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A Comprehensive Taxonomy of Modern Public Cloud Services for Infrastructure Selection

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ABSTRACT The rapid adoption of public cloud services has transformed the digital landscape, offering diverse solutions to meet different business needs. However, this diversity of services also presents a challenge: the need for a structured, comprehensive taxonomy to navigate and understand the offerings. This paper presents a comprehensive taxonomy for public cloud services, aiming to provide clarity and structure in this domain. Leveraging extensive market research, analysis of leading industry reports, and insights from top cloud vendors, we have identified key criteria that form the foundation of our taxonomy. The taxonomy passed the validation process, involving industry experts from Ukraine's largest telco operator, ensuring its practical relevance. The results have proven the taxonomy's effectiveness in classifying a wide range of cloud services, highlighting its potential as a valuable tool for businesses, researchers, and cloud practitioners. This research serves as a foundation for future improvement of complex processes of cloud provider selection.

KEYWORDS Cloud Computing; Private Cloud; Infrastructure as a Service; Platform as a Service.

I. INTRODUCTION

CLOUD computing has emerged as a key and foundational element in the digital transformation journey of numerous organizations spanning various industries and geographical regions. It has significant role in changing how computing resources are consumed and delivered. As different businesses aim to become more agile, responsive, and heavily data-driven, the undeniable appeal of flexible, scalable, and economically cost-effective computing resources, which are easily accessible, becomes very popular. The complex evolution and maturation of cloud services have surged and progressed at an astonishingly staggering rate. This has led to a flourishing and burgeoning ecosystem replete with a diverse array of tools, platforms, infrastructures, and associated technologies. Nevertheless, this rapid and swift expansion, while beneficial, brings with it the intricate challenge of deciphering and understanding the vast and expansive landscape of myriad offerings and solutions. Against this backdrop, this paper ambitiously aims and aspires to demystify and simplify the understanding of the modern public cloud environment. It does so by meticulously presenting a detailed and comprehensive taxonomy of the diverse services readily available in the contemporary market. This paper aims to simplify the modern public cloud environment understanding by presenting a comprehensive taxonomy of services available in the market.

The term "cloud computing" has been a subject of discussion and exploration for years. Mell and Grance [1] provided a seminal description, laying out the primary characteristics, service models, and deployment strategies of cloud computing. Their work has been foundational, offering a blueprint for understanding and segmenting cloud services. According to them, cloud computing is a model facilitating ubiquitous, convenient, on-demand network access to shared computing resources that can be provisioned rapidly and released with minimal management effort or service provider interaction.

In accordance with this publication from the NIST, four deployment models of cloud computing services have been established.

In recent years, several authoritative reports and studies have delved deeper into the cloud market, observing its growth trends and forecasting its future trajectory. For instance, the Flexera 2023 State of the Cloud Report [2] offers a wealth of insights into how enterprises are adopting and optimizing cloud usage. Based on this report, most of the organization embrace multi-cloud approach with Public Cloud as a key element of Infrastructure.

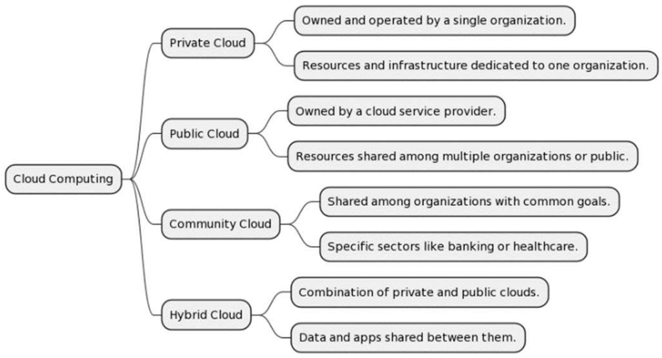

Figure 1. Cloud Services Deployment Models

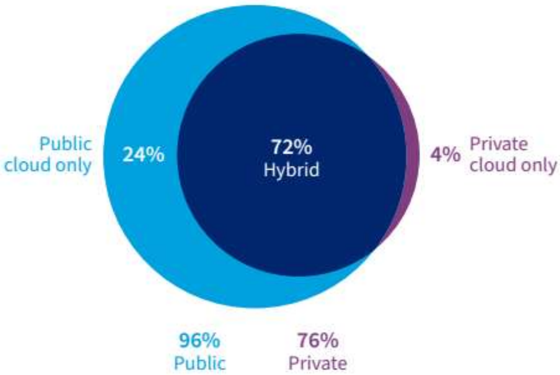

Figure 2. Public vs. private cloud usage [2].

Furthermore, the analysis and reviews offered by leading industry research firms such as Gartner [3] and Forrester [4] provide crucial qualitative data on the state of the cloud market. Such insights provide an empirical foundation upon which a taxonomy can be based, ensuring its relevance and applicability.

Forrester's analysis complements this perspective, emphasizing the significance of public cloud platforms in today's global digital landscape. The Forrester Wave: Public Cloud Development And Infrastructure Platforms report from Q4 2022 [4] offers a rigorous evaluation of the top providers in the space, considering their offerings, strategy, and market presence. Based on Forrester's 33-criterion evaluation of public cloud development and infrastructure platform providers identified the 10 most significant ones — Alibaba, Amazon Web Services (AWS), Google, IBM, Microsoft, Oracle, OVHcloud, Rackspace Technology, Salesforce, and SAP.

The Gartner Magic Quadrant for Cloud Infrastructure and Platform Services [3] further highlights the leaders, challengers, visionaries, and niche players in the market, presenting a holistic view of the competitive landscape in 2022. Based on this report the key players are Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform, Alibaba Cloud, Oracle Cloud Infrastructure, Tencent Cloud, IBM Cloud and Huawei Cloud.

Furthermore, IDC's Worldwide Whole Cloud Forecast for 2022–2026 [5] encapsulates the next stages of the shift to a cloud-centric technology industry. The report underscores the anticipated movements in the market, including projections about growth areas and potential saturation points paying special attention to such key players as Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform, IBM Cloud and Oracle Cloud.

Considering this wealth of data and analysis, there is an inherent need to organize and classify the variety of public cloud services available to users today. Such a taxonomy serves multiple purposes. Firstly, it acts as a guide for businesses and individuals looking to navigate the vast cloud landscape. Secondly, it provides researchers and academics with a structured framework to study the evolution of cloud services over time. Lastly, for vendors and service providers, understanding such a taxonomy can guide product development, marketing, and strategic decisions.

In this work, we perform a general taxonomy of Public Cloud Services based on solution provided by the following key vendors recognized as leader based on market share:

- Amazon Web Services (AWS)
- Microsoft Azure
- Google Cloud Platform
- Alibaba Cloud
- Oracle Cloud Infrastructure
- Tencent Cloud
- IBM Cloud
- OVHcloud
- Rackspace Technology
- Salesforce
- SAP
- Huawei Cloud

This paper seeks to present a comprehensive, structured, and informed view of the modern public cloud services ecosystem, grounded in both seminal academic definitions and cutting-edge market research. As cloud technologies continue to evolve and influence the broader IT landscape, a clear understanding of the available tools, platforms, and infrastructures becomes increasingly crucial for all stakeholders.

II. RELATED WORK

Cloud Computing has garnered significant attention in both academic and business environments due to its transformative potential in how data and services are managed. While the concept of cloud computing is not entirely new, its evolution and significance in modern technology landscapes cannot be understated.

This section integrates the key insights from related work, offering a comprehensive overview of cloud computing's taxonomy studies, its various models, and the associated challenges.

The pursuit to categorize and systematize the vast expanse of cloud computing services and technologies has been the objective of several scientific papers in recent times. One of the most salient points from their review is the identification of the essential characteristics of cloud computing as defined by the National Institute of Standards and Technology (NIST) [1]. This standard defines the following Service Models:

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

In [6] authors compare public clouds and private data centers emphasizing the following advantages of Public Cloud:

- Appearance of infinite computing resources on demand.
- Elimination of an up-front commitment by Cloud users.

- Ability to pay for use of computing resources on a short-term basis as needed.
- Economies of scale due to very large data centers.
- Higher utilization by multiplexing of workloads from different organizations.
- Simplify operation and increase utilization via resource virtualization.

In this paper, the following key distinguishing features of different cloud providers are defined:

- Availability/Business Continuity.
- Data Lock-In.
- Data Confidentiality and Auditability.
- Data Transfer Bottlenecks.
- Performance Unpredictability.
- Scalable Storage.
- Bugs in Large Distributed Systems.
- Scaling Quickly.
- Reputation Fate Sharing.
- Software Licensing.

Zhang, Cheng, and Boutaba [7] presented an in-depth survey of cloud computing, emphasizing its key concepts, architectural principles, and the state-of-the-art implementation. They highlighted the layered model of cloud computing, which includes the hardware/datacenter layer, the infrastructure layer, the platform layer, and the application layer. The authors also discussed the business models associated with cloud computing, categorizing them into Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Furthermore, they explored the different types of clouds, such as public clouds, private clouds, hybrid clouds, and Virtual Private Clouds (VPC), each with its unique benefits and challenges.

In their comprehensive review, Diaby and Rad [8] traced the evolution and history of cloud computing, providing a detailed overview of its various definitions. They emphasized the primary service models of cloud computing, which, consistent with the NIST standard, encompass Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Beyond these service models, their work also shed light on the different deployment models of cloud computing, classifying them into private, public, hybrid, and community clouds.

Building upon this foundation, other authors [9] provided insights into the opportunities and challenges associated with cloud computing delivery and its models. They highlighted the transformative potential of cloud computing, emphasizing its roots in grid and distributed computing. The paper underscored the importance of understanding the various delivery models and their implications, especially in the context of security concerns, data storage, and network vulnerabilities. Their work serves as a testament to the dynamic nature of cloud computing, emphasizing the need for robust security measures and the challenges posed by virtualization techniques.

Another paper [10] provides a detailed taxonomy of security issues across various cloud infrastructure levels. These levels include the application, network, host, and data. At each level, the authors identify potential security threats and challenges:

- Application Level: This level is most exposed to end-users and is susceptible to threats like malware, Distributed Denial of Service (DDoS) attacks, and application vulnerabilities.
- Network Level: Challenges here include eavesdropping, man-in-the-middle attacks, and IP spoofing.
- Host Level: This level faces threats from virtual machine (VM) escape, VM hopping, and side-channel attacks.
- Data Level: Data breaches, data loss, and data unavailability are primary concerns at this level.

Rania Fahim El-Gazzar paper [11] delves deep into the various factors affecting cloud adoption, categorizing them into distinct categories such as internal, external, evaluation, and more. Among these, certain adoption factors stand out as particularly valuable for the taxonomy of cloud services. These factors, when understood and addressed, can be applied in a structured framework for enterprises to navigate the complex landscape of cloud services.

Mohammed Alnuem et al. (2018) [12] in their paper focuses on a comparative analysis of various Information Security Risk Management (ISRM) frameworks tailored for cloud environments. A notable aspect of this paper is its emphasis on taxonomy, which provides a structured and comprehensive approach to understanding and categorizing the multifaceted dimensions of cloud security risks. One of the paper's strengths lies in its systematic approach to comparison. By dissecting each framework through the lens of the taxonomy, the authors provide a clear picture of how each framework aligns with the unique challenges posed by cloud computing. For instance, while some frameworks offer robust mechanisms for risk identification and assessment, they might fall short in providing clear guidelines for risk mitigation in a cloud context. Such insights are invaluable for incorporating in holistic private cloud taxonomy.

A systematic literature review by Amin Jula, Elankovan Sundararajan, and Zalinda Othman [13] delves into the intricacies of cloud service composition, emphasizing the significance of taxonomy in streamlining the selection and optimization of cloud services. Through a meticulous systematic literature review, the authors explore the challenges faced by cloud service brokers, such as selecting appropriate services, navigating composition restrictions, and prioritizing various quality of service parameters. Central to their discourse is the role of taxonomy in facilitating efficient service composition, ensuring that users can seamlessly access and integrate the myriad services offered in the cloud ecosystem. The paper underscores the five essential characteristics of cloud computing, its three service models (SaaS, PaaS, IaaS), and the four deployment models, highlighting the importance of a structured classification system in enhancing the user experience and ensuring optimal resource utilization. This research serves as a pivotal reference for stakeholders in the cloud domain, emphasizing the indispensable role of taxonomy in navigating the complex landscape of cloud computing services.

In [14] the comprehensive taxonomy was developed using a method by Nickerson. It started with a systematic literature review, followed by workshops with experts from industry and science. The taxonomy was iteratively refined based on feedback and insights. This taxonomy is divided into three meta-dimensions based on the Kano model of customer satisfaction: Basic needs, Performance needs, and Attractive needs. Each meta-dimension has specific dimensions and characteristics. For instance, under Basic needs, there are dimensions like deployments (with characteristics like private, public, hybrid, community) and services (IaaS, PaaS, SaaS).

Finally, "A Comparative Taxonomy and Survey of Public Cloud Infrastructure Vendors" by Dimitrios Sikeridis, Ioannis Papapanagiotou, Bhaskar Prasad Rimal, and Michael Devetsikiotis [15] provides a comprehensive taxonomy of cloud services offered by four dominant cloud vendors. The primary focus of the paper is to identify similarities, common design approaches, and functional differences in the services provided by these vendors. The authors have taken a systematic approach to classify the services into major categories such as computing, storage, databases, analytics, data pipelines, machine learning, and networking. This categorization is logical and aligns with the general understanding of cloud services. The authors acknowledge the dynamic nature of the cloud industry, where services are continuously updated, and new ones are introduced. This acknowledgment is crucial as it sets the expectation for the readers about the temporal relevance of the taxonomy. While the paper provides a comprehensive taxonomy, it primarily focuses on the top four vendors by market share. Including more vendors or a broader range of services might have provided a more exhaustive view. However, focusing on the top four players does ensure that the most widely used and recognized services are covered.

The dynamic nature of the cloud computing landscape necessitates a continuous evolution in the way we understand and categorize its services. As evident from the reviewed literature, while significant strides have been made in developing taxonomies for cloud services, the rapidly changing private cloud market, the emergence of a broader list of vendors, and the need for a more holistic view underscore the importance of revisiting and refining these taxonomies.

The reviewed works provide a comprehensive overview of the existing taxonomies, emphasizing the importance of structured categorization for better understanding and utilization of cloud services. However, as the cloud market expands and diversifies, there is a pressing need to incorporate newer services, vendors, and paradigms into these taxonomies. For instance, while the focus of many taxonomies has been on the dominant players in the market, the emergence of niche and specialized vendors calls for a more inclusive taxonomy that captures the breadth of offerings in the market.

Furthermore, the reviewed literature highlights the importance of a holistic view that goes beyond just categorizing services. As cloud computing becomes more intertwined with other technological paradigms like IoT, AI, and edge computing, the taxonomy needs to reflect these intersections and the new challenges and opportunities they bring.

While the existing taxonomies provide a solid foundation, the dynamic nature of the cloud computing landscape calls for continuous refinement and expansion of these taxonomies. A more comprehensive and up-to-date taxonomy will not only aid researchers and practitioners in navigating the complex cloud ecosystem but will also ensure that the full potential of cloud computing is realized in various application domains.

III. RESEARCH METHODOLOGY

In our study, we adopted a systematic and structured approach to develop a comprehensive taxonomy. The methodology was designed to ensure a thorough understanding of the current cloud landscape and to create a taxonomy that is both relevant and usable.

We meticulously employed a systematic and structured approach grounded in scientific rigor. The methodology was meticulously crafted to ensure not only a profound understanding of the prevailing cloud landscape but also to produce a taxonomy that stands up to academic scrutiny and offers practical relevance. The overarching goal was to bridge any existing gaps in the literature while providing a holistic view of modern public cloud services. The subsequent sections elucidate the methodological steps, underpinned by specific goals and scientific criteria, undertaken in our research:

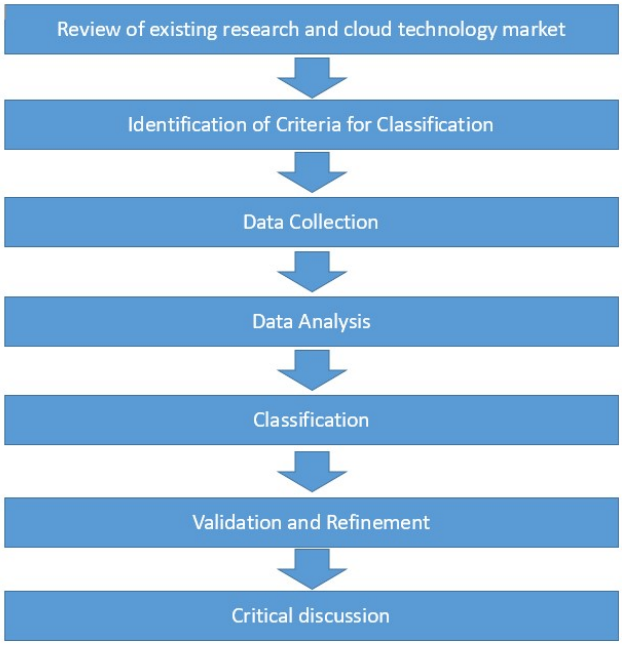

Figure 3. Research methodology.

In synthesizing the insights from these comprehensive studies, this paper endeavors to present a consolidated taxonomy of modern public cloud services, contextualized within the current technological landscape.

The goal of Review of Existing Research and Cloud Technology Market step is to to construct a foundational knowledge base by synthesizing insights from extant literature and industry reports. This step aims to discern the current state of cloud services, identify dominant market players, and highlight any gaps or emerging trends in the existing taxonomies.

The goal of Identification of Criteria for Classification step is to delineate the essential features and characteristics intrinsic to cloud services. This phase is pivotal for establishing the parameters that will guide the subsequent classification, ensuring that the taxonomy is both comprehensive and relevant.

The goal of Data Collection step is to amass a robust dataset on cloud services from leading providers. By focusing on top market players and solutions, this step ensures that the taxonomy is representative of the most influential and widely adopted cloud services in the current market landscape.

The goal of Data Analysis step is to meticulously scrutinize the amassed data, identifying patterns, disparities, and unique attributes of various cloud services. This analytical phase is crucial for understanding the underlying structure and relationships within the dataset.

The goal of Classification step is to systematically categorize cloud services based on the previously identified criteria. This step transforms the analyzed data into a structured taxonomy, segmenting services into distinct categories and subcategories that reflect their core functionalities and attributes.

The goal of Validation and Refinement step is to ensure the taxonomy's robustness and applicability. By engaging a cohort of experts for validation, this step seeks to refine the taxonomy, making adjustments based on expert feedback to enhance its usability and precision.

The goal of Critical Discussion step is to reflect upon the taxonomy's development process, its implications, and potential areas for future research. This step provides a platform for introspection, discussing challenges encountered, and charting directions for subsequent research endeavors in the realm of cloud service taxonomies.

IV. REVIEW CLOUD TECHNOLOGIES MARKET

The realm of cloud computing has witnessed a proliferation of vendors, each offering a myriad of services tailored to diverse business needs. To ensure that our research captures a representative and comprehensive snapshot of the current cloud landscape, it is imperative to focus on vendors that have a significant impact on the market. Our selection criteria were rooted in a two-pronged approach:

- Market Share Analysis: A primary determinant of a vendor's influence and reach in the cloud market is its market share [2-5]. Vendors with a substantial market share not only demonstrate a high adoption rate among users but also set industry standards and trends. By focusing on these dominant players, our research ensures that the resulting taxonomy is both relevant and reflective of the services most widely utilized in the industry.
- Industry Research Firm Reviews: Leading industry research firms, with their rigorous methodologies and in-depth analyses, offer invaluable insights into the cloud market's dynamics [2-5]. Their evaluations, often based on parameters like service offerings, innovation, customer feedback, and global presence, provide a holistic view of each vendor's strengths and market positioning. By integrating these insights into our selection process, we ensure that our vendor list is both comprehensive and aligned with industry perspectives.

Given these criteria, the following vendors have been identified for consideration:

- Amazon Web Services (AWS) [16].
- Microsoft Azure [17].
- Google Cloud Platform [18].
- Alibaba Cloud [19].
- Oracle Cloud Infrastructure [20].
- Tencent Cloud [21].
- IBM Cloud [22].
- OVHcloud [23].
- Rackspace Technology [24].
- Salesforce [25].
- SAP [26].
- Huawei Cloud [27].

The selected vendors not only represent a significant portion of the cloud market share but also encompass a diverse range of services and geographical presences. This list, therefore, provides a robust foundation for a comprehensive and relevant exploration of modern public cloud services.

V. IDENTIFICATION OF CRITERIA FOR CLASSIFICATION AND TAXONOMY CREATION

This section aims to identify, describe, and decide on the necessary criteria for the classification of cloud services, offering a cohesive framework to understand and evaluate them, collect, analyze the data from vendors' offerings as well visual taxonomy hierarchy creation.

The identification of cloud services features is paramount to understanding their capabilities. The process was conducted systematically. Leading cloud service providers, including Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform, and others, were examined. Their service portfolios were analyzed to identify commonalities and unique offerings.

For a structured classification of cloud services, the following criteria were used:

- Functionality. The primary function of the service is the core criteria. Services were categorized based on what they primarily offer to the end-users.
- Usage & Popularity. Services widely adopted in the industry were given precedence. This ensured that the classification remained relevant to both academia and industry practitioners.
- Inter-dependability. If services typically operate in tandem or rely heavily on another service for functionality, they were grouped under the same category. For example, virtual networks and load balancers are both essential parts of cloud networking.
- Scalability. Services offering similar scalability options, be it horizontal or vertical scaling, were considered together.
- Security and Compliance. Given the growing emphasis on data privacy and security, services were also evaluated based on the security features they offer and how they comply with global regulations.

After a meticulous identification process, the 24 key cloud services features were recognized:

- Compute;
- Storage;
- Databases;
- Networking;
- Developer tools;
- Analytics & Big Data;
- AI/ML;
- Security & Identity;
- IoT;
- Migration & Hybrid Cloud;
- Management & Governance;
- Mobile Services;
- Enterprise Integration;
- Front-end Web & Mobile;
- Business Applications;
- Blockchain;

- Gaming;
- Multimedia Services;
- Content Delivery Networks;
- Satellite Services;
- Robotics;
- Quantum Computing;
- VR/AR.

The mind maps for each subgroup of services have been also created.

VI. TAXONOMY VALIDATION

The taxonomy outlined in the preceding section was the result of meticulous research, examination of primary vendors, and rigorous criteria classification. However, any proposed taxonomy, no matter how comprehensive, requires validation in real-world scenarios to ascertain its efficacy and applicability. This section delves into the validation process of our taxonomy, emphasizing its testing with a select group of experts from a leading Ukrainian telco operator and its subsequent use for classification of top public cloud providers.

For the purpose of validation, experts were chosen from one of Ukraine's largest telco operator. The selected group consisted of Senior Cloud Architect with extensive experience in designing and deploying cloud solutions, DevOps Technical Lead who oversee the day-to-day functionalities of various cloud services and IT Strategists and decision-makers responsible for choosing and integrating cloud solutions.

This diverse group ensured that the taxonomy was evaluated from multiple perspectives, ranging from technical design to operational feasibility.

A structured framework was established to guide the testing process. This consisted of:

- Orientation Session. An initial session to familiarize the experts with the proposed taxonomy. This included a detailed walkthrough of the classification criteria and the reasoning behind each group and subgroup.
- Scenario-based Testing. Experts were presented with various scenarios where they had to classify cloud services of varying complexities using the proposed taxonomy.
- Feedback Collection. After the testing, experts shared their insights, potential discrepancies they observed, and suggestions for refinements.

Post the orientation and scenario-based testing, experts were tasked with classifying services from top public cloud providers using the proposed taxonomy. This exercise aimed to evaluate the taxonomy's comprehensiveness and its capacity to accommodate real-world cloud offerings. Cloud providers included giants like Amazon Web Services (AWS), Google Cloud Platform (GCP), Microsoft Azure (MA), and others.

Below you can the sample of validation table.

Table 1. Public Cloud Classification (sample).

Groups & subgroups	**AWS**	**MA**	**GCP**
Compute			
Virtual Machines	EC2	Azure VM	Google Compute Engine
Containers & Kubernetes	EKS, ECS	AKS	Google Kubernetes Engine (GKE), Google Cloud Run
Serverless Functions	Lambda	Azure Functions	Cloud Functions
Batch & High-Performance Computing	AWS Batch, EC2 Spot Instances	Azure Batch, Azure High-Performance Computing (HPC)	Preemptible VMs
Storage			
Object Storage	S3	Blob Storage	Cloud Storage
Block Storage	EBS	Disk Storage, Managed Disks	Persistent Disk
File Systems	EFS	Azure Files	Filestore
Cold & Archival Storage	Glacier, S3 IA	Cool and Archive Blob Storage	Nearline, Coldline, Archive
Databases			
Relational Databases	RDS, Aurora	Azure SQL Database	Cloud SQL
NoSQL Databases	DynamoDB	Cosmos DB	Firestore, Bigtable
In-memory Databases	ElastiCache	Azure Cache for Redis	Memorystore
Database Migration Services	DMS	Azure Database Migration Service	BigQuery Data Transfer Service, Database Migration Service
Networking			
Virtual Private Cloud (VPC)	VPC	Virtual Network (VNet)	VPC
Content Delivery Network (CDN)	CloudFront	Azure CDN	Cloud CDN
Load Balancing	Elastic Load Balancing (ELB) Application Load Balancer (ALB) Network Load Balancer (NLB)	Load Balancer	Load Balancer
Network Security & Firewalls	Security Groups, NACLs, WAF	Azure Firewall, Network Security Groups	Cloud Armor, Firewall Rules, Identity-Aware Proxy (IAP)
Developer Tools			
Integrated Development Environments (IDE)	Cloud9	Azure DevOps Services, Visual Studio Code (VS Code)	Cloud Code, Cloud Shell Cloud SDK
Continuous Integration & Deployment (CI/CD)	CodePipeline, CodeBuild, CodeDeploy	Azure Pipelines	Cloud Build
Source Control	CodeCommit	Azure Repos	Cloud Source Repositories
Monitoring & Logging Tools	CloudWatch, CloudTrail	Azure Monitor, Log Analytics	Stackdriver (Cloud Monitoring & Logging)
Analytics & Big Data			
Data Lakes	S3, Lake Formation, Glue	Azure Data Lake Storage	Cloud Storage, Dataproc
Big Data Processing	EMR	Azure HDInsight, Databricks	Dataproc, Dataflow
Real-time Analytics	Kinesis	Azure Stream Analytics	Dataflow, Pub/Sub
Data Warehousing	Redshift	Azure Synapse Analytics	BigQuery

The classification exercise yielded several pivotal insights:

- • High Concordance Rate. There was a significant agreement among experts regarding the classification of most services, suggesting that the taxonomy was intuitive and aligned with industry understanding.
- • Flexibility. The taxonomy was found to be flexible, accommodating cloud services that were unique or proprietary to specific providers without necessitating major alterations.
- • Relevance. The criteria-based structure of the taxonomy was deemed relevant and timely, reflecting current industry trends and demands.
- • Suggested Refinements. While the taxonomy was largely validated, experts did suggest minor refinements in certain subgroup definitions for increased clarity.

VII. FUTURE RESEARCH CHALLENGES

The rapid evolution of cloud computing technologies and the increasing adoption of public cloud services by businesses worldwide present a myriad of research challenges and opportunities. As we delve deeper into the taxonomy of modern public cloud services, it becomes evident that the landscape is dynamic and ever-changing.

As cloud providers continuously introduce new services and update existing ones, maintaining an up-to-date taxonomy becomes a significant challenge. Future research needs to focus on developing adaptive taxonomies that can evolve with the changing cloud landscape.

Cost optimization and public cloud vendor selection criteria is another topic for consideration. With the multitude of services offered by cloud providers, businesses often struggle with cost optimization. Research on developing intelligent cost management tools and strategies as well as selection methodologies for cloud services is essential.

VIII. CONCLUSION

The realm of public cloud services has witnessed an exponential growth and diversification in recent years. As businesses and researchers grapple with the vast array of services on offer, the need for a structured, comprehensive taxonomy becomes paramount. Our research aimed to address this need, presenting a taxonomy that encapsulates the multifaceted dimensions of modern public cloud services.

The validation process reaffirmed the efficacy of the proposed taxonomy. Engaging with industry experts from the largest telco operator in Ukraine provided invaluable insights and feedback, ensuring that the taxonomy is not just theoretically sound but also relevant. Evaluating the taxonomy by classifying offerings from top public cloud providers further underscored its robustness and adaptability. Such real-world applications and validations are pivotal in establishing the taxonomy's credibility and utility.

The feedback and insights garnered from these validation exercises were instrumental in refining and optimizing the taxonomy. It was heartening to observe that the taxonomy, even in its nascent stages, resonated with industry experts and could effectively classify a diverse range of cloud services.

In conclusion, the taxonomy presented in this research stands as a reliable tool for businesses, researchers, and cloud practitioners. It offers a structured lens through which the complex landscape of public cloud services can be navigated and understood. While the validation process has bolstered its credibility, it is essential to acknowledge the dynamic nature of the cloud industry. As with any scientific endeavor, the taxonomy, while validated, remains open to iterative refinement. This adaptability ensures that it continuously aligns with the evolving landscape of cloud services, making it a relevant and valuable tool for years to come.

ACKNOWLEGEMENTS

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