Creating Sustainable and Scalable Services for Insurance Industry Using Deep Tech and DApps

Joseph Pablo Varun[1], Babu Devendiran[2]
Birla Institute of Technology and Science, Pilani, India 333 031. [2]Future CAE Technologies

Abstract

The concept of value-based care is gaining momentum as lots of technology-oriented companies have started acquiring healthcare-based startups to extend their services to insurance companies to manage their premium pricing and insurance claim. The big tech companies leverage the data that was previously collected by the acquired startups to add value to the insurance services. With the advent of IOT (Internet of things) based systems, the big data technologies, artificial intelligence and various Blockchain platforms, the collection and, storage and processing of health-related data related to the user is more reliable and sophisticated and the insights obtained from the outcomes the model predicted based on the historical data have a profound impact on the revenues of the insurance providing companies. The study examines the role that these technologies have in monitoring and diagnosing the health of patients on a day-to-day basis. Hence, a broad field of study called "Insurtech", comprising business, technology and healthcare has emerged. This study is an explorative qualitative research based on a case study approach to share best practices for developing robust applications and data pipelines for achieving sustainable and scalable solutions for the general practitioners, patients and the insurance companies. This study recommends some of the best practices to develop robust, secure and scalable applications for the insurance industry in the healthcare perspective by leveraging data from various sources and analytical solutions and highlights growth metrics for tracking the progress of the companies.

Keywords: Value-Based Care, Insurtech, Artificial Intelligence, Blockchain, Internet of Things (IOT)

1. Introduction

The advancements in the healthcare technology and the Internet of Things (IOT) provides daily active monitoring of the patients by collecting various types of data related to the health using the IOT(Internet of Things) devices and making each individual's healthcare journey more targeted and personalised. Modern-day health care is being continuously redefined with non-intrusive monitoring solutions that enable real-time detections and assistance from providing general reminders for taking medicines to tracking and monitoring the remote patients. The data collection is done by devices such as GPS(Global Positioning System), Wearables and Virtual Personal Assistants (VPA) and stored in the remote cloud server for future use. The data sources in Insurtech comprises open data from API (Application Programming Interface), aggregated datasets from the users and from other business entities. Simon Behm et al, 2019 explains about various important technologies used in the insurance sector like Chatbots, telematics, AI(Artificial Intelligence) etc and these data sources help insurance companies to provide value-based care to their customers (Zahy Abou-Atme et al, 2022).

According to Insurtechdigital.com (Anja Friedrich, 2022), the digitalisation of the insurance industry demands investments in technologies such as artificial intelligence and Data Analytics enable automation and improvement in decision making for businesses to evolve and adapt to the market dynamics. Insurance providers are now equipped with the tools to create more customised products. For example, the driving habits of the customers are taken into account by using the telematics data. The concept of 'Dynamic pricing' enables insurers to navigate the risks associated with the uncertainty due to the prevailing market conditions. The insurance businesses can meet the customer expectations by aligning with market conditions by using the technological capabilities.

The insurance policy premiums can be personalised according to the risk profiles of the customers by leveraging the power of computing, connected devices and sophisticated storage systems. There are services such as instant quotation and easy approvals which have drastically reduced the paperwork and hard labour involved in the traditional insurance businesses.

The availability of cheaper electronic hardware, cloud storage and high-performance computing have given rise to a myriad of wearable gadgets which provide the users with sophisticated applications for tracking and monitoring one's health on a regular basis. For example, smartwatches are now equipped with sensors for measuring heart rate, blood glucose levels etc. There are some ongoing research aiming at capturing data related to blood pressure in a non-invasive way through sweat and breath which can be further utilised for medical diagnostics for the treatment of diabetes and skin related diseases.

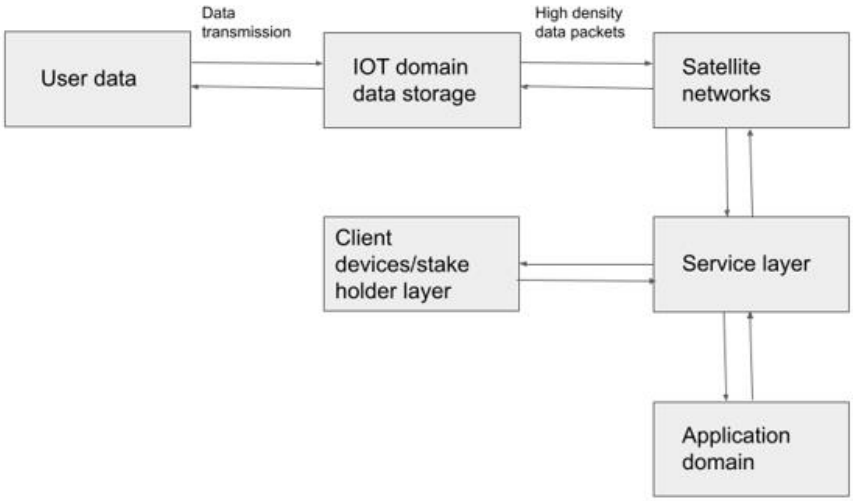
There are numerous factors such as the sensor hardware characteristics such as the size, power consumption, type of processor used, intellectual property rights, the type of data

ranging from unimodal to multimodal sensor data have a big deal in the insurtech ecosystem. Moreover, the communication network must address the constraints related to the long-haul data transmission, latency and throughput for preserving the data integrity.

The healthcare industry is more diverse, heavily regulated and highly fragmented. Furthermore, the healthcare industry caters to a wide range of spectrum which includes areas such as hospital services, medical devices, personal emergency response systems, fitness monitoring etc. Hence, we need to do appropriate market research, brand positioning and create brand awareness in order to connect the dots to meet the market demands of any geography. The insurtech landscape is omnidirectional as it relies on multiple stakeholders and vendors. It is very important that we design the landscape using the right stack that includes cloud storage systems, API (Application Programming Interface) services for sourcing the third-party data. In a nutshell, the business model should act as a bridge between the healthcare professionals and the end users so the decision made by the model must align with human judgement for any kinds of prediction and forecasting critical events.

Besides monitoring the patients very closely, the wearable devices can also help in generating patient-related data exponentially which can be further utilised to provide personalised health services as well as reducing the healthcare expenditures such as bringing down the number of clinical visits. The insurtech landscape involves convergence of many data pipelines and technology platforms which eventually makes the decision-making process very efficient.

Figure 1: IOT Landscape in Insurtech



Source: 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM) Insurtech Fostering Automated Insurance Process using Deep Learning Approach.

2. Objectives of the study

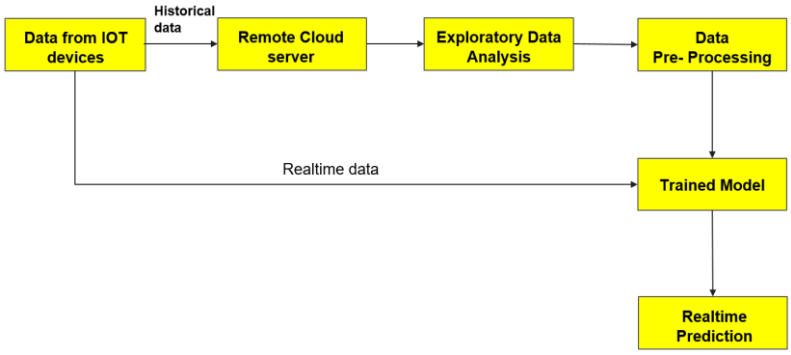
The objective of the study is to conduct an exploratory qualitative research to assess the impact of various technologies ranging from Data Management, Data Analytics, Cloud Computing, Blockchain, Artificial Intelligence, Machine Learning, and Internet of things (IOT) in various dimensions of the Insurance business landscape such as Capital expenditure,customer satisfaction etc., as well to identify Functional and Nonfunctional Requirements to develop DApps(Decentralised Applications), Risks and regulation challenges to develop Sustainable and Scalable Services for Insurance Industry.

2.1 Data Management and Analytics for Insurtech

The patient data for Insurtech can be obtained either from wearable sensors or from subjects logging their information such as height, weight and calories consumed in a meal etc. The data points are collected at a fixed sampling rate for various parameters and are managed in a remote cloud environment.

The data lake should have a customer identification number as a primary key followed by respective timestamps with various parameters such as blood sugar level, heart rate etc. We recommend a tabular structured database like an SQL (Structured Query Language) with a schematic representation for connecting many tables at various instances. The data can be collected from the wearables or can be procured from an external vendor like Fittr, Strava and many more. Paper by (Mostafa Haghi Kashani et al, 2021) discussed the data generation, data management and information consumed by the Analytics Team.

Figure 2: Data Analytics from data collected from IOT Devices



The Fig.2 shows how the data collected undergo various stages for real-time prediction in machine learning models. The data collected across multiple sources need to be cleaned and pre-processed for making up for missing values, outliers and duplicate values using descriptive statistical techniques. As the data is a time series, different features can be derived from the data in various aspects such as spectral, temporal and statistical domains. The features can be normalised using scaling techniques such as minmax normalisation, if it

involves many features in different scales. The data after normalisation can be utilised by machine learning algorithms to learn patterns from the past and to forecast the future outcomes such as health risks, premium pricings etc.

2.2 Technology and Functional Architecture

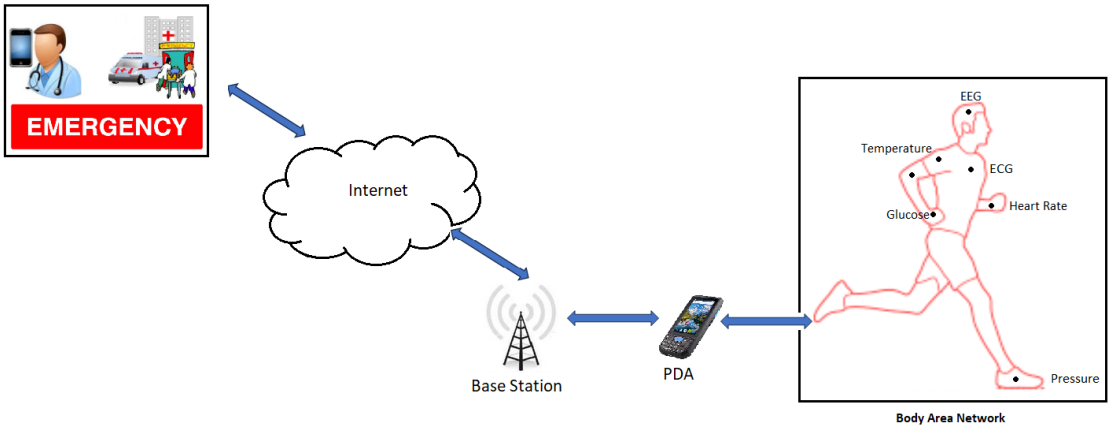
An IOT based insurance application has three principal layers:

- Data Recognition - comprises of sensors for collecting data from patients
- Organise Transmission - transmission using wireless methods: WIFI, Zigbee etc
- Application administration - store and manage information: cloud servers.

Fig.3 describes various data that can be captured by various means when a person performs an activity in all walks of life such as walking, running or even sleeping.

The Journal of NeuroEngineering and Rehabilitation (Emil Jovanov, Aleksandar Milenkovic, Chris Otto and Piet C de Groen, (2005)) explains about a wireless body area network where a network of intelligent sensors collect various data from patients to be utilised for computer assisted rehabilitation treatment. The radio frequency (RF) based wireless technologies facilitate remote monitoring of the patients, thus enabling physicians or doctors to receive information from those patients with minimal physical contact.

Figure 3: Data collection from human beings through a body sensor network



Source: Journal of Neuro Engineering and Rehabilitation A wireless body area network of intelligent motion sensors for computer assisted physical rehabilitation Emil Jovanov

Table 1: Human Body Metrics considered for the study

Metric	Target Patients	Applications	IOT Device Used
Blood Glucose Level	Diabetic	Helps to plan diet and physical activities based on the measurement	Wearable gadget
Body Temperature/calories	Dehydration, Hyperthyroid	To recognise homeostasis	Wearable gadget/smartphone apps
Heart rate monitor	Cardiac problems	Monitor blood oxygen level	smartphones/wearable gadgets

The above table (Peng Zhang et al, 2017) shows the prominent metrics such as blood glucose level, temperature and heart rate which can be captured using any simple wearable gadget in a non-invasive way. Besides being easy to measure variables, they have a profound impact in monitoring a patient's health as well as to help the insurer to set the premium dynamically.

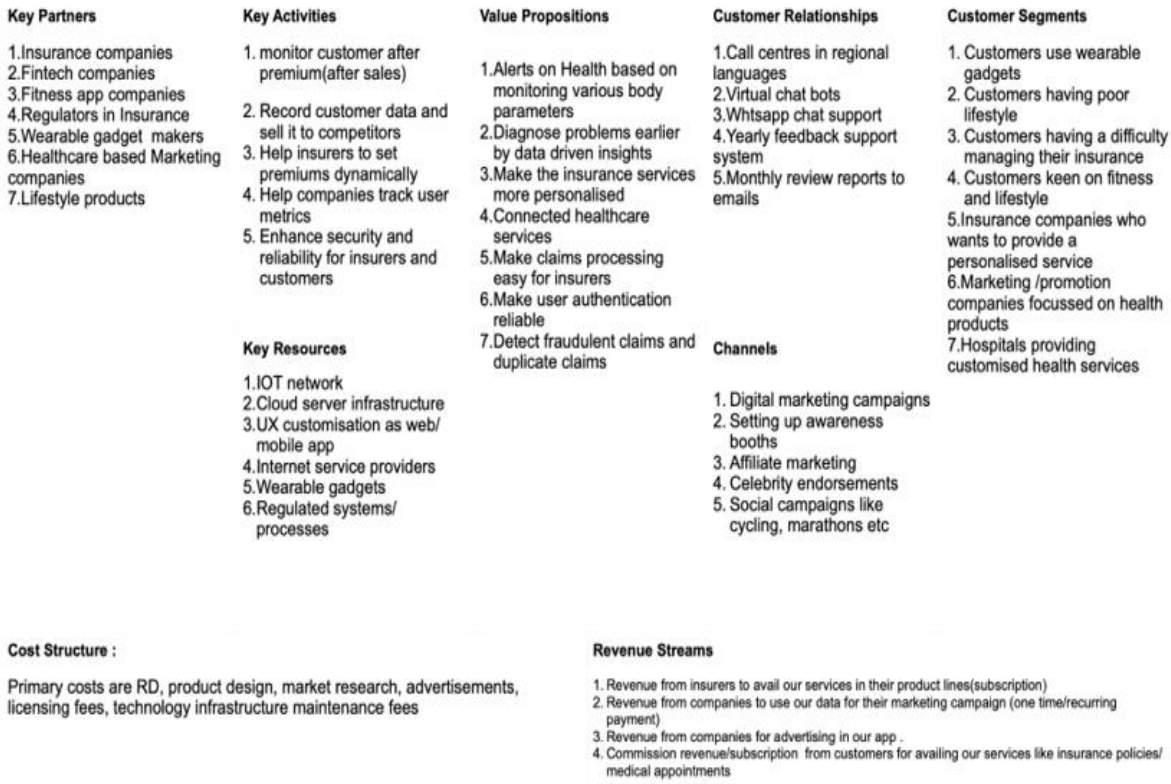
2.3 System Design Requirements (Non-functional Requirements)

The design of an IOT system for the healthcare applications must satisfy certain quality measures such as data privacy, data security, robustness and stability. Furthermore, the usability of the product must be prioritised by the designers by creating the appropriate user journey. The product owners and product managers must identify the metrics corresponding to the above measures and must engage their engineering teams to focus on the right direction to establish the product market fit. Any IOT(Internet of Things) system must meet the standards for stability and security for its long-term sustainability. The recent improvements in 5G communications provide ultra-wide band transmission of high-density data packets over a long range which enables smart features like multimodal communication, remote patient monitoring and anticipation and prediction of critical events possible in the real-time.

2.4 Business Model Canvas

Based on the analysis and market research done by surveying around fifty subject matter experts in the insurance industry and aggregating information from the current business trends, we have formulated the business model canvas:

Figure 4: Business Model Canvas



Source: https://www.score.org/manasota/resource/template/business-model-canvas-bmc

Fig.4 explains the various dimensions that are involved in the *Insurtech business model*. The Business Model Canvas for Insurtech DApps(Decentralised Applications) developed using the empty templates from the below source.

2.5 Role of Cloud computing, Big Data and AI in Insurtech

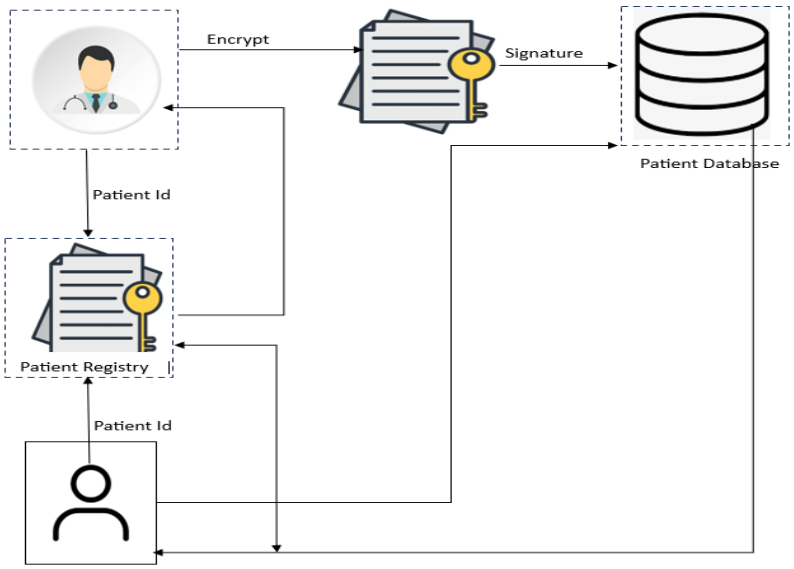
Connectivity and cloud computing (Trayush et al, 2021) explains in detail about the various building blocks involved in designing an information-driven IOT(Internet of Things) system specific to the healthcare industry. The data collected from multiple sources such as wearable devices, hospital records, and APIs(Application Programming Interface) need to be stored in dedicated data warehouses which can be utilised for decision making. The data driven decision making process makes use of the cloud infrastructure and machine learning algorithms which have become robust and faster with the developments in high performance computing GPU(Graphics Processor Unit) technologies. The decision support systems should be patient-centric, flexible and scalable for further business expansion. The big data processing systems enable useful features for data visualisation and reporting for realising the business goals. As data centres continue to expand in size and capacity, the internet bandwidth grows and the scope for reduction in latency is higher. According to the reports from the Organization for Economic Cooperation and Development(OECD), (Global

Insurance Market Trends, 2020), AI(Artificial Intelligence) and big data have a huge potential to impact various areas of insurtech ranging from production to customer satisfaction. The utilisation of AI(Artificial Intelligence) in the insurance industry is in the early stages. In the future, AI(Artificial Intelligence) can help this sector to improve decision making such as claim approvals, forecasting premiums, claim write offs, customer interactions. With the advent of deep neural networks and large language models (LLM) the generative AI applications have attracted many investors to focus on AI(Artificial Intelligence) related companies which directly or indirectly benefits the insurance industry by reducing the customer support executives and reducing the customer acquisition costs through targeted ad campaigns using the search engine optimization.

2.6 Role of Blockchain in Insurtech

Blockchain technology is the latest authentication platform for secure transactions between transacting parties. Fig.5 shows the basic blockchain process flow required for the decentralised applications (DApps). We are considering Ethereum 2.0 for this study (Peng Zhang et al, 2017). Advantages of blockchain technology include decentralisation, immutability, and consensus via cryptography and game theory. Smart contracts built on blockchains enable Decentralised Apps (DApps) development and blockchain interaction.

Figure5: Ethereum Blockchain architecture for Insurtech Applications



Source: Metrics for Assessing Blockchain-based Healthcare Decentralised Apps. IEEE journal: Peng Zhang)

2.6.1 Blockchain Compliance with HIPAA

The Health Insurance Portability and Accountability Act(HIPAA) provides a framework on how Personally Identifiable Information (PII) needs to be transferred, received, handled or

shared by healthcare professionals, Healthcare Insurance Service Providers and any DApps(Decentralised Apps) used by them. It does not restrict patients voluntarily disclosing their personal information to others.

Any DApps(Decentralised Apps) used or provided by healthcare professionals and healthcare service providers should comply with HIPAA guidelines.

2.7 Critical Issues and Challenges in Insurtech

There are two main issues which have been observed during the study and need to be addressed:

2.7.1 Scalability

The IOT(Internet of Things) ecosystem has billions of devices and sensors that are interconnected, which needs a robust network to manage this information burst. So, we need efficient data systems and a back-up environment to handle, store and manage the database. Also, we need to establish interoperability between various stakeholders such as the blockchain, cloud network without compromising on the compliance.

2.7.2 Security

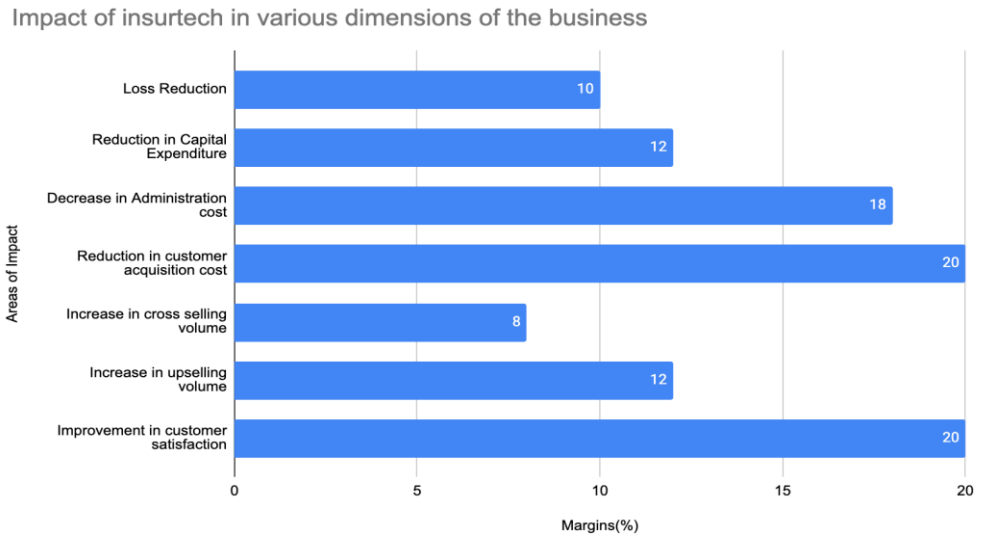
The data transmission should have secure encryptions and should be shared only among the authorised stakeholders. We must ensure that there are no data breaches and also the devices must be properly packaged and designed with a human centred approach. The system should abide by the legal requirements in any localised environment. For example, PDPA (Personal Data Protection Act).

2.8 Business Insights from the study

We have done a study on the major impact areas of businesses that have been the focus for Insurtech. The bar chart Fig.6 below shows the main focus areas of Insurtech based on the survey results (Sumit Agarwal et al, 2022). According to a Gartner article [Susan Moore 2019], Some of the metrics used are Average Order Value (AOV), Customer Lifetime Value (CLV), Customer Satisfaction (CSAT) and customer response time per email. Customer acquisition cost is the ratio between the sum of sales and marketing costs for a given time to number of new customers for the same period of time. Customer experience is calculated by calculating the NPS (Net Promoter Score). We have utilised the same metrics calculated by different companies from the survey and interviews that were conducted among the industry veterans.

We interviewed 50 industry experts working in the insurance sector using questionnaires and surveys for this study and found that the focus of the industry is mainly on improving user experience by providing more personalised solutions and to automate the inefficient processes by using chatbots and AI(Artificial Intelligence) driven recommendation engines and targeting advertisements to reduce marketing and acquisition costs and to reduce customer churn rate.

Figure 6: Insurtech Focus Areas based on the survey results



Source: 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM)Insurtech Fostering Automated Insurance Process using Deep Learning Approach

3 Related Work

There have been significant methods proposed by various researchers and domains to incorporate various technology stacks in the traditional insurance industry to substantially increase the profit margins in the long run. For example, (Peng Zhang et al, 2017) analysed the existing health IT (Information Technology) systems and presented some technical metrics focussed on blockchain based solutions for healthcare. Similarly, (Moinak Maiti et al, 2023) conducted a systematic review of the impact of Internet of Things (IOT) in the Fintech ecosystem focussing on the challenges and the impact of technology-oriented business models. Likewise, (Felipe Fernandez et. al) identified the key considerations while establishing collaboration between various stakeholders such as end users, UX (User Experience) designers, software developers, product marketers and product managers to have a structured systems engineering methodology to make correct decisions for the healthcare-IOT (Internet of Things) ecosystem.

Our research differs from the previous works on assessing the impact of various technology stacks such as blockchain, Internet of Things (IOT), Artificial Intelligence on the business in a holistic way. First, we have presented the Insurtech business model canvas which encompasses almost every aspect of business such as value propositions, key activities and revenue streams. Secondly, we have incorporated a qualitative approach based on domain specific knowledge and analysing the metrics that strongly indicate the performance trajectory of the businesses which have currently been

implemented in the healthcare technology ecosystem and the potential areas of impact such as reduction in customer acquisition cost and decrease in administration cost.

4 Concluding Remarks

Technological improvements in the field of computer science offer the benefits of data storage, decentralised ledgers for traceability and immutability, advanced algorithms for making optimal decisions and enhanced processing capabilities for handling large volumes of data. These benefits can be leveraged by the insurance businesses to improve the user experience, offer more personalised products and increase customer satisfaction. However, the existing literature does not provide satisfactory measures to identify the key metrics and the potential impact areas of these technological functions on the business as a whole. Our study attempted to bridge this gap by identifying various technical metrics and their potential impact in various dimensions of business. From both the technical and business domains, this study aimed to shed light on the vital factors that need to be considered for creating applications in the “Insurtech” space. In addition, this study aimed at analysing the different value chains in the Insurtech Ecosystem and identifying the important pain points and opportunities. In the future, we will expand this study to explore other appropriate metrics for evaluation and validation of our findings in a quantitative way using concrete Insurtech use cases.

References

Anja Friedrich, (2022), "What the future of dynamic pricing means for insurance", Available: https://insurtechdigital.com/articles/what-the-future-of-dynamic-pricing-means-for-insurance

Durga S., Rishabh Nag and Esther Daniel, (2019), "Survey on Machine Learning and Deep Learning Algorithms used in Internet of Things (IoT) Healthcare", *Proceedings of the Third International Conference on Computing Methodologies and Communication*, pp.1018-1022.

Emil Jovanov, Aleksandar Milenkovic, Chris Otto and Piet C de Groen, (2005), "A wireless body area network of intelligent motion sensors for computer assisted physical rehabilitation", *Journal of Neuro Engineering and Rehabilitation*, Available: https://jneuroengrehab.biomedcentral.com/articles/10.1186/1743-0003-2-6

Felipe Fernandez, G. C.Pallis, (2014) "Opportunities and challenges of the Internet of Things for Healthcare", *4th International Conference on Wireless Communications in Healthcare*, pp.263-266, Available: doi: 10.1109/MOBIHEALTH.2014.7015961

Global Insurance Market Trends 2020(OECD), Available: https://www.oecd.org/daf/fin/insurance/Global-Insurance-Market-Trends-2020.pdf

Moinak Maiti, Uttam Ghosh, (2023), "Next Generation Internet of Things in Fintech Ecosystem", *IEEE Internet of Things Journal*, pp.2104-2111, Available: doi: 10.1109/JIOT.2021.3063494

Mostafa Haghi Kashani, Mona Madanipour, Mohammad Nikravan, Parvaneh Asghari and Ebrahim Mahdipour, (2021), "A systematic review of IoT in healthcare: Applications, techniques, and trends", *Journal of Network and Computer Applications* 192(2021) 103164, Available: https://doi.org/10.1016/j.jnca.2021.103164.

Simon Behm, Ulrike Deetjen, Sanjay Kaniyar, Nadine Methner and Björn Münstermann (2019), "Digital ecosystems for insurers: Opportunities through the Internet of Things", Available:*https://www.mckinsey.com/industries/financial-services/our-insights/digital-ecosystems-for-insurers-opportunities-through-the-internet-of-things*

Susan Moore (2019). "How to measure Customer Experience". Available: https://www.gartner.com/smarterwithgartner/how-to-measure-customer-experience

Peng Zhang, Michael A. Walker, Jules White, Douglas C. Schmidt and Gunther Lenz (2017), "Metrics for Assessing Blockchain-based Healthcare Decentralised Apps", *IEEE 19th International Conference on e-Health Networking, Applications and Services, Available: https://www.dre.vanderbilt.edu/~schmidt/PDF/IEEE-Healthcom-2017.pdf*.

The Impact of Big Data and Artificial Intelligence (AI) in the Insurance Sector 2020(OECD), Available: https://www.oecd.org/finance/Impact-Big-Data-AI-in-the-Insurance-Sector.pdf

Trayush, Ruchika Bathla, Sonia Saini and Vinod Kumar Shukla (2021), "IOT in healthcare: Challenges, benefits, Applications and Opportunities", *International conference on Advance computing and innovative technologies in Engineering*, pp.107-111.

Zahy Abou-Atme, Rob Alterman, Gunjan Khanna and Edward Levine (2022), "Investing in the new era of value-based care", Available: https://www.mckinsey.com/industries/healthcare/our-insights/investing-in-the-new-era-of-value-based-care