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A systematic literature review on web services composition

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Abstract

Web services composition is one of the most fundamental and pressing issues when developing Web-based systems in accordance with Service-Oriented Architecture. The main challenge is selecting and composing a proper set of web services to fulfil various demands of clients over the World-Wide-Web. This paper reports results of a systematic literature review conducted on the state of the art of achievements in web services composition. It starts with a set of research questions that lead to a set of relevant keywords for querying four well-known digital libraries. Search results are then filtered through based on some inclusion and exclusion criteria. Finally, 269 most relevant documents were identified. The extracted information from these resources is analysed and results are reported, concerning three major viewpoints: bibliography, research quality, and strategy.

Keywords: Service-Oriented architecture, Web services composition, Systematic literature review (SLR)

1. Introduction

This report presents a systematic literature review on the web services composition. Systematic reviews are meant to help experts who need to keep their knowledge up-to-date within an area of research, or those who seek information about subjects that are in centre of attention or in contrary, the issues less covered by the researchers so that they can select their future working subjects more accurately [126].

Nowadays, it appears that web services dominate the software industry. There are numerous web services available for fulfilling various service-based applications. Ever-increasing use of Service-Oriented Architecture (SOA) [305] for developing web-based applications demands more efficient and quality-aware web services composition algorithms.

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1.1. Service-Oriented architecture (SOA)

A service can be defined as any act offered by a provider which is valuable from the clients' point of view. In other words, a service is a unit of work done by the provider and is presented to the client.

The SOA is a software development style in a distributed environment based on reusable services composition. In this style, software systems are logically created by inter-connecting services via their interfaces. This architecture can handle heterogeneity of distributed providers' platforms. It can also handle changes in system requirements resulted from the changes in the organization.

1.2. Web service

A web service is a software system designed for machine-to-machine interaction at the network level and has a machine-understandable description using WSDL (Web Service Description Language) protocol [308]. Other software systems, just have to find the most suitable service and bind to the provider of the service. The run-time binding between the provider and the requester is done via the SOAP (Simple Object Access Protocol) [306]. In other words, the web services are software systems that are published, found, and bonded within the network.

2. Problem statement

Web services composition is about optimum coordination among available web services to provide a new composed web service for user's requirements that a single web service cannot satisfy. An important goal of composing services is to achieve the maximum flexibility for dynamic adaptation to the environment, because base services are subject to change due to availability, load balancing, and application.

2.1. Composed service plan

Generally, there are two methods for producing composed service plans [309, 23]:

1. Workflow techniques
2. AI planning techniques

The workflow techniques consider a composed service as a set of atomic services along with a workflow. A workflow includes a data flow and a flow of control for the execution of the composed services. These techniques provide some automatic methods for binding abstract roles to the atomic services.

AI planning techniques produce a composed service plan using AI techniques. In these methods, it is assumed that each service can be defined and identified by preconditions and its executional effects on the environment. Therefore, a plan can be generated automatically using AI planning techniques, without having any predefined knowledge of workflow.

2.2. Composed service execution

There are two strategies for execution of composed web services namely Orchestration and Choreography. Orchestration is based on a coordinator, which itself can be a service, for controlling and coordinating the services involved in the composition. The coordinator should be aware of the overall purpose of the process, definitions of the roles, and the order of employing the web services involved in the composition. Therefore, base services are not aware that they are part of a higher-level business process.

Choreography, by contrast, does not need a coordinator. Hence, any service involved in the composition operation needs to know when it should collaborate and with which service it should interact, that called execution scenario. The collaboration is done via message passing. Every service involved in the composition should be aware of the general business process, the task of the composed service, and the schedule of all sending and receiving messages [309, 154].

2.3. Automatic web services composition

Automatic web services composition is when generation of the composition plan is done on the fly and at runtime, without any manual interference. In this method, a service request, including the characteristics of the requested service, would generate a web service consisting of several components, which has not been existed before the request. In other words, in this method, any service request instead of being just a contact solicitation for an interface, it would be considered as a request for a composed service [23, 212].

2.4. Static or dynamic web services composition

Web services composition can be divided into two general classes, static or dynamic. In static web services composition, the information of available services that can potentially be used in the composition should be prepared and collected before composition. Considering the great number of web services and the fact that they get frequent updates by the providers in terms of updating existing services as well as adding new web services to the community, collecting information about available services for the composition operation is the main issue in this method. Therefore, this method of web services composition is inherently inflexible. Furthermore, scalability can be an issue when using these methods, due to lack of load balancing in the partner services.

In dynamic web services composition, the composition plan is formed based on the present state of the web services. Therefore, it is not necessary to collect information about all available services before the composition.

2.5. Quality-aware web services composition

In addition to the functional specification, web services are also known by their non-functional attributes, usually referred as Quality of Service (QoS). The importance of QoS attributes become apparent when several web services offer the same functionality. The QoS can be used to choose the most appropriate web service that satisfies non-functional attributes. This is called QoS-aware web services composition.

3. Research method: a systematic literature review

Systematic Literature Review (SLR) is a research methodology which is used for the purpose of collection and evaluation of all of the existing studies related to a special subject [144, 185]. The systematic literature review follows an exact sequence of defined and strict steps that is resulted in an exact protocol. This protocol plays a central role in the study and it is based on well-defined concepts and terms. Those concepts and terms are used for generation of research questions in an exact, clear, predefined, and sufficiently concentrated and structured form. The systematic review has some prescribed strategies for the following activities:

1. Extraction of sample studies by concentrating on the research questions.
2. Filtration of the extracted samples based on some well-defined criteria.

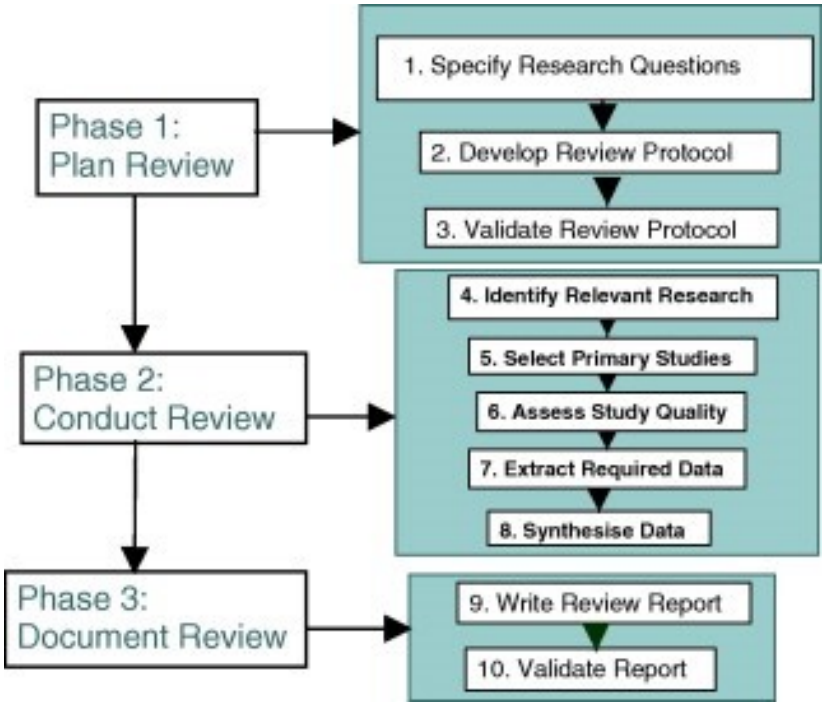

Figure 1: The systematic review protocol [308]

3. Synthesis of the results.

A software engineering specific SLR has been proposed in [154, 144, 36, 41, 24, 131, 133, 197, 242, 253]. Applying the SLR in the field of software engineering is harder than other domains, mainly due to inaccuracy of the results reported by the researchers in the field. Further, it is almost impossible to compare qualitative results reported in the studies. Moreover, lack of standards for the presentation of results in the field had negative effect on conducting an SLR.

3.1. SLR protocol

An SLR collects, evaluates, and interprets all of the studies related to a special subject or question in the form of an exact and reviewable procedure [197]. In this section, the protocol of the present SLR is briefly described as a part of the planning phase. The protocol of the present review has been designed and performed based on the instructions and points expressed in [144, 185], and [154]. The structure of the protocol is based on [89].

3.1.1. Research questions

RQ1: What are the suggested methods for web services composition?
RQ2: To what extent, does each of the suggested methods correspond to the following concerns?

1. Completeness: Guarantee To reach the intended composed service (satisfying the functional requirements),
2. Composition execution strategy: Orchestration or Choreography,
3. Level of automation: Automatic, manual or hybrid web services composition,
4. Composition planning strategy: It could be based on workflow or AI Planning,

5. Dynamicity: Dynamic or static web services composition,
6. Scalability: To be sustainable against scale of available Web services and request size,
7. Distribution: Capability of composition method to be executed by collaboration of composition agents,
8. Maturity: Is there available the details of Simulation, implementation, and experiments?
9. QoS-awareness: Taking the non-functional aspects into account.

RQ3: The level of attention each of the above concerns has received in the literature?
RQ4: Forums and research organizations with the most publications in the web services composition?
RQ5: Is the web services composition currently an open and hot subject in the software engineering domain? Are the research trends indicate that the researchers' attention moving toward/away from the subject?

3.1.2. Data sources

Selected studies in this SLR are mostly based on the automatic search queries to the following three digital libraries:

- IEEE Explore Digital Library
- ACM Digital Library
- Springer Link

These digital libraries are well-known scientific recourses used in most systematic reviews in Software Engineering domain, which cover the related publications adequately [41]. However, in order to make sure of the completeness of our search, Google Scholar search engine has also been queried.

3.1.3. Generating the query string

In order to generate the search query string for the above mentioned scientific digital libraries, the following steps have been taken:

Step1 - The base term "Web Services Composition" was broken into "web services" and "composition" as the base keywords.

Step2- The equivalent keywords including synonyms and near concepts and/or with the partial-to-total connection to each of the two base keywords have been identified using ontologies in IT and Software Engineering domains such as [307]. Further, both singular and plural forms of the equivalent keywords have also been considered (see Table1).

Table 1: The systematic review protocol [308]

Base term	Web Services	Composition
Equivalent keywords	Web services Network Services	Orchestration Choreography Synthesis Combination Hybrid

Step3- In order to generate the final query string, all possible combinations of the keywords (including both based and their equivalents) are produced. Those combinations are then connected using "OR" operator (see Table 2).

Table 2: The final query string

	Composition	Orchestration	Choreography	Synthesis	Combination	Hybrid
Web Services	Web Services Composition	Web Services Orchestration	Web Services Choreography	Web Services Synthesis	Web Services Combination	Web Services Hybrid
Web-services	Web-services Composition	Web-services Orchestration	Web-services Choreography	Web-services Synthesis	Web-services Combination	Web-services Hybrid
Network Services	Network Services Composition	Network Services Orchestration	Network Services Choreography	Network Services Synthesis	Network Services Combination	Network Services Hybrid

3.1.4. Inclusion and exclusion criteria

In this review the following inclusion criteria have been applied:

1. Research reports must be relevant to the research questions
2. Research reports must have introduced a web services composition method,
3. Research report must be published between 2010/01/01 and 2019/06/09.
4. Research reports must be in English,
5. Research reports must be published in reputable forum including:
    a. journals in the first three quarters of the SJR [304] and/or JCR [303],
    b. Conferences with at least h-index of 10 according to Google Scholar [302],
    c. Technical reposts that have experimental data,
6. Each research report must have at least 3 citations.

The following exclusion criteria have also been applied:

1. Research reports on simple service selection,
2. Research reports on Composite service recovery,
3. Research reports on conformance checking with SOA,
4. Research reports without technical suggestion and/or executable solution

3.2. Quality assessment of documents

In order to apply the inclusion and exclusion criteria consistently, an online quality assessment form has been developed. The form has been designed and structured based on best practices in [89, 108, 145]. The form is then used by each researcher for assessing the documents following the steps in Table 3.

Execution of step1 has resulted in 562 studies, of which 524 studies were primary, and 38 were secondary (empirical and/or review studies). As the secondary studies were not the subject of our systematic review, they were not included in the selected studies. Based on our expert opinion, 269 of the primary studies were chosen as selected studies.

Table 3: Steps for selecting high quality related studies (based on [242], [89])

	Operation
Step 1	Apply the query string (from section 3.1.3) to the digital sources (from section 3.1.2) and make a list of the resulting documents.
Step 2	Delete repeated documents from the list.
Step 3	Filtering through the list by applying the inclusion and exclusion criteria (section 3.1.4) to the title of each document.
Step 4	Filter the list (from previous step) by applying the inclusion and exclusion criteria to the abstract and conclusion of each document.
Step 5	If needed (see section 3.2), filter the resulting list from previous step by applying the inclusion and exclusion criteria to the main text of the documents. The remaining documents form the list of selected studies.

Table 4: Results of the stage of quality assessment of documents

<table>
<tr><td colspan="3">Total studies assessed qualitatively
562</td></tr>
<tr><td colspan="2">Primary studies
524</td><td rowspan="2">Secondary studies
(empirical or review)
38</td></tr>
<tr><td>Selected studies
269</td><td>Studies unrelated or without required quality
255</td></tr>
</table>

3.3. Data extraction

At this stage, related information to the research questions is extracted from the selected studies using data extraction form. In order to assure the accuracy and consistency of the data extraction operation, we have used the method suggested in [146]. In doing so, after extracting the information from the selected studies, 20 of them have been selected randomly and the extraction operation has been performed on them again. Then the results have been compared with the first extraction. Since not much difference has been observed between the results of the first and the second round, we have concluded that our initial data extraction was reasonably accurate and consistent.

3.4. Data analysis

In order to do the data analysis, the extracted data from the selected studies need to be synthesized according to the meta-ethnography method. The synergy and further analysis of the data extracted from the selected studies are named synthesis. The presented categorizations are one of the results of synthesis in the present research. In the presented categorizations, the number of studies related to every category is included. Authors believe that the number of studies of each category is not necessarily a good indicator for significance of the subject or the aggregated value of studies of that category; however, it can be regarded as a gauge for the extent of straightforwardness of both the concept and the implementation of the method(s) of that category.

The meta-ethnography method is applied for the synthesis of data extracted from the primary studies. This method has been presented in [42]. Table 5 presents seven steps of meta-ethnography.

The first three steps, the aim is to identify the main concepts of the primary studies as expressed by the authors. In the fourth step, determining how the studies are related, based on the RQs the main concepts of the studies are categorized into one or several tables. In the next step, translating the studies into one another, the categorized concepts from the tables are interpreted and rewritten in common terms (Results of these five steps have been presented in Appendix 1). After these five steps, the possibility for the comparison among the primary studies is provided. In tow final steps, The comparison of studies is done similar to the analysis of qualitative data [186]. At first, the difference between the results of studies is recognized; then, it is surveyed that whether these differences result

Table 5: Meta-ethnography steps [186]

1.	Getting started
2.	Deciding what is relevant to the initial interest
3.	Reading the studies
4.	Determining how the studies are related
5.	Translating the studies into one another
6.	Synthesizing translations
7.	Expressing the synthesis

from the research method or the research characteristics (e.g. research place, characteristics of research scope and so forth).

3.4.1. Bibliography analysis

The frequency of publication of the articles selected in different years has been presented in Figure 2. Two points are reminded: the first is that the number of references to an article has been of key criteria for the selection of that article, though it is not alone very promising inasmuch as there have been fewer opportunities for the increase of the number of references to the articles published in recent years.

The second point is that the stage of the search for studies has been carried out by June 2019 while a considerable number of articles of every year are listed in the source digital libraries during the next year. This point should be regarded in the number of articles in 2019.

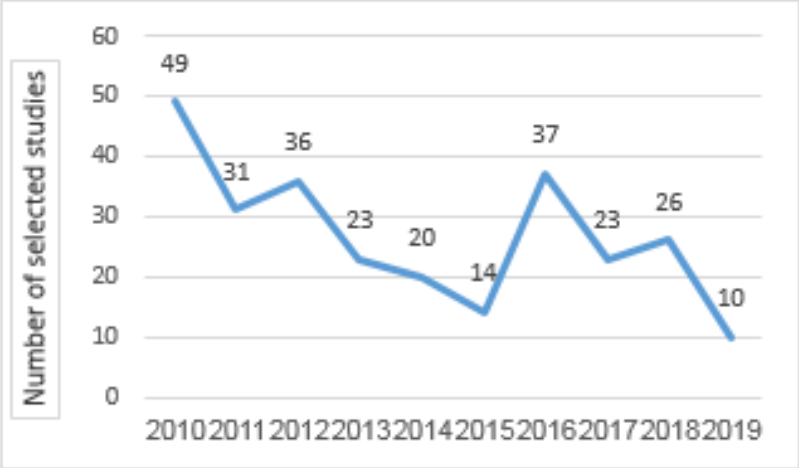

Figure 2: Frequency of publication of articles in different years

From the selected articles, the ratio of the number of articles published in the journal to the ones presented in the conferences is observable in Figure 3. The higher number of articles presented in the conferences in comparison with the ones published in the journal is indicative of the higher rate of idea generation in comparison with the perfect studies with precise implementation and assessment and it indicates the existence of unknown aspects and openness of the research subject and basis.

The journals and conferences that have published the highest number of selected studies are shown in Table 6 and Table 7.

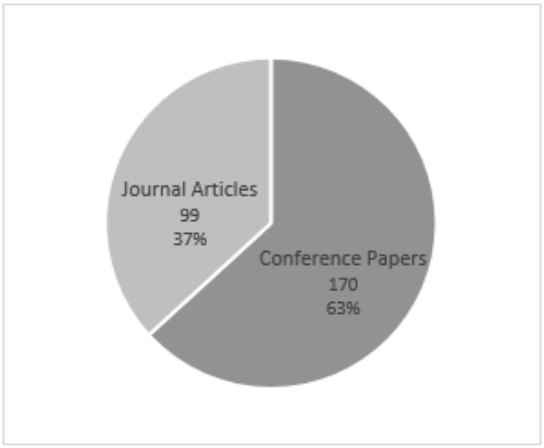

Figure 3: Publication kind

Table 6: The most relevant journals

Journal Title	URL	Number of Selected articles
IEEE Transactions on Services Computing	https://www.computer.org/csdl/journal/sc	16
Soft Computing	https://link.springer.com/journal/500	5
Service Oriented Computing and Applications	https://link.springer.com/journal/11761	5

Table 7: The most relevant conferences

Conference Title	URL	Number of Selected articles
IEEE International Conference on Web Services (ICWS)	https://conferences.computer.org/icws/2019/	21
iiWAS: International Conference on Information Integration and Web-based Applications & Services	http://www.iiwas.org/conferences/iiwas2019/	12
IEEE International Conference on Services Computing (SCC)	https://conferences.computer.org/scc/2019/	8

The international organizations which have had the most activities and publications in the field of web services composition have been introduced in Table 8.

Table 8: Leading organizations in web services composition

Organization	URL
IBM	www.ibm.com
W3C (World Wide Web Consortium)	www.w3.org
OASIS (Advancing open standards for the information society)	www.oasis-open.org

3.4.2. Quality analysis

To demonstrate the quality of articles selected in the present research, the mean value and standard deviation of the citations to every selected article have been presented in Table 9.

Table 9: Citation analysis of selected articles

Mean of the citations to every article	15.637
Standard deviation of the citations to every article	29.010

To demonstrate the quality of journals and conferences which their articles have been selected in the present research, the mean value and standard deviation of h-index of the journals and conferences have been presented in Table 10 and 11.

Table 10: The h-index analysis of selected articles' publishers

Mean of h-index of journals	24.671
Standard deviation of h- index of journals	17.528

Table 11: The h-index analysis of selected articles' conferences

Mean of h-index of conferences	18.253
Standard deviation of h- index of conferences	19.419

The status of journals publishing the selected articles, in the SJR list, has been presented in Figure 4.

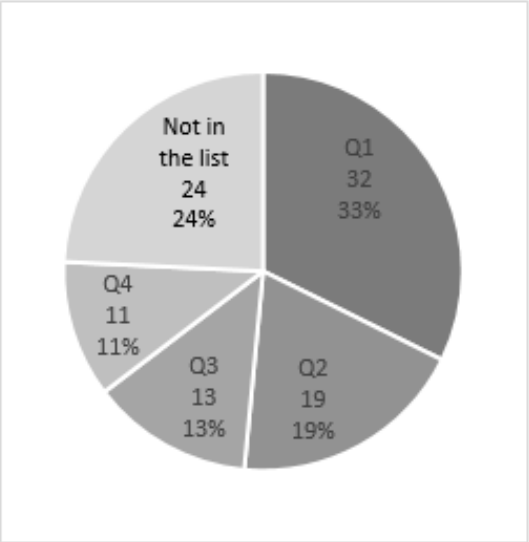

Figure 4: Status of journals publishing the selected articles, in SJR list

The articles that not in the SJR list, but have been entered in selected studies, are which the reviewer has been emphasized on high relevance to the research questions, and transparency of the solution and detailed reporting of results.

3.4.3. Composition strategies analysis

The categorization and frequency of the studies based on their service composite execution strategy is presented in Figure 5.

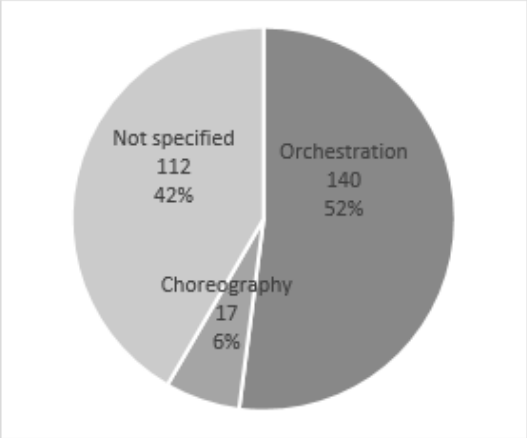

Figure 5: Service composite execution strategies

The "Not specified" category, are those studies that only generate the composition plan without specifying their execution strategy. Furthermore, their resulting compositions are not relying on tools or protocol specific to two either Orchestration or Choreography.

Regardless of the composition strategy, there are two aspects of any composition, execution and planning. As for the execution, it appears that Choreography-based service composition methods are tended to use agent-based technology in their implementation (13 out of 17 studies).

As for the planning strategy, Figure 6 presents categorization and frequency of the studies.

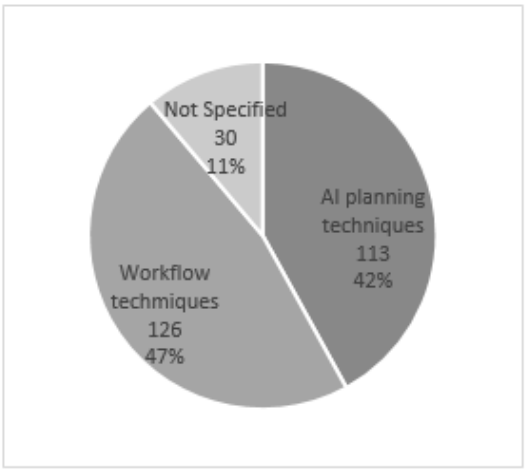

Figure 6: Service composite planning strategies

The workflow-based compositions are often carried out using an optimization method. The most frequently used optimization methods in the selected studies are shown in Table 12.

As for the AI planning-based methods, 41 studies have modeled the composition problem as a search problem in a tree or graph. These studies have used heuristic or metaheuristic methods (e.g. the Greedy search, A*, Cuckoo search, Tabu search) for searching. The most commonly used method in these studies for reducing the state space and pruning the search tree is the Skyline [266, 270, 12, 16, 156].

The ratio of the studies concentrated on the automatic services composition to the other studies has been presented in Figure 7. Majority of the methods considered as automatic web services composition are AI planning based (57 out of 70 methods). A minority of those automatic composition

Table 12: Common optimization methods used in workflow planning

Optimization method	Number of studies using it	References
Genetic Algorithm (GA)	31	[272, 252, 253, 273, 172, 242, 153, 279, 10, 53, 173, 254, 86, 73, 94, 281, 294, 265, 75, 220, 231, 95, 7, 74, 76, 77, 178, 190, 282]
Particle Swarm Optimization (PSO)	14	[107, 70, 54, 174, 223, 102, 122, 224, 129, 264, 157, 213, 295, 177]
Ant Colony Optimization (ACO)	8	[172, 107, 230, 257, 155, 286, 201, 219]
Artificial bee colony algorithm	4	[61, 116, 228 , 58]
Cuckoo search	3	[222, 60, 105]

methods are dynamic (17 out of 70 methods). Of those 17 studies, 13 are also AI planning based.

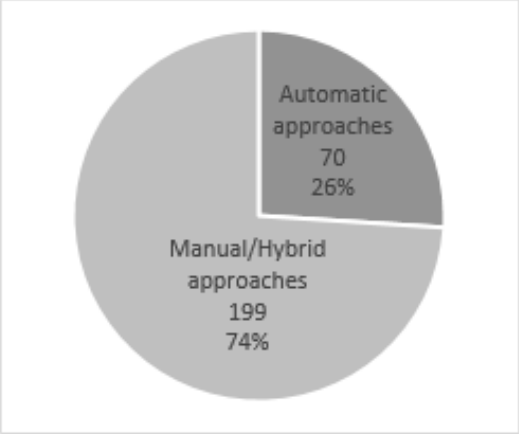

Figure 7: Level of composition automation

Figure 8 presents the overall number and ratio of quality-aware web services composition methods. 85 studies have concentrated on one or more QoS attributes of composition execution. Table 13

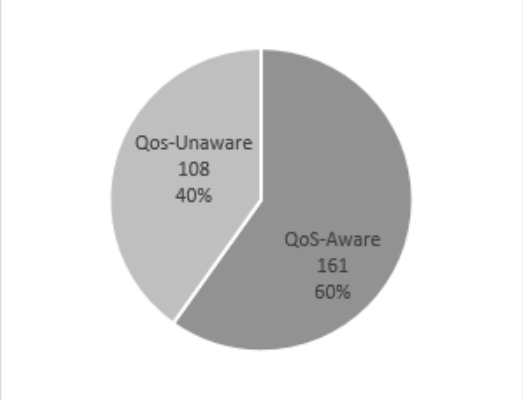

Figure 8: Quality-awareness

depicts frequency of studies considering each of the QoS attributes.

Table 13: Considered QoS attributes

QoS attribute	Number of Studies	References
Reliability Fault tolerance Robustness Flexibility	17	[265, 105, 87, 171, 32, 37, 150]
Scalability	13	[191, 147, 17, 49, 214, 287, 211, 28, 18, 188, 64, 136, 21]
Availability Successful execution rate	10	[10, 105, 81, 189, 13, 233, 11, 132, 208, 14]
Execution Time Efficiency Performance Response time	8	[10, 105, 171, 13, 11, 132, 208]
Privacy	8	[91, 66, 138, 33, 175, 239, 139, 104]
Execution Cost Price	5	[10, 105, 11, 132, 164]
Trust	5	[257, 189, 19, 20, 259]
Security	5	[91, 104, 17, 34, 3]
Reputation	4	[10, 132, 20, 131]

Distribution can be considered as one of the quality attributes of composition plan production methods. This has been considered in 27 studies ([283, 222, 174, 16, 44, 117, 28, 188, 64, 13, 235, 189, 273, 148, 38, 4, 299, 65, 63, 200, 247, 301, 52, 182, 128, 15]. In 13 cases of the 27 studies, agent-based technology has been applied for producing the composition plan([16, 28, 188, 64, 235, 189, 273, 4, 65, 200, 247, 182, 15].

Figure 9 shows distribution of studies concentrated on dynamic vs. static web services composition.

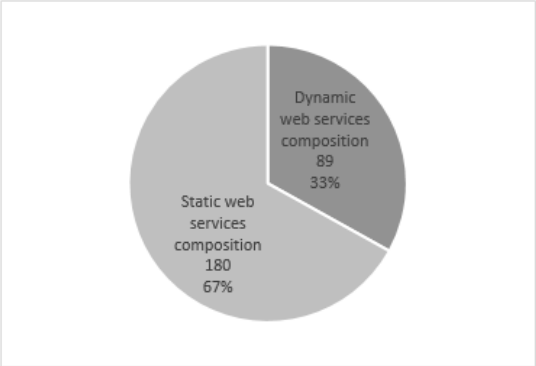

Figure 9: Dynamic vs. static web services composition

Figure 10 presents percentile of studies concentrated on semantic web services composition. Table

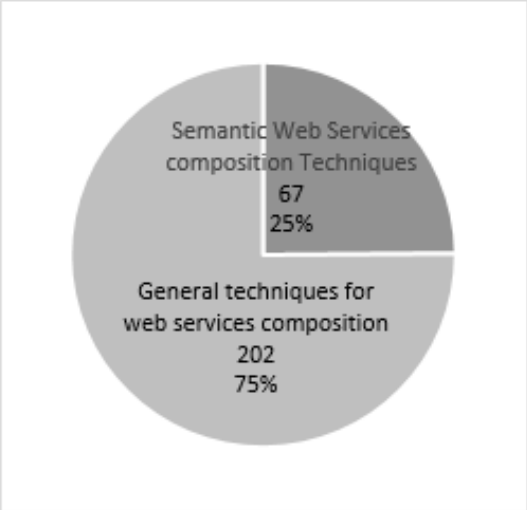

Figure 10: Semantic web services composition

14 presents some other features considered in number of studies, which have not been expressed in the above-mentioned categorizations.

Table 14: Other characteristics of selected studies

QoS attribute	Number of Studies	References
Reliability Fault tolerance Robustness Flexibility	17	[265, 105, 87, 171, 32, 37, 150]
Scalability	13	[191, 147, 17, 49, 214, 287, 211, 28, 18, 188, 64, 136, 21]
Availability Successful execution rate	10	[10, 105, 81, 189, 13, 233, 11, 132, 208, 14]
Execution Time Efficiency Performance Response time	8	[10, 105, 171, 13, 11, 132, 208]
Privacy	8	[91, 66, 138, 33, 175, 239, 139, 104]
Execution Cost Price	5	[10, 105, 11, 132, 164]
Trust	5	[257, 189, 19, 20, 259]
Security	5	[91, 104, 17, 34, 3]
Reputation	4	[10, 132, 20, 131]

4. Discussion and conclusion

Table 15 presents a categorization of service composition methods and their characteristics.

4.1. Web services composition research strengths and limitations

Our study indicates that the web services composition problem has the capacity to be formulated in many different forms, such as planning, search, constraint satisfaction or optimization problem.

Table 15: Service composition Methods at a glance

Service Composition plan		Method description	References	Execution of Composed Services	Automation	Supporting Parallel composition	Dynamic Planning	Supporting composed Service recovery	QoS-Awareness	Considering user preferences	Distribution	Scalability
Workflow-based	There is a workflow as part of the request. The main problem is the optimal selection of services for roles in the workflow. The problem is modeled as a multi-objective optimization problem (MOOP).	Using heuristic and meta-heuristic methods for optimization	[53, 295, 232, 95, 174,122, 214, 155, 116, 58, 164,260, 52, 160, 98, 193,59, 168,137, 227,236]	Orchestration	×	✓	Semi-dynamic	Fully (service substitution)	✓	✓	×	✓
		Using Linear or Integer Programming for optimization	[13, 106, 103, 210]	Orchestration	×	✓	Semi-dynamic	Partially (service substitution)	✓	✓	×	✓
		Modeling and solving as a Constraint Satisfaction Problem (CSP)	[12, 170, 134]	Orchestration	×	✓	Semi-dynamic	Partially (service substitution)	✓	✓	×	✓
		Clustering or indexing available services based on functional or non-functional features by the service brokers.	[70,220, 271, 250, 50, 213, 124, 161, 162, 200]	Orchestration	×	✓	Semi-dynamic	Fully (service substitution)	✓	✓	×	✓
	Workflow is generated.	Design of composition is performed in two phases: 1) workflow generation, 2) optimal selection of services for roles in the workflow. Due to complexity of workflow generation, these methods are domain-specific.	[173, 224, 225, 19, 226]	Orchestration	✓	✓	Semi-dynamic	Partially (service substitution – partial replanning)	✓	✓	×	×
AI Planning-based	Available services are modeled as graphs (Automata, Finite State Transducer (FST) or Colored Petri Net (CPN)). These methods require high preprocessing and model rebuilding. Major problems in this category are: 1) Incompatibilities of the highly dynamic environment of web services, 2) imbalance of load on the services involved in the composition.		[223, 215, 246, 203, 25, 247, 289, 96, 239, 275, 187, 31, 99, 92, 277, 100, 26]	Orchestration	✓	×	Static	×	✓	×	×	×
	Available services are modeled as rule-based expert systems. These methods require high preprocessing and rebuilding of inference engine.		[201, 280]	Orchestration	✓	×	Static	×	×	×	×	✓
	The problem is modeled as a tree, which is solved by searching. No preprocessing is required. Using agent technology and users' feedbacks is possible. The highest degree of flexibility and loose coupling is available.		[102,135, 142, 83, 57, 79,248, 270, 216, 80, 230, 269, 192, 288, 132, 15, 123, 281, 82]	Orchestration	✓	×	Dynamic	Partially (partial replanning)	×	×	✓	✓

Therefore, more recent techniques that are used in other domains, such as Software Engineering, Artificial Intelligence, Computational Logic, Semantic Web, Distributed Computing, Big data, and even multi-disciplinary approaches have been applicable when solving this problem.

Our study has also identified some weaknesses and restrictions in the research done in web services composition. Some of these weaknesses include: threats to validity of the methods, metrics, frameworks; lack of standard data set and unavailability of implementation of the methods. Furthermore, many limitations and assumptions on the problem have been made that threaten their applicability to the real world of web services composition.

4.2. Open problems and fields of future studies

Based on this review, we believe that future research in web services composition can be done in the following directions:

1. Dynamic, distributed and automatic web services composition,
2. Trust, privacy, and security consideration in composed services,
3. Validation and evaluation of web services composition,
4. Optimization of web services composition using Linear (Integer) programming and other new optimization algorithms like Imperialist Competitive Algorithm (ICA),
5. Semantic web services composition using ontologies (like OWL-S or WSMO),
6. Use of agent-based technologies because of intuitive harmony with the problem.
7. Optimization of web services composition based on users' feedback, reputation and service execution logs,

8. Using fuzzy logic in description of services and quality features, recognition and selection of services,

9. Considering user preferences in web services composition,

10. Improving reliability and fault-tolerance in composition execution.

4.3. Limitations of the present study

The most important restrictions of the present research can be summarized as follows:

1. Lack of full access to some of the articles,

2. Small-sized research team which has prolonged the SLR process,

3. Exclusion of studies published in other languages (especially Southeast-Asian languages, German and Russian).

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5. Appendices

Appendix 1: Summery of data extracted from selected studies

	Publication Kind (Conference Paper/ Journal Article)	h- index of publisher	Number of citations	Status of journal publishing the article, in SJR list	Service composite execution strategy (Orchestration/ Choreography)	Service composite planning strategy (Workflow-based/ AI planning-based)	Dynamic vs. static web services composition (Dynamic/ Static)	Semantic web services composition	Level of composition automation (Automatic/ Manual)	QoS-awareness	Focused QoS attributes (if exists)	Is the presented composition method is scalable?	Is the suggested composition method is distributed?	Whether the formal assessment has been done for the method?	Whether the implementation or prototyping has been available?
SS1 [107]	CP	17	1			AI	st	×	M	✓		×	×	×	×
SS2 [70]	CP	17	1		Orch	Wo	st	✓	M	✓		×	×	×	×
SS3 [192]	CP	21	2			AI	st	×	A	×		✓	×	✓	×
SS4 [189]	JA		17	Q1	Chor	AI	Dy	×	A	✓	Trust	×	✓	×	×
SS5 [206]	CP	26	70		Chor	Wo	St	×	M	×		×	×	×	×
SS6 [122]	CP	10	3		Chor	Wo	Dy	×	M	✓		×	×	×	×
SS7 [287]	CP	24	9		Chor	Wo	Dy	×	M	×		×	×	×	×
SS8 [274]	CP	19	10		Orch	AI	St	×	A	×		×	×	×	×
SS9 [273]	CP	13	1		Chor	Wo	Dy	×	A	×		×	✓	×	×
SS10 [300]	CP		2		Orch	AI	St	×	A	✓		×	×	×	×
SS11 [148]	CP		4		Orch	AI	Dy	×	M	✓		×	✓	×	✓
SS12 [147]	CP		10			AI	St	×	A	×		✓	×	×	×
SS13 [38]	CP	15	2		Orch	Wo	St	✓	A	×		×	✓	×	×
SS14 [232]	CP	9	9		Orch	AI	Dy	×	M	✓		×	×	×	×
SS15 [17]	CP		4		Orch	Wo	St	×	M	✓	Security	×	×	×	×
SS16 [57]	CP	26	12			AI	St	×	A	✓		×	×	✓	×
SS17 [279]	CP	12				Wo	St	✓	A	✓		×	×	✓	×
SS18 [292]	CP	17	5			Wo	St	✓	M	✓		×	×	×	×
SS19 [254]	CP	21	9		Orch	AI	St	×	M	✓		×	×	×	×
SS20 [91]	CP	7			Orch	AI	Dy	×	M	✓	Security Privacy	×	×	×	✓

SS21 [6]	CP	26	8		Orch	Wo	Dy	×	M	×		×	×	×	✓
SS22 [294]	CP	9				AI	Dy	✓	M	×		×	×	×	✓
SS23 [252]	CP					AI	St	✓	M	×		×	×	×	×
SS24 [164]	CP	17	7		Orch	Wo	St	×	M	✓	Execution cost	×	×	×	✓
SS25 [199]	CP	17	3			AI	St	✓	A	×		×	×	×	×
SS26 [66]	CP	26	26		Orch	Wo	St	×	M	✓	Privacy	×	×	×	✓
SS27 [118]	CP	26	21			Wo	St	✓	M	×		×	×	×	×
SS28 [4]	CP	21			Orch	AI	Dy	×	A	×	Execution cost	×	✓	×	✓
SS29 [119]	CP	15	2				St	×	M	✓		×	×	✓	×
SS30 [163]	CP	12	2			Wo	St	✓	A	×		×	×	×	×
SS31 [86]	CP		3		Orch	AI	St	×	M	✓		×	×	×	×
SS32 [127]	CP	21	9	Q1	Orch	Wo	St	×	M	×		×	×	×	×
SS33 [299]	CP	12	13		Orch	AI	St	✓	M	×		×	✓	×	✓
SS34 [289]	CP		5		Orch	AI	St	×	A	×		✓	×	×	×
SS35 [190]	CP	26			Orch	Wo	Dy	×	M	✓	Availability	×	×	✓	✓
SS36 [269]	JA	32	3	Q1	Orch	Wo	St	×	M	×		×	×	×	✓
SS37 [65]	CP	12	1		Orch	Wo	St	×	A	×		×	✓	×	✓
SS38 [40]	CP	12	1		Chor	Wo	St	✓	M	×	User constraints Preferences	×	×	×	×
SS39 [35]	CP		2		Orch	Wo	Dy	✓	A	×		×	×	×	✓
SS40 [138]	CP	12	0		Orch	Wo	St	×	M	✓	Privacy	×	×	×	×
SS41 [209]	JA	21	2		Orch	Wo	Dy	×	M	✓	Reliability	×	×	×	×
SS42 [183]	CP	0	0		Orch	Wo	St	×	M	×		×	×	×	×
SS43 [47]	CP	12	0		Orch	Wo	St	×	M	×		×	×	×	×
SS44 [169]	CP	0	0				St	×	A	✓		×	×	×	×
SS45 [13]	JA	32	31	Q1		Wo	Dy	×	M	✓	Response time Availability	×	✓	×	×
SS46 [179]	CP	7	1		Orch		Dy	✓	M	×		×	×	×	×
SS47 [165]	CP	0	0			AI	St	×	M	✓		×	×	×	×
SS48 [251]	CP	0	2		Orch	Wo	St	×	M	✓		×	×	×	×
SS49 [270]	CP	0	0			AI	Dy	×	M	✓		×	×	×	×
SS50 [68]	CP	0	1		Orch	Wo	St	✓	M	×		×	×	×	×
SS51 [69]	CP	0	0		Orch	Wo	St	✓	M	✓		×	×	✓	×
SS52 [5]	CP	12	0				St	✓	M	✓	Forensics	×	×	×	×
SS53 [12]	CP	0	62			AI	Dy	×	M	✓	Forensics	×	×	✓	×
SS54 [88]	CP	12	0		Orch	Wo	St	×	M	×		×	×	×	×
SS55 [180]	CP	12	0			Wo	St	×	M	✓		×	×	×	×
SS56 [61]	CP	12	0			AI	St	✓	A	×		×	×	×	×
SS57 [278]	CP	0	2			AI	Dy	×	A	✓		×	×	×	×
SS58 [29]	JA	36	6	Q2		Wo	St	✓	M	✓		×	×	×	×
SS59 [229]	CP	5	0			AI	St	×	M	✓		×	×	×	×
SS60 [152]	CP	12	1		Orch	Wo	St	✓	M	×		×	×	×	×
SS61 [33]	CP	0	0			AI	St	×	M	✓	Privacy	×	×	×	×
SS62 [96]	JA	32	0	Q1	Orch	Wo	St	✓	M	×		×	×	×	×
SS63 [151]	CP	0	1				Dy	×	M	✓	Flexibility	×	×	×	×
SS64 [109]	CP	20	2			Wo	Dy	×	M	×		×	×	×	×
SS65 [44]	CP	10	6		Orch	Wo	Dy	×	M	×	Reliability Fault tolerance	×	✓	×	×

SS66 [235]	CP	12	1			Wo	Dy	×	M	✓	Availability	×	✓	×	×
SS67 [27]	CP	0	0		Orch		St	✓	A	✓		×	×	×	×
SS68 [30]	JA	0	0		Orch	Wo	St	✓	M	✓		×	×	✓	×
SS69 [220]	CP	2	0		Orch	AI	St	×	A	×		×	×	×	×
SS70 [7]	CP	0	0		Orch	WoI	St	×	M	✓		×	×	×	×
SS71 [62]	CP	0	0			AI	St	×	M	✓		×	×	×	×
SS72 [74]	JA	46	1	Q2		AI	St	×	A	✓		×	×	✓	×
SS73 [125]	JA	0			Orch	AI	Dy	×	A	✓		×	×	×	×
SS74 [19]	JA	17		Q2	Orch	Wo	St	✓	A	✓	Trust	×	×	✓	×
SS75 [213]	JA				Orch	AI	St	×	A	×		✓	×	✓	✓
SS76 [226]	CP	177		Q4	Orch	AI	St	×	A	✓		×	×	×	×
SS77 [171]	JA	45		Q2	Orch	Wo	Dy	×	M	✓	Reliability Efficiency	×	×	×	×
SS78 [76]	JA	13	2		Orch	AI	St	×	A	×		×	×	×	×
SS79 [28]	CP				Chor	Wo	Dy	×	M	×		✓	✓	×	×
SS80 [129]	JA	4		Q4		AI	St	×	M	✓		×	×	×	×
SS81 [178]	CP	177	1	Q3	Orch	AI	St	×	M	✓		×	×	✓	×
SS82 [259]	CP	177	1	Q3	Orch	AI	Dy	×	M	✓	Trust	×	×	×	×
SS83 [103]	CP	177	1	Q3		AI	St	×	A	✓		×	×	×	×
SS84 [77]	CP	177		Q3		AI	St	×	A	✓		×	×	×	×
SS85 [224]	JA					AI	St	✓	M	✓		×	×	×	×
SS86 [191]	CP	177		Q3		AI	St	×	M	×		×	×	×	×
SS87 [284]	JA	6				AI	St	×	M	✓		×	×	✓	×
SS88 [79]	JA	42	11	Q1		AI	St	✓	A	✓		×	×	✓	×
SS89 [266]	JA	62		Q2		AI	Dy	×	M	✓		×	×	×	×
SS90 [32]	JA	14		Q3	Chor	Wo	Dy	✓	M	×	Reliability Fault tolerance	×	×	×	×
SS91 [255]	CP	177	2	Q3	Orch	AI	St	×	M	×		×	×	✓	×
SS92 [236]	CP	177		Q3			Dy	×	M	✓		×	×	×	×
SS93 [275]	CP	177		Q3		Wo	St	×	M	✓		×	×	×	×
SS94 [239]	JA	9	1			AI	Dy	×	M	×		×	×	×	×
SS95 [97]	JA	22		Q3	Orch	Wo	Dy	×	M	✓		×	×	×	×
SS96 [277]	JA	17	9	Q2		Wo	St	✓	M	✓		×	×	×	×
SS97 [157]	JA	14	1	Q3		AI	St	×	M	✓		×	×	×	×
SS98 [120]	JA	14	1	Q3	Orch	AI	St	✓	M	✓		×	×	×	×
SS99 [181]	JA	16		Q4	Orch	Wo	Dy	×	M	✓	Reputation	×	×	×	×
SS100 [155]	CP				Orch	Wo	St	×	M	✓		×	×	×	×
SS101 [243]	JA	14		Q3		AI	Dy	×	M	×		×	×	×	×
SS102 [143]	JA	19		Q4			St	✓	M	×		×	×	×	×
SS103 [295]	JA					Wo	Dy	✓	M	×		×	×	×	✓
SS104 [63]	JA	14		Q3	Orch		Dy	×	M	×		×	✓	×	×
SS105 [60]	JA	32	2	Q4		AI	St	✓	M	✓		×	×	×	×
SS106 [166]	CP	177		Q3		Wo	St	✓	A	×		×	×	×	×
SS107 [218]	CP	177		Q3	Orch	AI	Dy	✓	M	✓		×	×	✓	×
SS108 [18]	JA				Orch	AI	St	✓	A	×		✓	×	×	×
SS109 [188]	CP	177		Q3	chor	Wo	Dy	×	M	×		✓	✓	×	×
SS110 [39]	CP	177		Q3	Orch	Wo	St	×	M	×		×	×	×	×

SS111 [37]	CP	177	2	Q3	Orch	AI	St	×	M	✓	Reliability	×	×	✓	×
SS112 [64]	CP	177		Q3	Chor	Wo	Dy	×	M	×		✓	✓	×	×
SS113 [268]	CP	177	2	Q3		AI	St	×	A	×		×	×	×	×
SS114 [150]	JA	43	27	Q2		AI	Dy	×	A	✓	Reliability	×	×	×	×
SS115 [200]	CP	177	1	Q3	chor		St	✓	A	×		×	✓	×	×
SS116 [87]	JA	19		Q4	Orch	Wo	Dy	×	M	×	Fault tolerance Reliability	×	×	×	×
SS117 [22]	JA						Dy	×	M	✓		×	×	×	×
SS118 [291]	JA	31	6	Q3		Wo	St	×	M	✓		×	×	×	×
SS119 [121]	JA	29	1	Q2		Wo	St	×	M	×		×	×	×	×
SS120 [249]	CP	177		Q3		AI	St	×	A	×		×	×	×	×
SS121 [71]	CP	177		Q3		Wo	St	✓	M	×		×	×	×	×
SS122 [114]	CP	177	3	Q3	Orch	AI	St	✓	A	×		×	×	×	×
SS123 [84]	JA	19		Q4	Orch	Wo	Dy	×	M	✓		×	×	×	×
SS124 [234]	CP	177		Q3		Wo	St	×	M	✓		×	×	✓	✓
SS125 [215]	JA	19	4	Q4		AI	St	×	M	✓		×	×	✓	×
SS126 [160]	CP	177	1	Q3		AI	St	×	M	✓		×	×	✓	×
SS127 [136]	CP	177		Q3	Orch	AI	St	×	A	×		✓	×	×	×
SS128 [293]	CP	177		Q3		AI	St	×	M	✓		×	×	×	×
SS129 [204]	CP	177		Q3	Orch	Wo	St	✓	M	✓		×	×	×	×
SS130 [149]	CP	11	4		Orch	Wo	Dy	×	M	✓		×	×	×	×
SS131 [245]	CP	26	31		Orch	Wo	Dy	×	M	×		×	×	×	×
SS132 [280]	CP	7	3			AI	Dy	✓	A	✓		×	×	×	×
SS133 [272]	CP	13	2	Q1	Orch	Wo	Dy	×	M	×	Fault tolerance Reliability	×	×	×	×
SS134 [246]	CP	21	6			AI	Dy	✓	M	×		×	×	×	×
SS135 [172]	CP	6	28			AI	Dy	×	M	✓		×	×	×	×
SS136 [244]	CP	51	106		Orch	AI	St	×	M	✓		×	×	×	×
SS137 [93]	CP	13	1		Orch	Wo	Dy	✓	M	✓		×	×	×	×
SS138 [175]	CP		5		Orch		St	×	M	✓	Privacy	×	×	×	×
SS139 [113]	CP		5				Dy	✓	M	×		×	×	×	×
SS140 [130]	CP				Orch	Wo	Dy	×	M	×		×	×	×	×
SS141 [290]	CP	21	11			Wo	St	✓	M	×		×	×	×	×
SS142 [21]	CP	26	53			AI	St	✓	A	✓		✓	×	×	×
SS143 [72]	CP	14	1				St	×	M	✓		×	×	×	×
SS144 [135]	CP	3	1	Q3		Wo	St	×	M	✓		×	×	×	×
SS145 [265]	CP	19	7		Orch	Wo	St	×	M	×		×	×	×	×
SS146 [167]	CP		2		Orch	Wo	Dy	×	M	×		×	×	×	✓
SS147 [276]	CP	17	5			AI	St	✓	A	×		×	×	×	×
SS148 [271]	CP	17	28			AI	St	×	A	✓		×	×	×	×
SS149 [205]	CP		7				Dy	×	M	✓		×	×	×	×
SS150 [34]	CP	16	6				St	×	M	✓	Security	×	×	×	×
SS151 [285]	CP	8	4				Dy	×	M	✓		×	×	×	✓
SS152 [46]	CP	26	22		Orch	Wo	St	×	M	×		×	×	×	×
SS153 [207]	CP	26	71		Orch	Wo	St	×	M	×		×	×	×	×
SS154 [55]	CP	26	1			Wo	St	×	M	✓	Reliability Robustness	×	×	×	×
SS155 [90]	JA	36	265	Q1	Orch	Wo	St	×	M	✓		×	×	×	×

SS156 [288]	CP	19	79			AI	Dy	×	M	✓		×	×	×	×
SS157 [153]	JA	119	80	Q1		Wo	St	✓	M	✓		×	×	×	×
SS158 [217]	CP	26	64		Orch	AI	Dy	✓	A	×		×	×	×	×
SS159 [297]	CP	75	57	Q1		AI	St	×	M	✓		×	×	×	×
SS160 [170]	JA	67	58	Q2		Wo	St	×	M	✓		×	×	×	×
SS161 [247]	JA	94	54	Q1	chor	AI	St	×	A	×		×	✓	×	×
SS162 [20]	CP		45			Wo	Dy	×	M	✓	Trust Reputation	×	×	×	×
SS163 [240]	JA	112	42	Q1		AI	St	×	M	×		×	×	×	×
SS164 [85]	JA	48	39	Q3	Orch	Wo	St	×	M	×		×	×	×	×
SS165 [214]	CP	3	21		Orch	Wo	Dy	×	M	✓		×	×	×	×
SS166 [115]	JA	24	36		Orch	AI	St	✓	A	×		×	×	×	×
SS167 [301]	CP		32			AI	St	×	M	×		×	✓	×	×
SS168 [117]	CP	26	30		chor	Wo	Dy	×	M	×	Distribution Performance Scalability	✓	✓	×	×
SS169 [67]	JA		30	Q2			St	×	M	✓		×	×	×	×
SS170 [45]	JA	20	28	Q2			St	×	M	✓		×	×	×	×
SS171 [298]	CP		25		Orch	Wo	St	×	M	×		×	×	×	×
SS172 [134]	CP	49	24		Orch	Wo	St	×	M	×		×	×	×	×
SS173 [219]	JA	20	17	Q3	Orch	AI	St	✓	A	×		×	×	×	×
SS174 [262]	JA	31	26	Q1	Orch	Wo	Dy	×	A	×		×	×	×	×
SS175 [250]	JA		19		Orch	Wo	Dy	×	M	✓	Reliability	×	×	×	×
SS176 [241]	JA	36	22	Q1	Orch		St	×	M	×	Privacy	×	×	×	×
SS177 [264]	JA	10	22	Q1			St	×	M	×		×	×	×	×
SS178 [195]	JA	48	21	Q1			Dy	×	M	×		×	×	×	×
SS179 [177]	CP	21	17		Orch	Wo	Dy	×	M	✓		×	×	×	×
SS180 [11]	CP		14			Wo	St	×	M	✓	Execution cost Execution time Availability Successful execution rate	×	×	×	×
SS181 [196]	JA	48	18	Q1	Orch	Wo	Dy	×	M	×		×	×	×	×
SS182 [8]	JA	36	17	Q1	Orch	Wo	Dy	×	M	✓	Replaceability Reliability	×	×	×	×
SS183 [281]	CP	8	13			AI	St	×	M	✓		×	×	×	×
SS184 [10]	JA		15		Orch	Wo	St	×	M	✓	Execution cost Execution time Availability Reputation Successful execution rate	×	×	×	×
SS185 [203]	CP	12	14			AI	St	✓	A	✓		×	×	×	×
SS186 [116]	JA	22	15	Q4	Orch	AI	St	×	M	✓		×	×	×	×
SS187 [260]	CP	21	13		Orch	AI	St	×	M	×		×	×	×	×
SS187 [260]	CP	21	13		Orch	AI	St	×	M	×		×	×	×	×
SS188 [221]	JA		12		Orch	AI	St	✓	M	✓		×	×	×	×

SS189 [132]	JA	39	14	Q2		AI	Dy	✓	M	✓	Reputation Price Availability uration	×	×	×	×
SS190 [198]	JA	48	0	Q3		AI	St	×	M	×		×	×	×	×
SS191 [53]	JA	89	0	Q1	Orch	Wo	Dy	×	M	✓		×	×	×	×
SS192 [173]	JA	74	9	Q1	Orch	Wo	Dy	×	M	✓		×	×	×	×
SS193 [52]	JA	98	11	Q1		Wo	St	×	M	✓		×	✓	×	×
SS194 [16]	JA		0			Wo	St	×	M	✓		×	✓	×	×
SS195 [124]	CP	2	1		Orch	Wo	Dy	×	M	×		×	×	×	×
SS196 [256]	CP		0		Orch	Wo	St	✓	M	✓		×	×	✓	✓
SS197 [54]	CP	0	1		Orch	Wo	St	✓	M	✓		×	×	×	×
SS198 [73]	CP	14	0			AI	St	×	A	✓		×	×	×	×
SS199 [25]	JA	19	0	Q2		AI	St	✓	A	✓		×	×	✓	✓
SS200 [105]	JA	53	1	Q1	Orch	AI	St	×	A	✓	Response time Availability Reliability Price	×	×	✓	×
SS201 [94]	CP	0	0		Orch	Wo	St	×	M	✓		×	×	×	×
SS202 [283]	CP	0	0		chor	Wo	St	×	M	×		×	✓	×	×
SS203 [49]	JA	35	0		Orch	AI	St	×	A	✓		✓	×	×	×
SS204 [296]	CP	0	0		Orch	Wo	St	×	M	✓		×	×	×	×
SS205 [2]	CP	50	0		Orch	Wo	St	✓	M	×		×	×	×	×
SS206 [267]	CP	5	0		Orch	Wo	St	×	M	✓	Stability	×	×	×	×
SS207 [261]	JA	44	4	Q1	Orch	Wo	St	×	M	✓	Trust	×	×	×	×
SS208 [210]	CP	7	0		Orch	Wo	Dy	×	M	✓	Availability Performance	×	×	×	×
SS209 [168]	JA	44	4	Q1	Orch	Wo	St	×	M	✓		×	×	×	×
SS210 [14]	CP	0	1		Orch	AI	Dy	×	A	×	Availabilit	×	×	×	×
SS211 [208]	CP	0	2		Orch	AI	St	✓	A	✓		×	×	×	×
SS212 [176]	CP	8	2		Orch	AI	Dy	✓	M	×		×	×	×	×
SS213 [161]	JA	44	2	Q1	Orch	AI	St	×	A	✓		×	×	✓	✓
SS214 [194]	CP	7	1		Orch	AI	St	×	A	×		×	×	✓	✓
SS215 [48]	JA	44	0	Q1	Orch	AI	St	×	M	✓		×	×	×	×
SS216 [187]	JA	15	1	Q2		AI	St	×	A	×		×	×	×	×
SS217 [263]	JA	44	15		Orch	AI	St	×	A	×		×	×	×	×
SS218 [182]	CP	4	0		Chor	AI	Dy	×	A	×		×	✓	×	×
SS219 [156]	CP	9	0			AI	St	×	A	×		×	×	×	×
SS220 [216]	JA	44	32	Q1	Orch	Wo	St	×	M	×		✓	×	×	×
SS221 [141]	CP	5	0		Orch		Dy	×	M	✓		×	×	×	×
SS222 [?]	CP	7	2		Chor	Al	St	×	A	×		×	✓	×	×
SS223 [174]	JA	34	0				St	×	M	×		×	✓	×	×
SS224 [225]	CP	18	2		Orch	AI	St	×	A	✓		×	×	×	×
SS225 [184]	CP	4	0		Orch	Wo	Dy	×	M	✓	Reliability	×	×	×	×
SS226 [139]	CP	3	0		Orch	Wo	St	×	M	✓	Privacy	×	×	×	×
SS227 [56]	CP	9	0		Orch	Wo	St	✓	M	✓		×	×	×	×
SS228 [211]	CP	9	0		Orch	Wo	St	×	M	✓		×	×	×	×
SS229 [51]	CP	9	2		Orch	Wo	Dy	×	M	✓		×	×	✓	✓

SS230 [106]	JA	49	2	Q2	Orch	Wo	St	×	M	✓		×	×	×	×
SS231 [230]	JA	49	2	Q2		Wo	St	×	M	✓		×	×	×	×
SS232 [282]	CP	6	2		Orch	Wo	St	×	M	✓		×	×	×	×
SS233 [257]	CP	19	5				St	×	A	✓		×	×	×	×
SS234 [98]	CP	13	1			Wo	St	×	M	✓		×	×	×	✓
SS235 [99]	CP	13	2		Orch	AI	St	×	A	×		×	×	×	✓
SS236 [25]	JA	16	22	Q3	Orch	AI	St	×	A	✓		×	×	×	✓
SS237 [78]	CP	1	27			Wo	St	×	M	✓		×	×	×	×
SS238 [54]	CP	27	9			Wo	St	✓	M	✓		×	×	×	×
SS239 [102]	JA	25	2	Q4	Orch	AI	St	×	A	×		×	×	×	×
SS240 [9]	CP						St	×	M	✓		×	×	×	×
SS241 [258]	CP		4			Wo	St	×	A	✓		×	×	×	×
SS241 [231]	JA				Orch	AI	St	×	M	✓		×	×	×	×
SS243 [80]	JA	28		Q3	Orch	AI	St	×	A	×		×	×	×	×
SS244 [75]	CP		5			AI	St	×	A	✓		×	×	×	×
SS245 [128]	CP					AI	St	×	M	×		×	✓	×	×
SS246 [110]	CP					Wo	St	×	M	×		×	×	×	×
SS247 [286]	CP				Orch		Dy	×	M	✓		×	×	×	×
SS248 [101]	CP		1		Orch	Wo	St	×	M	×		×	×	×	×
SS249 [222]	CP		5		Orch	Wo	St	×	A	×		×	✓	×	×
SS250 [233]	CP		1		Orch	Wo	St	×	M	✓		×	×	×	×
SS251 [238]	CP		2		Orch	Wo	Dy	×	M	✓		×	×	×	×
SS252 [227]	CP		5		Orch	Wo	St	×	A	✓		×	×	×	×
SS253 [201]	CP				Orch	Wo	St	×	M	✓		×	×	×	×
SS254 [50]	JA	56	7	Q1	Orch	Wo	St	×	M	✓		×	×	×	×
SS255 [31]	JA	30	5	Q3		AI	St	×	A	×		×	×	×	×
SS256 [3]	CP		2				St	✓	M	✓	Security	×	×	×	×
SS256 [58]	CP				Orch	Wo	St	×	M	✓		×	×	×	×
SS258 [111]	CP						Dy	×	M	✓	Reliability	×	×	×	×
SS259 [140]	CP		9		Orch	Wo	St	×	M	×		×	×	×	×
SS260 [112]	JA	49		Q3			St	×	M	✓		×	×	×	×
SS261 [92]	CP		2		Orch	AI	Dy	✓	A	×		×	×	×	×
SS262 [223]	CP		1				St	×	M	×		×	×	×	×
SS263 [104]	CP		1		Orch	Wo	St	×	M	✓	Privacy Security	×	×	×	×
SS264 [95]	CP		1			Wo	St	×	M	✓		×	×	×	×
SS265 [123]	CP		3		Orch	AI	Dy	✓	M	×		×	×	×	×
SS266 [15]	CP				Orch	AI	Dy	×	A	×		×	✓	×	×
SS267 [43]	JA	40	1	Q3			St	×	M	✓	Fault tolerance	×	×	×	×
SS268 [193]	JA	25		Q3	Orch	Wo	St	×	M	✓		×	×	×	×
SS269 [248]	JA	47	3		Orch	AI	St	✓	A	×		×	×	×	×