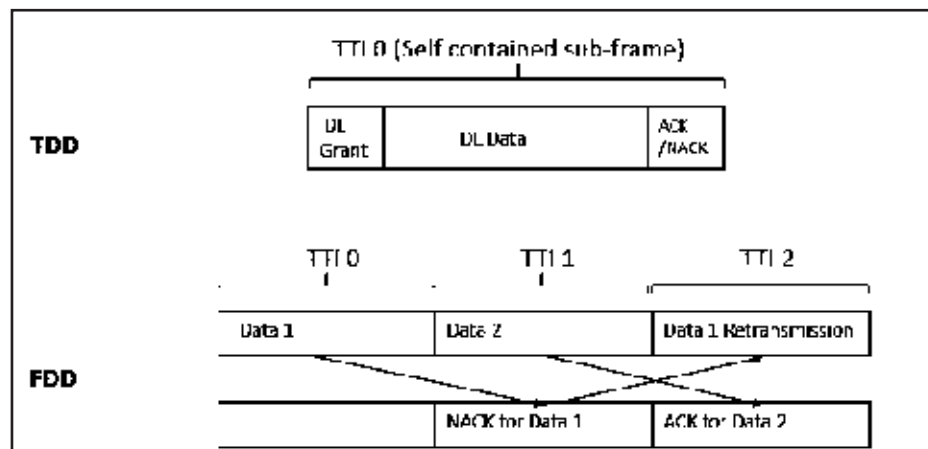


Fig. 4: Faster HARQ

4.1.4 Grant-Free Uplink Transmission

In Grant-free uplink transmissions, gNB configures periodic uplink resources for a UE. When UE has data, it can transmit on the configured resources without requesting for frequent uplink grants resulting in shorter uplink latency.

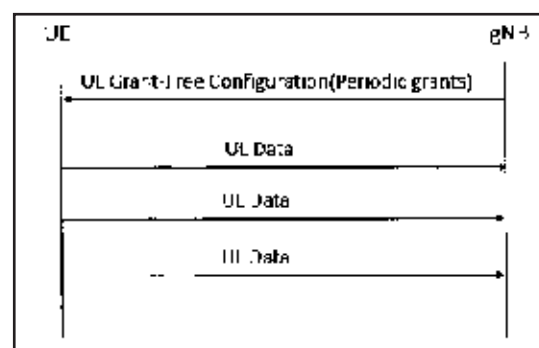


Fig. 5: Grant-Free Transmission

4.1.5 Pre-Emption

URLLC data is given higher priority over other services. When gNB receives URLLC data, it immediately transmits it by preempting ongoing eMBB transmission thus reducing latency for time critical services.



Fig. 6: Pre-Emption

4.2 Reliability Requirement

Reliability is defined as the probability of successfully transmitting and receiving a fixed size packet within a given time. The target reliability for URLLC is 99.999% in 1msec for a 32-byte packet. Some of the techniques used to achieve high reliability without affecting latency are listed below (Bennis, Debbah, & Poor, 2018).

4.2.1 Multi-Connectivity

5G supports data duplication through multiple links. Data between network and UE can be sent via multiple base stations. This increases robustness against adverse channel conditions like fading, shadowing and cell failures.

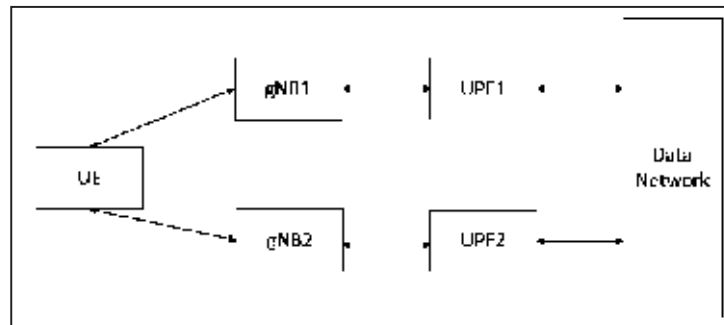
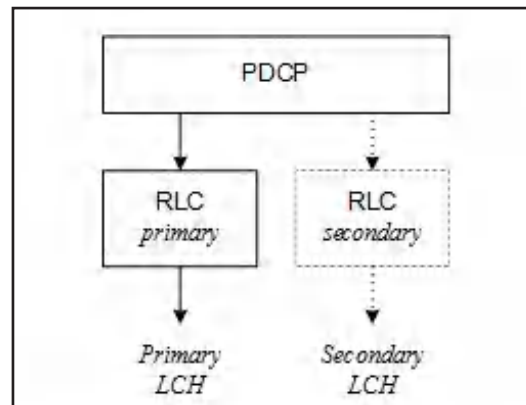


Fig. 7: Multi-Connectivity

4.2.2 Data Duplication

Data duplication at PDCP level is also supported in 5G. When duplication is configured for a radio bearer, an

additional RLC entity and an additional logical channel are added to the radio bearer to handle duplicated PDCP PDUs.

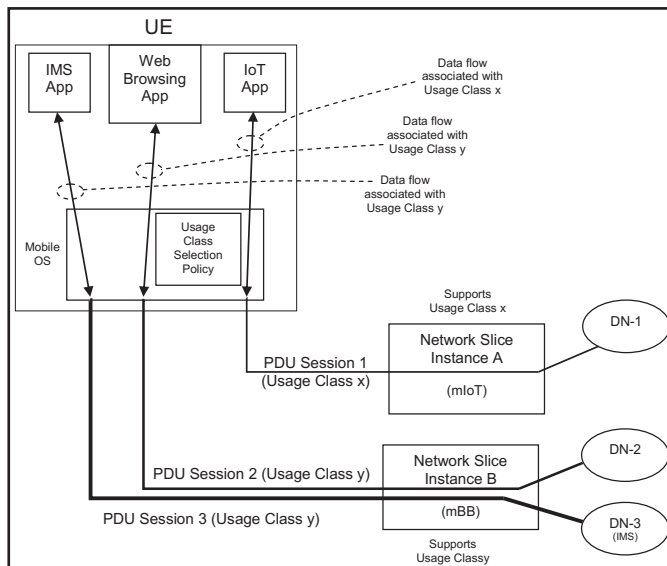


Source: 3GPP TS 38.300

Fig. 8: PDCP Duplication

4.2.3 Network Slicing

Network Slicing is the process of slicing a physical network into logical sub-networks for specific types of services. The idea is to allocate dedicated resources for each of these services. For example, one slice with stringent reliability guarantees can be allocated to mission-critical applications like V2V applications.



Source: 3GPP TR 23.799

Fig. 9: Network Slices

4.2.4 Blind Repetition

In Blind repetition or K-repetition, same data packet is sent K times without waiting for HARQ feedback. Higher layers configure redundancy version for each repetition. Frequency hopping can also be configured for these repetitions, which will further increase reliability by providing both time diversity and frequency diversity. Since the transmitting side does not wait for HARQ feedback before K-repetition, this technique improves probability of successful reception without additional latency.

4.2.5 Interference Mitigation

With massive MIMO it is possible to focus transmitted signal into very narrow beams thus reducing intra-cell interference. Network-based inter-cell coordinated scheduling will also be implemented to reduce inter-cell interference. 5G devices will also implement advanced interference cancellation receivers (MMSE-IRC or

NAICS) which will further improve signal reception and thereby improve reliability.

5. CHALLENGES

Though the methods discussed in the previous section can help achieve URLLC requirements, there are certain implementation challenges. For example, LDPC code's high error correcting capability and its potential to approach Shannon capacity limit is a key enabler for URLLC. However, computational complexity of LDPC is a critical issue especially in devices with limited battery power. A lot of research has been aimed at optimizing and reducing the complexity of LDPC decoding algorithms. Some of these techniques like early termination and forced convergence are detailed in (Sarajlic, Liu, & Edfors, 2014). Usage of short TTI also has a drawback in terms of higher overhead (CP and resource grants). This may not have any significant impact on services that require infrequent bursts of data. However, if the service requires continuous data for a long duration, the additional overhead can adversely affect the overall performance. Hence, it is important to choose the appropriate TTI duration depending on the service requirement. Similarly, the techniques used for improving reliability like K-repetition, data duplication etc. will result in inefficient use of radio resources. Pre-emption of eMBB data for URLLC services can also have adverse impact on the performance of high data rate applications. Hence, for fair co-existence of different services, network should implement intelligent and efficient scheduling algorithms that can balance the requirements of URLLC and other service categories.

6. USE CASES OF URLLC

URLLC can be an enabler for a wide range of mission-critical delay-sensitive applications. When combined with AI, it has the potential to bring about a phenomenal change in the way we work and live. A few use cases that can transform some important areas that affect rural and urban life (namely, agriculture, education, healthcare and transport) are described below.

6.1 Agriculture

Precision Farming: Agricultural productivity depends on extremely granular environmental variations that farmers cannot monitor manually. For autonomous surveillance

of fields, sensors embedded in farms can collect data on factors such as weather, sunlight, soil nutrients, water content in soil and plant health in different areas of the field. This data can be sent to Agricultural Bots. Team of robots guided by AI enabled systems will traverse the fields autonomously and perform weeding, watering, apply fertilizers and pesticides in the necessary areas (Brown, 2018). This will optimize the use of agricultural inputs (water, fertilizer, pesticides etc.) by applying just the right amount of inputs only in the areas of the field that require it.

Such autonomous operations in the field require precise and quick data exchange between all the entities (sensors, AI systems, robots). URLLC will enable this precision and speed in the field and will help create higher crop production.

6.2 Education

Primary Education: There is a severe shortage of schools in rural areas and hence many children are deprived of basic education. In addition, poor quality of teachers, low teacher-student ratio and non-availability of good learning material contribute to early school dropouts.

One solution for this is to use internet to connect teachers in urban areas to students in every village. However, this has not been very effective mainly due to high latency of existing internet connections. With 5G, connectivity to villages will be highly reliable and responsive. This can pave the way for new methods of teaching like sharing digital images, videos or even simulating real world in virtual reality. It will also be possible for teachers and students to perform science experiments interactively. These methods can make education very interactive and immersive and will encourage more and more students to go to school.

Enhanced Training: 5G based AR and VR simulations can be used for vocational training where artisans, trainee engineers and mechanics could be taught the necessary skills for their jobs. Highly reliable and responsive 5G connectivity will enable trainees to see, hear and feel the exact hand movements of the instructor. Instructors can also feel the trainee's movements and correct them when necessary (GSMA, 2018a).

6.3 Healthcare

Telemedicine: Availability of timely professional healthcare is also a challenge in rural areas. There aren't enough primary healthcare centers in many villages. 5G enabled wellness monitors or kiosks can improve primary healthcare drastically. People in villages can approach their nearest kiosk, which will collect their vital signs and connect them to qualified doctors in cities. Doctor can perform remote physical examination with full audio-visual feedback and can provide remote consultation (Stefano & Kream, 2018).

Tele-Surgeries: Tele-surgery requires extremely low latency and high reliability, which existing technologies cannot guarantee. With URLLC, it will be possible for surgeons to carry out remote procedures using specialized robots with great precision. At MWC2019, the first tele-mentored surgery over a 5G connection was demonstrated with a renowned medical expert advising an in-theatre surgeon in near real time (Donkin, 2019).

6.4 Transport

Road Safety: URLLC based V2X communication can be used for road safety applications like collision warning, collision avoidance etc. Vehicles can exchange information with each other about their speed, location, trajectory, road conditions, traffic congestion etc. This data can help neighboring vehicles to take informed decisions. For these applications to be effective, communication between all traffic entities (vehicles, infrastructure, pedestrians) should be almost instantaneous. Even a millisecond delay can lead to fatality. Hence 5G URLLC based V2X will be better equipped than technologies like DSRC and LTE to enable road safety applications. At CES2019, a use case of how vehicles can co-operate autonomously in a non-signalized intersection was demonstrated (Qualcomm, 2019). Many network operators are also adopting URLLC for road safety applications (AUTO Connected Car News, 2019).

Intelligent Public Transport: Fleet of buses can exchange real-time information about traffic pattern, road conditions etc. so that the entire fleet can take autonomous decisions regarding optimized routes leading to better schedule management. Real-time information regarding number of

commuters in each location can also help the fleet operator take quick decisions about adding or reducing buses in different routes thereby improving commuter experience and optimizing operational costs. In MWC2019, an implementation of 5G-connected transportation solution was demonstrated that improves user-experience and work environment for operators remote-controlling fleets of autonomous vehicles (Enride, 2019).

7. URLLC PERFORMANCE

Field trials are currently being done to evaluate the performance of URLLC. In (Liu, Guangyi, 2018) U-plane latency was measured for 32-byte packets using short TTI and grant-free transmissions. It was observed that U-plane latency was around 0.5msec for a 32-byte packet and around 1msec for a 1500-byte packet. An interesting

observation in these measurements is that SINR had almost no impact on U-plane latency (Table 1).

Table 1: Latency vs. SINR

SINR	U-Plane Latency (msec)
Bad	0.5
Medium	0.5
Good	< 0.5
Perfect	0.5

(NTT DoCoMo, 2018) presents the results of tests carried out using 20MHz bandwidth in 4.5GHz band. Trials were carried out with both stationary and moving vehicles. Results showed that the URLLC requirements of latency and reliability were met both in stationary and mobility scenarios for different packet sizes.

Table 2: Latency and Reliability Measurements

Test Vehicle Speed	Packet Size (Bytes)	Distance from gNB	U-Plane Latency	Successful Transmission Rate
0Kmph (stationary)	200	0.33 Km	0.5 to 0.7 msec	99.999 to 100 %
	200	0.8 Km		
	100	1.0 Km		
25Kmph	100	0.3 to 0.6 Km		

8. CONCLUSION

5G URLLC is expected to be a game changer for mission-critical delay sensitive applications. As compared to existing technologies like LTE, 5G provides better performance in terms of scaling, latency and reliability. This will enable large scale IoE connectivity and extremely low latency applications. It can be used not only for sophisticated applications like autonomous cars, but also for some very basic human needs like education and healthcare. When combined with AI, 5G has the potential to bring a new era of intelligent connectivity that can drastically improve the quality of our lives.

REFERENCES

- 3GPP TR 23.725. (2018). Study on enhancement of Ultra-Reliable Low-Latency Communication (URLLC) support in the 5G Core network (5GC).
- 3GPP TR 38.824. (2018). Study on physical layer enhancements for NR Ultra-Reliable and Low Latency Case (URLLC).
- 3GPP TR 38.913. (2017). Study on scenarios and requirements for next generation access technologies.
- 5G Americas. (2018, November). New services & applications with 5G ultra-reliable low latency communications. Retrieved from http://www.5gamericas.org/files/5115/4169/8314/5G_Americas_URLLC_White_Paper_Final_11.8.pdf
- AUTO Connected Car News. (2019, February). Retrieved from <http://www.autoconnectedcar.com/2019/02/mwc-2019-att-vodafone-5g-for-automotive/>
- Bennis, M., Debbah, M., & Poor, V. H. (2018). Ultra-reliable and low-latency wireless communication: Tail, risk and scale. *Proceedings of the IEEE*, 106, 1834-1853.
- Brown, M. (2018). Smart farming - automated and connected agriculture. Retrieved from <https://www.engineering.com/DesignerEdge/DesignerEdgeArticles/ArticleID/16653/Smart-FarmingAutomated-and-Connected-Agriculture.aspx>

- Chen, H., Abbas, R., Cheng, P., Shirvanimoghaddam, M., Hardjawana, W., Bao, W., . . . Vucetic, B. (2017). Ultra-reliable low latency cellular networks: Use cases, challenges and approaches. *IEEE Communications Magazine*, p. 99.
- Donkin, C. (2019, February). Retrieved from <https://www.mobileworldlive.com:https://www.mobileworldlive.com/featured-content/home-banner/mwc19-hosts-5g-surgery-breakthrough/>
- Enride. (2019, February). Retrieved from <https://www.einride.tech/news/einride-showcases-new-teleoperation-solution-at-mobile-world-congress/>
- GSMA. (2018a, September). Intelligent connectivity how the combination of 5G, AI and IOT is set to change the americas. Retrieved from <https://www.gsma.com/IC/wp-content/uploads/2018/09/21494-MWC-Americas-report.pdf>
- GSMA. (2018b, May 30). New GSMA study: operators must look beyond connectivity to increase share of \$1.1 trillion IOT revenue opportunity. Retrieved from <https://www.gsma.com/newsroom/press-release/new-gsma-study-operators-must-look-beyond-connectivity-to-increase-share/>
- ITU. (2018). Key features and requirements of 5G/IMT-2020 networks. Retrieved from <https://www.itu.int/en/ITU-D/Regional-Presence/ArabStates/Documents/events/2018/RDF/Workshop%20Presentations/Session1/5G-%20IMT2020-presentation-Marco-Carugi-final-reduced.pdf>
- Ji, H., Park, S., Yeo, J., Kim, Y., Lee, J., & Shim, B. (2018). Ultra reliable and low latency communications in 5G downlink: Physical layer aspects. *IEEE Wireless Communications*, 25(3), 124-130.
- Khan, A. H., & Roy, K. C. (2013). Comparison of turbo codes and low density parity check codes. *IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)*, 11-18.
- Liu, G. (2018). Lessons from the 5G trials in China. Retrieved from GSMA <https://www.gsma.com/spectrum/wp-content/uploads/2018/07/GTI-Liu-Guangyi-Lessons-from-the-5G-trials-in-China.pdf>
- NTT DoCoMo. (2018, July). Field experiments on 5G ultra-reliable low-latency communication. *NTT DoCoMo Technical Journal*, 20. Retrieved from https://www.nttdocomo.co.jp/english/binary/pdf/corporate/technology/rd/technical_journal/bn/vol20_1/vol20_1_003en.pdf
- Sarajlic, M., Liu, L., & Edfors, O. (2014). *Reducing the Complexity of LDPC Decoding Algorithms*. IEEE 25th International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC).
- Stefano, G. B., & Kream, R. M. (2018). The micro-hospital: 5G telemedicine-based care. *Medical Science Monitor Basic Research*, 103-104.
- Qualcomm. (2019, January). Audi, Ducati and Ford Host Live Interactive Demos in Las Vegas Using C-V2X Solutions Provided by Qualcomm. Retrieved from <https://www.qualcomm.com/news/releases/2019/01/07/audi-ducati-and-ford-host-live-interactive-demos-las-vegas-using-c-v2x>

GLOSSARY

Term	Expansion
3GPP	Third Generation Partnership Project
AI	Artificial Intelligence
AR	Augmented Reality
DSRC	Dedicated short-range communication
eMBB	Enhanced Mobile Broadband
E2E	End-to-End
FDD	Frequency Division Duplex
gNB	Next Generation Node B
HARQ	Hybrid Automatic Repeat Request
IoE	Internet of Everything
ITU	International Telecommunication Union
LDPC	Low-density parity-check
MIMO	Multiple Input Multiple Output
mMTC	Massive Machine Type Communication
MMSE-IRC	Minimum Mean Square Error – Interference Rejection Combining

Term	Expansion
NAICS	Network Assisted Interference Cancellation and Suppression
PDCP	Packet Data Convergence Protocol
PDU	Protocol Data Unit
PUCCH	Packet Uplink Control Channel
RLC	Radio Link Control
SINR	Signal to Interference Plus Noise Ratio
TDD	Time Division Duplex
TTI	Transmission Time Interval
UE	User Equipment
UPF	User Plane Function
URLLC	Ultra-Reliable Low Latency Communication
VR	Virtual Reality
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Everything

A Study of Collective-Work Approach on Perceived Creativity for Enhancing Leadership Qualities in IT Companies

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ABSTRACT

The present work aims to examine the effect of collective-work approach on creativity for improving leadership qualities in an unstructured decision-making process especially in uncertainty of IT sections. Perusing related studies surrounding the current issue, it is realized managers can involve team setting policy in developing options stage of a non-programmed decision-making process since the secondary data indicate collective work can elevate creativity sources. Besides, creativity is considered as a moderator for reinforcing leadership attributes. While these qualities enhance leadership performance enabling managers to detect the optimum options when they encounter organizational chaos. Accordingly, a model of an unstructured decision-making process is hypothesized in which team-setting is considered as a predictor variable for increasing creativity sources which are recognized as moderators. Then, leadership qualities crenellated by creativity are recognized as a criterion variable for promoting leadership performance. So, the primary data are collected through 38-statements questionnaires involving collective work, creativity and leadership qualities from 86 IT managers in Pune-India being ready to approach collective work policy in their unstructured decision-making. Through correlation, regression analysis and Durbin-Watson test, it is found there is a positive relationship between the variables. The tests between-subjects effects and SEM show the predictor variables have significant interaction with the criterion variables. Besides, ANOVA illustrates there is a significant difference between the means of predictors of this study. It would be concluded team setting approach can enhance creativity to moderate the leadership qualities for an effective unstructured decision-making process.

Keywords: Collective Work, Leadership Attributes, Creativity, Unstructured Decision-Making Process

1. INTRODUCTION

Nowadays external and internal changes cause organizations to continuously encounter critical uncertainties requiring prompt, innovative and creative decision-making by management to handle abrupt critical situations through generating new and creative ideas (Goerge, 2007). Besides, unstable customers' choices are being dramatically changed requiring creative decision-making to find a novel approach to satisfy customers' unstable preferences. So, inevitable stressful situations occurring in organizations involve managers in making decisions creatively and effectively. Since decision-making is an executive function in managerial

performance, creativity as a cognitive ability is required recognized as a principle for other leadership traits to handle organizational situations (Mumford et al., 1993) especially uncertain ones. Indeed, managers may confront with chaos of change which requires promotion of creativity in organizations (Aswathappa, 2008). On the other hand, as organizations need to generate creative solutions to make effective decisions in critical and novel situations which are not experienced before, scholars emphasize creativity might not be applicable in all types of decision-making since some problems are routine, repetitive and experienced. So according to situations, decisions can be divided into two types: programmed (with respect to routine and repetitive problems) and

non-programmed (with respect to unique, non-repetitive and complex problems) (Wehrich & Koontz, 2001; Singh, 2009; Ghuman & Aswathappa, 2010), the latter one requires managers' creative thinking to reach an effective decision-making in complex situations (Singh, 2009). Besides, researchers indicate decision-making is a three-phases process: defining the problem, developing feasible options and determining the optimum solution (Adair, 2013). This is while applying creative thinking is a requisite during generating alternatives (George, 2007) being the second phase of a decision-making process. Then, managers can design a sort of a decision-making process in which creativity enhancers might be implemented in the second phase of a decision-making process to develop novel solutions. Furthermore, in determining the optimum option stage of decision-making process as an executive performance; there are leadership characteristics reinforced by creativity sources (Mumford, Zaccaro, Harding, Fleishman & Reiter-Palmon, 1993). An unstructured decision is defined as a decision-making process not being experienced by an organization in the same form and there is not any predicted and ordered set of responses to encounter with this novel situation (Mintzberg, 1976). Besides, there are interrelated sources that enhance creativity in novel situations such as intellectual ability, knowledge, style of thinking, personality, motivation, environment (source of social support) (Sternberg & Lubart, 1999) and efficacy which can be self-efficacy or collective-efficacy (Bandura, 1995). On the other hand, in her componential theory of creativity Amabile (2013) emphasizes there are three intrinsic components: domain-relevant skills, creativity-relevant processes, and intrinsic task motivation and one extrinsic component: the social environment which can enhance creativity during individual's creative work process. Therefore, in an undetermined situation it is required to enhance creativity sources to generate unique solutions during the stages of developing options of a decision-making process. In this paper it is attempted to model an unstructured decision-making process through scrutinizing secondary data related to the ways of enhancing creativity and its role as a principle for promoting leadership attributes in an unstructured decision-making.

2. BRIEF REVIEW OF LITERATURE

There are a huge number of studies discussing different sources as the enhancers of creativity in decision-making. Hargadon and Beckhy (2006) find out to

get more creativity, involving in a social interaction lead to a confluence of retrospective foresights and new ideas. Likewise, in their study Riorden and Reilly (2011) declare community participation and brainstorming provide the inspiration of creativity. In his work Feenstra (2010) recognizes environment and society as the sources of social support being the most effective factors for enhancing creativity. He asserts during encountering an uncertain situation; individuals prefer to form a group to increase collective-efficacy as a source of creativity. Feenstra's work shows that interacting with other members and forming a group can increase some creativity sources such as collective-efficacy, extrinsic motivation, collective knowledge, etc. to enhance creativity during a decision-making process in an uncertain environment. Similarly, Tongo (2015) shows collective work improves individuals' motivation as they share their knowledge with each other. Accordingly, collective work enhances creativity sources to solve organizational problems (Hargadon & Beckhy, 2006) especially to make effective decisions in unprogrammed situations (Sternberg & Lubart, 1999; Amabile, 2013). Collective work might respectively bring about creativity sources such as supportive environment, collective knowledge, collective-efficacy and extrinsic motivation (extrinsic components). Other creativity sources as mentioned in introduction like intellectual ability, style of thinking, personality and motivation (intrinsic components), to a great extent, depend on decision makers' characteristics (managers' leadership characteristics) that would be much more significant in the last stage of a decision-making process as managers can determine the optimal option to make an effective decision in an unstructured situation. Since Mumford et al. (1993) mention leadership characteristics such as cognitive factors, personality, motivation, appraisal abilities and knowledge can promote leadership performance in organizational situations like executive functions (problem-solving, decision-making, etc.). They assert that creativity as a cognitive ability is a crucial determinant of high-level organizational leadership that is a kind of problem-solving ability (Mumford et al., 1993). Accordingly, this study models a causal relationship of the main determinants of an effective unstructured decision-making shown in Fig. 1.

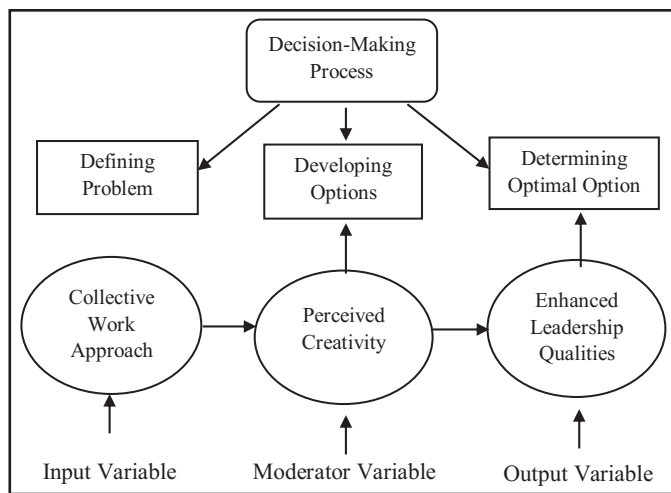


Fig. 1: A Model of Unstructured Decision-Making Process

In the light of previous works, this paper assumes a model for enhancing the effectiveness of an unstructured decision-making process in uncertain organizational situations. As noted earlier, decision-making process includes three stages. So here, in the stage of developing options, Fig. 1 suggests a collective work approach since it enhances creativity sources to develop creative solutions. Additionally, leadership qualities are reinforced by perceived creativity. So collective work as an input variable enhances creativity for developing novel options and perceived creativity as a moderator variable influences the strength of the relationship between collective work and leadership quality for determining optimal option. Herein, enhanced leadership quality is recognized as an output variable strengthened via interacting of collective work and perceived creativity. Arguing that there is a causal relationship between these three variables, the general hypotheses of this paper can be produced as the following:

- Collective work, creativity and leadership qualities have a positive relationship with each other.
- Collective work and creativity have a significant interaction to affect leadership qualities.
- Collective work and creativity as independent variables have different means.

To support or fail to support these assumptions, the research is conducted according to the designed methods declared in the following through surveying IT managers' unstructured decision-making process in uncertain changes. Accordingly, the main objective of this research is to study the linear combination between the variables.

3. RESEARCH METHODOLOGY

This research is conducted in IT companies in Pune-India. Around 600 IT companies in Pune, 324 ones are in access out of which 86 IT companies ready to approach collective work in their unstructured decision-making or even share their experiences with this research. So three researcher-made questionnaires with 38 statements measuring collective work, perceived creativity and leadership qualities are purposively distributed among 86 top level managers who are recognized as the main decision-makers in IT companies. The sample size calculation formula for finite population (Godden, 2004) gives approximately the same as well. The subscales surrounding cognitive ability, knowledge, thinking, personality, motivation, social environment and efficacy are derived from the related works as mentioned before (Bandura, 1995; Sternberg & Lubart, 1999; Amabile, 2013). Furthermore, the respondents assert that in collective work approach they prefer to make unstructured decisions with the cooperation of other concerned managers. Meanwhile the feasibility of the research is supported through measuring the consistency and accuracy of questionnaires as the figures achieved show cronbach's alpha > 0.80, percentage of variance > 60%, factor loadings > 0.4 and confirmatory factor analysis shows significant estimated figures and T-values as well.

4. DATA ANALYSIS

According to Pearson correlation analysis, the variables; collective work, perceived creativity and leadership quality show significant correlation of more than 0.72 with each other at 0.01 level of significance. Besides to this, the regression coefficients analysis and Durbin-Watson test give the following data:

Table 1: Regression Coefficients Analysis

Coefficients ^a						
<i>Model</i>	<i>B</i>	<i>Unstandardized Coefficients</i>		<i>Standardized Coefficients</i>	<i>t</i>	<i>Sig.</i>
		<i>Std. Error</i>	<i>Beta</i>			
1	(Constant)	13.242	3.047		4.346	.000
	Team Work	.333	.080	.363	4.184	.000
	Creativity	.385	.062	.535	6.161	.000

a. Dependent Variable: Leadership Quality

Table 1 illustrates there is a positive relationship between the variables with significant level less than 0.05 as leadership quality increases by 0.80 and 0.62, when there is an increase in team work and creativity by 1 unit, respectively.

Table 2: Durbin-Watson Test Model Summary^b

<i>Model</i>	<i>R</i>	<i>R Square</i>	<i>Adjusted R Square</i>	<i>Std. Error of the Estimate</i>	<i>Durbin-Watson</i>
1	.836 ^a	.699	.692	2.79098	1.731

a. Predictors: (Constant), Creativity, Team Work
a. Dependent Variable: Leadership Quality

It is obvious from Table 2, there is a positive serial correlation between the variables as the Durbin-Watson test shows a significant level less than 2.

ANOVA is carried out to find out whether there is a significant difference between the means of independent variables:

Table 3: One Way Analysis of Variance

ANOVA ^a						
<i>Model</i>		<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
1	Regression	1501.557	2	750.779	96.382	.000 ^b
	Residual	646.536	83	7.790		
	Total	2148.093	85			

a. Dependent Variable: Leadership Quality

b. Predictors: (Constant), Creativity, Team Work

It is seen in Table 3 the level of significance < 0.05 in F test achieved through ANOVA shows there is a significant difference between the means of predictor variables of this study.

To test the significance of interaction of predictor variables on criterion variable; tests of between-subjects effects run through SPSS and structural equation modeling (SEM) run through LISREL are conducted as the following:

Table 4: Tests of Between-Subjects Effects

Dependent Variable: Leadership Quality					
<i>Source</i>	<i>Type III Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
Corrected Model	1888.404 ^a	27	69.941	15.621	.000
Intercept	67282.155	1	67282.155	15027.091	.000
Team Work	177.182	10	17.718	3.957	.000
Creativity	444.698	9	49.411	11.036	.000
Team Work * Creativity	141.628	6	23.605	5.272	.000
Error	259.689	58	4.477		
Total	258790.000	86			
Corrected Total	2148.093	85			

a. R Squared = .879 (Adjusted R Squared = .823)

It is illustrated in Table 4, the interaction of collective work and creativity on leadership quality is significant at the level of significance of 0.000.

Moreover, the interaction of predictor variables on criterion variable is tested through SEM:

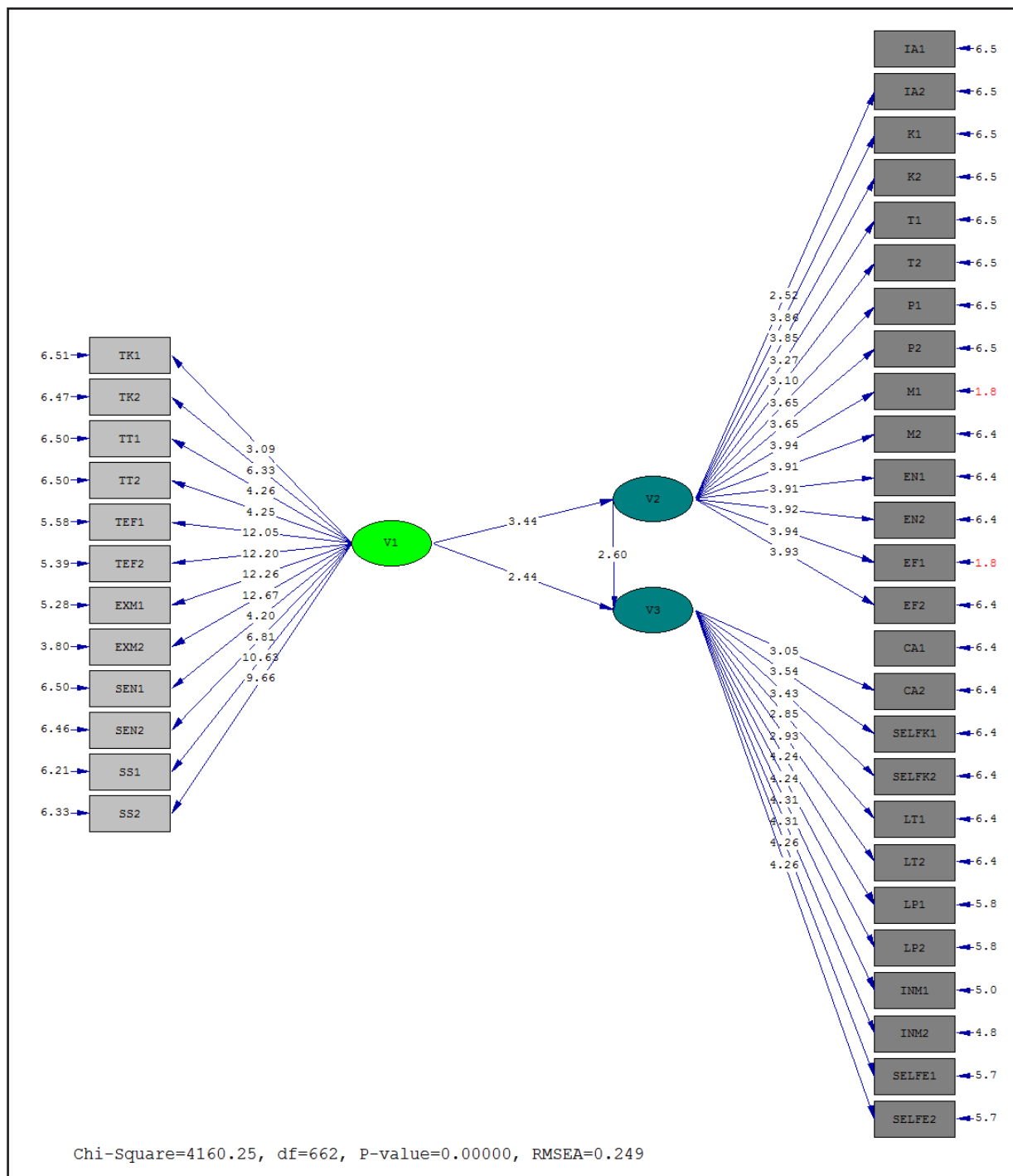


Fig. 2: The Illustration of Interaction of the Independent Variables on the Dependent Variable. v1: Collective Work, v2: Perceived Creativity, v3: Leadership Quality

In Fig. 2, the estimated figures achieved through SEM show collective work and perceived creativity have a significant interaction on leadership quality.

5. HYPOTHESES-TESTING RESULTS

Through the Figs. attained in data analyses the following results can be declared:

- The correlation analysis, Durbin-Watson test and regression analysis show collective work, creativity and leadership qualities have a positive relationship with each other.
- Tests of Between-Subjects Effects and SEM show collective work and creativity have a significant interaction to affect leadership qualities.
- ANOVA shows collective work and creativity as independent variables have different means.

Furthermore, it is found collective work has a positive effect on creativity as well as creativity has a positive effect on leadership qualities. Considering the findings of the linear relationship between collective work, creativity and leadership quality, consequently the objective of this study is achieved.

6. DISCUSSION

Emerging abrupt technological changes in organizations especially in IT sections induces top level managers to approach policies actuating their cognitive capacities to be more creative in generating novel solutions. Related studies suggest collective-work approach incorporated in unstructured decision-making as an enhancer for perceiving more creativity. This study aims to examine the linear relationship between the collective work, perceived creativity and leadership qualities in an unstructured decision-making process. It is assumed collective work approach during an unstructured decision-making process enhance decision-makers' creativity in developing options. Supposedly, the perceived creativity may lead leadership qualities to be improved in order to determine the optimal options in decision-making. This causal relationship is tested through collecting data in IT companies in Pune-India among top level managers. Similarly, the results declare collective work helps managers to perceive creativity more to develop options collaboratively during the first stages of decision-making, then the perceived creativity increases their leadership qualities to determine the optimal options individually during the last stages of decision-making. As far as the top level managers (of IT companies in Pune-India) assert they prefer to make unplanned decisions with other managers, the members of collective work are confined to managers. Additionally, as other organizational hierarchies are not included in this study, the findings can neither be attributed to other levels nor to other companies at any time. With regard to the achieved findings of the current work it

can be concluded the IT managers could improve their leadership characteristics to determine optimum options in unstructured decision-making through collective-work approach which enhances their creativity perception.

REFERENCES

- Adair, J. (2013). *Decision making and problem solving*. Kogan Page. ISBN 978-0-7494-6696-1
- Amabile, T. M. (2013). Componential theory of creativity. In: Kessler, E.H., Ed., *Encyclopedia of Management Theory*, pp. 134-139. Sage Publications, London.
- Aswathappa, K. (2008). *Organizational behavior: Text, cases & games*. Himalaya Publishing House.
- Feenstra, R. H. (2010). *The role of creativity in naturalistic decision-making environments: A systems approach*. UNLV Theses, Dissertations, Professional papers, and Capstones, Paper 743.
- George, J. M. (2007). Chapter 9: Creativity in organizations. *The Academy of Management Annals*, 1(1), 439-477.
- Ghuman, K., & Aswathappa, K. (2010). *Management: Concept, practice and cases*. McGraw Hill: New Delhi. ISBN 9780-07-068218-4
- Godden, B. (2004, January). Sample size formulas. Retrieved from <http://williamgodden.com/sample-size-formula.pdf>
- Hargadon, A. B., & Bechky, B. A. (2006). When collections of creatives become creative collectives: A field study of problem solving at work. *Organization Science*, 17(4), 484-500.
- Mintzberg, H., Raisinghani, D., & Theoret, A. (1976). The structure of unstructured decision processes. *Administrative Science Quarterly*, 21(2), 246-275.
- Mumford, M. D., Zaccaro, S. J., Harding, F. D., Fleishman, E. A., & Reiter-Palmon, R. (1993). *Cognitive and temperament predictors of executive ability: Principles for developing leadership capacity*. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.
- Riordan, N. O., & Reilly, O. P. (2011). Virtual worlds: S(t)imulating creativity in decision making. *Journal of Decision Systems*, 20(3), 325-351.
- Singh, N. (2009). *Organizational behaviour: Concepts, theory and practices: Managing people in the 21st century*. Deep and Deep Publications: New Delhi. ISBN 81-7629-287-7

- Tongo, C. I. (2015). Collective work motivation in knowledge based organizations. *Team Performance Management, 21*(7/8), 386-404.
- Wehrh, H., & Koontz, H. (2001). *Management: A global perspective*. Tata Mc Graw-Hill. ISBN 0-07-047378-1

Layered Approximation for Deep Neural Networks

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ABSTRACT

Artificial Intelligence has created immense hype in the last decade and the credit for the same goes to the groundbreaking breakthrough named “Deep Learning” or “Deep Neural Network”. Although “Artificial Neural Network”, the foundation of Deep Learning as a concept has been prevalent since 1958 but the actual implementation for solving real business use cases have only been possible over the last decade. Deep Neural Networks has demonstrated significant results in the fields of computer vision, speech recognition, and machine translation, and outperformed human brain in many instances. Artificial Neural Network, as it is inspired from human biological neural superstructure has few structural similarities but not possible in terms of how the human brain or biological neural network works because we have still limited information on its functioning. Nevertheless, Deep Neural Network paved the way for many possibilities and currently it is the most promising technology that we have in the field of Artificial Intelligence.

Keywords: Deep Neural Network, Artificial Intelligence, Artificial Neural Network, Layered Approximation

1. FUNDAMENTAL LIMITATIONS OF ARTIFICIAL NEURAL NETWORK

Although Artificial Neural Network has numerous advantages but they also have a couple of fundamental limitations. These limitations can be broadly classified into two categories-

- *Scientific or Mathematical Limitations and*
- *General Limitations*

Scientific or mathematical limitations include issues with- “Piece-wise Linear Curve”, “Flat Activations”, “End-To-End-Learning”, “Learning Many Orthogonal Functions” and actual validation of “Universal Approximation Theorem” with a single layer Perceptron which are beyond the scope of this research paper. But there are other general limitations as well as -

- Requirement of a huge relevant dataset for training the deep neural networks (Jason Brownlee, 2019).
- Requirement of huge computational power for training and substantial time requirement for training such models.
- Hyper-parameter tuning for the deep learning models is sometimes a tedious process although some automation of such activities are now available but still needs maturity (we know very little about human brain, n.d.).

Few of the comments from experts on the limitations of deep neural network are:

- Francois Chollet, Google, inventor of Keras library said - “*Current supervised perception and reinforcement learning algorithms require lots of data, are terrible at planning, and are only doing straight-forward pattern recognition*”.
- Similarly, ‘Intriguing Properties of Neural Networks’ by Christian Szegedy from Google and others commented like - “*We can cause the network to misclassify an image by applying a certain noise, which is found by maximizing the network’s prediction error*”.
- Another comment from the expert community is - ‘Deep Networks are Easily Fooled’ by Anh Nguyen at the University of Wyoming - “*Changing an image of a Lion in a way imperceptible to humans can cause a Deep Neural Network to label the image as something else entirely mislabeling, a lion a Library*”.

Also, “Universal Approximation Theorem” which claims that a neural network with a single hidden layer containing a finite number of neurons can approximate any continuous function (Huang, Chen, Siew, 2006).

This implies - for any problem, there exists a neural network which can approximate it with some degree of

accuracy. But unfortunately, it provides little information about which classes of functions can they approximate well. Why some of them work unreasonably well and some others not at all. And what depth and size of a network are sufficient to guarantee an approximation in a particular scenario?

Moreover, it is unclear how to design a very deep neural network effectively. Many times arbitrarily adding more layers does not help rather worsen the performance of the network which has been observed in many practical scenarios.

But more than all the above, Artificial Neural Network and for that matter, the AI itself is lagging the most important and the most aspired capability; what is called the “General Intelligence” which is far beyond what we have achieved with AI till now, the “Narrow Intelligence”.

To overcome the above mentioned limitations and the limitations imposed by “Back Propagation” process namely - “Vanishing Gradient” and “Exploding Gradient” in many cases where the network essentially ceases to learn further because the gradient value either becomes too negligible or too big; researchers has also suggested few alternatives such as “*Geoffrey Hinton’s - Neuron Capsules*”, “*Yann LeCun’s - Energy-based models*” and “*Zhi-Hua Zhou’s - Deep gcForest*” but none of these has been turn out to be that effective neither adopted well till now.

An AI system can be far better than human in performing some activity in the single domain it is made for but it doesn’t have the awareness of what it is performing. Also it can’t bring in the experience from some other context (cross-domain experience) to the current context or relate experiences. Human brain can do this very well and many more amazing things which are normally referred as “General Intelligence”.

An effort has been made in this research paper to refer back to the very fundamental elements and principles on which human neural system works and reference those back in the case of Artificial Neural Network and try to address some of the fundamental limitations.

Recent research in neuroscience has revealed the fatigability of neurons, meaning neurons has a tendency to get tired or lose strength very quickly. Neurons are electrically polarized and exhibit an electric potential difference of only “-70” Micro Volt with their surroundings and they are capable of sending weak electric signals. Due to which they can’t be the center of human cognition, they

can probably be the smallest units in the human cognition system. Rather a cortical map is a set of thousands of cortical columns and each column a set of about 100,000 neurons claimed to be the center of cognition for human brain. This is again on a very higher abstract level than the extremely granular neurons level. So cortical columns should be considered as the building blocks of cognition and intelligence.

If we consider this to be factual and apply the similar approach in Artificial Neural Network as well, will apparently solve some of the fundamental limitations, like requirement of huge training data, huge computational power and significant training time. In this case the layers of artificial neurons will be abstracted to be the center for artificial cognition rather than the individual neurons. The group of neuron layers in a layer can be visualized as network-of-networks.

2. BIOLOGICAL NEURAL NETWORK

The nervous system is the central part of the human body which transmits signals back and forth to different parts of the body that helps coordination of our voluntary and involuntary movements. At a cellular level the nervous system consists of a special type of cell called “neuron”. There are near about 100 billion neurons in human brain and they are connected to each other through a wire like structure called Synapse, which acts like a pathway for electrical signals to travel from one neuron to the other.

Arguably, neurons - the tiny polarized cells inside the brain are considered to be the “Center of Cognition” of human.

As per the information available, the protein synthesis occurs at the nucleus of the biological neuron called “Soma” considered to be the process responsible for human cognition. The signals emitted by the neurons from one to the other through Synapse are believed to be partly electrical and partly chemical that is the byproduct of the phenomena that happens due to the protein synthesis inside it.

Human neurons receive the inputs to be processed from the outside world through our five senses - ear, eye, nose, skin and tongue. The inputs received through these organs are encoded into electrical signals before being sent to the layers of neurons to be processed. The biological neurons works on a “Threshold Based” principle. This means whenever the input signal received by a neuron after its chemical synthesis crosses a particular electrical

threshold limit, it fires the signal to the next neuron. The next neuron then takes this signal as its input and does the same process which continues through millions of subsequent layers of neurons until arrives at a conclusion on the piece of information that has been processed.

3. COMPARISON - BIOLOGICAL VS. ARTIFICIAL NEURAL NETWORK

The Artificial Neural Network works very similarly in the same fashion, “Threshold Based” principle called activation functions. The difference primarily lies between how both these networks learn new things or the learning process.

Scientists have revealed that child’s brain at a very early stage from zero to one year used to have around 100 billion neurons and only few million connections. But these connections exponentially multiplies during the development stage of the brain till the age of 6 (six) years

at the rate of around 1000 (thousand) connections per second. That’s how a child learns and the learning process is essentially through building more and more connections among the neurons. An interesting fact about the human brain is its constantly changing, constantly evolving and establishing millions and billions of new connections, redefining existing connections and removing irrelevant connections among the neurons across different parts of our brain. This is the process how human brain learns new things, adds experience to those learnings and draws conclusion on the incidents about our life.

In case of Artificial Neural Network the learning process is called “Back Propagation”, is a process of optimizing the connections among the artificial neurons from backward by adjusting the “weight” and “biases” variables and finally move as close to the ideal state and the golden matrix of weights and biases where the network is optimized to provide the best possible predictions.

4. LAYERED APPROXIMATION - PHILOSOPHY

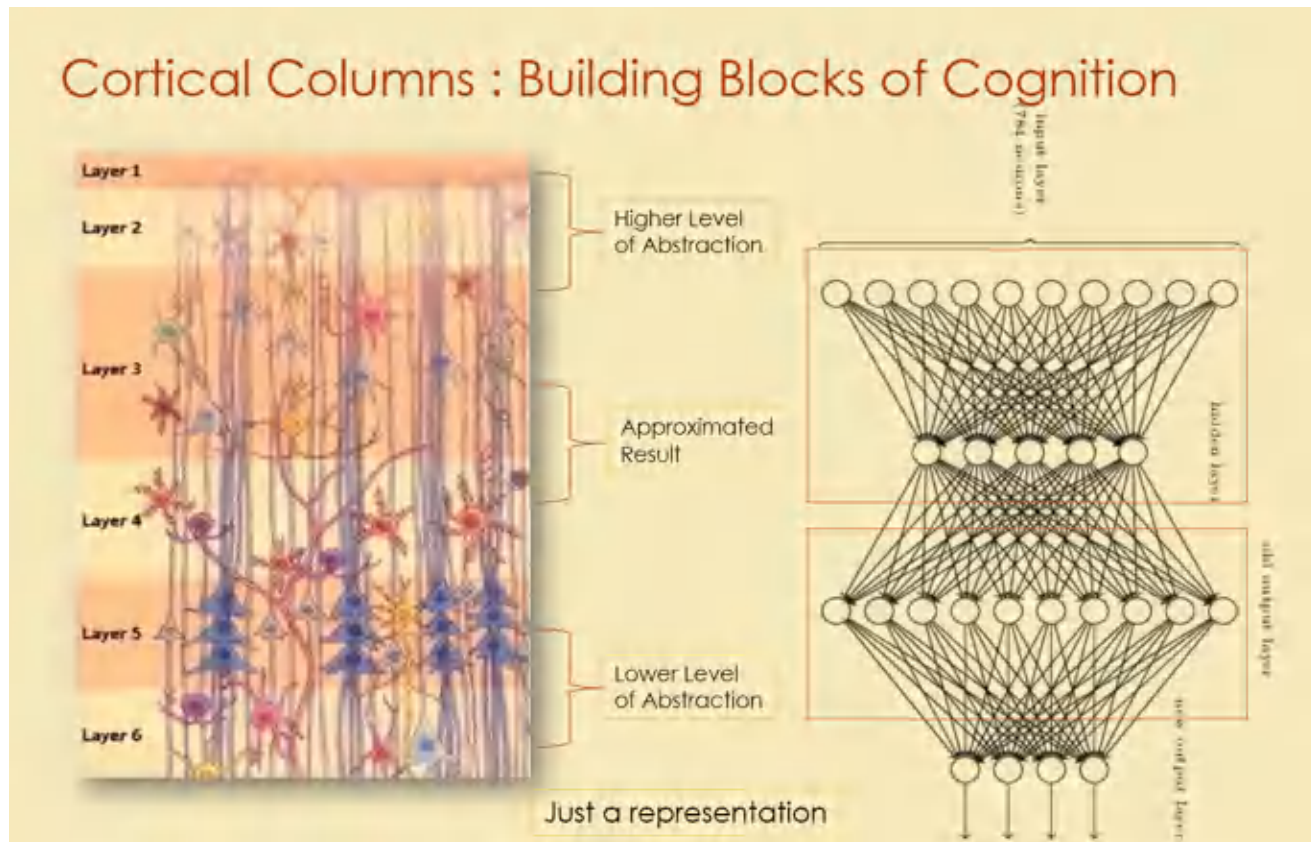


Fig. 1: Cortical Columns - Building Blocks of Cognition

“Layered Approximation” for Deep Neural Network is a design principle inspired from the real world fact that “Everything we see, we do and we perceive in this universe are outcomes of approximated functions, approximated actions and approximated decisions and none of those are absolute in nature”.

Aristotle once wrote - “It is the mark of an instructed mind to rest satisfied with that degree of precision which the nature of the subject limits, and not to seek exactness where only an Approximation of the truth is possible”.

Layered Approximation principle also advocates that whatever operations (chemical or mathematical) that happens inside human brain are approximated operations and generates approximated results in a layered (zoom-in / zoom-out) fashion. If the complexity of the problem in hand increases, the operations to deal with such more complex problems leads to more and more minute or detailed operations which demands zoom-in to the situation hence more computation and as more detailing involved. In case the problem in hand can be dealt with higher level of abstraction (zoom-out), the operations take place inside the brain for such scenarios are on higher abstract level and requires less computation and detailing.

A classic example is, we can easily drive a car in an empty road for couple of hours at a stress without having much mental exhaustion because the operations happen in your brain (inside the neuron layers) in this scenario are on a much higher level of abstraction which requires less computation and processing. Whereas if you have to drive in nasty traffic, although you will probably travel much lesser distance and spend lesser time but you will be tired and stressed out even driving lesser. This is because, here in this scenario your brain has to take into consideration every meter, every minimum curve while driving in such narrow space and hence the operations happen inside the brain with lesser abstraction and with more detailing.

Another good example, we can do work which requires higher abstraction and less computation for tasks like writing a poem or writing a novel. Probably we can keep writing at a stress for couple of hours. But when it comes to solving a complex mathematical problem, perhaps it will be very difficult to concentrate constantly for an hour or so and even then we get fully stressed out.

Through abstraction and approximation human brain optimizes its computational resources for many complex operations which otherwise would have not been possible considering its tiny size.

Similarly while learning new things human brain takes an abstract approach. Unlike Artificial Neural Network which learns pixel-by-pixel from an image; human brain creates an abstract image of the actual image for learning. Likewise for recognizing an image, human brain tries to map it with abstraction first to quickly recognize it fast and probably then goes into details by zooming in if the situation demands detailing. So essentially there is a “Decision Making System (DMS)” that works together in collaboration to decide what level of abstraction is necessary for the given situation and where to stop and where more dip down is required.

Augmenting “Decision Making System (DMS)” along with the Deep Artificial Neural Network is core of Layered Approximation approach. The DMS is going to aid in deciding at which particular layer the approximation performed by the network is sufficient and acceptable for that particular problem in hand. This approach is going to reduce the requirement of huge computational capability, huge training data and significant training time to train the network drastically.

A real life example is it's because of approximation our brain can be of that sure identifying a person or any object even looked at from a distant acute angle, low light for just a fraction of a second. Even with that very minimum information “Decision Making System (DMS)” can essentially be sure of to take a decision that you have seen that person or the object. Of course that minimum information should be vital information to distinguish and identify that particular person or the object with the degree to certainty expected by DMS. Without the involvement of “Decision Making System (DMS)” it will not be possible for the brain to provide a prediction with that little information in those scenarios.

5. PRACTICAL APPROACH FOR IMPLEMENTATION

Designing and Testing a Deep Neural Network for any specific requirement is always a challenge and does not guarantee that it will always provide the same level of accuracy for different data sets. As the deep network grows in size and depth the testing complexity becomes almost unmanageable. Also, the hyper parameter tuning becomes more and more complex. All these challenges come from limitations of the very fundamental principles on which Neural Network training process is based on, the Back Propagation.

Proposed Layered Approximation is a design principle which can be applied to a deep neural network during its design that can address the training & testing challenges to a great extent although it can't solve all the fundamental challenges at least at its present stage.

With Layered Approximation design approach applied to a Deep Neural Network, the requirement of huge training data and huge computational power can also be addressed to a certain extent and thus the reduction in training time and testing complexities.

REFERENCES

- Huang, G. B., Chen, L., & Siew, C.-K. (2006). Universal approximation using incremental constructive feedforward networks with random hidden nodes. *IEEE Trans. Neural Networks*, 17(4), 879-892. Retrieved from <http://www.ntu.edu.sg/home/egbhuang/pdf/I-ELM.pdf>
- Brownlee, J. (2019, January 2). Impact of dataset size on deep learning model skill and performance estimates. better deep learning. Retrieved from <https://machine-learningmastery.com/impact-of-dataset-size-on-deep-learning-model-skill-and-performance-estimates/>
- LeCun, Y., Chopra, S., Hadsell, R., Ranzato, M., & Huang, F. J. (2006). A tutorial on energy-based learning. In G. Bakir et al., *Predicting Structured Data*. MIT Press. Retrieved from <http://yann.lecun.com/exdb/publis/>
- Nielsen, M. A. (2015). *Neural networks and deep learning*. Determination Press. Retrieved from <http://neural-networksanddeeplearning.com/chap4.html>
- Sara, S., Nicholas, F., & Hinton, G. E. (2017). *Dynamic routing between capsules*. 31st Conference on Neural Information Processing Systems (NIPS 2017), Long Beach, CA, USA. Retrieved from <https://arxiv.org/pdf/1710.09829.pdf>
- We Know Very Little About Human Brain. (2018, August 19). Retrieved from <https://mc.ai/we-know-very-little-about-human-brain-artificial-neural-network-vs/>
- Zhou, Z. H., & Feng, J. (2017). *Deep forest: Towards an alternative to deep neural networks*. Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (IJCAI-17). Retrieved from <https://arxiv.org/abs/1702.08835>

Data Monetization Strategies for New Age Digital Communication Providers in India

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ABSTRACT

India has quickly evolved into a converged digital communications market. It is the second largest telecom market with close to 1.2 billion subscribers and third largest Internet market which is nearing 500 million users. The Digital disruption has changed the market dynamics and the way the Telco's operate today. This quicksilver Digital transformation has made way for this new makeover.

The interesting 'phase-shift' phenomenon has been the switching of the most valuable contributor towards the overall ARPU (Average revenue per user). Data revenue has toppled voice to come on the top with a practical swap in the percentage contribution figures (44% vs 21%).

The telecom regulator (Telecom Regulatory Authority of India) re-christened itself as Digital Communications Regulatory Authority of India (DCRAI); while the Telecom Commission became Digital Communications Commission (DCC). The National Telecom Policy (NTP 2012) is gives way to National Digital Communications Policy (NDCP). This regulatory change has formalized the hitherto Telecom sector to become a Digital Communication sector and the Network Operators as Digital Telco or Digital Communications Providers.

To be relevant in the Digital era the Telco's have to innovate and evolve their business models: The induction of telecom sector within the overarching Digital ecosystem or economy (including the much needed regulatory policies); thus opens new avenues for growth and innovation driven business models. The research paper analyzes the myriad data monetization strategies that the Telco's have and prioritizes their strategies and digital product/service initiatives to maximize data revenue monetization.

Keywords: Digital Telco, OTT, Data Monetization, Evolution of Telecom in India, Data Monetization Strategies, Digital Business, Mobile Network Operator

1. INTRODUCTION: MAKING OF THE DIGITAL TELCO IN INDIA

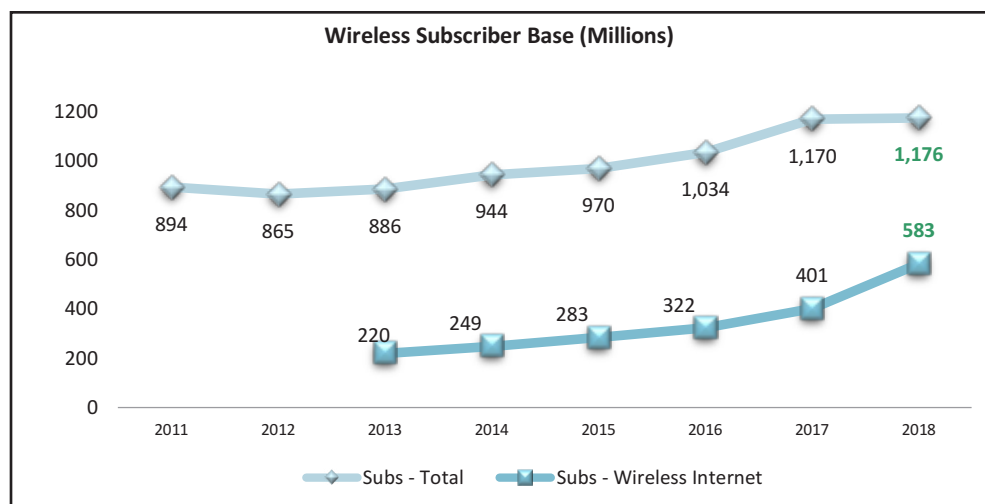
India has quickly evolved into a converged digital communications market. It is the second largest telecom market with close to 1.2 billion subscribers and third largest Internet market which is nearing 500 million users. The Digital disruption has changed the market dynamics and the way the Telco's operate today. This quicksilver Digital transformation has made way for this new makeover. The telecom watchdog has been re-christened as Digital Communications Regulatory Authority of India (DCRAI) while the Telecom Commission was renamed as Digital Communications Commission (DCC). The National

Telecom Policy (NTP 2012) gives way to proposed National Digital Communications Policy (NDCP 2018).

Table 1: Digital Communications Performance Dashboard

Particulars	March 2018	December 2018	%age Change
Total Subscribers	1,206	1,198	-0.7%
Wireless	1,183	1,176	-0.6%
Wire line	23	22	-4%
Tele-density	93	91	-2%
Urban	166	160	-4%
Rural	59	59	0%

Source: TRAI



Source: TRAI Performance Report 2011-2018 (2018 depicts data as of December 2018).

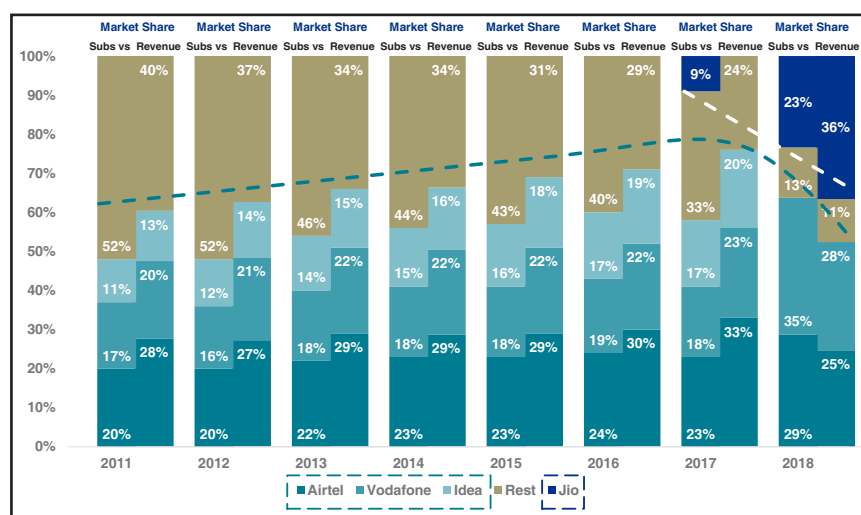
Fig. 1: Subscriber Growth

A deeper introspection of the current market performance throws some good insights on the impact of consolidation being witnessed in the last few years. In the dominant wireless segment, there were 10 players (8 private and 2 PSUs) at the start of FY18-19; however this count is expected to reduce to just 5 players (3 private and 2 PSUs):

- Vodafone and Idea merged their operations to give birth to the youngest and market leading telco: Vodafone Idea Ltd.
- Reliance Communications exiting the B2C segment.

- Aircel closing down their operations.
- Telenor India's acquisition by Airtel.
- Tata Teleservices and Tata Teleservices Maharashtra being acquired by Airtel (subject to regulatory approvals).

This consolidation has heavily tilted the subscriber and revenue market share (RMS) towards the incumbent Duo (Airtel-Vodafone Idea) and Reliance Jio. The new Trio (Airtel-Vodafone Idea-Jio) now own close to 87% of the subscriber base and approx. 90% of the gross revenue share.

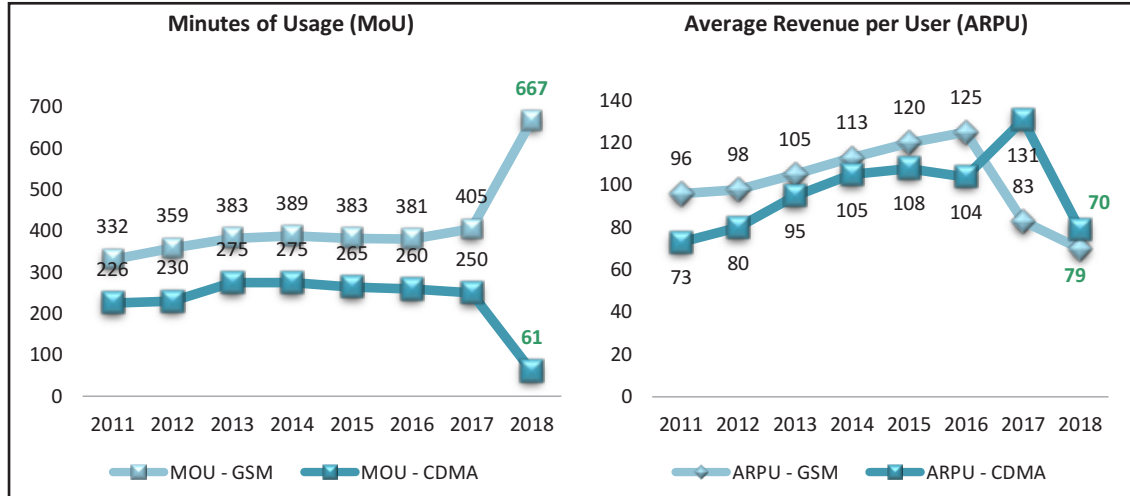


Source: TRAI Performance Report 2011-2018 (2018 depicts data as of December 2018; Vodafone-Idea merged figures depicted for 2018).

Fig. 2: Revenue & Subscriber Market Share

Interestingly, Reliance Jio has put a significant jolt to the year-on-year RMS consolidation being achieved by the erstwhile incumbent Trios (Airtel-Vodafone-Idea). There

has been a handsome 65% growth registered in the voice usage in FY17-18.

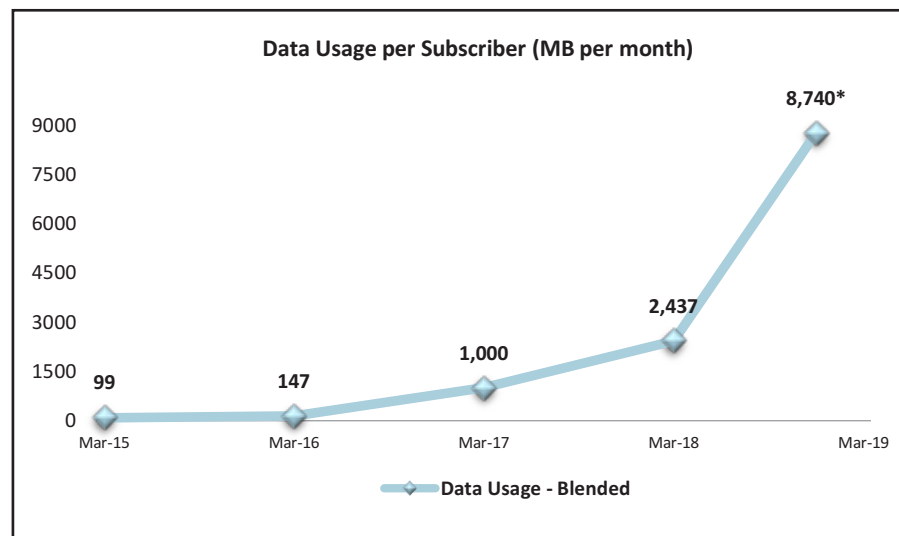


Source: TRAI Performance Report 2011-2016 (2018 depicts data as of December 2018).

Fig. 3: MOU and ARPU

Reliance Jio has continued to unsettle the sector by forcing its competitors to match its slew of free and low-cost packages. This is clearly evident in the growth of average data usage per subscriber: A whopping 580% increase in FY16-17 and another 144% in FY17-18 respectively.

However, the significant increase in voice and data usage bears no positive uplift to the ARPU figures: A straight 46% drop in ARPU from INR 131 to INR 70. This signifies that the market has not arrested the promotion of “unlimited usage” schemes; allowing below par revenue realization.

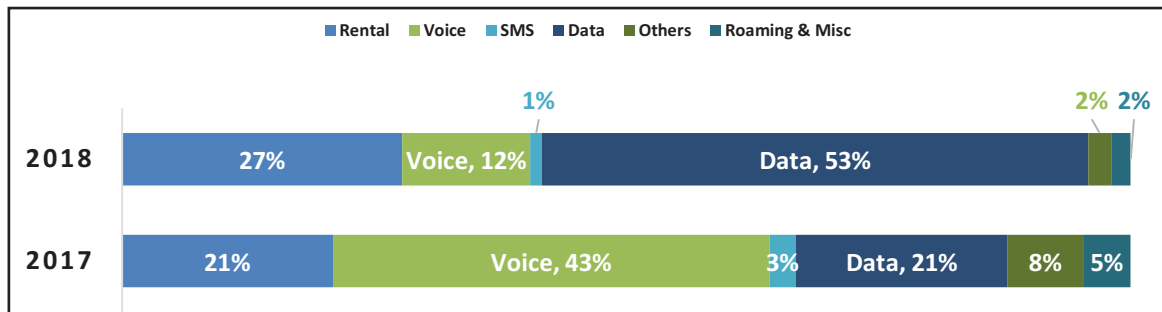


Source: TRAI Performance Report 2011-2018 (* represents Dec 2018 figures).

Fig. 4: Data Usage Per Subscriber (MB Per Month)

The interesting ‘phase-shift’ phenomenon has been the switching of the most valuable contributor towards the overall ARPU. Data revenue has toppled voice to come on

the top with almost 2.5x increase (53% vs 21% earlier) and the average data usage has seen a similar swing of 2.6x increase in just 3 quarters (March vs December 2018).



Source: TRAI Performance Report 2011-2018 (2018 depicts data as of December 2018).

Fig. 5: Composition of ARPU

2. LITERATURE REVIEW

Traditionally the main revenue for the telecom operators were from the voice and messaging services with the revenue from data being the last till recently (Sujata et al., 2015). The Indian mobile service industry is undergoing a shift in their business models from a voice-centric business to a data focused business (TRAI Performance Report, 2011-2016). The mobile operators are exploring different avenues to increase the contribution of non-voice revenue with respect to their overall service revenue. There is also a shift in the communication and social interaction from the traditional SMS and emails to social media becoming the front-runner. Most of the people now opt for data plans than for voice plans which have led to the reduction of revenue from voice business, thus making the mobile network operators explore the business strategies for the increasing their revenue from the data plans they offer to their consumers. In order to maximize the adoption of advanced data plans or products, Telco's would have to invest in Analytical solutions to offer real-time opportunity detection, real-time offer placement and real-time offer subscription (Arthur D. Little, 2018). Operators also sit on a goldmine of digital data and can open up avenues of customer data monetization (by collaborating and/or sharing with cross-Industry players) to define new product offerings.

The operators are investigating the behavior and the aspirations of the subscribers with respect to the mobile-based data services and hence are making extra-large investments on next-generation technologies like 4G LTE/5G. There is a growing recognition across the

globe that advancement in technology especially in 5G, Artificial Intelligence and Internet of things (IOT) may lead the new age Digital Telco's to generate new avenues of revenue (Forbes, 2018).

Social media and over-the-top (OTT) streaming services is vastly popular over mobile devices. OTT video services namely Netflix, Hot star, etc. and OTT communication services like WhatsApp, Facebook Messenger, etc. are not controlled by the Telco's. However, it may be prudent for the Operator to collaborate with these companies to provide richer and integrated experience to the subscribers. Some of the popular OTT categories include (Hitachi et al., 2018):

- **TV and Video:** Netflix, YouTube, Google Play, Amazon Prime, etc.
- **Music:** Saavn, Gaana, Amazon Music, Apple iTunes, etc.
- **Communication:** WhatsApp, Skype, Facebook Messenger, iMessage, Viber, etc.
- **Productivity:** Evernote, Salesforce, ZOHO, GoogleDocs, etc.
- **Technology:** Dropbox, iCloud, etc.
- **Community:** Facebook, LinkedIn, Twitter, Google+, Pinterest, Instagram, etc.

The IP-fication or digitization of the telecom network and infrastructure and growing adoption of OTT services over Telco's data pipe; makes it hyper-critical for the Digital Telco's to manage the ubiquitous network experience i.e. the data experience within or outside of homes (or offices).

Hitherto reactive resolution approach thus becomes detrimental to the goal of maximizing data revenues. Telco's are or in the process of deploying real-time (or near real-time) customer experience management (CEM) platforms (Sohag Sarkar, 2014) that can sense or detect the data (or network) experience at a regional-level, at a customer-level or even at the customer's device or application level. The degree of investment increases as one's goes closer to the source of usage. Further, Telco's are adopting Social CRM strategies to fit the customers' desires (Andresen Philip, 2017).

Telco's are investing millions in the upgrade of network (3G, 4G-LTE and now 5G); however the end-customer is somewhat agnostic to the adoption of these technologies and more interested in how the network performs seamlessly, faster than before, and has better coverage especially within the closed walls. The success and adoption of existing or future technologies (like 5G and beyond) would be determined by the strategies implemented by Telco's wrt to indoor connectivity solution namely Wi-Fi Hotspots, Small cell, etc. (Allan Tan, 2019).

3. RESEARCH PROBLEM

"Mobile Network Operators in India needs Data Monetization Strategies to maximize overall revenue generation".

Mobile Network Operators' "Voice based revenue" is witnessing zero to negative growth in wake of competition and growing market saturation. The only means of increasing their overall revenue is through increased focus on the "Non-Voice or Data revenue" streams. Operators are therefore investing in next generation data technologies like 4G-LTE/5G. One of the key propositions to increase data (or non-voice) revenue is through greater usage of data services over mobile devices (a trend sweeping across the advanced telecom markets of the world) or IOT/M2M nodes. Riding on this new wave of socialization; the Mobile Network Operators should therefore define innovative monetization strategies to capitalize on their revenue generation potential.

4. RESEARCH OBJECTIVE

The research aimed at achieving the following objective:

- To study the monetization strategies being adopted by Mobile Network Operators to enhance data revenue within the next 2-3 years.

- To ascertain the competitiveness of Top 3 Mobile Network Operators in India based on their data monetization strategies.

5. RESEARCH METHODOLOGY

The research is based upon descriptive and analytical research choice using a deductive approach.

- *Primary Data Source:* First-hand data from the respective stakeholders was collected from Mobile Network Operator's employees working across customer-facing functions namely: Strategy, Marketing (including Product & Branding), Customer Service, Digital Business, Customer Experience Management and Network & Technology. The representative samples were drawn using probability-based random sampling technique (Lim & Ting, 2013). These respondents were approached through emails to participate in the survey and were sent questionnaire and the filled questionnaires were consolidated and results were normalized consultatively to maintain the consistency ratio. A total of 63 respondents participated in the Data Monetization Survey.
- *Secondary Data Source:* It includes information collected from published sources like reports, journals, books, newspapers, magazines, online publications, government reports, regulatory reports and reports by third party (private) organizations or research agencies (national and international).

Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) was used to analyze the data monetization strategies and initiatives proposed by the respondents. This is a multiple criteria decision-making method (Thomas L. Saaty, 1977) that provides measures of judgement consistency, drives priorities among criteria and alternatives by simplifying preference ratings among decision criteria using pair wise comparisons.

AHP was executed in a phased manner as per the below process:

- *Step 1:* The key strategic areas for data monetization was finalized and prioritized using paired-comparison technique in joint consultation with customer-facing CXO, namely: (a) Digital or Over-the-top (OTT) Strategy (b) Data Product Strategy (c) Data Servicing Strategy and (d) Data Experience (or Network) Strategy.

- *Step 2:* The data monetization initiatives within the four strategy areas were elicited basis secondary research and through joint consultation with the respondents from the respective customer-facing functions. They were then asked to distribute 100

points amongst the data monetization strategies within each data strategy area basis the impact of the initiative on the overall data monetization objectives in the next 2-3 years.

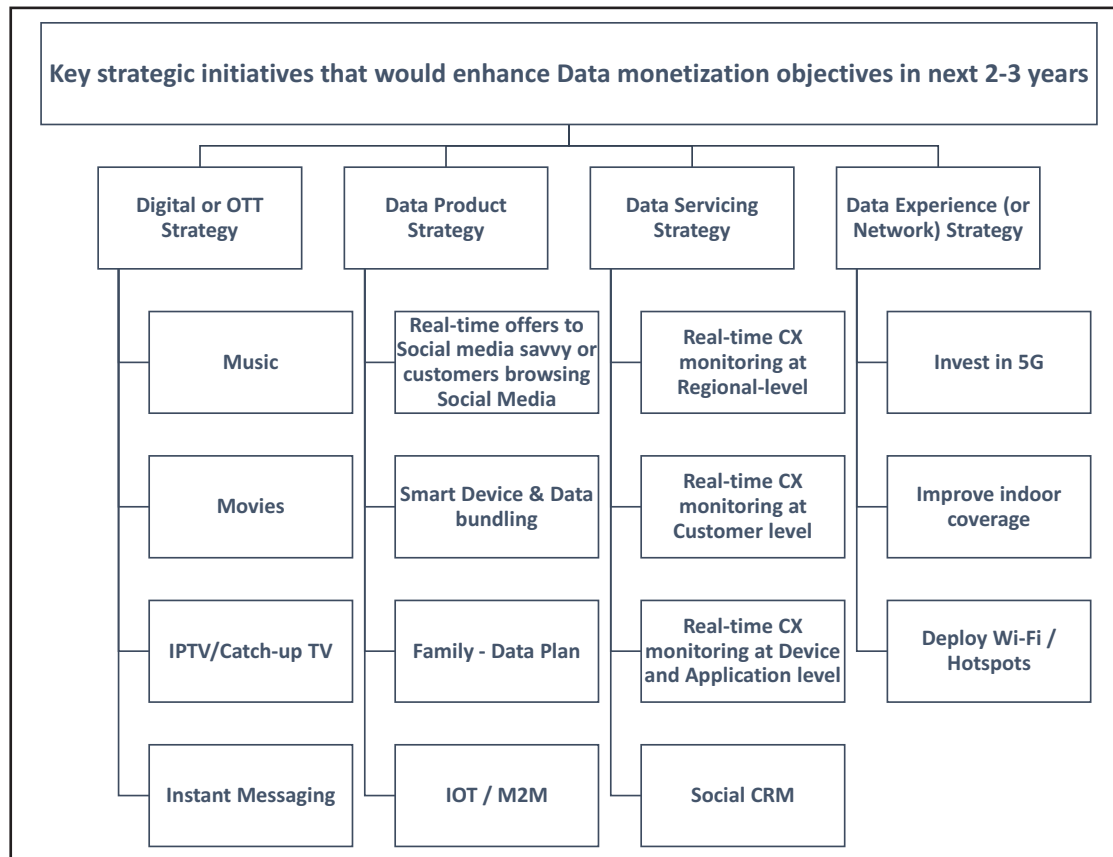


Fig. 6: AHP Model





- *Step 3:* These optimization and prioritization of these data initiatives were performed by means of paired-comparison technique in joint consultation with customer-facing CXO and the respondents. The relative ranking of the data monetization initiatives was derived.
- *Step 4:* The top 3 operators were ranked across these strategic initiatives to articulate their competitive edge wrt to the prioritized data monetization strategy.

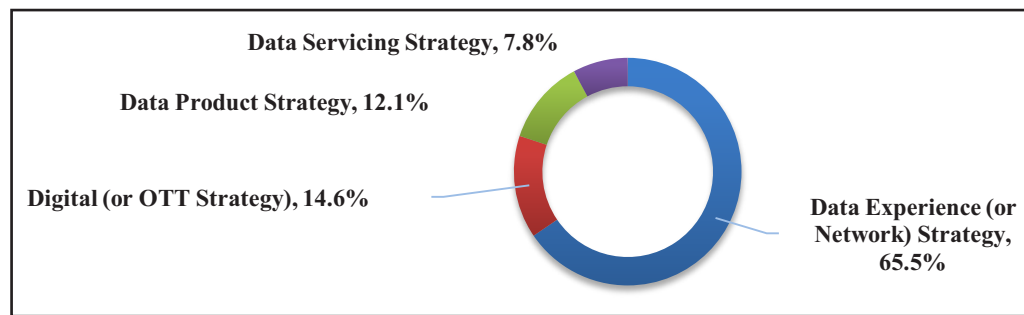
6. DATA ANALYSIS / FINDINGS

As a first step, the relative prioritization of key data strategy areas was derived using AHP. The key

consideration was the relative weightage that the Industry stalwarts would give to these strategies when compared to realistic investment potential and probabilistic return-on-investment in the next 2-3 year horizon. The significance of data experience (or network) strategy was overwhelming (65%). This justifies the hunger of the industry to scale to new or advanced technologies decade-on-decade (2G to 5G). The OTTs have given way to Value added services of earlier times and it comes a distant second (15%) when it comes to data monetization avenues. Not far behind was the Digital Telco's to use customer data to derive meaningful products and services including new offerings like IOT. Last but not the least, the data servicing strategy (8%) was the observed to value-add towards the data monetization objectives.

Table 2: Data Monetization Strategies

Rank	Data Strategy Type	
1		Data Experience (or Network) Strategy: Enhancing data revenue by investing in Network infrastructure to improve uptake, consumption and experience of Data services.
2		Digital or OTT Strategy: Launch (own or co-branded) OTTs and/or monetize from existing OTTs available to the customer.
3		Data Product Strategy: Enhancing data revenue by means of real-time targeted, new Data Product placement or Customer data monetization.
4		Data Service Strategy: Proactively monitoring and servicing the needs or complaints of Data Subscribers.

**Fig. 7: Priority Ranking and Weights of Data Strategies**

Next, a total of 16 strategic initiatives were short-listed and mapped across the four strategic areas. This was carried out using the same criterion viz. realistic investment potential and probabilistic return-on-investment in the next 2-3 year horizon:





- **Invest in 5G:** The primary use case of 5G include services requiring high capacity but low latency connectivity. IOT/M2M is one such application; Cloud services would be another.
- **Improve Indoor Coverage:** The real-estate congestion in ultra-urban areas and the quality of spectrum frequency (lower the better) affect the availability and experience of in-building data services. There are multiple alternatives available for improving the coverage as well as speed in an indoor environment. Fiber-to-the-curb or building (FTTx) is one such wireline technology, while deployment of small cells (low-powered radio access nodes) helps provide service to both indoor and outdoor areas.
- **Deploy Wi-Fi/Hotspots:** To enable connectivity in high footprint areas like shopping arcades, transport points like airports or railway stations; operators or facilities provider are resorting to provide free and/or paid Wi-Fi or Hotspot facilities.

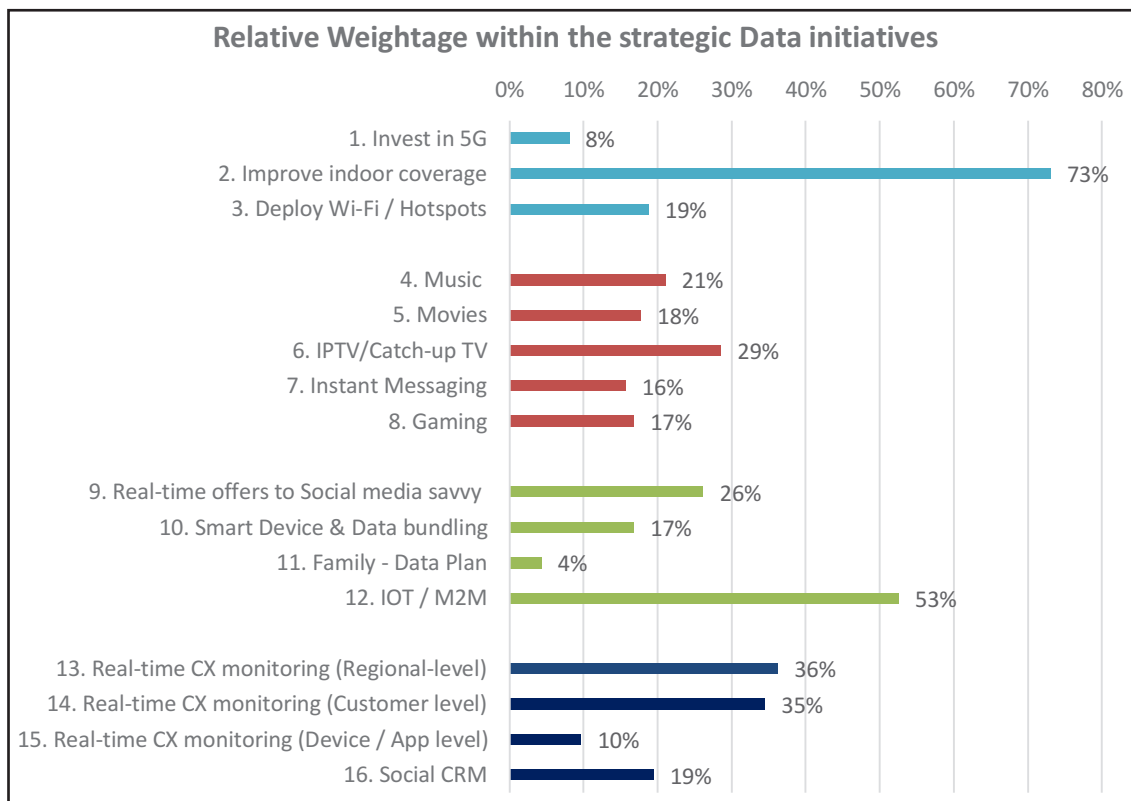
- **Music, Movies and IPTV/Catch-up TV:** Streaming content (music or video) has boomed across urban as well as rural hinterlands. Indian OTT market was valued at US\$ 280 mn in January 2018 (Deloitte, 2019).
- Indian consumer listens to music an average 21.5 hours per week as against a global average of 17.8 hours. Popular OTT music platforms include JioSavaan, Gaana, Hungama, Wynk and Vodafone-Idea Music, as well as International platforms like Apple Music, Amazon Music, Google Play and new arrival (Spotify). Music OTT users are estimated to be approx. 150 million users.
- In India, Video OTT users are estimated to be approx. 225 million. The video market in 2018 was expected to be approx. US\$ 700 million (Arun Gupta, 2019) and expected to reach US\$ 2.4 billion by 2023 (Media Partners Asia).
- In 2018, IPTV overtook direct-to-home (DTH) to become the second-largest multichannel platform in the world next only to cable TV, accounting for 23.4% of the total market of 1.07 billion

households (Dylan Bushell-Embling, 2019). Out of the global users, approx. 57% comes from China, India and the USA.

- *Gaming:* Online gaming has seen a big-shift amongst the Internet diaspora. As per a KPMG report (2019), the revenues figures are approx. US\$ 625 million in 2018. There has been approx. ten times growth in the user base from 20 million to 250 million between 2010 and 2018. Majority of the online gaming is accessed over mobile devices (85%).
- *Instant Messaging:* India has emerged as the largest market for instant messaging giant WhatsApp. Others global players are steadily increase investment and users in India. Seeing the shift of telecom users from the Operator's Voice, Messaging and Video services; Telco's are trying to find avenues to leverage the Instant Messaging space to their advantage: either by launching complimentary services or by collaborating with OTT players.
- *Customer Data & Analytics:* Telco's had a very high maturity when it comes to micro-segmentation and campaign management. However, the cost and conversation ratio was rather skewed; until digitization was introduced. Advanced analytical platform (Big data) and technologies (Customer Experience Management) are available that are optimizing STP (Segmentation, Targeting and Proposition) while increasing the conversion ratio. Deep packet inspection is being leveraged to understand the customer data monetization potential. Though it is still at an early stage, there can be multiple use cases of generating new revenue streams. Potential. Telco's are empowered to launch real-time offers to social media savvy (or customers browsing social media).
- *Smart Device & Data Bundling:* Smart device (mobiles, tablets, wearables) penetration is expected to grow to 830 users by 2023. Telco's are expected to leverage this opportunity of combining the device sales with their data product bundling.
- *Family - Data Plan:* In some of the advanced telecom markets, the concept of Family Data Plan has been very successful. The same format is being modelled in India across households (B2C) and corporate users (B2B).
- *IOT / M2M:* Internet of Things (IOT) poses the next big leap for Telco's to connect machines. IoT market in India is expected to grow to US\$ 15 billion with 2.7 billion units by 2020 from current US\$ 5.6 billion and 200 million connected units. IoT market in India is projected to grow at a CAGR of more than 28% during 2015-2020 (Ayoub Aouad, 2018).
- *Real-Time CX Monitoring and Management:* Advanced analytics clubbed with Network monitoring platforms provide a formidable opportunity to the Digital Telco's. They can proactively monitor the data experience at different levels: (a) Across high data savvy regions or locations (b) Across High Net worth Individuals (c) across customer's devices or applications. This capability allows them to proactively manage the customer experience and avoid any data leakages owing to bad network experience.
- *Social CRM:* The popularity of social media channels has crafted new avenues for the customer to engage and share their experiences (good or bad) to the wider audience. Thus far, Telco's used to own the channels of engagement with the customer; but now no more. These social media channels are beyond the control of the Telco's. There are two critical aspects here: (1) To listen to channels beyond the one's owned by the Telco to understand what the customers are experiencing and (2) To proactively engage with the customer from grievance management as well as branding (or marketing) perspective. Social CRM serves as the right platform to perform all these critical activities. Telco's are or have deployed Social CRM to perform customer engagement and brand building.

Table 3: Strategic Data Initiatives

















<i>Data Strategy Type</i>	<i>Data Initiative Type</i>
Data Experience (or Network) Strategy 	1. Invest in 5G
	2. Improve indoor coverage
	3. Deploy Wi-Fi / Hotspots
OTT Strategy 	4. Music
	5. Movies
	6. IPTV/Catch-up TV
	7. Instant Messaging
Data Product Strategy 	8. Gaming
	9. Real-time offers to Social media savvy (including customer data monetization)
	10. Smart Device & Data bundling
	11. Family - Data Plan
Data Service Strategy 	12. IOT / M2M
	13. Real-time CX monitoring and management at Regional-level
	14. Real-time CX monitoring and management at Customer level
	15. Real-time CX monitoring and management at Device / Application level
	16. Social CRM

**Fig. 8: Priority Ranking and Weights of Strategic Data Initiatives**

To derive the relative priority of the data initiatives, the respondents across cross-functional areas distributed

‘100-points’ to the initiatives across the respective strategic areas.

Table 4: Priority Ranking and Weights of Strategic Data Initiatives

<i>Priority Rank</i>	<i>Data Initiative Type</i>
1	 Improve indoor coverage
2	 Deploy Wi-Fi / Hotspots
3	 IOT / M2M
4	 Invest in 5G
5	 IPTV/Catch-up TV
6	 Real-time offers to Social media savvy or customers browsing Social Media (including customer data monetization)
7	 Music OTT
8	 Real-time CX monitoring and management at Regional-level
9	 Real-time CX monitoring and management at Customer level
10	 Movies OTT
11	 Gaming OTT
12	 Instant Messaging OTT
13	 Smart Device & Data bundling
14	 Social CRM
15	 Real-time CX monitoring and management at Device and Application level
16	 Family - Data Plan

Using paired-comparison technique the priority was then optimized. And, finally AHP was executed to derive the priority ranking and paired weights of these data initiatives.

7. CONCLUSION

The Mobile Network Operators (MNOs) have 16 strategic initiatives (or opportunities) to take advantage of. These strategic initiatives would require varying degree of upfront (Capex) followed by recurring (Opex) investments. Further, the return on investment (ROI) may vary based on varying factors or stakeholders (customer, regulatory environment, internal capabilities and cross-Industry alliances/partnerships amongst other considerations). These strategic initiatives may be prioritized bases two dimensions:

- Extent of Investment required (mostly Capex) and
- Return on Investment (within the next 2-3 years).

The size of these investments has been categorized across the following brackets:

- *Low*: Ranging from INR 10 million to INR 100 million.
- *Medium*: Ranging from INR 100 million to INR 1 billion.
- *High*: Ranging from INR 1 billion to above INR 1 trillion.

It has translated into higher financing costs, reduction in debt repayment abilities and worsening interest coverage ratios. In FY16-17, the burgeoning debt burden of the major telcos increased by 19%; so much that it instigated the Reserve Bank of India to caution the commercial banks who were providing loans to this sector. The current debt stands over INR 8 trillion or US\$ 112 bn (Gagandeep Kaur, 2019). In lieu of these market realities, the new-age Telco's are hyper-conscious of their dollar (or rupee) investments. Therefore, a balancing act is critical to implement or further the top data monetization strategic initiatives.

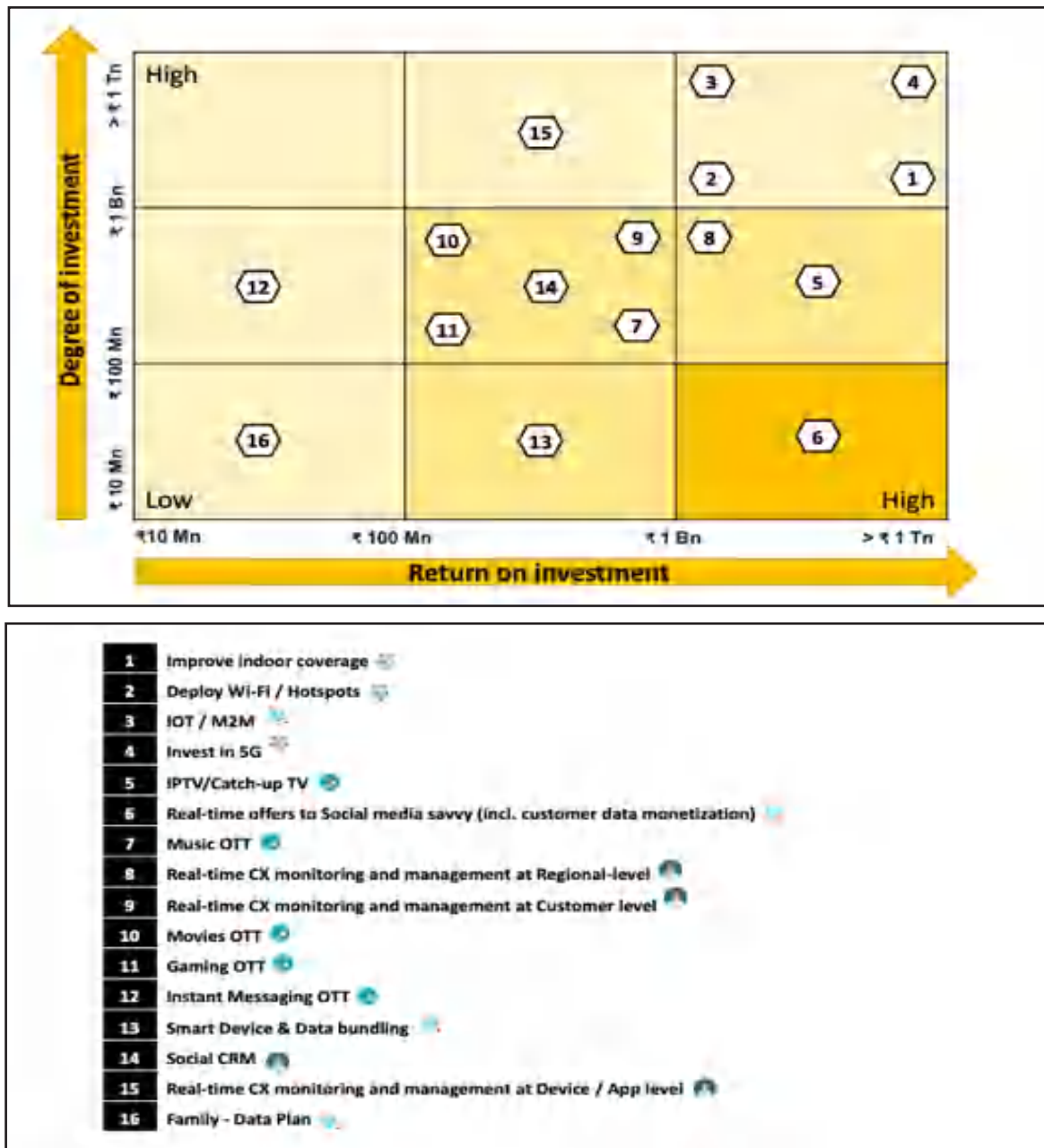


Fig. 9: Priority Ranking of Strategic Data Initiatives

To remain competitive in the market and differentiate service offerings are like two-ends of the spectrum:

- *Data-Centric (or Digital) Business Model:* The revenue and usage trends dictate the rise of data-centric business model viz. is evident from the following facts:
 - 2.5x increase in revenue contribution by data alone (53% of ARPU).
 - 2.6x increase in average data usage (8,740 MB per month).
- *Digital Telco Leadership:* The revenue market share has shifted towards operators who have been able to transition their business operations more seamlessly as a Digital Telco:
 - Top 3 market leaders namely Reliance Jio, Vodafone Idea and Bharti Airtel own close to

87% of the subscriber base and approx. 90% of the gross revenue share.

Table 5: Overall Operator Ranking and Score Across Data Initiatives

Rank	Most Competitive Telco's Across the Top 16 Data Monetization Strategic Initiatives	
1		Reliance Jio
2		Bharti Airtel
3		Vodafone Idea

The comparative analysis of the top 3 market leaders across the prioritized data monetization initiatives using Analytical Hierarchy Process (AHP) reveals the reason why the market leader has been able to win 36% of the market revenue by acquiring 23% of the mobile subscribers.

REFERENCES

- Tan, A. (2019). The future of indoor: WiFi [Blog post]. Retrieved from <https://www.telecomasia.net/>
- Andresen, P. (2017). *Acquiring customers through social customer relationship management: An explorative case study within the telecom industry* (Dissertation). Retrieved from <http://urn.kb.se/resolve?urn=urn:nbn:se:ltu:diva-64521>
- Little, A. D. (2018). Telecom data monetization: A reality, not a mirage. Retrieved from <http://www.adl.com>
- Gupta, A. (2019). OTT players will be as big as the Indian film industry. Retrieved from <https://www.dnaindia.com>
- Aouad, A. (2018). India soon will be leader in IOT (NASSCOM Report). Retrieved from <https://www.businessinsider.com>
- Deloitte. (2019). Audio OTT economy in India - Infection point. Retrieved from <http://www.deloitte.com>
- Bushell-Embling, D. (2019). Kagan: IPTV to drive pay TV business in 2018. Retrieved from <https://www.telecomasia.net/>
- Forbes Insights Team. (2018). Beyond connectivity: Three strategies for telecom growth. Retrieved from <http://www.forbes.com>
- Kaur, G. (2019). India to hold 5G auctions in June 2019. Retrieved from <https://www.lightreading.com>
- Vantara H., & Ravi, K. (2018). Transform telecom: A data-driven strategy for digital transformation. Retrieved from <https://www.hitachivantara.com>
- Joshi, S., Sohag, S., Tanu, D., Chintan, D., Shubham, P., & Sumit, G. (2015). Impact of over the top (OTT) services on telecom service providers. *Indian Journal of Science and Technology*, 8(S4), 145-160.
- KPMG. (2019). The evolving landscape of sports gaming in India. Retrieved from <https://www.kpmg.com>
- Sarkar, S. (2014). CEM - A strategic move up the telecom value chain. *Communication Today*, 21(10).
- Telecom Regulatory Authority of India. (2011-18). The Indian telecom services performance indicators. Retrieved from <http://www.trai.gov.in>
- Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences*, 1(1), 83-98.

Executing Strategies - A Bird's Eye View of the Future of the Communications Sector

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ABSTRACT

Scenario: Dec' 2024, Annual Board Meeting of two different Telecom operators.

One of them, Smart Telecom, remained the undisputed leader with 46% Revenue Market share as opposed to 35% in 2019, with EBITDA growing at CAGR of 5.5% over the last 5 years, and profits going up by 7%, making it extremely lucrative for investors. On the other hand, GTel, once an incumbent leader in its own market, saw a slump in revenue market share from 45% to 32% over the course of 5 years, with EBITDA growth down to -2% between 2019-2024 from 3% between 2015-2019. Customer complaints grew more than usual during this period along with an uncharacteristic degradation of network quality, which caused many customers to switch over to other operators.

The story of the radically different fates of these two Telecom operators serves as an important lesson to other operators who are looking to gain a competitive advantage to sustain in the next decade.

Keywords: Communication, Strategy, Value Chain, Business Model, Agile

1. DEC'2019, LOCATION - HEADQUARTERS OF GTel & SMART TELECOM

Let us go back to where it all started.

5 years back, both Smart Telecom and GTel were in the same place. They had evolved from being voice factories and traditional cloud service providers to leaders in data & cloud infrastructure in their respective markets and they wished to transform themselves from traditional CSPs to Digital Partners to sustain in the face of stagnating growth and increasing competition.

The key strategic objectives were as follows:

- Focus on product rationalization.
- Improve Quad-play penetration by cross sell/up sell of additional services.
- Empower the customer with the freedom to migrate between plans and pay only for the services they value by using self-service capabilities.
- Lead in all network performance surveys.
- Transform the current operating model to become "organization of the future" by embracing new ways

of working through agile transformation and adoption of Artificial Intelligence.

Smart Telecom and GTel created a 5-year roadmap on 6 key pillars to meet their strategic objectives.

1. *Simplify Product Portfolio:* In order to focus on Customers who wanted products that are simple, easy to use and pay for, both operators planned to radically simplify and rationalise their product portfolio.
2. *Provide Superior Digital Customer Experience:* Both the operators wanted to improve their brand value and increase NPS by transforming their customer experience. This involved eliminating customer pain points and migrating customers to an all-digital experience. They also aimed to transform their Sales and Marketing Function, come up with Innovative Loyalty programmes to increase brand value and optimize their Distribution Channel Strategy ("How are CSPs using ...", Jan 2018).
3. *Achieve Network Leadership:* In order to achieve network leadership and improve on the network resilience and reliability, they planned to be 5G ready and leverage Network Function Virtualization

(NFV) and Software Defined Network (SDN) in order to scale network capabilities as and when required, improve the quality of services and improve customer experience. Additionally, they planned to be 5G network ready for commercial purposes and leverage the 5G infrastructure to operationalize B2B digital partner ecosystems by embracing disruptive and non-disruptive creations around Smart Cities, Internet of Medical things, Autonomous Vehicles, Remote Surgery, Mobile Gaming, HD Videos, etc.

4. *Simplify Operating Model & Innovate Business Model*: Both the operators planned to have a highly agile and digital workforce and flatten the existing organization structure by doing away with hierarchical management layers. Both the operators planned to innovate their current business model.
5. *Simplify Internal Processes to Optimize Costs*: They envisaged significant cost savings by the lean transformation of their internal processes. They also wanted to build capabilities around Artificial Intelligence, Machine Learning & Intelligent Automation with a

strong focus on Data Governance (“The journey to lean telco”, Jun 2014).

6. *Monetize Digital Platforms*: Revamping their B2B Strategy to generate new revenue streams was on the radar for both the operators. This involved innovative solutions/platforms/applications across industries (both public and private sector). Initiatives around connected living and sustainable development goals were on top of the list.

The roadmap of both Smart Telecom and GTel revolved around 4 key strategic imperatives - ‘Redefine the Customer Journey’, ‘Revalidate the Value Chain’, ‘Rebuild the Organization’ and ‘Reimagine the Business Model’. While the underlying strategic objectives were the same, the roadmap for Smart Telecom was outcome-centric with the success definitions clearly articulated, with complete buy-in from the executive and senior management level. On the other hand, the roadmap for GTel was centred around activities, with vague definitions of how success will be measured, along with inadequate organization level ownership and buy-in.

Table 1

<i>Pillars</i>	<i>Smart Telecom</i>	<i>GTel</i>
Simplify existing Product Portfolio	<ul style="list-style-type: none"> • Reduce the number of Product offerings from 1000 to 25 in the next 5 years. 	<ul style="list-style-type: none"> • Optimize existing Product Portfolio.
Provide Superior Digital Customer Experience	<ul style="list-style-type: none"> • Increase NPS by 2-4 points per annum. • Eliminate 50% of Service Calls through conversational AI. • Shift 80% of the existing customer base to the new digital self-service apps over the next 5 years. 	<ul style="list-style-type: none"> • Automated Customer Experience Management through AI. • Shift Existing Customers to the new digital technology Stack.
Achieve Network leadership	<ul style="list-style-type: none"> • Monetize US\$ 3 billion from Network as a Service (NaaS) through network superiority in the next 5 years. • National Rollout of 5G over the next 5 years. 	<ul style="list-style-type: none"> • Asset Monetization in the next 5 years. • Countrywide 5G Rollout.
Simplify Operating Model & Innovate Business Model	<ul style="list-style-type: none"> • Flatten Organization Structure by removing 2-3 Levels of Management. • 75% Digital and Agile Workforce. • Plan to diversify by merger and acquisition in M&E, Fintech and E-Commerce industry by 2021. 	<ul style="list-style-type: none"> • Organization Restructuring. • Creation of Digital & Agile Workforce.
Simplify Internal Processes to Optimize Costs	<ul style="list-style-type: none"> • Costs to decline or remain flat in the next 5 years. • Labour Cost to Sales Ratio to go down by 15% in the next 5 years. • CAPEX to Revenue to go down to 25% in the next 5 years. 	<ul style="list-style-type: none"> • Process Optimization through Lean Transformation.
Monetize Digital Platforms	<ul style="list-style-type: none"> • US\$ 3 billion additional revenue from the partner ecosystem in the next 5 years. 	<ul style="list-style-type: none"> • Leveraging suitable partnership opportunities to build the use cases of the future.

In the months that followed, Smart Telecom moved quickly to inject agility into its transformation initiatives across all the pillars. To become an agile organization

(“The five trademarks...”, Jan, 2018), they stressed on implementing the following practices:

- Cross-functional agile teams were identified comprising scrum masters, product owners, architects, functional/technical specialists, UI/UX designers, developers, testers.
- The teams received training in agile ways of working by external agile coaches.
- Policies and procedures were established to ensure that the information flow across the organization was clear, transparent and easily accessible to different teams.
- The focus was on building performance-oriented self-organizing teams and continuous improvement through iterations.
- The teams were empowered with the complete responsibility and accountability of finalizing the definition of “Done” and doing whatever was required to achieve the desired outcomes for each of the initiatives in the pillars.

At the same time, GTel was not able to embed agile ways of working in its transformational initiatives because of organizational bureaucracy, resistance to change among employees due to fear of losing jobs, and inability to navigate regulatory barriers quickly. Additionally, the “Data-Driven AI Enterprise” aspiration did not quite kick off. Agile Transformation and Data-Driven AI Enterprise remained support functions instead of at the heart of the transformation.

In the latter part of 2019, Digicom* conducted a detailed assessment of the market to understand the latent demand around B2B and B2C segments and devised a market entry strategy to start operations around the beginning of 2021. They came up with a 3-year roadmap to open their own subsidiary with huge investment planned around the rollout of the 5G network, creation of digital platforms and development of competencies to offer “Business Consulting as a Service” to other sectors.

* A global conglomerate with headquarters in Asia.

Some of the key points in their AI First Strategic Roadmap were:

- Fast and efficient scale-up of 5G roll-out with self-organizing networks to provide superior customer experience and build innovative use cases. They avoided a blanket coverage strategy for their network. They identified geographies for 5G roll-out, locked in clients from retail, manufacturing, utilities, logistics and hospitality sectors and signed an agreement for network sharing in areas where they were not present (“Digital Transformation Initiative ...”, Jan 2017).
- Develop a partner ecosystem comprising technology players, AI start-ups to build a sustainable aggressive B2B Strategy.
- Product Re-Bundling to suit the requirement of the millennial customers with a personalized cognitive Self-service app as the face of the organization.
- Digitization and Automation of all the internal processes to improve productivity and reduce waste.
- Innovations around Customer Service with Virtual Assistants.
- Agile and Digital Workforce.

Digicom’s aggressive strategy was ready to pose a tough challenge to the incumbent GTel. The execution plan was based on FAST (Frequently discussed, Ambitious, Specific, Transparent) Goals.

2. DEC’2021, LOCATION - HEADQUARTERS OF GTEL, DIGICOM & SMART TELECOM

Digicom waged a full-scale price war against GTel and captured 8% market share in the B2C segment and 25% market share in the B2B segment within a period of 11 months. In order to effectively execute their roadmap, Digicom took the first movers’ advantage to capture the B2B space by building a sustainable partner ecosystem.

At the year-end management review meeting of GTel, the senior management reviewed the results of the execution of the roadmap across all the pillars.

Table 2

<i>Pillars</i>	<i>GTel</i>
Simplify existing Product Portfolio	<ul style="list-style-type: none"> Most of the new ideas proposed by the product innovation leads were not in alignment with the Senior Management's vision. As a result, they were lagging far behind in releasing new products and removing the existing redundant ones.
Provide Superior Digital Customer Experience	<ul style="list-style-type: none"> There were frequent shifts in priorities and inadequate transparency across the organization. They defocused from 4G and went back and forth between improving existing network capabilities and rolling out the 5G network. This resulted in deteriorating Service Quality. Customer complaint calls increased by 20% and NPS was down by 5 points. The digital platforms, including the self-service apps, did not meet the millennial customers' expectations and received a lukewarm response. Customer Churn increased from 5% to 12%, most of whom were high-value subscribers.
Achieve Network leadership	<ul style="list-style-type: none"> The 5G rollout strategy did not work as a result of which costs escalated by 15% without any significant increase in revenue.
Simplify Operating Model & Innovate Business Model	<ul style="list-style-type: none"> Due to the lack of transparency and reluctance to adopt an agile methodology, there were a significant number of attritions in the middle management level. Attrition rate increased to 18%. The agile way of working was not implemented properly, resulting in the poor quality of deliverables causing a significant delay in projects and cost overruns. There were no plans to evolve the current business model to drive growth.
Simplify Internal Processes to Optimize Costs	<ul style="list-style-type: none"> GTel's processes were inefficient compared to Digicom, resulting in a much higher cost structure.
Monetize Digital Platforms	<ul style="list-style-type: none"> Even though they partnered with a production house to generate personalized content, and partnered with Health Care industry but a lack of proper Use Case Prioritization and improper stakeholder on-boarding did not allow them to leverage the benefits from their partner ecosystem.

In order to survive against Digicom in the market, GTel planned a slew of initiatives to counter Digicom. They planned to prioritise their focus on the B2C segment, their bread and butter. Some of the key countermeasures were:

Coming up with better products/offers with competitive prices, Churn Prediction Measures, Revenue enhancement by improving Cross-Sell/Up-Sell, optimizing online-offline channel mix instead of trying to eliminate offline channels, prioritising B2B initiatives based on their existing relationships and market opportunities. However,

most of these initiatives were quick-fix solutions and lacked long term vision. They were not enough to curb the growth of Digicom and produced marginal improvement in the current situation. The actual problems, execution not aligned with strategy and lack of digital agility were far from addressed.

During the same period, the management review meeting for Smart Telecom was proceeding smoothly. Shareholder returns had increased by 10%, leading to positive market sentiments.

Table 3

<i>Pillars</i>	<i>Smart Telecom</i>
Simplify existing Product Portfolio	<ul style="list-style-type: none"> The product portfolio was optimized by around 20%. Duplicate offerings and loss-making products were done away with.
Provide Superior Digital Customer Experience	<ul style="list-style-type: none"> NPS had soared by 6 points and the social media was abuzz with excellent feedback from the customers.
Achieve Network leadership	<ul style="list-style-type: none"> The 5G rollout strategy was going as per the initial plan. They optimized the network rollout with the help of Analytics.
Simplify Operating Model & Innovate Business Model	<ul style="list-style-type: none"> 80% of the Smart Telecom workforce had become agile at Level 4 Maturity. Smart Telecom acquired start-ups to venture into Media & Entertainment, E-commerce, Fintech business.
Simplify Internal Processes to Optimize Costs	<ul style="list-style-type: none"> Artificial intelligence and Intelligent automation was heavily used to improve the efficiency of the internal processes, resulting in internal cost savings of 7%. CAPEX to Revenue Ratio reduced to 30% from 35%.
Monetize Digital Platforms	<ul style="list-style-type: none"> New Digital platforms resulted in \$ 0.5 billion in revenues from the B2B segment. A new subsidiary was opened up to drive the digital business.

The trend continued, and over the years, the transformation journey of the 3 operators can be depicted as follows (Fig. 1) (“Vision 2020”, May 2018).

- Smart Telecom moved from a traditional CSP to a Digital Partner via Digital Platform businesses.

- GTel struggled to become a Digital Service Provider (DSP) from a traditional CSP.
- Digicom started off as a Digital Service Provider (DSP) and embraced blue-ocean battlegrounds by becoming a Digital Partner via Digital Platform Businesses.

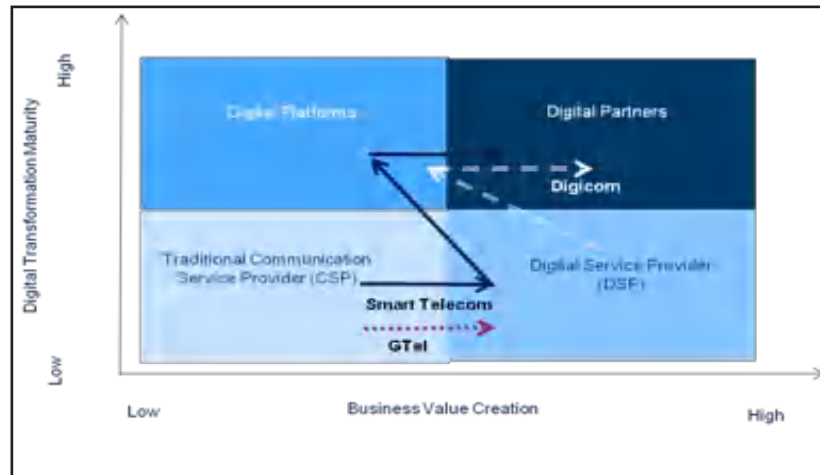


Fig. 1: Digital Transformation Journey of Smart Telecom, Digicom & GTel

3. DEC'2024, LOCATION - HEADQUARTERS OF GTEL, DIGICOM & SMART TELECOM

In the next 3 years, Digicom managed to capture 20% of the revenue market share from the incumbent operator GTel. They successfully rolled out initiatives around Smart Cities, Smart Farming, Smart Retail, Smart Park, Smart Health, Internet of Medical things, Location Tracking, Activity Management, Supply Chain, Fleet Management, Connected Cars Asset Management & Digital Health Solutions, Cyber Security, etc. Revenue from Digital business was US\$ 3 billion for the current year.

For GTel, there was no significant ROI for the millions of dollars invested to build a slew of new services. Nothing seemed to bring up the Revenue and returns to shareholders reduced by 30% in 5 years, which left them visibly unimpressed. An organization restructure was imminent. During the 2024 annual board meeting, it was decided that GTel is going to disinvest and sell its infrastructure business to another player in the industry. Smart Telecom, on the other hand, gradually increased the gap between itself and the other competitors who steadily lost market share over the years. They managed to execute as per the strategy defined in 2019.

The closing of the financial year of 2024 saw a strong financial performance from Smart Telecom across all service lines, demonstrating a 12% YTD revenue growth and 20% YTD growth in EBITDA. The Capex to Revenue ratio stood at 38%.

GTel's financial performance continued the same downward trend, with 2% Revenue decline YTD and 5% decline in EBITDA margins. Digicom demonstrated 25% Revenue growth and 32% EBITDA growth YTD. The CAPEX to Revenue ratio stood at 40%.

4. CONCLUSION

The story, of course, is hypothetical but provides a clear example of the implications of execution not aligned with strategy. While Smart Telecom embraced digital agility, GTel could not, creating an obvious vulnerability which was identified and used effectively by Digicom to enter the market and strengthen its foothold.

A transformation strategy, however, complex it may be, must be broken down to simple guidelines with defined outcomes or benefits, so that it is simple enough for all the employees at each level of the organization to understand. Most telecom operators choose a path which is somewhere

between the aggressive Digicom and the bureaucratic GTel. Some of the initiatives mentioned can help operators identify an optimal mix of Innovation and Status Quo to survive in today's competitive environment. Getting the desired outcome of the strategic objectives will depend on how well the operator is able to translate the strategy to simple, clear and flexible execution directions to be followed effectively by self-organizing agile teams. At the end of the day, "Success doesn't necessarily come from breakthrough innovation but from flawless execution. A great strategy alone won't win a game or a battle; the win comes from basic blocking and tackling."

REFERENCES

- Harshak, A., Schmaus, B., & Dimitrova, D. (2013, April 23). Building a digital culture - How to meet the challenge of multichannel digitization. Retrieved from <https://www.strategyand.pwc.com/report/building-a-digital-culture>
- Larsen, A. H., Lancry, O., & Gul, M. (2018, January 5). A step-by-step guide to digital transformation. Retrieved from <https://www.bain.com/insights/a-step-by-step-guide-to-digital-transformation-world-economic-forum/>
- Rauchfuss, A., Wilms, M., Lightburn, C., Chishty, F., & Stern, S. (2018, April). To fuel growth telco's, need a digital makeover. Retrieved from http://image-src.bcg.com/Images/BCG-To-Fuel-Growth-Telcos-Need-a-Digital-Makeover-Apr-2018_tcm9-188665.pdf
- Gupta, S. (2018). *Driving digital strategy: A guide to reimagining your business*. Boston: Harvard Business Review Press.
- Kim, W. C., & Mauborgne, R. (2017). *Blue ocean shift: Beyond competing - Proven steps to inspire confidence and seize new growth*. London: Macmillan.
- Moncada, J., Padmanabhan, V., & Sinha, V. (2017, June 19). Six IT design rules for digital transformation. Retrieved from <https://www.bain.com/insights/six-it-design-rules-for-digital-transformation/>
- Newman, M., & Haslam, C. (2018, May). Vision 2020: Future CSP business models. TM Forum. Retrieved from <https://inform.tmforum.org/research-reports/vision-2020-future-csp-business-models/>
- Newman, M. (2018, January). How are CSPs using AI for customer experience. Retrieved from <https://inform.tmforum.org/data-analytics-and-ai/2018/01/how-are-csps-using-ai-for-customer-experience/>
- Dixon, M. (2018, December). Reinventing customer service. *Harvard Business Review*. Retrieved from <https://hbr.org/2018/11/reinventing-customer-service>
- Berger, R. (2014, June). LEAN TELCO redefining the telecom business - From cost-cutting to smart efficiency. Retrieved from file:///C:/Users/HP-PC/Downloads/roland_berger_tab_lean_telco_20140731.pdf
- Aghina, W., Smet, A. D., Lackey, G., Lurie, M., & Murark, M. (2017, October). The five trademarks of agile organization. *McKinsey Quarterly*. Retrieved from <https://www.mckinsey.com/business-functions/organization/our-insights/the-five-trademarks-of-agile-organizations>
- World Economic Forum. (2017, January). Digital transformation initiative telecommunications industry. Retrieved from <http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-telecommunications-industry-white-paper.pdf>

Revolutionizing Healthcare With 5G

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ABSTRACT

This paper discusses the impact of latest telecom communication standard like 5G on the future of healthcare and how it will digitally transform preventive, routine diagnostic checkup and therapeutic care. At the core of the discussion would be the breath of applications encompassing Big Data, Wearable devices, IoT and Analytics; all of which would disrupt and transform the healthcare value chain. Everything from resource efficiency, convenience and security would drive telecommunication operators to explore and penetrate the healthcare ecosystem.

Keywords: Healthcare, 5G, AI, IoT

1. INTRODUCTION TO THE 5G ECOSYSTEM

Our “need for speed” has put automobile, aviation and telecom industry on tenterhooks. As per Gartner (Liam Tung, 2017), 20.8 billion devices would be connected to the internet by 2020. This number stands at only 6.4 billion as of now. Telecom companies have just a little over a year to bridge this gap. And that calls for a new paradigm of connectivity. This is where 5G comes into the picture.

There’s a huge speculation (not without any reason!) about 5G becoming the de facto standard for wireless network speed. Businesses and consumers are gradually getting a feel of the future 5G networks. As per (Tom Chitty, 2019) CNBC news, the massive and aggressive development in China is driving much of the early adoption of 5G. This is expected to result into 1 billion global consumers on 5G speed by 2030.

Here are a few predictions (Hung, 2017) related to 5G and how it will affect business and individuals:

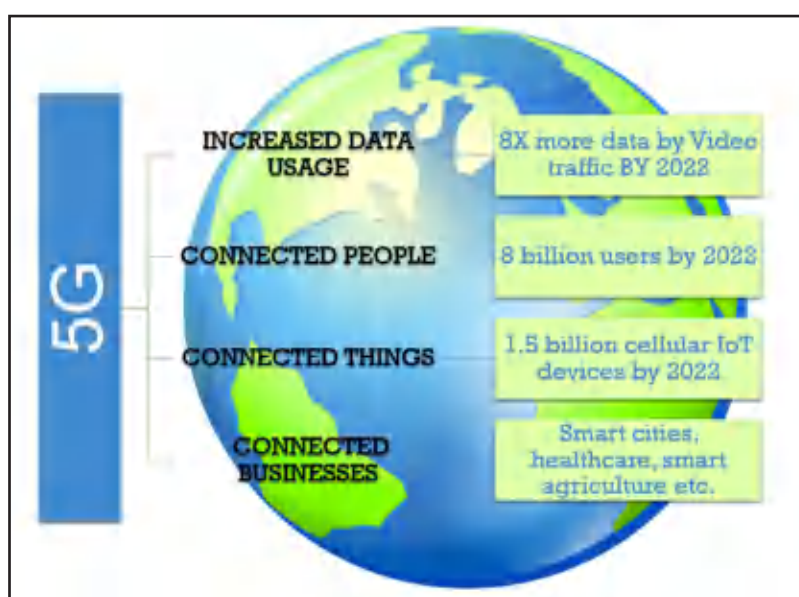


Fig. 1: 5G Ecosystem

5G is not just a small upgrade in the upload/download speeds. Just to give some perspective, today the average US home enjoys download speeds of approximately 6.5 megabytes/second but 5G will provide them the speed of 500 megabytes/second. It's the sheer speed of the network that has immense applications.

This phenomenal speed that 5G promises will potentially change the ways organizations manage their day to day communications internally and externally with their customers. In near future, business communications and operations are expected to be more efficiently managed by leveraging mobile technology.

In this paper, we will talk about at some of the most important changes 5G will bring to the healthcare industry.

2. 5G TRANSFORMING THE FUTURE OF HEALTHCARE

The Healthcare system is confronted with abundant challenges spread across data management, lack of expert workforce, connectivity, infrastructure and lack of real time monitoring framework. A study shows that 40% of the countries have less than 1 doctor available per 1000 population. The statistics is worse for hospital beds per patient (Krishna Rao, n.d.).

Issues like connectivity, available bandwidth, network speed, available spectrum and lack of dedicated network slice for healthcare are impediments to improving the quality of healthcare and life.

Communication technologies have come a long way in being able to support real-time healthcare needs. This was not possible when the first-generation cellular systems using analog signal transmission came on the scene. Data speed of less than 10 Kbps had no application in healthcare. Then came the digital signal processing based 2G network. This was that time when healthcare applications started getting explored. It was possible to transmit voice and other data (in compressed format) through TDMA, CDMA, GSM and iDEN algorithms. But healthcare needed more than 2G to be usable. 3G and 4G were the ones where healthcare saw applications. With the advent of millions of connected devices and need to real-time data, even 4G was not enough.

We are on the verge of a massive healthcare revolution and it would be driven by 5G. The convergence of myriad technologies (5G, Smart Sensors & AI) is going to change the healthcare ecosystem. It is going to transform the way

people comprehend health, diagnose and deliver treatment and to expand the network of people who need access and the experts.

The key here is the data and how to access to it is fast or easy. As per research data (Gemalto Publications, 2018), healthcare contributes to about 30% of the world's data and needless to mention, its increasing as medical technology gets more advanced. 6.5 We believe that this data, combined with 5G and AI can help in unleashing insight from data. Healthcare is about to get wings of predictive and proactive prognosis and diagnosis.

The last healthcare revolution saw the advent of telehealth and remote home monitoring systems. These systems are still prevalent now and are exploding. People in remote or rural areas with limited access to healthcare (when they need it most) get access to consultations and treatment over a video call and even send prescriptions or imaging device output. This has resulted in congestion and lag in network speed. As the number of patients seeking remote consultations increase, the network is the first casualty. The problem compounds as more and more connected devices get added and the Internet of Things (IoT) technologies create devices that create more data. Here is when 5G would come to the rescue. Here are a few areas that benefit from the advent of 5G technology:

- *Expanding the Horizon of Telehealth:* As per Market Research Future, the telehealth industry is set to grow at a GAGR of 16-17% from 2017 to 2023 (Market Research Future Publications, 2018). This also means that more people in rural areas would have access to healthcare. This explosion can only be supported by 5G that would allow real-time HD video consultations. This would result in people getting access to specialist as and when they need it.

5G comes to help when high quality imaging files are involved. MRI, CAT and other healthcare imaging systems generate huge sized image files. If they can be transmitted to specialist for consultations and advice, both individuals and hospitals can benefit by saving precious time during emergencies.

Capture Proof is one such company that has taken telehealth to the next level. It provides a HIPAA compliant solution for patients & providers to communicate through sharing of photo/video with the entire care team. In India, 'mfine ONE' is an AI driven, on-demand solution that provides access to physicians (Capture Proof, n.d.).

- **Real Time Monitoring Device Getting More ‘Real’:** IoT technologies enable wearable devices to send health related information to experts for getting personalized care. The number of wearable devices is going to increase as they become more capable of helping doctors take quick (and sometimes lifesaving) decisions. With 5G, the ever increasing IoT devices can be supported and would help in improving the quality of healthcare services.

ADAMM manufactures wearable technology to monitor asthma. It includes a wearable device, a smartphone app and a portal to detect and treat asthma. Health Patch MD has come up with a skin patch-based technology for healthcare professionals to keep tabs on the vital information of their patients. iTBra by Cyncadia Health is a smart bra helps keep track of breast health. It has embedded sensors that keep track of the conditions and rhythms in the breast tissue to alert the possibility of breast cancer (Health Care Originals, n.d.).

- **AI Powered Healthcare:** As previously mentioned, 30% of the world’s data is healthcare related. This data is getting richer by the day and most of it would be useless if experts can’t derive any insights from it. Artificial Intelligence can work on this data (most of it are located remote) and make the right medical decision. With 5G, AI tools can run on the smallest of devices and help healthcare experts predict, diagnose and treat ailments.

IMB is at the forefront of using AI for healthcare. Launched 3 years ago, IMB launched Watson Health that brought the power of AI to help medical and healthcare professionals take on the biggest healthcare challenges. Amongst many use cases, the following are the ones that stand out:

- Helping diabetic and non-diabetic people manage their glucose levels.
- Helping in cancer related clinical decision making with a suite of oncology products.

IBM Watson leverages the power of AI and data to inform the daily decisions doctors make in treating cancer. These data points could be in various formats (video, images, data etc.) and require 5G for reaching the right people at the right time (IBM Watson, n.d.).

Apart from the ones mentioned, there are various other areas of healthcare that would get transformed. Think of

how healthcare can be improved or dispensed with Virtual Reality and Augmented Reality? Networking Hardware companies like ZTE and Huawei are making substantial strides in development of several components of 5G that would possibly do away with bulky computer terminals and make healthcare VR and AR practical on a large scale (J.C. Kuang, 2018).

One such application, BioflightVR’s pediatric trauma simulations, combines rich 3D models and AI-powered curriculum customization to simulate real-world conditions which can be experience by healthcare professionals using AR and VR. 5G is poised to open a new chapter in healthcare, wave particle by wave particle (Bioflightvr, n.d.)!

3. KEY TRENDS AND TECHNOLOGIES - 2019 & BEYOND

5G will not only make consumers’ lives easier and provide them the speed that they dreamt off; it will also enable businesses to become far more efficient. Newbie technologies like - AI, 5G and the IoT are top on the list to transform nearly every industry in near future.

To put it in the words of Brain Modff, EVP Qualcomm:

*“We spent the last 30 years connecting people.
We will spend the next 30 years connecting things”.*

Let’s look at the Technology Trends of 2019 & beyond from the report captured by CES (Pete Pachal, 2019).



Fig. 2: Technology Trends of 2019 & Beyond

Expanding connectivity will be the focus of the next era. Bear in mind, 4G came to the market only in 2010 and it already accounts for more than 50% of the connected market in the developed nations.

Industry reports suggests that global mobile data consumption is projected to reach 49 exabytes in 2021 from 0.3 exabytes back in 2010 (Cisco Publications, 2014).

Connectivity will further bring lot of behavioral shifts of how we use technology today. YouTube is the world's second largest search engine today - it has 3 billion users per month, out of which 1 billion are unique users (Mushroom Networks Publications, n.d.). More than 100 videos are watched every minute (Mushroom Networks Publications, n.d.). Today YouTube is bigger than Bing, Yahoo, Ask and AOL (Mushroom Networks Publications, n.d.).

Tech companies across the globe are watchful of the trends & progress of 5G - a new video sharing Chinese app called TikTok, is gaining lot of market momentum. Facebook is not behind; they have built Lasso (a video

sharing app) to capitalize on the market share of TikTok (Lasso by Facebook, n.d).

5G is being piloted in many cities in 2019 before it's official launch in 2020. It will allow people to view high quality video without any latency or buffering. This is expected to revolutionize Robotic surgeries and have more success stories of digital healthcare in the near future. Apart from high connectivity, 5G will also increase the amount of meaningful data being captured from sensors through wearable devices, leading to proliferation digital healthcare sector and discovery of newer drugs. All of these in turn is expected to improve the modern healthcare sector and improve human lives across the globe (Caitlin McGarry, 2019).

In this context, below is a sneak peak of 5G development around the world (Corinne Reichert, 2019):



Information Source: CES

Fig. 3: 5G Progress Around the Globe

4. CONCLUSION

The rise of 5G technology represents a vital expansion role of 5G radio network mobile technologies in the wider economy to drive more efficiency. 5G will aid the Mobile technology to transition from an enabling technology to a transformative, general purpose technology across industry verticals. The health care sector is a perfect example of this transition. The dependability and omnipresence of 5G networks, in conjunction with the role of such networks in empowering “computing at the edge”, will directly enable

the personalization of health care. The personalization of health care means “more prevention”, “more precision”, improving patients’ quality of life, improving health outcomes and reducing costs to the health care system. 5G will enable considerable advancements in health informatics and thus empower both new business opportunities and significantly enable “outcome-based” health care model - the much needed one.

Every disruptive technology has its own set of challenges. Needless to say, 5G technology’s use in healthcare may have substantial issues to deal with. We can only hope

that the initial challenges are ironed out, but we really cannot predict the quantum of influence and the future of this revolutionary technology.

REFERENCES

- BioflightVR Company Pages. (n.d.). Retrieved from <https://www.bioflightvr.com/>
- Capture Proof Company Pages. (n.d.). Retrieved from <http://captureproof.com/> and <https://in.linkedin.com/company/captureproof>
- Chitty, T. (2019). 5G is coming to your smartphone but the big change is for industry. Retrieved from <https://www.cnbc.com/2019/03/08/5g-is-coming-to-your-smartphone-but-the-big-change-is-for-industry.html>
- Cisco Publications. (n.d.). Cisco visual networking index: Global mobile data traffic forecast update 2014-2019. Retrieved from https://www.researchgate.net/publication/313629843_Cisco_Visual_Networking_Index_Global_Mobile_Data_Traffic_Forecast_Update_2014-2019
- Gemalto Publications. (2018). How big data and AI are transforming healthcare. Retrieved from <https://www.gemalto.com/review/Pages/How-big-data-and-AI-are-transforming-healthcare.aspx>
- Health Care Originals Company Page. (n.d.). Retrieved from <http://healthcareoriginals.com/>
- Hung, M. (2017). Leading the IoT. Retrieved from https://www.gartner.com/imagesrv/books/iot/iotEbook_digital.pdf
- IBM Watson Company Page. (n.d.). Retrieved from <https://www.ibm.com/watson>
- Kuang, J. C. (2018). The caring cloud: The role of 5G in healthcare VR and AR. Retrieved from <https://greenlightinsights.com/caring-cloud-5g-healthcare-xr/>
- Market Research Future Publications. (2018). Telemedicine market research report - Forecast till 2023. Retrieved from <https://www.marketresearchfuture.com/reports/telemedicine-market-2216>
- McGarry, C. (2019). The truth about 5G: What's coming (and what's not) in 2019. Retrieved from <https://www.tomsguide.com/us/5g-release-date,review-5063.html>
- Mushroom Networks Publications. (n.d.). How SD-WAN / multi-WAN technology handles the data avalanche from YouTube. Retrieved from <https://www.mushroomnetworks.com/infographics/youtube---the-2nd-largest-search-engine-infographic/>
- Pachal, P. (2019). 7 Tech trends that will dominate CES 2019. Retrieved from <https://mashable.com/article/ces-2019-tech-trends/#I55cZavRnEq4>
- Rao, K. (n.d.) The path to 5G for health care. Retrieved from <https://futurenetworks.ieee.org/images/files/pdf/applications/5G--Health-Care030518.pdf>
- Reichert, C. (2019). CES 2019: The biggest 5G news. Retrieved from <https://www.zdnet.com/article/ces-2019-the-biggest-5g-news/>
- TikTok's Lasso Social Media Page. (n.d.). Retrieved from <https://www.producthunt.com/posts/lasso-by-facebook>
- Tung, L. (2017). IoT devices will outnumber the world's population this year for the first time. Retrieved from <https://www.zdnet.com/article/iot-devices-will-outnumber-the-worlds-population-this-year-for-the-first-time/>

Big Data Analytics for Customer Lifetime Value Prediction

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ABSTRACT

Predicting all the values that a business can derive from its long-standing relationship with its customers is Customer Lifetime Value. As it helps to create a sustainable relationship with selected customers, the importance of CLV is growing at a brisk pace, generating higher revenue that in turn enhances business growth. With increasing competition, retaining existing customers is more profitable than acquiring new customers. To manage and allocate resources efficiently for each and every customer, big data analytics comes into play. Taking this into account, a large amount of data should be taken into consideration, such as client's attrition, objectives, diverse products and services that they use, client's characteristics viz demographic, psychographic, geographic etc. First step to this is data cleaning, pre-processing and data manipulation to achieve a meaningful outcome or information from the raw data, followed by data analysis and visualization. Techniques that can be recommended for the data analysis and visualization of CLV model can be Stepwise regression, Classification and regression trees (CART), Generalized linear models (GLM). To determine the dynamic view of customer behavior, future marketing strategies and to foster brand loyalty, prediction of a proper CLV model is much needed.

Keywords: CLV, Predictive Models, Pareto/NBD Model, Gamma-Gamma Model, Retail Industry CLV, Purchase Count, Lifetime Value, Monetary Value

1. INTRODUCTION

The enhancement of faster processing through Pentium processors introduced back in the early 1990s marked the beginning of the era of information economy. It improved the processing speed of the computers, the ability to run state-of-the-art software devices and store huge amount of data (Kudyba, 2002). Big Data is one of the most hyped terms in today's market and there is no consensus as how to define it. It is not a specific application type but can be rather considered as a collection of trends observed from multiple application types. Big data can include data from web server logs, internet clickstream data, social media content, social media activity reports, customer emails, surveys, CDRs, data from sensors connected to Internet of Things.

Data growth can be classified according to - amount of input data (volume of data), data input type (variety of data), faster ingest of data (velocity of data), data quality or trustworthiness (veracity of data). Through big data analytics it is easier to find unknown patterns and market trends, correlations, association, customer preference and other actionable insights. The analytical observations can lead to better decision making, finding out more effective marketing strategies, new revenue opportunities, improve operational efficiency. It gives competitive advantage over its competitors and provide with business benefits. Big data is used with related concepts of Business Intelligence (BI) and data mining. But the hyped term is different from the other two when data complexity, data volume and the huge data sources are taken into consideration. Data warehouses may not be capable of handling the high

processing demands faced due to huge volume of data sets which needs to be frequently updated or even in real-time. With the purpose of collecting, processing and analyzing of big data, a set of new technologies including Hadoop and tools such as YARN, Spark, Hive are budding. These technologies support the processing of vast and diverse data across clustered systems.

With the increase in customer transaction data it has been quite an interest to estimate the value of customers or assessment of customers. This is an important trend in the disciplines such as - accounting, finance and especially marketing catering to various sectors (Peterson, Blattberg & Wang, 1993).

2. PROBABILITY MODELS

2.1 Pareto/NBD Model

Pareto/NBD Model is one of the most widely used methods for calculating Customer Lifetime Value (Schmittlein, Morrison and Colombo, 1987). It is used to predict the future activities of the customer. The order history is considered to be the primary input and takes into order the frequency and recency of the orders. The basic model stimulates two events - coin and dice. The coin is used to determine the churn rate of the customers and dice to determine how many items a customer will order. Pareto distribution is used to model the coin whereas negative binomial distribution is used to model the dice.

The prediction done by this model rests on the following assumptions (Charu, Trisha, Jarred & Edward, 2013):

- Consider the customer to be alive even after they become permanently inactive.
- While alive, the customer's purchasing behavior follows a Poisson process with a transaction rate to be considered.
- There is heterogeneity in transaction rates and drop-out rates across customers that follow a gamma distribution.

This model focuses only on the time length for which a customer is observed, time of the customer's last

transaction and how many transactions the customer has made. The demographic or the earlier transaction details are not considered.

2.2 Gamma-Gamma Model: Extension to the Pareto/NBD Model

Pareto/NBD focuses only on the number of transactions/purchase count throughout lifetime but does not focus on the monetary value component whereas; Gamma-Gamma model focuses on the monetary value also.

Gamma-Gamma model is based on three general assumptions:

- The monetary value of a transaction randomly varies around their average transaction value at customer level.
- The average transaction value is independent of time for an individual but it varies across customers.
- The distribution of average transaction does not depend of the transaction process across customers. Hence, monetary value i.e. Gamma-Gamma model can be formed separately from the lifetime components and purchase count of the model i.e. the Pareto model.

3. TWO MODELS TOGETHER: ESTIMATION OF CLV AT CUSTOMER LEVEL

- The expected number of purchases done by the customer in a forecasted period is computed by Pareto/NBD model.
- The monetary value to each of these future purchases is assigned by Gamma-Gamma model.
- To forecast CLV for each customer became simplified tying these two models. Comparing CLVs became easier considering the monetary value of lifetime purchases.

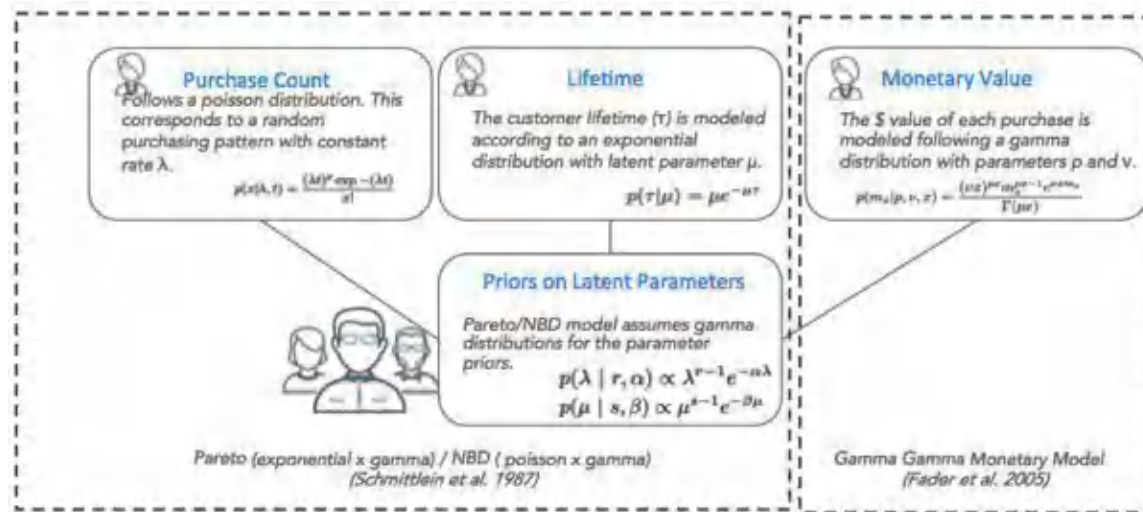


Fig. 1: Two Models: Pareto/NBD and Gamma-Gamma

4. USE CASE FOR RETAIL INDUSTRY

A non-contractual relationship exists between businesses and customers in e-Commerce or retail business. In the non-contractual world, churning of customers happens silently. So, it is more complex to model customer lifetime value for non-contractual businesses and we need prediction for this.

- **Data to Analyze**
 - Customer's last transactions.
 - Is the customer "dead", or is the customer alive but dormant?
 - What is the frequency of repeat purchases made by the customer?
 - The age of the customer or the duration between a customer's first purchase and the end of the period (under consideration).
 - Recency or the age of the customer when they made their most recent purchases (Thus if only 1 purchase is made, the Recency is 0.).
- **RFM (Recency, Frequency, Monetary) Analysis:** RFM analysis is used to quantitatively determine the recency of purchase done by the customer, purchasing frequency of a customer and the expense done by the customer (monetary) from this, probability of customers who are surely alive, can be predicted. Customers having very high frequency and very high recency are likely to be the best customers in future.

- **Prediction of CLV Using Probabilistic Models:** These models (Pareto/NBD model) work on a method which predicts a customer's expected purchases in the next period going by their transactional history. Data should be predicted by the model and tested and cross-validated by machine learning practices to achieve higher model accuracy for predicting CLV. According to that trained model, the historical probability of customer being alive is predicted, given a customer's transaction history. For predicting monetary value, Gamma-Gamma model is ideal, since this model considers the economic component of each transaction and then estimates customer's probability to remain "alive" indicating proper customer's CLV prediction in retail businesses.

5. VALUE ADDITION OF PARETO AND GAMMA-GAMMA MODEL FOR PREDICTIVE CLV CALCULATION

Historical customer lifetime value is the simplest approach for calculating CLV. The historical methods do not account for time. It is solely based on the past transactions but doesn't help in predicting the future activities of the customer. This approach is valid if the customers have same behavioral pattern and over a same time span. Among customers, there can be a good amount of heterogeneity. Historical approach of CLV estimation will apply recency of the last purchase, thereby filtering out the criteria of segregation between the non-active and the active users.

The aim of a predictive model is identifying the purchasing behavior of customers in order to predict the future activities of a customer. In the non-contractual business context, Pareto model is a frequently applied probabilistic model. It focuses on three latent behaviors, the time period for which the customer is in relationship with the company or defining customer lifetime behavior and the number of purchases made by the customer over a given period or the purchase rate. The lifetime distribution follows an exponential distribution with slope μ and the purchase count follows a Poisson distribution with rate λ . The Pareto model is trained to find out the parameters over a particular training period within a minimum time span that corresponds to thrice of the typical inter-purchase time of the customers. Pareto model takes the historic or transaction data as primary input to predict for the future, thereby helping in business contexts.

6. CONCLUSION

Pareto/NBD model mainly focuses only on modelling purchase count and lifetime but Gamma Gamma model provides monetary aspect of the future purchases also. Hence, Gamma Gamma model is basically the monetary value extension to the Pareto/NBD model. The expenditure of a client is assumed to be independent of the transaction behavior in case of Gamma-Gamma model. Models like Pareto/NBD only predict the transaction behavior, independent of the monetary value and this limitation is being nullified by Gamma-Gamma model.

REFERENCES

- Custora, U. (n.d.). Pareto/NBD model. Retrieved from <https://university.custora.com/for-marketers/clv/advanced/pareto-nbd>
- Fader, P. S., & Hardie, B. G. S. (2013). The gamma-gamma model of monetary value. Retrieved from http://www.brucehardie.com/notes/025/gamma_gamma.pdf
- Kudyba, S. (2002). Pentium processors improved the processing speed of the computers. Retrieved from <https://www.modernanalytics.com/wp-content/uploads/2014/07/Chapter-1.pdf>
- MyCustomer. (n.d.). Customer lifetime value: How online retailers can measure and use CLV. Retrieved from <https://www.mycustomer.com/community/blogs/silviya-dineva/customer-lifetime-value-how-online-retailers-can-measure-and-use-clv>
- Peterson, B., & Wang, P. (1993). During the past century, database marketing techniques have become increasingly important. Retrieved from <https://www.scholars.northwestern.edu/en/publications/database-marketing-past-present-and-future>
- Schmittlein, D. C., Morrison, D. G., & Colombo, R. (1987). Counting your customers: Who are they and what will they do next? *Management Science*, 33(1), 1-24. Retrieved from https://www.jstor.org/stable/2631608?seq=1#metadata_info_tab_contents
- Towards Data Science Pages. (n.d.). Retrieved from <https://towardsdatascience.com/whats-a-customer-worth-8daf183f8a4f>

Moving Beyond Paperwork: Blockchain in Public Sector

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ABSTRACT

The purpose of this research paper is to focus on the granular assessment at use-case level of the opportunities of blockchain in the public sector. Blockchain is a secure, shared, distributed ledger that can redefine the nature of transactions and transform global administration and economy. As governmental documentation requires extensive paperwork that involve intermediaries and centralized ledgers, the system remains untrustworthy, tedious, expensive and inefficient. Moreover, a significant challenge for the public sector involves the lack of effective traceability and transparency. The establishment of a trusted identity becomes a problem due to forgery, expensive background checks and enormous paperwork necessary during verification. The paper also aims on how governments or public sectors can utilize blockchain - a distributed and secured ledger, which can improve security, data transparency, documentation and rate of inspection. Blockchain can prove to be a technological platform for various public sector use-cases like - tax collection and reporting, identity management, digital currency, public procurement, voting, land registry, government records etc. In each of the mentioned cases, blockchain has the potential to create value regardless of the type of record keeping or transaction involved which will help governments and public sectors to build trust and transparency and thus changing the way to deliver for the citizens.

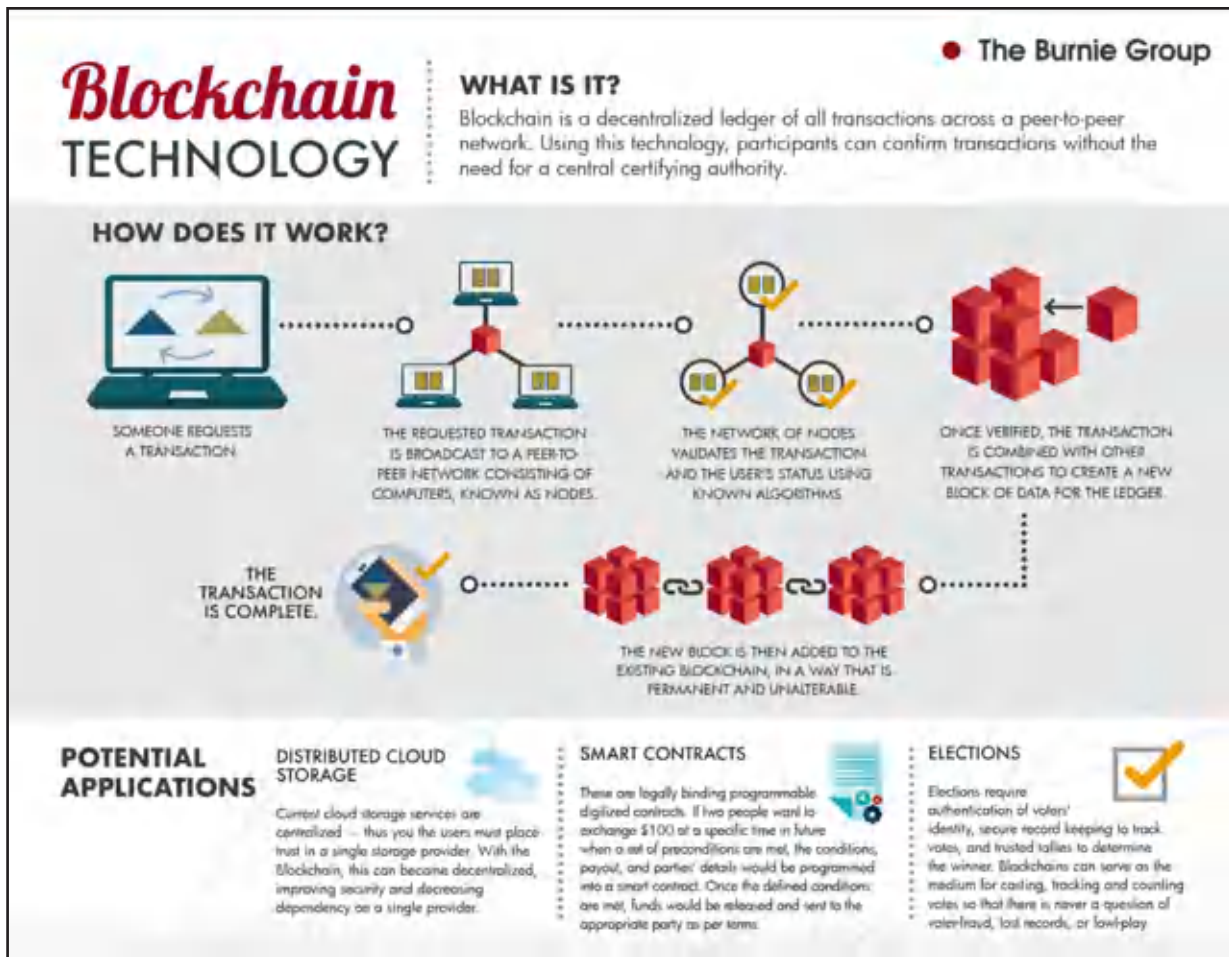
Keywords: Blockchain, Public Sector, Distributed Ledger, Consensus, Land Registry, Voting, Digital Certificates Value, Monetary Value

1. INTRODUCTION

From barter to bitcoin, with time, the way we trade and exchange value has evolved in our society. Blockchain, being the latest of all, is expected to transform not just monetary transactions, but the idea of exchanging of all kinds of digital pieces of information. In its most literal sense, blockchain is just a chain of blocks. However, not in the traditional sense of those words. In this context, “blocks” are the digital information and “chain” is the public database that the “blocks” are stored in (Danial Daychopan, 2016).

Blockchain, although a term that is not alien to none, is a concept that is yet to be comprehended by majority.

This complex concept consists of different technologies, where each one is as important as the other and makes it the revolutionary concept that it is. Let's take the example of Google Docs. Before the Google Docs era, we worked on Microsoft Word which required a lot of back-and-forth. If it was a document that multiple people had to work on, the others had to wait for the one who was working on to send it to them, edit or add comments on it and send it back. However, with Google Docs, anyone who has access to the document can edit and collaborate with others working on it in real-time. The changes made by one cannot be denied, but is seen by everyone. This is precisely how blockchain works. Whereas in this context, instead of a shared document, it's a shared ledger that all the involved parties have access to. And the changes made within it can be verified by everyone in that network.



Source: <https://burniegroup.com/infographic-a-look-at-blockchain-technology/>

Fig. 1

2. BLOCKCHAIN WITH A REAL-WORLD ANALOGY

- The Central Parking System Analogy:** A simple real world analogy of a parking lot system will help in demystifying this foundational technology. Take an example of a big parking space built by a private company which can accommodate 500 cars at a time. Note that the parking space has a single main gate which stays locked and is only opened when a car enters or exits. A deeper analysis into this analogy will help in understanding various facets of blockchain (Siddharth M, 2016).
- Price:** The parking space is built by a private company, and the owner of the parking space bears the operational and maintenance expenses. Hence, the private company rents out the parking space with very high rental charges.
- Security:** Since there is only a single main gate for for entry or exit, any trespasser or burglar who manages to cross this main gate can access any of the cars parked in the parking space.
- Limit:** The total accommodation limit of the parking space cannot exceed. If there is a need for accommodating more than 500 cars, the private company has to build a new parking space.
- Trusted:** As a rental charge is levied for using the parking space, the car owners trust the company for the security and reliability.
- Centralized:** The cars are parked in a single parking space with a single main gate for entry and exit hence the parking space can be considered as a centralized system.
- The Distributed Parking System Analogy:** The above mentioned parking system analogy can be modified

to understand a different point of view the system. Consider there are 500 houses in the city and each of these houses have two garages. One of the garages of each house has one car parked in it (those 500 cars that were earlier parked in the centralized parking) and the other one is empty. The owners of these garages plan to rent out the empty garage thus solving the problem of accommodating more number of cars than before. To understand the outcome of this modification various parameters can be analysed similar to the previous analogy.

- **Price:** The parking space is now owned by individuals, planning to rent out the other garage. Since the parking space is small and the owners didn't plan to rent out the garage when built the rental charges would be comparatively cheaper. Moreover, the operational and maintenance costs incurred to the owners would be lesser compared to the single large parking space.
- **Security:** The cars are parked in different garages. Even if the trespassers or burglars manage to open the garage, they can access only one car that is parked in the garage. Thus increasing the level of security in a distributed parking system.
- **Limit:** The total accommodation limit of the parking space cannot exceed. If there is a need for accommodating more than 500 cars, the private company has to build a new parking space.
- **Trustless:** The lack of a central authority control ensures that in the distributed parking spaces, there will be certain rules set by all the participating garage owners for renting out their places.
- **Decentralized:** As these parking spaces are distributed throughout the city, it can be considered as a decentralized parking.

3. WILL BLOCKCHAIN TRANSFORM THE PUBLIC SECTOR?

The unique design of the blockchain makes it ideal for situations requiring security, transparency and collaboration. The blockchain is thus seen to have limitless potential, especially in public sector, because of these traits. The public sector, federal, state and local governments are flooded with data. The growing need for adoption of exponential technologies on a large scale is encouraging countries across the globe for experimenting with multiple use cases of blockchain technology. However, a major challenge for government organizations is to understand how to apply the technology to optimise their services. The starting point for this could be by looking at the specific pain points in the current processes. Next step would be to identify ways to optimise these processes by leveraging the blockchain technology. Once the vision is set, it should be formalized into use cases to design solutions.

The influence of blockchain in the public sector is mostly going to be behind the curtains. But it is expected to bring efficiency, security and speed to varied range of services and processes in the public sector. Storage of static information, i.e., record keeping is a critical action when it comes to public sector. Timely updation of records, ensuring adequate security, managing the access to these records, immutability, transparency, secure storage and preservation of data are paramount to areas in the public sector where information has to be stored across different systems or databases. Thus, it is necessary to select the right use cases to come up with viable business case to project the solutions on a larger scale (Mckinsey, 2018).

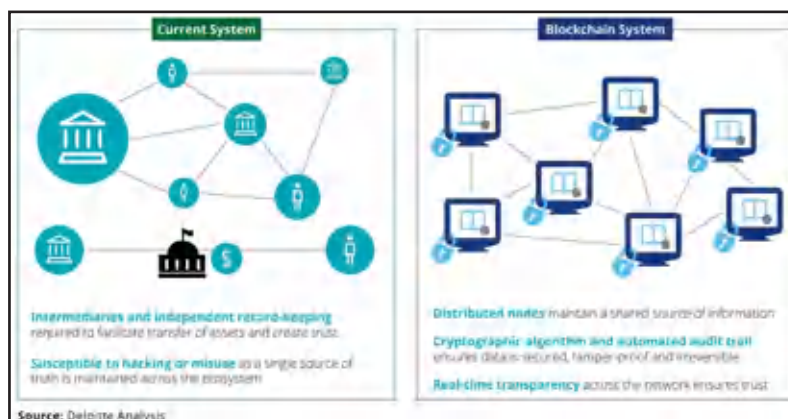


Fig. 2: Traditional Database vs Blockchain-Based Distributed Ledger

- **Land Registry:** Land is one of most valued assets and source of investment for various organizations, registered institutions and even individuals. Land ownership being a highly priced asset it has been the crux for various frauds and crimes. Land registry is a critical procedure that needs intense verification and authentication. In the absence of a transparent

and effective land registry system, land ownership, land title transfers, deeds, notary etc. will not be able to provide critical protection to the land owners or buyers (Jamie B, Théo B, Angela H, 2018). The following explains the crucial pain-points in the current land registry process:

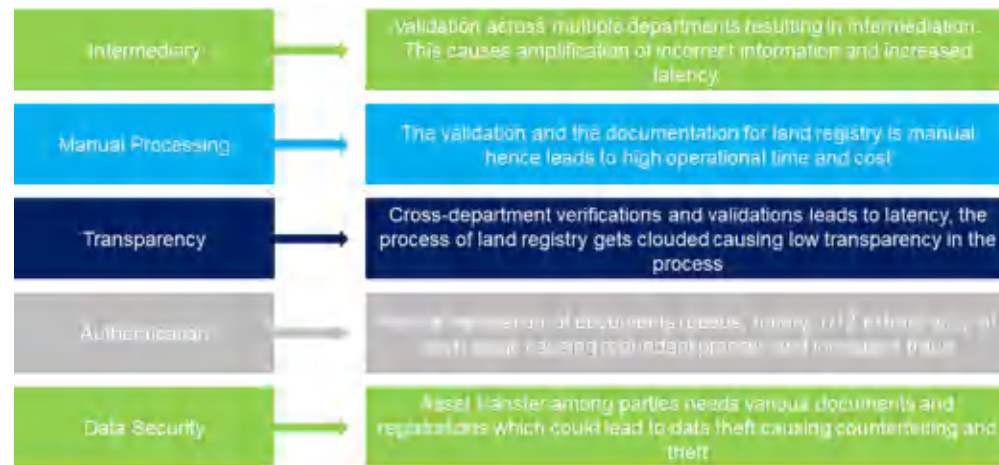


Fig. 3

Blockchain can prove to be an effective technology to vanish the pain-points of the land registry procedure. The ‘proof of process’ and ‘proof of existence’ features enable blockchain to be the apt technological inculcation in the public domain. A decentralized system can reduce the intermediate departments and processes, increasing trust and efficiency by reducing operational time and cost. The traceability feature of blockchain we provide visibility of all land title exchanges and thus reducing civil cases related to property conflicts. Blockchain being tamper-proof ledger, counterfeiting documents would be difficult

enabling the the land registry being more transparent and authentic.

- **Voting:** Voting is one of the fundamental elements in forming a government. Due to the criticality, the voting procedure (from registration of citizens to declaration of results) must be highly transparent. Conducting elections on national or regional level could be cumbersome and challenging. The following explains the crucial pain-points in the current voting process:

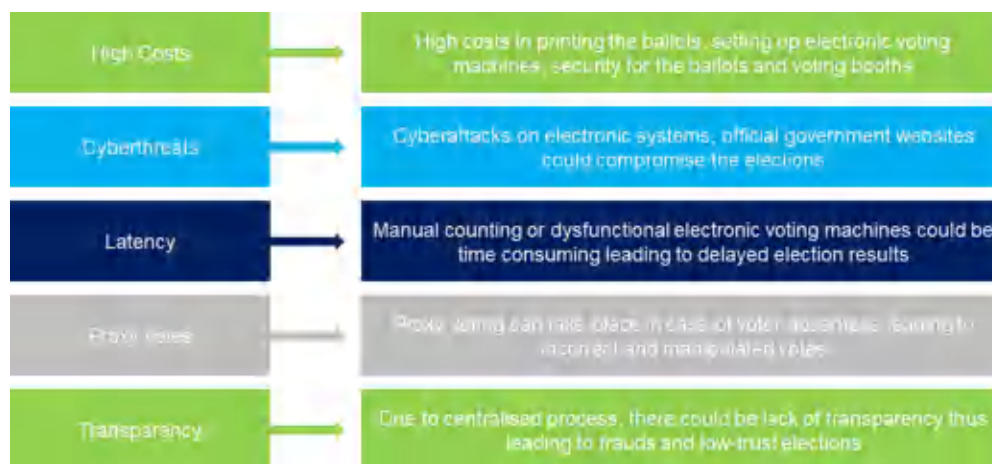


Fig. 4

With the inculcation of blockchain technology citizens can cast votes in the similar way as they perform other transaction. Citizens can initiate secure voting, validate the casted vote and even verify the declaration of results. A blend of anonymous vote-casting, identity management using digital method, personalized ballots etc. can make voting more transparent and efficient. Operational costs are reduced due to blockchain, thus saving government's expenditure for elections. Enhanced security and authenticity of votes can be achieved by using blockchain. Blockchain will enable citizens to vote remotely and thus leading to increased participation and reduction in proxy votes.

- **Digital Certificates:** Citizens use e-cards or digital copy of identity cards (government, official etc.) while interacting with e-commerce, government agencies, banking sites etc. Third party institutions/agencies use these digital copies for remote verification or online transactions. Unverified or counterfeited documents can lead to identity theft or misuse of documents for frauds. The following explains the crucial pain-points in the current digital certificate authorization process:

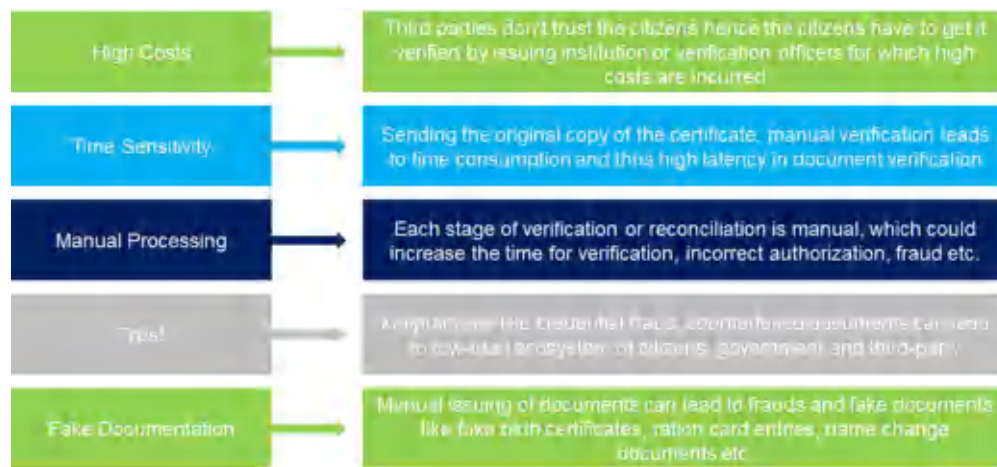


Fig. 5

Advancements in blockchain technology will enable citizens, government and third parties to store and retrieve verified digital certificates anywhere and anytime. The hash of the issued certificate will be stored immutably. The certificate would be signed by the issuer digitally and the hash will be stored in the blockchain. Blockchain will ensure that the citizens are the sole owners of their credentials irrespective of the issuing institution. Blockchain technology will enable verification of documents almost real-time thus reducing the time and cost. Fake documentation, misrepresented documents, misuse of credentials can be reduced by adopting blockchain due to its tamper-proof feature. Blockchain is

immutable and hence the certificate issued can be used any number of times in the future (Deloitte, 2017).

4. CONCLUSION

The broad applicability and its transformative potential thus makes blockchain technology worthwhile to venture the plethora of possibilities in the public sector. Evidently, a blockchain based solution to its current alternative could improve the existing situation in terms of efficiency and could potentially reduce or entirely eliminate frauds (McKinsey, 2018). A granular assessment on the proposed use cases showing the impact vs feasibility plot is given below:

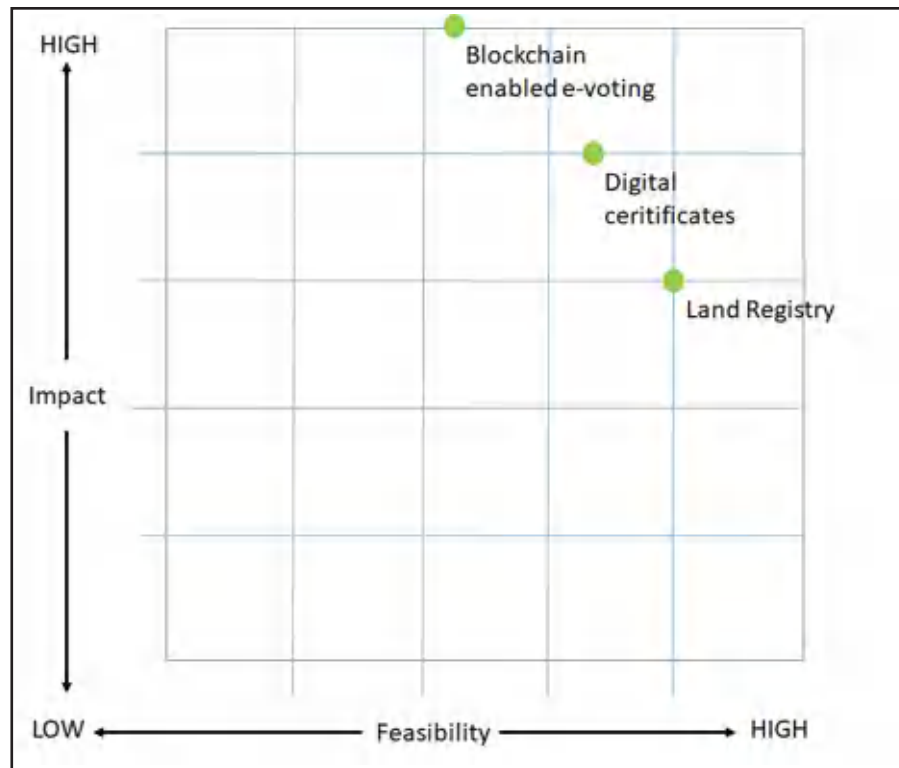


Fig. 6

With the right platform and necessary guidelines in place, if the government works as a facilitator, providing an enabling environment to interested players, successful implementation of blockchain is in the near future. However, there is a need for industry enabling initiatives like roadmap initiatives defining use cases to be explored over a period of time, encouraging start-ups to conduct pilot testing through regulatory sandbox, building an ecosystem to accelerate the adoption of blockchain, etc. by the government. Though large scale applications in the public sector may still look like a long shot, it is quite possible that the public sector will experience the impact of blockchain very soon.

REFERENCES

- Daychopan, D. (2016). Barter to bitcoin - History of money and the blockchain. Retrieved from <https://medium.com/@DDhopn/the-only-security-in-this-world-is-a-reserve-of-knowledge-not-money-so-said-the-industrialist-69fef9011074>
- Deloitte. (2017). Will block chain transform the public sector? Retrieved from <https://www2.deloitte.com/insights/us/en/industry/public-sector/understanding-basics-of-blockchain-in-government.html>
- Deloitte. (2017). Block chain technology and its potential in taxes. Retrieved from: https://www2.deloitte.com/content/dam/Deloitte/pl/Documents/Reports/pl_Blockchain-technology-and-its-potential-in-taxes-2017-EN.PDF
- Berryhill, J., Bourgerly, T., & Hanson, A. (2018). Guide to block chain technology and its use in the public sector. Retrieved from <https://www.oecd.org/gov/innovative-government/oecd-guide-to-blockchain-technology-and-its-use-in-the-public-sector.htm>
- Humenansky, J. (2018). The impact of digital identity. Retrieved from <https://blockchainatberkeley.blog/the-impact-of-digital-identity-9eed5b0c3016>
- Mckinsey Digital. (2018). Block chain explained: What it is and isn't, and why it matters. Retrieved from <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/blockchain-explained-what-it-is-and-isnt-and-why-it-matters>
- Siddharth, M. (2018). Beginner's guide to blockchain - Explaining it to a 5 year old. Retrieved from <https://hackernoon.com/beginners-guide-to-blockchain-explaining-it-to-a-5-years-old-772caac6ae97>

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Sachs, J.D., Bajpai N. and Ramiah, A. 2002. Understanding regional growth in India. CID Working Paper No. 88. Center for International Development, Harvard University, Massachusetts.

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Give the author's name, if known and year of publication; or give the periodical/newspaper's name or the organisation's name as author. This should be followed by the full title of the document; the http, or other addresses; and the date the document was posted or accessed. Basu, I. 2004. India's thorny FDI rule under scrutiny. Asia Times.

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