INTERNET OF THINGS (IOT) AS KEY ENABLER FOR EFFICIENT BUSINESS PROCESSES

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ABSTRACT

Most of the failures in business are related to the unavailability of correct business data. Internet of Things (IOT) offers a great promise in various business functional areas in terms of efficiency enhancement, correctness of information, profit gains and even the development of new business processes and models.

The methodology proposed is constructed from two key sources: Literature review and informal surveys. In this, Interviews of 8-10 business managers of different organisations were conducted to get the correct feedback and business data.

This paper aims to show how IOT can be used to make business functions efficient and affordable.

The paper critically examines the conditions under which IOT innovation is justified by business purposes. The purpose of the paper is to forward a methodology capable of giving wise and successful investment in the IOT.

The paper identifies enabling conditions to maximise the success of IOT adoption in Business applications.

INTRODUCTION

Internet of Things (IoT) is currently one of the most buzzing and discussed topic in research field. The Internet of things implies to an umbrella keyword for combining and covering the major aspects related to the extension of the Internet and Web into the physical world, by means of deployment of spatially distributed devices that contains embedded identification, sensing and/or actuation capabilities.

The term Internet of Things (IOT) has been around since the last few years. In recent time, it is getting more attention due to the advancement and increase in use of wireless technology. The basic idea is due to the variety of objects- such as RFID, NFC, Sensors, actuators, mobile phones, etc. which can interact with each other by having a unique address. IoT empowers conventional devices to see, hear, think and perform jobs by making them talk with each, to share information with each other and to synchronize data. IoT converts these native devices from conventional to smart by upgrading its underlying technologies.

When, IoT was introduced, Radio frequency (RFID) seemed to be necessary for it. There are many technologies similar to RFID, Machine to Machine (M2M), vehicular to vehicular communications (V2V) and Near Field communications (NFC) which can be used to implement the modern idea of IoT [1]. The life of end user/common people can become easy and comfortable by adopting various technologies based on IoT. In addition, IoT has dramatic effect on domestic sphere, such as assisted living, smart homes, smart cars, etc. In business sector,

IoT has noticeable advancement in manufacturing and service industry such as better services, more production and superior quality. The worldwide adaption

of above-mentioned technologies does appear smooth but involves lots of issues, that needed to be solved before it worldwide acceptance. The major issues that IoT is of security because of Internet hackers.

Some of the other problems in IoT implementation are standardization issues, addressing problems and scalability problems etc. Due to this reason, intensive research is needed to resolve these complicated issues. Cisco approximates that IoT will consist of 50 billion devices connected to the Internet by 2020 and will achieve deeper insight with analytics using Cisco IoT System to enhance productivity, generate new revenue streams and create new business models [2].

IoT devices and services have reached an acceptance point of 18% to 20% adoption in 2019. DBS Asian Insights is predicting that the IoT installed base will grow from 6.3M units in 2016 to 1.25B in 2030 [3].

LITERATURE REVIEW

In 2010, Y. Lu, X. Li, J. Zhong and Y. Xiong [4] analysed the characteristics of Green Agricultural products, combining the use of Internet of Things (IOT), and proposed an innovative Business Strategy Model.

In 2011, Qian Xiaocong and Zhang Jidong [5] proposed the structure of Internet of Things (IOT) business operation support platform (BOSP). The paper introduced the development of IOT, and focuses on carriers that play leader role in IOT industry chain.

In 2013, F. Berkers, M. Roelands, F. Bomhof, T. Bachet, M. van Rijn and W. Koers [6] investigated how a smart horizontal IoT service platform can bring value and economies of scale to all required ecosystem stakeholders.

In 2015, M. Ide, Y. Amagai, M. Aoyama and Y. Kikushima [7] proposed a lean design methodology for business models, which repeatedly design business-model hypotheses in researching manner, moreover, with which corporate businesses can create new business value utilizing IoT.

In 2016, M. Bagheri and S. Movahed [8] investigated and analysed how IoT has changed the Education Business Model.

J. Ju, M. Kim and J. Ahn [9] aimed at developing a generic business model framework for IoT business through literature analysis and interviews. To test the proposed business model framework, they undertook case studies of current IoT companies.

In 2017, A. Onasanya and M. Elshakankiri [10] proposed the implementation of an IoT based healthcare system focusing on two services, namely, cancer care and business analytics/cloud services.

U. Raza, J. Lomax, I. Ghafir, R. Kharel and B. Whiteside [11] built upon a novel architecture for monitoring the μIM process using: IoT devices; distributed Service Orientated Architecture (SOA), with the Enterprise Service Bus (ESB) at its core; Business Processes for linking with other standard processes and Google Applications for web monitoring.

A. Ali, I. El-Dessouky, M. Abdallah and A. Nabih proposed Sitechain [12] a new architecture to integrate IoT platforms with blockchain technology.

F. Martins and D. Domingos [13] said that as the computational power of IoT (Internet of Things) devices increases, business processes can use them to provide information about real world as well as to execute part of business processes, reducing the amount of exchanged data and central processing.

In 2018, S. Mahendra, M. Sathiyanarayanan and R. Vasu [14] said that the main aim of their paper was to enhance the traditional security business model. The security system based on the IoT platform had the potential of interacting real-time with the device.

K. Routh and T. Pal [15] emphasized on the different influencing aspects of IoT, namely Technology, Business and Society.

K. Saraubon, N. Kongsanit and N. Santawesuk [16] presented an IoT & mobile-based system for business. It was designed and developed in the form of a case study of a quick service restaurant.

In 2019, A. Aagaard, M. Presser and T. Andersen [17] contributed theoretically to digital transformation and business model literature in understanding the influence of IoT and digital transformation on digital business models.

N. Chandra, S. Khatri and S. Som [18] tried to explain the application of IOT in different aspects of our day to day life and in Industry and businesses.

I. Lee [19] presented an IoT ecosystem, IoT architecture, and the IoT service business model essential for the selection and deployment of IoT services in various enterprise and business settings.

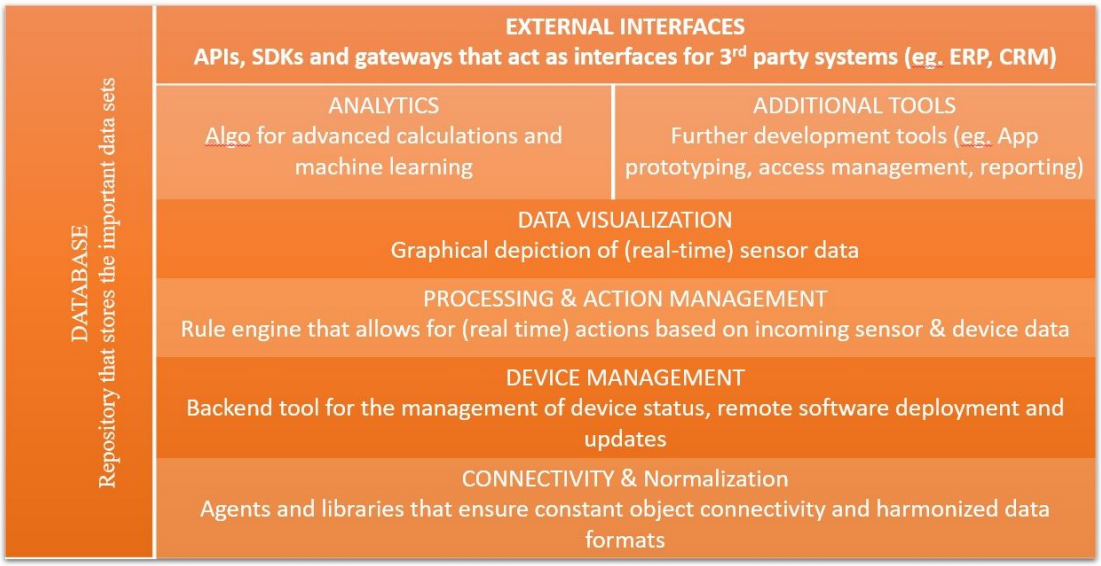
V. Tsiatsis, S. Karnouskos, J. Höller, D. Boyle and C. Mulligan [20] described the drivers for the Internet of Things (IoT) from a business perspective.

IOT FRAMEWORK /ARCHITECTURE

Proposed IOT Framework

An IoT framework is just about enabling connectivity between “things” or devices. A true end-to-end IoT platform consists of 8 important architectural building blocks [21]:

i. Connectivity & normalization: It brings different protocols and different data formats into one software interface ensuring and providing accurate data flow and interaction between all devices.
ii. Device management: ensures the connected “things” are working properly, seamlessly running patches and updates for software and applications running on the device or edge gateways.
iii. Database: Scalable storage of data generated by devices creates the requirement for hybrid cloud-based databases to a new level in terms of data volume, variety, velocity and veracity.
iv. Processing & action management: It brings data and devices to life with actions based on rules and events which in-turn triggers execution of smart actions based on specific data from the sensors.
v. Analytics: It performs a number of complex analysis, out of the IoT data-stream, from basic data clustering and deep machine learning to predictive analytics. Meanwhile, extracting the most valuable outputs.
vi. Visualization: It facilitates humans to recognize patterns and observe most common trends from visualization dashboards. The data is portrayed through line, graphs, or pie charts, etc.
vii. Additional tools: It permits visualizing, managing and controlling connected devices, of IoT developers’ prototype, test and market the IoT use case creating platform ecosystem apps for.
viii. External interfaces: they help integrate third party apps, systems and the other IT-ecosystem with help of application programming interfaces (API), software development kits (SDK), and gateways.



Frameworks are helpful because they abstract a lot of common functions away from the specific application logic. A good architecture dramatically reduces the cost of developing and maintaining applications. IoT platforms are all of those things because different frameworks in the market solve different needs. For example

- Automate the management of connectivity.
- Enable the rapid development of software applications.
- Gather, integrate and provide report on device data in real-time.
- Enabling direct device management into backend IT systems

Some of the top IoT Platforms are listed below [21]:

- AWS IOT
- Microsoft Azure IOT Suite
- Google cloud
- Cisco IOT system

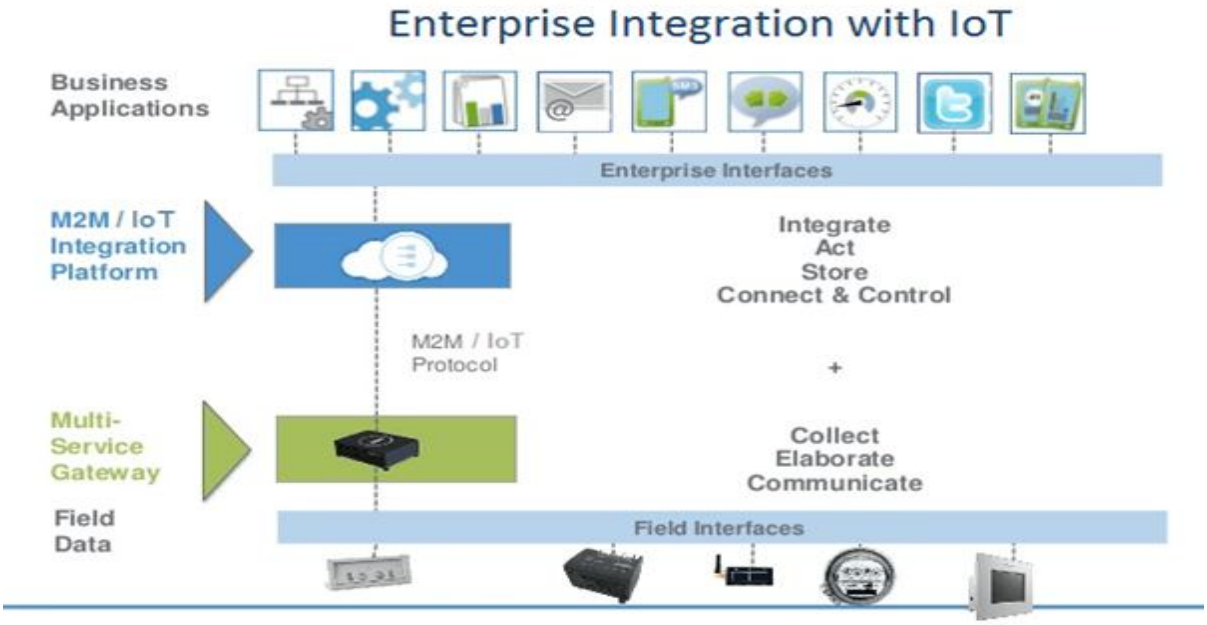
Enterprise Integration with Internet of Things (IoT)

Enterprise integration refers to joining two or more separate programs, applications, or machines with the services of other systems. It is the use of technologies and services within an enterprise which enables the integration of applications and hardware systems. Enterprise Integration provides the ability which integrates the diverse data and information, sourced from within as well as outside enterprise into a single unique coherent framework. A cohesive information infrastructure can then be shared by applications as customer relationship management, executive information portals, dashboards, reporting systems and automated supply chain systems. Due to the intercommunication between the various enterprise applications and Internet of Things an advanced level of automation is created that requires minimal manual/human intervention. Enterprise Integration with IoT requires extending connectivity from enterprise and the cloud to devices at the edge of network.

Enterprise Architecture with Layers for IoT - The Eclipse Foundation's IoT Working Group recently discussed this at length in the white paper, The Three Software Stacks Required for IoT Architectures [23]. The IoT technology stack consists of three tiers: sensor devices, gateways, and the data centre or cloud IoT platform. IoT system consists of

many devices that may uses a gateway to communicate to an enterprise back-end server which is running an IoT platform/software that helps in integrating the IoT information received into the existing enterprise [23]."

The device focuses on information gathering via sensors that can be embedded in many different types of devices, including mobile computing devices, wearable technology, and autonomous machines and appliances. They collect information about the physical environment, such as humidity, light, pressure, vibration and chemistry, speed, ambiance etc. Standard-based wired and wireless protocols are used to transmit the generated telemetry data from the device to the cloud. It is generally telemetry data, but it can also be some command and control requests. The devices layer is the foundation of an IoT stack [24]. Legacy peripherals that have been there for decades and modern, intelligent, and connected devices, together, form the core. Each device is, in its own manner, capable of acquiring data from a number of sensors that keep track of the required critical parameters. These devices, at certain situation, can be used to control the state of the equipment also. For example, switching off a machine when a fault is encountered. The devices layer also represents the current state of the devices along with the ability to remote control them, for some devices.



The gateway, also referred to as the control tier, acts as an intermediate layer that facilitates communications, offloads processing functions and drives action [24]. Since some sensors generate a huge number of data points every second, the gateway provides a point to pre-process the data locally before sending it further to the cloud tier. When data is aggregated at the gateway, summarized and tactically analysed, it can minimize the volume of unnecessary data forwarded on. Minimizing the amount of data and/or removing noises can have a big impact on network transmission costs. The control tier is bidirectional i.e. it can control the devices also, such as configuration changes, and it can give responses to data tier command-and-control requests, such as a security request for authentication.

The data centre/cloud tier performs large-scale data computation to produce useful information that generate business value. It offers analysing the data in order to create and adapt business rules based on historical data present, and then creating new and useful business rules downstream. It needs to scale to support an ever-growing number of connected devices, and to address a variety of different IoT solutions. Core functions of an IoT data centre include connectivity and message routing, device management, data storage, event processing and analysis, and application integration and enablement.

The functional capabilities of an IoT enterprise lies in the software platform that manages the devices, stores the data, analyses it, and presents the insights to the decision makers. It acts as the middleware that controls the entire workflow. Given the attributes of cloud such as elasticity, reliability, and scale, it is becoming the preferred deployment environment of IoT platforms.

IOT APPLICATIONS IN BUSINESS

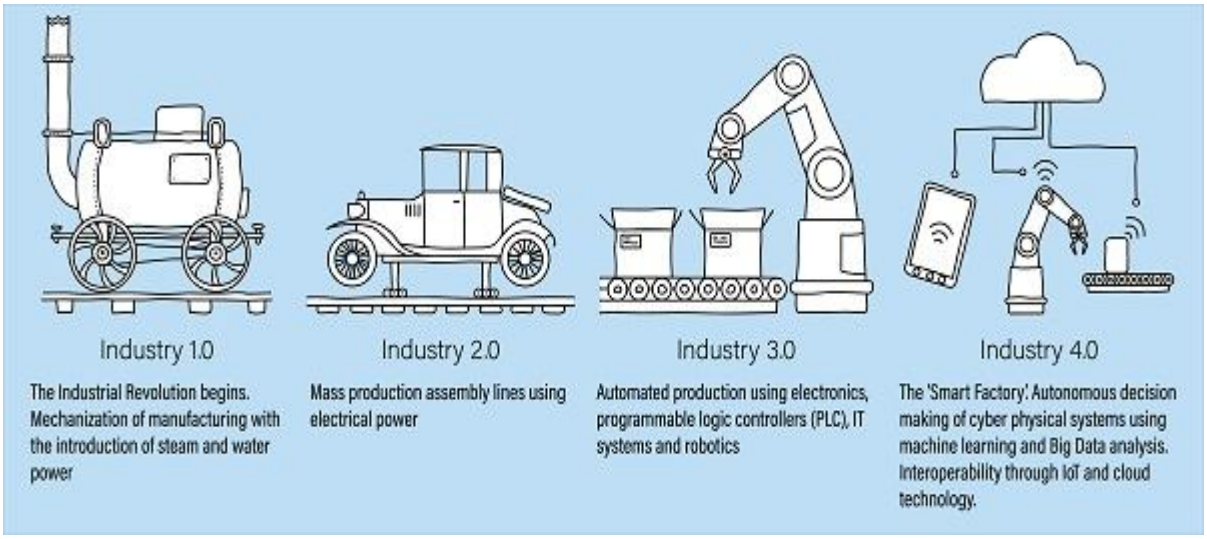
- Manufacturing

The growing manufacturing industry will benefit the most from the integration of this technology in the workplace. Manufacturers are leveraging this solution to track the flow of production on the supply chain. Data collected these IoT sensors is being utilized to monitor each component of a product. Companies can also use this data to improve the quality of a product, as well as enhancing workplace safety.

From the ability to collect big data and metadata to make better decisions, or leveraging insights to create more efficient technologies to maximize cost saving, to the environmental impact that data and technologies can provide, IoT is reshaping the way manufacturers produce goods and drive revenue and efficiency [25].

- Healthcare

The healthcare industry, initially, was a slow adopter of IoT. In 2016, Internet of Things in healthcare was allocated only 14% of IT budgets. Fast forward over two years later, and the healthcare industry is embracing this technology at a rapid pace. Medical facilities are using IoT to cut costs and improve the quality of care that patients receive. With help of this technology, the industry has increased the usage of remote patient monitoring with different devices, and the popularity of telehealth (or telemedicine) has increased. The data collected from different sensors are being used to manage patients, staff,



and to reduce emergency room waiting room times.

- Transportation and Logistics

IoT is changing the way that the transportation industry operates. IoT Sensors attached to the vehicles track the exact locations where they are on their routes. The data from the sensors is used to determine precise delivery times, and rerouting vehicles in case of an accident or inclement weather. It can also track fuel consumption, which will improve fuel efficiency and lower costs.

Transportation companies have the opportunity to become the model for best practices in IoT [25]. “Sensors, mobile scanners and other Internet-connected devices are being used to manage a multitude of different variables including warehouse management, schedules and transportation routes, fuel efficiency, theft etc.

- Retail

IoT is impacting every end of a retail operation. The IoT technology is immensely improving the customer experience, which includes beacons that push out more relevant messages at the point-of-sale, and automated checkout capabilities in the front of the store. Retailers are leveraging the solution to enhance inventory management, with smart shelves that track which items the store is running low on. There are also capabilities that alert stores when theft has occurred, which saves both time and money. All of these benefits allow retail operations to cut back costs and it empowers workers to focus on more meaningful tasks.

- Financial Services Industry

IoT is reshaping the entire financial services industry, with enterprises leveraging the new data to gain deeper customer insights, and to deliver more personalized offers. In banking, IoT devices are the first line of defence used to prevent theft in ATMs. Insurance companies are using the data from sensors to determine potential risks and future pay-outs to customers. The usage of this technology in financial services is expected to surpass $2 billion in the next five years.

IoT Challenges That Business Enterprises Are Facing

At the present, business enterprises and companies are facing immense competition from each other, challenges other than this are just beneath the surface. If internet connected devices are integrated into any business process, they are there to be present, we cannot get rid of them. However, they may come across some new vulnerabilities and challenges that may hinder their ability to satisfy the desired needs.

Some common challenges that businesses might face with using IoT devices, and to keep the enterprise better prepared for them, are [26]

- Security at Stake

IoT is gaining popularity at a very noticeable speed, so are its security threats. The company's data is at a greater risk of being compromised on IoT devices. However, the more one is prepared, the better it will protect the business. The simple rule that applies in IoT is to have security of the big data and IoT devices a priority from the start of development.

- Privacy Issue

IoT works through remote sensors, and it could make the privacy aspect of the business open to all. Business enterprises and companies do not want IoT devices

and big data to be accessible to all, or at least to certain people. It could be dangerous and even fatal in medical and assisted-living applications.

- Dealing with Complexity

IoT is connected through many devices and all work simultaneously. It raises questions about data collection and its potential issues. Problems can be solved by implementing a framework that allows flawless connection between the different IoT devices and are secure from intruders.

- Generating Insights May be Tough

At the pace with which big data is being generating by IoT, sooner or later, at some point in time, it will be complicated to track the precious/useful information. The data collection process should be simple and in a form that makes information easy and everyone can understand it.

CONCLUSION

The methodology adopted and the proposed framework gave a clear indication of possible support for the conclusion that Indian business system is ready for IOT innovations and transformation from traditional business sites into smart environments at best performance values.

The business sector has appreciated the role of IOT in the success of its functions. According to our surveys in over 10 companies in 10 cities, the acceptance is likely to rise to over 50% in 2020.

IOT has made noticeable advancement in manufacturing and service industry such as better services, more production and superior quality at affordable cost. Improved business insights and customer experience, cost and downtime reductions, asset tracking & waste reduction are other few advantages of the approach.

In our surveys and findings, we have seen that there are problems related to security, privacy and standardization still acting as a bottle neck in the success of IOT. Security framework has to be strengthened to get the best out of this methodology.

REFERENCES

[1] Azori, luigi; iera, antonio; morabito, giacomo. The internet of things: a sur- vey. Computer networks, v. 54, doi.10.1016/comnet.2010.05.010.

[2] http://www.cisco.com/c/en/us/solutions /internet-of-things/overview.html.

[3] https://www.forbes.com/sites/louiscolumbus/2018/12/13/2018-roundup-of-internet-of-things-forecasts-and-market-estimates/#426efb2d7d83

[4] Y. Lu, X. Li, J. Zhong and Y. Xiong, "Research on the Innovation of Strategic Business Model in Green Agricultural Products Based on Internet of Things (IOT)", 2010 2nd International Conference on E-business and Information System Security, 2010. Available: 10.1109/ebiss.2010.5473338

[5] Qian Xiaocong and Zhang Jidong, "Study on the structure of “Internet of Things(IOT)” business operation support platform", 2010 IEEE 12th International Conference on Communication Technology, 2010. Available: 10.1109/icct.2010.5688537

[6] F. Berkers, M. Roelands, F. Bomhof, T. Bachet, M. van Rijn and W. Koers, "Constructing a multi-sided business model for a smart horizontal IoT service platform", 2013 17th International Conference on Intelligence in Next Generation Networks (ICIN), 2013. Available: 10.1109/icin.2013.6670903

[7] M. Ide, Y. Amagai, M. Aoyama and Y. Kikushima, "A Lean Design Methodology for Business Models and Its Application to IoT Business Model Development", 2015 Agile Conference, 2015. Available: 10.1109/agile.2015.8

[8] M. Bagheri and S. Movahed, "The Effect of the Internet of Things (IoT) on Education Business Model", 2016 12th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS), 2016. Available: 10.1109/sitis.2016.74

[9] J. Ju, M. Kim and J. Ahn, "Prototyping Business Models for IoT Service", Procedia Computer Science, v0l. 91, pp. 882-890, 2016. Available: 10.1016/j.procs.2016.07.106

[10] A. Onasanya and M. Elshakankiri, "IoT Implementation for Cancer Care and Business Analytics/Cloud Services in Healthcare Systems", Proceedings of the10th International Conference on Utility and Cloud Computing - UCC '17, 2017. Available: 10.1145/3147213.3149217

[11] U. Raza, J. Lomax, I. Ghafir, R. Kharel and B. Whiteside, "An IoT and business processes based approach for the monitoring and control of high value-added manufacturing processes", Proceedings of the International Conference on Future Networks and Distributed Systems - ICFNDS '17, 2017. Available: 10.1145/3102304.3102341

[12] A. Ali, I. El-Dessouky, M. Abdallah and A. Nabih, "The Quest for Fully Smart Autonomous Business Networks in IoT Platforms", Proceedings of the 3rd Africa and Middle East Conference on Software Engineering - AMECSE '17, 2017. Available: 10.1145/3178298.3178301

[13] F. Martins and D. Domingos, "Modelling IoT behaviour within BPMN Business Processes", Procedia Computer Science, vol. 121, pp. 1014-1022, 2017. Available: 10.1016/j.procs.2017.11.131

[14] S. Mahendra, M. Sathiyanarayanan and R. Vasu, "Smart Security System for Businesses using Internet of Things (IoT)", 2018 Second International Conference on Green Computing and Internet of Things (ICGCIoT), 2018. Available: 10.1109/icgciot.2018.8753101

[15] K. Routh and T. Pal, "A survey on technological, business and societal aspects of Internet of Things by Q3, 2017", 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU), 2018. Available: 10.1109/iot-siu.2018.8519898

[16] K. Saraubon, N. Kongsanit and N. Santawesuk, "IoT & Mobile-based System for Business", Proceedings of the 2018 2nd International Conference on Software and e-Business - ICSEB '18, 2018. Available: 10.1145/3301761.3301768

[17] A. Aagaard, M. Presser and T. Andersen, "Applying Iot as a leverage for business model innovation and digital transformation", 2019 Global IoT Summit (GIoTS), 2019. Available: 10.1109/giots.2019.8766397

[18] N. Chandra, S. Khatri and S. Som, "Business Models Leveraging IoT and Cognitive Computing", 2019 Amity International Conference on Artificial Intelligence (AICAI), 2019. Available: 10.1109/aicai.2019.8701287

[19] I. Lee, "The Internet of Things for enterprises: An ecosystem, architecture, and IoT service business model", Internet of Things, vol. 7, p. 100078, 2019. Available: 10.1016/j.iot.2019.100078

[20] V. Tsiatsis, S. Karnouskos, J. Höller, D. Boyle and C. Mulligan, "IoT – A Business Perspective", Internet of Things,

pp. 31-47, 2019. Available: 10.1016/b978-0-12-814435-0.00014-6

[21] http://www.iot.qa/2017/11/what-is-iot-platform.html

[22] https://enterprise.affle.com/blog/iot-internet-of-things-healthcare-smarthome-enterprise/

[23] https://iot.eclipse.org/resources/white-papers/Eclipse%20IoT%20White%20Paper%20-%20The%20Three%20Software%20Stacks%20Required%20for%20IoT%20Architectures.pdf

[24] http://www.enterox.com/IoT/articles/enterprise-internet-of-things.htm

[25] https://www.enterprisemobilityexchange.com/eme-big-data-analytics/articles/iot-devices-guide

[26] https://dzone.com/articles/iot-for-business-enterprises-attributes-challenges