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TELECOM BUSINESS REVIEW

Editorial Board

Editorial Review Board

Editorial Message

It gives me immense pleasure in presenting to you the Thirteenth issue of "Telecom Business Review" (TBR): A journal of Symbiosis Institute of Digital and Telecom Management, constituent of Symbiosis International (Deemed University). 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 2020 Issue, we have published articles on diverse topics such as , "Building Blocks of an AI Framework for an Enterprise", "Consumer Behavior towards Mobile Social Media and OTTs from Data Monetization and Customer Engagement Perspective", "A Survey of Methods, Tools and Applications of Knowledge Base Construction (KBC)", "Value Stream Mapping (VSM) Led Approach for Waste and Time to Market Reduction in Software Product Development Process", "Data Protection Framework for India", "Fintech: Emerging Trends", "Niral Open Product Framework", "Convergence of 5G, AI and IoT Holds the Promise of Industry 4.0"," Building the Next-Gen Cyber Security Operating Model in a Digital Eco-System".

I am sure the TBR Research Journal 2020 will help to trigger quality studies in the field of Digital & Telecom Business Management and enlighten and educate the Digital & Telecom fraternity.

At the release of the Thirteenth 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 Digital & 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 SIDTM

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Building Blocks of an AI Framework for an Enterprise

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Abstract

Speaking broadly, an AI framework consists of six main layers starting with Data Integration layer. All AI applications need some kind of integration with the input data sources from enterprise applications. So, it is essential that AI framework has the capability to integrate with different data sources for seamless data exchange. This study is an overview of the building blocks of an AI Framework to deal as an analytic tool for the manager's tussle with AI's influence on their industries. The core of the framework is an "AI Ecosystem" where all AI, ML & NLP capabilities or "AI Assets" will reside and will have the option to pick and choose the best of the breed capabilities for building AI, ML applications. These AI capabilities can be versatile, like cognitive text processing, speech, computer vision, cognitive search, etc. Also, the framework should be able to connect to different hosting applications or channels to host AI applications or solutions. It is also advisable to have a Framework Management layer wherein features like setup & configuration, monitoring of different services, monitoring and reporting can be embedded. As security is one of the key elements of any framework, it should also be accounted for while designing a sustainable AI framework. Such a framework is going to provide flexibility and agility while building any AI solution. As AI is purely data-driven, this study intends to provide an insight into an enterprise-wise policy or data standard to designing and assembling an AI system.

Keywords: AI Framework, Data Integration Layer, AI Ecosystem, Computer Vision and Cognitive Search

1. Introduction

Some organizations are already into their Artificial Intelligence journey while many are yet to embark on or have just started, probably in a very nascent stage. The typical challenges that every organization encounter while stepping into their AI journey are similar at a broader level, so the solutions to overcome those are also somewhat similar. An AI Framework or it can be termed as an AI Platform can help to overcome many of those challenges. An AI framework can be as light as the only couple of core components, capabilities and libraries loosely integrated to start with. But this will create a huge difference in terms of the flexibility and agility that it can bring while building AI applications and solutions.

The reason why an AI framework plays a major role is, AI is an evolving field, many of the AI capabilities are still maturing and many times some amount of experimentation or R&D is indispensable while developing most of the AI solutions. Even while building solutions leveraging AI capabilities from external providers it empowers with the flexibility to experiment with different capabilities from different providers for the best results (Bhatia, 2017). Secondly, a framework boosts rapid development because the developers can concentrate on the functionalities of the use case and need not have to ground up everything from the scratch every time which saves a lot of time and effort (Harald Gunia, 2018) and most importantly, a framework is always proof of concept (PoC) friendly, PoCs can be developed quickly within the framework and showcased those to the stakeholders for further perusal and confidence building for decision making (Dialani, 2019). Also, a framework will provide the power to try and test alternative approaches quickly and "Fail Fast".

Speaking broadly, an AI framework consists of six main layers starting with a Data Integration layer. All AI applications need some kind of integration with the input data sources from internal or external enterprise applications. So, it is essential that AI framework has the capability to integrate with different data sources or it is capable of sitting on top of a data platform for seamless data exchange. The data platform can be a Big Data platform or a Data Lake which probably is widely popular nowadays in an enterprise environment (AIM, 2020). If a data platform is already available within the enterprise that can process and offer data in a format that can be

directly consumable by the AI applications, then curated data can be directly integrated with the framework. But in most cases that may not be the case, and data scientists end up doing the heavy lifting transforming the raw data to an AI ingestible format within the AI framework. There are some data platforms available in the market today, they use machine learning and other data processing techniques and can provide data in an abstract layer wherein the machine learning algorithms and AI applications can directly consume those as input.

2. Literature Review

AI has proven itself as a technology that has the potential for disruption of the status quo. Using AI/ML the tasks of prediction has now become simpler, easier and more accurate. The value of prediction realized with faster, accurate predictions having high productivity. Enterprises have leveraged this in several ways (Tesafaye, 2019).

Prediction becomes easier when a variety of data are available to be ingested in AI platforms. Since data is the backbone of these AI frameworks, the amount and variety of data availability is very necessary for better prediction (Fintech News, 2020).

There has been research on AI frameworks in finance sectors and there are multiple use cases developed to predict and assist loan requirements for customers. Automating the process of insurance using AI techniques has been successfully verified with many use cases with faster and more reliable results with fewer paper works (Buchanan, 2019).

However, the development of the AI platforms is still at a nascent stage and many enterprises are yet to adopt the platforms. The rudimentary problems faced across is not domain-specific rather is a generalized issue in nature.

There has been less research on building blocks of AI frameworks and insights on an enterprise-wide policy or data standard to designing and assembling an AI system upon which is the main purpose of this research paper.

2.1. AI Framework and AI Ecosystem

The core of the framework is an "AI Ecosystem" where all the AI, ML & NLP capabilities or "AI Assets" will reside and will provide the flexibility to pick and choose the best of the breed capabilities for building any AI, ML applications (Wade, 2020). These AI capabilities can be versatile, like cognitive text processing, speech, computer vision, cognitive search, advanced analytics services, machine learning and deep learning capabilities etc. AI ecosystem may also consist of NLP engines & capabilities or even cognitive OCRs and automation capabilities like RPA/iRPA. These AI capabilities or AI assets can be from external providers as well as capabilities developed in-house that comprises the core of the framework.

Around the core AI & ML assets, one may build custom capabilities which can either be specific to a domain or specific to the group of use cases. The capabilities or components a level above the granular services helps rapid use case development just by connecting the components instead of building it from the algorithm or asset library level (AIQRATE, 2020). Examples can be cognitive knowledgebase search engine, NLP processing engines of specific use or even any other analytics engines for that matter, or the components powered by Fuzzy Logics or other ML custom classifiers reside.

Another capability which is essential for an ideal AI framework is, it should be able to connect to the different hosting applications or channels to host the AI applications or solutions (Paschen et al., 2019). The channels or hosting applications can be any of the enterprise applications and mobile apps or social media channels like Facebook, WhatsApp, Skype and Emailing systems etc. Hosting channels can be even virtual assistants like Alexa, Google Home, Siri or any other voice-enabled devices. Hosting channels can be in many times the applications & mobile apps in the partner ecosystem. This layer essentially acts as a middleware with a variety of connectors to hook AI solutions to different hosting channels.

It is also advisable to have a Framework Management layer as the bottom-most layer in AI framework wherein features like setup & configuration, provisioning and monitoring of different services, monitoring and reporting can be embedded. This layer essentially will become the foundation of the framework and will be responsible for providing support to different services of various AI applications running on top of it. In many cases, some of the infrastructure-related stuff can also be controlled and configured in this layer. As security is one of the key elements of any framework, it should also be accounted for while designing a sustainable AI framework. Security features can be ranging from data security, securing AI applications, security aspects of integration points and interfaces, all can be configured and managed at the framework level in the management module.

At an advanced stage, as the AI framework matures, one should also think of "Templatized Use Cases" and solutions built-in to the framework or custom wizards for building solutions. This topmost layer ideally should contain different template applications that can be dragged and dropped into the framework workbench, and the application with minimalistic features and algorithms should be ready just by dragging and dropping. For example, if someone wants to build a recommendation engine of some kind of a solution on credit risk assessment or even a ChatBot; it should be able to just drag and drop the template recommendation engine or chatbot in the workbench and the recommendation engine or the chatbot in its simplistic form is just ready with minimal features or MVP (Minimal Viable Product). The minimalistic algorithm required for the use case along with interfacing with the input data sources and hooking with y hosting channels will be ready. So, the ground-zero activities and the heavy lifting that someone normally does while building any application is now just a click away. This can reduce up to sixty percent of the time and effort that which is usually spent just to build the skeleton of any application (Buckl, 2010). Once this huge chunk is automated, developers can concentrate on rest of the things like adding more features, fine-tuning for better accuracy and all types of optimizations and polishing which are anyways beyond the scope of automation in an enterprise environment.

Other essential elements of the AI framework are "Domain Vocabulary" or Metadata and a "Feedback Learning" process (Pruss, 2017). As AI, machine learning algorithms need domain specific information to better perform, so maintaining a domain vocabulary is desirable. Similarly, any AI application is going to faulter in certain scenarios and may throw those into an exception queue wherein most cases it will expect human intervention although some automation is possible in some of those scenarios as well nowadays. In either case, integrating feedback learning process within AI applications through framework will essentially increase the accuracy of AI applications over the period of time and such an approach can reduce those exceptional scenarios significantly.

3. High-Level Building Blocks of an AI Framework

Analytical and balanced Platform which is modular, customizable and help to build rapid solutions connecting the knowledge assets of the enterprise (Paschen, 2019). It is a platform which provides a building solution. The deployable run times are available on the cloud environments like AWS, Google, Azure, IBM Bluemix and this has resulted in lower costs and easy maintenance. Switching between different environments was easy as cloud integrators were modular and were easier to deploy.

Fig. 1: Framework Architecture

3.1. Building Blocks of an AI Framework

The AI framework has six major building blocks on a high level.

The First Block is an AI Eco System (AI Assets) – It consists of a range of different AI capabilities and provides the flexibility of integrating the best of the procreate capability for providing different AI solutions like chatbot, text processing, speech synthesis and analytics, computer vision, NLP engines, standard machine learning models or any other AI applications (Tesafaye, 2019).

The Second Block in the Framework is AI Plugins: The plugins help to choose the best capability and build a hybrid solution. AI plugins are used for custom services to be written and integrated into the form of Machine Learning, NLP and Deep Learning capabilities. Plugins are a level higher in the abstraction from the core granular AI assets (Tsiukhai, 2020).

The Third Block is Cognitive Engines: Orchestration between all the different blocks and bringing the AI Services live is what the Cognitive Engines does. It wires and provides the services for the realization of different AI solutions (Singh, 2019).

The Fourth Block is a Connector to Hosting Channels: The platform provided the flexibility of delivering AI capabilities on many different Channels. Those could be channels like Web, Mobile Apps, Facebook, Slack, WhatsApp and conversational channels like Alexa, Google Home, Siri etc. (Shvayetsky, 2020).

The Fifth Block is Middleware or Connectors/Adapters for Enterprise Systems: As the fifth block or the platform, it provides intelligence in the context of the enterprise knowledge assets along with many transactional features. These knowledge assets reside in different internal and external enterprise systems, the adapters provide a vital link to join and leverage the information in the enterprise systems (Bennaceur, 2013).

The Sixth Block is Domain Vocabulary: Artificial Intelligence solutions or NLP engine, it requires knowledge contextual to the enterprise and its domain. We have maintained and have kept enriching domain vocabulary related to banking & finance so that existing knowledge could be brought to the chatbot, text processing and other AI solutions.

The framework also provides the Setup, Configuration, Analytics and Reporting capabilities which came under Framework Management Core Services.

These services make the platform complete and fully customizable. It should also provide services for underlying infrastructure provisioning and management.

4. Conclusion

Some of the benefits of the framework approach are, it will also help in standardization and consolidation of the AI applications in an organization's AI landscape which is essential when the number of AI applications grows in the organization.

Bringing the AI framework up to a stage wherein independent AI solutions that can be built on top of it may be a bit time consuming and one may not be able to justify the time and the investment to the higher management or decision makers easily. But the beauty of this approach is, the development of the framework and some of the AI solutions that are being targeted to achieve can go in parallel. So, essentially it will be possible to deliver some of the AI solutions while the framework development phase is in progress. The framework, once it's ready even in its very basic form can improve the development efficiency and reduce the timeline for development and testing to a great extent. It can really bring the agility in AI application development lifecycle in any organization operating in whatsoever domain.

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Consumer Behavior towards Mobile Social Media and OTTs from Data Monetization and Customer Engagement Perspective

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Abstract

A remarkable growth has been illustrated by the Indian telecom industry. In terms of wireless customers, internet users and data consumption, the mobile communications sector has been at the forefront of this movement that will help India to be one of the biggest markets in the world. Social media witnessed a similar evolution, that become a worldwide phenomenon by transcending regional borders. Nearly 73% of total web users use social networking sites in one way or the other. In North & South America, Western Europe, and Oceania, the number of social media users is humongous. The research *"Consumer behavior towards mobile social media and OTTs from data monetization and customer engagement perspective"* summarizes the findings of a pan-India study conducted with the main objective of researching customers' behavior, expectations and key facilitators (Technology, Operation, Computer, etc.) that would then assist Indian mobile network operators (MNOs) to direct their strategy to monetize their data. It tracks user behavior towards social media platforms and offers perspectives from the marketing and customer care perspective on popular social networking, mobile phone items, devices, the effect of social networking/OTT platforms on the voice and messaging systems of the network, as well as the effect of customer interaction on social media.

Keywords: Digital Telco, OTT, Data Monetization, Data Monetization Strategies, Digital Business, Mobile Network Operator, Top OTTs, Top Social Media

1. Introduction

1.1. Background

As we know today, the desire for ubiquitous means of communication has given birth to 'Mobile Services'. While it is continually changing and evolving; over the last decade (2009-2019), the popularity of mobile services has increased leaps and bounds. India, the seventh largest nation by region and the second most populous nation, has been at the forefront of a mobile revolution with over 1,339 billion people (Worldbank, 2020). Taking examples from the global telecommunications industry, the Indian industry has scripted an unparalleled growth story. A paradigm shift from the "voice-centric" business model to a "data-focused" business has taken place in Indian mobile services. This turning point has prompted the (MNOs) to search for new innovative ways to maximize their data revenue.

On the other hand, social media has become pervasive and essential for social networking and the sharing of information. It has become an online discourse category where people at a prodigious pace build content, distribute and network (Asur et al., 2010). The change is advocated by the increased use of smart and mobile devices. In India, the popularity of social media has increased in importance and the use of social media has increased by the day-one in every three minutes used to access a social media platform online (We are social, 2018).

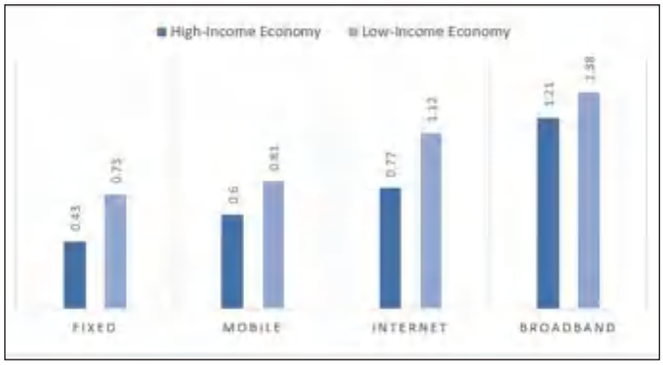
An increasing number of businesses have come to accept social networking platforms as the ultimate medium for consumer interaction and branding (Allen & Overy, 2012).

Operators opened their data pipe with open arms to the innovative Over-the-top (OTT) applications; only to cannibalize their conventional services (Voice, Video and Messaging). MNO's are being marginalized and becoming a 'dumb pipe' with the growing popularity and relevance of OTT players. Operators look forward to engaging with their social media peers and establishing agile market plans. Facebook and Reliance Jio partnership is one such example (2020).

During, the COVID-19 pandemic, with social distancing and remote working norms witnesses change in media habits across the globe. There has been 18% increase in data consumption in March 2020 compared to last year (comScore, 2020). The increase in device usage (Statista, March 2020) was exceptionally high for Smartphone (70%) when compared to others, namely, Laptop (40%), PC (32%), Smart TV or Media streaming services 30%), Tablet (22%) and Gaming console (14%).

1.2. Global Telecom Industry

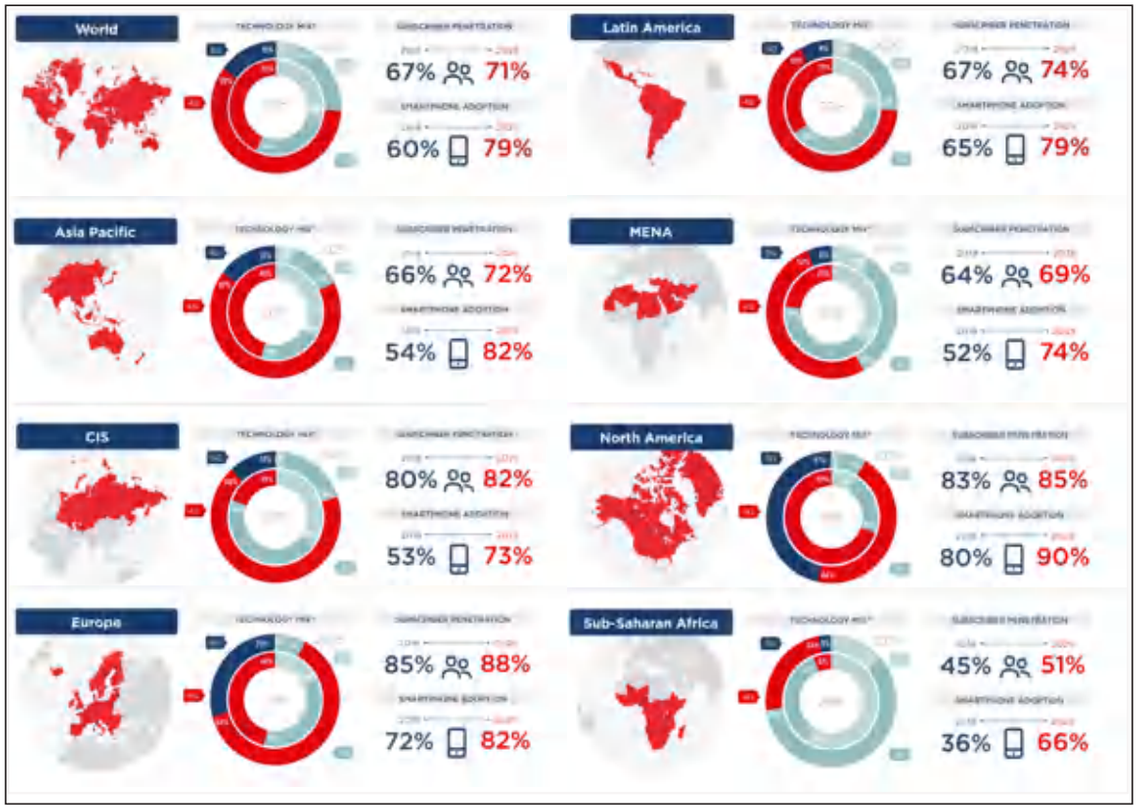
Telecommunications has developed as the lifeline market that drives exogenous economic development. It has profoundly affected the needs of the masses for connectivity, information & entertainment. Telecom has been credited by various reports as a mechanism for economic and social change. The availability of cheaper telecommunications services contributes to greater rates of GDP growth, creates a greater and more skilled population, and makes the population more productive.



Source: World Bank, Information and Communication for Development Report, 2009

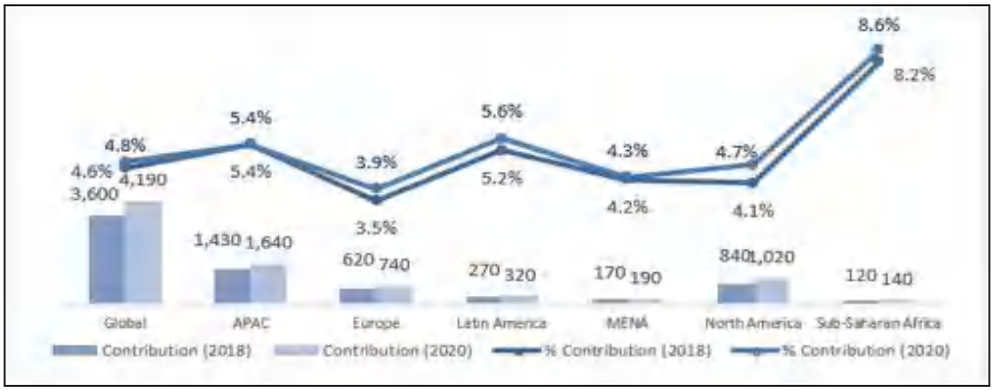
Graph 1: ICT 's Growth Impact (GDP Per Capita Percentage Point Rise with Every Ten-Percentage Point Increase in ICT Penetration)

Mobile networks can be developed at a quicker speed than fixed line systems and can also offer access to geographically disadvantaged regions. The global (individual smartphone subscriber) invasion is a staggering 67 with APAC marginally behind at 66.



Source: GSMA, The Mobile Economy, 2019 (*Note: %age of cellular connections excluding cellular IoT)

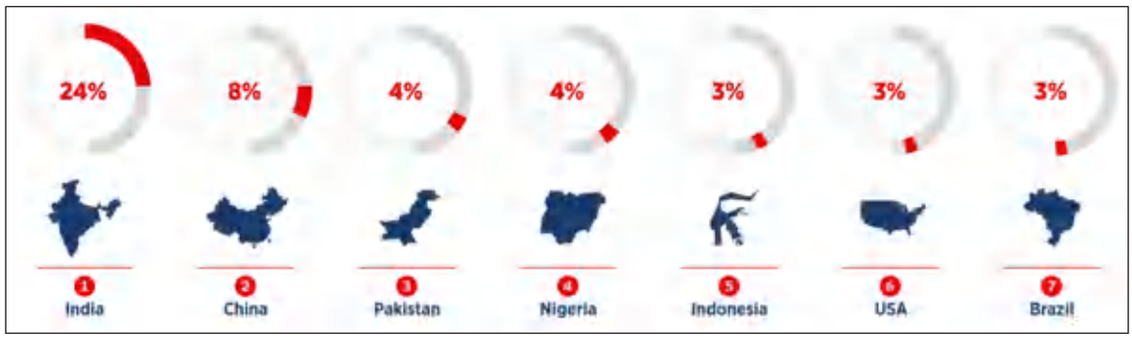
Fig. 1: GSMA - The Mobile Economy 2019



Source: GSMA Intelligence Data, February 2019

Graph 2: Cellular Contribution to GDP (US$ bn)

The developing countries are propelling the subscriber growth. There are about 3.6 billion smartphone network subscribers (almost half of world's population). Half of the world 's device interactions account for 4G. On the other side, smartphones contribute 60% of the connections. GSMA forecasts that by 2025, seven countries will register for new customers: India is at the top with a share of 24% out of 710 million.

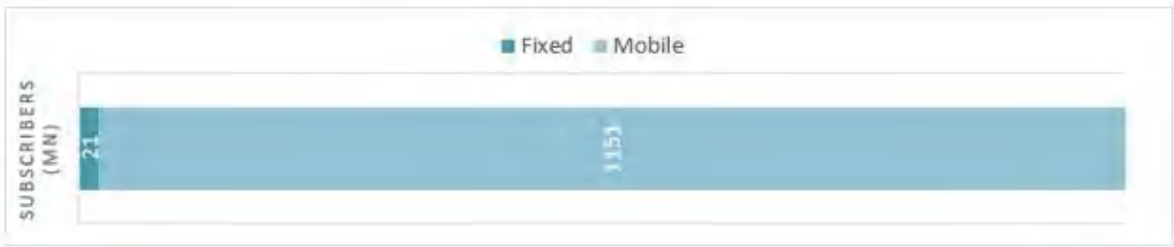


Source: GSMA, The Mobile Economy, 2019

Fig. 2: New Additions for Smartphone Subscribers (By 2025, Top 7 Countries)

1.3. Indian Telecom Industry

The development witnessed by the telecom industry of India has been nothing short of remarkable and is still one of the fastest expanding telecommunications markets in the world. The total smartphone customer base was over 1,151 million by 2020, resulting in a nationwide mobile tele-density of 86.98. Cell penetration over rural hinterlands (tele-density of 56.39) and is dominant in urban echelons (tele-density of 151.90).



Source: Telecom Regulatory Authority of India (TRAI), 2019

Graph 3: Mobile vs. Fixed Line Consumers in India in Million (2019)

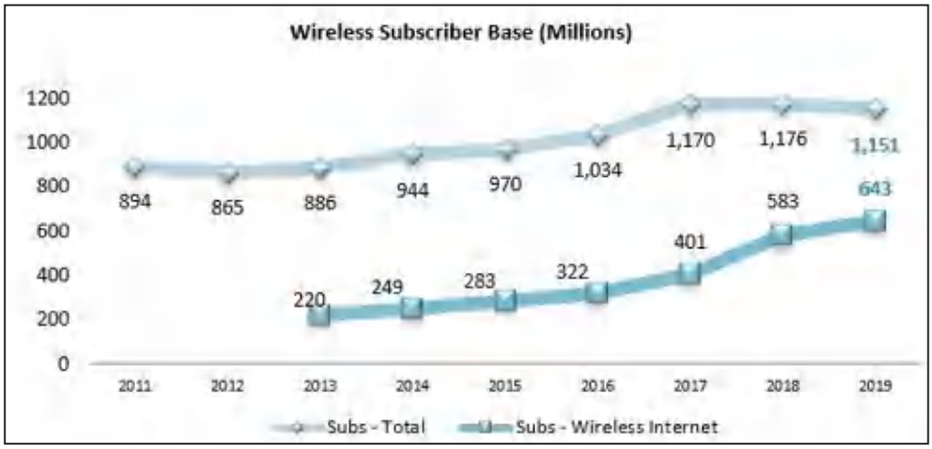
India is the second largest telecommunications market with close to 1.1 billion customers and the third largest mobile market with more than 660 million users.

Table 1: Digital Communications Performance Dashboard (2019)

Particulars	*December 2018*	*December 2019*	*%age Change*
Total Subscribers	1,198	1,172	-0.7%
Wireless	1,176	1,151	-2.1%
Wire line	22	21	-4%
Tele-density	91	89	-3.1%
Urban	160	156	-2.3%
Rural	59	57	-4.8%

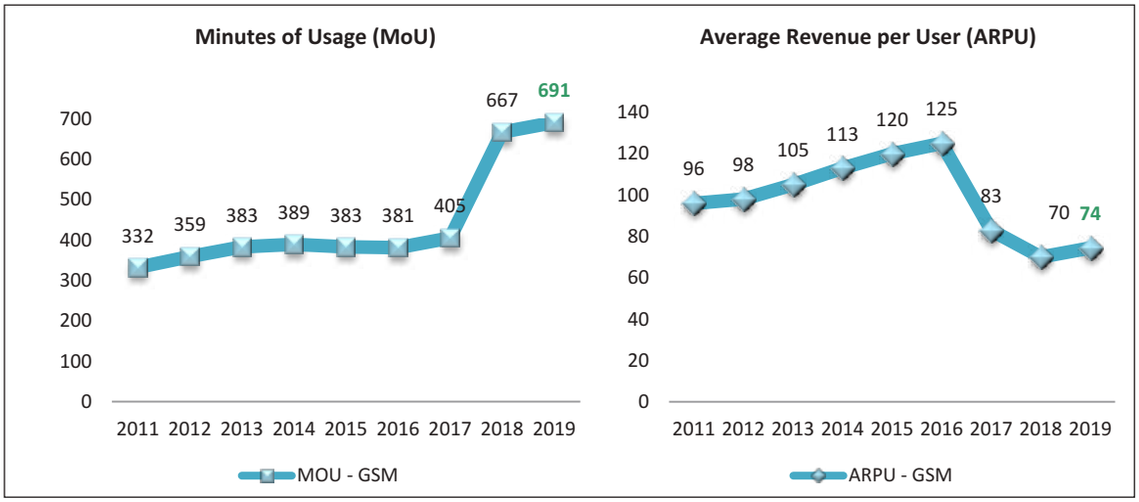
Source: TRAI Performance Report 2018-2019

The industry has witnessed a slight de-growth in overall subscriber base because of market consolidation and exit of multiple players. However, broadband penetration has shown a growth of 60% (post entry of Reliance Jio in 2017). The average minutes of (voice) usage and revenue has shown slight upward trend.



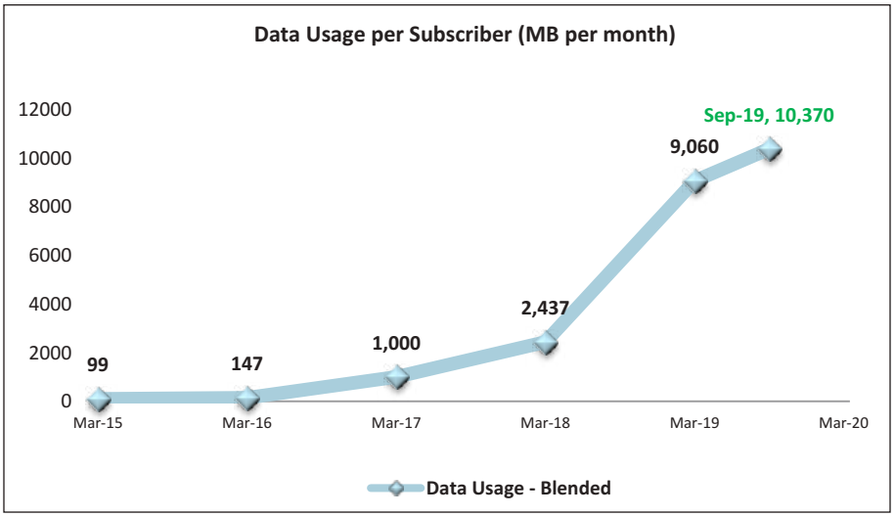
Source: TRAI Performance Report 2011-2019 (2019 depicts data as of December 2019)

Graph 4: Subscriber Growth



Source: TRAI Performance Report 2011-2019 (2019 depicts data as of Sep-2019)

Graph 5: MOU and ARPU

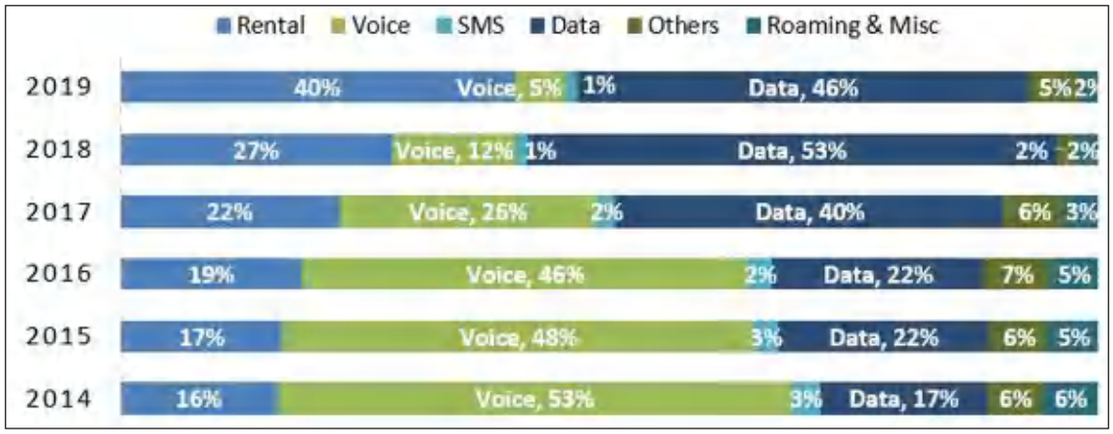


Source: TRAI Performance Report 2011-2019

Graph 6: Data Usage per Subscriber (MB per month)

The interesting 'voice-to-data' phase-shift phenomenon has resulted in 'data' becoming the most valuable contributor:

- The average monthly data usage has seen 10x increase in less than 3 years (i.e. from 1 GB in 2017 to 10+ GB in Sep-2019).
- Data income has moved over the voice to gain the top position (22% in 2016 to 46% in 2019) while Voice revenue has reduced to a minimum (46% in 2016 to mere 5% in 2019).



Source: TRAI Performance Report 2014-2018 (Note: 2019 figures represent Sep 2019)

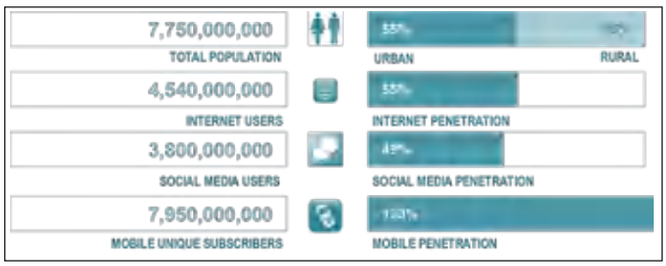
Graph 7: Composition of ARPU

1.4. Social Media Evolution

The intrinsic search of humanity to connect and interact has shifted over the path of information and has given rise to the incredibly popular 'Social Media.' Currently, an engaged social media customer is one out of every four people across the globe (3.8 billion users, Jan 2020). It's a strong customer engagement platform for the company. With the launch of new service services and greater acceptance of smart devices, the scope and use of social networking sites is constantly increasing.

Nearly 100% of the active users are accessing social networking platforms over mobile devices. The increase in popularity of social media sites has been due to the development of Over-the-top (OTT) applications downloadable on smart devices.

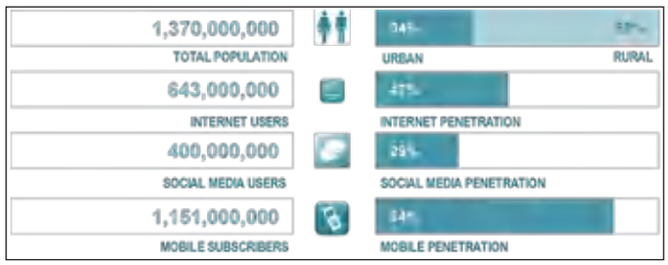
Social networking is a worldwide phenomenon today. Near to 84% of web users use social media (4.54 billion).



Source: We are Social, Global Digital Yearbook (2020)

Fig. 3: Social Media Graph – Worldwide

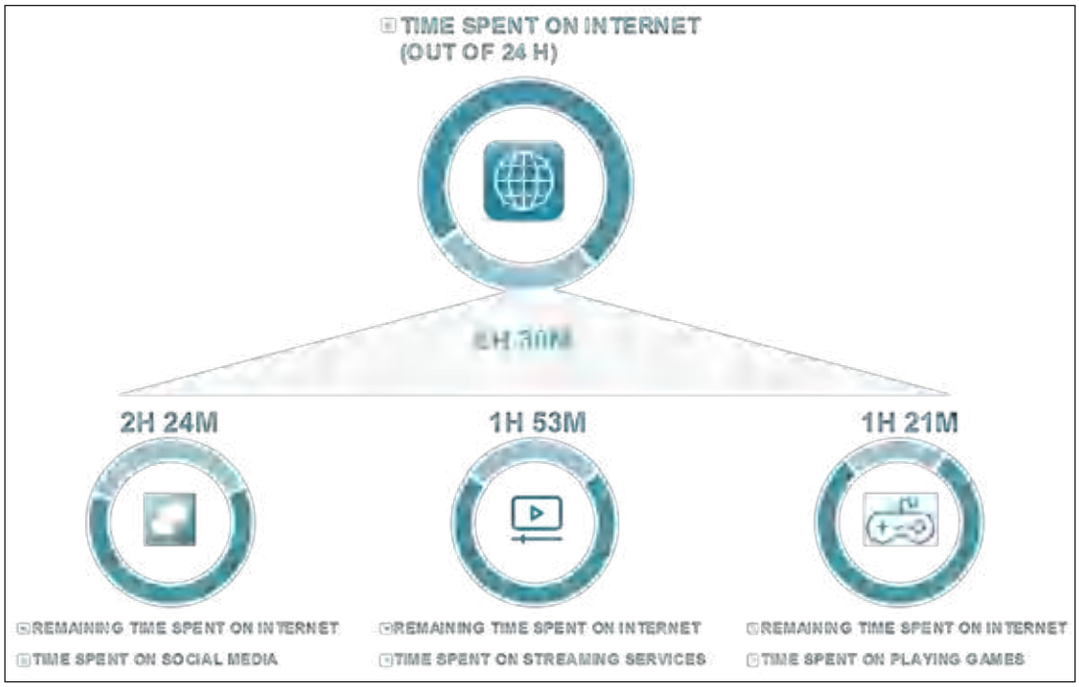
India has never been a step behind in the social media revolution, with close to 30% of its population now active on the social media.



Source: We are Social, Digital 2020 India (2020)

Fig. 4: Social Media Graph - India

On average, Indians spend 7.5 hours online every day: 35% spend on social media platforms; another 41% watch TV (on demand broadcasting, video and streaming) and approx. 19% is spent on streaming music.

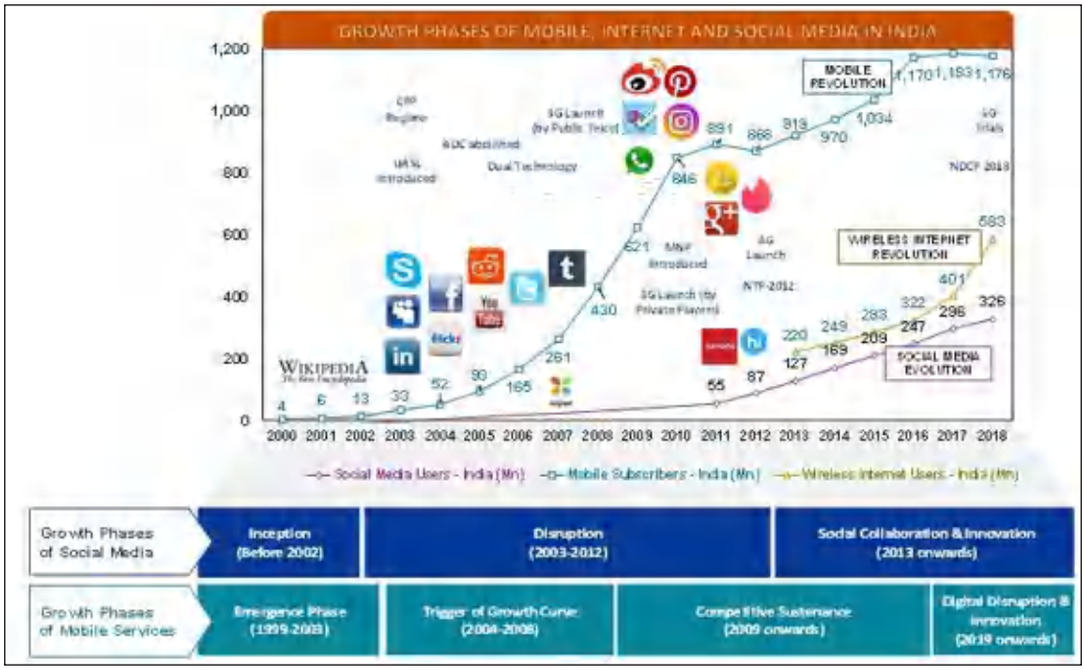


Source: We are Social, Digital 2020 India (2020)

Fig. 5: Internet Time Spent

1.5. Data Monetization

The 'maturity curve' is hitting both the social media and Indian telecom service markets. Indian telecom networks have entered a period of 'digital transformation and growth'. Although social media has entered the 'global collaboration and innovation' period beyond the economic sustenance process, leaving behind the transition phase.



Social Media Growth Phase	Description
I: Inception (Before 2002)	• Inception of Social Media sites using the concepts of Web 2.0
II: Disruption (2003-2012)	• Disruption of socializing model both at an individual as well as organization level
III: Social Collaboration & Innovation (2013 onwards)	• Collaborative business models or technologies to introduce new services or more feature rich propositions

Mobile Service Growth Phase	Description
I: Inception (1992-1998)	• Liberalization of Telecom market and introduction of Mobiles Services in the country
II: Emergence (1999-2003)	• Emergence of unified service providers for growth of telecom infrastructure within the country
III: Trigger of the Growth Curve (2004-2008)	• Dominance of mobile services and momentous growth in national Tele-density
IV: Competitive Sustenance (2009-2018)	• Increase in competitive environment and market driven low-tariff pricing; followed by consolidation
V: Digital Disruption and Innovation (2019 onwards)	• Telco's re-christened as Digital Communications Providers with introduction of National Digital Communications Policy (2018)

Source: Research Scholar's Analysis

Fig. 6: Mobile, Internet and Social Media Development Phases in India

In order to evolve and extend their platforms and engaged customers, social media firms have followed the smartphone path. On the other hand, telecom providers are looking for ways to expand the use of data by their new customers. From a potential growth viewpoint, all of these players can look forward to data monetization strategies.

2. Literature Review

The largest income for telecoms companies has historically been from voice and texting services, with data sales at the bottom until recently (Sujata et al., 2015). The mobile service market of India is moving from a voice-centric company to a data-focused company in its business models (TRAI Performance Report, 2011-2016). Cellular operators are pursuing numerous ways to raise non-voice (or data) sales contributions. Telco invests in predictive solutions to enable real-time demand discovery, real-time deal positioning and real-time deal registration to optimize the acceptance of innovative service plans (or products) (Arthur D. Little, 2018). Operators also sit on a digital data goldmine which will open up opportunities for monetization of consumer data.

MNOs are investing in four strategic areas for monetizing data in next 2-3 years (Sarkar, S., & Sarkar, P., 2019): Digital or OTT, Data experience (or network), Data services and Data product. The research paper highlights 16 strategic data monetization initiatives across these four strategic areas.

The thesis (Audrey Cuillierrier, 2016) discusses the effects of interaction with social media customers. The research examines the influence of social media on consumer satisfaction and suggests that social media has a personal touch to reach consumers, thereby converting consumers over social media as brand ambassadors.

The paper (Mahmoud Abdel Hamid Saleh, 2016) looks at the relationship between the use of social media and consumer relationships in Saudi Arabia with three MNOs. Three factors specific to social media clients were chosen by the researcher: usability and commitment, service evaluation, and interaction with knowledge. The study showed a clear correlation with the use of social networks with the enhancement of the company's customer relationship, confidence and trustworthiness, and service assessment, but not with interaction with knowledge. The results also revealed substantial positive trust and loyalty and customer experience indicators.

3. Objectives

The research aimed at achieving the following objective:

- To analyze the data consumption by mobile subscribers using different data products (specialized vs standard).
- To analyze the behavior of mobile subscribers towards Over-the-top (OTT) services over MNO's services (voice, messaging, or video).
- To study the popular social media sites that generates the maximum data usage (or revenue) for the MNO.
- To assess the efficacy of the social media platform from the viewpoint of mobile customer interaction and operator branding.

4. Research Methodology

The research choice is descriptive and analytical and used a deductive approach.

- *Primary Data*: First-hand information of the respective stakeholders was obtained:

Table 2: Data Source (Primary)

Category	*Population*	*Sample Size*
Mobile Subscribers	1.152 billion (Source: TRAI)	~11,000

Source: Research Scholar's Analysis

- *Secondary Data:* This includes data obtained from written documents such as surveys, articles , books, newsletters, magazines, web outlets, government records, administrative surveys, MIS reports from MNO, and other organizations.

Pilot testing learnings were incorporated to improve the final survey questionnaire and parametric statistical techniques (ANOVA and Pearson's Correlation Test) used for hypothesis testing.

5. Data Analysis/Findings

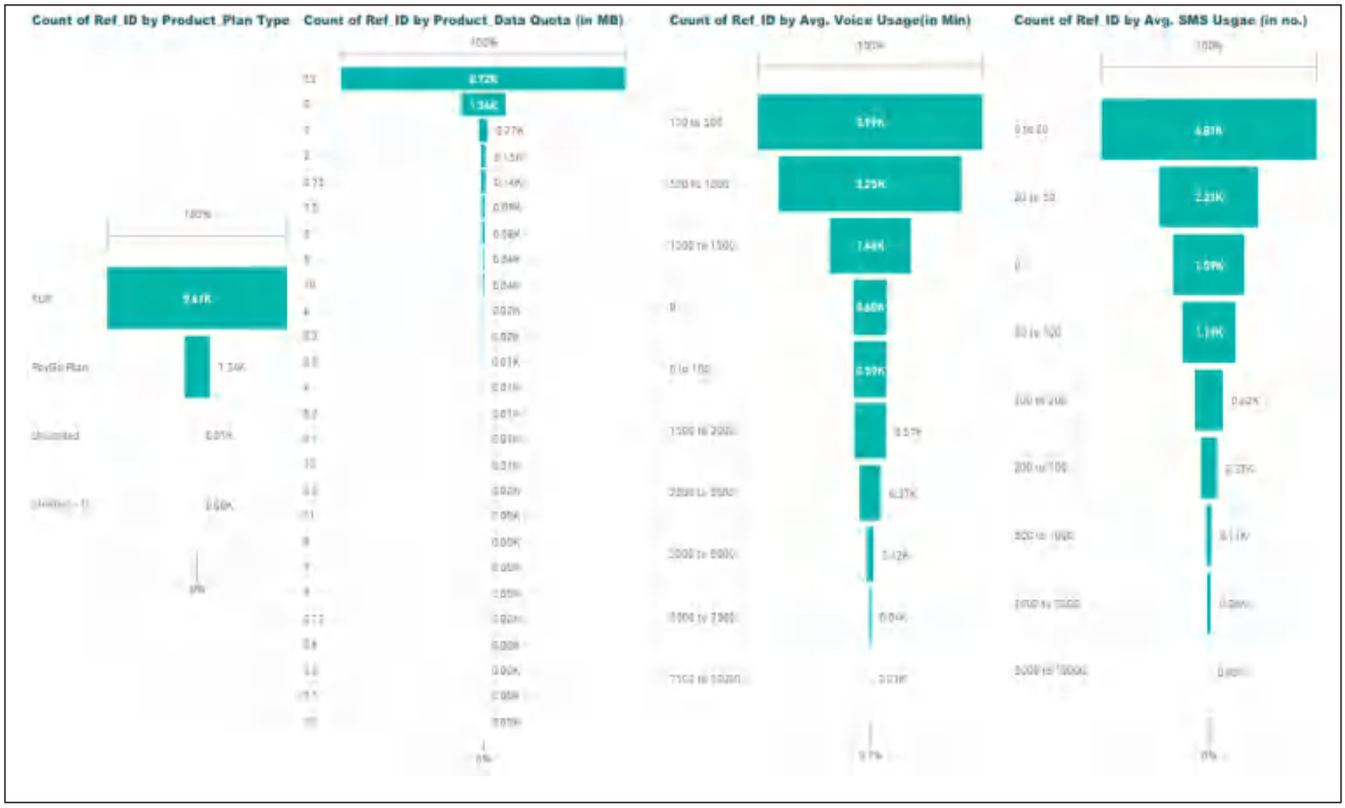
Data analysis performed on the pan-India customer survey with approx. 11,000 respondents spanning across 28 state territories (22 Telecom Circles) and covered 494 cities of India:

- Demographic Analysis performed across following parameters: Gender, age, occupation, geography (category of town , state, town, Telecom Circle and Wireless Circle category).

Source: Primary data analysis

Fig. 7: Customer Survey - Demographic Analysis

- Network and device analysis performed across following parameters: Form of network, Type of Operation, Type of Device, Operating System of the unit.
- Product and usage analysis performed across following parameters: Data, Voice and Messaging, Product Type, Product Sub-type.



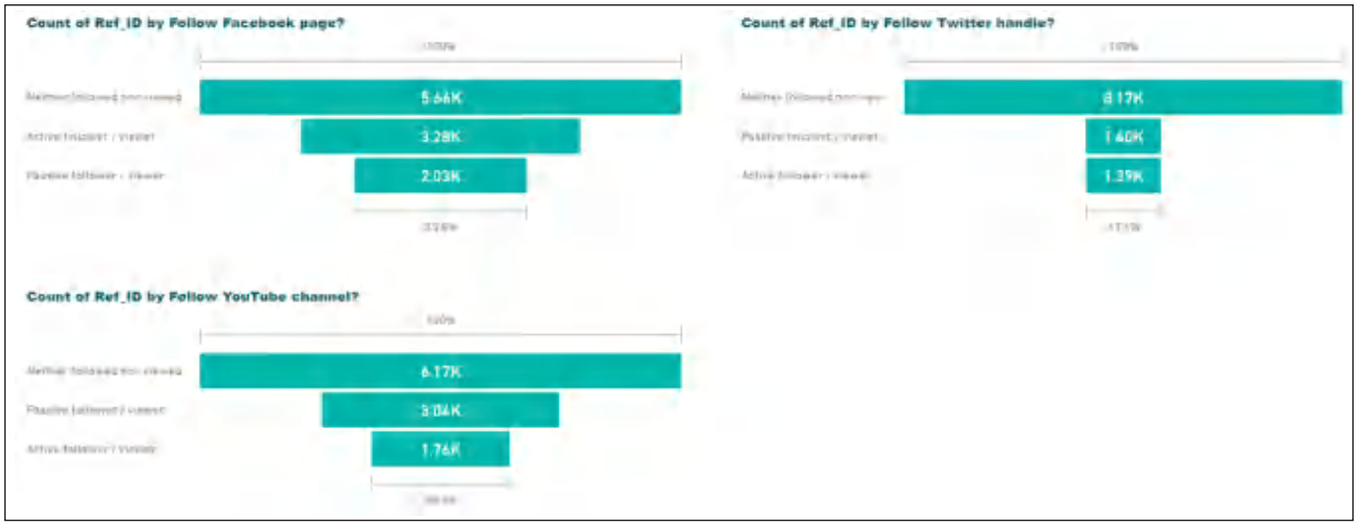
Source: Primary data analysis (includes MNO data)

Fig. 8: Customer Survey - Product and usage analysis

Source: Primary data analysis (includes MNO data)

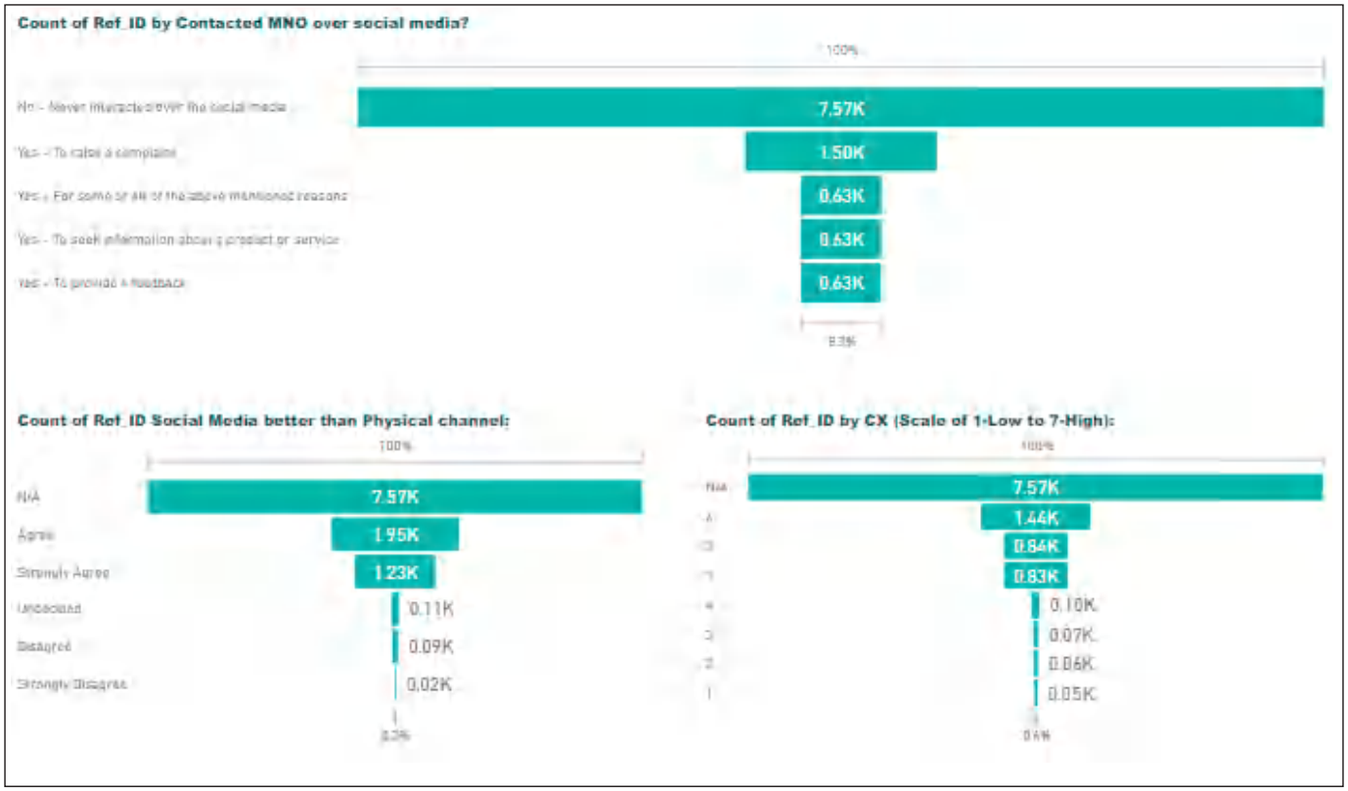
Fig. 9: Customer Survey – Top 20 URLs

- URL analysis performed to gauge the top 20 URLs that contribute to data usage.
- Social media branding analysis performed across following platforms: Via Facebook, YouTube, and Twitter.
- Social media servicing analysis performed through customer processes, social media platform used for Telco interaction, and social media customer understanding or experience.



Source: Primary data analysis

Fig. 10: Customer Survey – Social Media Branding and Servicing Analysis



Source: Primary data analysis

Fig. 11: Customer Survey – Social Media Branding and Servicing Analysis

6. Conclusion

Key deductions based on the Mobile Subscriber (or Consumer) survey are as follows:

- From a data monetization standpoint, advanced application items are more beneficial:
  - A host of ambitious plans to target data-hungry subscribers have been launched by Mobile Network Operators (MNOs). These initiatives were listed under two groups in light of the stated study goal and mobile social media users:
  - *Standard Data Products*: Standard tariffs (or rates) in this category extend to the use of data by consumers and are generally referred to as the PayGo Package (or Pay-as-you-go).
  - *Specialized Data Products:* As it suggests, they provide pricing plans who-in-turn provide the data clients with differentiated experience. Common under 3G/4G-LTE/5G, they offer unrestricted or defined free-quota data use data (under a fair use policy). After the free quota, the user goes down to 4G, 3G or 2G (low bandwidth or network). Social media packs, introduced earlier, stand withdrawn because of net neutrality or regulatory recommendations.
  - The average data consumption across specialized data products is greater than the standard data products. This shows that mobile subscribers or social media users are more inclined towards data experience.
- The implementation of Over-the-top (OTT) networks sabotages the additional services offered by Mobile Network Operators (MNOs) to date:
  - Mobile Network Operators (MNOs) has been providing three basic services: Voice, Messaging and Data. Network IP-fication (or digitization) has converge Under the umbrella service, the voice, video, and messaging service, i.e. data.
  - Mobile social media users have greater affinity and Adoption of common OTT services: WhatsApp, Twitter, Skype, Google Cloud Messaging, etc. Such affection is at the detriment of facilities offered by operators. This means that customers are more likely to follow and use OTT platforms to fulfil their demands for speech, video, and messaging.
- Top URLs that generate maximum data usage:

  Social networking (Twitter Video, Google, YouTube, Twitter, Instagram) and instant messaging platforms (Google Cloud Messaging, Facebook Messenger, Skype, WhatsApp, XMPP, IMO) are firmly tilted to the top 20 URLs that produce results.
- Social networking consumer engagement has a positive impact on consumer loyalty:

  In order to convey and share their interactions with smartphone goods (or services), consumers use social media platforms. The contribution could be to: (a) provide input (b) raise a concern (c) pursue product (or service) information.

Table 3: Top URL Categorization

Provider	Social Media	Instant Messaging or VOIP	OTT	Video content
Facebook	✓		✓	✓
Facebook Messenger	✓	✓	✓	✓
Facebook Video	✓		✓	✓
Google	✓		✓	✓
Google Cloud Messaging	✓	✓	✓	✓
IMO	✓	✓	✓	✓
Instagram	✓		✓	✓
Skype	✓	✓	✓	✓
WhatsApp	✓	✓	✓	✓
XMPP	✓	✓	✓	✓
YouTube	✓		✓	✓

Source: Primary data analysis

- MNOs have targeted the social media channels for: (a) Proactive customer engagement around Brand and Marketing (b) Reactive engagement for service or grievance redressal. The famous social media platforms where MNOs have a devoted their presence include, among others: (a) YouTube (b) Facebook (c) Twitter.

- The level of customer satisfaction was analysed across:

  Proactive Engagement: The effect on customer loyalty w.r.t. dedicated presence was found to be poorly coupled across the above social media platforms, while the affect was favourable.

  Reactive Engagement: The effect on customer loyalty was found to be more promising (than constructive engagement) for reactive interaction over social media; and the effect is positive.

- Customer engagement costs are more costly than digital or social media platforms through physical networks such as retail stores, call centres, etc. Operators are finding ways to transfer consumer engagement to less disruptive (or self-serve) platforms, such as smartphone applications, online portals, USSD and/or social media.
- The customer perceived value was significantly higher over social media channels in comparison to physical channels.
- Aforementioned results show that both constructive and reactive social media engagements positively impact consumer loyalty and physical platform experience.

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A Survey of Methods, Tools and Applications of Knowledge Base Construction (KBC)

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Abstract

Knowledge Bases (KBs) have recently become very valuable because of their use in many Artificial Intelligence (AI) applications. For example - KBs are a critical part of conversational agents that are rapidly being adopted by the industry. Knowledge Bases are made up of a number of facts about the real world, and the number of such facts is typically very large. The construction of the KB involves identifying the facts from unstructured data such as text, images, videos and speech. Due to the challenges of processing unstructured data, Knowledge Base Construction (KBC) used to be done manually, requiring huge efforts and long timelines. In recent years, intelligent technologies such as Machine Learning and Deep Learning are being employed for the purpose of KBC. In this paper, we provide an introduction to KBC and describe how various cutting edge technologies are being employed for its automation. We then mention some KBC systems created by academic as well as commercial groups. We survey some solutions in the industry that are already using KBC. In addition, we attempt to predict the future research possibilities in this field.

Keywords: Knowledge Base Construction, Information Extraction, Text Processing, Knowledge Graph, Machine Learning

1. Introduction

The last few years have seen unprecedented growth in intelligent systems such as Artificial Intelligence (AI). AI systems aim at developing human capabilities through learning from data. A 'learner' that performs this task is the central component of any AI system. Learners are implemented using various algorithms, but a large set of real world knowledge is always required to prepare this learner. A logic based learner such as decision tree is almost entirely dependent on a set of facts about the world. A learner using Artificial Neural Network (ANN) requires huge amount of knowledge to train its network. Probabilistic Graphical Models such as Bayesian and Markov use knowledge as priors as well as for grounding the network.

There are many reasons why AI systems use knowledge other than for learning. A conversational agent (also called chatbot) requires knowledge for answering questions. Augmented Analytics systems use the knowledge to map user needs on system queries. This growing list of applications has made Knowledge Bases (KBs) a vital part of AI architectures (Ratner & Re, 2018).

Knowledge Bases store huge amount of facts about the world. The architecture of KBs make it easy to store various types of facts and query them. The knowledge of the world resides in a variety of sources, most of them unstructured. There are text sources, such as documents, websites and emails and non-text sources such as images and videos. The text itself may be plain or formatted in tables and charts. Knowledge has to be extracted from all these sources and populated in the KB to be useful.

Considering the above points, it is then easy to imagine that the process to populate a KB is of utmost importance. This process is called Knowledge Base Construction (KBC). A KBC system must be able to understand and extract relevant facts from a large variety of sources. The complexity and uncertainty in the source material make KBC a challenging task. The performance of a KBC system is measured by the accuracy (how much knowledge was correct) and completeness (what fraction of knowledge contained in a source was extracted).

This paper is an introduction to KBC. The author has been working on various aspects of KBC during the development of a Learn and Recite (L&R) software system at his organization. The material given here is the result of studies done for the conceptualization and design of this system over past few years. The objective of this paper is to introduce students and engineers to the emerging and promising field of KBC and to facilitate research and development in the area.

The paper is organized as follows – Section 3 explores the history of Knowledge Base Construction, Section 4

enlists the challenges faced by KBC systems, Section 5 delves into the architecture of the systems in terms of components and technologies used, Section 6 looks at some of the existing KBC systems, Section 7 mentions the applications of KBC in the industry.

2. Literature Review

In Knowledge base construction is the process of populating a knowledge base (KB) with facts extracted from various types, especially unstructured data (Computer Science Department, Stanford University [CS-SU], n.d,), (Shin et al., 2016). The challenges in this process due to the unstructured nature of data and the various subtasks involved have been well documented in work such as Ratner and Re (2018). The recent interest in knowledge base construction due to QA agents, also called chatbots has been described by Subasic, Yin and Lin (2019).

While the author derives the various steps involved in KBC from his own experience in the field, the principals involved in the tasks are referred from the excellent sources provided by leading researchers in the field, such as Oro and Ruffolo (2009), Eftimov, Seljak and Korosec (2017), Zhang and Wang (2015). The applications and existing systems have been studied from the original papers published by the creators of the systems, like Dong et al. (2014).

3. History

The origins of knowledge bases can be traced to the 'Expert Systems' of 1970s that were probably the first commercially successful application of AI (Leonard-Barton & Svikova, 1998). The expert systems phase convinced some scientists about the importance of collecting real world knowledge. The Cyc project started in 1984 with an objective of collecting Common Sense Knowledge – knowledge about real world entities and the rules binding them together (Lenat, 1995). Cyc is the world's longest running knowledge collection program and contained more than 1.5 million terms as of 2017.

In the first decade of 2000's, the concept of semantic web drew attention of the industry and scientific community. Semantic web technologies such as RDF and OWL have since become important parts of the KB technology (Gangemi, 2013). The 2011 win of Jeopardy! competition by IBM Watson became a good demonstration of the power of knowledge bases and their use for question answering.

In the 2010's, two factors became the main drivers of knowledge base technology. Since the 2010 introduction of Siri in Apple Inc's iOS, virtual assistants have gained prominence. The assistants and their variation the chatbots have found commercial success (Ratner & Re, 2018). Many voice enabled assistants such as Google Assistant, Amazon's Alexa, Microsoft's Cortana are being widely used by people. Since these assistants are primarily question answering agents, knowledge base is an integral part of their architecture.

The second driving factor is the rise of Deep Learning as the preferred method of implementing AI. While DL is a powerful learning method, it requires huge amount of labeled data for preparing the learner. Automated knowledge base construction from variety of sources has emerged as the standard solution to this requirement.

4. Challenges

Constructing a knowledge base is a challenging task. The major challenges arise because of three reasons:

4.1. Nature of Sources

By its very definition, KBC involves processing of unstructured sources to generate structured knowledge. Unstructured sources include text, scanned documents, pdf's, web pages, images and so on (Computational Biology Institute [CBI], 2018). These sources are difficult to read for computer programs due to following of their characteristics (Ratner & Re, 2018), (Lin, Liu, Sun, Liu & Zhu, 2015):

Uncertainty: Various layouts, use of elements like tables and charts and rich formatting introduce element of doubt in the interpretation of most unstructured sources. Even when the source is pure text, the meaning of the text is ambiguous due to the nature of natural language. Scans and images contain noise that adds further uncertainty.

*Complexity***:** Knowledge is a combination of various elements such as entities, relationships, intents, purposes and so on. The number of combinations of these elements is very large, posing a challenge for the systems that seeks to identify only those combinations that are both meaningful and useful.

Configuration Efforts: The KBC system is owned by domain experts. If the system is too complex and involves technical activities, the domain experts have to work with technical experts for the configuration. This makes the configuration too expensive and difficult to organize. On the other side, the system should be powerful enough to require minimum manual efforts to create the KB. Balancing the simplicity in configuration with the power of automating knowledge extraction creates the effort challenge.

Quality Requirements: The KB is used for a specific purpose such as training a machine learning model or answering questions. In order to fulfil this purpose, the generated KB must satisfy certain quality criteria (Subasic et al., 2019). The main requirements are:

Completeness: Out of the total knowledge required for the job, how much has been harvested (Razniewski, Suchanek & Nutt, 2016).

Accuracy: Out of the total knowledge harvested, how much is accurate (Subasic et al., 2019), (Razniewski, Suchanek & Nutt, 2016).

For example, for a chatbot, the knowledge should be such that it can provide correct answers to all expected answers. These quality requirements put a challenging responsibility of the KBC system.

5. Architecture of KBC Systems

The knowledge contained in a KB can be classified as schema elements (entities and relationships) and data elements (instances). While data elements represent the ultimate use of the KB, schema elements are used for reasoning and selection of the right data elements for the purpose. For example, in a pharma KB, the categories and properties of molecules are part of schema, whereas the trial results are instances.

The schema elements are usually found in natural language format ('Tobramycin is an aminoglycoside antibiotic'). Data elements are found both in natural language and in formatted layout such as a table. For example, the test results are more likely to be found in a table than in a paragraph of text.

The extraction from text involves Natural Language Processing (NLP). NLP based knowledge extractors can use grammatical analysis implemented through regular expressions and FSA based algorithms. The grammatical method is fast and effective, however it involves complex programming and has limited scalability. In the last few years, Multi-layer Neural Networks (MLNN), termed as Deep Learning (DL) models are increasingly being used for text processing. These models require sizeable amount of data to get off the ground, but they 'democratize' the KBC process as non-programmers can also train and use DL based extraction pipeline.

The data elements are mainly found in formatted and image-based sources such as scanned documents and pdf's. The pipeline to extract instances from these sources has to utilize spatial relationships and contains modules to convert image to text (popularly termed as OCR), analyze the layouts and tag the values with appropriate schema element (Oro & Ruffolo, 2009), (Oro & Ruffolo, 2008).

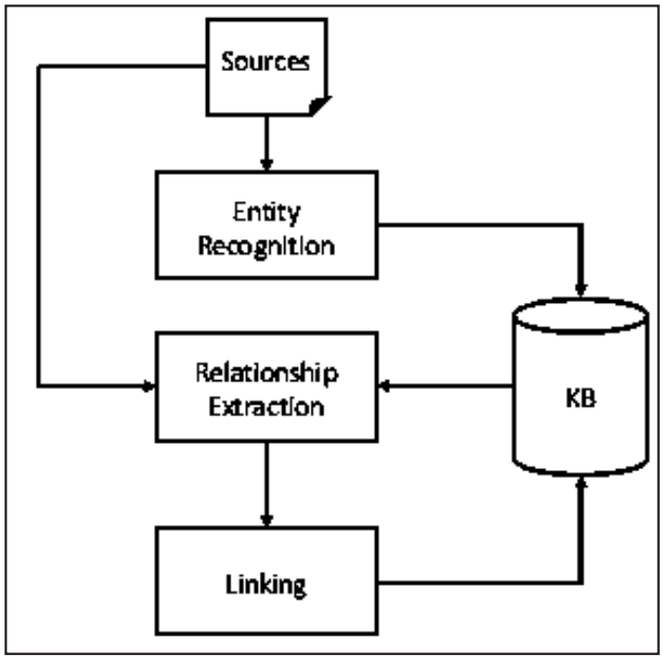

Fig 1: Basic Pipeline of Knowledge Extraction

Some of the important tasks in both pipelines are explained here:

Entity Identification: Entities are usually noun phrases. They can be identified by various methods in Computational Linguistics (CL) such as Part of Speech (POS) tagging and Named Entity Recognition (NER) (Eftimov et al., 2017). Compound entity identification is a recursive process that involves identifying both simple entities and relations.

Relationship Extraction: Extracting relationships is a tough challenge owing to the large number of possible relationships and also the large number of possible ways in which they can be expressed in text. To counter this, some methods (Clark et al., 2014) require the relationships to be defined in advance to narrow the possibilities.

Various methods have been employed to identify and extract relationships. Use of regular expressions to identify patterns is popular since early days of KBC (Clark et al., 2014). More advanced NLP tools such as Dependency Parsers are used by some systems (Al-Zaidy, Rabah & Giles, 2018). In recent times, Deep Learning (DL) models are used to find relation mentions (Zhang & Wang, 2015), (Santos, Xiang & Zhou, 2015) and to extract the relation.

OCR: OCR extracts text from image sources. Older OCR tools used image processing and had limited accuracy. Modern OCR engines use DL models and are proving to be far superior (Breuel, 2008), (Breuel, 2017).

Layout Analysis: As mentioned, instance data is usually found in tables or charts. Even when the table is not explicitly drawn, the elements of data are arranged on the paper as though they belong to a table. Extracting such data requires spatial understanding of the document to correctly group the text returned by OCR (Oro & Ruffolo, 2009). This is an area of continuing research and various methods that use different ML/DL models are being tried out.

Schema Tagging: Extracting data elements involves associating them with the right schema elements. For instance, if the viscosity value of a drug is mentioned in a specification table, it has to be tagged as the value for the property viscosity for the particular drug, along with probably its batch number. Since many layouts are ambiguous, this is a challenging task requiring resolution and judgment. A host of techniques are being developed that employ some form of uncertain inference.

6. Existing Systems

The Knowledge bases and KBC systems currently available broadly fall into three categories:

6.1. Publicly Available KBs

The best known example of these systems is DBPedia (Lehmann et al., 2012), which extracts structured information from Wikipedia pages and makes it available as RDF dataset over the World Wide Web. The DBPedia extraction process uses the 'infoboxes' included in Wikipedia pages and thus is more focused on relationship extraction and linking process. The current release of DBPedia has 4.5 million entities in its English dataset. Another example of a public KB is the Never Ending Language Learning (NELL) project (Mitchell et al., 2018). NELL is a KBC system that extracts facts from the web. An initiative of the Carnegie Melon University, it is running continuously since January 2010 and has collected around 50 million candidate facts in its knowledge base thus far.

6.2. Open Source Platforms

Quite a few KBC platforms were developed in academic institutions and were subsequently made available to the community as open source software. Deep Dive is a KBC platform developed in the Stanford University (Shin et al., 2015). Its commercial version was acquired by Apple Inc in 2017. Snorkel is another system created by Stanford that focuses on creating weakly supervised data for training deep learning models (Ratner et al., 2017). Fonduer, also developed at Stanford, aims at extracting knowledge from richly formatted text (Wu et al., 2018).

6.3. Commercial Products

Many technology companies have developed software products that have KBC capabilities. The leader in KBC systems is IBM, whose Watson set the KBC trend rolling in 2011. IBM has developed another product called Socrates that powers semantic search through knowledge base extracted from text (IBM Research Editorial Staff [IBM-RES], 2017). SystemT is another product by IBM that is used for quite a few commercial KBC projects (Li, Reiss & Chiticariu, 2011). Google has its Knowledge Vault (Dong et al., 2014) that is used to power its 'information boxes' in search and to answer queries to Google Assistant.

7. Applications in Industry

The Knowledge bases and knowledge base construction systems are being employed by many commercial organizations across the world. While some are using commercially available products, others are using open source tools to build their own KBC systems. Here we try to explore the usage of KBC in some noteworthy applications:

7.1. Search

As the volume of data has multiplied in recent years, search has become an important application both for individuals and organizations. Internet search which is probably the most used application of all time has evolved from being a directory lookup to handling queries semantically. Google search recognizes entities being searched and shows detailed information using its Knowledge Vault (Dong et al., 2014). Wolfram Alpha is a search engine designed to handle semantic queries (Johnson, 2009).

Enterprise search is an equally important area considering that huge organizations own truly gigantic quantities of data. Products such as IBM's Watson Discovery help to create search indexes that can be used for querying. Socrates, a KBC product from IBM product can be used along with Watson Discovery to populate a knowledge base (IBM-RES, 2017).

7.2. Virtual Assistants

Siri, introduced by Apple Inc. in its iPhone in 2011 was the first well known virtual assistant. Since then Google Assistant by Google, Cortana by Microsoft, Alexa by Amazon and other assistants have been introduced. Special devices such as Amazon Echo and Google Home have become popular. They are all supported by large knowledge bases of their own (Ratner & Re, 2018), apart from using public KBs like Wikidata (Simonite, 2019). The construction method of most of these organizations is not known.

Chatbots are virtual assistants that can handle natural language text as input. Most of the chatbot providers also include a KB and some KBC mechanism to populate it. Rasa, a widely used open source chatbot platform, can be integrated with a knowledge base such as Grakn (Bocklisch, Faulker, Pawlowski & Nichol, 2017), (Bergmann, 2019).

7.3. Research Databases

KBC is being used to extract data from a large number of sources for research purposes. Deep Dive and Snorkel, the KBC systems developed in the Stanford University have been used to create databases for paleontology record, human trafficking and pharmacology (Computer Science Department, Stanford University [CS-SU], n.d).

7.4. Training Data Generation

Manually labelling data for training DL models is expensive and time consuming. Weak supervision is a technique of training a DL learner that uses small quantities of good quality labelled data combined with large amounts of weakly labelled data (Ratner et al., 2017). Weakly labelled data contains labels that are not 100% accurate. KBC is used to generate such weakly labelled data, reducing the time and cost of the model training activity.

8. Conclusion and Future Directions

In this paper we introduced the knowledge base extraction (KBC) systems that have become very important constituents of AI solutions. KBC systems face challenges due to unstructured nature of sources and quality requirements on the knowledge extracted. There is a growing need to make KBC accessible to domain experts rather than programmers. This need to 'democratize' KBC is driving larger use of deep learning based architectures. Since an estimated 80% of the world's data is in unstructured form, the demands on KBC systems are going to increase in coming times. Future research in this field must focus on building learning based system that can be trained by domain experts on an ongoing basis. Since KBC can also create training data for machine learners, such architectures can give rise to an endless virtuous loop of knowledge creation.

9. Implications of Research

Industry persons and researchers working on applications such as chatbots, automation, text processing, analytics are already employing knowledge bases and knowledge graphs to a large extent. They will be able to use the material presented in this paper to take advantage of KBC for populating their knowledge bases. A fundamental understanding of the working principles of KBC will enable to make better utilization of the existing KBC systems such as mentioned in this paper more effectively.

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Value Stream Mapping (VSM) Led Approach for Waste and Time to Market Reduction in Software Product Development Process

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Abstract

Digital transformation involving business model, products and business process innovation is the hottest buzzword in the industry today. Digital transformation in Telecom Service Providers (Telco) needing quicker software product and services development and delivery is heavily leveraging the Agile DevOps techniques. So far, the attempts at expediting product rollout have been only partly successful in realizing their stated objectives of faster time to market, and maximizing return on investments (ROI) for product and services innovation investments. Among the challenges, lack of end to end value stream visualization, siloed tools with different data sources to lacking right measures, governance resulting are the key ones resulting in longer & unpredictable time to value. The challenges can be remediated by leveraging Value Stream Management (VSM) approach being widely used in the manufacturing industry. In this paper we present value stream management (VSM) led approach to remediate agile DevOps implementations as well as to better digital transformation ROI. This approach hinges on the key improvement strategies vis-à-vis traditional in respect of a) creating end to end value chain visibility facilitating value chain monitoring and tracking b) developing a normalized common data model across disparate value chain components c) integrating product engineering tools across the value chain d) eliminating non value adds (NVAs) from the value chain. The approach has been illustrated by taking an example of VSM led DevOps implementation in a telco covering the methodology in detail, leading to the improvements in key KPIs.

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

1. Introduction

1.1. Need for VSM Approach for Software Product Development

Telcos aggressively engaged in digital transformation and new products/services rollout are faced with the challenge of selecting the right approach and the methodology for a cost effective and efficient way of product development. The various approaches that have been tried range from traditional waterfall to later v-model and more recently Agile approach (Balaji & Murugaiyan, 2020). The biggest advantage the agile approach offers over the previous ones is that of being able to accommodate the changing requirements (Martin, 2003). Agile DevOps is increasingly being adopted as a methodology of choice by organisations to deliver software products faster and with higher quality (Wettinger et al., 2015). However the issues pertaining to the lack of end to end visibility of agile DevOps value stream, siloed implementation etc seem to be impacting agility, quality and risk mitigation (Condo & Lo Giudice, 2020) in software product development. In particular, there are three major issues the teams are grappling with which are dragging down the agile product development process:

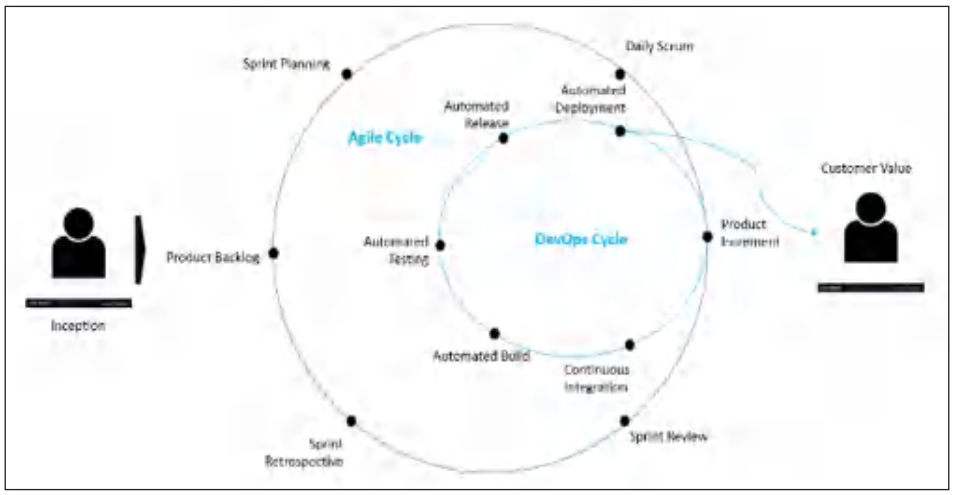
1.1.1. Non Value Adds (Nvas) in the Process Not Being Addressed Fully before Value Chain Automation

It is imperative for organisations to know beforehand what is adding value as also what is clogging up the flow and throughput in their agile DevOps enabled product development process. To maximise the benefits

of automation the non-value adds must be identified and eliminated before taking up an automation program in code build, test and deployment areas (Ung, 2020).

1.1.2. Lack of Clarity Around the Scope i.e. the Start and the End Point of Process

In large number of cases where Agile DevOps has been implemented, the application development and delivery teams seem to have been focusing on the improvements in either of Agile (involving PI planning, backlog, daily scrum etc) or DevOps cycle involving continuous build, integration, testing etc (Fig. 1 below), not both i.e. the end to end from concept to product, thereby limiting the benefits delivered by the improvements to either of the cycles (West & Sklavounakis, 2019). The real end to end agile DevOps would include all the phases starting with inception to product backlog creation to product increment development (minimum viable product-MVP) and then to inner concentric circle, being referred to as DevOps cycle all the way to value delivery for the customer (Chapman, 2020). However not many organisations seem to be doing it right by focussing either on the Agile or the DevOps cycle and thus accruing limited benefits.



Source: West & Sklavounakis, 2020

Fig. 1: End to End Agile Cycle

1.1.3. The Lack of End to End Visibility into Enterprise Software Delivery at Scale, Limiting Team's Ability to Manage, Measure, Across and Improve Software Product Development Process as a Whole

These challenges/issues pertaining to tracking, monitoring and managing the process and eliminating wastes obviously lead to sub-optimal performance of agile DevOps product development process resulting in lowered throughput and velocity (Sambandam, 2020).

Hence the objective of this paper is to elaborate a solution approach for addressing the issues mentioned above leveraging strategies such as a) creating end to end value stream visibility facilitating value chain monitoring and tracking b) developing a normalised common data model across disparate value stream components c) integrating product engineering tools across the value stream d) eliminating non value adds (NVAs) from the value stream.

The remaining portion of the paper has been structured in the following way:

Section 2: Strategies to Remediate Agile DevOps Enabled Product Development Process

Section 3: How to Go About Software Product Development Process Optimisation

Section 4: A Proof of Concept (PoC) for US Telecom Services Provider

Section 5: Discussion and Conclusion

Section 6: Implications of the study

Section 7: Acknowledgements

Section 8: References

2. Strategies to Remediate Agile DevOps Enabled Product Development Process

In order to address the challenges that product development and delivery teams implementing agile DevOps are facing, organisations need to embrace a new value stream mapping (VSM) led approach for their agile implementations.

As per Condo and Lo (2020) VSM is a methodology combining process, people and technology that aims at mapping, optimizing, visualizing and measuring "as-is" and improving "to-be" and governing business value flow (including epics, stories, and work items) through heterogeneous enterprise software delivery pipelines. Various VSM software tools enable the practices of VSM.

In order to address the challenges prevailing with current agile implementations, the improvement teams need to focus on four pronged strategies as below:

- Accelerate delivery by identifying and eliminating non value added activities (eight wastes of lean) in the 'as-is' application development process. The waste in Agile DevOps pipeline could be of eight different types e.g. waiting. If the process requires waiting for an approval by senior authority and is found to be incurring loss of efficiency, then the process could be re-engineered with senior stakeholder's approval activity taken up at the start of the process. This removes non value add (waiting time) and accelerates the process.
- Effectively integrate disparate agile DevOps tools which might be implemented across 'as-is' process--into a common horizontal VSM tool layer and create an e2e process visibility. Existing DevOps implementations have many disparate automation/tools implementation for 'as-is' process. E.g. Atlassian tools for code build, Selenium for Testing, AppDynamics for monitoring performance etc. However, since these tools are not interconnected /integrated and that adds to inefficiencies in the process.
- Facilitate data capture across end to end application development and delivery process by creating a normalised common data model covering the entire process. Once the disparate tools are integrated/interconnected, the data pertaining to the underlying DevOps process can be brought up in a horizontal data store and leveraged for variety of purposes from dash boarding to efficiency improvement.
- Improve governance and control through right measures and metrics at the back of end to end visibility and deep analytical insights powered by data. Once the disparate tools are integrated the data across entire value stream could be harnessed by setting up right measures (KPIs) on the process. These measures can be tracked and monitored to initiate continuous improvement across the value stream.

3. How to Go About Software Product Development Process Optimisation?

In order to optimise product development process, a systematic four-pronged approach as elucidated in Fig. 2 is needed. This approach was also implemented at the largest US based telecom service provider for their trouble ticket management platform development and deployment (TechM PoC, 2019).

3.1. Step 1

Map "As-Is" Software Product Development Value Stream- "as-is" value stream assessment should primarily be aimed at gaining clarity on as-is state of affairs. This includes gaining a good understanding about- (TechM Research, 2019).

- The key activities in the current process of product development and operations.
- Who are the key stakeholders/actors involved in the as-is process?
- How is the agile DevOps process performance measured today? What are the key Performance Indicators (KPIs) used to assess as-is performance?
- What is the average activity time for individual process steps such as plan, build, environment set up, testing etc.? What is the end to end lead time (which is aggregation of the activity time)? What is the release cycle time for a typical software release/MVP? What is the as-is process throughput
- What is the Value Added (VA) and non-value added (NVA) time for each step? This excludes waiting time—such as being in queue—or any other non-productive work time.

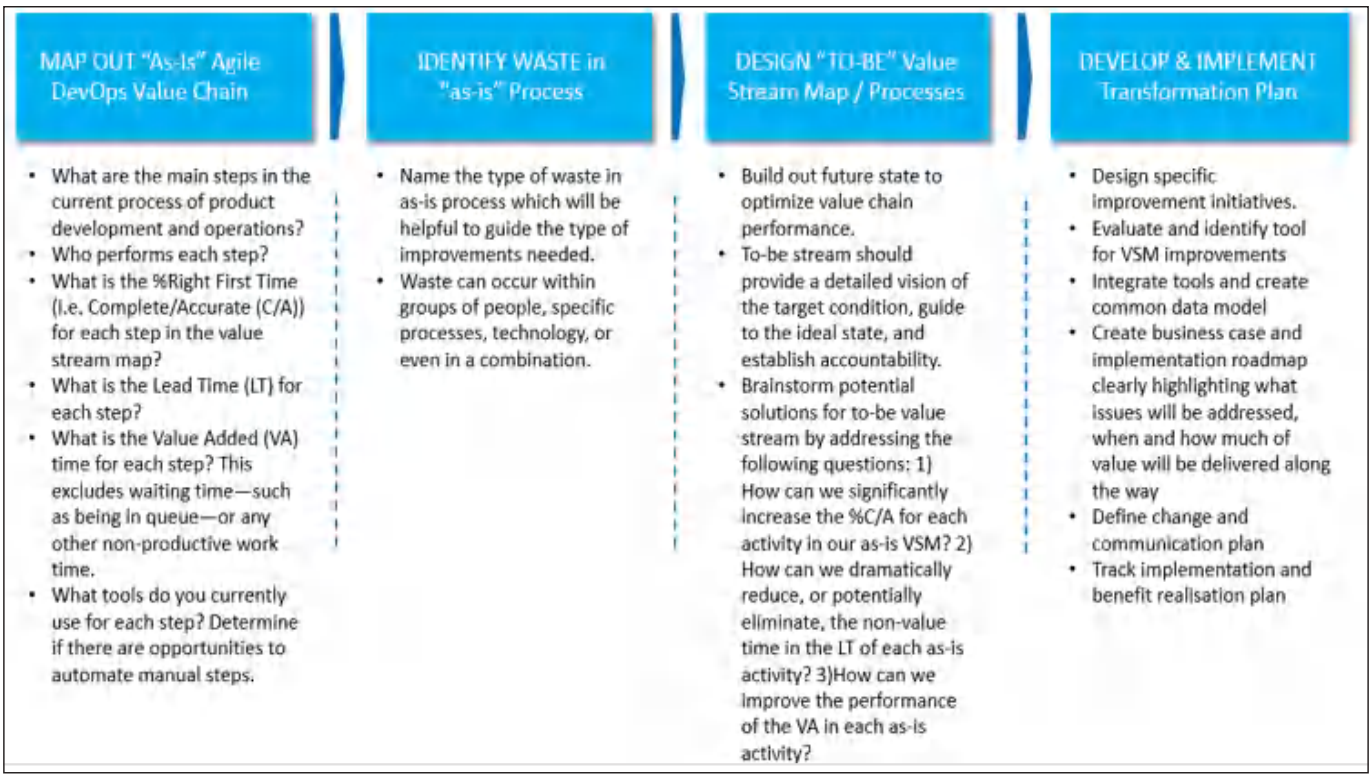


Fig. 2: Approach to Software Product Development Process Optimisation

- What process automation tools are being used for each step? E.g. Selenium for test automation, Jenkins for continuous automation. Determine if there are further opportunities to automate manual steps?

3.2. Step 2

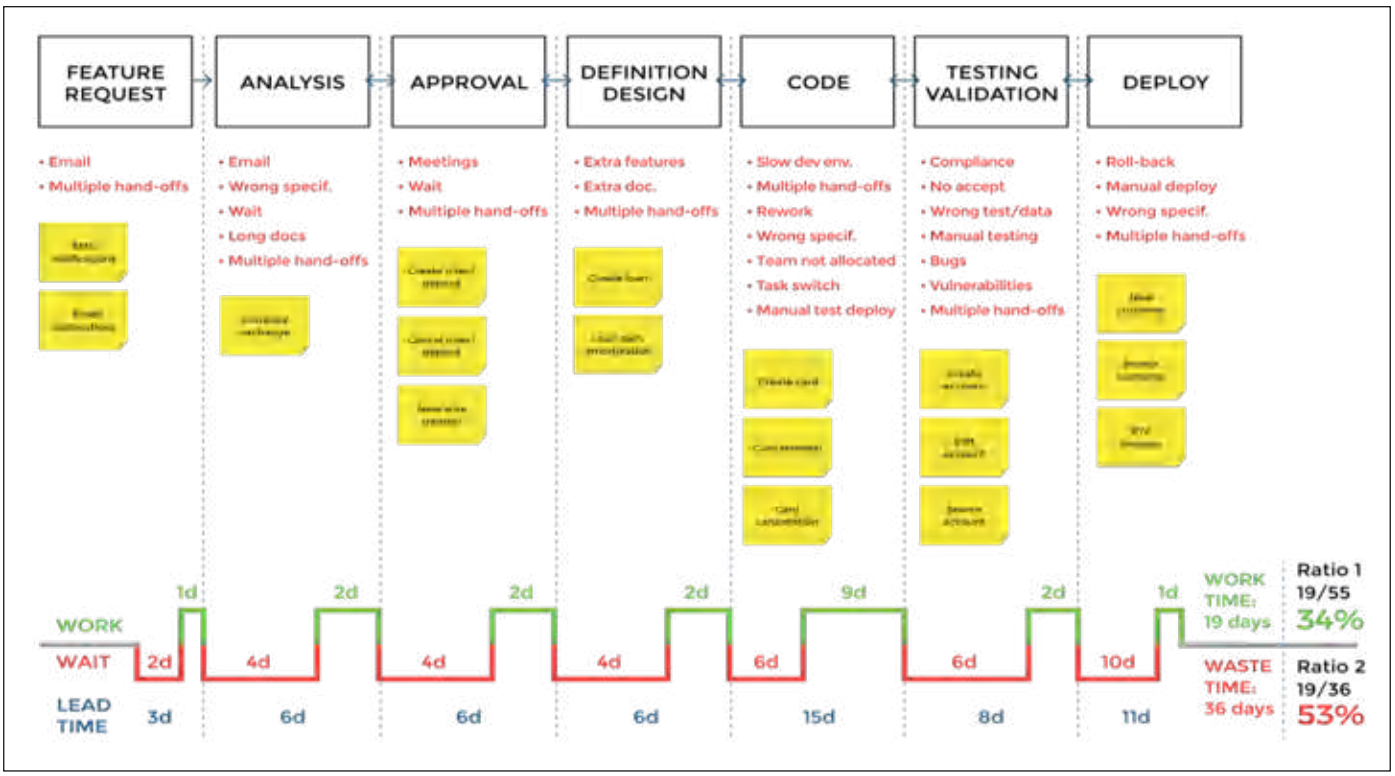
This step involves identifying waste in "as-is"- (TechM Research, 2019) As-is assessment should clearly bring out the details around the activities where the time is being wasted, whether the releases are happening on time and meeting the quality gates. The example in Fig. 3 illustrates how non value-added activities in the process such as multiple hand-offs, wait time, slow development environment etc. drag the efficiency and productivity down.

As part of Toyota Production System (TPS), Taiichi Ohno, the Chief Engineer at Toyota developed seven wastes (Muda). The seven wastes are Transportation, Inventory, Motion, Waiting (e.g. a feature is complete but waiting for stakeholder approval), Overproduction (e.g. extra features used rarely), Over processing (e.g. creating excess capacities) and Defects (e.g. code defects /technical debt surfacing late in the lifecycle). They are often referred to by the acronym 'TIMWOOD'. The 8th waste of non-utilized talent or 'Skills' of workers (e.g. lack of full stack developer requiring frequent hand-over leads to wastage) was later introduced in the 1990s when the Toyota Production System was adopted in the Western world (Skhmot, 2017). As a result, the eight wastes are commonly referred to as 'TO WISDOM'.

3.3 Step 3

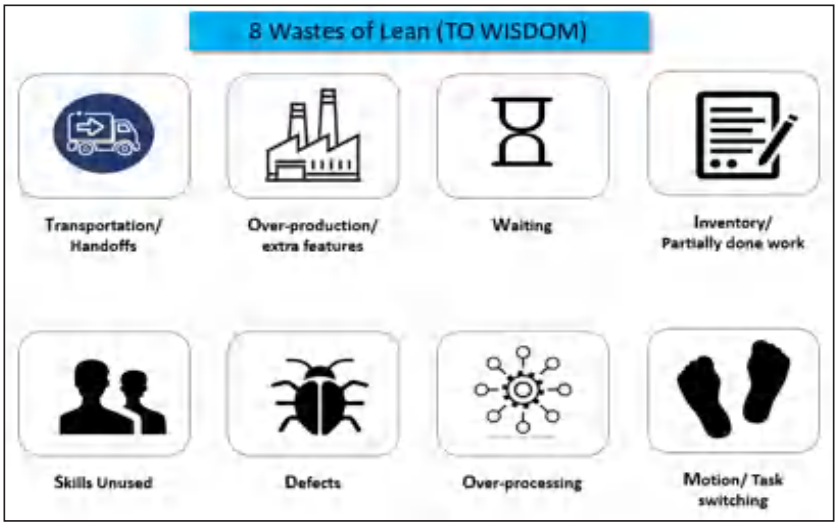
Design "To-Be" Value Stream- After having mapped "as-is" and identified wastage the next logical step is to analyse in detail the performance of the value stream and design 'to-be' value stream addressing the issues identified in as-is. The aim of the reformation should be to maximize flow and throughput of the process i.e. the process should be able to compress end to end release cycle time and deliver more number of releases in a stipulated time period (TechM Research, 2019).

The primary objective of 'To-be' value stream design should involve activities to optimize overall value stream performance. To-be value stream should bring out a detailed view of the to-be map, address issues/ wastages identified in the as-is assessment, and establish clear roles and responsibilities and accountability for the stakeholders across the value stream.



Source: TechM Research, 2019

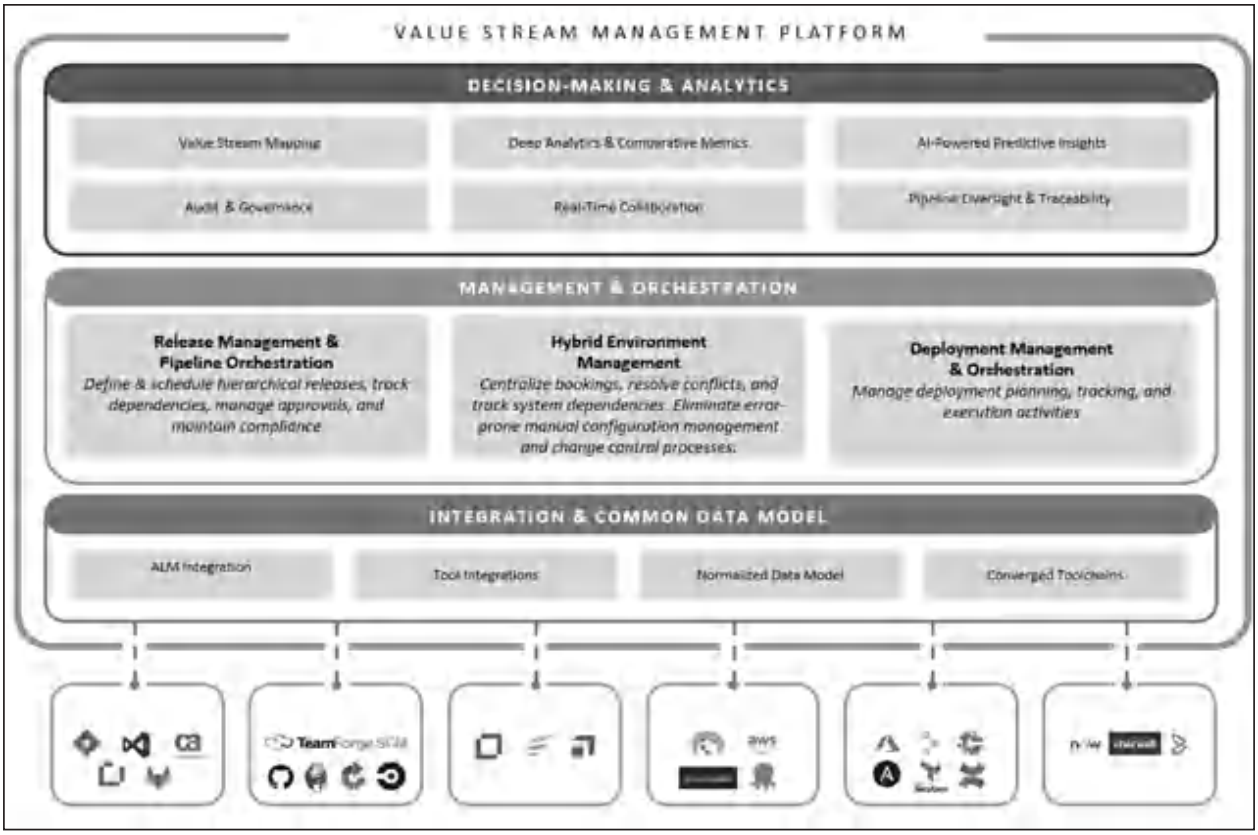
Fig. 3: NVA in the Process



Source: Skhmot, 2017

Fig. 4: Eight Wastes of Lean

The potential solutions for 'to-be' value stream design hinges on addressing the following questions:



Source: The Plutora Platform - Value Stream Management Platform - Plutora.com, 2020

Fig. 5: A Typical Value Stream Management Platform

1) How can we significantly increase the % quantum of complete/accurate work items for each activity in our as-is VSM? 2) How can we potentially eliminate, the non-value time in the lead time of each as-is activity and improve process cycle efficiency (PCE)? 3) How can we improve the performance of the value added in each as-is activity? 4) How can be leverage KANBAN to continuously ensure shift right on the Kanban dashboard?

This also involves integrating the disparate value streams into a common horizontal layer being called as Value Stream layer to let teams visualize more than a single process area. It not only allows to identify the waste but also helps to see the sources of waste by highlighting the bottlenecks.

Value Stream Management Platform: A typical value stream management platform consists of three layers as shown below in Fig. 5 (The Plutora Platform - Value Stream Management Platform - Plutora.com, 2020.

Integration and Common Data Layer: At this layer, the integration with existing software development Agile DevOps tools as well as creation of common data model should happen so as provide an end to end visibility and bi-directional data flow for the underlying processes, tools etc. The need for correlation of sourced data from existing tools - so that it can be turned into an actionable insights - is important. Product Development and delivery teams need a a common view across entire value stream of correlated data that provides insight across all stages of the product delivery lifecycle, from planning and application development to testing, deployment, and production monitoring.

Business Process Layer: BP Layer Generates views and insights on key processes such as release management, environment management and deployment management. The views so generated are important to monitor and track the processes in an efficient manner. For example, release management view should give a complete picture of the release's activity progress, number and names of applications impacted, release health, test progress, defects at any given point in time, metrics etc

Decision Making and Analytics Layer: This layer should enable design studio for value stream mapping as well

as AI powered predictive insights on the data collated through integration layer.

4. Case Study of US Telecom Services Provider

A large US based telecom service provider was facing number of issues pertaining to release, deployment management processes for their service management platform vTM development program. These issues were obviously having detrimental impacts on the release cycle times, costs and productivity of the product development process. Below table (sample) summarizes the release management related challenges, the use cases and business impacts.

Table 1: Issues in US Telecom Operator's Agile DevOps Implementations

Release Issues	*Use Cases*	*Business Impact*
Parallel release going on	A real time release dashboard with up to date status	Direct impact on the business users working as functionality may get blocked.
Each release has dependency on other	Manage dependencies between releases, applications and association scope	May hinder production functionality.
Common modules being updated for different teams for different releases	Tool to check sign off and lead architect	Chances on missing delivery artifacts impacting incorrect deployment.
Code merging after release	A tool to ensure merge activity completed	High risk of getting incorrect and irrelevant code getting deployed production
Tracking testing completion status for each release	A tool to integrate with existing test tracking tool and provide real time status	Risk of getting untested or partially tested code deployed to production
Question always there whether the modules is ready to go to be deployed or not	Need way to find percentage completion for each planned release	Risk of getting untested or partially tested code deployed to production
Providing environments and resources for parallel releases	Need a tool to provide resource availability and % utilization	Resource utilization fails which leads to delay delivery time lines/ efficiency
Making sure each release through ST, UAT, LSP(Performance environment) test cycle	Need a tool to capture testing phases. Need a tool to show development methodology and governance	Risk of getting untested or partially tested code deployed to production

Source: TechM PoC, 2019

A similar set of challenges, use cases and business impacts were formulated for environment management and deployment management areas

Solution involved mapping 'as-is' value stream, designing 'to-be' by eliminating non-value adds in the process, integrating disparate agile DevOps tools into a common horizontal VSM layer and creating common data model and governance to address the issues and use cases listed above.

On the basis of systems integration, common data model and data storage, monitoring, tracking and reporting of the process was enabled through reporting dashboards.

5. Discussions and Conclusion

Based on the literature survey as well as the practical experiences of running agile DevOps implementations, it was identified that the existing Agile DevOps methodology - although far superior to the earlier ones like waterfall and V-model - had a few shortcomings in terms of not being able to present the real-time end to end view of the value stream leading to difficulties in monitoring, tracking and improvements. Value stream mapping led agile DevOps approach was found suitable to addressing the existing challenges. VSM led Agile DevOps approach although widely used in manufacturing industry is new to the software product development industry and hence proof of concept was planned to prove the concept and the benefits.

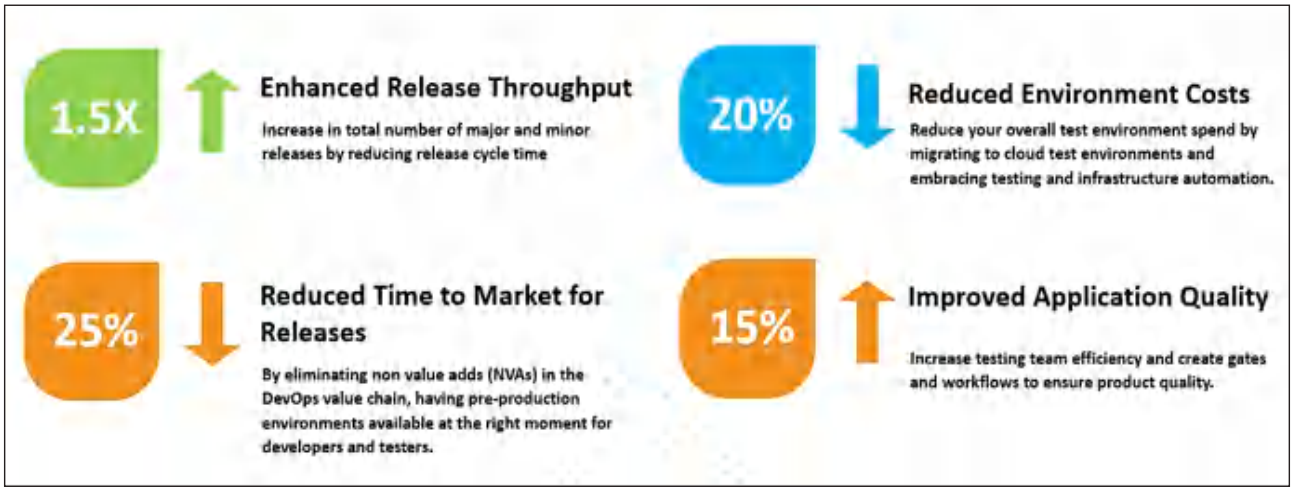
PoC was planned on a Telco service management platform. Plutora tool was used for the purpose of developing the PoC. Value stream maps were developed to identify the value adds. Re-engineered value stream maps removing non value adds (eight wastes of lean) were developed and deployed.

In conclusion the concept was proven - on a smaller scale - and can be easily scaled up for a full scale VSM led agile DevOps implementation accruing business benefits as discussed in section 6.

6. Implications of the Study

The Proof of Concept (PoC) demonstrated the benefits for the trouble ticket management platform for a US Telecom operator, its Service Management department, TechM Platform Innovation teams. A similar benefit could be accrued to a typical product development effort.

The PoC led to a significant (1.5X) improvements in the release throughput, reduced release environment cost (20%) and significantly reduced (25%) time to market for releases.



Source: TechM PoC, 2019

Fig. 6: Business Benefits of Proof of Concept (PoC)

7. Acknowledgements

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Data Protection Framework for India

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Abstract

Technology has rapidly altered the course of lives of the common people and has made life fundamentally connected. People are using the digitally connected world for a plethora of activities starting from Personal Communications to Business Transactions. Activities over the internet invariably involve exchange/sharing of Data/Information. The information exchanged can provide powerful insight into the user's individual, social, political, economic interest and preferences (Nawrot et al., 2010). This information exchange resulting in collection of Data from Data Subjects is happening in a continuous manner across digital infrastructure and by almost all stake holders. This poses serious issues related to data protection and privacy of the users. Countries across the world have awakened to the need for protecting privacy and data of its citizens. India, an emerging economy, house to a sixth of global population and an aspiring Regional Power has also made numerous piecemeal efforts, mostly reactive, to address the issues of Digital Privacy and Data Protection. In this paper, the authors analyse the global practices on Data Protection with an aim to identify key ingredients which must essentially be incorporated in the Data Protection Framework formulated by India.

Keywords: Data Protection, Digital Privacy, India, GDPR

1. Introduction

Emergence of Digital delivery of Services and its absorption by the State/Public Sector and the Private Sector has led to a huge increase in digital transactions/services. Reports indicate that approximately 2.5 quintillion (IBM, 2017) bytes of data are being generated daily globally. Driven by the desire of market dominance and offering of customized yet differentiated services, Service Providers are increasingly focusing on acquisition, storage, processing, analytics and subsequent trading of data of its users. While some of the data collected is generic, a significantly large portion of this data can be classified as Personal Data or Information, some of which Sensitive and containing Personal Identifying Information (PII). Uncontrolled monetization potential of this data in the absence of comprehensive framework on the methodology of collection, retention, processing and sharing of data has its impact on privacy, identity, reputation and critical personal and financial data of the users. Breach or compromise of this data can cause irreparable harm to these users. Data has also emerged as a powerful socio, economic, political and strategic asset. The exploitation of Facebook data by Cambridge Analytica (Boldyreva, 2018) to influence political decision making and opinion shaping of citizens across various countries is a small example of how multiple data sources can be collected, collated and analyzed for targeted campaigns. Countries across the world have awakened to the value of data and the need to provide an effective data protection framework in respect of both personal and business data.

2. Literature Review

The need for a Data Protection Framework has its origins in the emerging strategic nature of Data. Countries across the world are now alive to the need for Data Sovereignty. The authors felt it was only prudent to study the initiatives and enactments by Developed and Developing countries of significance to propose a Data Protection Framework for India. The initiative by EU, that is the General Data Protection Regulations (GDPR) (Intersoft Consulting, 2016), by the BRICS countries, i.e., Brazil's Civil Rights Framework for Internet Act (Civil Internet Framework, 2014), Russia's Federal Law on Personal Data(Federation Council, 2006), China's Cyber Security Law (National People's Congress, 2018), South Africa's POPI Act (National Assembly, 2013) besides initiatives in India which include Justice AP Shah Committee (Planning Commission, 2012) and Justice BN Srikrishna Committee (MeitY, 2018), so that a balance Data Protection Framework, which is consistent with the

world community while simultaneously safeguarding India's interest, can be proposed.

3. Digital Service Delivery Model and Areas of Concern

The Non-Rivalrous, Invisible and Recombinant nature of Data (Moniodis, 2013) coupled with its growing commodification, lends it vulnerable to the possibility of uncontrolled proliferation, has the potential to harm/haunt the user, who in the first place unsuspectingly shared it with the environment, himself.

For demystifying the maze around data, a closer look at the infrastructure, stakeholders enabling delivery of digital services is essential. A typical digital service delivery infrastructure is shown in Fig. 1.

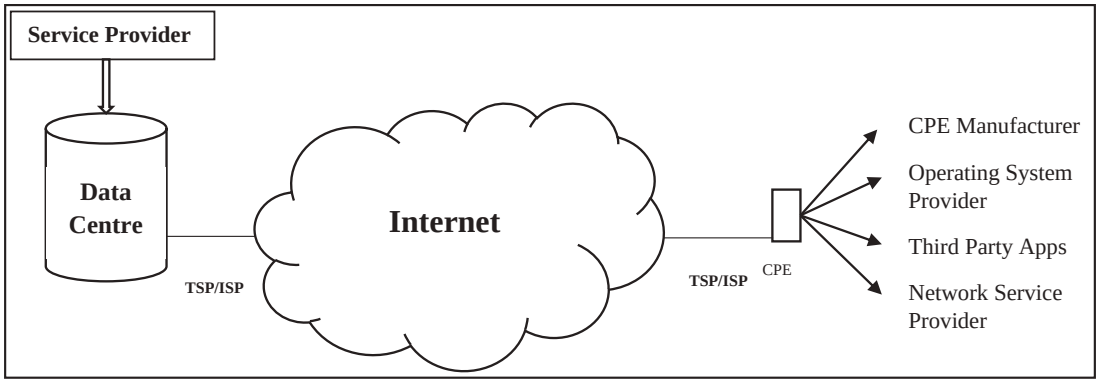

Fig. 1: Digital Service Delivery Infrastructure

Delivery of Digital Service is now not constrained by geographical boundaries of the User's or the Service Provider's State. Typically, a Service Provider hosts the Service through a server hosted in a Data Centre. The End User, through an End User Device/Customer Premise Equipment (CPE) avails of the services over the internet. The service provisioning is based on an affirmative acceptance of the terms and conditions of provisioning of service by the Service Provider. The challenge however is that besides the User and Service Provider, there are other embedded stakeholders like the Data Centre Facility Provider, Internet/Telecom Service Provider, End User Device/CPE manufacturer and the Application Provider. Therefore, a user consent for one intended Business to Consumer (B2C) service in the digital domain creates opportunities for at many other Business to Business (B2B) and B2C services, with each stakeholder vying for a large pie of the data transmitted/shared by the User, for subsequent storage, processing, analytics and reuse. This is facilitated by obtaining a very generically worded wide sweeping one-sided consent (take it or leave it) from the user.

The consenting users are mostly unaware of the impact of sharing this seemingly harmless bits personal information, which leads to emergence of areas of concern like Information Asymmetry (TRAI, 2017), Bounded Rationality (Bhandari & Sane, 2016; Radinsky, 2015), Data Monopoly, Ownership, Integrity, Residency and Cross border Flow. Various countries across the world have therefore initiated/implemented regulatory framework for protection of data of its Data Subjects. Nearly 120 countries (Greenleaf, 2017) across the world have enacted comprehensive data protection and e-privacy laws to holistically address these issues. Various facets of Data Protection laws/initiatives by USA, OECD, EU, UK, Australia, Canada, South Africa, China, Russia, Japan, Brazil are summarized as Appendix to this paper. Analysis of the Data Protection frameworks brings out Inadequacy of Existing Regulations, Emergence of Data Protectionism and a growing realization of Citizen's Right Protection.

In light of the above it is imperative that India develop a comprehensive Data Protection Framework, for protection of its citizen's rights to data protection and privacy. In the next section we examine the existing data protection framework in India and identify key constituents which must be considered for formulating a comprehensive Data Protection Framework for India.

4. Existing State of Data Protection and Informational Privacy in India

India has embarked itself on an ambitious plan for e-governance and digitized service delivery to its citizens through the Digital India initiative (Ministry of Electronics & Information Technology, 2015). Snapshot of the present state of exploitation of Digital Infrastructure in India as on Jan 2020 is shown in Fig. 2 (Hootsuite, 2020).

Source: https://datareportal.com/reports/digital-2020-india

Fig. 2: Digital Activity in India

However, India, as on date, does not have a comprehensive Data Protection Framework. Data Protection is enabled through a combination of Constitutional Rights and Acts, Government Guidelines and Sector Specific Regulations like Privacy Law enshrined under article 21 of the constitution, IT Act 2000 (Ministry of Law, Justice and Company Affairs, 2000), Indian Contract Act 1872, IT Rules on sensitive personal data on information (Ministry of Communications and Information Technology, 2011) and various related sectoral regulations issued by RBI, SEBI, IRDAI, TRAI etc.

The above approach of piecemeal plugging challenges related to Data Protection suffers from inherent drawbacks. Data of a Data Subject is collected by Public and Private entities alike, however Data Subject can claim infringement of Fundamental Rights only from the State and not Corporate Bodies. Similarly, the State not being a Corporate Body remains exempted from the provisions of the IT Act 2000. Therefore, initiatives like tabling of draft Personal Data Protection Bill in 2006 and subsequent appointment of Justice AP Shah Committee (Planning Commission, 2012) to propose a comprehensive Data Protection Framework of India were undertaken. As on date a revised Draft of Data Protection Bill has been tabled in 2019.

A Nine judge Constitutional Bench of the Supreme Court of India, on 24 Aug 2017, ruled Right to Privacy as a Fundamental Right. Right to Privacy was analyzed in the context of global information-based society. The Government of India on 31 Jul 2017 constituted a committee (Ministry of Electronics & Information Technology 2017) headed by Justice BN Srikrishna to suggest a draft Data Protection Bill for India. The committee in Nov 2017 has published a white paper (Ministry of Electronics & Information Technology, 2017) seeking comments of the public and stakeholders.

5. Proposed Framework for Data Protection in India

It is only prudent that the proposed data protection framework not only benefits from the previous work but

also incorporate the additional experience gained and challenges faced in the intervening period. The authors have taken cognizance of both local and global initiatives in proposing a Data Protection Framework for India. Key facets of the proposed data protection framework are discussed in the succeeding paragraphs.

5.1. Scope of Regulations

Rules of Jurisdiction in International law state that State Jurisdictions end at its territorial boundaries unless specifically permitted under scope of bilateral/multilateral treaties (France V Turkey, 1927 ICJ). International Laws, however, under certain circumstances permits exercise of extra territorial jurisdiction. Processing of personal data of a citizen of a given state, over the internet, could easily take place across multiple jurisdictions. This clearly leads to a situation where action in one state has its impact/effect in another. The scope of Extra Territorial Jurisdiction must include processing of data originated from citizens of India.

5.2. Applicability of the Regulations

The regulations must apply equally to Natural/Juristic Citizens and Public/Private Entities with some reasonable exception for the State. The Regulations must be applied prospectively with provision for Retrospective enforcement on some previously collected data.

5.3. Notice and Consent

Consent as an enabling/validating mechanism enables protection of an individual's informational privacy (Reidenberg et al., 2015) and provides the moral backing to the Data Controller/Processor for their subsequent actions. 'Consent' to the 'Notice' forms the foundation of most data protection laws/frameworks across the world. The Notice should clearly state the Nature/Type of data being collected, the Use for which it is collected and whether or not it will be shared further with third parties. A differentiated level of consent (European Commission, 2011) must be provided, giving option to the user to restrict data controlled for one/all of the above options without being denied the Service by a Service Provider.

5.4. Purpose Specification and Use Limitation

The service provider or Data Collector/Processor must clearly specify the Purpose of data collection and provide for enforcement of Use Limitation by the User with certain exceptions for processing of data by the State for activities like law enforcement, legislations, public interest (European Commission, 2014). Besides facilitating a lawful means of data collection, this would prevent subsequent unexpected/objectionable use of user data (European Commission, 2013).

5.5 Sensitive Personal Data

The authors do not propose sub classification of data as sensitive or otherwise. Technology today is so pervasive that harmless bits of data aggregation, correlation and analysis, can depending on its use, cause more harm to an individual even if provision for direct protection for sensitive data exist. Differentiated levels of consent for different type of data as proposed earlier will aid adequate protection for data perceived sensitive by each Data Subject.

5.6 Data Storage Limitations

It is only logical that collected data where the purpose of use of the data has been achieved and the Data Subject's consent imposes further use limitation be erased. It must however be noted that with emergence of technologies like IoT, AI and Big Data, where potential use cases of data may not be known apriori, it makes sense that Data Retention be preferred over Storage Limitation. The authors on this count are at variance with many recent global regulations like the EU-GDPR and are of the opinion that that the data required to be retained should be anonymized (OECD, 2013). Technological Solutions be deployed for encryption and storage of anonymized data sets, while at rest or in transit, besides imposing legal penalties for violation/breach of data protection framework on user data.

5.7. Data Authenticity

An individual's right to access data about himself, allow determination of its correctness, lawful processing and

removal of inaccuracies, should therefore be at the core of the data protection framework. It is proposed that Individual should be accountable for correctness of shared consented data. Thereafter, it should be responsibility of the collector/processor to ensure data authenticity whether processed or otherwise. The User must have a right to demand data correction/updation.

5.8. Safeguard Against Pitfalls of Automated Decisions

Data Protection framework must provide for grant of relief against inconvenience caused to Data Subject due to application of incorrect/inaccurate logic for arriving at automated decision on user data sets. The User must have the liberty to restrict data processing based on inaccurate data which could lead to denial of services to him.

5.9. Data Portability

Data portability is very important for ensuring user autonomy and therefore is correctly being considered as an integral part of the envisaged data protection framework.

5.10. Right to be Forgotten

It is essential that an 'Exit Clause' mandatorily be incorporated in Notices enabling the Data Subject to exercise his Right to be Left Alone or Forgotten from the digital world. This directly implies that a data controller/processor must erase all data of a Data Subject on exercise of his Right to be Forgotten (Jeffries, 2011).

5.11. Data Transfer Tracking

Any Data Controller/Processor must not share data of a Data Subject with any third party without explicitly informing the Data Subject of the intention to do so and obtaining the consent of the Data Subject.

5.12. Data Protection Authority

It is important that a robust, independent and technically sound supervisory Authority, namely Data Protection Authority be established. The fact that Sectorial Regulators exist and have evolved relevant regulatory framework for their respective sectors, it may be more prudent to adopt the co-regulatory model. The Data Protection Authority could also serve as a platform for Inter Sector Regulatory Synchronization. The Data Protection Authority must undertake periodic audits of organizations to ensure that the organizations collecting/processing data are adhering to the laid down regulatory Framework.

5.13. National Perspective

It is important that a state also protects its Data Sovereignty. Economic activities in this digital age are largely data centric and therefore certain issues like Data Democracy, Data Localization and Cross Border Flow of Data should be dealt as subjects of National Strategy.

6. Conclusion

India, home to one sixth of the global population and one of the fastest growing economy, must adopt an effective yet realistic Data Protection Framework. The migratory path from the existing state of Data Colonization to the desired state of regulated Data Democracy will be very challenging. A global consensus on data protection framework and its consequent compliance by the State and Sectoral stakeholders is the most desirable state. However, since the utopian state does not exist, efforts must also be made at regional levels or between member states having common stated aim and objective towards data protection like the EU to evolve a common data protection framework.

Early finalization and adoption of a Data Protection Framework based on the factors highlighted in this paper would help India catapult itself towards a growth trajectory effectively harnessing the potential of the next generation technologies.

Appendix

Table 1: Summary of Important Provisions of Data Protection in Various Countries

Parameters	*EU*	*UK*	*US*	*Canada*	*Australia*	*South Africa*	*China*	*Russia*	*Japan*	*Brazil*
Law	EU GDPR 2018	Data Protection Act 2018	Privacy Act FTC, GLB, HIPAA, COPPA Electronic Communication Privacy Act	Privacy Act, PIPEDA	Privacy Act 1988	POPI,2013	Systems for Cyber Security Law 2018	Federal Law on Personal Data 2006	APPI 2016	Civil Rights Framework for the Internet 2014
Extra Territorial Scope	Includes controllers and processors outside EU	Applicable to Overseas Organisations and Operators which carries on business in Australia and personal data collected or held in Australia.		Silent and subject to interpretation by courts		Applies to automated or non-automated data processing within South African Territory only	All entities irrespective of physical location accessing localised Chinese data automatically covered under the Chinese law	All entities irrespective of physical location accessing localised Russian data automatically covered under the Russian law		
Applicability Of The Regulations	Natural Persons Public and Private Entities	Public and Private Entities	Some Private and Most Govt Entities	Govt and Private Entities No retrospective application	Some Private and Most Govt Entities	Natural and Juristic Persons Consensus on no retrospective application				
Notice And Consent	Explicit, Specific, Informed and Unambiguous	Explicit, Specific, Informed and Unambiguous	Consent is mandatory	Graduated consent standard Consent valid only if individual reasonably understands nature, purpose and consequence of consent	Consent not an essential prerequisite. Necessity of collection of data must exist	Explicit, Specific, Informed and Unambiguous			Consent is mandatory	Consent is mandatory

Parameters	*EU*	*UK*	*US*	*Canada*	*Australia*	*South Africa*	*China*	*Russia*	*Japan*	*Brazil*
Purpose Specification And Use Limitation	Strict adherence to purpose and use limitations agreed between Data subject and Controller/ Processor with exemption for Scientific, Historical, Statistical Research or Law Enforcement	Strict adherence to purpose and use limitations agreed between Data subject and Controller/ Processor with exemption for Scientific, Historical, Statistical Research or Law Enforcement	Strict adherence to purpose and use limitations agreed between Data subject and Controller/ Processor	Strict adherence to purpose and use limitations agreed between Data subject and Controller/Processor with exemption for Scientific, Historical, Statistical Research or Law Enforcement	Adherence to purpose specification for data collection is expected. Consent required for secondary use with exemptions for law enforcement	Strict adherence to purpose and use limitations agreed between Data subject and Controller/Processor Only compatible further processing permitted			Strict adherence to purpose and use limitations agreed between Data subject and Controller/Processor	Strict adherence to purpose and use limitations agreed between Data subject and Controller/Processor
Data Storage Limitations	Storage limited to purpose of use or archiving for research purposes	Storage limited to purpose of use	Data no longer required after purpose of use is over must be destroyed. Exemption for data required for legal purposes	Data no longer required after purpose of use is over must be destroyed or anonymised	Data no longer required after purpose of use is over must be destroyed. Exemption for data required for legal purposes	Storage limited to purpose of use or archiving for contract verification and research purposes				
Data Authenticity	Accuracy of Data be ensured through updation and rectification or erasure of inaccurate data	Accuracy of Data be ensured through updation and rectification of inaccurate data	Accuracy of Data be ensured through updation and rectification of inaccurate data	Accuracy of Data be ensured through rectification of inaccurate data. Updation permitted only if required for processing within the specified purpose of use	Accuracy of Data be ensured through updation and rectification of inaccurate data	Accuracy of Data be ensured through updation and rectification of inaccurate data			Accuracy of Data be ensured through updation and rectification of inaccurate data	Accuracy of Data be ensured through updation and rectification of inaccurate data

Parameters	*EU*	*UK*	*US*	*Canada*	*Australia*	*South Africa*	*China*	*Russia*	*Japan*	*Brazil*
Safeguard Against Pitfalls Of Automated Decisions	Data Subject has right to know the details of Data Processor, Access and update personal data, verify purpose of use and logic behind automated decision	Data Subject has right to access and update personal data, verify purpose of use and logic behind automated decision		Data Subject has right to access challenge accuracy, completeness of data, update personal data and verify purpose of use. Exemption include non updation if updation/ correction cost is prohibitively costly etc	Data Subject has right to access personal data. This right is not absolute and can be denied under exempted circumstances. Data updation requests can be made for correction of inaccurate data	Data Subject has right to know the details of Data Processor, Access and update personal data, verify purpose of use and details of data required to de destroyed/ deleted. Exemption stipulated by "Promotion of Access to Information Act 2000".				
Restriction And Objection To Processing	Specific to EU or countries following EU model, not translated into law	Broadly following EU model, not translated into law				Broadly following EU model, not translated into law				Broadly following EU model, not translated into law
Data Portability	Specific to EU or countries following EU model, not translated into law	Broadly following EU model, not translated into law				Broadly following EU model, not translated into law				Broadly following EU model, not translated into law
Right To Be Forgotten	Recognised by GDPR	Recognised by DPA 2018		Upheld under PIPEDA		Not explicitly permitted but caters requests for deletion of personal data				Upheld under the Civil Rights Framework

Parameters	*EU*	*UK*	*US*	*Canada*	*Australia*	*South Africa*	*China*	*Russia*	*Japan*	*Brazil*
Data Transfer Tracking										
Data Localisation	Data to be localised within EU				Restrictions imposed on transfer of certain types of data outside Australian territory		Data centres storing data of Chinese citizens must be located within Chinese Territory	Data centres storing data of Russian citizens must be located within Russian Territory		Data centres storing data of Brazilian citizens must be located within Brazil's Territory
Cross Border Flow of Data	Adequacy Test Model contract laws and Binding Corporate Rules	Adequacy Test Model contract laws and Binding Corporate Rules	Privacy Shield	Permitted. Organisations sharing data responsible for its protection	Automatic application of APP on recipient entity by means of extra territorial jurisdiction	Permitted if recipient country has same level of Data Protection guaranteed as existent in South Africa			Permitted if recipient country has same level of Data Protection guaranteed as existent in Japan	Permitted if recipient country has same level of Data Protection guaranteed as existent in Brazil

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Fintech: Emerging Trends

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Abstract

Fintech in simple terms is leveraging technology to deliver banking and financial solutions to individual and enterprise customers. This is one of the fastest-growing sectors in both developed & developing countries with India amongst the top three fintech start-ups globally. Blockchain, Cryptocurrency, AI, Data Analytics, Machine learning, Big data, Robotics, and Cloud are some of the top technologies leveraged by fintech firms to deliver products. Domestic & global broadband connectivity setup by telecom service providers made available basic infrastructure needed for fintech growth. One of the early fintech innovations was the installation of the first ATM by Barclays Bank in 1967. Post global financial crisis in 2008, many ex-employees of financial firms came up with innovative fintech products. The objective of this paper is to identify globally emerging fintech trends. The Qualitative research methodology was used relying on a review of literature, discussion with the professionals and researchers. The emerging trends include IMF focus on leveraging fintech for cross border payments using distributed ledger technology, Augmented reality for customer satisfaction, Digital insurance, Digital invoicing, Crowd-funding, Crowd investing, Robotics investment advisory, Future relationships between Banks and Fintech firms, Central bank regulatory role. It also came out that although there are many research papers on fintech globally, however, there is not much research work carried out on fintech in India and there is an opportunity for further research on innovation and growth of fintech in India.

Keywords: Fintech, Finance, Digital, Technology, Innovation

1. Introduction

'FinTech', 'digital finance', or 'financial technology', in simple terms, all relate to leveraging of newer technology, to transform and innovate the delivery of financial services. Fintech firms could be technology startups, e-commerce companies, or large-tech companies. These firms use emerging technologies like cloud computing, blockchain, artificial intelligence, machine learning, data analytics, and robotics, to offer financial services at a reduced cost for a better value proposition.

1.1. Fintech 1.0 (1867-1967)

One of the first instruments for analog finance technology were coins and paper money. The laying of the transatlantic cable (for transmitting telegraphic messages) between London, Paris and New York in 1867 is generally considered the beginning of the first era of fintech. This was later followed by the connectivity of London with Shanghai and Hongkong and subsequently all other markets globally. This was also the beginning of large-scale infrastructure setup for connecting people, media, governments, organizations, and financial markets across the globe (Arner et al., 2016).

1.2. Fintech 2.0 (1967-2008)

In 1967, Barclay's bank established the first ATM in London, and in the same year, the Texas Instrument launched the first hand-held calculator machine. Both of them were significant innovations and were considered to be the beginning of the second era of fintech. This was the period of digitization, from analog paper to the beginning of the transformation to the digital world with the use of the calculator, computers, and ATMs. Between 1960-1970, payment systems like SWIFT evolved, which formed the basis of large-scale online transactions. In 1971, the first electronic stock exchange NASDAQ was established, a step towards the digitization of the stock market. Beginning of the 1980s, most of the banks in developed countries migrated from manual to computerized systems. Internet technologies transformed from email to internet services facilitating online business. In between, there were three major market crashes: global stock market crash known as Black Monday in 1987, internet and dot

com bubble crash in 1999, and 2008 global financial market crash due to subprime real estate market lending defaults. After every such crisis, a series of reforms and regulations were introduced.

1.3. Fintech 3.0 (2008-present)

Post the 2008 market crash, several regulatory changes were introduced which increased compliance costs and decreased profitability. Many employees lost their jobs and ventured into fintech startups offering innovative financial solutions. These startups were not 'banks' in the strict sense but were offering banking solutions. Twentieth-century witnessed the emergence of cryptocurrencies, mobile payments, crowdfunding, initial coin offering, new forms of peer to peer lending, and data-driven finance.

1.4. India

India is one of the fastest-growing markets for fintech start-ups. The basic infrastructure of connectivity started through the telecom network and was followed by a digital India flagship program for connecting 250,000 gram-panchayats across the country (Broadband highways n.d.). This infrastructure was a launch-pad for fintech firms to roll out banking like products to the unbanked population. The demonetization announced by the government of India in Nov'16 further accelerated the adoption of digital transactions.

This paper is a study of emerging trends in fintech.

2. Objectives

Fintech is one of the fastest-growing sectors with several start-ups, e-commerce, and technology companies operating in this space across the globe. Fintech has disrupted financial business and has been posing challenges for traditional banks, financial institutions, central banks, and regulatory bodies. It has also been a topic of great interest for academicians, financial institutions, and research houses. The main purpose of this study is to: (1) understand the definition of fintech; (2) understand opportunities in fintech; (3) study opportunities and challenges of fintech for banks; (4) study emerging trends in fintech; and (5) gather topics for further research on fintech.

3. Literature Review

3.1. Fintech

Fintech is normally associated with the use of newer technologies for innovative delivery of financial services. *"Fintech is a new financial industry that applies technology to improve financial activities"* (Schueffel, 2016). The financial industry can be a startup or a tech firm or a financial institution that leverages technology to improve financial activities. *'FinTech' is technologically enabled financial innovation that could result in new business models, applications, processes, products, or services with an associated material effect on financial markets and institutions and the provision of financial services,* (Schindler, 2017). This definition is comprehensive, with a focus on innovation leading to improvement in business activity with material impact. *"The term "FinTech" (sometimes: fintech, fin-tech, or Fintech) is a neologism which originates from the words "financial" and "technology" and describes, in general, the connection of modern and, mainly, Internet-related technologies (e.g., cloud computing, mobile Internet) with established business activities of the financial services industry (e.g., money lending, transaction banking)"* (Gomber, 2017).

3.2. Banks

Banks missed the initial phase of fintech innovation and acted largely as a pass-through gateway for fintech firms. Banks need to stimulate innovation, drive fintech transformation programs, and invest in fintech initiatives/ firms, by organizing focused internal programs, organization, and cultural changes. In the future, banks and fintech firms may co-exist and complement each other. It is possible that larger fintech firms eventually become dominant financial institutions, with banks primarily left to manage wholesale funding. *Banks may have a limited role and would eventually become fractional banks* (Adrian et al., 2019). Most of the banks now have an online presence as internet age customers prefer online transactions. Banks need to take advantage of data-driven analytics for decision making. SIM swap, vishing, phishing, and money laundering are some of the common fraud faced by banking customers. Customer awareness programs have proved useful in the prevention of such frauds and such programs should continue.

3.3. Central Bank and Regulator

The role of the central bank is primarily to ensure inter-bank operability, however, this may get challenged in future, if digital money firms take up interbank operability and hold reserves similar to the central bank. This can lead to a monopoly of large e-money providers and can be a risk to the system. *Central banks can be issuing agency for grant of licenses for e-money providers ensuring strict governance and compliances.* (Adrian et al., 2019). Central banks are setting up regulatory sandbox environments for fintech to test regulatory compliances. There were instances, where fintech firms had launched their products without fully complying with central bank regulations like partial adherence to Know Your Customer (KYC) process. *Fintech firm's large term objectives are not aligned with regulatory bodies* (Philippon, 2016). Collaboration between regulators and fintech firms can be of mutual benefit, fintech firms can share changing consumer behavioural data insights that can be used by regulators to create consumer-friendly regulations (Romānova et al., 2016). The machine language, artificial intelligence, and big data for the understanding of human behaviour mimic would be a major program for the regulatory framework, enforcement, and compliance in the USA (Bauguess, 2017).

3.4. Digital Money

Digital money, e-money, and mobile wallets with online payments, fund transfers, and other banking services, have good awareness and adoption with online customers. M-Pesa, launched in March 2007 in Africa, was one of the first mobile digital wallet products, with wider reach and adoption by a large unbanked population (What is M-Pesa?. n.d.). This was the beginning of the digital money innovation by fintech start-ups.

3.5. Cross Border Payments

Cross-border payment is a key mandate of the International Monitory Fund for fintech innovation using blockchain, an open system distributed ledger technology. This system can set up trust between intermediaries and address terror funding and money laundering issues. This can potentially reduce costs and improve service parameters. *A key uncertainty is whether changes in financial markets will be gradual and evolutionary or potentially disruptive* (He et al., 2017).

3.6. Blockchain

The launch of the first cryptocurrency Bitcoin was a stepping stone for blockchain technology. Bitcoin and other cryptocurrencies are on open-source distributed ledger technology, with no role of the central bank, and managed by transparent interactions of parties on a trusted and secure network. (Nakamoto, 2019). The internet of trusted data, robust digital identity, distributed internet trusted authorities, distributed safe computation, universal access would be leading financial technologies (Pentland et al., 2016).

3.7. Niche Technologies

Blockchain, machine learning, artificial intelligence, data analytics, robotics, and cloud computing are major technologies used by fintech firms in product development. An evidence-based study summarizes the internet of things (IoT), robo-advising, and blockchain as the most valuable innovations for the financial sector (Chen et al., 2019). Unmanned drones have an application in insurance, financial, and underwriting businesses by capturing sensor data and transmitting through wireless communication for insurance claim adjustments (Luciani et al., 2016). Some of the emerging trends are mobile wallets, growth of neo banks with virtual presence and new millennial age customers having strong connect with technology companies like Amazon and Google. These firms have leveraged machine learning & data analytics for customer support, artificial intelligence for investment advisory, blockchain for peer to peer lending & contract management, etc. Augmented Reality (AR) can be leveraged for better customer engagement and can be a major service differentiator. AR enables consumers to observe information in an engaging, concise, and immersive way (Dubey, 2019).

3.8. Fintech Research Topics

Fintech is at the growth stage and with the evolution and maturity of newer technologies has the potential for further innovation & transformation of business products, services & processes. There are several opportunities for research in fintech especially in emerging areas like digital insurance, electronic invoicing, electronic factoring or electronic leasing, crowd investing, robot investment advisory, and understanding of cryptocurrencies other than bitcoins and their interlinkages (Gomber, 2017).

Robot investment advisory can be studied to understand the relationship between intent to use the service and using the same, technology readiness and need for social interaction (Belanche et al., 2019).

3.9 Fintech in India

India is considered as one of the fastest-growing markets for fintech innovations and is a global leader along with China at 87% fintech adoption of digital payments amongst the digitally active users. Similarly, 99.5% of digitally active users in India are aware of the availability of fintech services for making online payments and fund transfers. This awareness is attributed to the government of India's announcement in 2017 for reducing paper money circulation in the open market (Global fintech adoption. 2019). Many successful fintech innovative products were launched by the government organization like Immediate Payments Service (IMPS), Unified Payments Interface (UPI), Bharat Interface for Money (BHIM), Bharat Bill Pay System (BBPS) and Aadhaar-enabled Payment System (AePS). These products or interfaces are used by fintech firms and banks. Some of the thrust areas of the Reserve Bank of India, a central bank, are financial inclusion, regtech-technology for regulatory function, suptech - technology for supporting regulatory supervision function, and sandbox infrastructure for fintech innovators. (Das, 2019). Fintech use cases in India have come up in the social sector as well, with organizations such as Milaap helping with online fundraising. (Jutla et al., 2016). NASSCOM has predicted stronger data analytics, a need for enhanced collaboration amongst stakeholders, customized solutions, and democratizing data as major fintech 2020 trends for India. They have recommended that the regulator simplifies the KYC process, adoption of digital KYC, and setting up a default reporting platform (Fintech Lending – Unlocking Untapped Potential, 2019).

3.10. Risks

As fintech firms are launching new products and services, there are underlying risks of using technology for financial institutions especially concerning technology failure, data security, cyber threat, and regulatory compliances. *There is a need for new and modified regulations for fintech companies due to evolving business models* (Pejkovska, 2018).

4. Methodology

A comprehensive review of the literature on fintech, digital money, fintech innovations, cryptocurrency, blockchain, and financial technology was undertaken to define the scope of the study and ensure its objectivity. The selection criteria were based on top-cited research papers on google scholar website and the International Monetary Fund website. Some key data and trends for future innovations in fintech were taken from websites of leading market research organizations.

5. Findings/Discussion

The study examines the definition of fintech, emerging trends in fintech, the impact of fintech on financial institutions, risks from fintech innovations, and future opportunities. Fintech is transforming the world of finance faster than ever before using newer technologies. Some of the key findings from the review of literature are:

Fintech has 64% global consumer adoption; 96% of global consumers are aware of digital payment services, 68% of consumers prefer non-banking institutions for financial services, and 46% of consumers are willing to share their banking data with the non-banking firm are key findings of 2019 fintech consumer survey. On the SME segment, 25% is the global adoption rate, 56% use banking payment & fintech service, and 46% use fintech financing service (Global fintech adoption, 2019).

Digital payment has maximum awareness and adoption rate, with India and China being global leaders. It has become the backbone for non-finance industries like insurance (comparison, purchase), transportation (e.g. radio taxi), telecom & utility (recharges, bill payments), travel (bookings, payments, offers), hospitality (booking, payments), entertainment (content purchases), FMCG (point of sale), e-commerce, etc. Even, the government in many countries like India are carrying out direct fund transfer for purchases and subsidies to eliminate corruption and reduce the cost of a transaction. Digital payment shall continue as core fintech services with further innovation.

Banks are driving initiatives to encourage fintech innovation, they need to address challenges from people, processes, and organizational culture. Neo-banks are posing challenges for traditional banks by offering innovative products at a lower cost.

Regulatory bodies and central banks are supporting fintech innovations by setting up sandbox environments and policy changes for licensing and governance. The regulator needs to leverage fintech innovations for its governance and supervision function and be more proactive using newer technologies.

Blockchain has immense potential to transform businesses, reduce costs, and improve trust and transparency. The potential of tracking any transaction from source to target with trusted intermediaries is a powerful capability of blockchain and has strong use cases, like diamond stone tracking from mining to retail store, organic farming from farmer to market, land records in maintaining a transparent history of ownership and sharing secure medical records of a patient.

Newer technologies like cloud computing, blockchain, artificial intelligence, cognitive learning, machine learning, robotics, augmented reality, big data, IoT, and drones are leveraged by fintech firms.

IMF as a global financial institution believes fintech can improve cross border payment service, cost of the transaction, and transparency using blockchain distributed ledger technology.

Digital insurance, digital invoicing, electronic factoring, electronic leasing, crowd investing and interlinkages of cryptocurrencies other than bitcoin are newer topics where further research can be carried out.

Investment advisory using robots has the potential to disrupt the investment advisory business. These robo-advisors can meet the customer expectation of trust and transparency, at a lower cost, and with better knowledgeable information; however, customers still expect a human interface for investment advisory, which can be addressed by a hybrid model of a human face along with a robo-advisor.

6. Conclusion/Implications

Fintech has disrupted financial markets with technology and innovation by transforming the finance business and is growing faster than ever before. Digital finance is now emerging as the backbone of businesses. This makes it crucial for fintech firms to address concerns relating to online business risks more proactively. The financial market crisis of 2008 was the beginning of fintech and it has evolved with time. The challenges for fintech firms in the current year have increased substantially due to the coronavirus pandemic; however, the current situation also presents them with the opportunities to monetize from increasing digital transactions and growing demand for tele-medicines and insurance products. Currently, the new investments in fintech have almost stopped as many firms are forced to cut costs and reduce redundancies. The online or digital business is here to stay, and fintech firms can further learn from the current crisis and come out strongly with innovative solutions (Beyond COVID-19: New Opportunities for fintech companies, 2020).

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Niral Open Product Framework

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Abstract

Mobile Network Operators have traditionally been dependent on a handful of vendors. This dependency made the upgrades slower, increased cost and hampered innovation. Adoption of open and disaggregated solution has enabled Cloud Service Providers to innovate rapidly. Operators understand the need for innovation and are increasingly evolving to transparency and disaggregation from conventional and proprietary strategies. Networks with 5 G are expected to be 10X denser than networks with 4G. More vendor equipment will be required for the denser network, contributing to an extra risk of vendor lock-in. Therefore, the purpose of this paper is to explore a potential solution to the problem described above. The idea of the Vendor Agnostic Open Product System was conceptualized by Niral Networks. The Niral Open Product Structure allows MNO's shift to operator controlled from vendor controlled, hence reducing the risk of vendor lock-in and fostering competition through better supplier, product, cost and solution management.

Keywords: 5G, Open Source, Curation, Disaggregation, White box, Niral Open Product Framework, Telecom Network Transformation, Vendor Agnostic

1. Introduction

1.1. Networking Landscape in Last Decade

The Networking landscape has changed rapidly in the last decade. Few of the notable factors that has emerged are:

- Open Source Offering became matured.
- Availability of Multiple White box ODM.
- Emergence of SDN and NFV.
- Industry realization of the risk of vendor lock-in.
- Industry movement towards Open Network Adoption.

Most Cloud Service Providers like AWS, Facebook, Google adopted open source and white box hardware solution pretty early. They have in-house R&D team that develops and contributes to many open source projects. Most of their data center runs on open, disaggregated software and hardware.

Mobile Network Operators have traditionally been dependent on a handful of vendors. This dependency made the upgrades slower, increased cost and hampered innovation.

Table 1: Dependency of Services on Vendors

	Mobile Operators	*Cloud Service Providers*
Dependency on Traditional OEMs	High	Low
In-house R&D	Limited	High
Adoption of Open Source	Low	High
Adoption of White box	Low	High
Adoption of SDN and NFV	Low	High

Source: McKinsey & Company, 2018

Adoption of open and disaggregated solution has enabled Cloud Service Providers to innovate rapidly.

1.2. Transformation of Mobile Networks Operators

MNOs' are familiar with the possibility of vendor lock-in and are increasingly shifting to openness and fragmentation from traditional and proprietary technology. To reduce the risk of vendor lock-in, several operators have established their own R&D division and have collaborated with open source groups or developed their own NOS (Niral Networks, 2020).

Table 2: CSP's having Indigenous R&D Team

Operators with indigenous R&D team	AT&T, Verizon, Orange, NTT, Viettel, Jio

Source: Niral Networks

In partnership with open-source initiatives, network providers such as AT&T have more frequently started to adopt the idea of disaggregated routing. AT&T acquired the Vyatta virtual router software from Brocade and announced plans to deploy 60,000 Disaggregated cell site routers (DCSG) in 2018 (Haranas, 2017). Rakuten and Telefonica have conducted field trials with disaggregated software and hardware in 2019 and have started deployment (iGR, 2020).

A list is given below of the few Open Source projects that operators contribute to.

The word "OPEN" in Telecom has various definitions depending on the methods employed by the provider to create the device.

In the telecom parlance OPEN means closed, customized software developed on the basis of open standard, with APIs interoperable in nature and integrated off-the-shelf White Box hardware to create an Open, Disaggregated Network Solution.

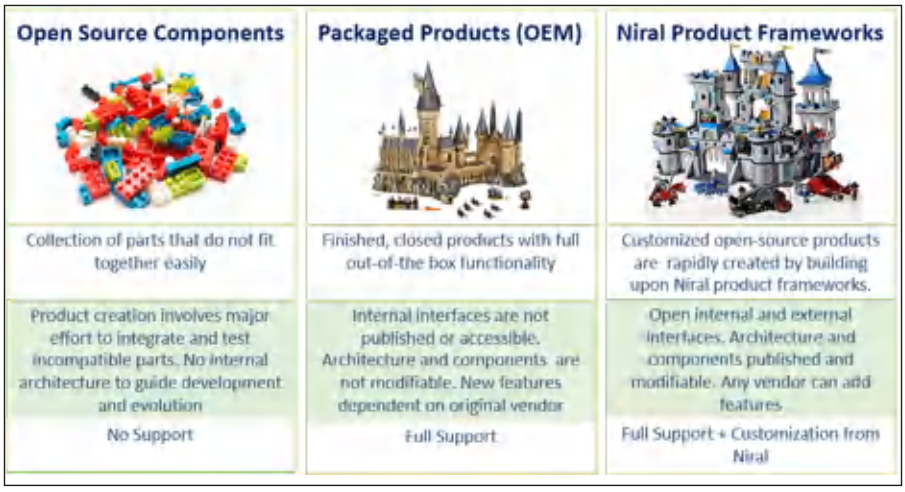
Such solutions are still Vendor Controlled, as Operators have little control over the proprietary software and its enrichment. The feature's technology or innovation and, its technical support is totally vendor controlled. Vendors such as Altran, Metaswitch and IP Infusion are offering proprietary NOS, they share only their binary and therefore indirectly create a vendor lock-in.

Table 3: Contribution to Open Source Projects Made by Operators

Project / Community	Operator Contributors	Other Contributors
DANOS	AT&T	Niral
FRR	Orange	Cumulus, Niral, Vmware
O-RAN	AT&T, China Mobile, NTT, BT, Jio, Airtel, etc.	Ericsson, IBM, Intel, Altiostar, Mavenir, Parallel Wireless
ONOS	AT&T, China Unicom, NTT, Comcast, etc.	Google, Edgecore, Intel, Ciena, Broadcom, Delta
STRATUM	China Unicom, KPN, NTT, Turk Telecom	Big Switch, Cisco, Delta, Broadcom, Barefoot, Mellanox
DPDK	AT&T	Intel, ARM, Ericsson, F5, NXP
LF Networking	Deutsche Telecom, AT&T, Bell, Vodafone	Ericsson, Cisco, Huawei, Intel, Juniper, Red Hat, ZTE
LF Edge	NTT, AT&T	DELL, GE, HP, Samsung, Qualcomm
Open Compute	AT&T	Arista, ASUS, Alibaba, IBM
FRRLWRT	BT, Vodafone, Verizon, Deutsche Telecom	Intel, Broadcom, Qualcomm

Source: Niral Networks

OPEN can also means applications which are open-source and are based on open standards and APIs which are interoperable, where any person within the Enterprise, Open Source network, Open Innovation Group can contribute to Linux-like applications enrichment or support that can be compatible with any off-the-shelf White Box hardware. This approach is truly Vendor-Agnostic as it uses open source.



Source: Niral Networks

Fig. 1: Comparison of Frameworks

2. Literature Review

We are moving from traditional vendor controlled approach to vendor agnostic approach which will unlock new set of unchartered opportunities for the Mobile network operators. In vendor controlled approach, Mobile Network Operators are tied up with few vendors and thus it results in vendor lock in, prices of various equipment's will eventually increases at a later stage by the vendors in the future and will result in less profits. Considering the present market condition, MNO's are looking at some innovative solutions approach which will possible through vendor agnostic approach only. In vendor agnostic approach, company will have various set of vendor options to choose the best services according the requirements (Abbasi, 2019).

The Niral team conceived the idea of the Vendor-Agnostic Open Product Framework after several discussions with clients and open source ecosystems. The Product Structure helps MNO to shift to Operator Deliberated from Vendor Regulated to, reduce the possibility of lock-in of suppliers and encouraging competition by better managing their provider, product, cost and solution.

3. Discussions and Findings

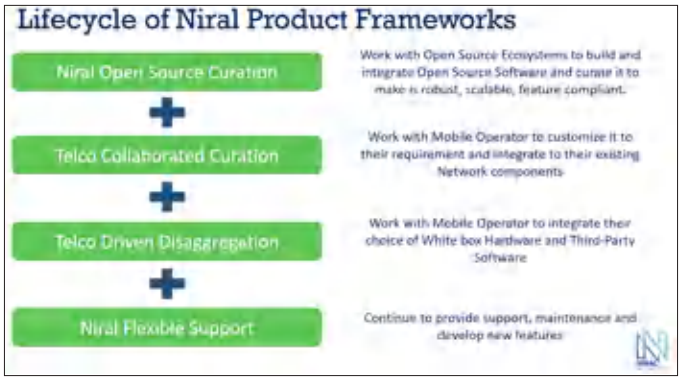
3.1. Conceptualization of the Niral Open Product Framework

The Niral Platforms are open source products designed with interoperable APIs and curated to be flexible, stable and compatible with features. An individual or group is can contribute to the enrichment or benefit of its apps. The development of a Disaggregated Networking Solution can be built into any off-the-shelf White Box hardware.

The Niral Open Product Framework is based on 4-principles:

- Open Source Software Curation – Working with Open Source Platforms to build, implement and curate Open Source Applications to be stable, flexible, usable and standard compliant.
- Telco Collaborated Customization – Act for the Telecom Provider to tailor it to their needs and incorporate it into their current elements of the network.
- Disaggregation for white box hardware and software according to the operator's preference- Contract with MNO to merge their Third-Party Device option and White Box Hardware.
- Niral or other Third-Party Versatile Assistance – Continue assistance, repair and development of new features

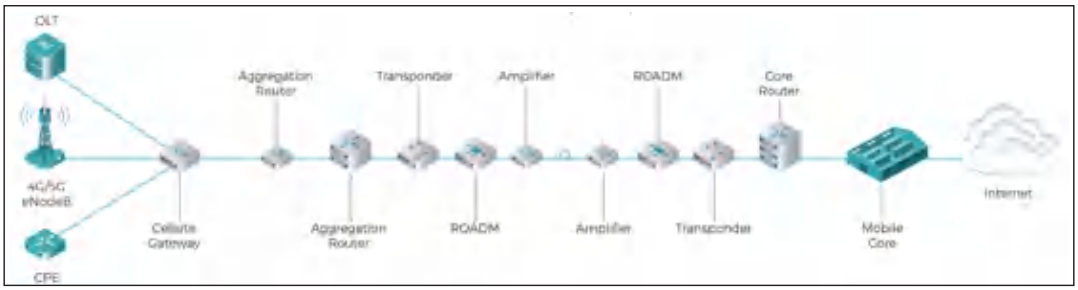
3.2. Lifecycle of Niral Product Frameworks:



Source: Niral Networks

Fig. 2: Life Cycle of Niral Product Frameworks

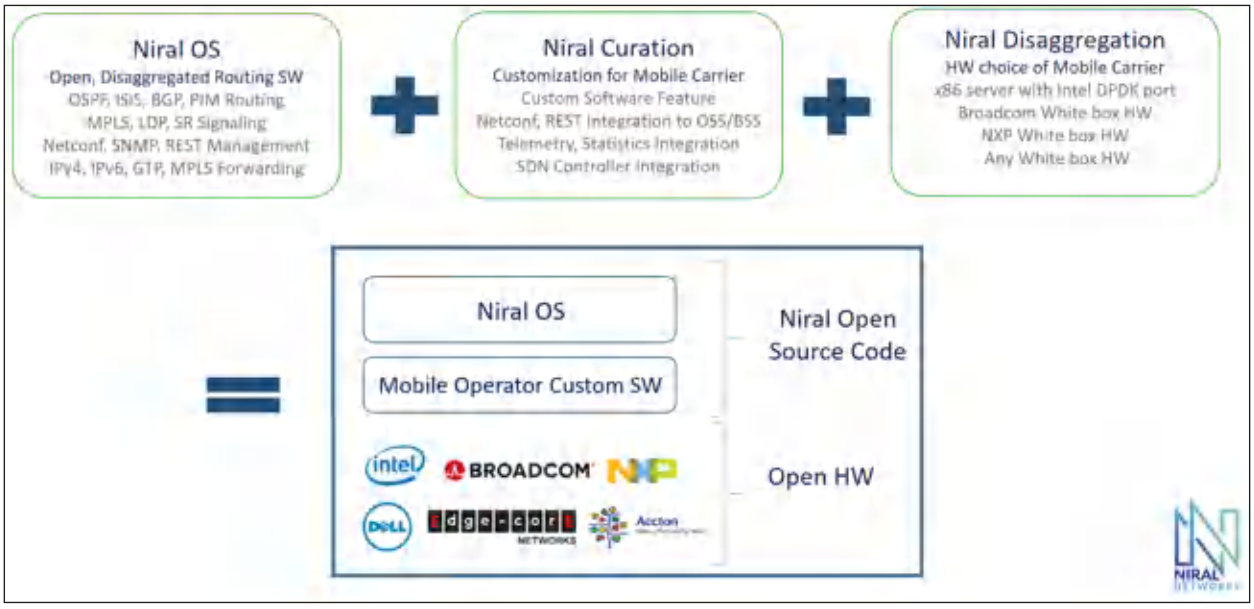
3.3. Niral Open Product Framework for Disaggregated Cell Site Gateway (DCSG)



Source: Telecom Infra Project (TIP)

Fig. 3: DCSG

Disaggregated Cells Site Gateway (DCSG) is deployed near the 4G/5G cell site and forwards cell site traffic towards the Core network. DCSG supports IPv4, IPv6 routing protocols, MPLS Signaling. CSR forwards IPv4, IPv6 or MPLS packets towards the Core Networks.

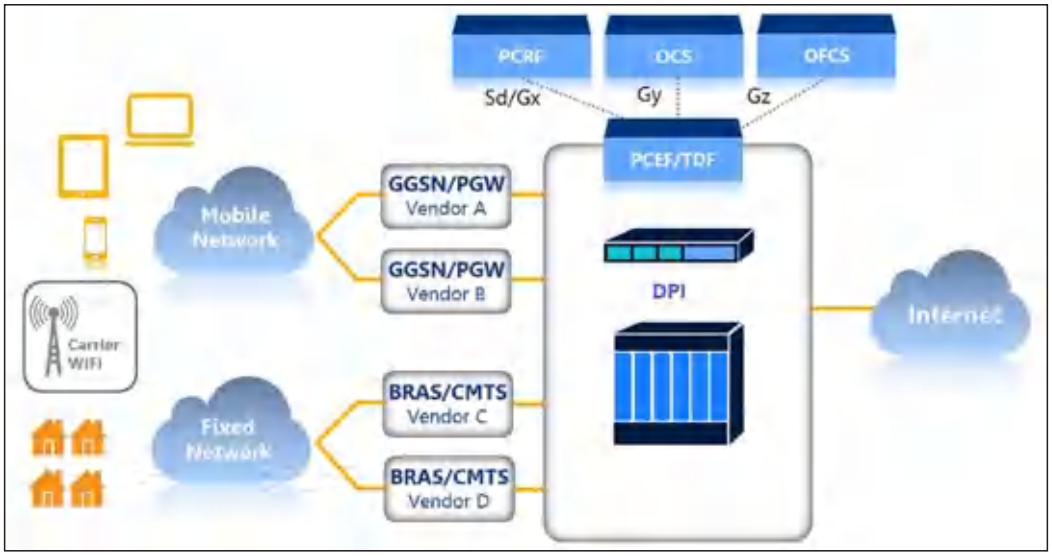


Source: Niral Networks

Fig. 4: NiralOS Curation Process

Niral's DCSG NOS has been integrated to x86 Server with DPDK, Broadcom and NXP based white box HW. Niral NOS can be integrated with any white box HW based on performance and scalability requirement.

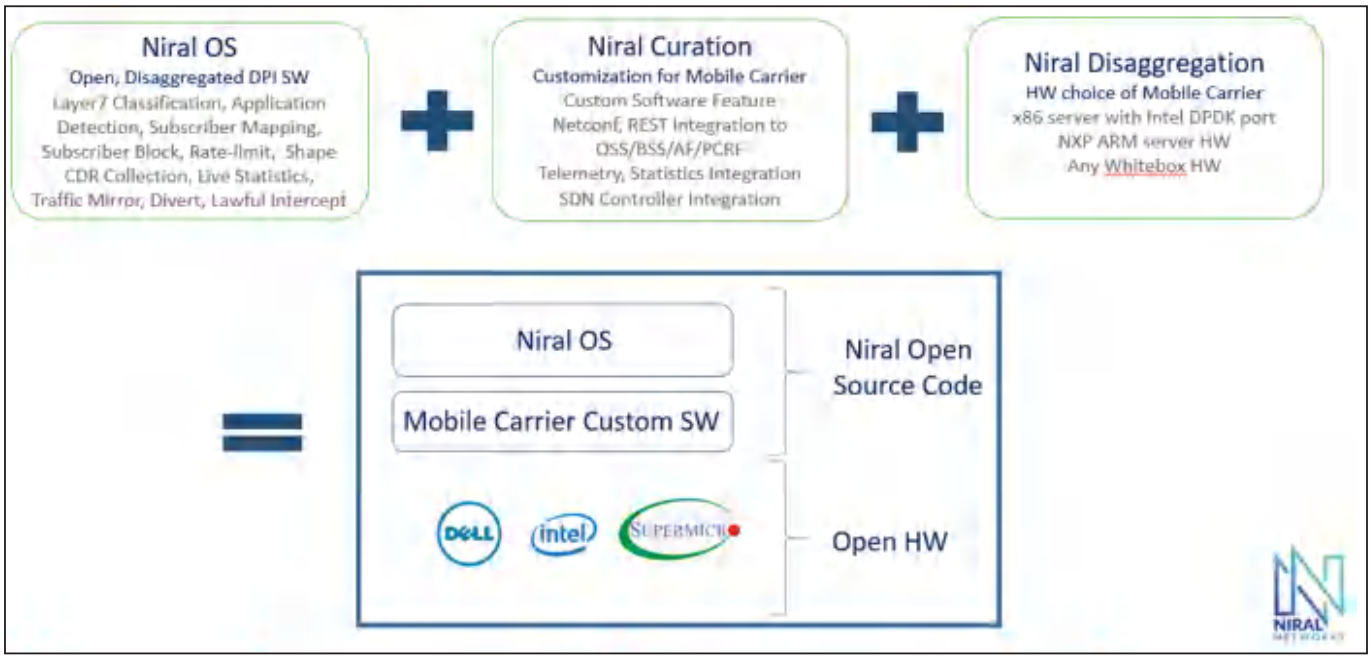
3.4. Niral Open Product Framework for Deep Packet Inspection (DPI)



Source: Allot Communications

Fig. 5: DPI

DPI is deployed as a bump in the wire and is transparent to the network components in either side. In 5G, DPI can be deployed in the Edge and Core network. DPI parses all traffic passing through it and detects the application used by mobile subscriber, applies policy and collects statistics for billing (NEAL, 2019).



Source: Niral Networks

Fig. 6: Niral Curation

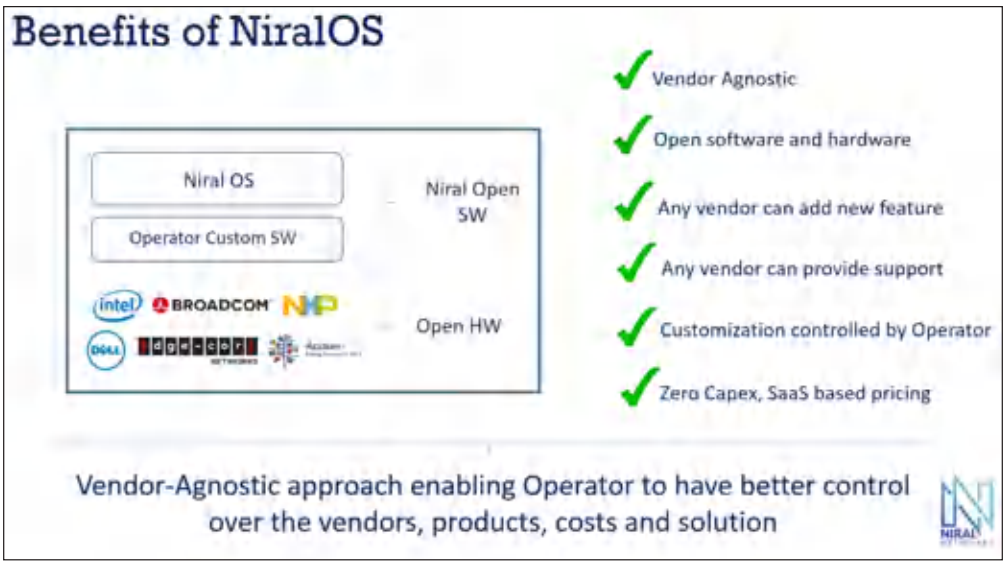
DPI node can be deployed as a cluster in offline or inline mode. Niral's DPI can be deployed as a VNF or integrated to an x86 or ARM based white box Server.

3.5. Benefits of Niral Open Product Framework

Niral Open Product Platform is created with input from the Open Source communities, Open Source Innovation Group within an enterprise, people who want to engage with Open source ecosystems.

- The roadmap for new feature conception is discussed in the community, and operators can work together to influence their roadmap.
- Operators can obtain support with flexibility from vendor of choice or from their own R&D team, making the Niral Open Product Platform completely agnostic.
- Versatility in enriching functionality as every team can enrich the open source code, along with the operator's own R&D team.
- The MNO is flexible for working with Niral Networks in order to construct its own customization related to north-bound integration, third-party app integration, contextual white box integration. The source code of the customizable part is the customer's intellectual property.
- Cost-efficient pricing and flexibility. A Zero-CAPEX, SaaS-based pricing model.

(Source: Niral Networks)



Source: Niral Networks

Fig. 7: Benefits of NiralOS

4. Conclusion

Vendor-agnostic approach is the next big potential market for the entire telecom industry. It will definitely add values to product as different vendors will able to contribute in project without having any kind of barriers. It will enable all the operators to have better control over the vendors, products, costs and solution thus Mobile Network Operators will have the leverage to select the best service provided by different vendors.

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Convergence of 5G, AI and IoT Holds the Promise of Industry 4.0

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Abstract

The Information and Communications Technology (ICT) industry across the globe is at the forefront of major transformations that are poised to impact the way industries work. In today's ultra-competitive markets, organizations across industries rely upon next generation ICT technologies to create and deliver game changing value propositions which are market disruptive in nature. Today, the ICT industry evolution has reached a stage where majority of ICT players (i.e. communications service providers, IT service providers, software makers and OEMs) are in a race to ride the much awaited 5G, AI and IoT waves to gain from the first mover advantage and find avenues for generating new revenue streams while obtaining thought leadership in this new marketplace. Among these players, especially, the communications service providers are betting big on these 3 emerging technologies as their traditional revenue streams from voice and data have shrunk in the recent past due to intense competition, commoditization of services, increasing spectrum costs and price pressures (decreasing ARPU). A wide range of IoT applications will be empowered by 5G backbone augmented using AI driven algorithms which can deliver the promise of a smart, ultra-fast, automated and data intelligence driven use cases across industries and ultimately realize the vision of Industry 4.0.

Keywords: ICT, 5G, IoT, AI, Industry 4.0

1. Introduction

The Information and Communications Technology (ICT) industry across the globe is at the forefront of major transformations that are poised to impact the way industries work. In today's ultra-competitive markets, organizations across industries rely upon next generation ICT technologies to create and deliver game changing value propositions which are market disruptive in nature.

ICT industry has witnessed a phenomenal growth and rapid evolution of technologies over the past two decades i.e. since the days of proliferation of one-way pager devices of the late 90's to today's web, mobile, social media messaging, video conferencing, IP based unified communications capabilities and AI driven chat-bots.

1.1. Objective

To highlight the importance of convergence of 5G, AI and IoT technologies which in many ways will be a facilitator and accelerator of the next generation industrial revolution, often referred to as Industry 4.0.

2. Literature Review

Last few years has seen a tremendous highlight of digital technologies such as 5G, AI, IoT, Data analytics, Big data etc. as the quantity of data generated over the years has exploded. However, the application of these technologies in isolation provides lesser value compared to when these technologies orchestrate together (Research and Markets, 2020). The technologies have the potential to add to new revenue streams. Hence organizations other than CSP's are also embracing the change. The convergence of these technologies has varied use cases that leads to a paradigm shift to Industry 4.0. This research tries to study how the use cases with convergent technologies working in tandem leads to Industry 4.0 by studying as-is condition to the to-be condition.

2.1. Riding the Next Big Waves in ICT Industry: The 'Trinity Waves' of 5G, AI and IoT

Today, the ICT industry evolution has reached a stage where majority of ICT players (i.e. communications service providers, IT service providers, software makers

and OEMs) are in a race to ride the much awaited 5G, AI and IoT waves to gain from the first mover advantage and find avenues for generating new revenue streams while obtaining thought leadership in this new marketplace. Among these players, especially, the communications service providers are betting big on these 3 emerging technologies as their traditional revenue streams from voice and data have shrunk in the recent past due to intense competition, commoditization of services, increasing spectrum costs and price pressures (decreasing ARPU) (Middleton & Contu, 2020).

2.2. Convergence of the 'Trinity Waves' is the Way Forward

Earlier this year, at Mobile World Congress in Barcelona, 5G was discussed in combination with AI and IoT. The potent combination of these technologies will empower industries to truly embrace digital transformation in the years ahead.

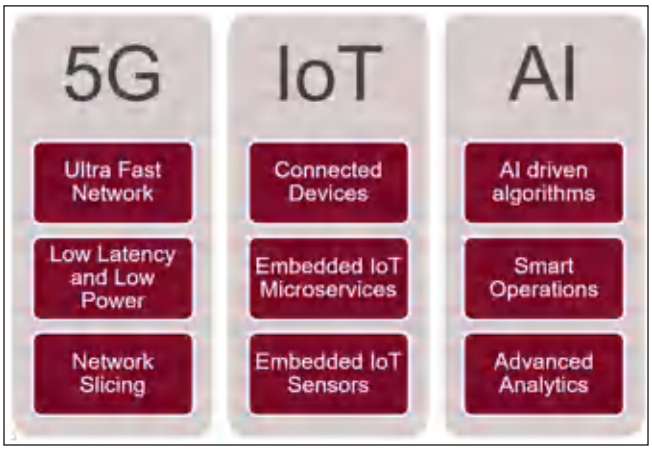


Fig. 1

With the promise of unprecedented speed (40x > 4G LTE), ultra-low latency, innovative network slicing capability, and unmatched reliability; advent of 5G is poised to have a material impact on widespread success and proliferation of industrial IoT frameworks. As per Gartner forecast, IoT will account for 1/4th of the global 41 million 5G connections in 2024 [(Muralidhar Somisetty, 2018)].

3. Key Catalysts for 5G Roll Out and Adoption

- *Use of Millimeter Wave (> 6 GHz) Spectrum:* Enables high bandwidth capacities (~1Gbps) but dictates denser deployment footprint due to coverage and propagation limitations.
- *Massive Densification:* Results from use of millimeter wave and dictates operators to double the number of radio access locations [Muralidhar Somisetty (2018)].
- *Multi-Access Edge Computing (MEC):* Multi-access edge computing brings compute/network/storage capabilities of the cloud directly into the radio access network (Q.Pham et al., 2020). MEC will be key to enable operators to rapidly provision new services quickly using cloud like deployment techniques.
- *SDN/NFV:* To enable network slicing, which allows highly granular QoS and QoE for separate users, devices and applications – all over same physical network.
- 5G is the next major step in the world of wireless connectivity and poised to be a game changer for telecom players. 5G will elevate the role of wireless connectivity in society and lead to a hyper-connected world. A wide range of IoT applications will be empowered by 5G backbone augmented using AI driven algorithms which can deliver the promise of a smart, ultra-fast, automated and data intelligence driven use cases across industries and ultimately realize the vision of Industry 4.0.

4. IoT based Analytics – A Major 5G Enabled Use-Case

IoT based analytics is key to success of Industry 4.0 and 5G is critical from network back bone perspective (Research and Markets (2020)). Here are top use-cases with regards to Industry 4.0:

Table 1: Use Cases for 5G, AI, IoT

Analytics Use Case (delivered by 5G, AI and IoT 'Trinity')	Industry 4.0
Context Sensitive	Asset Management
Predictive	Predictive Maintenance, Output Forecasting, Revenue Forecasting
Prescriptive	Energy Efficiency, Job Scheduling
Cognitive	Control & Automation

With advent of 5G, Telcos will need a holistic approach to collecting, processing, analyzing and visualizing data – network device data, network inventory data, network management systems, ERP and CRM data, and other relevant logs – and then applying predictive algorithms to forecast a hardware failure. In virtual environments, it will be necessary to ensure that NFV vendors provide adequate access to real-time operational data (Compare, Baraldi & Zio, 2020). Predictive systems must be able to conduct cross-vendor and domain correlation based on metrics for service availability and health. IoT sensors would be crucial for data collection and a combination of edge and centralized data processing would be required on case to case basis. Need for AI algorithms would be more than ever to reap benefits of intelligent automation of industrial processes (Deloitte, 2018). Today, every industry is betting big on automation as one of the key ingredients to improving efficiencies and accelerate time to market for their products and services. However, for a large spectrum and organization wide adoption of automation, it needs to encompass every sphere of the enterprise architecture and utilize relevant mix of AI and IoT platforms which can be further augmented by capabilities of 5G (Tony Joseph, 2018).

Connected Cars is a great example of the need for the said convergence. In recent years, global automobile giants have started building their own connected cars frameworks. Top 3 enablers for these frameworks include an ultra-fast & low latency communications network, AI driven edge analytics, embedded IoT sensors and cloud data services. Players such as Daimler, Ford, PSA Group, Deutsche Telekom, Ericsson, Huawei, Intel, Qualcomm and Samsung have all backed 5G as the preferred standard for their connected cars initiatives.

This convergence of the trinity will hold the key in delivering a unique technology framework which I would like to term as the Trinity Convergence Framework which can be readily consumed by enterprises across industries to design and deliver a range of smart and efficient, new-age solutions and services for industrial use cases.

5. Trinity Convergence Framework and the Role of Global System Integrators

World's largest Global System integrator (GSI) organizations have vast knowledge-base and intellectual properties (IP) across the ICT ecosystem of products, platforms and technologies as well as have deep expertise around integration and deployment of complex technology architectures. These unique capabilities naturally qualify them to be the best contenders who can provide end to end services around this massive convergence opportunity.

6. Industrial Impact of 5G, IOT and AI Convergence

Convergence of 5G, AI and IoT can significantly impact the way industries operate today. The benefits attained could help organizations take a giant leap towards:

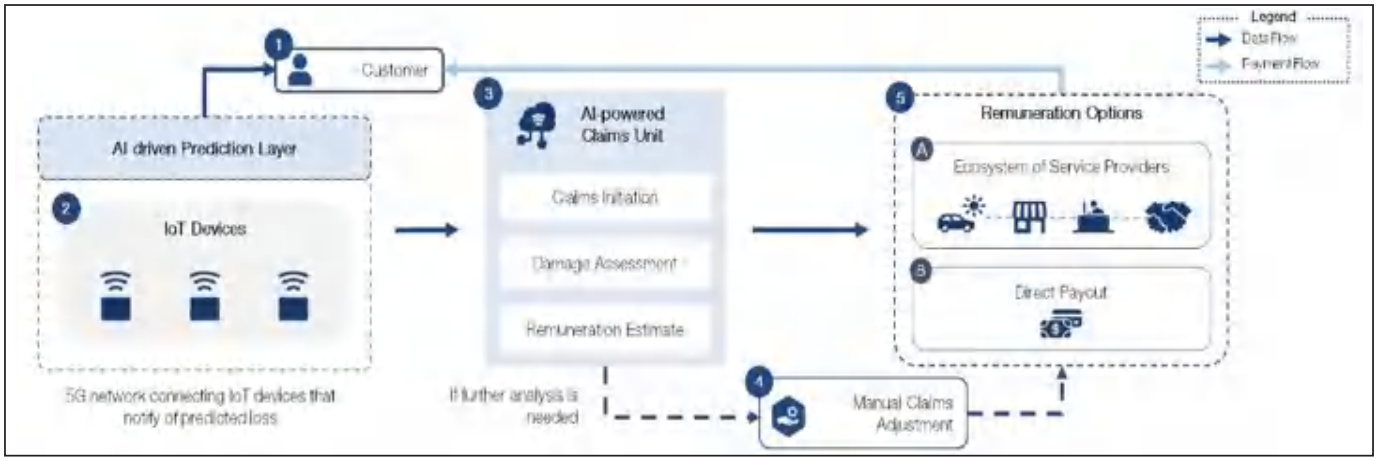
- Ability to carry predictive maintenance of equipments.
- Better resource monitoring and allocation (using IoT sensor monitoring and AI driven automatic resource allocation).
- Reduction of manufacturing waste and defects.
- Reduction of human errors.
- Improving quality of goods produced and services delivered (by virtue of gaining real time insights).
- Machine to Machine (M2M) collaboration due to smart connectivity and AI algorithms.

Fig. 2: Researchers Exploring 5G use Cases with a Robotic Arm at the Silicon Valley Research Center

With this being said, the giants of 5G and IoT such as Huawei, Ericsson and Hitachi are working in collaboration to cater to industry use case that requires 5G enabled IoT end node solutions to meet pipeline demand as 5G adoption increases (Hitachi, 2020). One such use case would be real time collaboration between skilled workers and machines. We can appreciate how 5G edge AI technology in collaboration with multi access edge computing servers provide a scenario for optimal control of onsite sensors.

With optimal utilization of large capacity sensor data from onsite premises, AI driven advanced analytics can be applied to supplement the decision making process by human.

Another compelling example from the field of finance services- a pervasive insurance plan can open up a plethora of opportunities in this domain. By creating an ecosystem wherein products and service providers offer well distinguished and attractive claims can be backed by the likes of 5G, AI and cloud enabled solutions. This claiming experience can create more personalized insurance plans depending on historical data of the customers (Drew Propson, 2020). This experience will result in increased customer loyalty and back end efficiency.



Source: World Economic Forum

Fig. 3: Process Flow for a Connected Post-Claims Experience

More specifically, if we deep dived into auto insurance, we can appreciate how an insurance company would be notified automatically if the vehicle met with an accident. High calibre sensor devices are embedded in the car and these devices provide immediate information about the vehicle's whereabouts (Stephen Gossett, 2019). Based on data points such as airbag deployment, impact of accident, break failure, the software can determine the extent to which the damage occurred and claims can be made available spontaneously, all without the intervention of human. Also, the sensors embedded in the car can automatically send a message to the nearby hospital for medical assistance (Krasniqi & Hajrizi, 2016).

7. Conclusion

Many complex business problems across various industries can be addressed with a digital transformation approach which involves a holistic approach by right sizing the mix of cutting edge technologies such as AI, 5G and IoT.

The dream of Industry 4.0 cannot be truly realized until there is a robust integration and co-ordination between the technological advancements manifested in form of digital technologies such as AI, 5G and IoT as well as operational technologies on the ground. It has been long observed that individual technologies seldom operate in isolation and a right mix is always required to create and deliver the desired value.

Organizations across industries are keen for this giant leap of transformation leveraging the trinity of 5G, AI and IoT.

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Building the Next-Gen Cyber Security Operating Model in a Digital Eco-System

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Abstract

The business of today are fast changing from a pipeline based model to a platform based model. The Digital businesses of today are focussed on this simple strategy which makes them use and rely more on technology enablers. These companies create new value and experiences that differentiate them with a competitive edge over their peers. New value is created in business models, customer experiences and the internal capabilities that support core operations of an organization. Thereby in the tech space, organizations transforming the programs to become digital business enablers, is very crucial in order to create an exponential value in this era.

A core entity due to this rapid transformation is Cyber Security and the blueprint which one needs to adapt within this ecosystem of devices, applications and interfaces. Due to requirement of enabling digital business, during digital transformation and afterwards organizations are exposed to different risk factors and situations which cannot be handled and detected by utilizing the conventional and existing security practices for IT. This paper essentially focusses on stitching the various capabilities that entails the need and desire of a winning proposition which stands in front of CxOs to start thinking of Risk management and Cyber Security in a very different light and how one can leverage this function to show its direct and indirect benefits. It must address a new reality in which IT organizations have little direct infrastructure, and their biggest security concerns will come from services outside their control eg. using cloud services. That is why it is required to build a Security operational model architecture in the Digital Business World. A Security operational model will integrate all required crucial capabilities along with the security operational processes, skills, infrastructure, security enablers and drivers of customer/ user experience followed by the next gen DNA which need to exist within the whole organization set up. This will eventually ensure better performance and even overcoming pitfalls of the processes by complementing each other and also adding value in terms of providing better customer experience, optimizing cost price, reducing time of operation and other conveniences compared to earlier individually existing conventional security methodologies. In order to create an effective and secured blueprint which will provide fruitful results due to transformation to digital business approach should be initiated by considering having a proper vision as the first and initial step, followed by changes in objectives, embracing principles to ensure trust resilience and developing an adaptive, Context Aware Security Architecture. Ensuring security is very crucial in different real world scenarios such as remote management of IT resources, shared cloud services, encrypting data in motion and rest, effective management of BYOD devices etc.

Keywords: Cybersecurity, Digital Business, Digital Transformation, Risk Management

1. Introduction

The changing competitive landscape has pushed a lot of industries and domains towards adoption of technologies and operating models, leading to creation of a new digital eco-system. This adoption is driven by consolidation and collaboration in the market, a need to identify new revenue streams to maintain the profitability, ways to enhance the customer experience and to remain higher in the evolving and merging value chain. As the boundaries blur and businesses move towards platform based model/new digital business models, the complexity in the eco-system increases with multiple partnerships and joint ventures.

1.1. Objective

No sector or industry whether it's Retail, IT, Communication, Media & Technology or Finance, has been left untouched by the atrocious hackers and security attackers. They have marked the headlines, incurring major data and security breaches costing them not only their revenues but also compromising their brand value. The ubiquitous nature of vulnerability can be explained due to the dissolving perimeters caused by more connected environments than before, adoption of new technologies like – Cloud, APIs, IoT devices, Mobile payments, M2M, BYOD etc (Choi, Kaplan, Chandru & Harrison, 2019). (Douglas & Loader,

2000) These technologies though enabling faster digital adoption are also increasing the touch points/threats for data and cyber security breaches. These security threats which were earlier handled reactively need to be catered more proactively in today's interconnected and complex eco-system.

2. A Sneak Peek into Past

Cybercrime can be considered as illegal activity which is done over networks connected over internet. It is perceived as unauthorized entry into network system with a motive to delete, modify or steal organizational data.

In some cases the motto of cyber criminals is to hack the digital ecosystem and steal the money from it. In other cases, the intention of cybercriminals is to cause reputational risk and therefore, they block the servers such that nothing can be accessed from it.

Cybercrimes are commonly considered for two types of crimes: new offences committed using new technologies such as offences against data and computer system, dealt with in the Computer Misuse Act 1990 and old offences committed using new technology, where networked computers and other devices are used to facilitate the commission of an offence.

Lastly there are huge number of researches done in past on cybercrimes and security laws and conventional way of mitigating issues. Very less research is done on use of technological models in digital ecosystems to prepare such security models that will understand, mitigate and develop auto solutions in order to prevent such attacks on an organization security in future. Hence this research is based of analysing and building operational security models using cutting edge technology.

3. The Changing Landscape of Cyber Security

Cyber Security is no longer the responsibility of just IT function but should run down from the CEO of the organisation to the lowest rank employee. It has emerged as a board room discussion and is more often than not considered as an enabler of risk transformation to drive efficiency, effectiveness and indirect cost benefits. The organizations of today are focused on building cyber war-gaming capabilities with real life simulations with component based operating model dimensions which would help look some of these ideas pragmatic and operational.

The stakes though are higher because of the magnitude of the advanced persistent threats and sophisticated malwares; it also presents an opportunity to look the security domain under a different light. The providers as well as consumers are moving towards better understanding on the importance of a robust cyber security operating model and strategies.

A core entity due to this rapid transformation is cyber security and the blueprint which one needs to adapt within this ecosystem of devices, applications and interfaces. Due to requirement of enabling digital business, during digital transformation and afterwards organizations are exposed to different risk factors and situations which cannot be handled and detected by utilizing the conventional and existing security practices for IT. This paper essentially focusses on stitching the various capabilities that entails the need and desire of a winning proposition which stands in front of CxOs to start thinking of Risk management and Cyber Security in a very different light and how one can leverage this function to show its direct and indirect benefits. It must address a new reality in which IT organizations have little direct infrastructure, and their biggest security concerns will come from services outside their control eg.using cloud services. That is why it is required to build a Security operational model architecture in the Digital Business World.

An effective security strategy should be the one which cuts across all the levels of the organisation and also takes into account the partners and end customers. Hence, the need of a new cyber security operating model which serves the digital eco-system. The cyber security model should be first of all in alignment with the Business Vision. It cannot work in solidarity from the business's core strategy as it used to be before. Since all the threats don't pose as much damage, focus should be on identifying major threats and the domains affected by them. The principle should be to Detect, Assess, Prevent and Respond. With the advent of strict GDPR regulations and other evolving regulations in the security world, regulatory compliance should form a prominent building block for the model.

4. Solution

Currently as stated cyber security models have a much decentralised approach in most of the organizations. They cater to threats as and when they come, mostly handling different malwares or threats through a plethora of different products. But considering the digital eco system, the need is to have a centralized cyber security model which can

uniformly prevent advanced threats on a business's entire infrastructure. It should not only respond holistically to the current attacks but also leverage emerging technologies to be prepared for any kind of advanced threats or malwares.

The initial foundation for the next generation cyber security operating model should be based on having a Business Vision for Security and Risk management functions which is in alignment with the Organization's core Values and principles. The strategy should be based not only on the current capabilities but also what the organization aims to achieve in the upcoming future. The current risk and security capabilities should be assessed leading to identification of the changes required to create the new competitive capabilities. Once it is identified the security goals should be defined in alignment with strategic management of security risk. Focussing on a risk based approach for security initiative will help in a more balanced and proactive response towards the current generation of security threats.

A Security operational model will integrate all required crucial capabilities along with the security operational processes, skills, infrastructure, security enablers and drivers of customer/user experience followed by the next gen DNA which need to exist within the whole organization set up. This will eventually ensure better performance and even overcoming pitfalls of the processes by complementing each other and also adding value in terms of providing better customer experience, optimizing cost price, reducing time of operation and other conveniences compared to earlier individually existing conventional security methodologies. In order to create an effective and secured blueprint which will provide fruitful results due to transformation to digital business approach should be initiated by considering having a proper vision as the first and initial step, followed by changes in objectives, embracing principles to ensure trust resilience and developing an adaptive, Context Aware Security Architecture.

Once the capabilities and goals are identified, the need is to ensure that there are in-place KPI/KRI metrics to measure the approach. This will help in rationalising the required digital capabilities to meet the risk management and security goals. An organization faces a lot of risks and threats, a targeted approach will lead to a more balanced utilisation of resources for increasing the security resilience. Once identified these targeted capabilities need to be mapped down to the core digital pillars of any organization i.e. Process, System, Organization and People. Security architectures should be designed in such a way that it manages the current as well as future generation of security attacks. Flexible and integrated products/platforms should be leveraged through alliances to have a centralised response to the attacks. Business processes should be articulated in alignment to the security and risk management goals.

The entire well placed cyber security model cannot function effectively unless and until every employee of the organization is made aware of their role in the security and risk strata. A Governance model will ensure that the security and risk management capabilities are distributed and embedded in the organization's culture and DNA. Proper awareness and trainings will help all the stakeholders understand their respective responsibilities for which they can be held accountable for. Partners and other external stake holders should also be made aware about their contribution in this secured eco-system. Proper role assignments will ensure better calibration of the changing regulations and standards. Thus, aligning cyber security and business with each other, will create a symbiotic relation that benefits both.

5. Conclusion

Security or Cyber in general in the context of Digital can no longer be looked upon as siloes entity. One needs to be look at the larger big picture of Digital and then try and amalgamate an integrated Blueprint which would act as an operational best practice pre-cursive model enabling Digital transformation initiatives of which Cyber Security is just one of them. To be in pro-active mode and understand the pre-emptive measures defined by the capabilities of the Security Operating Model should be an integral part of adoption of best practices. Cyber-attacks and threats have exposed the security and risk vulnerabilities of almost all the industries, costing them money and trust of their customers. Thus building the components of the Security Operating Model is not just a best practice but a proven necessity in the modern context of Digital. The advanced nature of threats and data breaches urge for a more proactive security response from the organizations. A well-crafted cyber security model stitched closely in accordance to the digital ecosystem will enable the organizations to achieve their business goals faster and in a more secured manner than ever.

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