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Capacity Planning of Cloud Computing Workloads

A Systematic Review

Presenter

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- Postgraduate in Management
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- Fields of Research: Software Engineering and Cloud Computing
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Summary

- **Subject:** Capacity Planning of Cloud Computing Workloads - A Systematic Review;

- **SLR Objective:** Identifying, evaluating and interpreting published research that examine sizing and capacity planning for cloud computing workloads;

- **Research Questions:**
  - What are the capacity planning models for cloud computing workloads available in scientific literature?
  - Do capacity planning models consider workloads with no historical use?
  - Are there capacity planning models for cloud computing workloads based on functional characteristics or its architecture?

Search and Extraction

Summary

- **Search, Extraction and Synthesis Strategies:**
  - Search for publications;

    ```
    (
    “cloud capacity planning” OR
    “capacity planning” AND “cloud computing” OR
    “capacity planning” AND “cloud”
    )
    ```
  - Manual classification of inclusion and exclusion criteria;
    - Inclusion Criteria
      - Publications related to research subject;
      - Studies published between 2017 and 2020;
    - Exclusion Criteria
      - Studies not published in the English language;
      - Studies that were unavailable online.
  - Titles and abstracts analysis;
  - Quality Analysis;
  - Synthesis.

Search and Extraction - Results

- **Selection Phase Results:**
  - 504 papers;
- **Phase 1 - Extraction (Title and Abstract Analysis):**
  - 137 included;
- **Phase 2 - Extraction (Answer Research Questions):**
  - 62 papers included;
- **Phase 3 - Quality Analysis:**
  - 52 papers included

- **Final Results:** 52 papers met our quality criteria.

Quality Analysis & Synthesis

Quality and Synthesis Method

- Establish the object of primary studies, from the perspective of capacity planning of cloud computing workloads available in the scientific literature;
- Define the thematic structure of the papers, standardizing labels and quantifying the findings:
  - Publication details (ID, Year, Country of Origin, Database);
  - Context of Publications (Capacity Planning Models, Most Used Keywords, Research Method Adopted, Research Objectives, Context of Studies);
  - Results of Publications (Methods of Data Collection, Scope of Studies, Results, Contribution generated);

Quality and Synthesis Method

- Standardization of variables and qualification structure for analysis of studies;
  - QC1 – Focus – Does the study examine capacity planning models for cloud computing workloads?
  - QC2 – Research – Is the study based on formal research methods - not just empirical applications?
  - QC3 – Objectives – Are the objectives of the study clearly defined?
  - QC4 – Context – Is the study context adequately described?
  - QC5 – Data Collection – Were the methods for data collection used and described correctly?
  - QC6 – Research Project – Was the research project adequate to achieve the research objectives?
  - QC7 – Validation – Have the research results been properly validated?
  - QC8 – Added Value – Does the study directly contribute to this research?
- Establish a protocol of divergences and convergences between studies;
- Extraction of keywords and grouping them among the quality criteria of the studies;
- Interpretation of the findings;
- Communication of results.

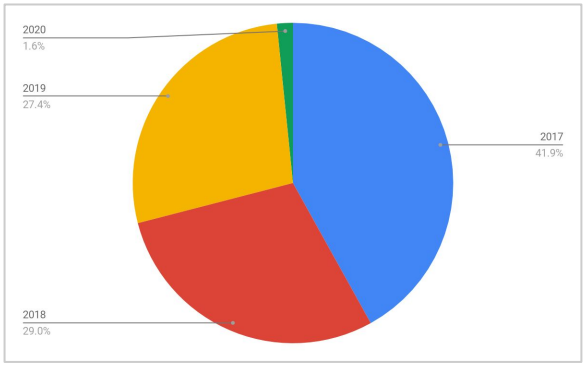
Results

Results

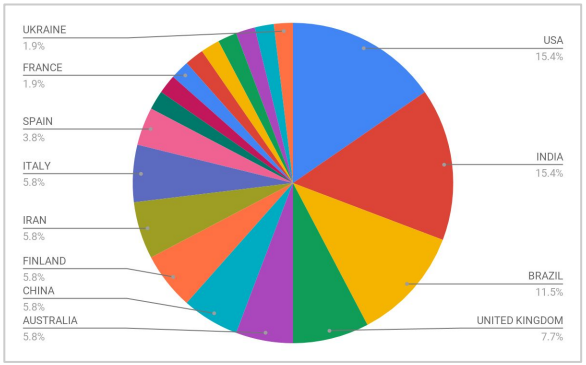
RQ1 - What are the capacity planning models for cloud computing workloads available in scientific literature?	RQ2 - Do capacity planning models consider workloads with no historical use?	RQ3 - Are there capacity planning models for cloud computing workloads based on functional characteristics or its architecture?
100% somehow responds Research Question 1	**25%** somehow responds Research Question 2	**42%** somehow responds Research Question 3

Results

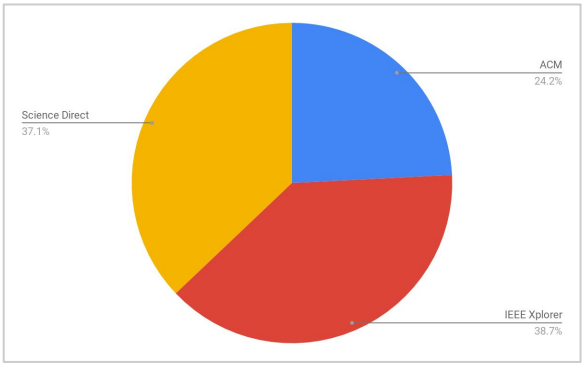
PUBLICATION YEAR



COUNTRY OF ORIGIN



DATABASE



QC1 – Focus – Does the study examine capacity planning models for cloud computing workloads?	QC2 – Research – Is the study based on formal research methods - not just empirical applications?	QC3 – Objectives – Are the objectives of the study clearly defined?	QC4 – Context – Is the study context adequately described?	QC5 – Data Collection – Were the methods for data collection used and described correctly?	QC6 – Research Project – Was the research project adequate to achieve the research objectives?	QC7 – Validation – Have the research results been properly validated?	QC8 – Added Value – Does the study directly contribute to this research?
100%	100%	73%	77%	67%	75%	77%	100%

Conclusions

Conclusions

- The research process conducted resulted in 52 primary studies;
- They were written by 185 authors affiliated to institutions of 19 different countries;
- Published between 2017 and 2020;
- There were identified 82 different keywords in all papers;
- Most of the publications were from:
  - United States and India (8 publications, each one with 15% of all primary studies);
  - Brazil (6 publications, 12% of all primary studies);
- The most common keywords used in primary studies:
  - cloud computing (13), capacity planning (8), performance model (5), resource management (5), prediction (4), application (3), performance (3), simulation (3), workload (3), auto-scaling (2), big data (2), quality of service (2), resource provisioning (2), web application (2), workload characterization (2);
- Top 3 keywords used - cloud computing and capacity planning, reflects exactly the subject of this research.

Conclusions

- This systematic review focuses on mapping and identifying studies that aim on establishing a formal process for capacity planning of cloud computing workloads;
- 504 papers were found, of which 52 were classified as primary studies;
- All papers were classified considering its focus on answering the research questions;
- Quality analysis was performed to access how the papers addressed eight different quality criteria;
- The majority of studies covered some sort of formal method to perform capacity planning of cloud computing workloads;
- Most of it focuses on historical use data to somehow predict future resources demands;
- This has not found a general method or framework to cover different types of workloads;
- There are methods to perform cloud capacity planning for specific workloads, but as mentioned before, each method establish a different approach and is focus in analyze a specific type of workload.

Thank you!

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