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An Elaborate Discussion on the Fundamental Concepts and Understandings of Service-Oriented Architecture: A Literature Review

Asma Joshita Trisha[1], Md. Neamul Haque[2], Kazi Ekramul Hoque[3]

Abstract

In today's digital world, we can't think about a moment without the virtue of mighty computer technology. Even in this modern era, we depend on various computer services. Well-organized service architecture has become essential to provide better software and application programs. Service-Oriented Architecture more precisely indicates the word "Service." Its primary concern is to develop such an architecture that provides services according to the demand of the users by maintaining its different parameters in optimal condition. Mainly Service-Oriented Architecture (SOA) delivers services to the component that requests the service where service is a method that is complete, independent, and only externally visible to the requester. Many aspects of SOA are available. In this review paper, we have focused on the illustrated structure and research area of SOA.

Keywords: Service-Oriented Architecture (SOA), Software, Application, Interface, Performance.

1. Introduction

Service-oriented architecture has its main focus on services. It is a software design style in which services are provided through communication and protocol to other components over a network by the service provider. To meet the customer's changing requirements, SOA is a mode of organizing software to facilitate companies so that they can respond swiftly. This technology is grounded on services, which are personalized units of software. It is also a fast-growing architectural style for integrating and developing different

[1]Asma Joshita Trisha
Assistant Professor, Department of Computer Science & Engineering, Premier University
Email: joshita.cu@gmail.com

[2]Md. Neamul Haque
Lecturer, Department of Computer Science & Engineering, Premier University
Email: neamul17@gmail.com

[3]Kazi Ekramul Hoque
Lecturer, Department of Computer Science & Engineering, East Delta University
Email: hoque.ekramul17@gmail.com

enterprise applications. There are several goals of SOA. One of the main goals is to support business solutions regarding companies and industries (Hamzah, Baharom & Haslina, 2019). It can provide a definite way to the business base to meet their IT demands through structured service (Marks & Bell, 2006). This can be changed according to the demand of the customers and also can be extended. Moreover, it provides a way to add the new components in the existing system without incurring the language, environment, or operations. Mainly it stands on the concept of reusing component-based software (Mahmood, 2007).

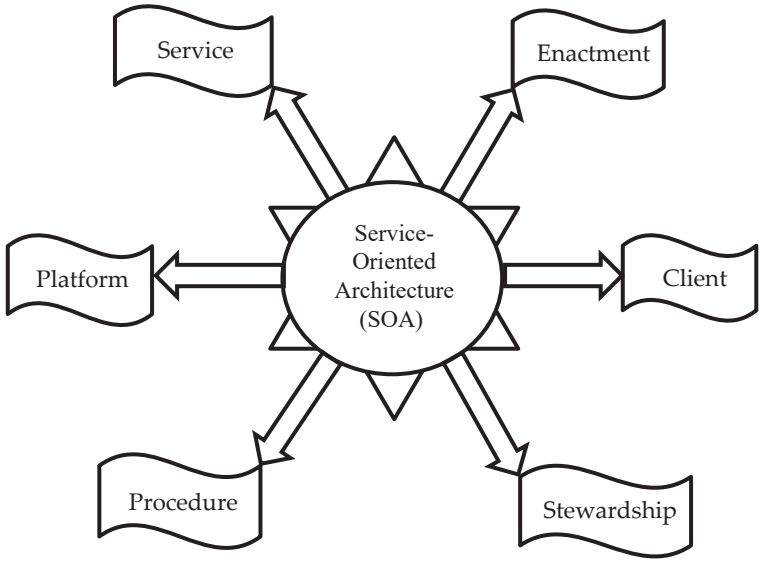

Figure 1: Overview of SOA (Erickson & Siau, 2009)

In figure 1, an overview of SOA has been shown. This figure resembles the critical factors of service-oriented architecture.

This article aims to deliver an entire concept on SOA. Here, at first, we discuss the key elements with its working procedure and the structure of SOA. Then in the fourth and fifth sections, we mention the basic principle and sectors for implementing SOA. After that, in the sixth and seventh sections, we discuss the advantages and disadvantages of it. In the last quarter, we present a discussion and conclude the article.

2. Related works

As SOA is the buzzing service in today's technology-based world, massive research is ongoing over it. This section provides an overview of some

related works on SOA regarding multimedia teaching platforms, digital gaming, emergency communication processing, IoT, and MSOA. Discussion-based works have been included on characteristics, reusability, scalability, advantages, and future directions of SOA.

Table 1: Overview of some of the most recent research works on SOA

Reference	Publcation's Title	Theme
(Liu, 2020)	Design and implementation of multimedia teaching platform based on SOA architecture.	Designed a multimedia platform for teaching indoor instruments of music.
(Cokro, Firmantyo, Dzaka, Putra & Wang, 2020)	SOA Architecture for Games Digital Distribution	Enhance the performance of digital distributed games for both user and server ends.
(Wang, Li & Yang, 2021)	Functional Requirements Analysis of Militia Emergency Communication Equipment Based on SOA Architecture	Improved the effectiveness and efficiency of emergency communication processing.
(Liu & Xia, 2020)	Research on Software Development Method Based on SOA Architecture	Discussion on characteristics and advantages of SOA.
(Li, 2019)	Design of B2B E-commerce Platform Based on SOA Architecture	Discussed about the reusability and scalability of the software.
(Gupta, Mokal, Shah & Satyanarayana, 2018)	Event-Driven SOA-Based IoT Architecture	Focused on the challenges of maintaining the scalability and throughput of IoT devices.
(Mohsin & Janjua, 2018)	A review and future directions of SOA-based software architecture modeling approaches for System of Systems	Showed the classification of software architecture's different modeling approaches, comparing and defining them using criteria crucial for the realization of SoS.
(Niknejad, Ismail, Ghani, Nazari, Bahari & Hussin, 2020)	Understanding Service-Oriented Architecture (SOA): A systematic literature review and directions for further investigation	TOE (Technology Organization Environment) is adopted along with SOA.
(Zhao, Chen, Zhang, Liang, Wang & Huang, 2018)	SOA Patterns Selection and Application Based on Software Quality Requirements	Survey and analysis on quality requirements, specified twenty-one requirements which are commonly used.
(Qadri & Hussaan, 2018)	SOA vs MSOA Comparative Analysis	Elaborated discussion between MSOA (Micro Service Oriented Architecture) and SOA, their characteristics, effectiveness etc.

3. Key elements of SOA

Service-Oriented Architecture consists of four key elements. In figure 2, all the key elements are indicated with their hierarchy and the origin of the working procedure flow. These necessary elements are briefly described below:

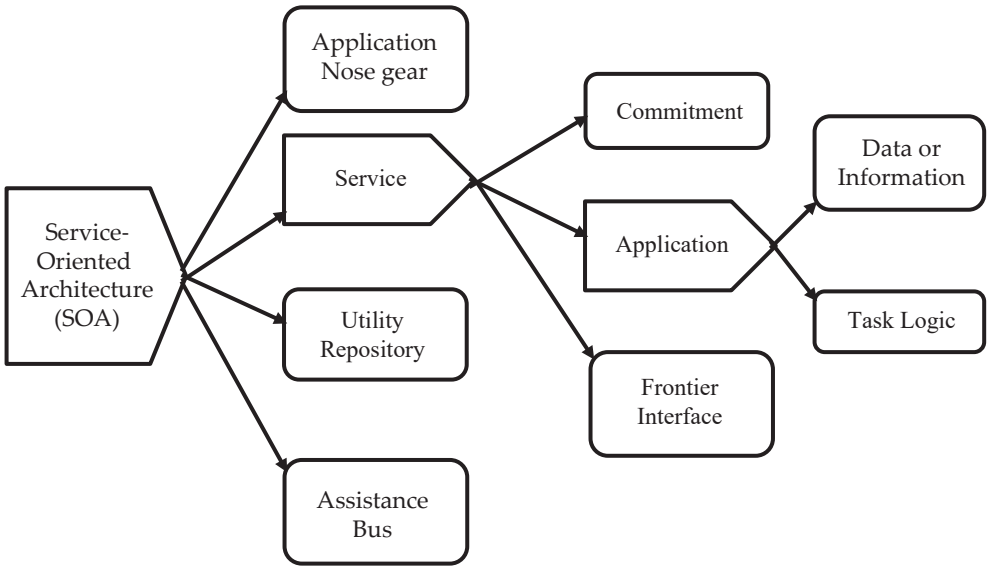

Figure 2: Key elements indication of SOA (Meyer, 2014).

3.1 Application Nose gear

It delivers the values of SOA to the end-users or service consumers. From the above diagram (Figure 2), it is clear that this phase stays in the first layer of key elements of SOA.

3.2 Service

A service is an autonomous unit of functionality. It is generally loosely coupled and can be reused, changed, and moved without changing the basic functionality. It is offered by a service provider. A service has mainly four properties given as follows:

i. It logically represents an activity with specific outcome.
ii. It is complete and independent.
iii. It is only externally visible to its clients.
iv. It may have been composed of other services (Service-Oriented Architecture – What Is SOA, 2016).

3.2.1 Commitment

The Service-Oriented Architecture (SOA) provides an arrangement of the impetus and activities. This arrangement helps to understand the scope and benefits. It also sets up the terms and conditions for different organization policies and customer services. Moreover, the Service-Oriented Architecture arranges the applications of services.

3.2.2 Frontier interface

The Service-Oriented Architecture (SOA) provides an arrangement of the demands, to-do lists, conditions, and limitations. According to the demands of the customers, an organization can select its functionality and can determine its constraints and policies for obtaining success.

3.2.3 Application

In the Service-Oriented Architecture (SOA), the service implementation part is very crucial because necessary business ideas, policies, and logic are provided in it. The appropriate and suitable data for business is gathered in this part of architecture. The SOA has at least one of the artifacts among data or information, databases, and programs or instructions.

3.3 Utility Repository

This part keeps the trace of the services and records their details which includes access rights, operations, owner, qualities that the service provider provides. This is one of the very crucial elements of the Service-Oriented Architecture system. Its working procedure is also shown in the figure (Figure 3.1) below.

3.4 Assistance Bus or Integrator of service

A piece of communication equipment that is changeable, combines and gathers applications and utilities. For doing such things, it routes messages. Moreover, it not only transforms various rules and regulations between customer and service but also manages the internal communication among applications, etc.

4. Concepts and structure of SOA

There are mainly three high-level components in SOA that deal with service. They are described as follows:

i. Service Pleader: A service seeker or customer fetches service details in the service registry, then packets and sends requests to the service for the response (Mohammadi, 2017; Duan, Narendra, Du, Wang & Zhou, 2014).

ii. Service Supplier: He promulgates service details from the service registry and administers the application of the service very carefully (Mohammadi, 2017; Duan et al., 2014).

iii. Service list directory or negotiator of service: He provides the service details or registry. Service registry means the list of all services and service providers with a description. But the service seller or broker is not mandatory (Duan et al., 2014). As a result, the service receiver can experience disruption of service unswervingly from the service supplier.

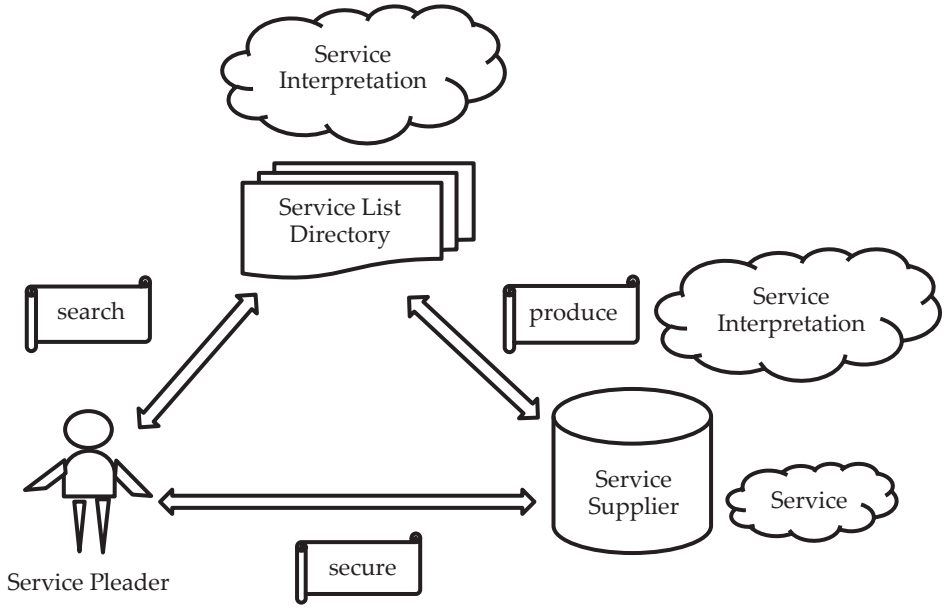

Figure 3: Structure of SOA (Mohammadi, 2017; Dan, Shi, Tao, Xiang-Yang, Zao-Qing, & Jun-Feng, 2006)

The above figure 3 shows the simplest form of service-oriented architecture. Usually, SOA systems have many service Consumers and providers from whom many consumers act as a provider. Thus, it is more complicated in detail design. Nevertheless, the basic principles are the same.

5. Basic principles of SOA

Though there are not any industry standard for construction of service-oriented architecture (Valipour, Amirzafari, Maleki, & Daneshpour, 2009), but the following ideas are the roots of SOA that later guided to the principles of SOA:

i. Reuse: A service functionality that can be reused in the future.

ii. Modularity: Any system composed of several components that can be connected together.

iii. Interoperability: It is the capability of a system to exchange and make use of information from different environments.

iv. Global Standard: It is the set of protocols and architecture that everyone has to use to develop their own system.

v. Service groupings and credentials: Creating a category for services and a detailed description of every service in a repository. In order to assist the consumer where he can fetch service and the description of the services.

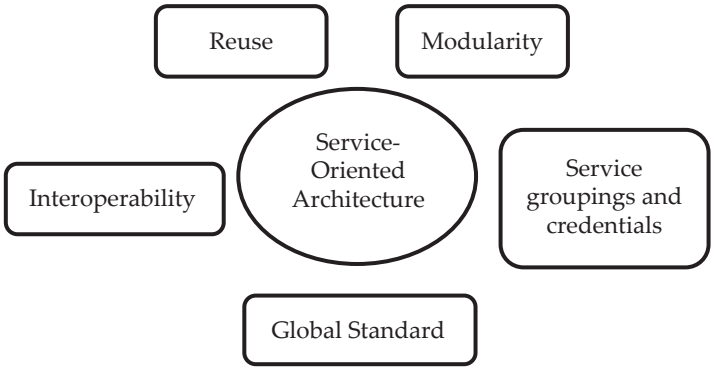

Figure 4: Basic and key principle of SOA (Bean, 2010)

From the ideas above summarized in the figure (Figure 4), the regulatory principles are formed. These are as follows (Mohammadi, 2017):

i. Service Encapsulation: To ensure that a well-defined interface uses the service functions as the service application will only be externally visible to the service consumer.

ii. Service Loose coupling: Services are designed as these are minimally dependent on others. So, it provides good maintainability.

iii. Service agreement: All of the services obey all transmission contracts and protocols that they use. Additionally, these are defined in the service explanation archive.

iv. Service aloofness: It only describes the service functionality. Besides that, the logic of the services is hidden from the outside world by the service itself.

v. Service adoption: The functionalities are uniformly distributed into different services. The main objective of this distribution is to embolden the adoption of services.

vi. Composability of service: Groups of different services sometimes can be synchronized and accumulated. The purpose of this synchronization and accumulation is to develop conglomerate services.

vii. Autonomy of service: These services possess complete control over the functional logic they hide from the outside world.

viii. Service statelessness: Services reduce gaining specific information to any activity.

6. Sector for Implementation

The word "service-oriented" and SOA existed earlier than the coming of Web service. For implementing SOA, web services are counted as the most appropriate modern technology, but it is not only the web services that can be implemented (Pan & Pohl, 2010).

SOA can be implemented with any of the service-based technologies. For example,

i. COBRA (Common Object Request Broker Architecture) and Internet Communication Engine or Ice, which is also created by the COBRA devel opers, can be implemented as SOA.

ii. Jini, which is also known as Apache River, provides the infrastructure of SOA.

iii. Moreover, message-oriented middleware systems such as JMS (Java Mes saging Service) and the IBM (International Business Machines Corporation) Message Queue Series can also be implemented as SOA; neverthe less, web dependent services are more loosely coupled in comparison to others (Mohammadi, 2017).

iv. Web services afford the supporting techniques with elements for SOA combining the definitive structure characterized by WSDL (Web Service Definition Language) the accepted transmission rules and regulations equipped by SOAP (Simple Object Access Protocol). It provides a tech nique for changing messages based on XML in web-based applications and UDDI (Universal Description, Discovery, and Integration) for providing the support for web services area administration (Mohammadi, 2017; Dhara, Dharmala & Sharma, 2015).

7. Advantages of SOA

There are several advantages of Service-Oriented Architecture. Some of them are mentioned below:

i. SOA provides better opportunities for business application assembly as it decreases the costs, simplicity in conservation, and advancement in resilience. Moreover, SOA enables business companies and their information and technology systems to be buoyant by providing higher maintainability. It offers a chance to accomplish broad-scale interoperability (exchange of information) while providing resilience to accustom to revolutionary technologies (Mahmood, 2007).

ii. SOA permits organizations to use new services or modify old services very easily as SOA is loosely coupled with applications and location transparency.

iii. SOA infrastructure has an ability called Location clarity or area transparency. This is a capability that empowers both service receivers or customers and service providers to act freely in their regions. It is possible for a service receiver to receive a particular service without knowing the location or region of the service provider. This happens because, during the run-time, the determination of the service provider's location takes place (Al-Ta'ani & Razali, 2017).

iv. SOA provides continuous connectivity and interoperability that creates opportunities to boost business dexterity. It also boosts up the capability to counter on appeal (Duan et al., 2014).

v. Mapping Information and Technology according to the need of the trade paves a way to re-create values to business functionalities.

vi. The most remarkable feature of SOA is its improved reuse of current assets and applications. As a result, it decreases the budget and reduces development time. Moreover, it lessens the time to launch the product in the market.

vii. The combination of Cloud computing and SOA reduces messaging overhead and intensifies the reliability of SOA (Bokhari, Azam & Habiba, 2015).

viii. Parallel and independent applications development is another fruit of SOA. This is because of reusing services and adding or withdrawing development with ease.

8. Disadvantages of SOA

When we compare distributed client-server architecture with SOA, it turns out SOA is an exquisite architecture as it introduces enormous advantages. One of them is using the same source code again and again. It has better assimilation and enhanced response to requests. But, the tradeoff between flexibility and efficiency exists as it always has existed. Moreover, there are some demerits also we have to face for SOA.

As SOA is structurally based on a loosely coupled model, it suffers from an element of synchronization. Some logical steps which are followed in SOA are not part of its model (Bokhari & Azam, 2015). SOA needed a large straight investment because of the automation, enhancement, and crew distribution. This large amount of investment may cause an enormous compromise. As a result, the Return on Investment (ROI) might take a longer time period to achieve. One of the significant drawbacks of SOA is that one service can call other services that can create a loop of calls if we do not validate every input parameter of the services. As a result, it affects the feedback time and overall machine load. Suppose there is a bug introduced in the service that can crash all the applications that are using that service. For a single application, the number of messages being exchanged by services can become enormous in number to maintain. Though SOA has some drawbacks, the positive parts have suppressed these. As a result, it is the most used and demanding architecture worldwide.

9. Future work

As the SOA can be extended based on the user's demand, there is vast scope in the field of SOA development. It can be implemented in various types of multimedia teaching platforms such as video conferencing, online education, animation, graphics, etc. (Liu, 2020). Using SOA in digital distribution games, hardware efficiency or performance of hardware can be improved (Gupta, Mokal, Shah, & Satyanarayana, 2018). The expansion opportunity of SOA can be attained by accommodating real-time requirements in SOA, investigating security aspects, continuous interaction with the user, collaboration between services, development in group services, mobile services, etc.

10. Conclusion

From this paper, we sum it up that SOA is used for developing and integrating different kinds of enterprise applications, that is especially for the software that is used for business purposes. In recent years, SOA has been adopted in prominent technologies such as Cloud Computing (CC) and Internet of Things (IoT) (Niknejad, Ismail, Ghani, Nazari, Bahari, & Hussin, 2020; Fayoumi, 2018; Srinivasulu, Babu, Venkat, & Rajesh, 2017). Generally, SOA relies on the design of service consumers, providers, and a broker. It is becoming more and more popular because of the combination of business and IT.

Modernization in the field of business-oriented systems depends on the migration of the legacy system into SOA (Abdellatif, Hecht, Mili, Elboussaidi, Moha, Shatnawi, Privat & Guéhéneuc, 2018). Service-oriented architecture mainly collaborates with the Web service protocol. Its purpose is to deliver the business agility & IT requirements for both the enterprises and consumers. Though, in the field of research, a few organizations have been able to connect their structural system with the SOA or Web services.

This paper presents a brief idea about service-oriented architecture and its basic principles. Also, the connection between SOA and web service has become the middle of interest for the developers. Moreover, its primary purpose is to assist the reader in understanding the pros and cons of SOA so that they can be careful in implementing the related features of SOA.

References

Abdellatif, M., Hecht, G., Mili, H., Elboussaidi, G., Moha, N., Shatnawi, A., Privat, J., & Guéhéneuc, Y. (2018, November 12-15). State of the Practice in Service Identification for SOA Migration in Industry. *16th International Conference*, ICSOC 2018, Hangzhou, China. Retrieved from https//doi.org/10.1007/978-3-030-03596-9_46.

Al-Ta'ani, R. H., & Razali, R. (2017). Process model for systematic requirements prioritisation process in an agile software development environment based on 5S approach: Empirical study. *Journal of Theoretical and Applied Information Technology, 95*(8), 1715–1736. Retrieved from https://www.researchgate.net/publication/316787243.

Bean, J. (2010). *SOA and Web Services Interface Design*, 25–41. Morgan Kaufmann Publishers is an imprint of Elsevier.

Bokhari, S., Azam, F., & Habiba, U. (2015). Limitations of Service Oriented Architecture and its Combination with Cloud Computing. *Bahria University Journal of Information & Communication Technologies, 8*(1), 7–13. Retrieved from https://www.researchgate.net /publication/301691260.

Cokro, R. S. B., Firmantyo, H. M., Dzaka, T. T., Putra, A. M., & Wang, G. (2020). SOA Architecture for Games Digital Distribution. *International Journal of Computing, Communications and Networking, 9*(4). Retrieved from https://doi.org/10.30534/ ijccn/2020/01942019.

Dan, X., Shi, Y., Tao, Z., Xiang-Yang, J., Qing, L. Z., & Jun-Feng, Y. (2006). An Approach for Describing SOA. 2006 *International Conference on Wireless Communications, Networking and Mobile Computing*. Retrieved from https: //doi.org/10.1109/WiCOM.2006.396.

Dhara, K. M., Dharmala, M., & Sharma, C. K. (2015). *Survey Paper on Service Oriented Architecture Approach and Modern Web Services*, 157. Retrieved from http://opus.govst.edu/capstoneshttp://opus.govst.edu/capstones/157.

Duan, Y., Narendra, N. C., Du, W., Wang, Y., & Zhou, N. (2014). Exploring Cloud Service Brokering from an Interface Perspective. *2014 IEEE International Conference on Web Services*, 329–336. Retrieved from https://doi.org/10.1109/ICWS.2014.55.

Erickson, J., & Siau, K. (2009). Web Services, Service-Oriented Computing, and Service-Oriented Architecture: Separating Hype from Reality. *Journal of Database Management, 19*(3), 42-54. Retrieved from https://doi.org/10.4018/jdm.2008070103.

Fayoumi, A. G. (2018). From Service-Oriented Architecture to Cloud Computing. *Global Journal of Computer Science and Technology: B Cloud and Distributed, 18*(1). Retrieved from http//doi.org/10.17406.

Gupta, P., Mokal, T. P., Shah, D. D., & Satyanarayana, K. V. V. (2018). Event-driven SOA-based IoT architecture. *In International Conference on Intelligent Computing and Applications*, 247-258. Retrieved from https://doi.org/10.1007/978-981-10-5520-1_24.

Hamzah, M. H. I. B., Baharom, F., & Haslina, H. M. (2019). An exploratory study for investigating the issues and current practice of service-oriented architecture adoption. *Journal of Information and Communication Technology*, *18*(3), 273-304. Retrieved from https://doi.org/10.32890/jict2019.18.3.3.

Li, J. (2019). Design of B2B E-commerce Platform Based on SOA Architecture. In IOP *Conference Series: Materials Science and Engineering, 569*(3), 32051. Retrieved from https://doi.org/10.1088/1757-899X/569/3/032051

Liu, S., & Xia, C. (2020). Research on Software Development Method Based on SOA Architecture. 2020 *5th International Conference on Technologies in Manufacturing, Information and Computing*. Retrieved from https://doi.org/10.25236/ictmic.2020.108

Liu, Y. (2020). Design and implementation of multimedia teaching platform based on SOA architecture. *Multimedia Tools and Applications, 79*(15-16), 10899-10914. Retrieved from https://doi.org/10.1007/s11042-020-08735-7.

Mahmood, Z. (2007). The promise and limitations of service oriented architecture. *International Journal of Computers, 1*(3), 74–78.

Marks, E. A., & Bell, M. (2006). *Service-Oriented Architecture: A Planning and Implementation Guide for Business and Technology*. John Wiley & Sons.

Meyer, J. (2014). Open SOA Health Web Platform for Mobile Medical Apps. *8th International Workshop on Service-Oriented Cyber-Physical Systems in Converging Networked Environments (SOCNE) in conjunction with ETFA 2014*. Retrieved from https://doi.org/10.13140/2.1.1041.7923

Mohammadi, M. (2017). Service Oriented Architecture: A Review and Evaluation of Reference Models. *International Journal on Information Technologies & Security, 4*(9), 37–51.

Mohsin, A., & Janjua, N. K. (2018). A review and future directions of SOA-based software architecture modeling approaches for System of Systems. *Service Oriented Computing and Applications, 12*(3), 183-200. Springerlink.

Niknejad, N., Ismail, W., Ghani, I., Nazari, B., Bahari, M., & Hussin, A. R. B. C. (2020). Understanding Service-Oriented Architecture (SOA): A systematic literature review and directions for further investigation. *ELSEVIER, Information Systems*, 91. Retrieved from https://doi.org/10.1016/j.is.2020.101491.

Pan, X., & Pohl, J. (2010). A Method to Implement Location Transparency in a Web Service Environment, *InterSymp-2010, Foc. Symp: Advances in Adaptive Planning Capabilities*, 2–6. Retrieved from http://digitalcommons.calpoly.edu/cadrc/94/

Qadri, S. S. H., & Hussaan, A. M. (2018). SOA vs MSOA Comparative Analysis. *2018 3rd International Conference on Emerging Trends in Engineering, Sciences and Technology (ICEEST)*, 1-8. Retrieved from https://doi.org/10.1109/ICEEST.2018.8643315

Srinivasulu, P., Babu, M. S., Venkat, R., & Rajesh, K. (2017). Cloud Service Oriented Architecture (CSoA) for Agriculture through Internet of Things (IoT) and Big Data. *2017 IEEE International Conference on Electrical, Instrumentation and Communication Engineering (ICEICE)*. Retrieved from https://doi.org/10.1109/ICEICE.2017.8191906.

Valipour, M. H., Amirzafari, B., Maleki, K. N., & Daneshpour, N. (2009). A brief survey of software architecture concepts and service oriented architecture. *2nd IEEE International Conference on Computer Science and Information Technology*, 34–38. Retrieved from https://doi.org/10.1109/ICCSIT.2009.5235004.

Wang, Y., Li, Q., & Yang, Z. (2021). Functional requirements analysis of militia emergency communication equipment based on soa architecture. 2021 *Asia-Pacific Conference on Communications Technology and Computer Science (ACCTCS)*, 310-314.

Retrieved from https://doi.org/10.1109/ACCTCS52002.2021.00068.

Service-Oriented Architecture – What Is SOA? (2016). Retrieved from https://www.opengroup.org/soa/source-book/soa/p1.htm.

Zhao, H., Chen, X., Zhang, W., Liang, P., Wang, J., & Huang, W. (2018). SOA Patterns Selection and Application Based on Software Quality Requirements. *2018 IEEE 9th International Conference on Software Engineering and Service Science (ICSESS)*, 361-364. Retrieved from https://doi.org/10.1109/ICSESS.2018.8663844.