Telecom Business Review
17 (1) 2024, 40-48
http://publishingindia.com/tbr/

The Operational Impact of 'Analytics' in Global Major Telcos

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Abstract

This paper focuses primarily on big data and analytics in the context of global telecommunications. Telecommunications is one of the most data-sustaining industries, where data is used across all dimensions of operations, such as IT and network management. The article points out that how operators wish to be data driven, they are unable to put this into practice as the data processing, data normalization, and data reporting present a challenge. The purpose of this study is to evaluate the state of the art of human decision support systems with respect to telecom operations in practice, highlight the relevant existing problematic aspects, and indicate the directions, where enhancement, especially in the context of AI and Gen-AI is likely to appear. The research points that stakeholders need to think out of the box and provides two operational approaches how analytics driven operations can be realized, in the first place with the help of cognitive managed services. The results obtained in the study demonstrate that while impact of analytics is usually associated with cutting down the costs, the real advantage of such analytics is in levers for operational initiatives to improve the level of service and efficiency. The said research stresses the importance of people, processes and technology in a mature operational model. It also notes the need for maintaining certain standards not only of data traceability but of data quality in a bid to enhance the feasibility of analytics accent strategy. The main novelty of the present research lies in the transformational nature of analytics in telecom operations that the research addresses in proposing a systematic way of dealing with decision processing which entails the use of artificial intelligence algorithms and data quality system. The paper also presents an analytics framework for telecom operators in order to realize the unrealized bulging potential of analytics.

Keywords—Telecom Operations, Big Data, Analytics, AI (Artificial Intelligence), Gen-AI

I. INTRODUCTION

The world of 'Big data and Analytics' is having tremendous potential, and visible impacts are seen across societies, telecom as an industry is not an exception in this regard. This being one of the leading data intensive and generating industries globally, consumption and usage of data across its various facets of the operations including networks and IT are highly visible amongst stakeholders. One needs to acknowledge the different nuances which come with it with regards to data processing, normalization as well as reporting of these data artifacts to generate significant operational value.

The objective of this paper is to understand the impact of data and analytics in key potential areas in the telecom operational landscape where it is being used, the present gaps that come with it and areas where it can be explored further. This is especially applicable in the era of AI and Gen-AI, as an enhanced extension of the Analytics. It's also an eye opener to various stakeholders working within a Telecom operator, who are accountable for those functions, to look at things differently in an 'out of the box' fashion. While we look into the impact of analytics it's also very critical to note that there is a dynamic shift happening in the Telco industry while adopting Cloud native technologies and design principles across networks and IT functions. It is also assessed if there are opportunities to workload, depending on the services and the use cases delivered subject to the portfolio of use cases within 5G and using Network slicing.

II. LITERATURE REVIEW

Telco companies have experienced innovative aspects in their activities and approaches with the involvement of Big Data Analytics (BDA). While carrying out a review of the literature on this domain, it is emphasized that the integration of BDA could be crucial in accomplishing objectives that include network optimization, customer experience, and cost efficiency, among other things. It will cover the current landscape on telecom analytics, applications of big data, BDA use cases, and NoSQL implementations in current systems, focusing on the added value of analytics for operations.

A. Telecom Analytics: Understanding its Significance

Every day, telecom operators generate and deal with enormous volumes of data from different sources such as call detail records (CDRs), network data logs, billing and accounts data, and customer service interaction as indicated by (Wang et al., 2017). The analytics of telecommunication has advanced into the most efficient means of analyzing and, consequently, understanding the extent of the changes in the network as well as the level of satisfaction of the users (Baştuğ et al., 2015). The analytics tool if implemented helps an organization as move from being reactive to predictive and prescriptive.

(Zheng et al., 2016) cited a network optimization as one of the fundamental components of analytics in the telecom. It creates the possibility for telecom services operators to provide management of network capacity well in advance and also to manage the internal failures without the effect of the failure falling onto the customers or outside service. Moreover, Traffic Analysis helps in making further networks investment more effectively by properly strategizing the finances for the networks enhancement thereby encouraging sustainable networks identifies defection through potential drops in subscriptions or decreased usage. According to (Mitchell, 2020), telecom companies can manage churn effectively by addressing untimely customer grievances and effectively managing the competition.

B. Applications of Big Data in Telecom: A Strategic Asset

Big Data has numerous impacts on the telecom industry, including network management and better and improved customer experience (McAfee et al., 2012). With 5G and IoT, the demand for data management has skyrocketed. As (Mayer-Schönberger & Cukier, 2013) concisely explains, operators can now sift through enormous amounts of data to look for patterns and correlations, which were not able to be felt before.

An application that has been accepted widely for a long time is Big Data in the detection of fraud. BDA can detect abnormal activities or behaviors in real-time which can help mitigate risks associated with telecom fraud (Zahid et al., 2019). This kind of real-time detection is not only useful in protecting revenue sources but also enhances customer confidence. Another application that is also very vital is customer segmentation and targeted marketing. Analytics help telecommunications providers to dig deeper to connect the different aspects of the customers and create individual marketing campaigns. Illustrations from (Wedel & Kannan, 2016), targeted marketing analytics deployed open up huge interaction with the customers and increases the revenues driving the business.

C. BDA Use Cases in Telecommunications: Driving Efficiency and Innovation

Out of all these factors, it is operational transformation that has undergone the most radical transition than any other aspect towards the empowerment of the organisation through the timely use of data. This, in turn, has helped in improving the quality of telecom services as well as the efficiency of telecoms operational. As indicated in (Daily & Peterson, 2017), downtimes have been cut short and services improved to the extent that network fault management systems using Big Data Analytics predictive maintenance have been implemented. Also, resource management and allocation are now done instantly, thanks to AI and machine learning, by the telecommunications companies. As (Tang et al., 2021) argues since telecoms apply operational efficiency enhancements which include such processes as machine learning techniques and routing

algorithm to minimize latency in more high demand zones, better network performance management, which is vital in the telecom industry competition, translates to cost economization. Furthermore, the 5G technology also allows the concept of network slicing which leads to more dedicated networks developed for particular use cases in the operators' infrastructure. Big Data Analytics' use allows the optimization of resource distribution across the slices depending on the data available at the given time (Chergui & Verikoukis, 2020). This is especially true for telecom service providers because they are transitioning from conventional designs to exceedingly flexible and cloud-centered designs.

D. NoSQL Implementations: Enhancing Data Storage and Processing

Data storage systems capable of managing enormous and varied amounts of data in real-time are crucial for telecommunications operations. Conventional relational databases fail to manage the volume, variety, and velocity of the telecom sector data which provides a better architecture for telecommunications data using NoSQL databases like MongoDB, Cassandra and Hadoop.

(Bhogal & Choksi, 2015) in their studies explain why NoSQL databases are beneficial to use in storing call records and network data. Also, unlike SQL, NoSQL facilitates horizontal scaling which enables the telecom companies to handle tremendous amounts of data while sustaining performance. Besides, it also provides for several other benefits; for instance, it allows telecoms to capture and keep information in the form of non-structure such as logs, which are very useful when combining with structured data as they facilitate clarity on critical aspects.

Moreover, the NoSQL implementations allow for fast ingestion of data streams from IoT devices which enables real-time network optimization and customer service (Gürcan & Berigel, 2018). It has an added advantage in that it can combine real time and batch processing as a single framework when dealing with complex operational data.

E. Challenges and Gaps in BDA Adoption in Telecommunications

Theoretically speaking, even if the various Big Data Analytics (BDA) tools and techniques have many possibilities in the telecommunications sector, their implementation is still faced by several challenges. One of the main challenges is data quality. Quite a number of researchers including (Janssen et al., 2017) insist that low quality data results in misleading insights that compromise the decision-making process. This problem is even worse in the case of telecom operations, since data is very much heterogeneously sourced, where several vendors and technologies are involved. A second major problem is the challenge of adding BDA onto pre-existing systems. (Persello et al., 2022) for example, indicate that many telecom operators are unable to incorporate legacy system with the real-time prognostics capability due to their out-dated data systems. Thus, BDA functionalities are largely underutilized. To remedy the situation, the authors argue that telecom organizations activate and uphold strong data management regimes which focuses on protection of data, its lineage and governance (Quach et al., 2022).

To put it succinctly, there is a clear operational impact in the telecommunications industry, with BDA showing its presence in virtually all activities including but not limited to network operations and customer care. There are challenges that are present, for instance factors such as data quality and old system integration retards progress but the advantages to be gained far exceed these drawbacks. Subsequent works on artificial intelligence and machine learning ought to be conducted on this line in a bid to enhance the current analytics infrastructural systems with the aim of achieving better and smarter functioning telecommunications systems.

III. RESEARCH METHODOLOGY

The exploration of big data and analytics (BDA) in the telecommunications sector is essential for enhancing operational effectiveness and improving customer

engagement. This research employs a systematic literature review (SLR) to synthesize existing findings, identify prevailing trends, and assess the applications of BDA within the industry.

A. Literature Review Process

For the purpose of this study, a more detailed step by step approach was taken to address the issue of the BDA influence on telecommunication industries. A large number of relevant articles were however collected in the process.

- *Domain Identification:* The review focused on four specific domains: telecom analytics, the application of big data within the telecom sector, BDA application scenarios in the telecom sector and NoSQL use in this area. These domains were picked in while considering the availability of different BDA interventions that have been deployed in the market.
- *Search Strategy:* Objectives were determined and strategies for achieving them were constructed.
  - *Keywords:* Because it was important to use proper terms, a collection of keywords such as 'big data', 'nosql', 'hadoop', 'telecommunications' and 'voip' were compiled and used. These keywords were then used to form specific searches in the relevant electronic media in a more sophisticated manner.
  - *Digital Sources:* Much attention was paid to fetching the required materials from bona fide research sources such as IEEE, ACM, Elsevier, Springer, Google Scholar, et al.
- *Article Retrieval:*
  - Thus, following the initial exploration, 233 articles were found, which were subsequently arranged by making use of the Mendeley Reference Manager to avoid duplications.
  - As the relevance of the abstracts was assessed, the number of articles obtained was reduced to 61.
  - Further evaluation of the introductory parts of the respective articles has made it possible to narrow down to 38 studies that fit the research purpose most optimal.

B. Data Collection Techniques

The data gathered for this review comprised:

- *Scholarly Articles:* Peer-reviewed research that discusses the implementation, benefits, and challenges of BDA within the telecommunications sector.
- *Industry Reports:* Findings from consulting firms and industry associations that capture trends and best practices in the application of BDA.
- *Case Studies:* Practical examples demonstrating how telecommunications operators have utilized BDA to drive improvements in operations and enhance customer experiences.

C. Data Analysis Methods

The analysis of the collected data included both qualitative and quantitative approaches:

- *Thematic Analysis:* Qualitative data underwent thematic analysis, which facilitated the identification of major themes, including operational efficiency, data integrity, and the influence of AI and Gen-AI on telecom analytics.
- *Quantitative Analysis:* In applicable instances, statistical methods were utilized to analyze quantitative data, evaluating the effect of BDA on key performance metrics such as cost savings and customer satisfaction levels.

IV. ANALYSIS

A. Importance of Making Data Driven Decision in Telecom

Telecom operators most definitely do have the ambition to be 'Data' driven but very few know the means to achieve it and therefore look for best implementation approaches. Most of these concepts stick around only at the design level and do not travel the distance beyond it. We must look for avenues to ensure this Data driven operational implementation is real and is fully traced back to the origin of the core business services which are being supported by the complex services portfolio that the Telco is offering backed by the core business and operational

processes and implemented by specific Data and AI use cases. It's then our priority to manage this list of AI & Data use cases with proper involvement of automation to ensure the real impactful messages are being delivered across CxOs which will eventually lead to either being customer centric or being operationally super-efficient, driving revenue or profitability. One must not forget that every CIO or IT/technology function is eventually viewed as a cost center in any Telecom operator, thus influencing the very aspect of revenue or cost eventually with tangible data points is eventually a 'dream come true' for a CIO. Data driven operations must empower the CIO or CDO (Chief Digital/Data officer) for any Telco to make effective choices of investments and help in strategy formulation and execution in the long run to drive the operators' business and operational agenda.

Often, Managed Services across Networks and IT function is an outsourcing decision which commonly lies with the CTO and CIO who eventually, looking at economies of scale, lines up the most economical deal with the SI or services partner. There is surely a demand for differentiated operations without being too tactical about it. Most outsourcing partners here showcase an efficiency game by picking up TAT (turnaround times) or % FTR (first time right) improvements without really looking at any Strategic KPIs around CSAT (customer satisfaction scores only in case of contact center operations) or NPS (net promoter score) unless asked for while correlating S-KPIs (service KPIs) as per contractual obligations. This is where the game changer in delivering Cognitive Managed services comes into light where service delivery accounts for something beyond efficiency and can be proved with the examples of data artifacts which prevail within the operational gambit.

B. Aligning Analytics with Strategic Value

The operational impact of Analytics is often viewed by different stakeholders, as an aftermath of service delivery, where prima-facie impact is around improvement of costs. While some of the strategic imperative must be around value being delivered and not just cost optimization, because of attaining a certain operational maturity, primary focus is now made towards attaining the derivatives of the new operating model developed as a blueprint thereby ensuring people, process and technology all three are very much aligned to it. This becomes the sole imperative of the CIO/ CTO organization, irrespective of networks and IT, to report back to the COO as a net gain of climbing up the desired maturity model. There is a significant scope of analytical driven operations to achieve this irrespective of the legacy and the other overheads, simply because being data driven solves for things being rather objective than subjective and helps to narrow down solutions.

One also needs to be mindful, that these incremental changes brought about by the technology implementation of 'data and analytics' to be truly impactful is a part of a larger transformational journey for Telcos and its nearby ecosystems, as they want to qualify them as tangible and visible impacts to stakeholders both internal and external

C. Proposed Implementation Strategies: Data Traceability and Process-Data Integration

There are two proposed options of implementing distinct operational strategies to achieve the outcome of the essential benefits of the analytics driven operations. The paper identifies 2 different propositions of how these analytics lead to the mantra of Cognitive decision making driven Managed services and operational transformation, which will encompass IT (OSS-BSS) and Networks operations. Under any circumstances these are not the only means to judge and assess the impact of analytics across Telco service providers' however these translate into tangible actions which make a significant impact and showcases the power of using analytics as a strong tool for differentiation.

D. Data Traceability Matrix

While implementing any data driven solution there is a fundamental need to define a Data Traceability matrix in line with all requirements as addressed by the requirements and their corresponding mapping into solution use cases. This is usually not the case during any implementation as the Data layer is more often not linked to either application or the business processes under scope of IT or networks. This is a very common error which most implementations follow as the only aim during the overall life cycle is to focus on the selected use cases so that Go-live can happen within the requisite timelines. The need of Data traceability helps

to understand and track all data sets within multiple applications and thereby easily helps to define their lineage without any specific pain. Not only this one can also understand the touch points where quality of data is most vulnerable given the multi-vendor COTS environment which often exists. When the same goes to operations driven by managed services it's very easy to apply any statistical modeling technique in this data workflow highlighting the data lineages to easily detect exceptions and thereby take corrective actions to resolve them as well. Deployment of LLMs (large language models) also becomes very easy on top of these data sets which are often termed as CDE – critical data elements. From a network operation standpoint, it's imperative to apply this concept using the network critical process set up across plan, build, design and operate. Also understand the business rules which define the construct and scope of the network design and impact operations and then further impact network services delivery.

E. Process-Data Integration

The other proposed solution will be to identify all possible business rules which are within applied processes in scope and then filter out the exact data sets which dictate the performance of these rules which thereby has an impact on the core process itself. This concept can largely be extrapolated as process-data integration or synergy driving process and data. The key thing is the convergence and the seamless experience of process and data integration which will eventually help in identifying exceptions by looking at these very data elements or structures and identifying their faults and exceptions. Hence data quality becomes utmost important as it drives the integrity of the data within the desired overall operational set up. Cognitive operations will require implementation of AI algorithms on top of these data sets while assuming their data quality is accurate enough and is handled in an automated fashion.

Data Quality platforms and tools with the ability to mine data will be the need of the hour for any standard operations which has the reason and the intent to boast about being 'data' driven. Hope this becomes a mass phenomenon as operations converge across networks and IT and differentiated automation becomes a key trend in days to come

V. CONCLUSION

Both proposed options are very much achievable by changing the process of implementation and managed services or as a prelude 'must have' req-requisite to any managed services operations. The unfortunate reality is most Telcos don't do it, despite acknowledging these benefits. The general tendency is to straight implement AI models post automation and then claim to be pro-active and intelligent. Deployment of AI models on inaccurate data leads to unexpected outcomes hence the desirable results are not often visible in Cognitive operations. The recommendation will be to ensure and to data driven and proactive the empowerment needs to be given to elements at the data layer which drives process efficiency hence the need of synergizing all processes with critical data sets and identifying the traceability of these data across the process life cycle, driven by a true open architecture driven by catalog of products and services to easily note different touch points which may exist. Baselining all decision paradigms with data sets is the true data driven operation which Telcos should aim for and then put the visualization layer as the last mile to improve reporting and analysis.

VI. IMPLICATIONS

Incorporating analytics and AI into the operations of a telecommunications company is a good outlook that combines several perspectives of operations and strategies. Firstly, there is a movement towards more cognitive decision models of operation in place of the old operatives. Equally important in the competition within the telecommunications market, AI and data analysis, allow telecom operators not only to enhance the efficiency of their operations but also to make strategic gains. This transformation is of utmost significance in the sector since survival and growth depend on how quick the data is processed and how personalized the operations are.

As an example, if a network is likely to suffer a breakdown or experience traffic congestion, it would be possible through AI analysis to foresee such situations and take all the necessary steps beforehand thus be able to maintain quality service provision. Already the very possession of this forecast capability enables to reduce the extent of damages caused by internal reasons, such as equipment

malfunctions, which in turn cause client churn and hence impact revenues. Also, it is possible to use analytics for the bettering of such processes as a network, slicing in the 5G network, targeting the addressable market. In other words, when for example telecom operators have sufficient demand for the tariffs that are coming fairly close to the level and pattern of available network resources, this will cause an improvement in the utilization of resource rights, increase the quality of service and most significantly lower the overall costs.

Nonetheless, as is the case with arms reporting operations and other management concepts, CIOs and CDOs are also capable of embedding data-oriented decision making at operational level and this enhances strategy formation as regards capital allocation, planning, human resource and stakeholder management. It implies that barriers to harnessing assets related to communication networks, computing technologies and recruitment of clientele are able to produce better long-term benefits instead of seeking quick returns.

VII. FUTURE RESEARCH

It is worth noting that there are additional opportunities for research particularly in light of the prospects regulation with new technologies. One such I have a good reason to think will arise is the implementation of machine learning models to customer behaviors. This would help a lot in customizing targeted marketing and new service provision. These models, for instance, can describe how aware the customers are of the products and or services on offer which in this case helps the telecom operators to enhance the timely promotion level and in turn reduce churn and increase the customer lifetime value.

Another promising research field is the predictive analytics for networks management. Problems of such networks design and management are becoming more and more complex due to the ongoing proliferation of the 5G networks across the globe. Search can focus on the issues of how data derived from the network nodes can be analyzed on a real time basis and applied in the machine learning algorithms that are meant for forecasting the degradation of service performance, timely distribution of resources and management of power within the network. Moreover, given the application of the Cloud Native Architecture in the telecommunication industry, the studies on the applicability of CNA versus conventional business operations is on the rise, more research could look at how existing telecom business processes would link with cloud solutions for optimal resource utilization. LLMs are another perspective that give hope for the future lines of research, in which one can mention planning, chatbots etc, or, auto-diagnostics of the telecom networks. Similarly machine LLMs integrated with telecom data help businesses handle complex customer requests and streamline technical support issues.

Additional studies on the data governance frameworks in place can be done in the future, which ensures the data quality and consistency across the telecom operations. In theory, telecommunications companies ready to take on AI decision support structures would, in due course need to have some reference point to tackle data quality in a sophisticated manner. There is a knowledge gap that can also be filled in terms of examining the effect of AI literacy programs on the personnel of telecom operators seeking to use AI and analytics in the business operations of the company. One more direction – focusing on other sectors (consider, for instance, how finance or healthcare sectors managed to build analytical components in their core activities). This should help to mitigate the skills gap and enable telecom operators to learn the following best practices; integration of data including where and when, management of the data as well as use of analytics as a final step. Also, with the advent of 5G cellular technology and changes in architecture as envisaged to be all cloud, there will be more studies needed regarding large scale AI applications – those that are still effective regardless of the size and configuration of a network. In relation to research going forward, other studies may delve more into the aspects concerning the ethics of using AI in telecommunications with regard to issues such as privacy, data ownership, and accountability. For example, telecoms ready to implement decision making based AI systems will need some form of reference to appropriately manage data quality. As such, further investigation can be undertaken into the ways in which AI literacy programs for telecommunications companies serve to equip the workforce with knowledge and skills regarding the application of AI and analytics to the use of resources. Another approach is to take proactive measures and study the best practices existing in other sectors (similar to such sectors as finance or healthcare which

successfully integrated analytical systems into their operational processes). This could help address the skills deficiency and provide telecom operators best practices in the following regard; where and how to integrate data, how to govern it and last but not the least, how to apply analytics.

VIII. LIMITATIONS

The prospect of advancing AI & analytics in the telecom industry is high, but there are pitfalls to discuss. Nevertheless, the feedback from this paper is that some items are still a problem, for example data quality. This has been as a result of imposing frequent and fragmented, inconsistent, and isolated data operations resulting from systemic use of often outdated systems, vendors, and data structures by telecom operators. Data silos of this nature can hinder information flow and consequently, organizational capability of analytics models to perform optimally. The kind of detail at the operational level that AI requires along with the integration often is not highly feasible in many telecom environments at this time.

Another limitation is that people apply various robotic tools to their working process, whereas the issues of data management are still unsolved. Using the models on a low quality dataset may result in wrong prediction conclusions and lead to operational losses. Moreover, the AI solutions are often perceived as one more answer to some problems without proper consideration given to the fact of how these solutions will be implemented into an organization's work and how the organizational culture will be adjusted to the new change. Today, many of the telecom operators want to incorporate AI and automation technology in their organization but perhaps they are not prepared to actually do it, or they do not have suitable manpower to do it properly. Lack of this knowledge and experience might lead to the situation, where the technology is utilized not to the maximum extent or is utilized inappropriately.

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