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A GENTLE INTRODUCTION OF SERVICE-ORIENTED ARCHITECTURE IN DEVELOPMENT OF LEADING TECHNOLOGIES

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Abstract: *Service-Oriented Architecture is a technique which can be employed to unite various services over the operating systems, platforms and networks. Several organizations fail to completely use SOA and the reason behind this is underdeveloped adoption process. The author has conducted an exploratory study to explore the recent concerns and numerous practices related with SOA adoption along with assessing various maturity levels used, role of information technology in SOA adoption. The required information is gathered by conducting a literature survey that explored the previously done work on SOA adoption by surfing through the net, reading journals and papers. The paper focuses on various significant issues related with adoption of SOA in organizations.*

Keywords: *Service-Oriented Architecture.*

I. INTRODUCTION

SOA has obtained a huge scrutiny in line with the heading towards overcoming challenges related with enhancement and sustenance of varied environments [1]. Switching from a traditional system to all new SOA-based system in order to upgrade the organisations software system has become a trend [2].
Now a days, various studies have pointed the advantages of implementing SOA in the growth of recent leading advancements like Cloud Computing [4,7], the IoT [3,8] and micro services [5]. The reason behind this is its service-based modular architecture; SOA renders flexibility in integration and reusability of service [6]. As SOA capsulize many applications and data sources in the form of a black box, it provides complete transparency .SOA is an architecture that is built on shared, reusable, networked services where all the services are business functions. It seamlessly unites different technologies over Web a service that permits different kind of systems and platforms to interact with each other using a common language without any customized interface.

So far, with respect to the industrial sectors, SOA has manifested to be one of the major paradigms in varied industries like banking, health, transport and many more. Even after realizing its advantages, some primary studies have exposed that organisations are still not able to understand the boon of SOA adoption. Lack of knowledge regarding the CSFs for SOA adoption and its deployment are the under lying reasons of failure [9].

1.1 Service-Oriented Architecture

Some of the researchers have explained SOA on the basis of varied perspectives like technology, architecture, business etc, so there is no definite definition for the said term. SOA is not a technology or a product or a solution which could handle the convolution of IT. Also, SOA does not ensure that all the existing challenges related to IT industry can be solved by implementing this. However, this could be claimed that Service Oriented Architecture is a concept that will be beneficiary in business, Information Technology industry and enterprises. [10]. SOA can be also be defined as an architectural concept that accelerates the loose coupling, reusability, modularity, interoperability, agility, efficiency as a service. These services are properly defined and provided as the separate units of standard functionality which are joined with each other to create an integrated business process.

Tang et al. (2019) [13] conducted a study in which he stated that SOA could be unified with healthcare technologies, wireless network technologies, RFID

technology, and also with Internet procedures to develop advanced automations. However, Gupta et al.(2018) [8] conducted another study and said that since SOA offers performance measurement, Attack revelation, and business intelligence, numerous IoT essentials could be satisfied by deploying the SOA approach. In study carried out by another researcher, Alsaryrah et al. (2018)[3] focussed that SOA has identified as the major enabler of IoT. Further, they discussed that the unification of IoT based services with SOA will increase the capability of advance IoT based applications by joining small services to give novel abilities.

Further advantages of practising SOA in business organisations incorporates decreased costs, increased returns on the investment, unification of essential services and traditional systems, reuse of existing services, and enhanced adjustment between businesses and Information Technology [10,11].

Yoon and Carter (2007)[12] emphasized the significance of IT in business by analysing numerous case studies. The outcomes of this study depicted the two advantages rendered by SOA's deployment in business organisations, the first is enhanced agility of business and other is the declined costs associated. The first stated benefit could be attained by the rapidly responding to the changes in the market and requirements of the customers. However by lessening the cost and time associated with the development of application, the reduced operational costs and reemploying the existing already developed applications also reduce the costs helps in cost reduction [12].

The web services give a compiled bunch of functionalities that can be used as an interface which are present through the internet [18]. These services are often present as standard XML format called WDSL. The Central repository known as UDDI, publishes in detail the services offered by the providers and can be accessed by service user. An agreement stated as SLA is done between the service providers and the service requesters after the service is selected by the customer [18].The various benefits attained by the Industry by implementing the SOA are platform independence, loose coupling, cost reduction, lessen development time, reemployment of earlier developed things and integration [19].

For exploration of the topic in detail, our study gives attention in searching the answers the following stated questions:

RQ1. What primary studies are conducted on SOA in the domain of IS?

RQ2. What are the various conceptual models that are focussed in recent research?

RQ3. What are the crucial factors that impact SOA's deployment in organisations?

RQ4. What are the research gaps, constraints, and future scope of the technology?

The researchers have conducted detailed exploration of recent researches to find answers of these questions. The outcomes of the study extends a contribution to the previously conducted research by enlisting of the important factors that impact the implementation of SOA figured from the cases studied and surveys conducted. This study adopts the two-step approach that is used by Busalim and Hussin (2016). To complete the first type i.e. automatic search, a string for search was defined based on the keywords used in research questions. The major keywords used were "SOA", "Information Systems", and "influential factors" and the operators "OR" and "AND" were applied to join these keywords, their synonyms, and few other associated terms.

Further, after conducting many tests, the below stated search string was chosen. The search string used was: (SOA or "Service-Oriented architecture", or "Web Services") & ("Information Systems" or "IS") & ("adoption" or "migration", or "legacy systems") & ("critical success factors" or CSF or "success factors" or "significant factors" or "influential factors"). To implement these keywords, Elsevier's Scopus database, one of the biggest databases, for peer-reviewed conferences and journals at international level in the field of IT was referred.

1.2 SOA Benefits

One of the prominent advantages associated with SOA technology are the reusability and its agile nature quoted the author Grigoriu [14]. The approach of SOA is enhanced at a slow pace, resulting in attaining no or very late agility. The reusability of technology required to redesign is quite expensive. The fact is that the reusability of business processes is far more important than reusability of IT services. SOA ascertains the similar business processes and activities and unites together in a group and renders them as a service. By diminishing the process replication SOA reduces the application duplication process[14].

As per another author Jayashetty and Kumar [15], SOA enhances the revenue by increasing the business agility by embracing improved modified models of business and by presenting the new products and facilities in correct time. The technology also decreases the cost associated by isolating the applied features from the consumers, by upgrading the reusability of existing things and by reducing the unwanted replication in the system. Yoon and Carter [12] conducted a study in

which they presented the benefits of choosing Service Oriented Architecture. In this case study, authors focussed on the impact of deploying SOA from the point of view of business. The researchers divided the advantages of SOA adoption into two groups: business agility and associated costs. Group of another authors Newcomer and Lomow [16]elaborated the blessings offered by Service Oriented Architecture. Further, the author talked about the dissimilarities between the technical and the business benefits. The benefits related to business (excluding increased customer satisfaction) are enveloped by the classification by Erl. The technical benefits enlisted by Newcomer and Lomow are related to "reduced IT burden" benefit by Erl [17].

II.   SOA TECHNOLOGIES

Web service is categorized as the most favoured technology to implement SOA. Web service details a standardized way for the integration of applications based on webby utilizing the technologies like SOAP, XML, WSDL and UDDI.

WS is a section of the software which acts with set of standards. The standards enable and support the world wide interpretability of computers systems regardless of the operating systems being used, underlying hardware platform, programming language being used, deployed infrastructure of the network in use etc. The three interconnected XML-based standards that form the foundation of XML are SOAP, WSDL and UDDI. The web services basically interchange messages through SOAP. Services that require many interfaces and description language can be invoked to do business processes through WSDL. All interactions are independent from each other. Network Transparency determines the ability of a WS to work on any network at any place with negligible effect on its performance. Web services extends its various characteristics as services, it also renders the flexibility to the websites over the internet. This is applicable to any computer system that is associated to network using the internet protocols. Web services are systematized and structured techniques to implement SOA. The available standards and the infrastructural support has finally made web services based SOA application possible [21].

2.1 Extensible Markup Language (XML)

The WWW Consortium has stated XML as a markup language based on text. In Contrary with Hyper Text Markup Language, that applies tags for demonstrating the performance, XML is used for the describing the ordered data that is portable. It is used as a language for defining DDL i.e. data description language like

grammars, mark-ups, vocabularies, exchange formats and various protocols for messaging [22].

XML offers many other advantages as well. Few of the advantages include unification of data of an organization collected from varied sources, the adjustable connection between objects and its application, simple at the same time powerful description information management. The stated benefits and other advanced technologies along with SOA provide a great dynamic e-business solution [22].

2.2 Simple Object Access Protocol (SOAP)

The Simple Object Access Protocol is based on XML for interchanging the information or messages in a distributed environment. It is a protocol used for messaging that transfers the information between applications or systems in a structured way. The requesting objects prepare the objects in an OOP fashion make a distant method request. User Land, IBM, Lotus, Develop Mentor and Microsoft are some SOAP requirement providers. SOAP form the grounds of decentralized object communication in vendor implementations. SOA do not present a messaging protocol. SOAP is vendor-neutral, this permits its implementation to be done independent of the platform, programming language and operating system, and however this adds to its advantages. On the other hand data-encoding techniques, binding strategies, and transport implementations are dependent [20–22].

2.3 Web Services Description Language (WSDL)

It is a XML word that readies a standard system of explaining administration IDLs. A combination of movement between NASSL and SDL (Microsoft) [20] results in WSDL. It presents a simple route for specialist co-ops to clarify the format of ask for and react messages for remote technique summons (RMI). WSDL drives this title of administration IDLs autonomous of the major convention and encoding necessities. A dynamic language for clarifying the activities of a help with information types and specific parameters is set up by WSDL. The portrayal of the setting and restricting highlights of the administration are tended to by the language also [21, 22].

2.4 UDDI

A group of SOAP Application Programming Interfaces that authorizes the completion of a service mediator is offered by the UDDI. In order to construct the pavement of enhancing the description, discovery, and integration of web-based services, the UDDI standards were cleared by IBM, Microsoft, and Ariba. In order to know and recognize the attributes of SOA, it is better to figure out the components of the SOA that execute mutually. A service offered develops a web service and

its detailed explanation and publishes the web service in UDDI.A service requester identifies the service using the UDDI connection once it is published. The UDDI then creates and provides the requester with desired WSDL service explanation and a URL for referring to the service. In the end, the service requester invokes the service by using the data to connect it [22]. The architecture of web service is shown in Fig. 1.
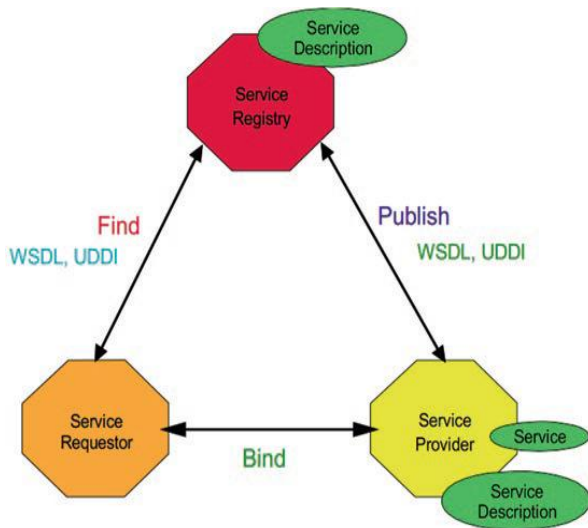

Figure 1: Web services roles, operations, and artifacts

III. SOA ADOPTION CHALLENGES AND PROBLEMS

SOA adoption is much different from application development that is a short term process. Indeed, it is a long journey for a business organization to attain some significant advantages related to SOA's deployment. Some vendors hold the opinion that SOA can be frequently and simply applied with the supported products. SOA adoption is an incremental process [23]. Contrary, SOA is incomplete and not problems free. Few statements like "SOA is dead" [24] and "SOA is a failure" [25] can be encountered over the Internet. Reason for such statements is that SOA is focused on creating design strategies to instruct developers how to generate services. The association with business goals cannot be developed; aims cannot be defined. Even though few standards have evolved to service the requirements of the management [26], the standardized SOA is not properly equipped to define that ina consistent manner [27].

The bewilderment of SOA and numerous overlapping and competing specifications are described as the problem domains for organizations that implemented SOA[20]. Further, when it comes to unification using SOA, the convolution disturbs many physical resources that are needed to address unification and affecting the complete project implementation [28].

SOA Adoption is not straightforward, many issues occur like under developed standards and inappropriate information [29]. Organisations have some arguments among them related to the disappointment for implementing SOA, let us say, the lack of planning, information related to available services, standards, and governance [30]. Other problems of implementing SOA are the misunderstanding of the similarities and dissimilarities between the distributed architecture and SOA, misinterpretation of the requirements related to SOA adoption. Reasons behind the failure behind the adoption of SOA by a firm can be its deployment without any clear strategic planning, without adopting different standards, without employing XML [2].

Applying WSDL and XML interoperability within the services by diverse organizations is assured. Web services also employ XML for the arrangement of information. Web services lay determined restrictions like lack of declaring semantic data. This means there is no adequate information related to provide service. Moreover, interoperability requires semantic along with syntactic agreements to grow.

Similar to the other applications, the quality may vary. It is essential to remember the changes that are required along with the attitude to choose and implement SOA. There is always a chance that some wrong service-centered architecture is created unconsciously and unintentionally. An author Erl [17] stated some frequently and usually made mistakes.

IV. SUMMARY

The awareness related to the impact of SOA's adoption and deployment in organization is not enough. For attaining the first objective of the study, author has explored a large number of earlier studies that are associated with SOA's adoption and the impact of SOA adoption on business organizations. SOA definitions and advantages are presented briefly. Further, web service is stated as the foremost technology for implementing SOA is elaborated and its various related standards like XML, WSDL, SOAP, UDDI are described.
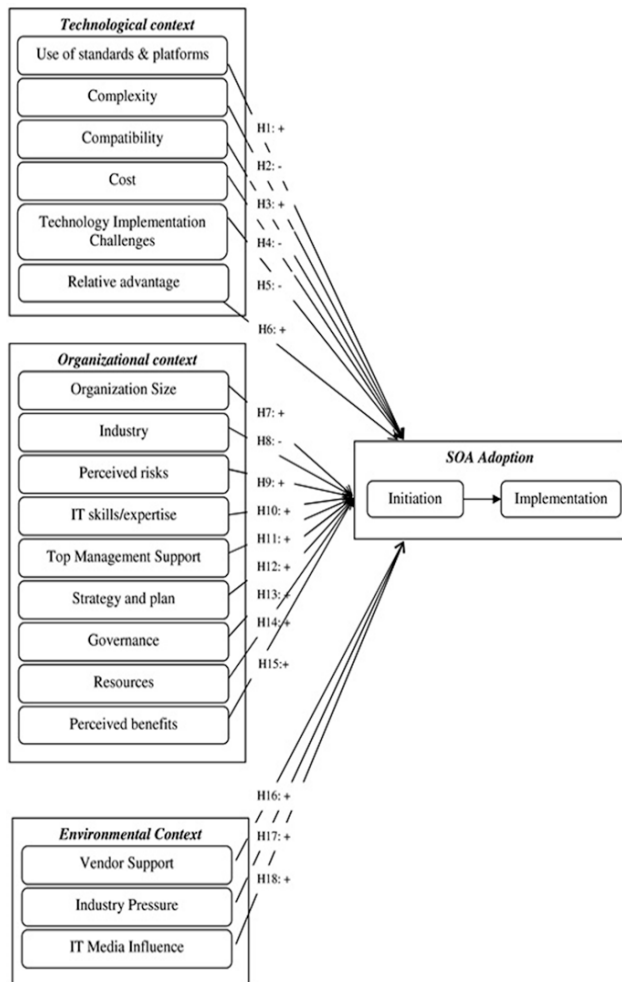
Figure 2: Model for adopting SOA based on TOE framework

ABBREVIATIONS:

CSFs: Critical Success Factors
IoT: Internet of Things
RFID: Radio-Frequency Identification
SLA: Service Level Agreement
SOA: Service-Oriented Architecture
SOAP: Simple Object Access Protocol
UDDI: Universal Description, Discovery, and Integration
WDSL: Web Service Definition Language
WSDL: Web Services Description Language
XML: Extensible Markup Language

REFERENCES

[1]. Shaheen, M., Anees, T., Hussain, N., & Obaid, I. (2019). A research on SOA in the IT industry of Pakistan. ACM International Conference Proceeding Series, Part F1482, 149–154. https://doi.org/10.1145/3323933.3324080

[2]. Abdellatif, M., Hecht, G., Mili, H., Elboussaidi, G., Moha, N., Shatnawi, A., … Guéhéneuc, Y.-G. (2018). State of the Practice in Service Identification for SOA Migration in Industry. In Service-Oriented Computing. ICSOC 2018. Lecture Notes in Computer Science (Vol. 11236, pp. 634–650). Springer, Cham. https://doi.org/10.1007/978-3-030-03596-9_46

[3]. Alsaryrah, O., Mashal, I., & Chung, T.-Y. (2018). Energy-aware services composition for Internet of Things. In 2018 IEEE 4th World Forum on Internet of Things (WF-IoT) (Vol. 2018-Janua, pp. 604–608). IEEE. https://doi.org/10.1109/WF-IoT.2018.8355213

[4]. Hayet, T., & Knani, J. (2019). SOAP-Based Web Service for Localization of Multi-robot System in Cloud. In Advances in Intelligent Systems and Computing (Vol. 857, pp. 398–410). Springer, Cham. https://doi.org/10.1007/978-3-030-01177-2_29

[5]. Rodríguez, G., Díaz-Pace, J. A., & Soria, Á. (2018). A case-based reasoning approach to reuse quality-driven designs in service-oriented architectures. Information Systems, 77, 167–189. https://doi.org/10.1016/j.is.2018.06.003

[6]. Hirschheim, R., Welke, R., & Schwarz, A. (2010). Service-oriented architecture: myths, realities, and a maturity model. MIS Quarterly Executive, 9(1), 37–48.

[7]. Puttonen, J., Lobov, A., Soto, M. A. C., & Lastra, J. L. M. (2019). Cloud computing as a facilitator for web service composition in factory automation. Journal of Intelligent Manufacturing, 30(2), 687–700. https://doi.org/10.1007/s10845-016-1277-z

[8]. Gupta, P., Mokal, T. P., Shah, D. D., & Satyanarayana, K. V. V. (2018). Event-Driven SOABased IoT Architecture. In International Conference on Intelligent Computing and Applications. Advances in Intelligent Systems and Computing (pp. 247–258). Springer, Singapore. https://doi.org/10.1007/978-981-10-5520-1_24

[9]. Emadi, S., & Hanza, R. H. (2013). Critical Factors in the Effective of Service-Oriented Architecture. Advances in Computer Science: An International Journal, 2(3), 26–30.

[10]. Marks, E. A. E., & Bell, M. (2008). Service Oriented Architecture (SOA): a planning and implementation guide for business and technology. John Wiley & Sons. John Wiley & Sons.

[11]. Koumaditis, Konstantinos, Themistocleous, M., Mantzana, V., & Souliotis, K. (2012). A Proposition of Critical Success Factors Influencing SOA Implementation in Healthcare. In European Conference on Information Systems (ECIS). AIS Electronic Library (AISeL).

[12]. Yoon, T., & Carter, P. E. (2007). Investigating the antecedents and benefits of SOA implementation: A multi-case study approach. AMCIS Proceedings, Paper 195

[13]. Tang, L.-L., Chan, Y., & Shen, S.-L. (2019). Investigating radio-frequency identification usage behaviours and organisational performance according to factors of user perception. International Journal of Services Technology and Management, 25(3/4), 199.

[14]. A. Grigoriu, SOA, BPM, EA, and Service Oriented Enterprise Architecture BPTrends, www. bptrends.com, 2007

[15]. S. Jayashetty, P. Kumar, Adopting Service Oriented Architecture increases the flexibility of your enterprise, 2006.

[16]. E. Newcomer, G. Lomow, Understanding SOA with Web Services (Independent Technology Guides). Addison-Wesley Professional, 2004.

[17]. T. Erl, Service-Oriented Architecture Concept, Technology and Design (Pearson Inc., Upper Saddle River, 2005)

[18]. Tsai et al. (2006). "Perspectives on Service-Oriented Computing and Service-Oriented System Engineering", Proceedings of the Second IEEE International Symposium

on Service-Oriented System Engineering (SOSE'06), pp. 505-512.

[19]. Bano, M. and N. Ikram. (2011), "KM-SORE: knowledge management for service oriented requirements engineering", 6th International Conference on Software Engineering Advances ICSEA, pp. 129-136.

[20]. C. Lawrence, Adapting legacy systems for SOA, Online, June, 2007

[21]. OASIS, Reference Model for Service Oriented Architecture 1.0, OASIS Standard, 2006

[22]. J. Bih, Service oriented architecture (SOA) a new paradigm to implement dynamic e-business solutions. Ubiquity 2006, 4 (2006)

[23]. S. Mulik, S. Ajgaonkar, K. Sharma, Where do you want to go in your SOA adoption journey? IT Prof. 10, 36–39 (2008)

[24]. A. T. Manes, SOA is dead; long live services, Burton Group, 2009. [Online]. Available: https://www.brighttalk.com/webcast/126/1722/soa-is-dead-long-live-services. [Accessed: 18-Mar-2010]

[25]. F. Kenney, Ahh Shucks, SOA Is A Failure, 2008. [Online]. Available: http://blogs.gartner.com/frank_kenney/2008/11/12/%0Aahh-shucks-soa-is-a-failure/. [Accessed: 14-Aug-2010]

[26]. OASIS, Web services distributed management: management of web services (WSDM-MOWS) 1.0, OASIS-Standard, March, 2005

[27]. M. Hiel, H. Weigand, W.-J. Van Den Heuvel, Enterprise Interoperability III (Springer, London,2008), pp. 197–208

[28]. J.H. Lee, H.-J. Shim, K.K. Kim, Critical success factors in SOA implementation: an exploratory study. Inf. Syst. Manag. 27, 123–145 (2010)

[29]. S. Tilley, J. Gerdes, T. Hamilton, S. Huang, H. Müller, D. Smith, K. Wong, On the business value and technical challenges of adopting web services. J. Softw. Maint. Evol. Res. Pract. 16, 31–50 (2004)

[30]. M. Ren, K. K. Lyytinen, Building enterprise architecture agility and sustenance with SOA, Cais, 27 (4), 75–86 (2008)

[31]. L. Cherbakov, M. Ibrahim, J. Ang, SOA Antipatterns: The obstacles to the adoption and successful realization of service-oriented architecture, 2006. http://www.ibm.com/developerworks/ webservices/library/ws-antipatterns/. Accessed: 01-Feb-2010

[32]. IBM Global services, Five best practices for deploying a successful service-oriented architecture(2008),http://viewer.media.bitpipe.com/1033409 397_523/1212083066_235/wp_fivebest- practices-for-deploying-successful-soa.pdf. Accessed 27 Nov 2012

[33]. K. Holley, J. Palistrant, S. Graham, Effective SOA governance IBM White Paper, IBM Corporation, March 2006.

[34]. P. Kaur, S. Chatterjee, and D. Singh, "Neural network technique for diabetic retinopathydetection," Int. J. Eng. Adv. Technol., vol. 8, no. 6, pp. 440–445, 2019.

[35]. Hooda, N., Bawa, S., & Rana, P. S. (2018). B2FSE framework for high dimensional imbalanced data: A case study for drug toxicity prediction. *Neurocomputing*, *276*, 31-41.

[36]. Hooda, N., Bawa, S., & Rana, P. S. (2018). Fraudulent firm classification: a case study of an external audit. *Applied Artificial Intelligence*, *32*(1), 48-64.

[37]. Hooda, N., Bawa, S., & Rana, P. S. (2020). Optimizing Fraudulent Firm Prediction Using Ensemble Machine Learning: A Case Study of an External Audit. *Applied Artificial Intelligence*, *34*(1), 20-30.

[38]. Bhardwaj, R., & Hooda, N. (2019). Prediction of Pathological Complete Response after Neoadjuvant Chemotherapy for breast cancer using ensemble machine learning. *Informatics in Medicine Unlocked*, *16*, 100219.

[39]. Gupta, R., Rao, U.P.: Achieving location privacy through CAST in location based services. Journal of Communication Network 19(3), 227–238 (2017)

[40]. Gupta, R., Rao, U.P.: VIC-PRO: Vicinity protection by concealing location coordinates using geometrical transformations in location based services. Wireless Personal Communication 107(2), 1041–1059 (2019)

[41]. Gupta, R., Rao, U.P.: A hybrid location privacy solution for mobile lbs. Mobile Information System, 2017 (2017)

[42]. Gupta, R., Rao, U.P.: An exploration to location based service and its privacy preserving techniques: A survey. Wireless Personal Communication 96(2), 1973–2007 (2017)

[43]. Gupta, R. and Rao, U.P.: Preserving location privacy using three layer RDV masking in geocoded published discrete point data. *World Wide Web*, *23*(1), pp.175-206 (2020)

[44]. S. Singh, M. Singh, C. Prakash, M. K. Gupta, M. Mia, and R. Singh, "Optimization and reliabilityanalysis to improve surface quality and mechanical characteristics of heat-treated fusedfilament fabricated parts," Int. J. Adv. Manuf. Technol., vol. 102, no. 5–8, pp. 1521–1536,2019.