2017 24th Asia-Pacific Software Engineering Conference Workshops

Understanding Quality Attributes in Microservice Architecture

Shanshan Li
Software Institute of Nanjing University
Nanjing, Jiangsu, P.R.China
Email: stu.shanshan.li@gmail.com

***Abstract*—As a prevalent architectural style, microservice architecture overcomes the challenges of monolithic architecture and achieves better quality by implementing small-scale microservice, rather than binding all functions into one monolith. Well-designed microservice architecture with better quality relies on clear understanding of related quality attributes. However, current understanding of quality attributes in microservice architecture is deficient and not comprehensive. In this study, we aim to construct knowledge of quality attributes in architecture through a Systematic Literature Review (SLR), the exploratory case study and the explanatory survey. By analyzing the influential factors and the corresponding tactics of related quality attributes, our research is aimed at providing a comprehensive guide on quality improvement in microservice architecture.**

***Keywords*—microservices, monolith, quality attributes, systematic literature review**

I. Introduction

Monolithic Architecture (MA) [1] is the traditional way for software development and advocates encapsulating all functions in one single application. Less complicated monolithic applications are simple to develop, test, deploy and scale. Nevertheless, the sheer size of the monolith can slow down the development and become an obstacle to continuous deployment because of the longer start-up time.

Microservice Architecture (MSA) is a well-known architectural style adopted by world-famous Internet services such as Netflix, Amazon and eBay. In comparison with monolithic architecture [1], microservice architecture advocates decomposing the monolith into a set of small services and making them communicate with each other through light weight mechanisms (i.e. RESTful API) [2].

At present, the advantages of microservices are commonly accepted both in academia and industry, for instance, quality attributes including maintainability, reusability, scalability and availability may be influenced in microservice architecture [3], [4]. Principles are proposed to help improve the quality attributes [5], among which Newman [6] defines microservices by seven principles, including "Model around business concepts", "Decentralize all the things", "Make services independently deployable" [7]. Some researchers also apply these principles into their migration practices from monolithic architecture to microservice architecture [8], [9].

However, principles and studies of improving the quality attributes in microservice architecture are deficient. Many aspects are still unclear and unexplored, for example, quality attributes influenced in microservice architecture, influential factors, tactics for improving these quality attributes and the evaluation methods. Our research is to explore these aspects based on evidence from academic publications and then construct the comprehensive knowledge. The results of our research are expected to provide the knowledge base for quality improvement of microservice architecture in industry.

II. Related Work

Despite of the growing interest in microservices, most studies are focusing on architectural principles as well as the application of the architectural pattern [10]–[12] in microservices migration practices, while no attention is paid to systematically understanding quality attributes in microservice architecture.

Some empirical studies on microservice architecture have taken the quality attributes into consideration, however, results involved quality attributes are not sufficient for well understanding about them. Pahl et al. [13] conducted a systematic mapping study on the motivation, type, techniques and challenges of microservices. They did not specifically focus on the quality attributes of microservices, although some key words about quality were extracted in their studies. Alshuqayran et al. [4] identified the related quality attributes in their systematic mapping study, while they only provided a list of some quality attributes and gave little discussion about them. Similar to the previous studies, Francesco et al. [3] also performed a systematic study on the trends, the focus and the potential direction of microservice architecture, however, the discussion about quality attributes is not detailed as well.

III. Research Objective

We aim to realize a systematic understanding of quality improvement in microservice architecture. To achieve this objective, we will address the following research questions:

RQ1: What quality attributes are identified in existing microservice architectures?

RQ2: How quality attributes are influenced in those microservice architectures?

RQ3: What tactics or solutions are adopted for improving the quality attributes in microservice architecture?

RQ4: How quality attributes and tactics are evaluated in microservice architecture?

978-1-5386-2649-8/17 $31.00 © 2017 IEEE

DOI 10.1109/APSECW.2017.33

IV. Research Methodology

In order to comprehensively capture the evidence related to quality attributes in microservice architecture, we will use a combined methodology including the Systematic Literature Review, the exploratory case study and the explanatory survey.

A. Systematic Literature Review

To initially capture the evidence of researchers understanding and knowledge about quality attributes of MSA, our research will start with the Systematic Literature Review, which is the most widely used method of Evidence-Based Software Engineering (EBSE), by following the guidelines by Kitchenham et al. [14]. To improve the rigor of search process of our research, we will apply the Quasi-Gold Standard (QGS) approach, which was proposed by Zhang et al. [15].

According to this systematic approach, manual and automated search strategies will be integrated into our SLR. We will select libraries for automated search. After manual and automated search, a selection criteria is needed to identify relevant studies that provide direct evidence of quality attributes in microservice architecture. Then a data extraction form will be utilized to extract items related to our research questions from the selected studies, for example, the quality attributes discussed (RQ1), the influential factors (RQ2), the tactics or solutions (RQ3) and the evaluation methods (RQ4).

B. Case study

Because the microservice architecture is widely adopted in industrial practices, the relevant research literature is not rich so far. In order to comprehensively address the research questions, we decide to carry out an exploratory case study in multiple small and large software development organizations.

To collect valuable data, we will use the interview (face-to-face or on-line) as the main data collection method in specific cases. We will design some open-ended questions and interview practitioners who have rich experiences in microservice architecture and also gather data from relevant documentations. The survey will be followed up after the initial results of the SLR and case study to improve the validity and generalizability. We plan to use experiment or questionnaire to collect quantitative or qualitative data respectively.

C. Data Synthesis

We plan to use the Grounded Theory (GT) [16] to analyze the gathered evidence. As a major qualitative synthesis method in EBSE, GT is effective for building new theories. By applying the coding technology of GT, we aim to identify the classification of quality attributes, then analyze the corresponding influencial factors, tactics and evaluation methods, and finally construct the comprehensive knowledge about the quality improvement in microservice architecture.

V. Current Status and Next Steps

By continually refining our search string, we have completed the process of publications search in four commonly used libraries, including IEEE Xplore, ACM Digital Library, SpringerLink and ScienceDirect. According to the Quasi-Gold Standard (QGS) approach, we gained about 160 related primary studies on the basis of our selection criteria. The next step considered is to extract data from primary studies selected and then achieve the data synthesis for the final results.

VI. Acknowledgments

The author is supervised by Prof. He Zhang in Nanjing University.

References

[1] C. Richardson, “Pattern: monolithic architecture,” 22 June 2017. [Online]. Available: http://microservices.io/patterns/monolithic.html

[2] M. Fowler and J. Lewis, “Microservices,” 10 June 2014. [Online]. Available: https://martinfowler.com/articles/microservices.html

[3] P. D. Francesco, I. Malavolta, and P. Lago, “Research on architecting microservices: Trends, focus, and potential for industrial adoption,” in *Proceedings of the 2017 IEEE International Conference on Software Architecture (ICSA)*. IEEE Press, April 2017, pp. 21–30.

[4] N. Alshuqayran, N. Ali, and R. Evans, “A systematic mapping study in microservice architecture,” in *Proceedings of the 2016 IEEE 9th International Conference on Service-Oriented Computing and Applications (SOCA)*. IEEE Press, November 2016, pp. 44–51.

[5] G. Kecskemeti, A. C. Marosi, and A. Kertesz, “The ENTICE approach to decompose monolithic services into microservices,” in *Proceedings of the 2016 International Conference on High Performance Computing Simulation (HPCS)*. IEEE Press, July 2016, pp. 591–596.

[6] S. Newman, *Building microservices*, 2nd ed. Sebastopol, California: O’Reilly Media, 27 February 2015.

[7] O. Zimmermann, “Microservices tenets: Agile approach to service development and deployment,” *Computer Science - Research and Development*, vol. 32, no. 3, pp. 301–310, July 2017.

[8] M. Gysel, L. Kölbener, W. Giersche, and O. Zimmermann, “Service Cutter: A systematic approach to service decomposition,” in *Proceedings of the European Conference on Service-Oriented and Cloud Computing*. Springer, September 2016, pp. 185–200.

[9] S. Hassan, N. Ali, and R. Bahsoon, “Microservice ambients: An architectural meta-modelling approach for microservice granularity,” in *Proceedings of the 2017 IEEE International Conference on Software Architecture (ICSA)*. IEEE Press, April 2017, pp. 1–10.

[10] A. Balalaie, A. Heydarnoori, and P. Jamshidi, “Microservices migration patterns,” Automated Software Engineering Group, Sharif University of Technology, Tehran, Iran, Tech. Rep. TR-SUTCE-ASE-2015-01, October 2015.

[11] J. Lin, L. C. Lin, and S. Huang, “Migrating web applications to clouds with microservice architectures,” in *Proceedings of the 2016 International Conference on Applied System Innovation (ICASI)*. IEEE Press, May 2016, pp. 1–4.

[12] S. Hassan and R. Bahsoon, “Microservices and their design trade-offs: A self-adaptive roadmap,” in *Proceedings of the 2016 IEEE International Conference on Services Computing (SCC)*. IEEE Press, June 2016, pp. 813–818.

[13] C. Pahl and P. Jamshidi, “Microservices: A systematic mapping study,” in *Proceedings of the 6th International Conference on Cloud Computing and Services Science*. ACM, April 2016, pp. 137–146.

[14] B. Kitchenham and S. Charters, “Guidelines for performing systematic literature reviews in software engineering version 2.3,” Software Engineering Group, School of Computer Science and Mathematics, Keele University and Department of Computer Science University of Durham, Keele, Staffs, Tech. Rep., July 2007.

[15] H. Zhang, M. A. Babar, and P. Tell, “Identifying relevant studies in software engineering,” *Information & Software Technology*, vol. 53, no. 6, pp. 625–637, 2011.

[16] K.-J. Stol, P. Ralph, and B. Fitzgerald, “Grounded theory in software engineering research: A critical review and guidelines,” in *Proceedings of the 2016 IEEE/ACM 38th IEEE International Conference on Software Engineering*. IEEE Press, May 2016, pp. 120–131.