

Poster: Exploration of Academic and Industrial Evidence about Architectural Tactics and Patterns in Microservices

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ABSTRACT

Microservices are quickly becoming an outstanding architectural choice in the service-oriented software industry. This approach proposes to develop each application as a collection of small services, each running on its process and inter-communicating with lightweight mechanisms. Currently, there is still no clear perspective of emerging recurrent solutions (architectural patterns) or design decisions (architectural tactics) in microservices both in industry and academia. This article describes a systematic review of the academic and industrial literature on architectural patterns and tactics proposed for microservices. The study reported: 44 architectural patterns of microservices in academia and 80 in the industry; architectural tactics related to microservices dependent on other disciplines; and it was also found that most of architectural patterns and tactics are associated to five quality attributes: scalability, flexibility, testability, performance, and elasticity. Added to that results, it was noticed that most microservices in the academic area are reported in evidence related to DevOps and IoT, but the industry is not interested in associating disciplines. Finally, a new proposal of microservices pattern taxonomy is suggested.

CCS CONCEPTS

• Software and its engineering → Software architectures;

KEYWORDS

Architectural patterns, architectural tactics, microservices, taxonomy, systematic literature review, academy, industry

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1 INTRODUCTION

Cloud computing is gaining popularity among mid-size and small business allowing new trends in software development, such as *microservices*. A microservices architectural style is an approach to develop a single application as a suite of small services, each running

in own process and communicating with lightweight mechanisms [4]. Companies like Netflix and Uber are adopting microservices in their business, improving reliability, scalability, and developing global standards for microservices. The number of companies that are taking microservices is increasing, making it attractive to investigate their relevance.

Despite the high interest in microservices, few proposals describe recurring situations (*architecture patterns*) or design decisions (*architectural tactics*) emerging in this discipline. Some studies [2] classify, compare, and evaluate architectural solutions, methods, and techniques for microservices, but we found no evidence of architectural pattern or tactics in academia or industry. Thus, the objective of this study is to explore architectural patterns and tactics for microservices in academic and industry literature.

2 REVIEW PLANNING

This study is based on procedures for performing systematic reviews [3]. We focus the research in three phases: (1) Phase 1 aims to extract the academic evidence regarding architectural pattern and tactics; (2) Phase 2 will complement the academic evidence with proposals obtained from other sources of information; (3) Phase 3 extract industrial evidence and compare results.

To establish the research questions, we did brainstorming meetings with experts focusing on the keywords “software architecture”, “microservices”, “quality attributes”, “patterns” and “tactics”. We established three research questions: RQ1: *What architectural patterns have been proposed for microservices?*; RQ2: *What architectural tactics have been proposed for microservices?*; RQ3: *What are the quality attributes (QAs) associated with architectural patterns and tactics in microservices?*

3 RESULTS AND ANALYSIS

We found academic evidence in several conferences: Internet-of-Things Design and Implementation, Advances in Databases, Knowledge, and Data Applications, ICSA (International Conference on Software Architecture), ECSA (European Conference on Software Architecture), and others [5]. On the industrial side, were considered blogs (for example, [6]) and white papers. For further and complete information about the patterns found in this review, see the following link¹. Next, we address the research questions.

RQ1: We found 44 architectural patterns of microservices in the academic field and 80 architecture patterns in the industry. A group of patterns converges in five topics concerning academic

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¹<https://drive.google.com/open?id=1sxbPsYxe8ZtpT7vZKjG5XRUEr03LA6hCJmR6S1ADnk>

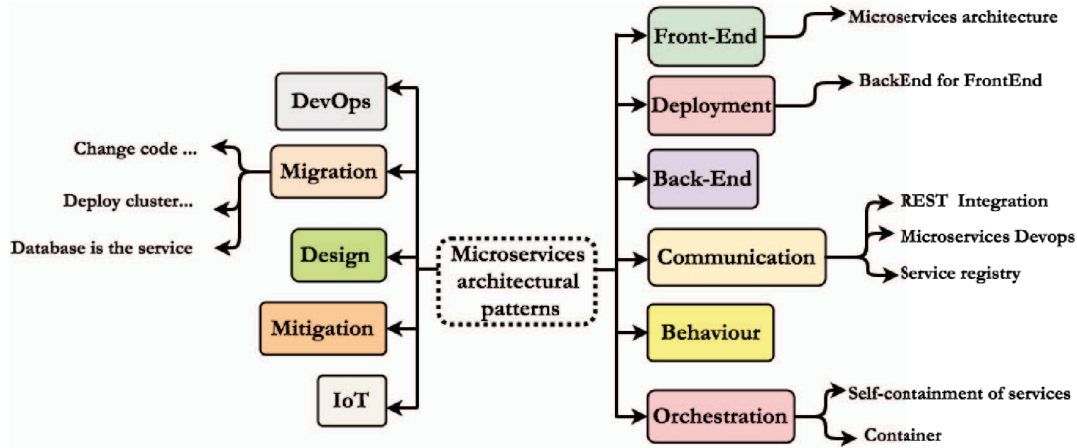


Figure 1: Microservices patterns taxonomy

and industry. The items are backend for frontends, service registry, containers, circuit breakers and database as services.

After performing a comprehensive analysis, the next patterns are those that we have verified that belong directly to the microservices: Backend for Frontend, Microservices DevOps, Service Registry, Change code dependency to service call, Deploy cluster and orchestrate containers, Microservices Architecture, Self-containment of services, Container, is the service, and REST Integration.

A quality assessment applied to the patterns reveal that 48% of academic and 29% of industrial patterns satisfy our quality criterion.

RQ2: We note that architecture tactics for microservices as such do not exist both academia and industry. However, there are architectural tactics that complement each other with other disciplines, such as DevOps (Development and Operations) [1].

RQ3: Since on the architectural tactics side we do not find enough evidence, we focus our efforts on architecture patterns. To obtain the QAs associated with the 124 architectural patterns observed in our study, we used information retrieval techniques, such as the Rapid Automatic Keyword Extraction (RAKE) algorithm [7], revealing the next QAs with the highest score: scalability, flexibility, testability, elasticity, and performance.

4 MICROSERVICES ARCHITECTURE PATTERNS TAXONOMY

We created a taxonomy of evidence-based architecture patterns. For the construction of the taxonomy, we have held brainstorming sessions and we following the strategy proposed by Velardi et al. [8] which is an automated procedure to achieve a significant speed-up factor (in our case, categories) in the development of resources (architectural patterns) with human validation and refinement. After a manual improvement of redundant concepts, Figure 1 illustrate our taxonomy and their corresponding categories referencing some of the patterns found.

5 CONCLUSIONS

This paper exhibits a summary of architectural patterns and tactics proposed for microservices in academia and industry. For architecture patterns in the academic and industrial field, the review

reported 124 patterns for microservices. The above point allowed us to understand which categories were explored, giving exciting evidence to present our taxonomy based on them. On the side of architectural tactics in academia and industry, we did not find architectural tactics related to microservices, allowing us to know and understand that it is an unexplored area. Finally, about quality attributes, we found that are associated architecture patterns and tactics with five quality attributes: flexibility, testability, elasticity, performance, and scalability, the latter two being the most dominant of them. Our taxonomy gives practitioners an array of tried and tested solutions to common problems, thus reducing the technical risk to the project by not having to employ a new and untested design.

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