# Methodology

Since the goal of this thesis is to map big data reference architectures and microservice patterns, it is consequently mandatory to get a comprehensive overview over both domains. For this purpose, it was decided to conduct two structured literature reviews (SLR), one for each domain.

The SLR method applied to both literature reviews comprised in this study follows the guidelines presented in Kitchenham et al. (2004) and Page et al. (2021). The former was used because of its clear instructions on critically appraising evidence for validity, impact and applicability. Complementary to that, we used the guidelines provided by Page et al. (2021) on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). PRISMA provided means for increasing systematicity, transparency, and prevention of bias.

To meaningfully capture the content of the identified studies, the methodology for thematic synthesis proposed by Cruzes and Dyba was applied (Cruzes and Dyba 2011). While it was initially planned to capture and present all identified microservice patterns by following the TOGAF template, this was later on omitted to save space and since a considerable number of them can already by found in (Richardson 2022). Since patterns are usually described in an informal way and the same applies to reference architectures, the matching of those two, as the primary research artifact of this paper, is also conveyed in the same way and supported by logical argumentation.

The first SLR was the less extensive one, since it is just an update to an already existing study. For this purpose, (Ataei and Litchfield 2020) as a thematically fitting study on big data reference architectures was extended up unto the current date, providing us with the necessary overview.

However, for the second review, the process had to be performed in total and was implemented as follows.

To assure the comprehensiveness of the review and following the recommendations of [REF], a broad set of scientific search engines and databases was queried. To increase the likelihood of finding all relevant contributions, it was decided to not discriminate between meta databases and publisher bound registers. Consequently, both types should be utilized. Therefore, ACM Digital Library, AISeL, IEEE Xplore, JSTOR, Science Direct, Scopus, Springer Link, and Wiley were included into the search process. For all of these, the initial keyword search was conducted on June 19, 2022, and there was no limitation to the considered publishing date.

Since there are differences in the filters of the included search engines, it was not possible to always use the exact same search terms and settings. Nevertheless, the configurations for the search were kept as similar as possible. Table 1 depicts the resulting mapping of databases and search terms. If a term in the “Search Term” column is printed in bold, this indicates a field of the search mask, where the following text is input. In case nothing is printed in bold, this means the whole term can be filled into the search bar without modification. As can be seen, due to the focus of this study, the term “microservice” or its plural always had to be included in the title. However, for those engines that yielded a high number of results, the scope was sharpened by also requiring variations of “pattern”, “architecture”, “design”, “building block”, or “best practice” to appear in title, abstract or keywords. If the latter could not be realized because of the interface, the most similar setting that is more lenient (therefore, potentially yielding more results) was chosen. This was the case for IEEE Xplore and SpringerLink. The terms themselves are picked because patterns are exactly what was sought for, architectures can contain such patterns, and design is often used as a synonym for architecture. Further, patterns can be seen as building blocks, therefore, the latter where also included. Finally, the use of patterns is often highlighted as a best practice and hence, in reverse, papers that refer to best practices might also contain information regarding the use of patterns.

Table 1. Mapping of databases/registers and search terms

|  |  |  |
| --- | --- | --- |
| Database/Register | Search Term | Records |
| ACM Digital Library  (“The ACM Full-Text Collection”, not “The ACM Guide to Computing Literature”) | [Title: microservice\*] AND [[Title: pattern\*] OR [Title: architecture\*] OR [Title: design\*] OR [Title: building block\*] OR [Title: best practice\*]] | 91 |
| [Title: microservice\*] AND [[Abstract: pattern\*] OR [Abstract: architecture\*] OR [Abstract: design\*] OR [Abstract: building block\*] OR [Abstract: best practice\*]] | 194 |
| [Title: microservice\*] AND [[Keywords: pattern\*] OR [Keywords: architecture\*] OR [Keywords: design\*] OR [Keywords: building block\*] OR [Keywords: best practice\*]] | 65 |
| AISeL | **Title:** microservice OR microservices | 10 |
| IEEE Xplore | "Document Title": microservice\* AND ("All Metadata": pattern\* OR "All Metadata": architecture\* OR "All Metadata": design\* OR "All Metadata": building block\* OR "All Metadata": best practice\*) | 759 |
| JSTOR | **Title:** microservice | 0 |
| **Title:** microservices | 0 |
| ScienceDirect | **Title, abstract, keywords:** pattern OR architecture OR design OR (building block) OR (best practice)  **Title**: microservice OR microservices | 79 |
| **Title, abstract, keywords:** patterns OR architectures OR designs OR (building blocks) OR (best practices)  **Title:** microservice OR microservices | 76 |
| Scopus | ( TITLE-ABS-KEY ( pattern\* OR architecture\* OR design\* OR ( "building block" ) OR ( "building blocks" ) OR ( "best practice" ) OR ( "best practices" ) ) AND TITLE ( microservice\* ) ) | 1534 |
| SpringerLink | **Title:** microservice\*  **With at least one of the words:** pattern\* architecture\* design\* "building block" "building blocks" "best practice" "best practices" | 433 |
| Wiley | **Title:** microservice\* | 38 |

As it can be seen, due to the specifics of their search masks, the searches in the ACM Digital Library (title, abstract, keywords could only be searched separately), JSTOR (no support of wildcards), and Science Direct (no support of wildcards) had to be split in several parts. Those were afterwards merged for each of them, and duplicates were removed. Overall, the keyword search yielded 3064 contributions. The total number of found publications per source as well as an overview of the further search process can be seen in Figure 1.

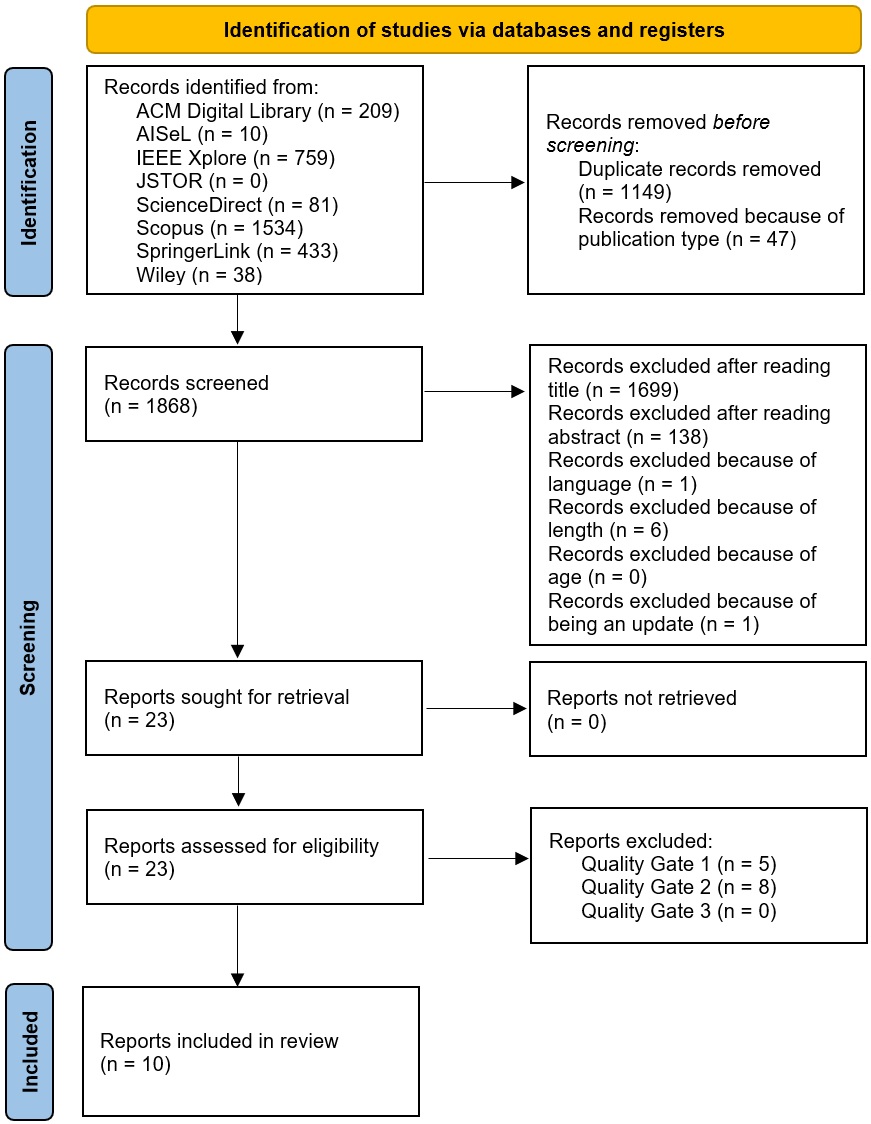


Figure 1. Overview of the search process

After the duplicates were removed, 1915 items were still left. To further reduce that number, a set of inclusion and exclusion criteria as shown in Table 1 was applied throughout the following phases. Since only conference papers and journal articles should be included, based on the fact that those are commonly peer reviewed, whereas this cannot be assumed for other literature types such as book chapters, 47 contributions were removed.

Table 2. Inclusion and exclusion criteria

|  |  |
| --- | --- |
| Inclusion Criteria | Exclusion Criteria |
| Was published as a conference paper or a journal article | Record is a duplicate |
| Contains a primary or secondary study | Record is not written in English |
| Was published between Jan 1st 2012 and June 19th 2022 | Informal literature surveys without any clearly defined research questions or research process |
| The focus of the record is on microservice patterns or microservice architectural constructs | An updated version of the paper is also part of the identified literature |
|  | The paper has a length of less than six pages, not counting references and acknowledgments |

The remaining 1868 papers were filtered by title to evaluate their relatedness to the concepts of microservice patterns or architectural constructs related to microservices. For this purpose, the first two authors separately evaluated each entry regarding inclusion or removal. If both agreed, this verdict was honored. In case of disagreement, they discussed the title to come to a conclusion. While the third author would have acted as the decision maker for situations where still no agreement is reached, this circumstance did never occur. In this phase, the first author initially included 113 papers and the second author 146. Of those, 41 were present in both sets and 1650 were excluded by both. This equates to an agreement rate of 90,5 percent (1691 of 1868 records) between the authors. After discussing the contributions with divergent evaluations, in total, 1699 of the 1868 papers were excluded, leaving 169 items for the next round.

Here, the same approach was followed, but this time based on abstracts instead of the titles. Moreover, the authors agreed to also allow themselves to look into the actual paper and not just the abstract, if they wanted to further explore certain contributions to improve their judgement. As a result, the first author evaluated 40 papers positively, and the second one 28. Both agreed on the inclusion of 22 papers and the exclusion of 123. This equates to an agreement rate of 85,8 percent (145 of 169 records) between the authors. Afterwards the discussion of the remaining ones followed. Again, the third author would have acted as the deciding factor in case of continued disagreement. Yet, this was not necessary. In total, of the 169 papers, 138 were removed and 31 were included in the next phase.

While conducting the first steps of our filter process, we encountered several hurdles that shall be highlighted to ensure transparency, especially since they can slightly affect the number of remaining entries after those initial phases. However, the final set of literature was not impacted and, therefore, those factors did not pose a threat to the studies validity.

For once, since not all entries of the combined literature list compiled from all the used sources specified a digital object identifier (DOI), the duplicate removal had to be conducted based on the publication title. Yet, in some rare cases, there were duplicates for which the spelling of the title was slightly altered (e.g., the two parts of a title were in one search engine separated by a hyphen and in another by a double colon), and which were, therefore, not detected in the initial duplicate removal phase. Instead, they were only identified during the scanning of the title. Furthermore, in SpringerLink, conference papers are classified as book chapter, since conference proceedings are published as books. This makes them indistinguishable from real book chapters, when only looking at the metadata. Book chapters are, however, not part of the search’s scope. Consequently, the removal of book chapters for SpringerLink could only be processed when inspecting the respective publications. To slightly reduce the effort, it was decided to only do this for those publications that passed the filtering by title. As a result, there are some publications in the phase where it was filtered by abstract that, in theory, should have already been removed in a previous step.

There, the papers that were not written in English (1; despite the abstract being in English) or for which an updated version exists (1) were filtered out. The same would have applied to papers published before the year 2012, because in the previous years, the concept of microservices as it the focus of this publication was not yet present. However, while there were three corresponding records in the initially obtained set of literature (from the years 2003, 2007, and 2010), those were already filtered out for other reasons by this stage. Further, publications that had a length of less than six pages, without counting the reference section and acknowledgments, were also removed, since those can’t provide the desired degree of comprehensiveness.

This filtering based on formal aspects was followed by the application of the quality criteria depicted in Table 3.

Table 3. The quality framework

|  |  |  |  |
| --- | --- | --- | --- |
| Quality Gate | Criterion | Considered Aspect | Rating to pass |
| 1 | Minimum quality threshold | Does the study report empirical research or is it merely a 'lesson learnt' report based on expert opinion? | 5/6 |
| The objectives and aims of the study are clearly communicated, including the reasoning for why the study was undertaken? |
| Does the study provide with adequate information regarding the context in which the research was carried out? |
| 2 | Rigor | Is the research design appropriate to address the objectives of the research? | 3/4 |
| Is there any data collection method used and is it appropriate? |
| 3 | Credibility | Does the study report findings in a clear and unbiased manner? | 3/4 |
| Relevance | Does the study provide value for practice or research? |

The filtering based on the quality criteria was divided into three differently focused phases, with each of them requiring the passing of a quality gate. In the first phase, the aim was to assure that the reports fulfill at least a desired minimum of comprehensiveness. For this purpose, it was evaluated if the content is actual research or just a mere report on some lessons or expert opinions. Further, the objectives, justification, and aim of the study shall be clearly communicated. Finally, also the context of the conducted research needed to be sufficiently described. This last criterion is primarily geared towards actual experiments. In the conducted literature search, primarily literature-based studies were found, which somewhat devalues this aspect. Nevertheless, to assure completeness, it was still evaluated. The first and second author independently rated the three aspects for all 23 remaining papers, giving one point respectively, if they deemed a criterion fulfilled and no point if they considered that aspect lacking. Consequently, for each aspect, zero to two points were archivable and for the phase as a whole, six points were available per paper. For inclusion into the second phase, at least five out of six points were demanded to assure a sufficient base quality. This corresponds to having at least 75 percent of the points (since 4,5 points were not possible). However, the two papers that obtained four out of six points were again discussed between the two authors to avoid any erroneous exclusion. Despite that additional check, both were still removed. In total, the authors agreed on 51 of 69 evaluations, resulting in an agreement rate of 73,9 percent.

The second phase was focused on rigor. Here, it was judged if the research design and the data collection of the remaining 18 papers are conducted in an appropriate manner. The general procedure with the first two authors independently evaluating the reports remained the same. For inclusion in the next phase, again, 75 percent of the obtainable point were needed (this time three of four). In total, the authors agreed on 23 of 36 evaluations, resulting in an agreement rate of 63,9 percent. While this value is rather low, this is likely caused by the narrow margins for some decisions. Once more, the papers with the highest score that didn’t suffice for inclusion (this time two) were discussed before inclusion, further counteracting possible fuzziness in the individual evaluations. Yet, again, none of the four papers was retroactively included. The remaining 10 papers were objected to the third and final phase.

Here, the credibility of the reporting and the relevance of the findings were evaluated. The procedure was the same as in the previous phases. However, this time, all of the remaining papers passed, making the discussion of barely excluded ones unnecessary. In this last phase, the authors agreed on 14 of 20 evaluations, resulting in an agreement rate of exactly 70 percent.

The final set of literature that is the output of the conducted review process is shown in Table 4.

Table 4. The final set of literature

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Title | Year | Quality Score | Type | Source | Found in | Ref |
| Architectural patterns for microservices: A systematic mapping study | 2018 | 11/14 | C | CLOSER 2018 - Proceedings of the 8th International Conference on Cloud Computing and Services Science | Scopus | (Taibi et al. 2018) |
| Actual Use of Architectural Patterns in Microservices-Based Open Source Projects | 2018 | 12/14 | C | Proceedings of the 25th Asia-Pacific Software Engineering Conference (APSEC) | Scopus, IEEE Xplore | (Marquez and Astudillo 2018) |
| Supporting architectural decision making on data management in microservice architectures | 2019 | 12/14 | C | Lecture Notes in Computer Science 11681  Proceedings of the Software Architecture: 13th European Conference, ECSA 2019 | Scopus, Springer Link | (Ntentos et al. 2019) |
| Using architectural modifiability tactics to examine evolution qualities of Service- and Microservice-Based Systems: An approach based on principles and patterns | 2019 | 13/14 | J | Software-Intensive Cyber-Physical Systems | Scopus | (Bogner et al. 2019) |
| Patterns Related to Microservice Architecture: a Multivocal Literature Review | 2020 | 14/14 | J | Programming and Computer Software | Scopus, SpringerLink | (Valdivia et al. 2020) |
| Data management in microservices: State of the practice, challenges, and research directions | 2021 | 12/14 | J | Proceedings of the VLDB Endowment 2021 | Scopus | (Laigner et al. 2021) |
| Deployment and communication patterns in microservice architectures: A systematic literature review | 2021 | 14/14 | J | Journal of Systems and Software | Scopus, ScienceDirect | (Karabey Aksakalli et al. 2021) |
| Decision Models for Selecting Patterns and Strategies in Microservices Systems and their Evaluation by Practitioners | 2022 | 13/14 | C | Proceedings of the 2022 IEEE/ACM 44th International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP) | IEEE Xplore | (Waseem et al. 2022) |
| Designing Microservice Systems Using Patterns: An Empirical Study on Quality Trade-Offs | 2022 | 13/14 | C | IEEE 19th International Conference on Software Architecture (ICSA) | IEEE Xplore | (Vale et al. 2022) |
| Taxonomical Classification and Systematic Review on Microservices | 2022 | 13/14 | J | International Journal of Engineering Trends and Technology | Scopus | (Weerasinghe and Perera 2022) |

As can be seen, all ten publications have been published in 2018 or later, with three of them even being from, 2022, which shows the timeliness of the topic. Further, eight of the ten papers could be found via Scopus, whereas the remaining two have been identified through IEEE Xplore. Consequently, for the search conducted for this paper, the other databases and registers have not been necessary. However, since this fact is only determinable now, their inclusion in the initial search was still sensible.

# Bibtex

% This file was created with Citavi 6.12.0.0

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@inproceedings{Ataei.2020,

author = {Ataei, Pouya and Litchfield, Alan},

title = {Big Data Reference Architectures, a systematic literature review},

publisher = {AIS},

booktitle = {Australasian Conference on Information Systems (ACIS) 2020},

year = {2020}

}

@inproceedings{Cruzes.2011,

author = {Cruzes, D. S. and Dyba, T.},

title = {Recommended Steps for Thematic Synthesis in Software Engineering},

pages = {275--284},

publisher = {IEEE},

isbn = {978-1-4577-2203-5},

booktitle = {2011 International Symposium on Empirical Software Engineering and Measurement},

year = {2011},

doi = {10.1109/ESEM.2011.36}

}

@inproceedings{Kitchenham.2004,

author = {Kitchenham, B. A. and Dyba, T. and Jorgensen, M.},

title = {Evidence-based software engineering},

pages = {273--281},

publisher = {{IEEE Comput. Soc}},

isbn = {0-7695-2163-0},

booktitle = {Proceedings of the 26th International Conference on Software Engineering},

year = {2004},

doi = {10.1109/ICSE.2004.1317449}

}

@article{Page.2021,

author = {Page, Matthew J. and Moher, David and Bossuyt, Patrick M. and Boutron, Isabelle and Hoffmann, Tammy C. and Mulrow, Cynthia D. and Shamseer, Larissa and Tetzlaff, Jennifer M. and Akl, Elie A. and Brennan, Sue E. and Chou, Roger and Glanville, Julie and Grimshaw, Jeremy M. and Hr{\'o}bjartsson, Asbj{\o}rn and Lalu, Manoj M. and Li, Tianjing and Loder, Elizabeth W. and Mayo-Wilson, Evan and McDonald, Steve and McGuinness, Luke A. and Stewart, Lesley A. and Thomas, James and Tricco, Andrea C. and Welch, Vivian A. and Whiting, Penny and McKenzie, Joanne E.},

year = {2021},

title = {PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews},

pages = {n160},

volume = {372},

journal = {BMJ (Clinical research ed.)},

doi = {10.1136/bmj.n160}

}

@misc{Richardson.2022,

author = {Richardson, Chris},

year = {2022},

title = {A pattern language for microservices},

url = {https://microservices.io/patterns/index.html},

urldate = {07.08.2022}

}

@article{Bogner.2019,

author = {Bogner, Justus and Wagner, Stefan and Zimmermann, Alfred},

year = {2019},

title = {Using architectural modifiability tactics to examine evolution qualities of Service- and Microservice-Based Systems: An approach based on principles and patterns},

pages = {141--149},

volume = {34},

number = {2-3},

issn = {2524-8510},

journal = {SICS Software-Intensive Cyber-Physical Systems},

doi = {10.1007/s00450-019-00402-z}

}

@article{KarabeyAksakalli.2021,

author = {{Karabey Aksakalli}, I{\c{s}}{\i}l and {\c{C}}elik, Turgay and Can, Ahmet Burak and Teki̇nerdo{\u{g}}an, Bedir},

year = {2021},

title = {Deployment and communication patterns in microservice architectures: A systematic literature review},

pages = {111014},

volume = {180},

issn = {01641212},

journal = {Journal of Systems and Software},

doi = {10.1016/j.jss.2021.111014}

}

@article{Laigner.2021,

author = {Laigner, Rodrigo and Zhou, Yongluan and Salles, Marcos Antonio Vaz and Liu, Yijian and Kalinowski, Marcos},

year = {2021},

title = {Data management in microservices},

pages = {3348--3361},

volume = {14},

number = {13},

issn = {2150-8097},

journal = {Proceedings of the VLDB Endowment},

doi = {10.14778/3484224.3484232}

}

@inproceedings{Marquez.2018,

author = {Marquez, Gaston and Astudillo, Hernan},

title = {Actual Use of Architectural Patterns in Microservices-Based Open Source Projects},

pages = {31--40},

publisher = {IEEE},

isbn = {978-1-7281-1970-0},

booktitle = {2018 25th Asia-Pacific Software Engineering Conference (APSEC)},

year = {2018},

doi = {10.1109/APSEC.2018.00017}

}

@incollection{Ntentos.2019,

author = {Ntentos, Evangelos and Zdun, Uwe and Plakidas, Konstantinos and Schall, Daniel and Li, Fei and Meixner, Sebastian},

title = {Supporting Architectural Decision Making on Data Management in Microservice Architectures},

pages = {20--36},

volume = {11681},

publisher = {{Springer International Publishing}},

isbn = {978-3-030-29982-8},

series = {Lecture Notes in Computer Science},

editor = {Bures, Tomas and Duchien, Laurence and Inverardi, Paola},

booktitle = {Software Architecture},

year = {2019},

address = {Cham},

doi = {10.1007/978-3-030-29983-5{\textunderscore }2}

}

@inproceedings{Taibi.2018,

author = {Taibi, Davide and Lenarduzzi, Valentina and Pahl, Claus},

title = {Architectural Patterns for Microservices: A Systematic Mapping Study},

pages = {221--232},

publisher = {{SCITEPRESS - Science and Technology Publications}},

isbn = {978-989-758-295-0},

booktitle = {Proceedings of the 8th International Conference on Cloud Computing and Services Science},

year = {2018},

doi = {10.5220/0006798302210232}

}

@article{Valdivia.2020,

author = {Valdivia, J. A. and Lora-Gonz{\'a}lez, A. and Lim{\'o}n, X. and Cortes-Verdin, K. and Ochar{\'a}n-Hern{\'a}ndez, J. O.},

year = {2020},

title = {Patterns Related to Microservice Architecture: a Multivocal Literature Review},

pages = {594--608},

volume = {46},

number = {8},

issn = {0361-7688},

journal = {Programming and Computer Software},

doi = {10.1134/S0361768820080253}

}

@inproceedings{Vale.2022,

author = {Vale, Guilherme and Correia, Filipe Figueiredo and Guerra, Eduardo Martins and de {Oliveira Rosa}, Thatiane and Fritzsch, Jonas and Bogner, Justus},

title = {Designing Microservice Systems Using Patterns: An Empirical Study on Quality Trade-Offs},

pages = {69--79},

publisher = {IEEE},

isbn = {978-1-6654-1728-0},

booktitle = {2022 IEEE 19th International Conference on Software Architecture (ICSA)},

year = {2022},

doi = {10.1109/ICSA53651.2022.00015}

}

@inproceedings{Waseem.2022,

author = {Waseem, Muhammad and Liang, Peng and Ahmad, Aakash and Shahin, Mojtaba and Khan, Arif Ali and Marquez, Gaston},

title = {Decision Models for Selecting Patterns and Strategies in Microservices Systems and their Evaluation by Practitioners},

pages = {135--144},

publisher = {IEEE},

isbn = {978-1-6654-9590-5},

booktitle = {2022 IEEE/ACM 44th International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP)},

year = {2022},

doi = {10.1109/ICSE-SEIP55303.2022.9793911}

}

@article{Weerasinghe.2022,

author = {Weerasinghe, Sidath and Perera, Indika},

year = {2022},

title = {Taxonomical Classification and Systematic Review on Microservices},

pages = {222--233},

volume = {70},

number = {3},

journal = {International Journal of Engineering Trends and Technology},

doi = {10.14445/22315381/IJETT-V70I3P225}

}

Publication bibliography

Ataei, Pouya; Litchfield, Alan (2020): Big Data Reference Architectures, a systematic literature review. In : Australasian Conference on Information Systems (ACIS) 2020. Wellington, New Zealand: AIS.

Bogner, Justus; Wagner, Stefan; Zimmermann, Alfred (2019): Using architectural modifiability tactics to examine evolution qualities of Service- and Microservice-Based Systems. An approach based on principles and patterns. In *SICS Softw.-Inensiv. Cyber-Phys. Syst.* 34 (2-3), pp. 141–149. DOI: 10.1007/s00450-019-00402-z.

Cruzes, D. S.; Dyba, T. (2011): Recommended Steps for Thematic Synthesis in Software Engineering. In : 2011 International Symposium on Empirical Software Engineering and Measurement. 2011 5th International Symposium on Empirical Software Engineering and Measurement (ESEM 2011). Banff, AB, 22.09.2011 - 23.09.2011: IEEE, pp. 275–284.

Karabey Aksakalli, Işıl; Çelik, Turgay; Can, Ahmet Burak; Teki̇nerdoğan, Bedir (2021): Deployment and communication patterns in microservice architectures: A systematic literature review. In *Journal of Systems and Software* 180, p. 111014. DOI: 10.1016/j.jss.2021.111014.

Kitchenham, B. A.; Dyba, T.; Jorgensen, M. (2004): Evidence-based software engineering. In : Proceedings of the 26th International Conference on Software Engineering. Proceedings. 26th International Conference on Software Engineering. Edinburgh, UK, 23.05.2004 - 28.05.2004: IEEE Comput. Soc, pp. 273–281.

Laigner, Rodrigo; Zhou, Yongluan; Salles, Marcos Antonio Vaz; Liu, Yijian; Kalinowski, Marcos (2021): Data management in microservices. In *Proc. VLDB Endow.* 14 (13), pp. 3348–3361. DOI: 10.14778/3484224.3484232.

Marquez, Gaston; Astudillo, Hernan (2018): Actual Use of Architectural Patterns in Microservices-Based Open Source Projects. In : 2018 25th Asia-Pacific Software Engineering Conference (APSEC). 2018 25th Asia-Pacific Software Engineering Conference (APSEC). Nara, Japan, 04.12.2018 - 07.12.2018: IEEE, pp. 31–40.

Ntentos, Evangelos; Zdun, Uwe; Plakidas, Konstantinos; Schall, Daniel; Li, Fei; Meixner, Sebastian (2019): Supporting Architectural Decision Making on Data Management in Microservice Architectures. In Tomas Bures, Laurence Duchien, Paola Inverardi (Eds.): Software Architecture, vol. 11681. Cham: Springer International Publishing (Lecture Notes in Computer Science), pp. 20–36.

Page, Matthew J.; Moher, David; Bossuyt, Patrick M.; Boutron, Isabelle; Hoffmann, Tammy C.; Mulrow, Cynthia D. et al. (2021): PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. In *BMJ (Clinical research ed.)* 372, n160. DOI: 10.1136/bmj.n160.

Richardson, Chris (2022): A pattern language for microservices. Available online at https://microservices.io/patterns/index.html, checked on 8/7/2022.

Taibi, Davide; Lenarduzzi, Valentina; Pahl, Claus (2018): Architectural Patterns for Microservices: A Systematic Mapping Study. In : Proceedings of the 8th International Conference on Cloud Computing and Services Science. 8th International Conference on Cloud Computing and Services Science. Funchal, Madeira, Portugal, 19.03.2018 - 21.03.2018: SCITEPRESS - Science and Technology Publications, pp. 221–232.

Valdivia, J. A.; Lora-González, A.; Limón, X.; Cortes-Verdin, K.; Ocharán-Hernández, J. O. (2020): Patterns Related to Microservice Architecture: a Multivocal Literature Review. In *Program Comput Soft* 46 (8), pp. 594–608. DOI: 10.1134/S0361768820080253.

Vale, Guilherme; Correia, Filipe Figueiredo; Guerra, Eduardo Martins; Oliveira Rosa, Thatiane de; Fritzsch, Jonas; Bogner, Justus (2022): Designing Microservice Systems Using Patterns: An Empirical Study on Quality Trade-Offs. In : 2022 IEEE 19th International Conference on Software Architecture (ICSA). 2022 IEEE 19th International Conference on Software Architecture (ICSA). Honolulu, HI, USA, 12.03.2022 - 15.03.2022: IEEE, pp. 69–79.

Waseem, Muhammad; Liang, Peng; Ahmad, Aakash; Shahin, Mojtaba; Khan, Arif Ali; Marquez, Gaston (2022): Decision Models for Selecting Patterns and Strategies in Microservices Systems and their Evaluation by Practitioners. In : 2022 IEEE/ACM 44th International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP). 2022 IEEE/ACM 44th International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP). Pittsburgh, PA, USA, 22.05.2022 - 24.05.2022: IEEE, pp. 135–144.

Weerasinghe, Sidath; Perera, Indika (2022): Taxonomical Classification and Systematic Review on Microservices. In *IJETT* 70 (3), pp. 222–233. DOI: 10.14445/22315381/IJETT-V70I3P225.