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A Systematic Mapping Study of Utility-Driven Models and Mechanisms for Interclouds or Federations

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Abstract-

Cloud computing is a dynamic paradigm that applies utility driven models at all layers in providing elastic services to the users and also facilitating the processes of the cloud provider. Utility-driven models and mechanisms for cloud federation play a very significant role on the cloud, hence worth researching on. However, the issue of finding out a similar study in models and mechanics for Interclouds or federation is an arduous task for most researchers. Systematic mapping studies delivers an outline of all that had been completed in a specific discipline. The objective is to carry out a systematic mapping study of utility driven models and mechanics for Interclouds or federation. Selected results showed that articles on environment had more in relation to metric with 2.78%, articles on design had more in terms of tool with 13.89%, articles on architecture had more in terms of model with 23.15%, articles on challenges had more in terms of method with 9.26%, and articles on policy had more in terms of tool with 6.48%. However, there were no articles on utility driven model and mechanisms for inter clouds or federation on the aspects of policy, architecture, design and challenges that consider metric. This study has identified research gaps in utility driven models and mechanics for Interclouds or federation which ought to inspire enthusiasm for further investigations by the scholars and industry experts.

Key words: Cloud computing, Cloud Federation, Interclouds, Systematic Mapping, Utility Driven Models.

1. Introduction

Cloud is a collection of corresponding and disseminated computing systems that comprises of a group of simulated, interconnected resources that are dynamically provisioned and has been identified as a group of computing resource(s) based on administration level understanding between the client and the cloud specialist organizations [1]. Cloud computing has several services being offered at all layers sometimes referred to as everything as a service (XaaS). However, the three cloud distribution representations are: Infrastructure-as-a-service (IaaS), Platform-as-a-service (PaaS), Software-as-a-service (SaaS). In SaaS, the cloud service providers (CSPs) using the internet provide applications and database to users. Such applications can be accessed through web browsers and user has no need for upgrade and licenses. In PaaS, the CSP offers the user the framework which enables the delivery of its own applications. However, the CSP controls the underlying infrastructure. In IaaS, several services are offered by the CSP through the internet, but the primary ones are the storage, network bandwidth, and compute resources. The user takes control of capacity and operating system and services presented on a pay-as-you-go basis. Cloud computing is an increasingly effective



service delivery platform, and those services are improving and expanding regularly on account of the underlying applications and architecture running on the cloud [2, 3].

There are four deployment models on the cloud which are private, public, community and hybrid clouds. Private clouds are usually hosted by one group on-premises which could be an expansion of the organizations' data center. Due to the fact that they are managed and utilized by in-house staff, they are considered more secure [4]. Public cloud Open offers benefits through the best in class foundation at the transfer of major CSPs. Community cloud are hosted by a third party for institutions that do similar things. Hybrid clouds leverage on the benefit of private clouds for hosting core functions, while using public clouds for less important activities. Even though the CSPs are endeavoring to give extremely effective and dependable administrations on the cloud, trust still remains an issue [5] There are lots of work going on in Interclouds and cloud federation. Interclouds aim to bring individuals and clouds in a manner that cloud users can access resources outside of a CSP's domain in a seamless manner. This has already been accomplished on the wireless network, but Interclouds are still in its theoretical stage. Here the term is cloud of clouds; then again, cloud federation associates the specialist organizations to decrease redundancy, especially in load balancing. A cloud customer who relies solely on the services of a CSP is sometimes without access to essentials and pays for resources, especially when the services are not available, hence the need for usage of multiple clouds to accomplish better quality of service (QoS), dependability and adaptability [6]. Cloud specialist organizations regularly propose their administrations utilizing restrictive administration programming, interfaces and virtualization that ruin the use of interoperability and relocation over suppliers' limits. However, organizing providers in federation has the potential to address these issues. Notwithstanding, because of the procedure of virtualization and multioccupancy on the cloud, there are worries about security [5, 7].

The Interclouds environment manages an exceedingly incorporated condition where administration correspondence is organized using coordinating instances [8, 9]. A joined cloud computing setting that assists in facilitating prompt opportunities and accessible provisions of application services, which dependably achieves QoS goals under adjustable workloads, resources as well as networks condition is discussed in [10]. Interclouds computing allows smooth interoperability between cloud, despite their hidden foundation, enabling clients to move their remaining tasks at hand crosswise over clouds effectively and also enabling the application of the concept of cloud brokerage [11]. The process of Interclouds and cloud federation are still in their early stages as can be alluded to from literature, hence it constitutes a veritable area for research. However, composing an article or setting out on research all in all, a specialist must think about a specialized region of intrigue. This includes a great deal of concentrates trying to comprehend the point. It typically involves looking through a few meeting procedures, diaries and even books. Furthermore, there may require seek through computerized libraries, go to workshops, classes and gatherings to so as to distinguish an exploration center. Likewise, watched wonder in a situation can fill in as force for some scientists to pick enthusiasm for specific regions. From the previous, clearly the way toward deciding an exploration point can be lumbering [12, 13]. On the other hand, systematic mapping studies assist in categorizing publications based on their frequencies and summarizing such studies in a way that is visual representation in form of a map is produced [14]. The map usually points to areas where gaps in study exists enabling a researcher to conduct further work.

The overview can be carried out in facets. It is built by examining utility driven models and mechanics for Interclouds or federation. Three facets were adopted in this paper namely: the topic, input, and the research aspects. The topic aspect was used to extract core issues on Interclouds and cloud federation as it relates to utility driven models and mechanism. The input aspect focused on issues like method and tool used, while the research aspect considered the type of research, for example, assessment and validation research [15]. Therefore, the objective of this paper is to conduct a systematic mapping study of utility driven models and mechanisms for Interclouds and cloud federation.

A number of works on systematic mapping, as related to this study, have been published and were reviewed. In [16] the scheduling stage of a systematic mapping study was investigated. The work identifies the software forms as apparent throughout the requirement engineering stage of developments, giving an understanding of the jobs carried out by these examples dependent on essential constraints required in the improvement procedure. A convention was produced for the investigation with fundamental strides to empower the replication of their work by the examination network for a validation of the study. The advanced libraries utilized for the study are ACM DL, IEEEExplore, SCOPUS, and Web of Science. The procedures arranged in [14] were observed for the study.

The study of [17] harps on the portrayal of the convention for a systematic mapping study as it identifies with space explicit dialects (DSL). The work is diverted towards an upgraded perception of the DSL space of research with an emphasis on research patterns and future bearing. This work secured the period July 2013 to October 2014, and it influences on three rules for performing methodical audit, to be specific; arranging, leading the survey, and announcing such.

[18] did a study on systematic mapping to improve the utilization of concept maps in Computer Science, however, the obtained result was centred on the concept and evaluation of the existing work in which five digital libraries were actualized using Backward snowballing and manual processes. The major objectives were achieved by proper investigation of concept map through effective teaching and learning.

In [19], an efficient mapping study was utilized to analyze how recreations related strategies have been utilized in programming building instruction and how these systems bolster explicit programming designing information spaces, with research holes, and future heading recognized. The essential investigations of the work moored on the utilization and assessment of recreations in programming building training. An aggregate of 156 essential investigations were recognized in this examination dependent on productions from 1974 to 2016. The mapping procedure of the work was done in accordance with the guiding principle in [14].

[20] completed a mapping of intensity framework model by giving a diagram of intensity framework models and their applications utilized by European associations regarding investigation of their demonstrating highlights and recognizable proof of displaying holes. There were 228 studies conveyed to control specialists for data elicitation, while 82 surveys were in the long run finished and utilized for the mapping.

[21], a deliberate mapping investigation of space explicit dialects was finished with fundamental enthusiasm for sort of commitment, kind of research, and the center zone. The work includes a pursuit from respectable sources from 2006 to 2012, while the precise mapping study done dependent on the procedure characterizing research questions, leading the hunt, screening, grouping, and the information extraction. The exploration materials for the work incorporates: supposition papers, experience papers, philosophical or theoretical papers, arrangement proposition, and approval examine materials.

[22] completed an efficient mapping of the writing on legitimate center ontologies. The work put together its pursuit with respect to "legitimate hypothesis" and "lawful ideas". Likewise, the chose investigations were classified dependent on commitments as far as language, apparatus, strategy, and model. Different advances incorporate ID of the utilized lawful hypotheses in lawful center ontologies building process, recognizable proof of spotlight with a reasonable proposal on the utilization of two ontologies, and the investigation of each picked research for relevant findings about legitimate and ontological research.

The study in [23] given an outline of exact research in programming cloud-based testing during the time spent structure an order plot and furthermore investigated non-useful and practical resting strategies. From 75 distributions, 69 essential examinations have been used. The examinations were utilized for a thorough factual investigation and a possible quantitative outcome. Dominant part of the investigations utilized a solitary examination for the assessment of their proposed arrangement. No related work on cloud business as well as legal implications have been found.

[24] introduced an extensive audit of learning the executives and the job Information Technology plays in those spots. Accentuation was likewise made on making, putting away, moving learning in associations.

[25], in their paper talked about the convenience and restrictions of deliberate writing survey in data framework and sociologies. They trust the general stand that methodical writing audit gives a comprehensive and better methodology than writing survey isn't just flawed yet in addition inadmissible. In their contention and avocation of this, they reasoned that alert and limits ought to be practiced while picking deliberate writing survey as it could undermine basic commitment with writing and the insightful idea of scholarly work.

[26] discussed the applicability the orderly writing audit procedure to programming building spaces. The study also discussed a number of reviews explored by other authors.

[27], in his paper opined that exploration reviews must give close consideration to thorough procedure that is expected of essential specialist. The creator further conceptualized research survey as a logical enquiry including five phases that parallel those essential researches which are: information accumulation, issue detailing, information focuses assessment, translation and examination of information. The wellsprings of change, capacities and the other potential treats to legitimacy with each stage are examined.

[28] given helpful bits of knowledge to specialists to doing writing survey. They proposed blending patterns and examples while getting ready to compose writing review, among which incorporates: the reason and voice before starting to compose must be considered, at that point think about how to reassemble the notes just as make a topical framework that follows the contention in the writing survey. These gives the rules to building up an intensive and intelligent writing review.

[29] evaluates the effect of methodical writing survey which are the prescribed proof-based programming designing techniques for conglomerating proof. The creators utilized a manual hunt of 10 Journals and 4 meeting procedures. 8 out of 20 contemplates investigated examine drifts rather. Cost estimation was investigated by 7 orderly writing audits. The nature of methodical writing surveys was reasonable with just three scoring under 2 out of 4.

[14] stressed the need to determine how the systematic mapping process is conducting based on related systematic maps. In the affirmative, systematic mapping studies have been conducting using best practices of some review guidelines. A number of guidelines have been used in conducting systematic mapping studies.

A systematic mapping study was conducted on deployment models for the cloud computing [30]. The categorization scheme considered design, service deployment, implementations, configurations, privacy, security in relation to design and deployment models. A total of 131 primary studies was utilized and the map created in line with the concepts in [31]. The search is conducted on ScienceDirect, ACM Digital Library, Springer and IEEExplore. There is no related on integrating cloud with IoT and edge computing.

2. Materials and Methods

This section presents the materials and methods utilized for this study.

2.1 Review Stage

The guidelines found in [32] and [33] are used for carrying out a methodical study for this paper. A methodical mapping study is a repeatable procedure for extracting and understanding available materials related to a investigation goal [30]. Fig. 1 details the steps necessary for a successful methodical mapping study. Firstly, the investigation interrogations are defined. Secondly, the search for primary studies are conducted then screening help determine relevant articles. The process of key wording is used on the abstracts for designing an arrangement plan. The previous stage comprises mining the data useful in constructing the systematic map.

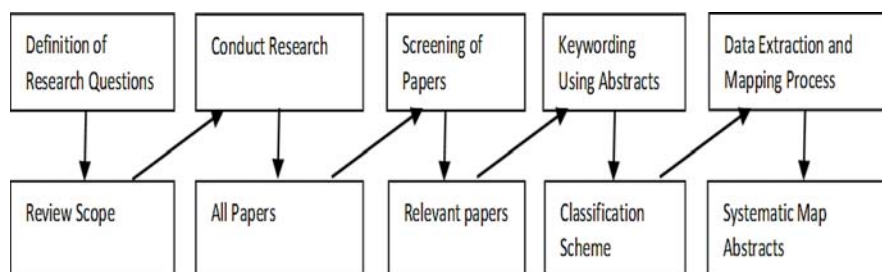


Figure 1: The Systematic Mapping Process [14]

2.2 Definition of Research Questions

The systematic map provides an insight quality of work that has been done in a particular knowledge domain. Which could likewise be essential to know where the papers were published. The resulting investigation question are defined below:

RQ1: What areas of utility-driven models and mechanism for inter-clouds or federations are addressed and how many articles cover the different areas?

RQ2: What types of papers are published in utility-driven models and mechanism for inter-clouds or federation and in particular what evaluations and novelty do they constitute?

2.3 Conduct of Research

The search is usually conducted on numerous scientific databases. This can also be done manually by searching journals and conference publications. Scope of the search only covers workshops, journals, books and conferences. Four major databases were because of the high impact factor of the journals and conference materials available in these databases. They are shown in Table 1.

Table 1: The Used Electronic databases

Electronic Database	URL
ACM	http://dl.acm.org/
IEEE	http://ieeexplore.ieee.org/Xplore/
Science Direct	http://www.sciencedirect.com/
Springer	http://www.springerlink.com/

Keywords from the title of the study are used in the search string and is presented as follows:

TITLE-ABS-KEY (“utility-driven”) AND TITLE-ABS-KEY (models) OR TITLE-ABS-KEY (mechanisms) AND ALL (inter cloud AND federation).

The inquiry string utilized on the metadata guarantees that significant papers are not absent. For the investigation on inter cloud and cloud federation all the result from the selected databases related to cloud computing and computer science were considered. In context of our paper decision criteria, portrayed by the necessities of the examination destinations and research questions, this study used 127 papers out of 1392. This study covered the period 2003 to 2018. The rundown of included essential examinations used for this study are listed at the Appendix section.

2.4 Screening Papers

The selection criteria employed in the study involve an inclusion and exclusion process where papers not irrelevant and do not relate to the research questions discard papers Some abstracts had the main focus but did not discuss sufficient details hence, they were also discarded. This investigation prohibited papers on board talks, publications, instructional exercises, introduction slides, preludes, and outlines. It was anyway fundamental to incorporate papers that had the principle center and furthermore talked about adequate optional subtleties. The principle focal point of this investigation is on utility driven models and components for

Interclouds and cloud federation. Therefore, the inclusion and exclusion criteria are as shown in Table 2.

Table 2: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
The abstract explicitly discussed utility-driven models and mechanisms are mentioned. In relations to inter cloud and cloud federation, such platforms relate to cloud computing.	The abstract lies outside the area of distributed computing and utility computing the theoretical does not talk about utility-driven models and mechanisms.

2.5 Keywording of Abstract

Key wording of abstracts is an important feature of the methodical mapping process. Key wording of abstract improves the advancement of the characterization plan. Key wording was important in reducing the time needed to develop the characterization plan. Additionally, key wording certified that all relevant papers were taken into consideration. The key wording process involved studying the overviews to isolate thoughts and watchwords fundamental to consider. This additionally included knowing the investigation setting. The watchwords from various papers incorporated into the examination were gathered to give a knowledge into the sort and commitment to the investigation. This procedure was utilized to advance the grouping plan and hence the classifications utilized for this examination. It was in some cases important to peruse the decision and acquaintance of a paper with guarantee dependable key wording of every single essential examination. A group of catchphrases was at long last used to decide the classes used to make the systematic map.

In the study on utility driven models and mechanisms for Interclouds and cloud federation, three facets were utilized. The first facet was the topic facet focused on topics obtained during the key wording process. The second facet dealt with type of contribution made by a paper to a field of concentrate similar to metric, technique, model, system and mechanical assembly as suggested in [14]. The third facet examined issues relating to research types.

2.6 Research Type Facets with Categories and Descriptions

The third facet is the study category based on the approach in [34] classifies the papers according to the following:

- **Validation research:** Properties of the solution used are unique, but not yet implemented. It is still at the experimental stage.
- **Evaluation research:** The problem is implemented and evaluated the outcomes in terms of pros and cons.
- **Solution proposal:** The advocates for the relevance of an answer for an issue. The applications and advantages of arrangement are talked about.
- **Philosophical papers:** The procedures proffer new way of tackling a problem in terms of ideas and structure.
- **Opinion papers:** The technique does not have any significant bearing any known philosophy for research; it just communicates the sentiment of the creators.

- **Personal Experience papers:** It also reveals how things were done by emphasizing on ‘what’ instead of ‘why’.

This order of research approaches was viewed as sufficient and fitting for use in the characterization plan of this investigation. All the essential examinations were evaluated based on the categories and description in the classification of research approaches. The outcome of this process was the research category results used in this study.

2.7 Data Extraction and the Mapping Study

As a major aspect of the systematic process, the included articles were sorted into the classification scheme. This phase was used in extracting data from relevant articles being used for the study. During the extraction process, new categories were formed; some categories were merged, while others not considered relevant were discarded. The data extraction process for this investigation was done on a Microsoft Excel sheet. A few Excel tables were utilized for the arrangement plot. From that point, the frequencies of distribution contained in each table was incorporated into the tables containing either the theme/commitment or research/subject. The frequency of publications was presented based on the results from Excel sheets. The goal was to identify which aspect of the selected topics on utility driven models and mechanisms for Interclouds and cloud federation had more emphasis. These revealed gaps in the study and indicated regions for further investigations.

In view of the outcomes on the Excel tables the frequencies of publications was represented by a bubble plot. The coordinates had bubble sizes that compare to the quantity of articles present in such class. There remained two quadrants due to the three aspects utilized in the categories which provided a visual representation of the facets. Bubbles were added to the summary statistics to aid understanding. This provided a quick overview of study in utility-driven models and mechanisms for inter-cloud and cloud federation.

3. Result and discussions

This section presents the findings and discussion of the results of this study. The systematic map on utility driven model and mechanism for inter clouds federations is at Figure 2. The first quadrant presents the topic and contribution facet intersection, while the second quadrant presents the topic and research facet intersection.

3.1 Topic and Contribution Facet

The topic category was central to this study has the following topic areas:

- a. Policy
- b. Architecture
- c. Design
- d. Challenge
- e. Environment
- f. Orthogonal

The rundown of essential examinations relating to the topics and contribution facet is at Table 3. The result indicated that publications that discussed model in relation to utility driven model

and mechanism on inter clouds or federation was 38.89% out of 108 papers reviewed. In addition, metric was 2.78%, tool had 27.78%, method had 21.3% and process had 9.26%. Model discussion contributed 38.89% of the papers reviewed. The breakdown showed that 23.15% of model discussion was on architecture, 13.89% was on design and 1.85% on environment. The remaining contributions are as shown in Figure 2.

Table 3: Primary Studies for Topic and Contribution facet

Contribution Facet	Metric	Tool	Model	Method	Process
Topic					
Policy		15, 29, 75,90, 104,112, 118		3, 5, 9, 62,65	20, 24, 26, 33, 46, 103
Architecture		1, 4, 55, 58, 66	8,10,21,22,23,27,30,31,32,36,39, 63,70,73, 81,83,84,87,89,92, 95,97, 98, 109,111	6, 45, 85, 91, 94,	
Design		7,12,18,25,37,41, 42, 47, 48,49, 51, 52,53, 56, 61	2, 17, 28, 38, 43,72, 82, 88, 93, 96, 105, 108, 115, 116, 121	99	
Challenges		14, 50, 54		11,13,16,19, 60,64, 67,69, 86, 117	68
Environment	35,79,80		74, 78	76, 77	34, 44, 107
Percentage	2.78%	27.78%	38.89%	21.30%	9.26%

3.2 Topic and Research Facet

The rundown of essential examinations relating to the topics and research facet is at Table 4. The results showed that publication that discussed solution research was 33.86% out of 127 papers in this category. Furthermore, evaluation had 24.41%, and experience had 14.96%. Solution research discussion constituted 33.86% of the papers reviewed. The breakdown showed that 1.55% solution research articles were on policy; 11.81% were on architecture, 18.11% were on design, and 2.36% were on environment. The remaining types of research and their contribution to the topic are shown in Figure 2.

Table 4: Topics and Contribution Facet Primary Studies

Research Facet	Evaluation	Validation	Solution	Philosophical	Experience	Opinion
Topic						
Policy	9,15,20,24, 26, 29, 57, 75, 90, 104, 112, 118	3, 5, 33, 46, 103	62, 65,			

Architecture	8, 10, 32, 71, 81, 83,	1, 4, 6, 55, 58,66	21, 22, 23, 27, 36, 39, 63, 70, 73, 84, 87, 95, 98, 109, 111	89, 92,	30, 31, 45, 85, 91, 94, 97,	
Design	115, 116, 119		7,12,18,25,37, 41,42, 47, 48, 49, 51, 52, 53, 56, 61, 72, 82, 88, 93, 96, 105, 108, 121	99	2, 17, 28, 38, 43	
Challenges	13, 16, 19, 64, 69, 86	11, 54, 50, 60, 101, 113		117	14, 67, 68	
Environment	35, 79, 80, 120	40, 59, 74, 100, 114	78, 102, 110	76, 77	34, 44, 106, 107	
Percentage	25.62%	18.18%	35.54%	4.96%	15.70%	0.00%

3.3 Major Findings

As mentioned earlier, the analysis made it possible to identify which category of the study had more emphasis. The following are the major findings from the results:

- Starting with the left quadrant, it was observed that there were more publications in terms of the topic on environment in relation to metric with 2.78%, more papers distributed on configuration regarding instrument with 13.89%, more articles on architecture in terms of model, more publications on challenges in terms of method and more publications on policy in terms of process.
- Similarly, the right quadrant illustrated that there were more publications that discussed policy in relation to evaluation research with 9.45%, and more articles examined challenges in terms of validation research with 4.725%. There were more publications that discussed architecture in terms of experience research with 4.72%.
- On the other hand, there were no articles on utility driven model and mechanisms for inter clouds or federation on the aspects of policy, architecture, design and challenges that focused on metric. There were no publications distributed on condition and symmetrical regarding apparatus. There were no examinations on approach and difficulties in connection to display. In addition, no papers on design in terms of validation research have been published. Also, no articles published on policy in terms of philosophical research and experience. In this study no opinion at all on utility driven models and mechanism for inter cloud and cloud federation.
- From the visual map of the study, it can be identified that topics architecture and design generally had the highest publications in terms of model and solution research respectively.

Obviously, several themes can be extracted from the visual map depending on the interest of a researcher. Generally, a lot of interesting aspects can be seen on the map. The graphic intrigue of a systematic map makes it very valuable especially with the combination of categories. The map will generate interest as it helps to summarize and makes results available to interested persons.

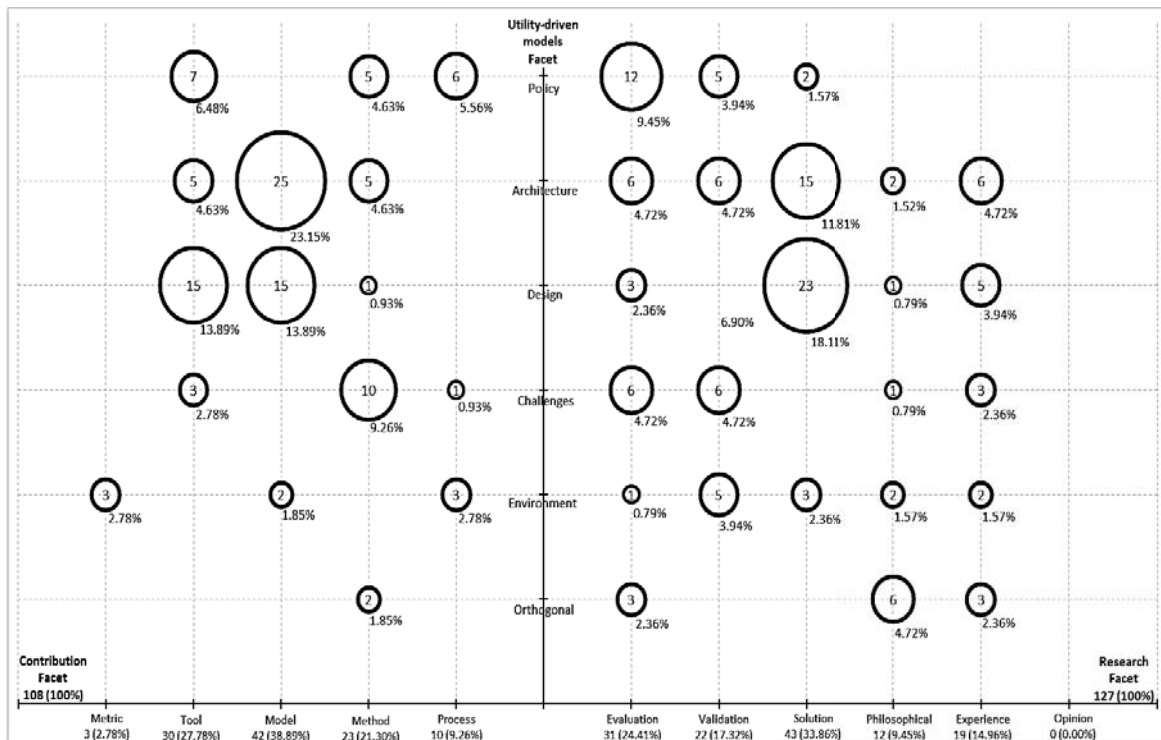


Figure 2: Systematic Map on Utility-Driven Models

Be sufficient to reference that a systematic map lacking uninterrupted systematic review is quite valued on its own. Due to the fact that the gaps in the objective of study is clearly presented, pointing intending researchers to interesting areas of research.

This work made available six categories of topics namely: policy, architecture, design, challenge, environment, orthogonal in relation to utility driven model and mechanism for inter clouds federations. The classes of study considered for further research are model, tool, process, metric or on the other hand as far as solution, justification evaluation, theoretical and estimation study. Lessons from this examination proves that research work is a never-ending process.

4. Conclusion

The cloud service providers and users have continued to enjoy mutual benefits and increased usage of the cloud has led to increases in concept, research work and attending technologies. The inter cloud and cloud federation are special areas in cloud computing that has continued to attract articles. There are volumes of studies on cloud federation and inter cloud relating to utility driven models and mechanism. Despite the level of research work, there are still several areas with very low level of research hence shortage of publications. This systematic mapping study has highlighted some of such areas, indicating gaps which could lead to further research in terms of utility driven model and mechanism for inter clouds federations. Contribution to knowledge has been realized by the gaps identified in several aspects of the study. The gaps identified would serve as a guide for research topics to be explored in the area of utility driven model and mechanism for inter clouds federations. Further study could likewise be done to approve this examination or reconcile conflicting issues. In overview, this systematic mapping

study of utility driven model and mechanism for inter clouds federations will go a long way in helping the researchers in discovering critical gaps of utility driven model and mechanism for inter clouds federations that have not been explored therefore improving research opportunities.

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Appendix: List of Primary Studies

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