Document name	Code	Segment	Created by
Ahmad2020-Cloud_Computing_Trends_and_Cloud_Migration_Tuple	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Additionally, this paper gives cloud computing technology trends that have evolved to address the challenges of latency and jitter, context awareness, Internet of Things, voluminous data, and mobility support. The results of this paper will help in understanding the cloud computing and migration thereof.	Ivon Miranda Santos
Ahmad2020-Cloud_Computing_Trends_and_Cloud_Migration_Tuple	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	Additionally, this paper gives cloud computing technology trends that have evolved to address the challenges of latency and jitter, context awareness, Internet of Things, voluminous data, and mobility support. The results of this paper will help in understanding the cloud computing and migration thereof.	Ivon Miranda Santos
Ahmad2020-Cloud_Computing_Trends_and_Cloud_Migration_Tuple	MULTI-CLOUD CHALLENGES > Data loss and privacy	Additionally, this paper gives cloud computing technology trends that have evolved to address the challenges of latency and jitter, context awareness, Internet of Things, voluminous data, and mobility support. The results of this paper will help in understanding the cloud computing and migration thereof.	Ivon Miranda Santos
Ahmad2020-Cloud_Computing_Trends_and_Cloud_Migration_Tuple	MULTI-CLOUD CHALLENGES > Cloud computing challenge	Cloud computing is relatively a recent paradigm to solve decades-old challenges of efficiency, effectiveness, and sustainability in the investments in the information and communication infrastructures (ICT). The cloud platform offers virtually unlimited compute, storage, and networking resources. Cloud computing has encapsulated all the previous standards for optimal computing as it is defined to consist of elastic computing, supporting variety of devices, running all present and past software, and compatible with range of network [1]. These features characterize it to be platform-independent, portable, and ubiquitous. The definition of cloud computing given by the National Institute of Standards and Technology (NIST) of USA is most cited in the literature. It focuses on the key features of cloud computing such as opportune and on-demand networked access, sharable and customizable collection of computing resources, quick and elastic allocation mechanism not requiring much interventions of providers or client organizations [2].	Ivon Miranda Santos
Ahmad2020-Cloud_Computing_Trends_and_Cloud_Migration_Tuple	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Its exponential growth of adoption is due to recent account-ability placed on ICT in the form of sustainability and high demand of ICT in latest innovations such as Smart city [6–8] and E-learning [9, 10]. Cloud computing itself is evolving very fast to cope with challenges namely low latency and jitter, context awareness, Internet of Things, voluminous data, and mobility support. This section will illustrate upon basics of cloud computing, container technology, fog computing, and edge computing. Cloud computing is deployed through public clouds, private clouds, community clouds, and hybrid clouds. It is offered through majorly one of the service deliv-ery models such as infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS).	Ivon Miranda Santos
Ahmad2020-Cloud_Computing_Trends_and_Cloud_Migration_Tuple	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	Its exponential growth of adoption is due to recent account-ability placed on ICT in the form of sustainability and high demand of ICT in latest innovations such as Smart city [6–8] and E-learning [9, 10]. Cloud computing itself is evolving very fast to cope with challenges namely low latency and jitter, context awareness, Internet of Things, voluminous data, and mobility support. This section will illustrate upon basics of cloud computing, container technology, fog computing, and edge computing.	Ivon Miranda Santos
Ahmad2020-Cloud_Computing_Trends_and_Cloud_Migration_Tuple	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	This section will illustrate upon basics of cloud computing, container technology, fog computing, and edge computing.	Ivon Miranda Santos

Ahmad2020-Cloud_Computing_Trends_and_Cloud_Migration_Tuple	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	Mobile: Support for mobile computing is a mandatory condition for all the lead-ing cloud service providers. Mobile edge computing is also essential to solve the problems of jitter and latency.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Cloud computing benefits both cloud services providers (CSPs) and consumers. The security challenges associated with cloud computing have been widely studied in the literature.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Other identified security risks were associated with the data intrusion and data storage in the cloud computing environment.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in risk and security	A security guide, developed in this research, enables the cloud user organizations to be aware of security vulnera-bilities and approaches to invade them.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Security vulnerabilities and challenges arise from the usage of cloud computing services. Currently, cloud comput-ing models are the primary source of these challenges and vulnerabilities.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Cloud computing challenge	Security vulnerabilities and challenges arise from the usage of cloud computing services. Currently, cloud comput-ing models are the primary source of these challenges and vulnerabilities.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	It has become essential to counteract the occurred and potential attacks [14]. Presence of the insecure interfaces is a big challenge to both cloud users and cloud service providers. Cloud services' security and availability mainly depend on APIs that involve in data access and data encryption on clouds.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in risk and security	In irre-sponsible media, the companies' offering of cloud service are regarded as fraudulent [37]. Utility based approach can be used to overcome the latter-mentioned challenge by detecting the malicious behavior of users. This utility allows users to recover their data.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Data tampering and leakage is the real concern of users in several domains. A cloud-based healthcare system may have challenges of patients' data leakage [47]. Forensic data collection and edge computing environments have severe security risks, including forensic data removal or log leak-age.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	As a result, security issues emerge in the confidentiality of stored data during outsourcing of data to a user. B. COMMERCIAL CLOUD COMPUTING PROVIDERS AND SECURITY CHALLENGES (RQ2) A survey study [53] finds that the top five cloud providers, including Amazon, Azure, Adobe, Google cloud platform, and VMWare, are efficient in their cloud services' data secu-rity feature.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud management	A survey study [53] finds that the top five cloud providers, including Amazon, Azure, Adobe, Google cloud platform, and VMWare, are efficient in their cloud services' data secu-rity feature.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Containers enable the cloud providers to continue managing their appli-cations on clouds [54]. Since application management at the edge is challenging for cloud providers, it is done either ad hoc or with the platform. When multi-tenant run their appli-cations on the same host resource, security, and privacy issues arise from their applications.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud management	When multi-tenant run their appli-cations on the same host resource, security, and privacy issues arise from their applications.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Therefore, it is users' workload based on the sensitive data that they do not need to outsource to a public cloud directly.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Therefore, it is users' workload based on the sensitive data that they do not need to outsource to a public cloud directly. Outsourcing the consumers' data and addressing the asso-ciated risks is challenging for both users and cloud service providers.	Ivon Miranda Santos

Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Outsourcing the consumers' data and addressing the asso-ciated risks is challenging for both users and cloud service providers. These risks include shadow-IT, security, control and transparency, and business continuity [56]. Interoperabil-ity is another challenge because many consumers are locked to a single CSP due to interoperability issues.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	challenges. This paper provides a substantial growing liter-ature on cloud computing security challenges, commercial cloud services providers, cloud consumers' concerns, and blockchain technology. The proposed taxonomy, as shown in Fig.	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Data tampering and leakage is one of the identified risks. Consumers' trustworthiness, data out-sourcing, and its associated risks are significant challenges identified in this SLR. This SLR identified commercial cloud services providers and highlighted the security issues they face during cloud services deployment and implementation. The trustworthiness of cloud users is challenging to con-sumers of commercial cloud services providers. Data unavail-ability, insufficient security measures, and vendor lock-in,	Ivon Miranda Santos
Alouffi2021-A_systematic_literature_review_on_cloud_computing_s	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	This SLR identified commercial cloud services providers and highlighted the security issues they face during cloud services deployment and implementation. The trustworthiness of cloud users is challenging to con-sumers of commercial cloud services providers. Data unavail-ability, insufficient security measures, and vendor lock-in,	Ivon Miranda Santos
Ardagna2015-Cloud_and_multi-cloud_computing_Current_challenges_	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	The Cloud promises the capability for cheap and flexible services for end-users and allows small organi-zations and individuals to host and offer world-scale services, themselves. However, while there has been substantial research in the field already, there still remain open challenges. Specifically, Cloud business models and technologies in-troduce critical issues, such as proprietary APIs and lack of interoperability [1]. The choice of the application architec-ture matching and fully exploiting the characteristics of the underlying Cloud environments is also critical [2], [3]. At the infrastructural layer, resource contentions lead to unpredictable performance [4] and additional work for resource management [5], automated VM and service migration [6] is still needed. Also networks are frequently the Cloud bottleneck and data center energy management is very critical [7]. To cope with such challenges the adoption of multi-Clouds [8], has been advocated by many researchers, since deploying software on multiple Clouds overcomes single provider un-availability and allows to build cost efficient follow the sun applications. Moreover, Cloud computing is also becoming a mainstream solution to provide very large clusters in a pay per use basis to support Big data applications [9]. Many cloud providers already include in their offering MapReduce based platforms	Ivon Miranda Santos
Ardagna2015-Cloud_and_multi-cloud_computing_Current_challenges_	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Also networks are frequently the Cloud bottleneck and data center energy management is very critical [7]. To cope with such challenges the adoption of multi-Clouds [8], has been advocated by many researchers, since deploying software on multiple Clouds overcomes single provider un-availability and allows to build cost efficient follow the sun applications. Moreover, Cloud computing is also becoming a mainstream solution to provide very large clusters in a pay per use basis to support Big data applications [9].	Ivon Miranda Santos
Ardagna2015-Cloud_and_multi-cloud_computing_Current_challenges_	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Also networks are frequently the Cloud bottleneck and data center energy management is very critical [7].	Ivon Miranda Santos

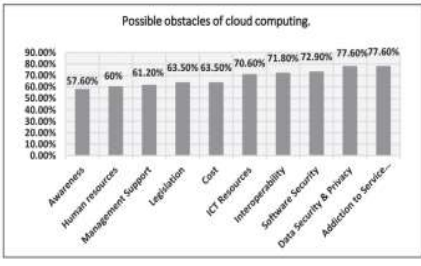|			
Ardagna2015-Cloud_and_multi-cloud_computing_Current_challenges_	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	Also networks are frequently the Cloud bottleneck and data center energy management is very critical [7]. To cope with such challenges the adoption of multi-Clouds [8], has been advocated by many researchers, since deploying software on multiple Clouds overcomes single provider un-availability and allows to build cost efficient follow the sun applications. Moreover, Cloud computing is also becoming a mainstream solution to provide very large clusters in a pay per use basis to support Big data applications [9].	Ivon Miranda Santos
Ardagna2015-Cloud_and_multi-cloud_computing_Current_challenges_	MULTI-CLOUD CHALLENGES > Difficulty for adoption the multi-cloud	Also networks are frequently the Cloud bottleneck and data center energy management is very critical [7]. To cope with such challenges the adoption of multi-Clouds [8], has been advocated by many researchers, since deploying software on multiple Clouds overcomes single provider un-availability and allows to build cost efficient follow the sun applications. Moreover, Cloud computing is also becoming a mainstream solution to provide very large clusters in a pay per use basis to support Big data applications [9].	Ivon Miranda Santos
Ardagna2015-Cloud_and_multi-cloud_computing_Current_challenges_	MULTI-CLOUD CHALLENGES > Challenges in cloud management	To cope with such challenges the adoption of multi-Clouds [8], has been advocated by many researchers, since deploying software on multiple Clouds overcomes single provider un-availability and allows to build cost efficient follow the sun applications.	Ivon Miranda Santos
Ardagna2015-Cloud_and_multi-cloud_computing_Current_challenges_	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	To cope with such challenges the adoption of multi-Clouds [8], has been advocated by many researchers, since deploying software on multiple Clouds overcomes single provider un-availability and allows to build cost efficient follow the sun applications.	Ivon Miranda Santos
Ardagna2015-Cloud_and_multi-cloud_computing_Current_challenges_	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	IDC estimates that by 2020, nearly 40% of Big Data analyses will be supported by public cloud. To support such challenges a Model-Driven Development (MDD) approach developed within the MODAClouds (www.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Moreover, such organizations typically try to avoid sticking to a single cloud provider and rather prefer to be able to spread out their applications across different providers. However, there are many challenges in achieving this.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	However, there are many challenges in achieving this. First, many of the applications that are required to be moved to the cloud might be legacy applications that do not have good documentation, and so it is not trivial to even assess whether it is feasible to move them to the cloud or not.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	. Large client may have significant percentage of applications in this category. So, one has to evaluate cloud feasibility and understand whether there is a need to re-architect application based on what services providers are able to offer. Second, clients usually define multiple features, encryption/security level, and other service level requirements they expect in the providers they will migrate each of their applications to. Thus, choosing the right providers for different application is another challenging task here.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Second, clients usually define multiple features, encryption/security level, and other service level requirements they expect in the providers they will migrate each of their applications to. Thus, choosing the right providers for different application is another challenging task here.	Ivon Miranda Santos

Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Thus, choosing the right providers for different application is another challenging task here. In this work-in-progress paper, we present a novel methodology for prepar-ing such a cloud migration solution, where we perform text mining on application data to evaluate cloud-migration feasibility and then recommend the optimal solu-tion using a mathematical optimization model.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Creating a multi-cloud solution	Thus, choosing the right providers for different application is another challenging task here. In this work-in-progress paper, we present a novel methodology for prepar-ing such a cloud migration solution, where we perform text mining on application data to evaluate cloud-migration feasibility and then recommend the optimal solu-tion using a mathematical optimization model.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Choosing the cloud providers	Thus, choosing the right providers for different application is another challenging task here. In this work-in-progress paper, we present a novel methodology for prepar-ing such a cloud migration solution, where we perform text mining on application data to evaluate cloud-migration feasibility and then recommend the optimal solu-tion using a mathematical optimization model.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	That is why different cloud vendors nowadays are enabling mix and match of cloud services across different clouds.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	That is why different cloud vendors nowadays are enabling mix and match of cloud services across different clouds.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	However, there are many challenges in achieving this. First, there are usually a lot of legacy applications that lack proper documentation.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	However, there are many challenges in achieving this. First, there are usually a lot of legacy applications that lack proper documentation. This makes it hard to even assess whether it is feasible to migrate such applications to the cloud or not. Also, sometimes these applications require an overall architecture overhaul, which again, suffer from the lack of documentation of the current architecture. Despite to momentum to shift to multi cloud, the cost-benefit analysis models illustrating the business impact of cloud adoption are still a significant risk factor [4]. It is sometimes challenging to redesign the current IT infrastructure to meet the requirement before moving to the cloud. Cloud providers charge customers on a variable cost pay-as-you-go basis determined by the number of users and their volume of transactions [5]. Organizations are not readily willing to pay extra for the additional cost [6].	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Despite to momentum to shift to multi cloud, the cost-benefit analysis models illustrating the business impact of cloud adoption are still a significant risk factor [4].	Ivon Miranda Santos
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Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Second, clients typically define requirements related to service levels they expect for each of their migrated applications. Determining the cloud migration solution that agrees to all these requirements while still be applicable, is not trivial and cannot be achieved by non-analytical/manual ways. To overcome these drawbacks and challenges, we propose a methodology that rec-ommends the optimal set of cloud providers and creates a multi-cloud solution for the client. We evaluate the optimal set of cloud providers based on best the fit between recommendations from historical data as well as a decision optimization solution frame-work. We also provide recommendation for multiple applications at once instead of just one application as the current literature. Lastly, we provide recommendation based on data collected from the client and processing it automatically instead of going back and forth by humans.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Determining the cloud migration solution that agrees to all these requirements while still be applicable, is not trivial and cannot be achieved by non-analytical/manual ways. To overcome these drawbacks and challenges, we propose a methodology that rec-ommends the optimal set of cloud providers and creates a multi-cloud solution for the client. We evaluate the optimal set of cloud providers based on best the fit between recommendations from historical data as well as a decision optimization solution frame-work.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Determining the cloud migration solution that agrees to all these requirements while still be applicable, is not trivial and cannot be achieved by non-analytical/manual ways. To overcome these drawbacks and challenges, we propose a methodology that rec-ommends the optimal set of cloud providers and creates a multi-cloud solution for the client. We evaluate the optimal set of cloud providers based on best the fit between recommendations from historical data as well as a decision optimization solution frame-work.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Drawback	Determining the cloud migration solution that agrees to all these requirements while still be applicable, is not trivial and cannot be achieved by non-analytical/manual ways. To overcome these drawbacks and challenges, we propose a methodology that rec-ommends the optimal set of cloud providers and creates a multi-cloud solution for the client.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Requirements of service levels	Determining the cloud migration solution that agrees to all these requirements while still be applicable, is not trivial and cannot be achieved by non-analytical/manual ways. To overcome these drawbacks and challenges, we propose a methodology that rec-ommends the optimal set of cloud providers and creates a multi-cloud solution for the client.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Creating a multi-cloud solution	Determining the cloud migration solution that agrees to all these requirements while still be applicable, is not trivial and cannot be achieved by non-analytical/manual ways. To overcome these drawbacks and challenges, we propose a methodology that rec-ommends the optimal set of cloud providers and creates a multi-cloud solution for the client.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Choosing the cloud providers	Determining the cloud migration solution that agrees to all these requirements while still be applicable, is not trivial and cannot be achieved by non-analytical/manual ways. To overcome these drawbacks and challenges, we propose a methodology that rec-ommends the optimal set of cloud providers and creates a multi-cloud solution for the client.	Ivon Miranda Santos
Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	To overcome these drawbacks and challenges, we propose a methodology that rec-ommends the optimal set of cloud providers and creates a multi-cloud solution for the client.	Ivon Miranda Santos

Asthana2021-Multi-cloud_Solution_Design_for_Migrating_a_Portfol	MULTI-CLOUD CHALLENGES > Drawback	In the aforementioned existing state of the art, we observe a few drawbacks. First, the time taken to gather all the features of the applications is quite inefficient, as it takes a lot of time and resources. Second, there is no analytical automated way of efficiently recommending a multi-cloud solution, where the current solutions rely on manual, inefficient evaluation of possible available cloud providers and thus requires a lot of back and forth with the client. That is, the prior art discussed above, as well as other works not reviewed above, focus on different aspects of cloud computing optimization and analytics, rather than multi-cloud solutions.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Cloud computing challenge	Universities face many challenges such as budget costs, licensing, and software and hardware management in their activities related to information and communications technology (ICT). Through overcoming these challenges, universities may deliver smart, secure, and fluent services for their instructors, students, researchers, information technologies (IT) staff, and administrators. Cloud computing can be a solution to these challenges. The transition to cloud computing in universities is an important step in terms of online education, economic crisis, globalization, and high and constantly changing requirements, especially in the COVID-19 period. Cloud computing can play a very important role in quickly solving the problems faced by universities during this coronavirus period.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In this context, a hybrid framework for adopting cloud computing in universities for them to overcome their identified challenges was proposed. The results are primarily intended to provide a guideline to universities in cloud computing adoption.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	In this context, a hybrid framework for adopting cloud computing in universities for them to overcome their identified challenges was proposed. The results are primarily intended to provide a guideline to universities in cloud computing adoption.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	The purpose of this research is to determine the position of universities in Turkey within the context of cloud comput-ing and to present an abstract hybrid cloud framework for adopting cloud computing into universities to overcome the identified challenges of the universities.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	The purpose of this research is to determine the position of universities in Turkey within the context of cloud comput-ing and to present an abstract hybrid cloud framework for adopting cloud computing into universities to overcome the identified challenges of the universities.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In the study, section "Literature Review" presents a literature review regarding the theoretical and conceptual background, and section "Purpose, Scope and Method of the Study" introduces the research model in detail.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	In the study, section "Literature Review" presents a literature review regarding the theoretical and conceptual background, and section "Purpose, Scope and Method of the Study" introduces the research model in detail.	Ivon Miranda Santos

Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	In overcoming these challenges and providing an alternative way to operate information systems in a cost-effective manner, the role of cloud computing is great, especially for universities with budget shortages. Although personalized learning, being economic, elasticity, measurability, accessibility, low carbon emission, and standardization are shown as some benefits of cloud computing in the education field, security, compliance issue, lock-in, reliability, lack of skills, insufficient support of cloud service providers, policies on the cloud, privacy, and the complexity of cloud technologies are shown as some of its challenges (Njenga et al., 2019; Sabi et al.,	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Although personalized learning, being economic, elasticity, measurability, accessibility, low carbon emission, and standardization are shown as some benefits of cloud computing in the education field, security, compliance issue, lock-in, reliability, lack of skills, insufficient support of cloud service providers, policies on the cloud, privacy, and the complexity of cloud technologies are shown as some of its challenges (Njenga et al., 2019; Sabi et al.,	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Although personalized learning, being economic, elasticity, measurability, accessibility, low carbon emission, and standardization are shown as some benefits of cloud computing in the education field, security, compliance issue, lock-in, reliability, lack of skills, insufficient support of cloud service providers, policies on the cloud, privacy, and the complexity of cloud technologies are shown as some of its challenges (Njenga et al.,	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Cloud computing challenge	• In this context, highlighting the role of cloud comput-ing adoption in overcoming ICT challenges faced by universities, and as a guide offering remedies to uni-versities to avoid these problems to a certain extent.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In the study of K. E. Ali et al.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	In the study of K. E. Ali et al. (2018), an abstract hybrid model for adopting cloud computing in e-government to overcome the e-government's challenges was proposed.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	(2018), an abstract hybrid model for adopting cloud computing in e-government to overcome the e-government's challenges was proposed.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In the study of Monsalve et al.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	In the study of Monsalve et al.	Ivon Miranda Santos

Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Difficulty for adoption the multi-cloud	In the study of Monsalve et al. (Alonso-Monsalve et al., 2018), the orchestration between the volunteer platform and the public, private, or hybrid clouds was described in the proposed hybrid cloud model. Juma and Tjahyanto (2019) proposed the ITOETAM model, which was the combination of the Technological, Organizational, Environmental (TOE), Technological Acceptance Model (TAM), and Internal, External (I-E) methods, to find challenges and suggest the solution to overcome those challenges (Juma & Tjahyanto, 2019). ITOETAM (the proposed model for cloud computing adoption challenges in Zanzibar's Universities), TOE (the model used previously in cloud challenges), TAM (the model used to solve the challenges of cloud computing), and I-E (the model used to solve challenges in cloud comput-ing) are examples for some different models used in the litera-ture (Juma & Tjahyanto, 2019; Tashkandi & Al-Jabri, 2015). These studies show that cloud-based learning models are becoming widespread and their use is gradually increasing.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	, 2018), the orchestration between the volunteer platform and the public, private, or hybrid clouds was described in the proposed hybrid cloud model. Juma and Tjahyanto (2019) proposed the ITOETAM model, which was the combination of the Technological, Organizational, Environmental (TOE), Technological Acceptance Model (TAM), and Internal, External (I-E) methods, to find challenges and suggest the solution to overcome those challenges (Juma & Tjahyanto, 2019). ITOETAM (the proposed model for cloud computing adoption challenges in Zanzibar's Universities), TOE (the model used previously in cloud challenges), TAM (the model used to solve the challenges of cloud computing), and I-E (the model used to solve challenges in cloud comput-ing) are examples for some different models used in the litera-ture (Juma & Tjahyanto, 2019; Tashkandi & Al-Jabri, 2015). These studies show that cloud-based learning models are becoming widespread and their use is gradually increasing.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	, 2018), the orchestration between the volunteer platform and the public, private, or hybrid clouds was described in the proposed hybrid cloud model. Juma and Tjahyanto (2019) proposed the ITOETAM model, which was the combination of the Technological, Organizational, Environmental (TOE), Technological Acceptance Model (TAM), and Internal, External (I-E) methods, to find challenges and suggest the solution to overcome those challenges (Juma & Tjahyanto, 2019). ITOETAM (the proposed model for cloud computing adoption challenges in Zanzibar's Universities), TOE (the model used previously in cloud challenges), TAM (the model used to solve the challenges of cloud computing), and I-E (the model used to solve challenges in cloud comput-ing) are examples for some different models used in the litera-ture (Juma & Tjahyanto, 2019; Tashkandi & Al-Jabri, 2015). These studies show that cloud-based learning models are becoming widespread and their use is gradually increasing.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Cloud computing challenge	ITOETAM (the proposed model for cloud computing adoption challenges in Zanzibar's Universities), TOE (the model used previously in cloud challenges), TAM (the model used to solve the challenges of cloud computing), and I-E (the model used to solve challenges in cloud comput-ing) are examples for some different models used in the litera-ture (Juma & Tjahyanto, 2019; Tashkandi & Al-Jabri, 2015).	Ivon Miranda Santos

Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Cloud computing challenge	 **Figure 10.** Obstacles of cloud computing. *Note.* ICT = information and communications technology.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Cloud computing challenge	A proposed architec-ture based on the hybrid cloud model which uses both the pub-lic and private clouds is simulated using CloudSim. It consists of two main parts, that is, the Cloud Management System and the Hybrid Cloud (Sqalli et al., 2012). In the cloud computing adoption model proposed by Okai et al. (2014), a roadmap for cloud computing adoption is proposed by universities to over-come the challenges faced. Among the examples of educational cloud-based applications, Microsoft Education Cloud (website creation, file sharing, Word processing, desktop sharing, resource scheduling), Google Education Cloud (Google Mail, Google Sites, Google Docs, Google Video, Google Calendar, Google Talk), Earth Browser (provide real-time data for weather, geological, and other data), Socratica (classrooms in science to access create and study modules), VMWare (provide virtual computers), and IBM Cloud Academy (Smart analytics system) can be listed (Alharthi et al., 2015). Arpaci (2019), investigated educational use of the mobile cloud computing services in the higher education based on data collected from 308 undergraduate students.	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In the cloud computing adoption model proposed by Okai et al. (2014), a roadmap for cloud computing adoption is proposed by universities to over-come the challenges faced	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	In the cloud computing adoption model proposed by Okai et al. (2014), a roadmap for cloud computing adoption is proposed by universities to over-come the challenges faced	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Difficulty for adoption the multi-cloud	In the cloud computing adoption model proposed by Okai et al. (2014), a roadmap for cloud computing adoption is proposed by universities to over-come the challenges faced	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In this study, literature studies focusing on cloud comput-ing in universities were reviewed based on the research ques-tions, and the position of universities in Turkey was determined. In the study, an abstract hybrid cloud framework that contains guidelines to overcome the major challenges identified was presented. Within this context, the existing conditions and problems in the use of the cloud service model in universities were tried to be identified and some recommendations for solving these problems were drawn up	Ivon Miranda Santos
Aydin2021-A_Study_of_Cloud_Computing_Adoption_in_Universities_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	In this study, literature studies focusing on cloud comput-ing in universities were reviewed based on the research ques-tions, and the position of universities in Turkey was determined. In the study, an abstract hybrid cloud framework that contains guidelines to overcome the major challenges identified was presented. Within this context, the existing conditions and problems in the use of the cloud service model in universities were tried to be identified and some recommendations for solving these problems were drawn up.	Ivon Miranda Santos
Baby2015-Multicloud_architecture_for_augmenting_security_in_clo	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The main obstacle that stands as a barrier for opting clouds, despite its benefits are its security challenges. Multicloud architecture is a solution that assures better security and performance at a nominal cost.	Ivon Miranda Santos

Baby2015-Multicloud_architecture_for_augmenting_security_in_clo	MULTI-CLOUD CHALLENGES > Challenges in cloud management	There are different approaches used for storing and processing data in a multicloud environment, this paper is a study on the different multicloud architectures and their benefits and limitations.	Ivon Miranda Santos
Baby2015-Multicloud_architecture_for_augmenting_security_in_clo	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Based on the application each cloud provider is assigned only subtasks on subset of data [2]. The main challenge for this approach is that there is no general format for splitting the logic and distributing among the clouds [6], therefore proper analysis of how the application logic can be divided among the clouds remain a headache for the users. The main two benefits in partitioning the application logic are, the cloud provider cannot understand the overall calculated result, and no cloud provider learns the application logic completely.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	A B S T R A C T Developers and users situated in low-resource settings are faced with unique contextual and infrastructure challenges when accessing and consuming cloud-based services. In low-resource settings, access to cloud services and platforms is usually characterized by low-end computing devices and often unreliable and slow mobile broadband Internet connections. In this paper, we discuss key challenges for developing for and accessing cloud services in resource constrained settings, namely, (1) Frequent Internet partitions and bandwidth constraints, (2) Data jurisdiction restrictions, (3) Vendor lock-in, and (4) Poor quality of service.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Developers and users situated in low-resource settings are faced with unique contextual and infrastructure challenges when accessing and consuming cloud-based services. In low-resource settings, access to cloud services and platforms is usually characterized by low-end computing devices and often unreliable and slow mobile broadband Internet connections. In this paper, we discuss key challenges for developing for and accessing cloud services in resource constrained settings, namely, (1) Frequent Internet partitions and bandwidth constraints, (2) Data jurisdiction restrictions, (3) Vendor lock-in, and (4) Poor quality of service. Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In this paper, we discuss key challenges for developing for and accessing cloud services in resource constrained settings, namely, (1) Frequent Internet partitions and bandwidth constraints, (2) Data jurisdiction restrictions, (3) Vendor lock-in, and (4) Poor quality of service. Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	In this paper, we discuss key challenges for developing for and accessing cloud services in resource constrained settings, namely, (1) Frequent Internet partitions and bandwidth constraints, (2) Data jurisdiction restrictions, (3) Vendor lock-in, and (4) Poor quality of service.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	In this paper, we discuss key challenges for developing for and accessing cloud services in resource constrained settings, namely, (1) Frequent Internet partitions and bandwidth constraints, (2) Data jurisdiction restrictions, (3) Vendor lock-in, and (4) Poor quality of service. Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Vendor lock-in	In this paper, we discuss key challenges for developing for and accessing cloud services in resource constrained settings, namely, (1) Frequent Internet partitions and bandwidth constraints, (2) Data jurisdiction restrictions, (3) Vendor lock-in, and (4) Poor quality of service. Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Legal restrictions / Data jurisdiction restrictions	In this paper, we discuss key challenges for developing for and accessing cloud services in resource constrained settings, namely, (1) Frequent Internet partitions and bandwidth constraints, (2) Data jurisdiction restrictions, (3) Vendor lock-in, and (4) Poor quality of service. Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Creating a multi-cloud solution	Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Monitoring	Inspired by these challenges, we propose a set of important design considerations and properties for a resilient multi-cloud service layer, that includes: (1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	(1) Containerization and orchestration of applications, (2) Application placement and replication, (3) Portability and multi-cloud migration, (4) Resilience to network partitions and bandwidth constraints, (5) Automated service discovery and load balancing, (6) Localized image registry, and (7) Support for platform monitoring and management.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	From experiences developing for and consuming cloud services in low-resources settings, we find that these assumptions are not true. In such settings, challenges such as frequent Internet parti-tions, unannounced power shutdowns, poor quality of services, among others, are the rule rather than the exception (Fig.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	by the above challenges when developing or consuming the cloud-based services. With the increased reliance on digital services especially for the attainment of global Sustainable Development Goals (SDGs), addressing barrier to adoption of cloud computing services will be critical	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	How can cloud platforms be designed to facilitate seamless access to cloud-services for users and developers situated in low-resource settings? To address the above challenges and the arising research question, this paper presents:	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	1. Challenges and requirements for designing and operating a re-silient multi-cloud model for low resource settings. 2.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	1. Challenges and requirements for designing and operating a re-silient multi-cloud model for low resource settings. 2.	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Requirements of service levels	1. Challenges and requirements for designing and operating a re-silient multi-cloud model for low resource settings.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	Challenges and requirements for designing and operating a re-silient multi-cloud model for low resource settings.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Requirements for a custom cloud-service layer for low-resource settings. As introduced above, low-resource settings are characterized by contextual challenges that present additional and new requirements for cloud platforms. To concretize these challenges, we use a real world scenario from low resource settings and present the requirements in Section 2.2.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The above case study signals one of many other similar systems faced with technical hurdles when delivering cloud-based solutions in a low resource setting. To an extent, it reveals key requirements and challenges that can be addressed by containerized cloud-based systems that are developed in and for use in such environments.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	2.2.1.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	However, it is important to note that these issues are similar in any other location with similar resource constraints. The design and setup of most public cloud platforms assume stable infrastructure across the users and leave the issues of connectivity challenges to the applica-tion developers. This shifts the burden and unnecessary complexity to the application developers who must consider offering different function-trimmed variations of their app services for users situated in low-resource settings, for instance, Facebook Lite app (Shankar, 2015), WhatsApp Lite (DigitBin, 2019), Uber Lite (Uber, 2021), Google Go (Google LLC, 2019) and Gmail Basic (Google LLC, 2021) for slow Internet connections and low-end devices.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The design and setup of most public cloud platforms assume stable infrastructure across the users and leave the issues of connectivity challenges to the applica-tion developers. This shifts the burden and unnecessary complexity to the application developers who must consider offering different function-trimmed variations of their app services for users situated in low-resource settings, for instance, Facebook Lite app (Shankar, 2015), WhatsApp Lite (DigitBin, 2019), Uber Lite (Uber, 2021), Google Go (Google LLC, 2019) and Gmail Basic (Google LLC, 2021) for slow Internet connections and low-end devices.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The above issues form the motivation of the research work in this paper.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The microservice architecture and cloud orchestration platforms such as Kubernetes (Burns et al., 2016) promises potential remedies to this challenge. In the above scenario, the APDD system can be broken into independent microservices each with different data jurisdiction policies.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	The microservice architecture and cloud orchestration platforms such as Kubernetes (Burns et al.,	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	In the above scenario, the APDD system can be broken into independent microservices each with different data jurisdiction policies.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Legal restrictions / Data jurisdiction restrictions	In the above scenario, the APDD system can be broken into independent microservices each with different data jurisdiction policies.	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	The migration of cloud services from one provider to another usually requires major reworks on the application that may be catastrophic for mission-critical systems. For instance, the APDD case study may use vendor-specific machine learning libraries and tools making it difficult to migrate to another cloud when there is need.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	For instance, the APDD case study may use vendor-specific machine learning libraries and tools making it difficult to migrate to another cloud when there is need.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	For instance, the APDD case study may use vendor-specific machine learning libraries and tools making it difficult to migrate to another cloud when there is need.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Vendor lock-in	For instance, the APDD case study may use vendor-specific machine learning libraries and tools making it difficult to migrate to another cloud when there is need.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	The vendor lock-in challenge emphasizes the need for new abstrac-tion layers to alleviate the difficulty of migrating applications between clouds. New platforms and architectures such as Kubernetes (Burns et al., 2016) offer new possibilities to implement a vendor neutral layer on top of public and private clouds. However, the current offerings of managed Kubernetes layers assume migration of services in situations where there is stable connectivity and infrastructure and are not de-signed for data centers that may be characterized by frequent network partitions and bandwidth constraints.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	The vendor lock-in challenge emphasizes the need for new abstrac-tion layers to alleviate the difficulty of migrating applications between clouds. New platforms and architectures such as Kubernetes (Burns et al.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Vendor lock-in	The vendor lock-in challenge emphasizes the need for new abstrac-tion layers to alleviate the difficulty of migrating applications between clouds. New platforms and architectures such as Kubernetes (Burns et al.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	The vendor lock-in challenge emphasizes the need for new abstrac-tion layers to alleviate the difficulty of migrating applications between clouds. New platforms and architectures such as Kubernetes (Burns et al., 2016) offer new possibilities to implement a vendor neutral layer on top of public and private clouds. However, the current offerings of managed Kubernetes layers assume migration of services in situations where there is stable connectivity and infrastructure and are not de-signed for data centers that may be characterized by frequent network partitions and bandwidth constraints.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Microservice orchestration	The vendor lock-in challenge emphasizes the need for new abstrac-tion layers to alleviate the difficulty of migrating applications between clouds. New platforms and architectures such as Kubernetes (Burns et al., 2016) offer new possibilities to implement a vendor neutral layer on top of public and private clouds. However, the current offerings of managed Kubernetes layers assume migration of services in situations where there is stable connectivity and infrastructure and are not de-signed for data centers that may be characterized by frequent network partitions and bandwidth constraints.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	New platforms and architectures such as Kubernetes (Burns et al.,	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	New platforms and architectures such as Kubernetes (Burns et al.,	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	The longer the distance, the higher the number of intermediary links which can act as failure points (bottlenecks) and potentially introduce network packet losses. Furthermore, there are applications that are delay-sensitive and these require optimal and stringent quality of service parameter values such as low latency, low jitter and minimal or no packet loss for best performance. Currently, public cloud providers attempt to solve this challenge by moving services closer to the user. This approach however assumes presence of data centers closer to the user. Unfortunately this is not always the case for users located in regions where public cloud data centers are sparse. In the next section, we present the design options that need to be considered when developing a multi-cloud service abstraction layer to address the above challenges particularly in low resource settings. In the subsequent sections, we demonstrated the instantiation of the design considerations in a practical open source cloud project	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Furthermore, there are applications that are delay-sensitive and these require optimal and stringent quality of service parameter values such as low latency, low jitter and minimal or no packet loss for best performance. Currently, public cloud providers attempt to solve this challenge by moving services closer to the user. This approach however assumes presence of data centers closer to the user.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Furthermore, there are applications that are delay-sensitive and these require optimal and stringent quality of service parameter values such as low latency, low jitter and minimal or no packet loss for best performance. Currently, public cloud providers attempt to solve this challenge by moving services closer to the user.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Furthermore, there are applications that are delay-sensitive and these require optimal and stringent quality of service parameter values such as low latency, low jitter and minimal or no packet loss for best performance. Currently, public cloud providers attempt to solve this challenge by moving services closer to the user. This approach however assumes presence of data centers closer to the user.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Unfortunately this is not always the case for users located in regions where public cloud data centers are sparse. In the next section, we present the design options that need to be considered when developing a multi-cloud service abstraction layer to address the above challenges particularly in low resource settings. In the subsequent sections, we demonstrated the instantiation of the design considerations in a practical open source cloud project.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Unfortunately this is not always the case for users located in regions where public cloud data centers are sparse. In the next section, we present the design options that need to be considered when developing a multi-cloud service abstraction layer to address the above challenges particularly in low resource settings. In the subsequent sections, we demonstrated the instantiation of the design considerations in a practical open source cloud project.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Unfortunately this is not always the case for users located in regions where public cloud data centers are sparse. In the next section, we present the design options that need to be considered when developing a multi-cloud service abstraction layer to address the above challenges particularly in low resource settings.	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_ service_abs	MULTI-CLOUD CHALLENGES > Drawback	The popular centralized ser-vice registry/discovery solutions include Netflix's Eureka,18 CoreOS's highly available etcd19 key–value distributed datastore, consul20 and Apache ZooKeeper.21 The major drawbacks of centralizing the service registry/discovery are the introduction of points of failure, performance bottlenecks and possible network congestion. Distributing the nodes providing these services and ensuring there are multiple instances in a consistent way usually suffices. Zhou and Shi (2010) and Ranjan et al. (2010) proposed an unstructured Peer-to-Peer(P2P)-enabled service discovery method for cloud environments based on Distributed Hash Tables (DHTs) with a decentralized index system. The peers maintain their own services and descriptions and a semantic-based matching rule is used to map the user requirement expressed in the query message to the desired service.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_ service_abs	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Crane Cloud is an open source multi-cloud service layer designed to enable developers, organizations and researchers to set up reli-able cloud-services in low resource setting. The Crane Cloud software layer was conceived to address the key hurdles of operating a cloud-service platform in resource constrained environments characterized by challenges identified in Section 2.2. Its main ingredients include resilience to network partitions, support for microservice orchestration, support for migration of services between private and public clouds to avoid vendor lock-in issues, seamless downtime and network traf-fic load distribution, monitoring metrics, and tools for transforming existing non-cloud compliant services into compliant cloud services.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_ service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Crane Cloud is an open source multi-cloud service layer designed to enable developers, organizations and researchers to set up reli-able cloud-services in low resource setting. The Crane Cloud software layer was conceived to address the key hurdles of operating a cloud-service platform in resource constrained environments characterized by challenges identified in Section 2.2.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_ service_abs	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Crane Cloud is an open source multi-cloud service layer designed to enable developers, organizations and researchers to set up reli-able cloud-services in low resource setting. The Crane Cloud software layer was conceived to address the key hurdles of operating a cloud-service platform in resource constrained environments characterized by challenges identified in Section 2.2. Its main ingredients include resilience to network partitions, support for microservice orchestration, support for migration of services between private and public clouds to avoid vendor lock-in issues, seamless downtime and network traf-fic load distribution, monitoring metrics, and tools for transforming existing non-cloud compliant services into compliant cloud services.	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	Crane Cloud is an open source multi-cloud service layer designed to enable developers, organizations and researchers to set up reli-able cloud-services in low resource setting. The Crane Cloud software layer was conceived to address the key hurdles of operating a cloud-service platform in resource constrained environments characterized by challenges identified in Section 2.2. Its main ingredients include resilience to network partitions, support for microservice orchestration, support for migration of services between private and public clouds to avoid vendor lock-in issues, seamless downtime and network traf-fic load distribution, monitoring metrics, and tools for transforming existing non-cloud compliant services into compliant cloud services.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	Crane Cloud is an open source multi-cloud service layer designed to enable developers, organizations and researchers to set up reli-able cloud-services in low resource setting. The Crane Cloud software layer was conceived to address the key hurdles of operating a cloud-service platform in resource constrained environments characterized by challenges identified in Section 2.2. Its main ingredients include resilience to network partitions, support for microservice orchestration, support for migration of services between private and public clouds to avoid vendor lock-in issues, seamless downtime and network traf-fic load distribution, monitoring metrics, and tools for transforming existing non-cloud compliant services into compliant cloud services.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Monitoring	Crane Cloud is an open source multi-cloud service layer designed to enable developers, organizations and researchers to set up reli-able cloud-services in low resource setting. The Crane Cloud software layer was conceived to address the key hurdles of operating a cloud-service platform in resource constrained environments characterized by challenges identified in Section 2.2. Its main ingredients include resilience to network partitions, support for microservice orchestration, support for migration of services between private and public clouds to avoid vendor lock-in issues, seamless downtime and network traf-fic load distribution, monitoring metrics, and tools for transforming existing non-cloud compliant services into compliant cloud services.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Microservice orchestration	Crane Cloud is an open source multi-cloud service layer designed to enable developers, organizations and researchers to set up reli-able cloud-services in low resource setting. The Crane Cloud software layer was conceived to address the key hurdles of operating a cloud-service platform in resource constrained environments characterized by challenges identified in Section 2.2. Its main ingredients include resilience to network partitions, support for microservice orchestration, support for migration of services between private and public clouds to avoid vendor lock-in issues, seamless downtime and network traf-fic load distribution, monitoring metrics, and tools for transforming existing non-cloud compliant services into compliant cloud services.	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	The Crane Cloud software layer was conceived to address the key hurdles of operating a cloud-service platform in resource constrained environments characterized by challenges identified in Section 2.2. Its main ingredients include resilience to network partitions, support for microservice orchestration, support for migration of services between private and public clouds to avoid vendor lock-in issues, seamless downtime and network traf-fic load distribution, monitoring metrics, and tools for transforming existing non-cloud compliant services into compliant cloud services.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	The Crane Cloud software layer was conceived to address the key hurdles of operating a cloud-service platform in resource constrained environments characterized by challenges identified in Section 2.2. Its main ingredients include resilience to network partitions, support for microservice orchestration, support for migration of services between private and public clouds to avoid vendor lock-in issues, seamless downtime and network traf-fic load distribution, monitoring metrics, and tools for transforming existing non-cloud compliant services into compliant cloud services.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	IaaS (virtual machines) hybrid clouds using custom heuristics. Proper-ties such as high availability, scalability, fault-tolerance and monitoring are not discussed and the use of virtual machines may not be the most cost-effective approach to running application workloads.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	IaaS (virtual machines) hybrid clouds using custom heuristics. Proper-ties such as high availability, scalability, fault-tolerance and monitoring are not discussed and the use of virtual machines may not be the most cost-effective approach to running application workloads.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	IaaS (virtual machines) hybrid clouds using custom heuristics. Proper-ties such as high availability, scalability, fault-tolerance and monitoring are not discussed and the use of virtual machines may not be the most cost-effective approach to running application workloads.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Monitoring	IaaS (virtual machines) hybrid clouds using custom heuristics. Proper-ties such as high availability, scalability, fault-tolerance and monitoring are not discussed and the use of virtual machines may not be the most cost-effective approach to running application workloads. Filip et al. (2018) proposed a solution that considers a finite catalog of primitive microservices and designs a hybrid scheduling algorithm that matches tasks to resources based on task history and availability of resources.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Scalability	IaaS (virtual machines) hybrid clouds using custom heuristics. Proper-ties such as high availability, scalability, fault-tolerance and monitoring are not discussed and the use of virtual machines may not be the most cost-effective approach to running application workloads. Filip et al. (2018) proposed a solution that considers a finite catalog of primitive microservices and designs a hybrid scheduling algorithm that matches tasks to resources based on task history and availability of resources.	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Availability	IaaS (virtual machines) hybrid clouds using custom heuristics. Proper-ties such as high availability, scalability, fault-tolerance and monitoring are not discussed and the use of virtual machines may not be the most cost-effective approach to running application workloads. Filip et al. (2018) proposed a solution that considers a finite catalog of primitive microservices and designs a hybrid scheduling algorithm that matches tasks to resources based on task history and availability of resources.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Fault-tolerance	IaaS (virtual machines) hybrid clouds using custom heuristics. Proper-ties such as high availability, scalability, fault-tolerance and monitoring are not discussed and the use of virtual machines may not be the most cost-effective approach to running application workloads. Filip et al. (2018) proposed a solution that considers a finite catalog of primitive microservices and designs a hybrid scheduling algorithm that matches tasks to resources based on task history and availability of resources.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	of a resource constrained environment that includes poor Internet connectivity, frequent Internet partitions and data center power cuts ultimately resulting in poor user experience or even service unavail-ability. Based on these challenges, we enumerated a number of design considerations and properties for a resilient multi-cloud service layer that would form the foundation for Crane Cloud. From easing terminal complexities of operating a cloud service, desirable scaling, availabil-ity, migration and loadbalancing to platform monitoring, Crane Cloud tries to provide an all-inclusive solution that best fits the resource constrained compute environment.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Based on these challenges, we enumerated a number of design considerations and properties for a resilient multi-cloud service layer that would form the foundation for Crane Cloud. From easing terminal complexities of operating a cloud service, desirable scaling, availabil-ity, migration and loadbalancing to platform monitoring, Crane Cloud tries to provide an all-inclusive solution that best fits the resource constrained compute environment.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Based on these challenges, we enumerated a number of design considerations and properties for a resilient multi-cloud service layer that would form the foundation for Crane Cloud. From easing terminal complexities of operating a cloud service, desirable scaling, availabil-ity, migration and loadbalancing to platform monitoring, Crane Cloud tries to provide an all-inclusive solution that best fits the resource constrained compute environment.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Based on these challenges, we enumerated a number of design considerations and properties for a resilient multi-cloud service layer that would form the foundation for Crane Cloud. From easing terminal complexities of operating a cloud service, desirable scaling, availabil-ity, migration and loadbalancing to platform monitoring, Crane Cloud tries to provide an all-inclusive solution that best fits the resource constrained compute environment.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Creating a multi-cloud solution	Based on these challenges, we enumerated a number of design considerations and properties for a resilient multi-cloud service layer that would form the foundation for Crane Cloud. From easing terminal complexities of operating a cloud service, desirable scaling, availabil-ity, migration and loadbalancing to platform monitoring, Crane Cloud tries to provide an all-inclusive solution that best fits the resource constrained compute environment.	Ivon Miranda Santos

Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Monitoring	Based on these challenges, we enumerated a number of design considerations and properties for a resilient multi-cloud service layer that would form the foundation for Crane Cloud. From easing terminal complexities of operating a cloud service, desirable scaling, availabil-ity, migration and loadbalancing to platform monitoring, Crane Cloud tries to provide an all-inclusive solution that best fits the resource constrained compute environment.	Ivon Miranda Santos
Bainomugisha2022-Crane_cloud_A_resilient_multicloud_service_abs	MULTI-CLOUD CHALLENGES > Scalability	Based on these challenges, we enumerated a number of design considerations and properties for a resilient multi-cloud service layer that would form the foundation for Crane Cloud. From easing terminal complexities of operating a cloud service, desirable scaling, availabil-ity, migration and loadbalancing to platform monitoring, Crane Cloud tries to provide an all-inclusive solution that best fits the resource constrained compute environment.	Ivon Miranda Santos
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Balalaie2016-Microservices_architecture_enables_devops_Migratio	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	• Microservices is not a silver bullet:	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Difficulty for adoption the multi-cloud	2.1 Orchestration and adaptation in the cloud O1 will be addressed by developing cloud service orchestrators of the cloud-based application modules, and by adapting the specified orchestration . Orchestrators are widely used in the service-oriented computing paradigm [7,8,9,10,11], mainly focusing on behavioural and context-aware adaptation of services, by coordinating the interactions between different services. Several approaches exist that target formal verification and adaptation of orchestrated services, but, to the best of our knowledge, none of these approaches has been extended to the cloud environment. A cloud-compliant orchestration is not a trivial problem. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Microservice orchestration	A cloud-compliant orchestration is not a trivial problem. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers haveto be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers. Challenges in orchestration and adaptation for the cloud.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Multi-cloud/Cloud-compliant orchestration	A cloud-compliant orchestration is not a trivial problem. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers haveto be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers. Challenges in orchestration and adaptation for the cloud.	Ivon Miranda Santos

Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Requirements of service levels	Challenges in orchestration and adaptation for the cloud. SeaClouds will address the following challenges in order to extend service-oriented approaches to the cloud: – Adaptation contracts need to take into account cloud providers characteristics and Service Level Agreement (SLA). – Violations of Quality of Service (QoS) properties need to be monitored across different cloud platforms. – Dynamic architecture reconfiguration might involve migrating some compo-nents of the application to other cloud providers at runtime.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Monitoring	Challenges in orchestration and adaptation for the cloud. SeaClouds will address the following challenges in order to extend service-oriented approaches to the cloud: – Adaptation contracts need to take into account cloud providers characteristics and Service Level Agreement (SLA). – Violations of Quality of Service (QoS) properties need to be monitored across different cloud platforms. – Dynamic architecture reconfiguration might involve migrating some compo-nents of the application to other cloud providers at runtime.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Monitoring	NewRelic achieves platform-independency by requiring each provider to implement a monitoring component and integrate it in the offered cloud platform. On the one hand, this approach yields the best results from a monitoring point of view. On the other hand, it forces providers to invest quite some resources in order to implement the monitoring.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	By increasing service and application portability in a vendor-neutral ecosystem, TOSCA aims at enabling portable deployment to any compliant cloud, smoother migration of existing applications to the cloud, as well as dynamic, multi-cloud provider applications.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	By increasing service and application portability in a vendor-neutral ecosystem, TOSCA aims at enabling portable deployment to any compliant cloud, smoother migration of existing applications to the cloud, as well as dynamic, multi-cloud provider applications.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Vendor lock-in	By increasing service and application portability in a vendor-neutral ecosystem, TOSCA aims at enabling portable deployment to any compliant cloud, smoother migration of existing applications to the cloud, as well as dynamic, multi-cloud provider applications.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	Challenges in standards for cloud interoperability. SeaClouds intends to actively contribute to the standardization effort of CAMP [12] both by imple-menting a CAMP-compliant interface towards PaaS providers for management, and by contributing review proposals that will possibly emerge while specifying properties of SeaClouds orchestrations, adaptation and monitoring.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Monitoring	Challenges in standards for cloud interoperability. SeaClouds intends to actively contribute to the standardization effort of CAMP [12] both by imple-menting a CAMP-compliant interface towards PaaS providers for management, and by contributing review proposals that will possibly emerge while specifying properties of SeaClouds orchestrations, adaptation and monitoring.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Difficulty for adoption the multi-cloud	Challenges in standards for cloud interoperability. SeaClouds intends to actively contribute to the standardization effort of CAMP [12] both by imple-menting a CAMP-compliant interface towards PaaS providers for management, and by contributing review proposals that will possibly emerge while specifying properties of SeaClouds orchestrations, adaptation and monitoring.	Ivon Miranda Santos

Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Microservice orchestration	Challenges in standards for cloud interoperability. SeaClouds intends to actively contribute to the standardization effort of CAMP [12] both by imple-menting a CAMP-compliant interface towards PaaS providers for management, and by contributing review proposals that will possibly emerge while specifying properties of SeaClouds orchestrations, adaptation and monitoring.	Ivon Miranda Santos
Brogi2014-Seaclouds_Seamless_adaptive_multi-cloud_management_of	MULTI-CLOUD CHALLENGES > Multi-cloud/Cloud-compliant orchestration	Challenges in standards for cloud interoperability. SeaClouds intends to actively contribute to the standardization effort of CAMP [12] both by imple-menting a CAMP-compliant interface towards PaaS providers for management, and by contributing review proposals that will possibly emerge while specifying properties of SeaClouds orchestrations, adaptation and monitoring.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Section 2 will introduce a motivating example to illustrate the problems occurring when deploying an application on multiple cloud providers. Section 3 will position SeaClouds with respect to current cloud initiatives and single out the main challenges it wants to overcome.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Section 2 will introduce a motivating example to illustrate the problems occurring when deploying an application on multiple cloud providers. Section 3 will position SeaClouds with respect to current cloud initiatives and single out the main challenges it wants to overcome.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Several approaches exist that target formal verification and adaptation of orchestrated services, but, to the best of our knowledge, none of these approaches has been extended to the cloud environment. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have to be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Several approaches exist that target formal verification and adaptation of orchestrated services, but, to the best of our knowledge, none of these approaches has been extended to the cloud environment. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have to be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Several approaches exist that target formal verification and adaptation of orchestrated services, but, to the best of our knowledge, none of these approaches has been extended to the cloud environment. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have to be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Several approaches exist that target formal verification and adaptation of orchestrated services, but, to the best of our knowledge, none of these approaches has been extended to the cloud environment. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have to be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers.	Ivon Miranda Santos

Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	Several approaches exist that target formal verification and adaptation of orchestrated services, but, to the best of our knowledge, none of these approaches has been extended to the cloud environment. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have to be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Vendor lock-in	Several approaches exist that target formal verification and adaptation of orchestrated services, but, to the best of our knowledge, none of these approaches has been extended to the cloud environment. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have to be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Choosing the cloud providers	Several approaches exist that target formal verification and adaptation of orchestrated services, but, to the best of our knowledge, none of these approaches has been extended to the cloud environment. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have to be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Multi-cloud/Cloud-compliant orchestration	Several approaches exist that target formal verification and adaptation of orchestrated services, but, to the best of our knowledge, none of these approaches has been extended to the cloud environment. Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have to be addressed, as well as the different standards emerging from distinct vendors. Therefore, existing approaches should be (substantially) extended to operate on heterogeneous cloud providers.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Challenges such as heterogeneity of cloud platforms and migration to different cloud providers have to be addressed, as well as the different standards emerging from distinct vendors.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Challenges in orchestration and adaptation for the cloud SeaClouds will address the following challenges in order to extend service-oriented approaches to the cloud: • Adaptation contracts need to take into account cloud providers characteristics and Service Level Agreement (SLA).	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Challenges in orchestration and adaptation for the cloud SeaClouds will address the following challenges in order to extend service-oriented approaches to the cloud: • Adaptation contracts need to take into account cloud providers characteristics and Service Level Agreement (SLA).	Ivon Miranda Santos

Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	Challenges in orchestration and adaptation for the cloud SeaClouds will address the following challenges in order to extend service-oriented approaches to the cloud: • Adaptation contracts need to take into account cloud providers characteristics and Service Level Agreement (SLA). • Violations of Quality of Service (QoS) properties need to be monitored across different cloud platforms. • Dynamic architecture reconfiguration might involve migrating some components of the application to other cloud providers at runtime. The latter two challenges (addressed by O2 and O3) are discussed further in the following sections.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Creating a multi-cloud solution	Challenges in orchestration and adaptation for the cloud SeaClouds will address the following challenges in order to extend service-oriented approaches to the cloud: • Adaptation contracts need to take into account cloud providers characteristics and Service Level Agreement (SLA). • Violations of Quality of Service (QoS) properties need to be monitored across different cloud platforms. • Dynamic architecture reconfiguration might involve migrating some components of the application to other cloud providers at runtime. The latter two challenges (addressed by O2 and O3) are discussed further in the following sections.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Multi-cloud/Cloud-compliant orchestration	Challenges in orchestration and adaptation for the cloud SeaClouds will address the following challenges in order to extend service-oriented approaches to the cloud: • Adaptation contracts need to take into account cloud providers characteristics and Service Level Agreement (SLA). • Violations of Quality of Service (QoS) properties need to be monitored across different cloud platforms. • Dynamic architecture reconfiguration might involve migrating some components of the application to other cloud providers at runtime. The latter two challenges (addressed by O2 and O3) are discussed further in the following sections.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	SeaClouds will address the following challenges in order to extend service-oriented approaches to the cloud: • Adaptation contracts need to take into account cloud providers characteristics and Service Level Agreement (SLA).	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	• Dynamic architecture reconfiguration might involve migrating some components of the application to other cloud providers at runtime. The latter two challenges (addressed by O2 and O3) are discussed further in the following sections.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	• Dynamic architecture reconfiguration might involve migrating some components of the application to other cloud providers at runtime.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applicatio ns_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud management	• Dynamic architecture reconfiguration might involve migrating some components of the application to other cloud providers at runtime. The latter two challenges (addressed by O2 and O3) are discussed further in the following sections.	Ivon Miranda Santos

Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	• Dynamic architecture reconfiguration might involve migrating some components of the application to other cloud providers at runtime. The latter two challenges (addressed by O2 and O3) are discussed further in the following sections.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	The latter two challenges (addressed by O2 and O3) are discussed further in the following sections. 3.2 Monitoring of multi-cloud services	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud management	3.2 Monitoring of multi-cloud services	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Challenges in monitoring of services on multiple clouds. In order to address O2, SeaClouds' monitoring will use and enhance existing monitoring functionalities for the IaaS and PaaS levels.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The already mentioned Cloud4SOA project also offers deployment and lifecycle management functionality using a harmonized API layer to encapsulate the providers APIs. Challenges in unified application management of services distributed over different cloud providers SeaClouds will use Cloud4SOA's management functionality.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Challenges in unified application management of services distributed over different cloud providers SeaClouds will use Cloud4SOA's management functionality.	Ivon Miranda Santos
Brogi2015-Adaptive_management_of_applications_across_multiple_c	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Challenges in standards for cloud interoperability. SeaClouds intends to actively contribute to the standardization effort of CAMP [18] both by implementing a	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Challenges in cloud management	One aspect of this is scheduling apps at runtime to communicate with micro clouds along with data centers.	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	Of course, there are still many challenges to consider, such as negative effects on battery health, undesirable data traffic and more. However, even assuming that such an infrastructure would be limited and unreliable, it could be used in together with existing data centers to improve connectivity.	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Difficulty for adoption the multi-cloud	Of course, there are still many challenges to consider, such as negative effects on battery health, undesirable data traffic and more. However, even assuming that such an infrastructure would be limited and unreliable, it could be used in together with existing data centers to improve connectivity.	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	However, even assuming that such an infrastructure would be limited and unreliable, it could be used in together with existing data centers to improve connectivity. V. CHALLENGES OF MULTI-CLOUD INTEROPERABILITY After we presented an overview of most common architectures that involve multi-cloud integrations, we can summarize their common problems from the interoperability point of view. For a more focused review, the challenges will be split into organizational and technical.	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	V. CHALLENGES OF MULTI-CLOUD INTEROPERABILITY After we presented an overview of most common architectures that involve multi-cloud integrations, we can summarize their common problems from the interoperability point of view. For a more focused review, the challenges will be split into organizational and technical.	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	After we presented an overview of most common architectures that involve multi-cloud integrations, we can summarize their common problems from the interoperability point of view.	Ivon Miranda Santos

Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	A. Organizational problems	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Even successful cases of multi-cloud deployments in the industry have hit multiple limitations along the way as they try to integrate diverse platforms into a single, secure stack. According to the Forbes survey [19], respondents in the study pointed following challenges related to multi-cloud integration: ● 23%:	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Even successful cases of multi-cloud deployments in the industry have hit multiple limitations along the way as they try to integrate diverse platforms into a single, secure stack. According to the Forbes survey [19], respondents in the study pointed following challenges related to multi-cloud integration: ● 23%: Need to hire or train personnel for new skills, specific for public clouds support ● 23%: Complexity in environment management policies ● 23% Difficulties optimizing costs ● 25%: Risks related to security, data, and privacy issues ● 25%: Inconsistent infrastructure for APIs, databases, networks, and security. Although the aforementioned challenges are posing significant limitations from the business perspective, since they currently cannot be addressed by any technical means, we will not consider those factors in this article. Instead, while keeping organizational problems in mind, we will focus more on technical problems.	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Security	Even successful cases of multi-cloud deployments in the industry have hit multiple limitations along the way as they try to integrate diverse platforms into a single, secure stack. According to the Forbes survey [19], respondents in the study pointed following challenges related to multi-cloud integration: ● 23%: Need to hire or train personnel for new skills, specific for public clouds support ● 23%: Complexity in environment management policies ● 23% Difficulties optimizing costs ● 25%: Risks related to security, data, and privacy issues ● 25%: Inconsistent infrastructure for APIs, databases, networks, and security. Although the aforementioned challenges are posing significant limitations from the business perspective, since they currently cannot be addressed by any technical means, we will not consider those factors in this article. Instead, while keeping organizational problems in mind, we will focus more on technical problems.	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Data loss and privacy	Even successful cases of multi-cloud deployments in the industry have hit multiple limitations along the way as they try to integrate diverse platforms into a single, secure stack. According to the Forbes survey [19], respondents in the study pointed following challenges related to multi-cloud integration: ● 23%: Need to hire or train personnel for new skills, specific for public clouds support ● 23%: Complexity in environment management policies ● 23% Difficulties optimizing costs ● 25%: Risks related to security, data, and privacy issues ● 25%: Inconsistent infrastructure for APIs, databases, networks, and security. Although the aforementioned challenges are posing significant limitations from the business perspective, since they currently cannot be addressed by any technical means, we will not consider those factors in this article. Instead, while keeping organizational problems in mind, we will focus more on technical problems.	Ivon Miranda Santos

Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	According to the Forbes survey [19], respondents in the study pointed following challenges related to multi-cloud integration: ● 23%: Need to hire or train personnel for new skills, specific for public clouds support ● 23%: Complexity in environment management policies ● 23% Difficulties optimizing costs ● 25%: Risks related to security, data, and privacy issues ● 25%: Inconsistent infrastructure for APIs, databases, networks, and security.	Ivon Miranda Santos
Caceres2022-State-of-the-art_architectures_for_interoperability	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	● 23%:	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Concerns such as vendor neutral design, scalability, (self-)adaptation and monitoring of running applications need to be dealt with.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	ModelioSaaS. The main objective of MODAClouds is to offer a set of tools to the Application developers and Operators that help them in dealing with the challenges of designing and deploying cloud applications into multiple clouds. The main challenges it deals with are:	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	The main objective of MODAClouds is to offer a set of tools to the Application developers and Operators that help them in dealing with the challenges of designing and deploying cloud applications into multiple clouds. The main challenges it deals with are: (i) avoiding vendor lock-in; (ii) supporting risk analysis and management and (iii) guaranteeing predifined quality of service agreements. Fig 3. describes the architecture of MODAClouds. It provides a set of design time and run-time components that deal with these challenges	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Vendor lock-in	The main objective of MODAClouds is to offer a set of tools to the Application developers and Operators that help them in dealing with the challenges of designing and deploying cloud applications into multiple clouds. The main challenges it deals with are: (i) avoiding vendor lock-in; (ii) supporting risk analysis and management and (iii) guaranteeing predifined quality of service agreements. Fig 3. describes the architecture of MODAClouds. It provides a set of design time and run-time components that deal with these challenges	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	(i) avoiding vendor lock-in; (ii) supporting risk analysis and management and (iii) guaranteeing predifined quality of service agreements.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	describes the architecture of MODAClouds.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Drawback	The main drawback of the current version of the TeamWork Manager is that clients need to buy the hardware necessary to run the server. Moreover and they need to configure and maintain a SVN server on it, increasing its cost.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Which data structures will provide best performance for each service? These questions do not necessarily represent functionalities we intend to implement in our offering, but challenges we, as designers, need to overcome.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	These questions do not necessarily represent functionalities we intend to implement in our offering, but challenges we, as designers, need to overcome. First of all, the Administration Service needs to be extended with the support monitoring QoS on multiple clouds.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in cloud management	First of all, the Administration Service needs to be extended with the support monitoring QoS on multiple clouds.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	First of all, the Administration Service needs to be extended with the support monitoring QoS on multiple clouds.	Ivon Miranda Santos

daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	First of all, the Administration Service needs to be extended with the support monitoring QoS on multiple clouds. We intend to work on the monitoring resource status information such as the available and used memory and disk space, and the CPU consumption. We consider such pieces of information to be important for allowing our customers to decide upon when migrations need to be performed. Our current prototype actually has no monitoring capabilities. The challenge in monitoring such pieces of information is that a different set of measurements is provided by each cloud provider, making it hard to implement the monitoring code and to present a homogeneous user interface to the developers.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Monitoring	First of all, the Administration Service needs to be extended with the support monitoring QoS on multiple clouds. We intend to work on the monitoring resource status information such as the available and used memory and disk space, and the CPU consumption. We consider such pieces of information to be important for allowing our customers to decide upon when migrations need to be performed. Our current prototype actually has no monitoring capabilities. The challenge in monitoring such pieces of information is that a different set of measurements is provided by each cloud provider, making it hard to implement the monitoring code and to present a homogeneous user interface to the developers.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Microservice orchestration	First of all, the Administration Service needs to be extended with the support monitoring QoS on multiple clouds. We intend to work on the monitoring resource status information such as the available and used memory and disk space, and the CPU consumption. We consider such pieces of information to be important for allowing our customers to decide upon when migrations need to be performed. Our current prototype actually has no monitoring capabilities. The challenge in monitoring such pieces of information is that a different set of measurements is provided by each cloud provider, making it hard to implement the monitoring code and to present a homogeneous user interface to the developers.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Our current prototype actually has no monitoring capabilities. The challenge in monitoring such pieces of information is that a different set of measurements is provided by each cloud provider, making it hard to implement the monitoring code and to present a homogeneous user interface to the developers.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The current paper described ModelioSaaS, one of the case studies of the MODAClouds project. This case study, provided by SOFTEAM, a French medium sized company, illustrates the challenges involved in migrating web based services to the cloud while preserving cloud provider independence. As this project is still in its initial phase, the main contribution of this paper is not in describing a fail-proof method for migrating cloud applications.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The MODAClouds technologies will hopefully help to provision and monitor all cloud-based services, as well as, if necessary, to migrate them from one cloud provider to another. In this paper we have also described the remaining challenges, related to designing, and provisioning cloud applications that are still to be tackled throughout the MODAClouds project.	Ivon Miranda Santos
daSilva2013-From_the_desktop_to_the_multi-clouds_The_case_of_mo	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The MODAClouds technologies will hopefully help to provision and monitor all cloud-based services, as well as, if necessary, to migrate them from one cloud provider to another.	Ivon Miranda Santos

deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	While the cloud brings several benefits, there are still some challenges that need to be overcome to apply the cloud model in certain scenarios. One such problem is the so-called vendor lock-in since different cloud providers offer peculiar and often incompatible services, which results in the automatic migration impossibility of the application between cloud providers.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	One such problem is the so-called vendor lock-in since different cloud providers offer peculiar and often incompatible services, which results in the automatic migration impossibility of the application between cloud providers.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	One such problem is the so-called vendor lock-in since different cloud providers offer peculiar and often incompatible services, which results in the automatic migration impossibility of the application between cloud providers.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	One such problem is the so-called vendor lock-in since different cloud providers offer peculiar and often incompatible services, which results in the automatic migration impossibility of the application between cloud providers.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Vendor lock-in	One such problem is the so-called vendor lock-in since different cloud providers offer peculiar and often incompatible services, which results in the automatic migration impossibility of the application between cloud providers.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	This issue becomes even more problematic when thinking of future applications composed of services or components hosted by different cloud providers in a multi-cloud environment. Dealing with ven-dor lock-in in multiple clouds requires addressing two important challenges: interoperability and portability. Some solutions have been proposed to deal with both problems, but most of them fail to provide flexibility.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	This issue becomes even more problematic when thinking of future applications composed of services or components hosted by different cloud providers in a multi-cloud environment. Dealing with ven-dor lock-in in multiple clouds requires addressing two important challenges: interoperability and portability.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	This issue becomes even more problematic when thinking of future applications composed of services or components hosted by different cloud providers in a multi-cloud environment. Dealing with ven-dor lock-in in multiple clouds requires addressing two important challenges: interoperability and portability. Some solutions have been proposed to deal with both problems, but most of them fail to provide flexibility.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	This issue becomes even more problematic when thinking of future applications composed of services or components hosted by different cloud providers in a multi-cloud environment. Dealing with ven-dor lock-in in multiple clouds requires addressing two important challenges: interoperability and portability. Some solutions have been proposed to deal with both problems, but most of them fail to provide flexibility.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	This issue becomes even more problematic when thinking of future applications composed of services or components hosted by different cloud providers in a multi-cloud environment. Dealing with ven-dor lock-in in multiple clouds requires addressing two important challenges: interoperability and portability. Some solutions have been proposed to deal with both problems, but most of them fail to provide flexibility.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Dealing with ven-dor lock-in in multiple clouds requires addressing two important challenges: interoperability and portability. Some solutions have been proposed to deal with both problems, but most of them fail to provide flexibility.	Ivon Miranda Santos

deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Dealing with ven-dor lock-in in multiple clouds requires addressing two important challenges: interoperability and portability. Some solutions have been proposed to deal with both problems, but most of them fail to provide flexibility.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Some solutions have been proposed to deal with both problems, but most of them fail to provide flexibility.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	In this article, we also propose a definition of microservices and a comparative analysis of the works related to PacificClouds.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	In this article, we also propose a definition of microservices and a comparative analysis of the works related to PacificClouds. Finally, we show the main challenges of PacificClouds, and we point out the future directions.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Microservices can aid in obtaining the native cloud application's characteristics; therefore, they fo-cus on aspects as componentization of small and lig-htweight services, agile and DevOps practices, in-frastructure automation with continuous delivery fe-atures, decentralized data management, and decen-tralized governance among services. The microser-vices promise more agility, more delivery speed, and more scalability compared with traditional monolithic applications, resulting in less overall cost (Newman, 2015), (RV, 2016). In Section 3, we describe, present challenges and propose a definition for microservices.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The microser-vices promise more agility, more delivery speed, and more scalability compared with traditional monolithic applications, resulting in less overall cost (Newman, 2015), (RV, 2016). In Section 3, we describe, present challenges and propose a definition for microservices.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The microser-vices promise more agility, more delivery speed, and more scalability compared with traditional monolithic applications, resulting in less overall cost (Newman, 2015), (RV, 2016). In Section 3, we describe, present challenges and propose a definition for microservices.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in legacy architecture	The microser-vices promise more agility, more delivery speed, and more scalability compared with traditional monolithic applications, resulting in less overall cost (Newman, 2015), (RV, 2016). In Section 3, we describe, present challenges and propose a definition for microservices.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In Section 3, we describe, present challenges and propose a definition for microservices. In this work, we propose a novel architecture ba-sed on microservices to address interoperability for a multi-cloud environment, called PacificClouds, in or-der to mitigate vendor lock-in and aid to obtain full cloud advantages.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	In Section 3, we describe, present challenges and propose a definition for microservices. In this work, we propose a novel architecture ba-sed on microservices to address interoperability for a multi-cloud environment, called PacificClouds, in or-der to mitigate vendor lock-in and aid to obtain full cloud advantages.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	In Section 3, we describe, present challenges and propose a definition for microservices. In this work, we propose a novel architecture ba-sed on microservices to address interoperability for a multi-cloud environment, called PacificClouds, in or-der to mitigate vendor lock-in and aid to obtain full cloud advantages.	Ivon Miranda Santos

deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Vendor lock-in	In Section 3, we describe, present challenges and propose a definition for microservices. In this work, we propose a novel architecture ba-sed on microservices to address interoperability for a multi-cloud environment, called PacificClouds, in or-der to mitigate vendor lock-in and aid to obtain full cloud advantages.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	In Section 3, we describe, present challenges and propose a definition for microservices. In this work, we propose a novel architecture ba-sed on microservices to address interoperability for a multi-cloud environment, called PacificClouds, in or-der to mitigate vendor lock-in and aid to obtain full cloud advantages.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Interoperability	In Section 3, we describe, present challenges and propose a definition for microservices. In this work, we propose a novel architecture ba-sed on microservices to address interoperability for a multi-cloud environment, called PacificClouds, in or-der to mitigate vendor lock-in and aid to obtain full cloud advantages.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	In this work, we propose a novel architecture ba-sed on microservices to address interoperability for a multi-cloud environment, called PacificClouds, in or-der to mitigate vendor lock-in and aid to obtain full cloud advantages.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	In this work, we propose a novel architecture ba-sed on microservices to address interoperability for a multi-cloud environment, called PacificClouds, in or-der to mitigate vendor lock-in and aid to obtain full cloud advantages.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Last, in Section 7, we show this work's primary contributions, describe PacificClouds' main develo-ping challenges and discuss future directions. 2 MULTIPLE CLOUDS	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	2 MULTIPLE CLOUDS	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Multiple clouds enable applications to take advantage of the best features of different components provided by several cloud providers. Since there is still no stan-dardized taxonomy for the subject, different terms are used in the literature and they often have the same meaning or they are a branch of an existing one.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	Multiple clouds enable applications to take advantage of the best features of different components provided by several cloud providers. Since there is still no stan-dardized taxonomy for the subject, different terms are used in the literature and they often have the same meaning or they are a branch of an existing one.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	, 2013). However, the multiple clouds bring several challenges, as well, e.g., interoperability and portabi-lity related to mitigating vendor lock-in.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	,	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	, 2013). However, the multiple clouds bring several challenges, as well, e.g., interoperability and portabi-lity related to mitigating vendor lock-in.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Vendor lock-in	, 2013). However, the multiple clouds bring several challenges, as well, e.g., interoperability and portabi-lity related to mitigating vendor lock-in.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Interoperability	, 2013). However, the multiple clouds bring several challenges, as well, e.g., interoperability and portabi-lity related to mitigating vendor lock-in.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud management	However, the multiple clouds bring several challenges, as well, e.g., interoperability and portabi-lity related to mitigating vendor lock-in.	Ivon Miranda Santos

deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	However, the multiple clouds bring several challenges, as well, e.g., interoperability and portabi-lity related to mitigating vendor lock-in.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	However, the multiple clouds bring several challenges, as well, e.g., interoperability and portabi-lity related to mitigating vendor lock-in.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	However, the multiple clouds bring several challenges, as well, e.g., interoperability and portabi-lity related to mitigating vendor lock-in.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	We consider portability the ability to allow customers to migrate data and systems from one cloud to another and inter-operability capacity to allow customers to use servi-ces across multiple clouds (Rezaei et al., 2014)	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Definition (Microservices): are a set of autonomous, independent, self-contained services, in which each service has a single goal, is loosely coupled, and inte-ract to build a distributed application.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Definition (Microservices): are a set of autonomous, independent, self-contained services, in which each service has a single goal, is loosely coupled, and inte-ract to build a distributed application.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	Definition (Microservices): are a set of autonomous, independent, self-contained services, in which each service has a single goal, is loosely coupled, and inte-ract to build a distributed application.	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In this section, we describe an overview of the six most relevant works related to PacificClouds in regars to treating the interoperability in multiple clouds, in which each of them proposes a different solution to mitigate vendor lock-in. Cloud4SOA introduces a broker-based architec-ture whose primary goal is to address semantic in-teroperability challenges at the PaaS layer, based on SOA architecture (Dandria et al., 2012).	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	In this section, we describe an overview of the six most relevant works related to PacificClouds in regars to treating the interoperability in multiple clouds, in which each of them proposes a different solution to mitigate vendor lock-in. Cloud4SOA introduces a broker-based architec-ture whose primary goal is to address semantic in-teroperability challenges at the PaaS layer, based on SOA architecture (Dandria et al., 2012).	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	In this section, we describe an overview of the six most relevant works related to PacificClouds in regars to treating the interoperability in multiple clouds, in which each of them proposes a different solution to mitigate vendor lock-in. Cloud4SOA introduces a broker-based architec-ture whose primary goal is to address semantic in-teroperability challenges at the PaaS layer, based on SOA architecture (Dandria et al., 2012).	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Vendor lock-in	In this section, we describe an overview of the six most relevant works related to PacificClouds in regars to treating the interoperability in multiple clouds, in which each of them proposes a different solution to mitigate vendor lock-in. Cloud4SOA introduces a broker-based architec-ture whose primary goal is to address semantic in-teroperability challenges at the PaaS layer, based on SOA architecture (Dandria et al., 2012).	Ivon Miranda Santos

deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	In this section, we describe an overview of the six most relevant works related to PacificClouds in regars to treating the interoperability in multiple clouds, in which each of them proposes a different solution to mitigate vendor lock-in. Cloud4SOA introduces a broker-based architecture whose primary goal is to address semantic interoperability challenges at the PaaS layer, based on SOA architecture (Dandria et al., 2012).	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Cloud4SOA introduces a broker-based architecture whose primary goal is to address semantic interoperability challenges at the PaaS layer, based on SOA architecture (Dandria et al.,	Ivon Miranda Santos
deCarvalho2018-Pacificclouds_A_flexible_microservices_based_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	In this manner, PacificClouds provides other contributions: a) lightweight, since each microservice has only one function; b) decentralized governance of the application, because each microservice is in-dependent of one another, which allows loosely cou-pled; c) the software architect can request at runtime a new SLA by analyzing the monitoring metrics; d) facilitates the use of native cloud application in appli-cation development. One of the contributions of PacificClouds is the flexibility; however, to achieve this, some challenges need to be overcome. One of the more significant challenges is to reach the interoperability of clouds that possess distinct background technological; in this manner, software architects are primarily concerned with application development and the user's SLA.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Method:	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	However, the identification of opportunities for migration, the reasoning of an attractive cost-benefit relation-ship and the selection of service providers that best fit their needs are not trivial tasks [16,17].	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	However, the identification of opportunities for migration, the reasoning of an attractive cost-benefit relation-ship and the selection of service providers that best fit their needs are not trivial tasks [16,17]. The selection of commercial cloud providers is a challenging task and depends on several variables and indicators. Among other reasons, cloud providers may continually upgrade their hardware and software infrastructures, and new commercial Cloud services, technologies and strategies may gradually	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud management	However, the identification of opportunities for migration, the reasoning of an attractive cost-benefit relation-ship and the selection of service providers that best fit their needs are not trivial tasks [16,17].	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	However, the identification of opportunities for migration, the reasoning of an attractive cost-benefit relation-ship and the selection of service providers that best fit their needs are not trivial tasks [16,17]. The selection of commercial cloud providers is a challenging task and depends on several variables and indicators.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Requirements of service levels	However, the identification of opportunities for migration, the reasoning of an attractive cost-benefit relation-ship and the selection of service providers that best fit their needs are not trivial tasks [16,17]. The selection of commercial cloud providers is a challenging task and depends on several variables and indicators.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	The selection of commercial cloud providers is a challenging task and depends on several variables and indicators.	Ivon Miranda Santos

dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	For this end, the study present different approaches, techniques and tools to overcome diffi-culties and challenges in the context of CC. The scope of this review is specific to identify strategies that can help organizations to migrate and adopt CC, their perception of the cost-benefit relationship of this adoption and how com-panies can select service providers that best fit their needs and profile.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	For this end, the study present different approaches, techniques and tools to overcome diffi-culties and challenges in the context of CC. The scope of this review is specific to identify strategies that can help organizations to migrate and adopt CC, their perception of the cost-benefit relationship of this adoption and how com-panies can select service providers that best fit their needs and profile.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	During the conduction of this study, we found four systematic literature reviews (SLRs) focusing on the following themes: migration to the CC [10], service com-position [11], service evaluation [18] and challenges and concerns when building cloud-based architectures [1].	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The paper [S57] with 279 citations according to Google Scholar, proposes a framework and a mechanism to measure the quality and prioritize Cloud services providers. According to the authors, given the diversity of Cloud service offerings, an important challenge for customers is to find out appropriate Cloud providers that can satisfy their requirements (RQ3). This makes it difficult to evaluate service levels of different Cloud providers, justifying the use of a Analytical Hierarchical Process (AHP) based ranking mechanism to provide a quantitative basis for the ranking of Cloud services where the final ranking is based on the cost (RQ2) and quality [7].	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	F. de Carneiro	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The authors of [S22] discussed the migration of agile projects to the cloud in terms of cost, time and quality. [S23] discussed potential issues and challenges that organizations may face while considering to migrate workloads to the cloud: efficiency, agility, quality, security, governance and standardization in the delivery, consumption and operation of IT services, all at reduced capital and operational expense.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	The authors of [S22] discussed the migration of agile projects to the cloud in terms of cost, time and quality. [S23] discussed potential issues and challenges that organizations may face while considering to migrate workloads to the cloud: efficiency, agility, quality, security, governance and standardization in the delivery, consumption and operation of IT services, all at reduced capital and operational expense.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	The authors of [S22] discussed the migration of agile projects to the cloud in terms of cost, time and quality. [S23] discussed potential issues and challenges that organizations may face while considering to migrate workloads to the cloud: efficiency, agility, quality, security, governance and standardization in the delivery, consumption and operation of IT services, all at reduced capital and operational expense.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Security	The authors of [S22] discussed the migration of agile projects to the cloud in terms of cost, time and quality. [S23] discussed potential issues and challenges that organizations may face while considering to migrate workloads to the cloud: efficiency, agility, quality, security, governance and standardization in the delivery, consumption and operation of IT services, all at reduced capital and operational expense.	Ivon Miranda Santos

dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Creating a multi-cloud solution	The authors of [S22] discussed the migration of agile projects to the cloud in terms of cost, time and quality. [S23] discussed potential issues and challenges that organizations may face while considering to migrate workloads to the cloud: efficiency, agility, quality, security, governance and standardization in the delivery, consumption and operation of IT services, all at reduced capital and operational expense.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Multi-cloud/Cloud-compliant orchestration	The authors of [S22] discussed the migration of agile projects to the cloud in terms of cost, time and quality. [S23] discussed potential issues and challenges that organizations may face while considering to migrate workloads to the cloud: efficiency, agility, quality, security, governance and standardization in the delivery, consumption and operation of IT services, all at reduced capital and operational expense.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Scalability	The authors of [S22] discussed the migration of agile projects to the cloud in terms of cost, time and quality. [S23] discussed potential issues and challenges that organizations may face while considering to migrate workloads to the cloud: efficiency, agility, quality, security, governance and standardization in the delivery, consumption and operation of IT services, all at reduced capital and operational expense.	Ivon Miranda Santos
dePaula2016-A_systematic_literature_review_on_cloud_computing_a	MULTI-CLOUD CHALLENGES > Availability	The authors of [S22] discussed the migration of agile projects to the cloud in terms of cost, time and quality. [S23] discussed potential issues and challenges that organizations may face while considering to migrate workloads to the cloud: efficiency, agility, quality, security, governance and standardization in the delivery, consumption and operation of IT services, all at reduced capital and operational expense.	Ivon Miranda Santos
Elgedawy2015-Sultan_A_composite_data_consistency_approach_for_s	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	One approach for preventing such risk is to deploy business services on different clouds. SaaS multi-cloud deployment provides better performance and lower costs compared to the usage of a single cloud, as it provides better availability, responsiveness, and resources utilization [1]. However, SaaS multi-cloud deployment approach faces many technical chal-lenges such as cloud heterogeneity, ensuring data correctness, and security.	Ivon Miranda Santos
Elgedawy2015-Sultan_A_composite_data_consistency_approach_for_s	MULTI-CLOUD CHALLENGES > Challenges in cloud management	One approach for preventing such risk is to deploy business services on different clouds. SaaS multi-cloud deployment provides better performance and lower costs compared to the usage of a single cloud, as it provides better availability, responsiveness, and resources utilization [1]. However, SaaS multi-cloud deployment approach faces many technical chal-lenges such as cloud heterogeneity, ensuring data correctness, and security.	Ivon Miranda Santos
Elgedawy2015-Sultan_A_composite_data_consistency_approach_for_s	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	One approach for preventing such risk is to deploy business services on different clouds.	Ivon Miranda Santos
Elgedawy2015-Sultan_A_composite_data_consistency_approach_for_s	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	One approach for preventing such risk is to deploy business services on different clouds. SaaS multi-cloud deployment provides better performance and lower costs compared to the usage of a single cloud, as it provides better availability, responsiveness, and resources utilization [1]. However, SaaS multi-cloud deployment approach faces many technical chal-lenges such as cloud heterogeneity, ensuring data correctness, and security.	Ivon Miranda Santos
Elgedawy2015-Sultan_A_composite_data_consistency_approach_for_s	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	One approach for preventing such risk is to deploy business services on different clouds. SaaS multi-cloud deployment provides better performance and lower costs compared to the usage of a single cloud, as it provides better availability, responsiveness, and resources utilization [1]. However, SaaS multi-cloud deployment approach faces many technical chal-lenges such as cloud heterogeneity, ensuring data correctness, and security.	Ivon Miranda Santos

Elgedawy2015-Sultan_A_composite_data_consistency_approach_for_s	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	One approach for preventing such risk is to deploy business services on different clouds. SaaS multi-cloud deployment provides better performance and lower costs compared to the usage of a single cloud, as it provides better availability, responsiveness, and resources utilization [1]. However, SaaS multi-cloud deployment approach faces many technical chal-lenges such as cloud heterogeneity, ensuring data correctness, and security.	Ivon Miranda Santos
Elgedawy2015-Sultan_A_composite_data_consistency_approach_for_s	MULTI-CLOUD CHALLENGES > Vendor lock-in	One approach for preventing such risk is to deploy business services on different clouds. SaaS multi-cloud deployment provides better performance and lower costs compared to the usage of a single cloud, as it provides better availability, responsiveness, and resources utilization [1]. However, SaaS multi-cloud deployment approach faces many technical chal-lenges such as cloud heterogeneity, ensuring data correctness, and security.	Ivon Miranda Santos
Elgedawy2015-Sultan_A_composite_data_consistency_approach_for_s	MULTI-CLOUD CHALLENGES > Security	One approach for preventing such risk is to deploy business services on different clouds.	Ivon Miranda Santos
Elgedawy2015-Sultan_A_composite_data_consistency_approach_for_s	MULTI-CLOUD CHALLENGES > Creating a multi-cloud solution	One approach for preventing such risk is to deploy business services on different clouds.	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Abstract. Addressing the management challenges for a multitude of distributed cloud architectures, we focus on the three complementary cloud management problems of predictive elasticity, admission control, and placement (or scheduling) of virtual machines.	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Addressing the management challenges for a multitude of distributed cloud architectures, we focus on the three complementary cloud management problems of predictive elasticity, admission control, and placement (or scheduling) of virtual machines.	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Such a cloud appears to the service (content) provider as a sin-gle system always delivering sufficient capacity, where service capacity also can be increased or decreased rapidly to meet workload fluctuations. Despite these recent advances significant research challenges remain in terms of how to achieve e.g.,	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Despite these recent advances significant research challenges remain in terms of how to achieve e.g., flexibility, robustness, cost-efficiency, and sustainability of cloud infrastruc-tures [2,27,28,29].	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in cloud management	, flexibility, robustness, cost-efficiency, and sustainability of cloud infrastruc-tures [2,27,28,29].	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	[14], we address bursted private clouds (a service provider having a private cloud infrastructured with possibility to expand using external clouds), federated clouds (infrastructure providers using partners to en-sure the capacity needed to serve the service providers that are their customers), and multi-clouds (service providers working directly with multiple external in-frastructure providers). The management challenges in focus are not specific to any of the scenarios, but are rather derived from a single cloud deployment ab-straction meeting the needs for all three scenarios.	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	[14], we address bursted private clouds (a service provider having a private cloud infrastructured with possibility to expand using external clouds), federated clouds (infrastructure providers using partners to en-sure the capacity needed to serve the service providers that are their customers), and multi-clouds (service providers working directly with multiple external in-frastructure providers). The management challenges in focus are not specific to any of the scenarios, but are rather derived from a single cloud deployment ab-straction meeting the needs for all three scenarios.	Ivon Miranda Santos

Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	[14], we address bursted private clouds (a service provider having a private cloud infrastructured with possibility to expand using external clouds), federated clouds (infrastructure providers using partners to en-sure the capacity needed to serve the service providers that are their customers), and multi-clouds (service providers working directly with multiple external in-frastructure providers). The management challenges in focus are not specific to any of the scenarios, but are rather derived from a single cloud deployment ab-straction meeting the needs for all three scenarios.	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Requirements of service levels	[14], we address bursted private clouds (a service provider having a private cloud infrastructured with possibility to expand using external clouds), federated clouds (infrastructure providers using partners to en-sure the capacity needed to serve the service providers that are their customers), and multi-clouds (service providers working directly with multiple external in-frastructure providers). The management challenges in focus are not specific to any of the scenarios, but are rather derived from a single cloud deployment ab-straction meeting the needs for all three scenarios.	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	We are focusing on the three management problems of admission control (de-ciding whether to accept a new service request or not) for safe overbooking of elastic services and long-term capacity planning, placement (or scheduling) for optimal mapping of service components in cloud infrastructures comprised of many datacenters, and proactive elasticity to rapidly adjust capacity allocation to variations in demand.	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in cloud management	However, extended migration downtime is not the only issue with the stan-dard live migration algorithms.	Ivon Miranda Santos
Elmroth2011-Self-management_challenges_for_multi-cloud_architec	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	We have presented a unified approach to key challenges for autonomous cloud management, including results from on-going work on the three topics of elas-ticity control, admission control, and VM scheduling and the topic of automatic cloud governance for management actions towards high-level management ob-jectives.	Ivon Miranda Santos
Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Tools have been provided by many cloud service provider to migrate for instance data using data loaders. In [21], the top 10 challenges for start-ups are summarised, that also reflect the concerns for migrations by software vendors inexperienced in cloud technolo-gies, particularly if the cloud context is a novel environment.	Ivon Miranda Santos
Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Tools have been provided by many cloud service provider to migrate for instance data using data loaders. In [21], the top 10 challenges for start-ups are summarised, that also reflect the concerns for migrations by software vendors inexperienced in cloud technolo-gies, particularly if the cloud context is a novel environment. – Thriving in Technology Uncertainty, i.e.,	Ivon Miranda Santos
Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Tools have been provided by many cloud service provider to migrate for instance data using data loaders. In [21], the top 10 challenges for start-ups are summarised, that also reflect the concerns for migrations by software vendors inexperienced in cloud technolo-gies, particularly if the cloud context is a novel environment.	Ivon Miranda Santos
Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	Tools have been provided by many cloud service provider to migrate for instance data using data loaders. In [21], the top 10 challenges for start-ups are summarised, that also reflect the concerns for migrations by software vendors inexperienced in cloud technolo-gies, particularly if the cloud context is a novel environment.	Ivon Miranda Santos

Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Vendor lock-in	Tools have been provided by many cloud service provider to migrate for instance data using data loaders. In [21], the top 10 challenges for start-ups are summarised, that also reflect the concerns for migrations by software vendors inexperienced in cloud technolo-gies, particularly if the cloud context is a novel environment.	Ivon Miranda Santos
Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Choosing the cloud providers	Tools have been provided by many cloud service provider to migrate for instance data using data loaders. In [21], the top 10 challenges for start-ups are summarised, that also reflect the concerns for migrations by software vendors inexperienced in cloud technolo-gies, particularly if the cloud context is a novel environment.	Ivon Miranda Santos
Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Challenges in cloud management	And, furthermore, predicting the cost for a fully cloud-native solution is the challenge.	Ivon Miranda Santos
Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Challenges in cloud management	6 Architecture Migration and PaaS Deployment Cost Calculation	Ivon Miranda Santos
Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	– flexibility, allowing different access forms – expansion, requiring to facilitate new customers in new markets The challenge is a high-volume data storage and processing need.	Ivon Miranda Santos
Fowley2018-Cloud_migration_architecture_and_pricing_–_Mapping_a	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The earlier pricing samples reflect this storage/processing need already.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	This enables academia and practitioners in the cloud computing community to get an overarching view of the cloud migration process. Furthermore, the survey identifies a number challenges that have not been yet addressed by existing approaches, developing opportunities for further research endeavors.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Creating a multi-cloud solution	This enables academia and practitioners in the cloud computing community to get an overarching view of the cloud migration process. Furthermore, the survey identifies a number challenges that have not been yet addressed by existing approaches, developing opportunities for further research endeavors.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Moving to the cloud raises many concerns such as security, interoperability, and vendor lock-in.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The complexity of migration is exacerbated by the fact that some legacy applications may have been developed without taking into account the unique requirements attributed to cloud environments such as elasticity, multi-tenancy, interoperability, and refactoring. Such requirements raise new challenges to the migration of applications to the cloud and hence needs improving conventional software development methodologies to address these specific requirements.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The complexity of migration is exacerbated by the fact that some legacy applications may have been developed without taking into account the unique requirements attributed to cloud environments such as elasticity, multi-tenancy, interoperability, and refactoring. Such requirements raise new challenges to the migration of applications to the cloud and hence needs improving conventional software development methodologies to address these specific requirements. Various projects and studies in cloud computing community define migration approaches in order to enable legacy applications to take benefit from cloud services (e.g. reducing maintenance costs, economies of scale, and pay-as-you-go).	Ivon Miranda Santos

Gholami2016-Cloud_migration_process—a_survey __evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The complexity of migration is exacerbated by the fact that some legacy applications may have been developed without taking into account the unique requirements attributed to cloud environments such as elasticity, multi-tenancy, interoperability, and refactoring. Such requirements raise new challenges to the migration of applications to the cloud and hence needs improving conventional software development methodologies to address these specific requirements. Various projects and studies in cloud computing community define migration approaches in order to enable legacy applications to take benefit from cloud services (e.g. reducing maintenance costs, economies of scale, and pay-as-you-go).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey __evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	The complexity of migration is exacerbated by the fact that some legacy applications may have been developed without taking into account the unique requirements attributed to cloud environments such as elasticity, multi-tenancy, interoperability, and refactoring. Such requirements raise new challenges to the migration of applications to the cloud and hence needs improving conventional software development methodologies to address these specific requirements. Various projects and studies in cloud computing community define migration approaches in order to enable legacy applications to take benefit from cloud services (e.g. reducing maintenance costs, economies of scale, and pay-as-you-go).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey __evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	The complexity of migration is exacerbated by the fact that some legacy applications may have been developed without taking into account the unique requirements attributed to cloud environments such as elasticity, multi-tenancy, interoperability, and refactoring. Such requirements raise new challenges to the migration of applications to the cloud and hence needs improving conventional software development methodologies to address these specific requirements.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey __evaluation_framew	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	The complexity of migration is exacerbated by the fact that some legacy applications may have been developed without taking into account the unique requirements attributed to cloud environments such as elasticity, multi-tenancy, interoperability, and refactoring. Such requirements raise new challenges to the migration of applications to the cloud and hence needs improving conventional software development methodologies to address these specific requirements.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey __evaluation_framew	MULTI-CLOUD CHALLENGES > Requirements of service levels	The complexity of migration is exacerbated by the fact that some legacy applications may have been developed without taking into account the unique requirements attributed to cloud environments such as elasticity, multi-tenancy, interoperability, and refactoring. Such requirements raise new challenges to the migration of applications to the cloud and hence needs improving conventional software development methodologies to address these specific requirements. Various projects and studies in cloud computing community define migration approaches in order to enable legacy applications to take benefit from cloud services (e.g. reducing maintenance costs, economies of scale, and pay-as-you-go).	Ivon Miranda Santos

Gholami2016-Cloud_migration_process—a_survey_evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in legacy architecture	The complexity of migration is exacerbated by the fact that some legacy applications may have been developed without taking into account the unique requirements attributed to cloud environments such as elasticity, multi-tenancy, interoperability, and refactoring. Such requirements raise new challenges to the migration of applications to the cloud and hence needs improving conventional software development methodologies to address these specific requirements. Various projects and studies in cloud computing community define migration approaches in order to enable legacy applications to take benefit from cloud services (e.g. reducing maintenance costs, economies of scale, and pay-as-you-go).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey_evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	— To help both researchers and practitioners in the cloud community if they want to capture key facets of existing approaches and select or discard one or collection of them that may suite their needs for a particular migration exercise, and — To give a broad view of research challenges, specifically concerned with process models for the legacy to cloud migration that need to be investigated by researchers. Hence, a gateway to new research opportunities can be opened.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey_evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	— To help both researchers and practitioners in the cloud community if they want to capture key facets of existing approaches and select or discard one or collection of them that may suite their needs for a particular migration exercise, and — To give a broad view of research challenges, specifically concerned with process models for the legacy to cloud migration that need to be investigated by researchers. Hence, a gateway to new research opportunities can be opened.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey_evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	This paper is structured as follows: In Section 2, we give a general review of terms related to cloud migration, key challenges that need to be addressed in a migration process, and the related work to this paper. Section 3 describes proposed evaluation framework designed for the purpose of this paper.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey_evaluation_framew	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	This paper is structured as follows: In Section 2, we give a general review of terms related to cloud migration, key challenges that need to be addressed in a migration process, and the related work to this paper. Section 3 describes proposed evaluation framework designed for the purpose of this paper.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey_evaluation_framew	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Drawing on the general literature on cloud computing (Fox et al., 2009, Brebner, 2012, Rimal et al., 2009, Guo et al., 2007, Nathuji et al., 2010, Toosi et al., 2014, Dalheimer and Pfreundt, 2009, Ristenpart et al., 2009), we identified six cloud intrinsic key concerns as follow: (i) resource elasticity, (ii) multi-tenancy, (iii) interoperability and migration over multiple-clouds, (iv) application licensing, (v) dynamicity and unpredictability, and (vi) legal issues.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey_evaluation_framew	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Many legacy applications might not have been implemented with a support of dynamic scaling up/down of resources. They assume that elasticity is supported by providing more powerful physical servers. Inevitably, the architecture refactoring of these applications will not be easy and force many modifications in the application tiers	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey_evaluation_framew	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	However, migration from single-tenant to multi-tenant raises several issues, specifically for migration type II. As tenants are dedicated to the same instance of an application, there is often a concern that tenant's QoS is negatively affected by other tenants.	Ivon Miranda Santos

Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud management	, 2014). These issues face developers to heterogeneities across the application tiers, which imply a certain level of development effort, specifically in migration types I, II, III, IV, and V. As advancements in the cloud computing is still on on-going track and there is not a common standard for development cloud services, application portability is a challenge when its components are to move from a provider to another provider, but there is an incompatibility between underlying technologies of these providers (e.g. APIs).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	, 2014). These issues face developers to heterogeneities across the application tiers, which imply a certain level of development effort, specifically in migration types I, II, III, IV, and V. As advancements in the cloud computing is still on on-going track and there is not a common standard for development cloud services, application portability is a challenge when its components are to move from a provider to another provider, but there is an incompatibility between underlying technologies of these providers (e.g. APIs).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	These issues face developers to heterogeneities across the application tiers, which imply a certain level of development effort, specifically in migration types I, II, III, IV, and V. As advancements in the cloud computing is still on on-going track and there is not a common standard for development cloud services, application portability is a challenge when its components are to move from a provider to another provider, but there is an incompatibility between underlying technologies of these providers (e.g. APIs).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	These issues face developers to heterogeneities across the application tiers, which imply a certain level of development effort, specifically in migration types I, II, III, IV, and V. As advancements in the cloud computing is still on on-going track and there is not a common standard for development cloud services, application portability is a challenge when its components are to move from a provider to another provider, but there is an incompatibility between underlying technologies of these providers (e.g. APIs).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Choosing the cloud providers	These issues face developers to heterogeneities across the application tiers, which imply a certain level of development effort, specifically in migration types I, II, III, IV, and V. As advancements in the cloud computing is still on on-going track and there is not a common standard for development cloud services, application portability is a challenge when its components are to move from a provider to another provider, but there is an incompatibility between underlying technologies of these providers (e.g. APIs).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	APIs).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	APIs).	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	However, dynamic licensing is not often addressable in the application and, instead a negotiation between the application owner and provider is required, in particular for migration types I, II, and V.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	,	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Other studies such as (Singh and Chana, 2012) and (Taher et al., 2012) report general challenges of cloud-based application development in terms of cloud-based architecture, component-based development and reusability, quality, design, and security.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	The survey provided in the current study is different from the existing reviews in three salient aspects.	Ivon Miranda Santos

Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	In the migration approach proposed by Khajeh-Hosseini and Greenwood [S6], the main focus is on the early phases of the migration process and it suggests three kinds of activities named as Technology Suitability Analysis, Energy Consumption Analysis, and Stakeholder Impact Analysis.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	While all the reviewed approaches in the literature have merit and form a rich source of necessary activities and recommendations to be learned, our deep analysis revealed that still there are challenges which are yet to address. Given the RQ2 and in the light of evaluation results in Section 5, overcoming the following challenges may open new possibilities to ameliorate the state of process models for cloud migration in the literature that constitute future research directions in the field. — Approaches suffer from a sound research quality.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Specifying roles will make clear for developers their exact responsibilities and activities to the roles and may lead to better governing migration process.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	It is enjoyed by a novice who will engage in the cloud migration research and anyone who is interested in the methodological aspect of moving legacy enterprise applications to cloud environments. We hope that they expand cloud computing body of knowledge by addressing the identified challenges.	Ivon Miranda Santos
Gholami2016-Cloud_migration_process—a_survey__evaluation_framew	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	— Relevant to the first research question (RQ1) though it could be titled under different terms, — Focused on the migration of legacy applications to cloud environments, and directly dealt with the challenges as stated in Section 2.3, — Published between 2007 (the date of origination of cloud computing) and June 2015.	Ivon Miranda Santos
Gourisaria2020-An_Extensive_Review_on_Cloud_Computing	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The purpose of using cold migration is to reduce complexity and allow the transfer to be more effective. However, the downtime might affect the performance of business and thereby, cold migration is a challenge faced by companies. 8.3 Migration Risks	Ivon Miranda Santos
Gourisaria2020-An_Extensive_Review_on_Cloud_Computing	MULTI-CLOUD CHALLENGES > Challenges in risk and security	8.3 Migration Risks	Ivon Miranda Santos
Gourisaria2020-An_Extensive_Review_on_Cloud_Computing	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	However, data is stored in multiple copies in a server or multiple servers in the cloud. Deletion does not erase all the copies at one go, giving rise to the challenge of illegal data recovery without valid permission of the client.	Ivon Miranda Santos
Gourisaria2020-An_Extensive_Review_on_Cloud_Computing	MULTI-CLOUD CHALLENGES > Security	However, data is stored in multiple copies in a server or multiple servers in the cloud. Deletion does not erase all the copies at one go, giving rise to the challenge of illegal data recovery without valid permission of the client.	Ivon Miranda Santos
Gourisaria2020-An_Extensive_Review_on_Cloud_Computing	MULTI-CLOUD CHALLENGES > Legal restrictions / Data jurisdiction restrictions	However, data is stored in multiple copies in a server or multiple servers in the cloud. Deletion does not erase all the copies at one go, giving rise to the challenge of illegal data recovery without valid permission of the client.	Ivon Miranda Santos
Gourisaria2020-An_Extensive_Review_on_Cloud_Computing	MULTI-CLOUD CHALLENGES > Data loss and privacy	However, data is stored in multiple copies in a server or multiple servers in the cloud. Deletion does not erase all the copies at one go, giving rise to the challenge of illegal data recovery without valid permission of the client.	Ivon Miranda Santos
Gourisaria2020-An_Extensive_Review_on_Cloud_Computing	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Keeping in mind the security challenges and issues, cloud technology and its use must be developed to provide clients with a safe and dependable working platform.	Ivon Miranda Santos

Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	ABSTRACT In this paper, we tackle challenges in migrating enterprise services into hybrid cloud-based deployments, where enterprise operations are partly hosted on-premise and partly in the cloud. Such hy-brid architectures enable enterprises to benefit from cloud-based ar-chitectures, while honoring application performance requirements, and privacy restrictions on what services may be migrated to the cloud.	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	ABSTRACT In this paper, we tackle challenges in migrating enterprise services into hybrid cloud-based deployments, where enterprise operations are partly hosted on-premise and partly in the cloud. Such hy-brid architectures enable enterprises to benefit from cloud-based ar-chitectures, while honoring application performance requirements, and privacy restrictions on what services may be migrated to the cloud.	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in cloud management	In this paper, we tackle challenges in migrating enterprise services into hybrid cloud-based deployments, where enterprise operations are partly hosted on-premise and partly in the cloud. Such hy-brid architectures enable enterprises to benefit from cloud-based ar-chitectures, while honoring application performance requirements, and privacy restrictions on what services may be migrated to the cloud.	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	In this paper, we tackle challenges in migrating enterprise services into hybrid cloud-based deployments, where enterprise operations are partly hosted on-premise and partly in the cloud. Such hy-brid architectures enable enterprises to benefit from cloud-based ar-chitectures, while honoring application performance requirements, and privacy restrictions on what services may be migrated to the cloud.	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	In this paper, we tackle challenges in migrating enterprise services into hybrid cloud-based deployments, where enterprise operations are partly hosted on-premise and partly in the cloud. Such hy-brid architectures enable enterprises to benefit from cloud-based ar-chitectures, while honoring application performance requirements, and privacy restrictions on what services may be migrated to the cloud. W	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Requirements of service levels	In this paper, we tackle challenges in migrating enterprise services into hybrid cloud-based deployments, where enterprise operations are partly hosted on-premise and partly in the cloud. Such hy-brid architectures enable enterprises to benefit from cloud-based ar-chitectures, while honoring application performance requirements, and privacy restrictions on what services may be migrated to the cloud. W	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Performance	In this paper, we tackle challenges in migrating enterprise services into hybrid cloud-based deployments, where enterprise operations are partly hosted on-premise and partly in the cloud. Such hy-brid architectures enable enterprises to benefit from cloud-based ar-chitectures, while honoring application performance requirements, and privacy restrictions on what services may be migrated to the cloud. W	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Such hy-brid architectures enable enterprises to benefit from cloud-based ar-chitectures, while honoring application performance requirements, and privacy restrictions on what services may be migrated to the cloud.	Ivon Miranda Santos

Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Cloud computing challenge	Despite the significant interest, migrating enterprise applications to cloud computing is a major challenge (e.g., [11]). On the one hand, enterprise applications are often faced with stringent require-ments in terms of performance, delay, and service uptime. On the other hand, little is known about the performance of applications in the cloud, the response time variation induced by network la-tency, and the scale of applications suited for deployment. Further, industry-specific regulations (e.g., in health care industries), and national privacy laws may restrict what data an enterprise may mi-grate to the cloud [11].	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in cloud management	, [11]).	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Users ex-ternal to the enterprise could be handled through servers deployed in the cloud, while internal users could be handled through servers located on premise. In this paper, we take a first step towards articulating and ad-dressing two challenges involved in enabling enterprises to move to such a hybrid cloud model, as we discuss below:	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Users ex-ternal to the enterprise could be handled through servers deployed in the cloud, while internal users could be handled through servers located on premise. In this paper, we take a first step towards articulating and ad-dressing two challenges involved in enabling enterprises to move to such a hybrid cloud model, as we discuss below:	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Users ex-ternal to the enterprise could be handled through servers deployed in the cloud, while internal users could be handled through servers located on premise. In this paper, we take a first step towards articulating and ad-dressing two challenges involved in enabling enterprises to move to such a hybrid cloud model, as we discuss below: Component placement:	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	In particular, servers may be instantiated in the cloud when needed, while requests are in general served from the local data-center. In this paper, we address two key challenges associated with re-alizing hybrid cloud architectures: Planning which servers to migrate:	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	In particular, servers may be instantiated in the cloud when needed, while requests are in general served from the local data-center. In this paper, we address two key challenges associated with re-alizing hybrid cloud architectures: Planning which servers to migrate:	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	In particular, servers may be instantiated in the cloud when needed, while requests are in general served from the local data-center. In this paper, we address two key challenges associated with re-alizing hybrid cloud architectures:	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	In this paper, we address two key challenges associated with re-alizing hybrid cloud architectures:	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in risk and security	While §3 presented a framework to help decide which servers should be migrated to the cloud, an important challenge that must be ad-dressed is how security policies must be reconfigured.	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Maintaining the security and privacy of data once migrated to the cloud is a challenge [14, 28], and has started receiving attention from the community [19].	Ivon Miranda Santos
Hajjat2010-Cloudward_bound_Planning_for_beneficial_migration_of	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Maintaining the security and privacy of data once migrated to the cloud is a challenge [14, 28], and has started receiving attention from the community [19].	Ivon Miranda Santos

Haugeland2021-Migrating_monoliths_to_microservices-based_custom	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Monolithic applications have been the prevailing archi-tecture for enterprise applications after the emergence of frameworks like J2EE around 2000.	Ivon Miranda Santos
Haugeland2021-Migrating_monoliths_to_microservices-based_custom	MULTI-CLOUD CHALLENGES > Challenges in legacy architecture	Monolithic applications have been the prevailing archi-tecture for enterprise applications after the emergence of frameworks like J2EE around 2000.	Ivon Miranda Santos
Haugeland2021-Migrating_monoliths_to_microservices-based_custom	MULTI-CLOUD CHALLENGES > Drawback	Monoliths have many drawbacks. They are large and complicated, making them difficult to change, add new features, or adopt new technologies. Their large sizes also make them slower to move around networks, start or restart on failure and also inhibits scaling with unclear resource requirements. Reliability is impacted as even simple bug fixes cause the entire application to be updated in every deployment.	Ivon Miranda Santos
Haugeland2021-Migrating_monoliths_to_microservices-based_custom	MULTI-CLOUD CHALLENGES > Drawback	A. Monolithic Applications Monolithic application architecture is a common pattern that software applications follow. The pattern contains all the different layers of an application, including presentation, logic and persistence. All of which are contained within a single deployable package. The monolithic pattern is simple to deploy, scale and develop initially, but as the application grows and becomes more complex and developers encounter some new drawbacks with this pattern. Over time the single code-base for projects grows, and getting a complete understanding of all the internal complexities can become overwhelming. The frequency of changes in the application can potentially be an issue when the size of the application grows. Even the smallest changes require redeploying the entire application.	Ivon Miranda Santos
Haugeland2021-Migrating_monoliths_to_microservices-based_custom	MULTI-CLOUD CHALLENGES > Challenges in cloud management	A. Single-tenant to Multi-tenant One of the primary challenges with multi-tenant applica-tions, according to Kwok et al. [11] is that the application has to deliver a shared product to multiple tenants, resulting in one-size-fits-all solutions even though the different user-groups might have slightly different needs from the application.	Ivon Miranda Santos
Haugeland2021-Migrating_monoliths_to_microservices-based_custom	MULTI-CLOUD CHALLENGES > Challenges in cloud management	[12].	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Therefore, although the expectation has risen with various requirements on the target cloud platforms and environments, the cloud migration techniques have not provided enough options that can satisfy the various requirements. In this paper we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds. We formulate the problem as a constraint satisfaction problem, and iteratively decompose the server components and consolidate the servers.	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Therefore, although the expectation has risen with various requirements on the target cloud platforms and environments, the cloud migration techniques have not provided enough options that can satisfy the various requirements. In this paper we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds.	Ivon Miranda Santos

Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Therefore, although the expectation has risen with various requirements on the target cloud platforms and environments, the cloud migration techniques have not provided enough options that can satisfy the various requirements. In this paper we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds. We formulate the problem as a constraint satisfaction problem, and iteratively decompose the server components and consolidate the servers.	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Therefore, although the expectation has risen with various requirements on the target cloud platforms and environments, the cloud migration techniques have not provided enough options that can satisfy the various requirements. In this paper we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds. We formulate the problem as a constraint satisfaction problem, and iteratively decompose the server components and consolidate the servers.	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Requirements of service levels	Therefore, although the expectation has risen with various requirements on the target cloud platforms and environments, the cloud migration techniques have not provided enough options that can satisfy the various requirements. In this paper we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds.	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Choosing the cloud providers	Therefore, although the expectation has risen with various requirements on the target cloud platforms and environments, the cloud migration techniques have not provided enough options that can satisfy the various requirements. In this paper we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds.	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Existing tools aim to only provide an one-to-one migration that just copies a source image into a target image, but they do not find themselves as the comprehensive end-to-end migration toolings [8, 9].	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Existing tools aim to only provide an one-to-one migration that just copies a source image into a target image, but they do not find themselves as the comprehensive end-to-end migration toolings [8, 9].	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Existing tools aim to only provide an one-to-one migration that just copies a source image into a target image, but they do not find themselves as the comprehensive end-to-end migration toolings [8, 9].	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	Existing tools aim to only provide an one-to-one migration that just copies a source image into a target image, but they do not find themselves as the comprehensive end-to-end migration toolings [8, 9].	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	It is the most of importance that many of these processes can be smoothly executed with well planned resource mappings between the source and the target upfront. In this paper, we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds based on source requirements and target availability. We investigate the tranformation metrics that need to be taken into consideration for the migration resource planning, server consolidation, and server decomposition.	Ivon Miranda Santos

Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	It is the most of importance that many of these processes can be smoothly executed with well planned resource mappings between the source and the target upfront. In this paper, we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds based on source requirements and target availability. We investigate the tranformation metrics that need to be taken into consideration for the migration resource planning, server consolidation, and server decomposition.	Ivon Miranda Santos
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Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	It is the most of importance that many of these processes can be smoothly executed with well planned resource mappings between the source and the target upfront. In this paper, we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds based on source requirements and target availability. We investigate the tranformation metrics that need to be taken into consideration for the migration resource planning, server consolidation, and server decomposition.	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	It is the most of importance that many of these processes can be smoothly executed with well planned resource mappings between the source and the target upfront. In this paper, we propose a model to tackle the migration challenges that transform one resource into same or another resource in hybrid clouds based on source requirements and target availability. We investigate the tranformation metrics that need to be taken into consideration for the migration resource planning, server consolidation, and server decomposition.	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	CONCLUSION The enterprise-scale migration analytics provides an ef-fective migration planning capability that can transform re-sources from on-premise data centers to target clouds. We have described a model to tackle the migration challenges that transform one resource type into same or another resource type in hybrid clouds. We formulate the problem as a constraint satisfaction problem, and iteratively decompose the server components and consolidate the servers.	Ivon Miranda Santos
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Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Creating a multi-cloud solution	CONCLUSION The enterprise-scale migration analytics provides an ef-fective migration planning capability that can transform re-sources from on-premise data centers to target clouds. We have described a model to tackle the migration challenges that transform one resource type into same or another resource type in hybrid clouds.	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	The enterprise-scale migration analytics provides an ef-fective migration planning capability that can transform re-sources from on-premise data centers to target clouds. We have described a model to tackle the migration challenges that transform one resource type into same or another resource type in hybrid clouds. We formulate the problem as a constraint satisfaction problem, and iteratively decompose the server components and consolidate the servers.	Ivon Miranda Santos
Hwang2015-Computing_resource_transformation__consolidation_and_	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	The enterprise-scale migration analytics provides an ef-fective migration planning capability that can transform re-sources from on-premise data centers to target clouds. We have described a model to tackle the migration challenges that transform one resource type into same or another resource type in hybrid clouds. We formulate the problem as a constraint satisfaction problem, and iteratively decompose the server components and consolidate the servers.	Ivon Miranda Santos
Jambunathan2018-Architecture_decision_on_using_microservices_or	MULTI-CLOUD CHALLENGES > Challenges in cloud management	There are high elements of focus on whether to go for serverless or Microservice mode and should we use containers for deployment is the key debate among the people who are working in this area and are still not clear which way to go forward in the given situation.	Ivon Miranda Santos
Jambunathan2018-Architecture_decision_on_using_microservices_or	MULTI-CLOUD CHALLENGES > Drawback	Although there are some advantages, it also has few drawbacks like any other technology such as, □ Vendor control, multitenancy problems, vendor lock-in, and security concerns are some of the problems due to the use of third-party APIs. □ Developers are dependent on vendors for debugging and monitoring tools. □ Architecture complexity - It gets cumbersome to manage too many functions, and ignoring granularity will end up creating mini-monoliths. □ Integration testing serverless apps is tough. The units of integration with Serverless (Functions) are a lot smaller than with other architectures and therefore we rely on integration testing a lot more than we may do with other architectural styles.	Ivon Miranda Santos
Jamshidi2013-Cloud_migration_research_A_systematic_review	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	It also provides details on specific research challenges related to the maintenance and evolu-tion of service-oriented systems. Survey on SOA/Cloud migration.	Ivon Miranda Santos
Jamshidi2013-Cloud_migration_research_A_systematic_review	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	The growing maturity level.	Ivon Miranda Santos
Jamshidi2013-Cloud_migration_research_A_systematic_review	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	The growing maturity level. Although we observed that the maturity of cloud migration is in a formative stage, however, we can note a clear growth in maturity.	Ivon Miranda Santos

Jamshidi2013-Cloud_migration_research_A_systematic_review	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	In our search strategies, the key idea was to retrieve as much as possible of the available literature to avoid any bias. Another challenge in addressing these threats was to determine the scope of our study, since cloud migration relates to different communities including software engineering, information systems, and networks. These communities use different terminologies for the same concepts.	Ivon Miranda Santos
Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	We are concerned with the migration of legacy on-premise software to multi-cloud architectures. Multi-cloud deployment [4] is particularly effective in dealing with the following challenges: • Users are widely distributed where they are located around multiple data centers.	Ivon Miranda Santos
Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	We are concerned with the migration of legacy on-premise software to multi-cloud architectures.	Ivon Miranda Santos
Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	We are concerned with the migration of legacy on-premise software to multi-cloud architectures. Multi-cloud deployment [4] is particularly effective in dealing with the following challenges: • Users are widely distributed where they are located around multiple data centers. • Country regulations limit options for storing data in specific data centers, e.g., EU. • Circumstances where public clouds are used jointly with on-premises resources. • Cloud-based application must be resilient to the loss of a single data center.	Ivon Miranda Santos
Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Requirements of service levels	We are concerned with the migration of legacy on-premise software to multi-cloud architectures. Multi-cloud deployment [4] is particularly effective in dealing with the following challenges: • Users are widely distributed where they are located around multiple data centers. • Country regulations limit options for storing data in specific data centers, e.g., EU. • Circumstances where public clouds are used jointly with on-premises resources. • Cloud-based application must be resilient to the loss of a single data center.	Ivon Miranda Santos
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Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Legal restrictions / Data jurisdiction restrictions	We are concerned with the migration of legacy on-premise software to multi-cloud architectures. Multi-cloud deployment [4] is particularly effective in dealing with the following challenges: • Users are widely distributed where they are located around multiple data centers. • Country regulations limit options for storing data in specific data centers, e.g., EU. • Circumstances where public clouds are used jointly with on-premises resources. • Cloud-based application must be resilient to the loss of a single data center.	Ivon Miranda Santos
Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	The first step to identify migration patterns was to identify the concerns of organiza-tions moving on-premise applications to the cloud.	Ivon Miranda Santos
Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Re-architecting into independent components reduces dependencies and enables optimization for scalability and performance. However, challenges remain:	Ivon Miranda Santos
Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Re-architecting into independent components reduces dependencies and enables optimization for scalability and performance. However, challenges remain:	Ivon Miranda Santos

Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	(1) on-premise application modernized in isolation, not part of a consistent architecture,	Ivon Miranda Santos
Jamshidi2015-Cloud_migration_patterns_A_multi-cloud_service_arc	MULTI-CLOUD CHALLENGES > Cloud computing challenge	Problem: Coarse-grained applications are not agile enough to respond to requirement changes or variations in workload, and cannot take full advantage of the performance improvements that can be offered by cloud platforms	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	According to a Gartner report [4], multicloud strategies will become common for 70 percent of organizations by 2019.	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	According to a Gartner report [4], multicloud strategies will become common for 70 percent of organizations by 2019. Multi-cloud deployment is particularly effective in dealing with the following challenges [5]:	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	According to a Gartner report [4], multicloud strategies will become common for 70 percent of organizations by 2019.	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Legal restrictions / Data jurisdiction restrictions	According to a Gartner report [4], multicloud strategies will become common for 70 percent of organizations by 2019. Multi-cloud deployment is particularly effective in dealing with the following challenges [5]: Users are widely distributed around multiple data centers. Country regulations limit options for storing data in specific data centers. Circumstances which require public clouds to be used jointly with on-premises resources. Cloud-based applications must be resilient to the loss of a single data center or cloud provider.	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	Multi-cloud deployment is particularly effective in dealing with the following challenges [5]:	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	The first step to determine a migration process and patterns was to identify the concerns of organizations moving on-premise applications to the cloud.	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Re-architecting into independent components reduces depen-dencies and enables optimization for scalability and performance. However, challenges remain: (i) on-premise application modernized in isolation, not part of a consistent architecture; (ii) modernization performed primarily for technical reasons resulting in sub-optimal response to business change; (iii) architectures determined bottom-up from existing APIs and transactions may need re-evaluation for multi-clouds.	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Re-architecting into independent components reduces depen-dencies and enables optimization for scalability and performance. However, challenges remain:	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	However, challenges remain: (i) on-premise application modernized in isolation, not part of a consistent architecture; (ii) modernization performed primarily for technical reasons resulting in sub-optimal response to business change; (iii) architectures determined bottom-up from existing APIs and transactions may need re-evaluation for multi-clouds.	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	However, challenges remain: (i) on-premise application modernized in isolation, not part of a consistent architecture; (ii) modernization performed primarily for technical reasons resulting in sub-optimal response to business change; (iii) architectures determined bottom-up from existing APIs and transactions may need re-evaluation for multi-clouds.	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Performance	However, challenges remain: (i) on-premise application modernized in isolation, not part of a consistent architecture; (ii) modernization performed primarily for technical reasons resulting in sub-optimal response to business change; (iii) architectures determined bottom-up from existing APIs and transactions may need re-evaluation for multi-clouds.	Ivon Miranda Santos

Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Cloud-based applications must be resilient to the loss of a single data center or cloud provider. To address the challenges identified here and allow to guide the architecture migration process, we define an orthogonal variability model, as we explain below.	Ivon Miranda Santos
Jamshidi2017-Pattern-based_multicloud_architecture_migration	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	To address the challenges identified here and allow to guide the architecture migration process, we define an orthogonal variability model, as we explain below.	Ivon Miranda Santos
Kratzke2017-Understanding_cloud-native_applications_after_10_ye	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Such cloud-native applications are not just distributed systems.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Then, we present the multicloud taxonomy, and we study how service composition was tackled by researchers in multicloud environments. Finally, we iden-tify the challenges and the requirements of multicloud service composition, as well as the future directions.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	Finally, we iden-tify the challenges and the requirements of multicloud service composition, as well as the future directions.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Security and privacy, as well as other related issues in themulticloud setting, are briefly presented in Sections 8 and 9, respectively. Finally, we summarize the challenges and requirements for an effective service reuse in the multicloud environment, and we conclude the paper with future directions. 2 CLOUD-COMPUTING ARCHITECTURE	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Finally, we summarize the challenges and requirements for an effective service reuse in the multicloud environment, and we conclude the paper with future directions. 2 CLOUD-COMPUTING ARCHITECTURE	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	2 CLOUD-COMPUTING ARCHITECTURE	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Drawback	Extensive surveys have been conducted to study cloud service composition. However, the dramatically increasing number of research works encour-aged us to focus on service composition in a multicloud setting. Consequently, to provide a comprehensive study of the existing MCSC techniques, we started this survey with a background on service composition in single cloud. Then, we presented the major features and drawbacks in the pub-lished papers. In this section, we provide a description of the survey goals, and we raise a number of research questions related to the problem of MCSC. We also present statistics on published articles.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	MCSC, multicloud service composition FIGURE 3 Multicloud service composition: composition aspects and environments, considered service models, multicloud issues, and challenges. IaaS, infrastructureas a service; SaaS, software as a service; SLA, service level agreement	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	FIGURE 3 Multicloud service composition: composition aspects and environments, considered service models, multicloud issues, and challenges. IaaS, infrastructureas a service; SaaS, software as a service; SLA, service level agreement	Ivon Miranda Santos

Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Drawback	From the above few discussed approaches, it is clear that MCSC is a recent and emerging topic. Each of the existing solutions has its own advantages and drawbacks. In this section, we compare the discussed approaches based on the following criteria: • Goal: specifies the main objectives of the approach (eg, reducing the number of clouds, ensuring the privacy of services composition, and decreasing information leakage). • Composition criteria: indicates the criteria that must be satisfied during the composition of services or process fragments. • Service model: denotes the type of composed services in the approach (eg, Web service, process fragment, and mashup). • Composition unit: indicates whether the authors used simple services in the composition or they reused existing process fragments. • Used technique: presents the technique used for the composition (eg, particle swarm optimization, FCA, ACO, clustering, and MapReduce). • Context: indicates whether the composition is realized in a multicloud environment, a cross-cloud environment, an intercloud, etc. • Dimension: indicates whether the service composition is realized in a vertical or horizontal dimension. • Modality: determines whether the service composition is realized in a 1-time or persistent manner	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	From today's security solutions, we could mention the secure cloud storage, which is a cloud service responsible for protecting the data existing in some cloud models or other platforms. This solution gives the consumers access to control their sensitive information on the cloud, to always ensure their privacy.77 Another security solution is named the intelligent protection, which is also a cloud security service developed to ensure the security of servers and applications existing in the cloud infrastructures.77 Protecting the private and critical information from loss or theft, facing control and privacy issues, guaranteeing data integrity and confidentiality, etc are some of the challenges involved while dealing with cloud services.78 The issues surrounding security are serious in 1 single cloud as in a multicloud environment. But what makes the multicloud much better is that the trust, reliability, and security capabilities are distributed among (and ensured by) several cloud providers.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in risk and security	From today's security solutions, we could mention the secure cloud storage, which is a cloud service responsible for protecting the data existing in some cloud models or other platforms.	Ivon Miranda Santos

Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in risk and security	This solution gives the consumers access to control their sensitive information on the cloud, to always ensure their privacy.77 Another security solution is named the intelligent protection, which is also a cloud security service developed to ensure the security of servers and applications existing in the cloud infrastructures.77 Protecting the private and critical information from loss or theft, facing control and privacy issues, guaranteeing data integrity and confidentiality, etc are some of the challenges involved while dealing with cloud services.78 The issues surrounding security are serious in 1 single cloud as in a multicloud environment. But what makes the multicloud much better is that the trust, reliability, and security capabilities are distributed among (and ensured by) several cloud providers.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	9.1 Data service composition Given the rapid increase in the amount of generated data and the increasing ability of complex computational analysis, data-intensive services com-position has emerged, to offer complex services that are able to process the huge volume of highly dynamic data, so that to respond to consumers complicated requirements.83 This problem has been addressed in several approaches.83-86 The first appeared challenge, while dealing with this problem in a multicloud settings, is the huge volume of data transmitted between different data centers, which has a negative effect on the network bandwidths.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	This is achieved by using the Markov decision process. 10 MULTICLOUD ENVIRONMENT CHALLENGES The multicloud environment is becoming more and more popular, due to the variety of the appeared service models and its ability to deal with issues in the traditional cloud environment.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The multicloud environment is becoming more and more popular, due to the variety of the appeared service models and its ability to deal with issues in the traditional cloud environment.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	A challenging problem in a distributed, dynamic, and untrusted cloud environment is to consider security constraints in service composition.53 In fact, there are several security issues when composing services with uncertain availability and security constraints. Existing secure service composition mechanisms only focus on SLA availability rates and assume a fully trusted cloud provider, which is not always true.97 To address these issues in a multicloud environment, it is important to provide a service composition by combining the safest services coming from the most trusted cloud combination, ie, clouds that comply at best with user's preferences and policies and offer an appropriate level of safety. Also, with the growing need to offer business processes as Cloud services, also called BPaaS,98 it becomes a challenge for consumers to select a business process with high reputation and high reaction to changes.	Ivon Miranda Santos

Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in risk and security	A challenging problem in a distributed, dynamic, and untrusted cloud environment is to consider security constraints in service composition.53 In fact, there are several security issues when composing services with uncertain availability and security constraints.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Also, with the growing need to offer business processes as Cloud services, also called BPaaS,98 it becomes a challenge for consumers to select a business process with high reputation and high reaction to changes. Effectively reusing arbitrary granularities of BPaaS fragments has not been solved yet.19 Reusing BPaaS fragments rather than reusing atomic services from the multicloud can not only decrease the composition time, but also improve the reliability of the whole composition process.58 Seen that a multicloud deployment is costly, but at the same time it is more secure than a single one, it will be interesting to equilibrate these 2 criteria. For that, an alternative way is to combine the strengths of multicloud and cloud federation. In this way, enterprises can quickly adapt to new business requirements and reduce process development and maintenance costs.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Requirements of service levels	Also, with the growing need to offer business processes as Cloud services, also called BPaaS,98 it becomes a challenge for consumers to select a business process with high reputation and high reaction to changes. Effectively reusing arbitrary granularities of BPaaS fragments has not been solved yet.19 Reusing BPaaS fragments rather than reusing atomic services from the multicloud can not only decrease the composition time, but also improve the reliability of the whole composition process.58 Seen that a multicloud deployment is costly, but at the same time it is more secure than a single one, it will be interesting to equilibrate these 2 criteria. For that, an alternative way is to combine the strengths of multicloud and cloud federation. In this way, enterprises can quickly adapt to new business requirements and reduce process development and maintenance costs.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Security	Also, with the growing need to offer business processes as Cloud services, also called BPaaS,98 it becomes a challenge for consumers to select a business process with high reputation and high reaction to changes. Effectively reusing arbitrary granularities of BPaaS fragments has not been solved yet.19 Reusing BPaaS fragments rather than reusing atomic services from the multicloud can not only decrease the composition time, but also improve the reliability of the whole composition process.58 Seen that a multicloud deployment is costly, but at the same time it is more secure than a single one, it will be interesting to equilibrate these 2 criteria. For that, an alternative way is to combine the strengths of multicloud and cloud federation. In this way, enterprises can quickly adapt to new business requirements and reduce process development and maintenance costs.	Ivon Miranda Santos

Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	Also, with the growing need to offer business processes as Cloud services, also called BPaaS,98 it becomes a challenge for consumers to select a business process with high reputation and high reaction to changes. Effectively reusing arbitrary granularities of BPaaS fragments has not been solved yet.19 Reusing BPaaS fragments rather than reusing atomic services from the multicloud can not only decrease the composition time, but also improve the reliability of the whole composition process.58 Seen that a multicloud deployment is costly, but at the same time it is more secure than a single one, it will be interesting to equilibrate these 2 criteria.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Effectively reusing arbitrary granularities of BPaaS fragments has not been solved yet.19 Reusing BPaaS fragments rather than reusing atomic services from the multicloud can not only decrease the composition time, but also improve the reliability of the whole composition process.58 Seen that a multicloud deployment is costly, but at the same time it is more secure than a single one, it will be interesting to equilibrate these 2 criteria.	Ivon Miranda Santos
Lahmar2018-Multicloud_service_composition_A_survey_of_current_a	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Effectively reusing arbitrary granularities of BPaaS fragments has not been solved yet.19 Reusing BPaaS fragments rather than reusing atomic services from the multicloud can not only decrease the composition time, but also improve the reliability of the whole composition process.58 Seen that a multicloud deployment is costly, but at the same time it is more secure than a single one, it will be interesting to equilibrate these 2 criteria.	Ivon Miranda Santos
Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	With the emergence of cloud-native applications, the question arises how existing, often monolithic, applications can be migrated to this new paradigm.	Ivon Miranda Santos
Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Challenges in legacy architecture	With the emergence of cloud-native applications, the question arises how existing, often monolithic, applications can be migrated to this new paradigm.	Ivon Miranda Santos
Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	The requirements are specifically targeted at the necessary models, but also consider the overall approach. The necessities for the realization of a model-driven cloud-native migration approach are shown and remaining challenges are discussed. Keywords Cloud-native · Model-driven · Migration · Microservices · FaaS · Decomposition	Ivon Miranda Santos
Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Requirements of service levels	The requirements are specifically targeted at the necessary models, but also consider the overall approach. The necessities for the realization of a model-driven cloud-native migration approach are shown and remaining challenges are discussed.	Ivon Miranda Santos
Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	A key characteristic of CNAs is their fine-grained architecture, meaning that the application is composed of individual components which can be managed and evolved independently.	Ivon Miranda Santos
Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Challenges in legacy architecture	The key challenge of migrating an existing web-based application to a CNA is therefore, how to split a complex monolithic application into smaller components which adhere to the cloud-native paradigm.	Ivon Miranda Santos
Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	In general, a migration of an existing application to a CNA is therefore difficult and structured approaches to support the migration process are necessary.	Ivon Miranda Santos

Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Francesco et al. have investi-gated the approaches used and challenges met in the software industry when migrating to a microservices architecture [2].	Ivon Miranda Santos
Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Challenges in legacy architecture	In the monolithic application authentication and the configuration of which user role is nec-essary to invoke a certain operation was handled by Spring using annotations and globally available.	Ivon Miranda Santos
Lichtenthaler2019-Requirements_for_a_model-driven_cloud-native_	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	5.1 Importance of a feasibility study prior to the migration	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Findings – Research synthesis/SLR led to the identification of 31 issues/challenges, which may be termed as most critical based on their occurrence/frequency in past studies included. The topmost ten issues/ challenges amongst 31 identified include top management approach, change management, training and development, effective communication, system integration, business process reengineering, consultants/ vendors selection, project management, project team formation, team empowerment/skilled people and data conversing/migration. However, other issues/challenges identified such as security risks/data security, cloud awareness, functionality limitations, service level agreements and subscription expenses are more related to cloud ERPs.	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The issue/challenge concerning business process reengineering (BPR) is ranked #6 based on findings of this research. BPR may be defined as the rethinking and redesign of business processes to achieve improved organizational performance in terms of quality, cost, speed and service (Hammer and Champy, 1993).	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The next section reflects detailed analysis along with a discussion about the issues and challenges specifically related to cloud ERP (Table VI). 5.2 Cloud enterprise resource planning: issues and challenges Software as a service (SaaS) is one of the services offered by cloud providers. Cloud ERP system solutions offered by cloud providers fall in the SaaS category of cloud services. Although cloud ERP addressed different challenges of traditional ERP (Mijacc et al.,	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in risk and security	It requires to invest all types of resources for effective ERP implementation. This study has identified some issues and challenges (Table VI) such as security risks/data security, regulatory legal requirements (service level agreement (SLA) issues), functionality limitations, cloud awareness, subscription expenses and among others of cloud ERP that supports findings of past studies carried out so far (Salleh et al., 2012; McCrea, 2011).	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in risk and security	As compare to traditional ERP, there are more threats and security risks on cloud ERP because of high ability along with the accessibility of information from distributed databases. Meganathan and Jeyanthi (2014) mentioned data security in the cloud and lack of confidence as challenges related to cloud ERPs. Similarly, Sørheller et al. (2018) also suggested data security as one of the six challenges identified in his review. High availability of cloud services options led to more security risks (Elmonem et al.,	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Elmonem et al. (2016) say that managing security-related issues in cloud ERP is a complex and challenging process. So, to tackle this problem cloud vendors offer service of private cloud, which is more secure as compare to the public cloud.	Ivon Miranda Santos

Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	(2016) say that managing security-related issues in cloud ERP is a complex and challenging process. So, to tackle this problem cloud vendors offer service of private cloud, which is more secure as compare to the public cloud.	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Cloud computing challenge		Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Drawback	. Moreover, data security issues such as confidentiality, integrity and availability are identified in past research (Saa et al., 2017). According to Dillon et al. (2010), mentioned different drawbacks in cloud-based ERP relate to data security, performance and availability. Elmonem et al. (2016) say that managing security-related issues in cloud ERP is a complex and challenging process. So, to tackle this problem cloud vendors offer service of private cloud, which is more secure as compare to the public cloud	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Elmonem et al.	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	(2016) say that managing security-related issues in cloud ERP is a complex and challenging process. So, to tackle this problem cloud vendors offer service of private cloud, which is more secure as compare to the public cloud.	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Vendor lock-in	(2016) say that managing security-related issues in cloud ERP is a complex and challenging process. So, to tackle this problem cloud vendors offer service of private cloud, which is more secure as compare to the public cloud.	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Security	(2016) say that managing security-related issues in cloud ERP is a complex and challenging process. So, to tackle this problem cloud vendors offer service of private cloud, which is more secure as compare to the public cloud.	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	(2016) say that managing security-related issues in cloud ERP is a complex and challenging process. So, to tackle this problem cloud vendors offer service of private cloud, which is more secure as compare to the public cloud.	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in cloud management	6.	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in risk and security	awareness, subscription expenses, SLAs, and security risks/data security are mostly related to cloud ERP. Enterprises should focus on these socio-technical issues and challenges before going to implement ERP systems. The findings of this study confirmed that findings of past research relating to ERP issues/challenges are still valid and applicable.	Ivon Miranda Santos
Mahmood2020-Erp_issues_and_challenges_a_research_synthesis	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	New technologies such as cloud computing, IoT, Big data, among others provide revolutionary solutions to organizations. However, these technologies have different issues and challenges when enterprise systems are implemented using such technologies.	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	A large data management system within a company certainly requires a very large data storage area to support the company's business nets.	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Requirements of service levels	A large data management system within a company certainly requires a very large data storage area to support the company's business nets.	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Therefore, many companies that have this large data set are looking to migrate to the cloud.	Ivon Miranda Santos

Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Cloud computing challenge	Based on literature review on previous research that discusses risk categories in the cloud (Djemame et al., 2011), elements of risk in the cloud (Djemame et al., 2016), research on the classification of assets that are assessed at risk for big data in cloud computing (Bt Yusof Ali et al., 2018), challenges in adopting cloud computing (Khan and Al-Yasiri, 2016), it is important to do further research in the field of cloud computing.	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in risk and security	, 2016), research on the classification of assets that are assessed at risk for big data in cloud computing (Bt Yusof Ali et al., 2018), challenges in adopting cloud computing (Khan and Al-Yasiri, 2016), it is important to do further research in the field of cloud computing. In this study, this study is different from previous studies, where this study focuses more on the grouping of what is included in the types of risk in cloud migration, and wants to know what the risk components are, so that this can be used as a reference as components in assessing risk in cloud migration	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	, 2018), challenges in adopting cloud computing (Khan and Al-Yasiri, 2016), it is important to do further research in the field of cloud computing. In this study, this study is different from previous studies, where this study focuses more on the grouping of what is included in the types of risk in cloud migration, and wants to know what the risk components are, so that this can be used as a reference as components in assessing risk in cloud migration.	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Section 4 explain the results and discussion, which contains analysis of the results of the literature review, which relates to the types of risks and risk components in the cloud migration process, as well as trends in state-of-the-art results.	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Especially for public cloud service users who imple-ment a Shared Multi - tenant Environment. Multitenancy security and privacy are important challenges for cloud users, because multitenancy allows multiple users to run their applications	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Especially for public cloud service users who imple-ment a Shared Multi - tenant Environment. Multitenancy security and privacy are important challenges for cloud users, because multitenancy allows multiple users to run their applications	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Multitenancy security and privacy are important challenges for cloud users, because multitenancy allows multiple users to run their application	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Multitenancy security and privacy are important challenges for cloud users, because multitenancy allows multiple users to run their applications	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Cloud computing challenge	The results of surveys and literature studies on previous studies describe security problems in cloud computing (Efozia et al., 2017), as well as several forms of threats and vulnerabilities to cloud com-puting (Singh et al., 2016). Security is a big challenge in cloud com-puting (Amron et al., 2017).	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Security is a big challenge in cloud com-puting (Amron et al.,	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in risk and security	(2017) explained that in addition to technological readiness, human readiness, organizational support, and the envi-ronment in implementing cloud computing, things that are impor-tant to note are related to security and privacy, where the problems that often arise when migrating to cloud computing are Privacy (Yahuza et al.,	Ivon Miranda Santos

Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Cloud computing challenge	, 2020), also emphasized by Tabrizchi and Rafsanjani (2020) that in cloud computing, security and pri-vacy issues are significant challenges affecting its acceptance, so that it can hinder the adoption of cloud computing (Modi and Acha, 2016).	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Cloud computing challenge	In addition, the challenge in cloud computing is the occurrence of security problems on the virtual layer (Mohamadi et al., 2019), where virtual machines are a challenge for server con-solidation in virtualized data centrally (Dong et al., 2019). Survey results from (Abd Al Ghaffar, 2020) Denial of Service (DoS) attacks to distributed DoS (DDoS) attacks are also forms of security threats in cloud computing.	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in risk and security	And of course, for cloud service users, it is also important to choose the right CSP (Singh and Chatterjee, 2016).	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Cloud computing challenge	A study says that the challenges in cloud computing are related to the design of cloud systems in the future (Zhang et al., 2018), while factors that must be considered when adopting cloud com-puting are technological factors followed by environmental factors, and finally organizational factors (Abrar et al., 2018), besides fail-ure factors. management (failure management) must also be min-imized (Han et al., 2019).	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in risk and security	challenges as well, network infrastructure security problems are still the main key to cloud computing security risks, for example the use of firewalls [105], and many researchers still focus on the issue of adoption. to cloud computing due to its security issues (Buettner and Buettner, 2016).	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	To ensure security on cloud migration, it is a shared responsibil-ity for related parties, for example government, private organiza-tions, education sector and researchers. Research in the field of cloud computing still opens up great opportunities for researchers in the future, but the challenges will certainly increase, for this rea-son, it is necessary for similar studies to be developed continuously in the future.	Ivon Miranda Santos
Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	To ensure security on cloud migration, it is a shared responsibil-ity for related parties, for example government, private organiza-tions, education sector and researchers. Research in the field of cloud computing still opens up great opportunities for researchers in the future, but the challenges will certainly increase, for this rea-son, it is necessary for similar studies to be developed continuously in the future.	Ivon Miranda Santos
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Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Security	To ensure security on cloud migration, it is a shared responsibil-ity for related parties, for example government, private organiza-tions, education sector and researchers. Research in the field of cloud computing still opens up great opportunities for researchers in the future, but the challenges will certainly increase, for this rea-son, it is necessary for similar studies to be developed continuously in the future.	Ivon Miranda Santos

Maniah2022-A_systematic_literature_review_Risk_analysis_in_clou	MULTI-CLOUD CHALLENGES > Legal restrictions / Data jurisdiction restrictions	To ensure security on cloud migration, it is a shared responsibil-ity for related parties, for example government, private organiza-tions, education sector and researchers. Research in the field of cloud computing still opens up great opportunities for researchers in the future, but the challenges will certainly increase, for this rea-son, it is necessary for similar studies to be developed continuously in the future.	Ivon Miranda Santos
Mateen2021-A_dynamic_decision_support_system_for_selection_of_c	MULTI-CLOUD CHALLENGES > Drawback	Its main advantage is to reduce software concerns, but its ma-jor drawback is vendor lock-in. Microsoft Azure and Google App Engine are examples of PAAS. In the IAAS cloud computing structure, a repository and other resources are maintained by the service provider. The market for IAAS is network architects. Its main advantage is full control, and its major drawback is less efficiency. The examples for IAAS include Microsoft Azure and Amazon Web Service (AWS) [2]. Cloud computing has three main types (public, private, and hybrid) with different benefits for each type. The public cloud is a standard cloud computing model in which resources, such as CPU, memory, a repository, and APIs, are available to all users. These services can be public websites like Daraz, or storage space like Dropbox and OneDrive. A private cloud has a restricted environment where services are available through autho-rization (e.g., government ministry websites). In order to get the flavor of both public and private environments, there is a hybrid cloud. This type is not commonly used owing to some security concerns. Similarly, public users do not easily accept private cloud re-strictions. A community cloud is a variant of hybrid cloud that provides services within a community [3]. Figure 1 clearly shows that cloud services are dependent on the user's capability requirement and the openness of the membership. Appl. Sci. 2021, 11, x FOR PEER REVIEW 2 of 34 end-users. The advantage of SAAS is efficient	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Infrastructure as a Service (IaaS), Software as a Service, and Platform as a Service (PaaS).1 This paper focuses on IaaS in which customers can use available services (virtual machines [VMs], networking, storage, etc.) in terms of service level agreement; a contract between customers and cloud service providers where cloud service providers (the latter) guarantee a satisfactory level of quality of service (QoS) requirements.2 Cloud service provider selection is one of the most significant challenges for cloud customers.3,4 Due to the growing number of cloud providers, cloud market is becoming more and more competitive. Prices and performance levels of the similar offered services are varied, and, consequently, selecting an appropriate provider that can fulfill QoS requirements becomes increasingly difficult.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	) in terms of service level agreement; a contract between customers and cloud service providers where cloud service providers (the latter) guarantee a satisfactory level of quality of service (QoS) requirements.2 Cloud service provider selection is one of the most significant challenges for cloud customers.3,4 Due to the growing number of cloud providers, cloud market is becoming more and more competitive.	Ivon Miranda Santos

Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in cloud management	) in terms of service level agreement; a contract between customers and cloud service providers where cloud service providers (the latter) guarantee a satisfactory level of quality of service (QoS) requirements.2 Cloud service provider selection is one of the most significant challenges for cloud customers.3,4 Due to the growing number of cloud providers, cloud market is becoming more and more competitive. Prices and performance levels of the similar offered services are varied, and, consequently, selecting an appropriate provider that can fulfill QoS requirements becomes increasingly difficult.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Requirements of service levels	Cloud service provider selection is one of the most significant challenges for cloud customers.3,4 Due to the growing number of cloud providers, cloud market is becoming more and more competitive. Prices and performance levels of the similar offered services are varied, and, consequently, selecting an appropriate provider that can fulfill QoS requirements becomes increasingly difficult.	Ivon Miranda Santos
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Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Prices and performance levels of the similar offered services are varied, and, consequently, selecting an appropriate provider that can fulfill QoS requirements becomes increasingly difficult.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	That in addition to overlooking the customer's acceptable level of each criterion. Although using the data center of a single provider to host cloud applications is easy and provides obvious advantages, it arises a number of challenges. A large data center consumes a lot of energy to keep it operational, besides the risk of sin-gle point failures resulting from centralized cloud data centers.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	So, it is a strategy that helps customers to avoid vendor lock-in problem and improve QoS or minimize costs.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	So, it is a strategy that helps customers to avoid vendor lock-in problem and improve QoS or minimize costs. Building a multicloud solutions poses a number of challenges.22 One of these challenges is that each cloud provider has different application programming interfaces (APIs) that makes the provisioning, deployment, monitoring and manage-ment of multicloud systems is complex. However, some steps are already taken to solve this issue.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	So, it is a strategy that helps customers to avoid vendor lock-in problem and improve QoS or minimize costs.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	So, it is a strategy that helps customers to avoid vendor lock-in problem and improve QoS or minimize costs.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Vendor lock-in	So, it is a strategy that helps customers to avoid vendor lock-in problem and improve QoS or minimize costs.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Building a multicloud solutions poses a number of challenges.22 One of these challenges is that each cloud provider has different application programming interfaces (APIs) that makes the provisioning, deployment, monitoring and manage-ment of multicloud systems is complex. However, some steps are already taken to solve this issue.	Ivon Miranda Santos

Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	Building a multicloud solutions poses a number of challenges.22 One of these challenges is that each cloud provider has different application programming interfaces (APIs) that makes the provisioning, deployment, monitoring and manage-ment of multicloud systems is complex. However, some steps are already taken to solve this issue. The first step is provided by IaaS stacks, such as CloudStack,24 OpenStack,25 OpenNebula,26 and vCloud27 that provides APIs and dashboards to create and manage IaaS cloud services. IaaS stacks do not assist the development and administration of multicloud systems, so the second step provides abstraction layers that support numerous IaaS providers and IaaS stacks through IaaS/PaaS libraries. These libraries such as jclouds,28 libCloud,29 and Deltacloud30 facilitate the provisioning and deploy-ment of multicloud systems through a single interface, but it does not support automatic provisioning and deployment. Consequently, the third step provides PaaS frameworks such as Cloudify,31 CloudFoundry,32 and Scalr.33 Some of these frameworks base on so-called DevOps tools that automate the provisioning, deployment, and management of multicloud systems.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Cloud provider selection plays a significant role in increasing multicloud value. Despite of multiclouds challenges, its usage is increasing and, thus, it became the focus of recent research papers.21 References 34-37 focused on VMs and pro-posed models/schemes for VMs placement across multiple cloud providers. While References 38-40 proposed multicloud storage models in order to secure customer's data.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Cloud provider selection plays a significant role in increasing multicloud value. Despite of multiclouds challenges, its usage is increasing and, thus, it became the focus of recent research papers.21 References 34-37 focused on VMs and pro-posed models/schemes for VMs placement across multiple cloud providers. While References 38-40 proposed multicloud storage models in order to secure customer's data.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	Cloud provider selection plays a significant role in increasing multicloud value. Despite of multiclouds challenges, its usage is increasing and, thus, it became the focus of recent research papers.21 References 34-37 focused on VMs and pro-posed models/schemes for VMs placement across multiple cloud providers. While References 38-40 proposed multicloud storage models in order to secure customer's data.	Ivon Miranda Santos
Mohamed2020-A_multicriteria_optimization_model_for_cloud_servic	MULTI-CLOUD CHALLENGES > Security	Cloud provider selection plays a significant role in increasing multicloud value. Despite of multiclouds challenges, its usage is increasing and, thus, it became the focus of recent research papers.21 References 34-37 focused on VMs and pro-posed models/schemes for VMs placement across multiple cloud providers. While References 38-40 proposed multicloud storage models in order to secure customer's data.	Ivon Miranda Santos
Monrat2019-A_Survey_of_Blockchain_From_the_Perspectives_of_Appl	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	A number of research studies focus on the opportunity that blockchain provides in various application domains. This paper presents a comparative study of the tradeoffs of blockchain and also explains the taxonomy and architecture of blockchain, provides a comparison among different consensus mechanisms and discusses challenges, including scalability, privacy, interoperability, energy consumption and regulatory issues. In addition, this paper also notes the future scope of blockchain technology.	Ivon Miranda Santos

Monrat2019-A_Survey_of_Blockchain_From_the_Perspectives_of_Appl	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	However, similar to other emerg-ing technologies, blockchain has its limitations and is not feasible for many all types of business model. This section describes the issues and challenges of blockchain technology as the following: performance & scalability in Section V-A, privacy in Section V-B, interoper-ability in Section V-C, energy consumptions in Section V-D, selfish mining in Section V-E and current regulation problems in Section V-F.	Ivon Miranda Santos
Monrat2019-A_Survey_of_Blockchain_From_the_Perspectives_of_Appl	MULTI-CLOUD CHALLENGES > Challenges in cloud management	However, similar to other emerg-ing technologies, blockchain has its limitations and is not feasible for many all types of business model. This section describes the issues and challenges of blockchain technology as the following: performance & scalability in Section V-A, privacy in Section V-B, interoper-ability in Section V-C, energy consumptions in Section V-D, selfish mining in Section V-E and current regulation problems in Section V-F.	Ivon Miranda Santos
Monrat2019-A_Survey_of_Blockchain_From_the_Perspectives_of_Appl	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	For instance, the Financial Action Task Force reported in 2015 on how the founders of Liberty Reserve were able to launder hundreds of millions of US dollars for six years to criminal organizations. Blockchain's wider and deeper applications are potentially constrained by limitations posed by techni-cal/scalability challenges, business model challenges, scan-dals and public perception, government rules and privacy VOLUME 7, 2019 117147	Ivon Miranda Santos
Monrat2019-A_Survey_of_Blockchain_From_the_Perspectives_of_Appl	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Specifically, for the financial services sector, blockchain needs to overcome ten key hurdles before becoming a reality in the sector.	Ivon Miranda Santos
Monrat2019-A_Survey_of_Blockchain_From_the_Perspectives_of_Appl	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Specifically, for the financial services sector, blockchain needs to overcome ten key hurdles before becoming a reality in the sector.	Ivon Miranda Santos
Mostajabi2021-A_Systematic_Review_of_Data_Models_for_the_Big_Da	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The high volume, high variety, and high velocity of data have recently posed the challenge of 3Vs to this field, also known as the Big Data Problem. The 3Vs dimensions of complexities for the big data entails high-speed storage, scalability of database systems, suitable data models, real-time responsiveness and so on.	Ivon Miranda Santos
Mostajabi2021-A_Systematic_Review_of_Data_Models_for_the_Big_Da	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Accord-ing to [9], this growth rate doubles every two years and has increased tenfold within the years 2013 to 2020 (from 4.4 to 44 ZB). There was an urgent need for horizontal scalability and greater flexibility of databases due to the exponential growth of data volume, the change of data from structured to semi-structured [10] and non-structured, and the challenge of their storage. Hence, some practical solu-tions have been presented to satisfy such challenges to big data.	Ivon Miranda Santos
Mostajabi2021-A_Systematic_Review_of_Data_Models_for_the_Big_Da	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The graph data models have practical application in social networks concerning their rich and com-plex search demand. This poses the challenges of scalability which limit query performance by using the algorithms such as neighbor search or k-nearest neighbor. The distributed and encrypted graph was introduced to overcome this limitation.	Ivon Miranda Santos
Mostajabi2021-A_Systematic_Review_of_Data_Models_for_the_Big_Da	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	It aimed to cover horizontal scalability similar to NoSQL and maintain ACID properties similar to the relational model. NoSQL was proposed as a schema-less data model with respect to the stored data volume in the cloud environment, data growth rate, and big data challenges.	Ivon Miranda Santos
Mostajabi2021-A_Systematic_Review_of_Data_Models_for_the_Big_Da	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	In [25], a schema was developed for document-based data models such as MongoDB to support and store temporal data from sensors that continuously transmit data. With the aim of scalability of data integration in addition to flex-ibility evolution, this schema examined the challenges of temporary data modeling. Also, an algorithm was devel-oped for integrating JSON data as hierarchical documents.	Ivon Miranda Santos

Mostajabi2021-A_Systematic_Review_of_Data_Models_for_the_Big_Da	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Overall, NoSQL databases hold the first rank in the world of database technology with respect to the cumulative frequency of their several groups. On the one hand, features such as high scalability (horizontal), avail-ability, and schema flexibility provide these databases with the possibility to overcome big data challenges and the suit-ability for data streams. On the other hand, deficiencies such as static schema and limited types of predefined data to define relationships face relational models with major challenges.	Ivon Miranda Santos
Mostajabi2021-A_Systematic_Review_of_Data_Models_for_the_Big_Da	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	It is obvious that all of these features cannot be simultaneously gathered in a single model.	Ivon Miranda Santos
Mostajabi2021-A_Systematic_Review_of_Data_Models_for_the_Big_Da	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The scalability was increased with the decrease of ACID properties in NoSQL databases [19]. However, the more coverage of these features, the more capable is the data model when facing the challenge of 3Vs.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interoperability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider. Consequently, it is a tedious task to design distributed systems in multiple clouds.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interoperability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider. Consequently, it is a tedious task to design distributed systems in multiple clouds.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interoperability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider. Consequently, it is a tedious task to design distributed systems in multiple clouds.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interoperability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider. Consequently, it is a tedious task to design distributed systems in multiple clouds.	Ivon Miranda Santos

Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Vendor lock-in	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interoperability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider. Consequently, it is a tedious task to design distributed systems in multiple clouds.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Security	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interoperability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider. Consequently, it is a tedious task to design distributed systems in multiple clouds.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Data loss and privacy	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interoperability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider. Consequently, it is a tedious task to design distributed systems in multiple clouds.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Interoperability	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interoperability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider. Consequently, it is a tedious task to design distributed systems in multiple clouds.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Compatibility	Abstract—The design of distributed systems in multiple clouds have been gaining popularity due to various benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interoperability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider. Consequently, it is a tedious task to design distributed systems in multiple clouds.	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	The designing of distributed systems has many challenges such as successful handling of failure of machines, disks, networks, and software. Distributed systems can be made more effective if they are designed in multiple clouds by leveraging several benefits of the multi-cloud infrastructure such as minimizing vendor lock-in, data loss and downtime [3], [4]. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interop-erability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider [5]. Inevitably, it increases the complexity of design process of distributed systems and operations across multiple clouds [4].	Ivon Miranda Santos

Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	The designing of distributed systems has many challenges such as successful handling of failure of machines, disks, networks, and software. Distributed systems can be made more effective if they are designed in multiple clouds by leveraging several benefits of the multi-cloud in-frastructure such as minimizing vendor lock-in, data loss and downtime [3], [4]. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interop-erability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider [5]. Inevitably, it increases the complexity of design process of distributed systems and operations across multiple clouds [4].	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Vendor lock-in	The designing of distributed systems has many challenges such as successful handling of failure of machines, disks, networks, and software. Distributed systems can be made more effective if they are designed in multiple clouds by leveraging several benefits of the multi-cloud in-frastructure such as minimizing vendor lock-in, data loss and downtime [3], [4]. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interop-erability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider [5]. Inevitably, it increases the complexity of design process of distributed systems and operations across multiple clouds [4].	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Interoperability	The designing of distributed systems has many challenges such as successful handling of failure of machines, disks, networks, and software. Distributed systems can be made more effective if they are designed in multiple clouds by leveraging several benefits of the multi-cloud in-frastructure such as minimizing vendor lock-in, data loss and downtime [3], [4]. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interop-erability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider [5]. Inevitably, it increases the complexity of design process of distributed systems and operations across multiple clouds [4].	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Compatibility	The designing of distributed systems has many challenges such as successful handling of failure of machines, disks, networks, and software. Distributed systems can be made more effective if they are designed in multiple clouds by leveraging several benefits of the multi-cloud in-frastructure such as minimizing vendor lock-in, data loss and downtime [3], [4]. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interop-erability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider [5]. Inevitably, it increases the complexity of design process of distributed systems and operations across multiple clouds [4].	Ivon Miranda Santos

Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Fault-tolerance	The designing of distributed systems has many challenges such as successful handling of failure of machines, disks, networks, and software. Distributed systems can be made more effective if they are designed in multiple clouds by leveraging several benefits of the multi-cloud in-frastructure such as minimizing vendor lock-in, data loss and downtime [3], [4]. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interop-erability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider [5]. Inevitably, it increases the complexity of design process of distributed systems and operations across multiple clouds [4].	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Distributed systems can be made more effective if they are designed in multiple clouds by leveraging several benefits of the multi-cloud in-frastructure such as minimizing vendor lock-in, data loss and downtime [3], [4]. Nonetheless, this multi-cloud infrastructure also poses several challenges such as compatibility, interop-erability, complex provisioning and configuration due to the variation in technologies and services of each cloud provider [5]. Inevitably, it increases the complexity of design process of distributed systems and operations across multiple clouds [4].	Ivon Miranda Santos
Naik2021-Performance_evaluation_of_distributed_systems_in_multi	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Distributed systems can be made more effective if they are designed in multiple clouds by leveraging several benefits of the multi-cloud in-frastructure such as minimizing vendor lock-in, data loss and downtime [3], [4].	Ivon Miranda Santos
Opara-Martins2016-Critical_analysis_of_vendor_lock-in_and_its_i	MULTI-CLOUD CHALLENGES > Cloud computing challenge	Vendor lock-in is a major barrier to the adoption of cloud computing, due to the lack of standardization. Current solutions and efforts tackling the vendor lock-in problem are predominantly technology-oriented. Limited studies exist to analyse and highlight the complexity of vendor lock-in problem in the cloud environment	Ivon Miranda Santos
Opara-Martins2016-Critical_analysis_of_vendor_lock-in_and_its_i	MULTI-CLOUD CHALLENGES > Vendor lock-in	Core risk factors of lock-in In an effort to highlight factors which may affect future cloud migration decisions, participants were requested to identify practical challenges of lock-in they encountered when using cloud services. These issues relate to lack of integration points between existing management tools (47.7 %), incompatibility issues with on-premise software, and inability to move to another service provider or take data in-house (Fig.	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	abstract Despite the compelling case for moving towards cloud computing, the upstream oil & gas industry faces several technical challenges—most notably, a pronounced emphasis on data security, a reliance on extremely large data sets, and significant legacy investments in information technology infrastructure—that make a full migration to the public cloud difficult at present. Private and hybrid cloud solutions have consequently emerged within the industry to yield as much benefit from cloud-based technologies as possible while working within these constraints.	Ivon Miranda Santos

Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	abstract Despite the compelling case for moving towards cloud computing, the upstream oil & gas industry faces several technical challenges—most notably, a pronounced emphasis on data security, a reliance on extremely large data sets, and significant legacy investments in information technology infrastructure—that make a full migration to the public cloud difficult at present. Private and hybrid cloud solutions have consequently emerged within the industry to yield as much benefit from cloud-based technologies as possible while working within these constraints.	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Private and hybrid cloud solutions have consequently emerged within the industry to yield as much benefit from cloud-based technologies as possible while working within these constraints.	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	This paper argues, however, that the move to private and hybrid clouds will very likely prove only to be a temporary stepping stone in the industry's technological evolution. By presenting evidence from other market sectors that have faced similar challenges in their journey to the cloud, we propose that enabling technologies and conditions will probably fall into place in a way that makes the public cloud a far more attractive option for the upstream oil & gas industry in the years ahead.	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	This paper argues, however, that the move to private and hybrid clouds will very likely prove only to be a temporary stepping stone in the industry's technological evolution. By presenting evidence from other market sectors that have faced similar challenges in their journey to the cloud, we propose that enabling technologies and conditions will probably fall into place in a way that makes the public cloud a far more attractive option for the upstream oil & gas industry in the years ahead. The paper concludes with a discussion about the implications of this projected shift towards the public cloud, and calls for more of the industry's services to be offered through cloud-based "apps."	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	This paper argues, however, that the move to private and hybrid clouds will very likely prove only to be a temporary stepping stone in the industry's technological evolution. By presenting evidence from other market sectors that have faced similar challenges in their journey to the cloud, we propose that enabling technologies and conditions will probably fall into place in a way that makes the public cloud a far more attractive option for the upstream oil & gas industry in the years ahead.	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	We will then show how many of these challenges have also been encountered in other industries, and use these examples to shine light on how these problems might be overcome in the oil & gas sector. Next, we will consolidate these emerging trends from other industries into a prediction: whereas current cloud strategies in the oil & gas industry tend to be conservatively clustered around the concept of private clouds and hybridized cloud solutions, we believe that enabling technologies and conditions will fall into place in a way that makes the public cloud a far more attractive option for the upstream oil & gas industry in the years ahead.	Ivon Miranda Santos

Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	We will then show how many of these challenges have also been encountered in other industries, and use these examples to shine light on how these problems might be overcome in the oil & gas sector. Next, we will consolidate these emerging trends from other industries into a prediction: whereas current cloud strategies in the oil & gas industry tend to be conservatively clustered around the concept of private clouds and hybridized cloud solutions, we believe that enabling technologies and conditions will fall into place in a way that makes the public cloud a far more attractive option for the upstream oil & gas industry in the years ahead.	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	We will then show how many of these challenges have also been encountered in other industries, and use these examples to shine light on how these problems might be overcome in the oil & gas sector. Next, we will consolidate these emerging trends from other industries into a prediction: whereas current cloud strategies in the oil & gas industry tend to be conservatively clustered around the concept of private clouds and hybridized cloud solutions, we believe that enabling technologies and conditions will fall into place in a way that makes the public cloud a far more attractive option for the upstream oil & gas industry in the years ahead.	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	, Feblowitz, 2011; Yuan et al., 2011) and, in light of the considerable economic impact of the industry (Yergin, 1991) and the ''size of the prize'' that goes with this, someone in the market—perhaps an industry incumbent like an oilfield service company, or maybe a new entrant—may eventually rise to the challenge and offer solutions that reduce the barriers associated with sending this kind of sensitive data into increasingly public parts of the cloud. Data encryption protocols are a potentially promising way to address these types of issues.	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	, 2009). Thus, even if no customized, industry-specific solutions are put forward in the marketplace that address the oil & gas sector's specific technical challenges, the macro-level evolutionary changes that will emerge throughout the entire IT landscape may at least partially lower the barriers that the industry is facing en route to the public cloud. 6.	Ivon Miranda Santos
Perrons2013-Cloud_computing_in_the_upstream_oil_and_gas_industr	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	In each instance, there were mitigating factors that initially made it difficult to move data and computational functions to the public cloud. The technical and logistical challenges facing each of these sectors were in many ways reminiscent of those currently facing the upstream oil & gas industry in its own journey towards cloud computing. But in each example, the problem was overcome by some kind of technological solution or a shift in the underpinning market conditions, and then each organization successfully moved mission-critical data and functions into the public cloud.	Ivon Miranda Santos
Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	However a third party running services on multiple Clouds and offering unique entry points to various service customers is interested to ensure that the porting process is reversible, fast and semi-automated. The most challenging scenario for portability is that in which the Cloud applications are distributed across several administrative domains of different providers simultaneously, and, moreover, at least data (if not even application and service components) are ported from one Cloud environment to another.	Ivon Miranda Santos

Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Challenges in cloud management	However a third party running services on multiple Clouds and offering unique entry points to various service customers is interested to ensure that the porting process is reversible, fast and semi-automated. The most challenging scenario for portability is that in which the Cloud applications are distributed across several administrative domains of different providers simultaneously, and, moreover, at least data (if not even application and service components) are ported from one Cloud environment to another. A less discussed scenario is the reverse portability from the Cloud environment towards the own premises resources (even partially, lets say only the data part).	Ivon Miranda Santos
Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	However a third party running services on multiple Clouds and offering unique entry points to various service customers is interested to ensure that the porting process is reversible, fast and semi-automated. The most challenging scenario for portability is that in which the Cloud applications are distributed across several administrative domains of different providers simultaneously, and, moreover, at least data (if not even application and service components) are ported from one Cloud environment to another.	Ivon Miranda Santos
Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Difficulty of migrating applications between clouds	However a third party running services on multiple Clouds and offering unique entry points to various service customers is interested to ensure that the porting process is reversible, fast and semi-automated. The most challenging scenario for portability is that in which the Cloud applications are distributed across several administrative domains of different providers simultaneously, and, moreover, at least data (if not even application and service components) are ported from one Cloud environment to another.	Ivon Miranda Santos
Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Legal restrictions / Data jurisdiction restrictions	However a third party running services on multiple Clouds and offering unique entry points to various service customers is interested to ensure that the porting process is reversible, fast and semi-automated. The most challenging scenario for portability is that in which the Cloud applications are distributed across several administrative domains of different providers simultaneously, and, moreover, at least data (if not even application and service components) are ported from one Cloud environment to another.	Ivon Miranda Santos
Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Data loss and privacy	However a third party running services on multiple Clouds and offering unique entry points to various service customers is interested to ensure that the porting process is reversible, fast and semi-automated. The most challenging scenario for portability is that in which the Cloud applications are distributed across several administrative domains of different providers simultaneously, and, moreover, at least data (if not even application and service components) are ported from one Cloud environment to another.	Ivon Miranda Santos
Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Challenges in cloud management	They claim that there is no solution dealing with the impact of changes in the business process due to the use of one specific product, or working on issues related to the cross-organizational business in a portability scenario. Furthermore they claim that, from a research point of view, a challenge is to conduct more rigorous studies (e.g. only part of the studies of studies included a form of evaluation).	Ivon Miranda Santos
Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	A roadmap for the Cloud software engineering was proposed by Da Silva and Lucredio [36].	Ivon Miranda Santos
Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	A roadmap for the Cloud software engineering was proposed by Da Silva and Lucredio [36].	Ivon Miranda Santos
Petcu2014-Portability_in_clouds_Approaches_and_research_opportu	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	A roadmap for the Cloud software engineering was proposed by Da Silva and Lucredio [36].	Ivon Miranda Santos

Rai2015-Exploring_the_factors_influencing_the_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	For instance the cost saving has been the major driver for cloud adoption as mentioned and discussed about in several studies, also indicated in the Table 7 below. Challenges in cloud migration process In our previous work (Rashmi et al. 2013) we have iden-tified (refer Table 8) various challenges in the cloud mi-gration process and have attempted to answer the RQ2 by listing out various challenges which organizations face, while adopting the cloud. Existing processes or frameworks for secure cloud migration	Ivon Miranda Santos
Rai2015-Exploring_the_factors_influencing_the_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	For instance the cost saving has been the major driver for cloud adoption as mentioned and discussed about in several studies, also indicated in the Table 7 below. Challenges in cloud migration process In our previous work (Rashmi et al. 2013) we have iden-tified (refer Table 8) various challenges in the cloud mi-gration process and have attempted to answer the RQ2 by listing out various challenges which organizations face, while adopting the cloud.	Ivon Miranda Santos
Rai2015-Exploring_the_factors_influencing_the_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Table 8 Migration challenges Migration challenges — Description Business factors — →Costs, →Existing investments in IT, →Data security, →Regulations, →Provisioning Technical factors — →Existing infrastructure, →Security architecture, →Complexity, →Network and support, →IT skills, →Service Level Agreements (SLAs)	Ivon Miranda Santos
Rai2015-Exploring_the_factors_influencing_the_cloud_computing_a	MULTI-CLOUD CHALLENGES > Difficulty for adoption the multi-cloud	For instance the cost saving has been the major driver for cloud adoption as mentioned and discussed about in several studies, also indicated in the Table 7 below. Challenges in cloud migration process In our previous work (Rashmi et al. 2013) we have iden-tified (refer Table 8) various challenges in the cloud mi-gration process and have attempted to answer the RQ2 by listing out various challenges which organizations face, while adopting the cloud.	Ivon Miranda Santos
Rai2015-Exploring_the_factors_influencing_the_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	P22 Ward et al (2010) Workload Migration into Clouds – Challenges, Experiences, Opportunities	Ivon Miranda Santos
Rai2015-Exploring_the_factors_influencing_the_cloud_computing_a	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	After analyzing the studies collected through this Sys-tematic Review Process, a number of research challenges were observed and which indicated future directions of this research. i. Growing maturity of cloud migration – Even though it has been acknowledged that the maturity of the cloud migration is in its pivotal stage, one can observe a clear sign of growth by observing various types of cloud migration being reported in the literature (already discussed in Section 2.3).	Ivon Miranda Santos
Ranchal2020-Disrupting_healthcare_silos_Addressing_data_volume_	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	The HDI service plays a critical role by providing an accurate and efficient data acquisition mechanism in building an end to end healthcare solution. The aim of this paper is to highlight the challenges of large-scale healthcare data acquisition from multiple sources and provide guidance on leveraging cloud for building an HDI service for regulated environments. Thus, we have generalized the requirements, proposed design pat-terns, and provided a reference implementation of the HDI service without making it specific to a healthcare solution, cloud provider, or technology platform.	Ivon Miranda Santos

Ranchal2020-Disrupting_healthcare_silos_Addressing_data_volume_	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	The aim of this paper is to highlight the challenges of large-scale healthcare data acquisition from multiple sources and provide guidance on leveraging cloud for building an HDI service for regulated environments. Thus, we have generalized the requirements, proposed design pat·terns, and provided a reference implementation of the HDI service without making it specific to a healthcare solution, cloud provider, or technology platform.	Ivon Miranda Santos
Ravi2019-Emergence_of_middleware_to_mitigate_the_challenges_of_	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Avoiding vendor lock-in is challenging as each provider differs by proprietary implementations with custom interfaces and APIs. However, it could be possible if interoperability and portability issues are solved.	Ivon Miranda Santos
Ravi2019-Emergence_of_middleware_to_mitigate_the_challenges_of_	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Avoiding vendor lock-in is challenging as each provider differs by proprietary implementations with custom interfaces and APIs. However, it could be possible if interoperability and portability issues are solved.	Ivon Miranda Santos
Ravi2019-Emergence_of_middleware_to_mitigate_the_challenges_of_	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Before laying the middleware, the real challenge lies in creating the unique API set, iden-tifying the complexity of working with distributed cloud services, mapping each service to the middleware API, and an efficient approach to service clients with low bandwidth consumption, lesser energy, and faster and optimized response. The next section gives a generic overview about the API requirements and its expectations to fulfill the multi-cloud scenario for mobile devices.	Ivon Miranda Santos
Ravi2019-Emergence_of_middleware_to_mitigate_the_challenges_of_	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	Before laying the middleware, the real challenge lies in creating the unique API set, iden-tifying the complexity of working with distributed cloud services, mapping each service to the middleware API, and an efficient approach to service clients with low bandwidth consumption, lesser energy, and faster and optimized response. The next section gives a generic overview about the API requirements and its expectations to fulfill the multi-cloud scenario for mobile devices.	Ivon Miranda Santos
Ravi2019-Emergence_of_middleware_to_mitigate_the_challenges_of_	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Multicloud Middleware for Mobile Devices Cloud Interoperability is a very challenging task because of the existence of Cloud API propagation74 where each cloud provider provides its own set of Web services and Application programming Interfaces. Next generation mobile applications are focusing in the combination of different cloud capabilities from multiple clouds for the creation of composite services that are not tied to cloud specifications, and for transferring data easily from one cloud to another.	Ivon Miranda Santos
Ravi2019-Emergence_of_middleware_to_mitigate_the_challenges_of_	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Cloud Interoperability is a very challenging task because of the existence of Cloud API propagation74 where each cloud provider provides its own set of Web services and Application programming Interfaces. Next generation mobile applications are focusing in the combination of different cloud capabilities from multiple clouds for the creation of composite services that are not tied to cloud specifications, and for transferring data easily from one cloud to another.	Ivon Miranda Santos
Ravi2019-Emergence_of_middleware_to_mitigate_the_challenges_of_	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	Cloud Interoperability is a very challenging task because of the existence of Cloud API propagation74 where each cloud provider provides its own set of Web services and Application programming Interfaces. Next generation mobile applications are focusing in the combination of different cloud capabilities from multiple clouds for the creation of composite services that are not tied to cloud specifications, and for transferring data easily from one cloud to another.	Ivon Miranda Santos

Raza2019-A_review_on_security_issues_and_their_impact_on_hybrid	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Anukrati and Dubey et al. [14] address some challenges to consider when migrating to hybrid clouds and techniques can addressed in hybrid infrastructure securities can be provide to protect encryption and decryption communication, key based security algorithms which are countered authentication and authorization techniques secured over the intra cloud communication in which an automatic, intelligent migration service in hybrid cloud relay on agent technology. In this research paper major areas of focus on a group of unified Identity & Access Management and privacy frameworks across cloud computing applications or services.	Ivon Miranda Santos
Raza2019-A_review_on_security_issues_and_their_impact_on_hybrid	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Anukrati and Dubey et al. [14] address some challenges to consider when migrating to hybrid clouds and techniques can addressed in hybrid infrastructure securities can be provide to protect encryption and decryption communication, key based security algorithms which are countered authentication and authorization techniques secured over the intra cloud communication in which an automatic, intelligent migration service in hybrid cloud relay on agent technology. In this research paper major areas of focus on a group of unified Identity & Access Management and privacy frameworks across cloud computing applications or services.	Ivon Miranda Santos
Raza2019-A_review_on_security_issues_and_their_impact_on_hybrid	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Anukrati and Dubey et al. [14] address some challenges to consider when migrating to hybrid clouds and techniques can addressed in hybrid infrastructure securities can be provide to protect encryption and decryption communication, key based security algorithms which are countered authentication and authorization techniques secured over the intra cloud communication in which an automatic, intelligent migration service in hybrid cloud relay on agent technology. In this research paper major areas of focus on a group of unified Identity & Access Management and privacy frameworks across cloud computing applications or services.	Ivon Miranda Santos
Raza2019-A_review_on_security_issues_and_their_impact_on_hybrid	MULTI-CLOUD CHALLENGES > Security	Anukrati and Dubey et al. [14] address some challenges to consider when migrating to hybrid clouds and techniques can addressed in hybrid infrastructure securities can be provide to protect encryption and decryption communication, key based security algorithms which are countered authentication and authorization techniques secured over the intra cloud communication in which an automatic, intelligent migration service in hybrid cloud relay on agent technology. In this research paper major areas of focus on a group of unified Identity & Access Management and privacy frameworks across cloud computing applications or services.	Ivon Miranda Santos
Raza2019-A_review_on_security_issues_and_their_impact_on_hybrid	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	Anukrati and Dubey et al. [14] address some challenges to consider when migrating to hybrid clouds and techniques can addressed in hybrid infrastructure securities can be provide to protect encryption and decryption communication, key based security algorithms which are countered authentication and authorization techniques secured over the intra cloud communication in which an automatic, intelligent migration service in hybrid cloud relay on agent technology. In this research paper major areas of focus on a group of unified Identity & Access Management and privacy frameworks across cloud computing applications or services.	Ivon Miranda Santos
Raza2019-A_review_on_security_issues_and_their_impact_on_hybrid	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	This study summarizes major security issues based on a precise literature review.	Ivon Miranda Santos
Raza2019-A_review_on_security_issues_and_their_impact_on_hybrid	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	This study summarizes major security issues based on a precise literature review.	Ivon Miranda Santos

Raza2019-A_review_on_security_issues_and_their_impact_on_hybrid	MULTI-CLOUD CHALLENGES > Challenges in risk and security	This study summarizes major security issues based on a precise literature review.	Ivon Miranda Santos
Repschlaeger2012-Cloud_requirement_framework_Requirements_and_e	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	, 2011).	Ivon Miranda Santos
Repschlaeger2012-Cloud_requirement_framework_Requirements_and_e	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	, 2011). Due to the lack of a universal definition and various perceptions of Cloud Computing, including the related benefits and challenges, many companies struggle to make use of the Cloud concept (Nuseibeh, 2011; Leavitt, 2009; Marston et al. 2011).	Ivon Miranda Santos
Rosati2018-Making_the_cloud_work_for_software_producers_Linking	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	In this paper, we focus on software producers adopting the cloud to provide their solutions to enterprise customers.	Ivon Miranda Santos
Rosati2018-Making_the_cloud_work_for_software_producers_Linking	MULTI-CLOUD CHALLENGES > Choosing the cloud providers	In this paper, we focus on software producers adopting the cloud to provide their solutions to enterprise customers.	Ivon Miranda Santos
Rosati2018-Making_the_cloud_work_for_software_producers_Linking	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The analysis of relevant cost types and factors of cloud computing generate relevant information for the software producers when deciding to adopt cloud computing, and defining software pricing.	Ivon Miranda Santos
Rosati2018-Making_the_cloud_work_for_software_producers_Linking	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	, 2010).	Ivon Miranda Santos
Rosati2018-Making_the_cloud_work_for_software_producers_Linking	MULTI-CLOUD CHALLENGES > Challenges in cloud management	SPs typically migrate their software to a third-party platform (Infrastructure-as-a-Service – IaaS – or	Ivon Miranda Santos
Rosati2018-Making_the_cloud_work_for_software_producers_Linking	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	, 2013; Pahl and Xiong, 2013), research exploring the link between cloud architecture and TCO, and therefore on pricing cloud services from an SP perspective is lacking.	Ivon Miranda Santos
Rosati2018-Making_the_cloud_work_for_software_producers_Linking	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The use case we present in this paper involves a significant image-processing component resulting in high upload- and download- volumes and the in-cloud processing of images. The most critical challenge at the architectural level was to select the optimal Virtual Machine type from the available types on the Azure platform; we carried out a benchmark study of the performance of the different "flavors" of the role VMs, when running the data layer functions of the new application. The costs presented in Tables 9, 10, and 11 are based on the D2-v2 VM type which represented the best trade-off between TCO and SLA requirements on the basis of the average tenant usage.	Ivon Miranda Santos
Saif2022-CSO-ILB_chicken_swarm_optimized_inter-cloud_load_balan	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	1.1 Motivation	Ivon Miranda Santos
Saif2022-CSO-ILB_chicken_swarm_optimized_inter-cloud_load_balan	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Table 1 summarizes the cloud environment's most recent and efcient load balancing techniques. Balancing the load in multi-cloud is challenging; Table 1 shows that the exist-ing load balancing strategies focus on balancing the load in a single cloud, but there is no work mainly focused on load balancing in containerized multi-cloud. Therefore, the proposed article attempts to maintain the load balancing and ensure the vertical and horizontal elasticity in containerized multi-cloud through autonomic computing.	Ivon Miranda Santos
Saif2022-CSO-ILB_chicken_swarm_optimized_inter-cloud_load_balan	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Balancing the load in multi-cloud is challenging; Table 1 shows that the exist-ing load balancing strategies focus on balancing the load in a single cloud, but	Ivon Miranda Santos
Saif2022-CSO-ILB_chicken_swarm_optimized_inter-cloud_load_balan	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Balancing the load in multi-cloud is challenging; Table 1 shows that the exist-ing load balancing strategies focus on balancing the load in a single cloud, but there is no work mainly focused on load balancing in containerized multi-cloud. Therefore, the proposed article attempts to maintain the load balancing and ensure the vertical and horizontal elasticity in containerized multi-cloud through autonomic computing.	Ivon Miranda Santos

Saif2022-CSO-ILB_chicken_swarm_optimized_inter-cloud_load_balan	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	Balancing the load in multi-cloud is challenging; Table 1 shows that the exist-ing load balancing strategies focus on balancing the load in a single cloud, but there is no work mainly focused on load balancing in containerized multi-cloud.	Ivon Miranda Santos
Saif2022-CSO-ILB_chicken_swarm_optimized_inter-cloud_load_balan	MULTI-CLOUD CHALLENGES > Network (Load Balance, ,Latency, Jitter, etc..)	Balancing the load in multi-cloud is challenging; Table 1 shows that the exist-ing load balancing strategies focus on balancing the load in a single cloud, but there is no work mainly focused on load balancing in containerized multi-cloud. Therefore, the proposed article attempts to maintain the load balancing and ensure the vertical and horizontal elasticity in containerized multi-cloud through autonomic computing.	Ivon Miranda Santos
Saif2022-CSO-ILB_chicken_swarm_optimized_inter-cloud_load_balan	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Therefore, the proposed article attempts to maintain the load balancing and ensure the vertical and horizontal elasticity in containerized multi-cloud through autonomic computing.	Ivon Miranda Santos
Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Abstract. Key challenges in managing healthcare applications lie in the area of compliance of the deployment environments and the usage of hybrid clouds. Our approach, as reported in this paper, utilizes two innovative concepts:	Ivon Miranda Santos
Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Abstract. Key challenges in managing healthcare applications lie in the area of compliance of the deployment environments and the usage of hybrid clouds. Our approach, as reported in this paper, utilizes two innovative concepts:	Ivon Miranda Santos
Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	Abstract. Key challenges in managing healthcare applications lie in the area of compliance of the deployment environments and the usage of hybrid clouds. Our approach, as reported in this paper, utilizes two innovative concepts:	Ivon Miranda Santos
Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Our approach, as reported in this paper, utilizes two innovative concepts:	Ivon Miranda Santos
Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	6 Conclusion Modern healthcare applications present particular challenges in cloud and hybrid cloud environments. Keeping these applications up-to-date in live cloud environments can be costly and time consuming.	Ivon Miranda Santos
Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	6 Conclusion Modern healthcare applications present particular challenges in cloud and hybrid cloud environments. Keeping these applications up-to-date in live cloud environments can be costly and time consuming.	Ivon Miranda Santos
Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Complexity in environment management (including cost)	6 Conclusion Modern healthcare applications present particular challenges in cloud and hybrid cloud environments. Keeping these applications up-to-date in live cloud environments can be costly and time consuming.	Ivon Miranda Santos
Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Cloud-Native/Microservice architecture	6 Conclusion Modern healthcare applications present particular challenges in cloud and hybrid cloud environments. Keeping these applications up-to-date in live cloud environments can be costly and time consuming.	Ivon Miranda Santos
Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Modern healthcare applications present particular challenges in cloud and hybrid cloud environments. Keeping these applications up-to-date in live cloud environments can be costly and time consuming. HIPAA compliance, in particular, introduces technical and security challenges that are an overload to the developers and operators of cloud native solutions. Our experimentation has shown that through the use of open source tech-nologies, best of breed automation tools and the PaaS Platform interface we are able to implement a DevOps methodology that addresses and meets the HIPAA requirements.	Ivon Miranda Santos

Sailer2018-Healthcare_application_migration_in_compliant_hybrid	MULTI-CLOUD CHALLENGES > Challenges in risk and security	HIPAA compliance, in particular, introduces technical and security challenges that are an overload to the developers and operators of cloud native solutions.	Ivon Miranda Santos
Shastry2022-Approaches_for_migrating_non_cloud-native_applicati	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Abstract— This paper explores different strategies and tools for migrating non cloud-native or legacy applications to cloud.	Ivon Miranda Santos
Shastry2022-Approaches_for_migrating_non_cloud-native_applicati	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The approach taken involves studying the existing migration strategies and experimenting them on different types of non cloud-native applications to identify the strengths and challenges associated with each of them.	Ivon Miranda Santos
Shastry2022-Approaches_for_migrating_non_cloud-native_applicati	MULTI-CLOUD CHALLENGES > Drawback	The paper first discusses the existing work relating to the subject and the drawbacks of the same. This is followed by the research approach, which includes a discussion of the platforms/tools and strategies for migration proposed by the different leading cloud vendors, and the choice of applications and migration strategies for experimentation. Then, for every chosen strategy, the paper discusses the steps taken for the migration of different applications, and the results post migration. Finally, the paper concludes by providing a generic set of steps for each of the migration strategies, and the range of applications it would apply to.	Ivon Miranda Santos
Shastry2022-Approaches_for_migrating_non_cloud-native_applicati	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Research surrounding migration of applications to cloud has been underway since the advent of cloud. A significant challenge initially in cloud migration is the lack of a general process in selecting cloud models and the studies on the risks and benefits involved in migration. There are now many step-by-step decision processes such as the one proposed by Cloudstep [1].	Ivon Miranda Santos
Shastry2022-Approaches_for_migrating_non_cloud-native_applicati	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Research surrounding migration of applications to cloud has been underway since the advent of cloud. A significant challenge initially in cloud migration is the lack of a general process in selecting cloud models and the studies on the risks and benefits involved in migration. There are now many step-by-step decision processes such as the one proposed by Cloudstep [1]. There have also been numerous studies on the cost-benefit tradeoff for migration of different applications [2].	Ivon Miranda Santos
Shastry2022-Approaches_for_migrating_non_cloud-native_applicati	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Microservices which have been found to be suitable for development of web and mobile applications, also supported this decision.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Drawback	This is because a single cloud cannot cover all types of users' func-tional/nonfunctional requirements, in addition to several drawbacks such as resource limitation, vendor lock-in, and prone to failure. On the other hand, multicloud brings several merits such as vendor lock-in avoidance, system fault tolerance, cost reduction, and better quality of service.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	On the other hand, multicloud brings several merits such as vendor lock-in avoidance, system fault tolerance, cost reduction, and better quality of service. The biggest challenge is in selecting an optimal web service composition in the ever increasing multi-cloud market in which each provider has its own pricing schemes and delivers variation in the service security level. In this regard, we embed a module in the cloud broker to log service downtime and different attacks to measure the security risk.	Ivon Miranda Santos

Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	On the other hand, multicloud brings several merits such as vendor lock-in avoidance, system fault tolerance, cost reduction, and better quality of service. The biggest challenge is in selecting an optimal web service composition in the ever increasing multi-cloud market in which each provider has its own pricing schemes and delivers variation in the service security level. In this regard, we embed a module in the cloud broker to log service downtime and different attacks to measure the security risk.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in risk and security	On the other hand, multicloud brings several merits such as vendor lock-in avoidance, system fault tolerance, cost reduction, and better quality of service. The biggest challenge is in selecting an optimal web service composition in the ever increasing multi-cloud market in which each provider has its own pricing schemes and delivers variation in the service security level. In this regard, we embed a module in the cloud broker to log service downtime and different attacks to measure the security risk.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	On the other hand, multicloud brings several merits such as vendor lock-in avoidance, system fault tolerance, cost reduction, and better quality of service.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Vendor lock-in	On the other hand, multicloud brings several merits such as vendor lock-in avoidance, system fault tolerance, cost reduction, and better quality of service. The biggest challenge is in selecting an optimal web service composition in the ever increasing multi-cloud market in which each provider has its own pricing schemes and delivers variation in the service security level. In this regard, we embed a module in the cloud broker to log service downtime and different attacks to measure the security risk.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Security	On the other hand, multicloud brings several merits such as vendor lock-in avoidance, system fault tolerance, cost reduction, and better quality of service. The biggest challenge is in selecting an optimal web service composition in the ever increasing multi-cloud market in which each provider has its own pricing schemes and delivers variation in the service security level. In this regard, we embed a module in the cloud broker to log service downtime and different attacks to measure the security risk.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Monitoring	On the other hand, multicloud brings several merits such as vendor lock-in avoidance, system fault tolerance, cost reduction, and better quality of service. The biggest challenge is in selecting an optimal web service composition in the ever increasing multi-cloud market in which each provider has its own pricing schemes and delivers variation in the service security level. In this regard, we embed a module in the cloud broker to log service downtime and different attacks to measure the security risk.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Cloud computing challenge	The biggest challenge is in selecting an optimal web service composition in the ever increasing multi-cloud market in which each provider has its own pricing schemes and delivers variation in the service security level. In this regard, we embed a module in the cloud broker to log service downtime and different attacks to measure the security risk	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Since the cloud, as in other new technologies, is beginning to be threatened via known/unknown attacks, this trend needs to quantify cloud security risks.	Ivon Miranda Santos

Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in risk and security	As such, one of the biggest challenges is to select the best procedure and metrics to quantify system security risks that are qualitative in nature. Different works have been done to measure IT security risks, and several economic risk factors such as annual loss expectancy (ALE),21,22 mean time to failure (MTTF),23 and mean failure cost (MFC)24 have been introduced to show the volume of IT unreliabilities.25 For instance, ALE is used for the whole system annual monetary losses, but it does not determine the proportion of the system stakeholders' losses, which is why we adopt the MFC metric and extend it based on our subjective model.2	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	This way, based on our method, to meet the security SLA (price, availability, integrity, and confidentiality), the broker can estimate and quantify financial losses owing to cloud disability; then, it finds low risky clouds in MCE to cover the user's business process. Another challenge is to select appropriate providers along with related services to cover the user's business process in large search space of the ever increasing multicloud market, which has mis-cellaneous competitive providers and handful services. One important question that arises is which provider can satisfy the business functional and nonfunctional requirements, specifically the security requirement.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Another challenge is to select appropriate providers along with related services to cover the user's business process in large search space of the ever increasing multicloud market, which has mis-cellaneous competitive providers and handful services.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Drawback	3 However, in the related works, there are some drawbacks as well as benefits. For instance, some of the related works focus on just sheer economic or limited factors, which have less influence on security issues.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Moreover, each of which is not agile enough to take into account a variety of service types, a new organization policy, new cloud pricing schemes, and multisourcing cloud for reaching a sustainable decision point. To deal with the aforementioned problem and challenges, we develop an iterative decision model to decide between the development of internal IT and cloud migration for organization. The main contributions of this paper are as follows.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Moreover, each of which is not agile enough to take into account a variety of service types, a new organization policy, new cloud pricing schemes, and multisourcing cloud for reaching a sustainable decision point. To deal with the aforementioned problem and challenges, we develop an iterative decision model to decide between the development of internal IT and cloud migration for organization. The main contributions of this paper are as follows.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	Moreover, each of which is not agile enough to take into account a variety of service types, a new organization policy, new cloud pricing schemes, and multisourcing cloud for reaching a sustainable decision point. To deal with the aforementioned problem and challenges, we develop an iterative decision model to decide between the development of internal IT and cloud migration for organization. The main contributions of this paper are as follows	Ivon Miranda Santos

Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	There exist several threats that can attack cloud datacenter components to disrupt routine tasks; hence, we classify the datacenter compo-nents, cloud threats, probability of materialization, target of attacks, which lingers to deliver a suitable level of security and its vulnerability in forthcoming sections to quantify multicloud security risks (cf, Section 3.3.2). One of the biggest challenges is to quantify the security risk in terms of monetary losses in a multicloud environment; the reason why we extend the AMFC factor is to determine the amount of cloud adopter financial losses due to cloud disability to meet the security objectives. Based on our method, a broker can estimate the security risk for a related cloud.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in risk and security	There exist several threats that can attack cloud datacenter components to disrupt routine tasks; hence, we classify the datacenter compo-nents, cloud threats, probability of materialization, target of attacks, which lingers to deliver a suitable level of security and its vulnerability in forthcoming sections to quantify multicloud security risks (cf, Section 3.3.2).	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Challenges in risk and security	One of the biggest challenges is to quantify the security risk in terms of monetary losses in a multicloud environment; the reason why we extend the AMFC factor is to determine the amount of cloud adopter financial losses due to cloud disability to meet the security objectives. Based on our method, a broker can estimate the security risk for a related cloud.	Ivon Miranda Santos
Shirvani2018-An_iterative_mathematical_decision_model_for_cloud	MULTI-CLOUD CHALLENGES > Multi-cloud challenge	One of the biggest challenges is to quantify the security risk in terms of monetary losses in a multicloud environment; the reason why we extend the AMFC factor is to determine the amount of cloud adopter financial losses due to cloud disability to meet the security objectives.	Ivon Miranda Santos
Shyamasundar2017-Information_flow_control_for_building_security	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Further, successful hybrid cloud implementation requires a well-structured architecture supporting the functionalities of both private and public clouds and the seamless transitions between them. One of the challenges in a hybrid cloud is securing resource access, in particular, enforcing that the owners policy never gets violated even when the data gets consumed and processed in multiple domains. Existing mechanisms for achieving this, including industry standards such as XACML, SAML, and OAuth, are vulnerable to indirect information leaks as they do not keep track of information flow.	Ivon Miranda Santos
Shyamasundar2017-Information_flow_control_for_building_security	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Further, successful hybrid cloud implementation requires a well-structured architecture supporting the functionalities of both private and public clouds and the seamless transitions between them.	Ivon Miranda Santos
Shyamasundar2017-Information_flow_control_for_building_security	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Further, successful hybrid cloud implementation requires a well-structured architecture supporting the functionalities of both private and public clouds and the seamless transitions between them. One of the challenges in a hybrid cloud is securing resource access, in particular, enforcing that the owners policy never gets violated even when the data gets consumed and processed in multiple domains. Existing mechanisms for achieving this, including industry standards such as XACML, SAML, and OAuth, are vulnerable to indirect information leaks as they do not keep track of information flow.	Ivon Miranda Santos

Shyamasundar2017-Information_flow_control_for_building_security	MULTI-CLOUD CHALLENGES > Security	Further, successful hybrid cloud implementation requires a well-structured architecture supporting the functionalities of both private and public clouds and the seamless transitions between them. One of the challenges in a hybrid cloud is securing resource access, in particular, enforcing that the owners policy never gets violated even when the data gets consumed and processed in multiple domains. Existing mechanisms for achieving this, including industry standards such as XACML, SAML, and OAuth, are vulnerable to indirect information leaks as they do not keep track of information flow.	Ivon Miranda Santos
Shyamasundar2017-Information_flow_control_for_building_security	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Threat models and technical challenges in ensuring end-to-end security and privacy of data as it traverses the boundary of edge datacenter and cloud datacenter in an Internet-of-things (IoT) framework have been elucidated in [10].	Ivon Miranda Santos
SOrheller2018-Implementing_cloud_erp_solutions_A_review_of_soci	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Although according to Duan and colleagues this is rarely an issue for small organizations [4], the concern is raised in several articles that focus on SMEs [3, 13, 14]. Data Migration: the implementation of cloud-based ERP systems can be challenged when there is a need to migrate data from existing repositories to the cloud-ERP database. The rules and data structures of cloud ERP solutions can be very different to the rules and structures of systems that are already in use [15, 16].	Ivon Miranda Santos
SOrheller2018-Implementing_cloud_erp_solutions_A_review_of_soci	MULTI-CLOUD CHALLENGES > Data loss and privacy	Although according to Duan and colleagues this is rarely an issue for small organizations [4], the concern is raised in several articles that focus on SMEs [3, 13, 14]. Data Migration: the implementation of cloud-based ERP systems can be challenged when there is a need to migrate data from existing repositories to the cloud-ERP database. The rules and data structures of cloud ERP solutions can be very different to the rules and structures of systems that are already in use [15, 16].	Ivon Miranda Santos
SOrheller2018-Implementing_cloud_erp_solutions_A_review_of_soci	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	Data Migration: the implementation of cloud-based ERP systems can be challenged when there is a need to migrate data from existing repositories to the cloud-ERP database.	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Migrating to the Service Cloud Paradigm implies the migration of legacy software systems to a service-oriented architecture with deployment in the cloud. Although this specific software modernization paradigm promises numerous strategic and operational advantages, it poses also many complex organizational and technical challenges, among which is the lack of mature processes, methods and techniques.	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	This paper examines the questions of whether agile methods and techniques could be scaled to fit the migration to the Service Cloud Paradigm and how they could help overcoming the challenges of software modernization in this specific context. The research methodology presented here first extracts the challenges of the migration to Service Cloud Paradigm through a systematic literature review and then, using expert judgment, evaluates how different agile techniques, taken from Scrum and Extreme Programming (XP), could address the identified challenges. As a result, a ranked list of applicable agile techniques is presented and suggestions for their adoption in software modernization projects are drawn.	Ivon Miranda Santos

Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenge to cloud migration	The research methodology presented here first extracts the challenges of the migration to Service Cloud Paradigm through a systematic literature review and then, using expert judgment, evaluates how different agile techniques, taken from Scrum and Extreme Programming (XP), could address the identified challenges.	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Cloud computing challenge	The study presented in the paper proposes a systematic approach for reviewing the challenges of SOA and Cloud Computing relevant to Service Cloud Paradigm.	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	These agile techniques are taken from Scrum and XP software development methods since they are the most widely adopted methods through the agile community in the recent years (in more than two thirds of the projects surveyed by VersionOne1).	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	The reminder of the paper is organized as follows: Section 2 describes the methodology used for conducting literature review and evaluating agile techniques; Section 3 presents the challenges from SOA and Cloud Computing fields, extracted by the review process and relevant for the migration to the Service Cloud Paradigm; Section 4 discusses the results of the evaluation of agile techniques and their potential to address the identified challenges; and Section 5 concludes the paper and outlines directions for future research. 2 Methodology	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Cloud computing challenge	The reminder of the paper is organized as follows: Section 2 describes the methodology used for conducting literature review and evaluating agile techniques; Section 3 presents the challenges from SOA and Cloud Computing fields, extracted by the review process and relevant for the migration to the Service Cloud Paradigm; Section 4 discusses the results of the evaluation of agile techniques and their potential to address the identified challenges; and Section 5 concludes the paper and outlines directions for future research.	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Cloud computing challenge	The search strategy included both journals and conference papers, and was limited to the Scopus electronic database. Scopus is the largest abstract and citation database of research literature and quality web sources, which ensured the coverage of nearly 18,000 titles from more than 5,000 publishers. The titles of both journals and conference papers were searched using the following search terms: (1) Service-Oriented Architecture - ("Service-Oriented" AND (Challenges OR Review OR Landscape OR Roadmap OR "State of")); (2) Cloud Computing - ("Cloud Computing" AND (Challenges OR Review OR Landscape OR Roadmap OR "State of").	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Cloud computing challenge	(1) for Service-Oriented Architecture we included challenges relevant for both service consumers and providers, as software migration could involve both developing of new services and using external ones; (2) for Cloud-Computing we included only challenges relevant for the cloud consumers, excluding challenges covering the development of cloud infrastructure, how security should be achieved within this infrastructure and other challenges more relevant for the cloud provider.	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Cloud computing challenge	3.2 Challenges of Cloud Computing A total of 27 articles in the area of Cloud Computing were reviewed. The extracted challenges were further consolidated into 12 challenges, including 8 organizational challenges and 4 technical. They are shown in Table 2.	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Thus mistrust and lack of security and privacy might become the greatest barrier for the adoption of cloud solutions.	Ivon Miranda Santos

Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	Cloud Computing and its challenges further affect the way agile methods and techniques could be incorporated into the Service Cloud Paradigm. Trust (O1), security and privacy (O3) of data and computation are as much important for the organization as for its customers, so the organization-customer collaboration, central to agile software development, might need to be extended to include the cloud provider (in order to increase transparency, visibility, responsiveness, etc.,	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Cloud Computing and its challenges further affect the way agile methods and techniques could be incorporated into the Service Cloud Paradigm. Trust (O1), security and privacy (O3) of data and computation are as much important for the organization as for its customers, so the organization-customer collaboration, central to agile software development, might need to be extended to include the cloud provider (in order to increase transparency, visibility, responsiveness, etc.,	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in risk and security	Cloud Computing and its challenges further affect the way agile methods and techniques could be incorporated into the Service Cloud Paradigm. Trust (O1), security and privacy (O3) of data and computation are as much important for the organization as for its customers, so the organization-customer collaboration, central to agile software development, might need to be extended to include the cloud provider (in order to increase transparency, visibility, responsiveness, etc.,	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Cloud computing challenge	Cloud Computing and its challenges further affect the way agile methods and techniques could be incorporated into the Service Cloud Paradigm. Trust (O1), security and privacy (O3) of data and computation are as much important for the organization as for its customers, so the organization-customer collaboration, central to agile software development, might need to be extended to include the cloud provider (in order to increase transparency, visibility, responsiveness, etc., so needed for the building trust and confidence). Vendor lock-ins (O2) might further hinder organizational flexibility and agility (e.g. as one could not change its cloud provider effortless and in a timely manner), while external dependencies (O2) could decrease the business value delivered to customers (e.g. due to new requirements coming from the cloud infrastructure or the organization is pressured to use specific and expensive software licenses coming from the could provider, etc.) and could further decrease organizational responsiveness (e.g. due contracting). In terms of technical challenges, the maintenance and troubleshooting difficulties (T1), together with the lack of cloud support (T3), might require more involvement from upper management (in order to assure the commitment of the cloud provider). Also, the architectural and technical constraints (T2) and the need to consider quality aspects (T2, T4, such as interoperability, security, performance, etc.) might require considerable efforts to be made for	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud service providers	) and could further decrease organizational responsiveness (e.g. due contracting). In terms of technical challenges, the maintenance and troubleshooting difficulties (T1), together with the lack of cloud support (T3), might require more involvement from upper management (in order to assure the commitment of the cloud provider). Also, the architectural and technical constraints (T2) and the need to consider quality aspects (T2, T4, such as interoperability, security, performance, etc.)	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	) and could further decrease organizational responsiveness (e.g. due contracting).	Ivon Miranda Santos

Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in vendor lock-in	)	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud management	In terms of technical challenges, the maintenance and troubleshooting difficulties (T1), together with the lack of cloud support (T3), might require more involvement from upper management (in order to assure the commitment of the cloud provider). Also, the architectural and technical constraints (T2) and the need to consider quality aspects (T2, T4, such as interoperability, security, performance, etc.)	Ivon Miranda Santos
Stavru2013-Challenges_for_migrating_to_the_service_cloud_paradi	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	Afterwards, it might continue with Product / Sprint Backlogs, Daily Scrums, Continuous Integration and On-Site Customer in order to further address the challenges of the migration process.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Further; how an on-premise intranet can be migrated over cloud platforms with enhanced performance and extended/add-on features. After analysis of collected facts, understanding the issues, challenges and limitations of the existing state of art intranets, a strong need for performance enhancement and add on features was observed for Intranets. The study deeply investigated and analyzed the issues, challenges and limitations i.e. features and performances of the current state of the art of the intranets in general and on-premise Intranet of AMU in specific. Finally, an Intranet Migration Strategy Model over Hybrid Cloud was designed and developed using SaaS (i.e.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	The study deeply investigated and analyzed the issues, challenges and limitations i.e. features and performances of the current state of the art of the intranets in general and on-premise Intranet of AMU in specific. Finally, an Intranet Migration Strategy Model over Hybrid Cloud was designed and developed using SaaS (i.e.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	The study deeply investigated and analyzed the issues, challenges and limitations i.e. features and performances of the current state of the art of the intranets in general and on-premise Intranet of AMU in specific. Finally, an Intranet Migration Strategy Model over Hybrid Cloud was designed and developed using SaaS (i.e.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	The study deeply investigated and analyzed the issues, challenges and limitations i.e. features and performances of the current state of the art of the intranets in general and on-premise Intranet of AMU in specific. Finally, an Intranet Migration Strategy Model over Hybrid Cloud was designed and developed using SaaS (i.e.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The next generation intranets needs on-demand Scalability, Open boundary Accessibility, Service reliability, High Availability (Uptime), Cost effectiveness, High responsive, fault tolerant and high Performance with promised Security, Anytime, Anywhere over Any device Availability[4,5,7,8]. As on date such issues, challenges and limitations (on-demand Scalability, Open boundary Accessibility, Service reliability, High Availability (Uptime), High responsive, Fault tolerant with promised Security, Intelligent Search Content Filtration, Cost-effectiveness, and Anytime, Anywhere over Any device Accessibility) in the existing designs and practices over intranets are not addressed by specific design or models. This makes this research a worth initiating activity towards a new knowledge contribution in the domain and the same has been proved and mentioned in the table 1 under the review of literature section.	Ivon Miranda Santos

Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The next generation intranets needs on-demand Scalability, Open boundary Accessibility, Service reliability, High Availability (Uptime), Cost effectiveness, High responsive, fault tolerant and high Performance with promised Security, Anytime, Anywhere over Any device Availability[4,5,7,8]. As on date such issues, challenges and limitations (on-demand Scalability, Open boundary Accessibility, Service reliability, High Availability (Uptime), High responsive, Fault tolerant with promised Security, Intelligent Search Content Filtration, Cost-effectiveness, and Anytime, Anywhere over Any device Accessibility) in the existing designs and practices over intranets are not addressed by specific design or models.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Drawback	Relevant to this study but, in proposed study not only application developers are assisted i.e. all Stakeholders of the organization are proposed to be benefited from usage point of views. The drawback of this study was a lack of focus on the points; on-demand Scalability, Open boundary Accessibility, Service reliability, High Availability (Uptime), High responsive, Fault tolerant with promised Security, Intelligent Search Content Filtration, Cost-effectiveness, and Anytime, Anywhere over Any device Accessibility.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud management	They provided in-depth inputs and the facts about issues, limitations and challenges of the existing state of art intranet in the university system. From their responses, it was revealed that 97.37% respondents are aware about cloud and 89.47 % are using cloud services with promised trust and benefits and interested to have an alternative model/solution for Intranet for modernizing and upgrading the intranet features or services with enhanced performance of the existing Intranet.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud management	During the functional demo and survey it was clearly revealed that the current state of art intranets in the educational institutions of Ethiopia are not scalable, cost effective, rapidly upgradable, reliable, all time available with zero down time, and intelligent, and boundary-less accessible.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud migration process	During the functional demo and survey it was clearly revealed that the current state of art intranets in the educational institutions of Ethiopia are not scalable, cost effective, rapidly upgradable, reliable, all time available with zero down time, and intelligent, and boundary-less accessible.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Scalability	During the functional demo and survey it was clearly revealed that the current state of art intranets in the educational institutions of Ethiopia are not scalable, cost effective, rapidly upgradable, reliable, all time available with zero down time, and intelligent, and boundary-less accessible.	Ivon Miranda Santos

Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud management	This research study is an effort to explore the new knowledge contribution in constructing a migration strategy model for Intranets over Cloud. The study was focused on how different organization's traditional computing platforms and intranets are challenged in terms of poor performance and lack of advanced features. The research considered case based analysis of the AMU's Intranet. The research study tried to investigate and analyze the issues, challenges and limitations in existing state of art intranets and their performance, features by analyzing the satisfaction levels of the participants. Finally, the research designed a Migration Strategy Model named as "DPS-AA Model" for the Intranet over Cloud Platforms towards enhancing the performance and extending the features like on-demand Scalability, Open boundary Accessibility, Service reliability, High Availability (Uptime), High responsive, Fault tolerant with promised Security, Intelligent Search Content Filtration, Cost-effectiveness, and Anytime, Anywhere over Any device Accessibility.	Ivon Miranda Santos
Tona2020-DPS-AA_Intranet_migration_strategy_model_for_clouds	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The research study tried to investigate and analyze the issues, challenges and limitations in existing state of art intranets and their performance, features by analyzing the satisfaction levels of the participants. Finally, the research designed a Migration Strategy Model named as "DPS-AA Model" for the Intranet over Cloud Platforms towards enhancing the performance and extending the features like on-demand Scalability, Open boundary Accessibility, Service reliability, High Availability (Uptime), High responsive, Fault tolerant with promised Security, Intelligent Search Content Filtration, Cost-effectiveness, and Anytime, Anywhere over Any device Accessibility.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The main challenge in transforming applications to microservice architecture is to define the services as independent modules.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	In a microservice architecture, all the services work independently and are deployed separately.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	But with the microservice architecture, people can easily patch and adapt to the new requirements within short cycles with the leverage of Continuous Integration (CI) and Continuous Deployment (CD) pipelines [36].	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	This paper elaborates the findings on the challenge when using microservice architecture.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Another type is converting monolithic systems or service-oriented traditional systems to microservice architecture.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The first challenge in developing a microservice is to determine the scope of one service in a microservice architecture.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Hence, based on that, can't determine the connection points within microservice architecture.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Supporting the microservice architecture is very challenging because of the service distribution.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	The reason behind moving to hybrid cloud deployment is to minimize network latency based on geographical areas and to gain several cloud vendor services. The industry is rapidly moving to microservice architecture to associate with considerable challenges as well.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	The reason behind moving to hybrid cloud deployment is to minimize network latency based on geographical areas and to gain several cloud vendor services. The industry is rapidly moving to microservice architecture to associate with considerable challenges as well.	Ivon Miranda Santos

Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud management	The industry is rapidly moving to microservice architecture to associate with considerable challenges as well. The main challenge is the performance in terms of latency because of the inter-service communication between microservice in the distributed environment. Skill for development of the microservices is another channel in the software industry.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	When the application is deployed into the production operation, the troubleshooting with the tracing is quite complicated in the microservice architecture.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	With the technological advancement and the architectural patterns, some of the challenges are overcome but they are still faced with several issues in the microservice architecture.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	The main concern of the microservice architecture is the latency because of the distributed services.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud management	Another problem is the troubleshooting issue on the microservice, which is challenging for the support engineers. Continuous research of this to find a solution for the performance issue in the microservice architecture.	Ivon Miranda Santos
Weerasinghe2022-Taxonomical_classification_and_systematic_revie	MULTI-CLOUD CHALLENGES > Challenges in cloud-native architecture	Continuous research of this to find a solution for the performance issue in the microservice architecture.	Ivon Miranda Santos
Zhou2017-Cost_reduction_in_hybrid_clouds_for_enterprise_computi	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Enterprise application migration is an effective way to improve the efficiency of using the cloud infrastructures.	Ivon Miranda Santos
Zhou2017-Cost_reduction_in_hybrid_clouds_for_enterprise_computi	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Enterprise application migration is an effective way to improve the efficiency of using the cloud infrastructures.	Ivon Miranda Santos
Zhou2017-Cost_reduction_in_hybrid_clouds_for_enterprise_computi	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	However, it is a challenging problem to decide which parts of the applications to migrate and where to migrate. In this paper, we focus on the problem of planning the migration of enterprise applications in hybrid cloud infrastructures.	Ivon Miranda Santos
Zhou2017-Cost_reduction_in_hybrid_clouds_for_enterprise_computi	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	However, it is a challenging problem to decide which parts of the applications to migrate and where to migrate. In this paper, we focus on the problem of planning the migration of enterprise applications in hybrid cloud infrastructures.	Ivon Miranda Santos
Zhou2017-Cost_reduction_in_hybrid_clouds_for_enterprise_computi	MULTI-CLOUD CHALLENGES > Challenges in multi-cloud architecture	Servers belong-ing to different tiers may communicate with each other. To deploy an enterprise application in a hybrid cloud environment, a key challenge is determining the location of each server. In order to solve this issue, both academia and industry have proposed solutions in recent years [1–8].	Ivon Miranda Santos
Zhou2017-Cost_reduction_in_hybrid_clouds_for_enterprise_computi	MULTI-CLOUD CHALLENGES > Challenges in cloud infraestructure	Servers belong-ing to different tiers may communicate with each other. To deploy an enterprise application in a hybrid cloud environment, a key challenge is determining the location of each server. In order to solve this issue, both academia and industry have proposed solutions in recent years [1–8].	Ivon Miranda Santos