ORIGINAL

Applicable methodologies for business continuity management in IT services: A systematic literature review

Metodologías aplicables para la gestión de continuidad de negocio en los servicios de TI: Una revisión sistemática de literatura

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ABSTRACT

Introduction: currently, information technologies have one characteristic in common: their volatility. This is why it is important that companies have methodologies that allow adequate management of the continuity of the services offered through them.
Objective: in this sense, the purpose of this systematic literature review is to identify the most appropriate methodologies that can be implemented in companies to deal with these unforeseen interruptions.
Method: with a study based on a PICO question, the search for relevant literature in a scientific database was proposed using a search equation based on keywords.
Results: the studies offer qualitative results that mainly allow reducing response times before incidents of unforeseen interruptions, among the most notable is that the proposed systems help increase the success rate of recovery procedures by 80 %, allow identifying and apply integration technologies that allow improving business continuity systems, among others. However, there is a knowledge gap for which the implementation of these methods is suggested for future proposals in order to achieve quantitative results that can be presented through metrics.
Conclusions: in conclusion, the present systematic literature review carried out the analysis and a comparison of the methodologies proposed by the authors and analyzes the results achieved in each of them, suggesting that 69 % of the articles mention an origin of the associated interruptions to logical failures, 75 % of the studies indicate that business continuity plans mostly have a preventive focus and 44 % suggest continuous testing of plans to ensure their effectiveness.

Keywords: Unforeseen Interruptions; Response Times; Recovery Procedures; Business Continuity Systems.

RESUMEN

Introducción: en la actualidad las tecnologías de la información tienen una característica en común: su volatilidad. Es por ello por lo que es importante que las empresas cuenten con metodologías que permitan la adecuada gestión de la continuidad de los servicios que se ofrecen a través de ellas.
Objetivo: en este sentido, el propósito de la presente revisión sistemática de literatura es identificar cuáles son las metodologías más adecuadas que se pueden implementar en las empresas para hacer frente a estas interrupciones imprevistas.
Método: con un estudio basado en una pregunta de PICO, se propuso la búsqueda de literatura pertinente en una base de datos científica mediante una ecuación de búsqueda basada en palabras claves.
Resultados: los estudios ofrecen resultados cualitativos que principalmente permiten reducir los tiempos de respuesta antes los incidentes de interrupciones imprevistas, entre los más resaltantes se encuentra que los sistemas propuestos ayudan a incrementar el 80 % la tasa de éxito de los procedimientos de recuperación, permiten identificar y aplicar tecnologías de integración que permiten mejorar los sistemas de continuidad

del negocio, entre otros. Sin embargo, existe una brecha de conocimiento para la cual se sugiere para futuras propuestas la implementación de estos métodos con la finalidad de alcanzar resultados cuantitativos y que se puedan exponer a través de métricas.

Conclusiones: en conclusión, la presente revisión sistemática de literatura realizó el análisis y una comparativa de las metodologías propuestas por los autores y analiza los resultados alcanzados en cada uno de ellos, sugiriendo que el 69 % de los artículos mencionan un origen de las interrupciones asociadas a los fallos lógicos, 75 % de los estudios indica que los planes de continuidad del negocio tienen en su mayoría un enfoque preventivo y el 44 % sugiere el testeo continuo de los planes para asegurar su efectividad.

Palabras clave: Interrupciones Imprevistas; Tiempos de Respuesta; Procedimientos de Recuperación; Sistemas de Continuidad del Negocio.

INTRODUCCIÓN

In the current context of the increase in technologies and the development of new business applications, it is very important to have protection strategies that guarantee high availability of IT services that are basic for company operations, above all, one of the main and most valuable that is information. Studies affirm that since IT vulnerabilities increased, these constitute a real threat to the financial health of companies, because they have started using systems published on the Internet, which are usually more exposed to threats and crashes.[1]

Therefore, companies must be prepared to face business interruption events and have business continuity plans, since they allow for greater vision and strategic planning of actions to be carried out to reestablish services in the shortest possible time. It is known that business interruption is one of the main risks for companies, as each of them faces challenges associated with business continuity. It is important for companies to have a crisis management plan since each unplanned interruption can have serious effects for them, such as damage to actions, loss of customers or even bankruptcy of the organization.[2]

The main problem of the study lies in a lack of knowledge about the methodologies to be implemented and the favorable results they offer. As usual, these days many companies are dependent on technology, since most of their systems are based on IT, despite this, sometimes they are not correctly protected against IT risks and one of the main reasons is usually the little knowledge or low estimation of the financial consequences that may occur after a disaster.[1]

Another of the main reasons why the implementation of these continuity and contingency management plans is not considered is usually because they mean a greater investment by companies in their IT areas, however, it is more expensive then to enter a scenario of recovery; on the contrary, staying protected and having contingency plans implies obtaining an important competitive advantage in crisis management.[3]

This systematic review of literature was carried out with the purpose of validating the state of current knowledge and knowing proposals for business continuity plans that ensure the basic operations of companies, and solutions that guarantee having the shortest recovery times (RTOs) and recovery points (RPOs) in case of incidents and interruptions; best implementation practices and use cases. The current state of knowledge includes literature reviews dating back to 2017, therefore, it is important to update knowledge in management and making use of bibliographic sources based on original scientific articles that propose frameworks for the creation of continuity plans. of business and its application in the IT area of different business sectors. This study focused on Business Continuity Management, since it is a very sensitive topic today, due to the volatility of information systems, which causes them to be exposed to different types of risks.

From the analysis of the current state of knowledge, it was observed that this RSL can be contributed to the analysis of planning methodologies and their importance in organizations. In this work, a review of the existing scientific literature is carried out, from which the relevant information was extracted to make a comparison of the different approaches and work methodologies focused on large or small companies, considering business sectors dependent on IT.

The present study is structured as follows: in section 2, Methodology, a description of the methods used to obtain relevant scientific literature was made through the use of inclusion and exclusion criteria. In section 3, Results, the analysis and comparison of the results obtained after screening these articles was carried out, identifying the most important results and the most relevant proposals, while in section 4, a discussion of the results is carried out. proposed and provide key concepts to give one's own appreciation. Finally, in conclusions, a summary of the findings of the present study and suggestions for future research are provided.

METHODOLOGY

For this systematic literature review, a systematic search strategy was planned, starting from the formulation of a review question through the PICO strategy and the subsequent systematic selection process following the

guidelines of the PRISMA declaration. A systematic literature review is a method that allows evaluating the relevant criteria and content related to a particular topic of interest and has the purpose of resolving the research question posed for the study of the state of the art.[4] On the other hand, the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) methodology is made up of standards that guide authors in planning systematic reviews and meta-analyses through a justification of why such a report was carried out, why it was done, carried out by the author and what results he obtained.[5]

First, the definition of the PICO question was carried out, which is a strategy that facilitates the definition of the statement of the review question, due to its segmentation, consequently, it allows for more exact keywords to formulate the equation search.[6] The following was determined:

What type of business continuity plan methodologies help reduce the impact of unforeseen IT disruptions on organizations/companies?

In this research, "Population", which is the problem under investigation, is constituted by unforeseen interruptions in an organization's IT services. "Intervention" is the application of business continuity plans (BCP), which includes risk analysis, business impact analysis (BIA) and application of recovery plans (DRP) and contingency. The Comparison module has not been considered. Outcomes are shaped by the effectiveness of business continuity plans and the application scenarios of these plans. Finally, the context defined for the Context component is Companies and organizations.

As a result of the PICO question, the following research questions are broken down:

N°	Com.	Research questions	Expected result
		Table 1. Research questions	
1	P	What are the main unplanned interruptions in IT services to which a company is exposed?	Identify what have been the main factors of unforeseen IT service interruptions that have arisen in companies.
2	I	Which proposed business continuity systems are most suitable for companies?	Identify the suggested frameworks for the application of business continuity plans in information technologies.
3	C	-	-
4	O	What results could ensure the implementation of business continuity plans?	Determine the effectiveness of the implementation of business continuity plans in companies according to the type of planning suggested.
5	C	What context were the studies carried out?	Determine the context of the study and application of what is recommended (if applicable).

After segmenting the derived questions, we proceeded to define the keywords for each of their components:

N°	Component	Definition	Keywords
		Table 2. Keywords	
1	Population	IT service disruptions	("Business interruption" OR "power outage" OR "system outage" OR "downtime" OR "service disruption" OR "network failures" OR "operational disruptions" OR "IT interruption" OR "unplanned IT outage" OR "IT system failures" OR "data breach" OR "hardware failures" OR "IT downtime")
2	Intervention	Business continuity plans	("Business Continuity Management" OR "IT continuity Management" OR "Continuity Management" OR "Disaster Recovery planning" OR "IT resilience" OR "IT emergency response planning" OR "IT backup and Recovery solutions")
3	Comparison	-	-

| 4 | Outcomes | Mitigation of threats that can cause disruption of IT services. | ("Impact" OR "consequences" OR "effect" OR "IT downtime reduction" OR "IT outage mitigation" OR "IT Disaster Recovery" OR "IT resilience" OR "IT redundancy and Failover") |
| 5 | Context | Companies/Organizations | ("Business" OR "IT Support" OR "IT department") |

As reviewed, one of the RSL found in the state of the art dates back to 2017, therefore, articles from a previous year of the knowledge addressed were considered. With the research questions that were defined, the search equation was carried out in the database of scientific articles Scopus. The search equation was defined as follows:

Table 3. Search equation in Scopus
Search equation
(("Business interruption" OR "power outage" OR "system outage" OR "system failure" OR "IT service disruption" OR "IT interruption" OR "unplanned IT outage" OR "system failures" OR "hardware failures" OR "IT downtime" OR "Risk Management") AND ("Business Continuity Management" OR "IT continuity Management" OR "IT Disaster Recovery planning" OR "IT DRP" OR "IT resilience" OR "Health information technology" OR "IT emergency response planning" OR "IT government" OR "IT downtime reduction" OR "IT outage mitigation") AND ("Impact" OR "consequences" OR "use cases" OR "best practices") AND ("Business" OR "IT Services" OR "IT Support")).

The result of the search equation in the database was 76 original scientific articles. The following inclusion and exclusion criteria were defined:

Table 4. Inclusion and exclusion criteria				
N°	Inclusion criteria	N°	Exclusion criteria	
CI1	Articles referring to IT service interruptions were included.	CE1	Items older than 20 years were not considered.	
CI2	Articles referring to the implementation of Business Continuity Management were included.	CE2	Documents written in languages other than English, Portuguese or Spanish were excluded.	
CI3	Only original scientific articles and Conference Papers were considered.	CE3	Documents that do not correspond to original articles or Conference Papers were excluded.	

The following PRISMA diagram shows a graphical representation of the knowledge selection process. Screening was performed as follows:
- Databases: 1 (Scopus)
- Records: 76 articles as a result of the search equation.
- When applying the inclusion and exclusion criteria, 50 articles were eliminated, either due to the context - it did not focus on continuity of IT services - from the summary, the title not appropriate to the topic raised, etc.
- 5 original articles could not be recovered.
- Finally, there are 16 original articles for study in this RSL.

RESULTS

The findings of the systematic review were synthesized in this section. Based on the results analysis matrix detailed in table 6, the question posed for this research could be answered. The studies analyzed mostly present methodologies or frameworks that can be implemented and suggest favorable results, so we can classify them as success stories of the application of business continuity methods oriented to IT services.

Table 5 shows the studies that were selected for analysis after having defined the keywords, the definition of the PICO questions and having established the search equation applied in the scientific database used for the present study. In turn, the problem studied by each listed scientific article was indicated:
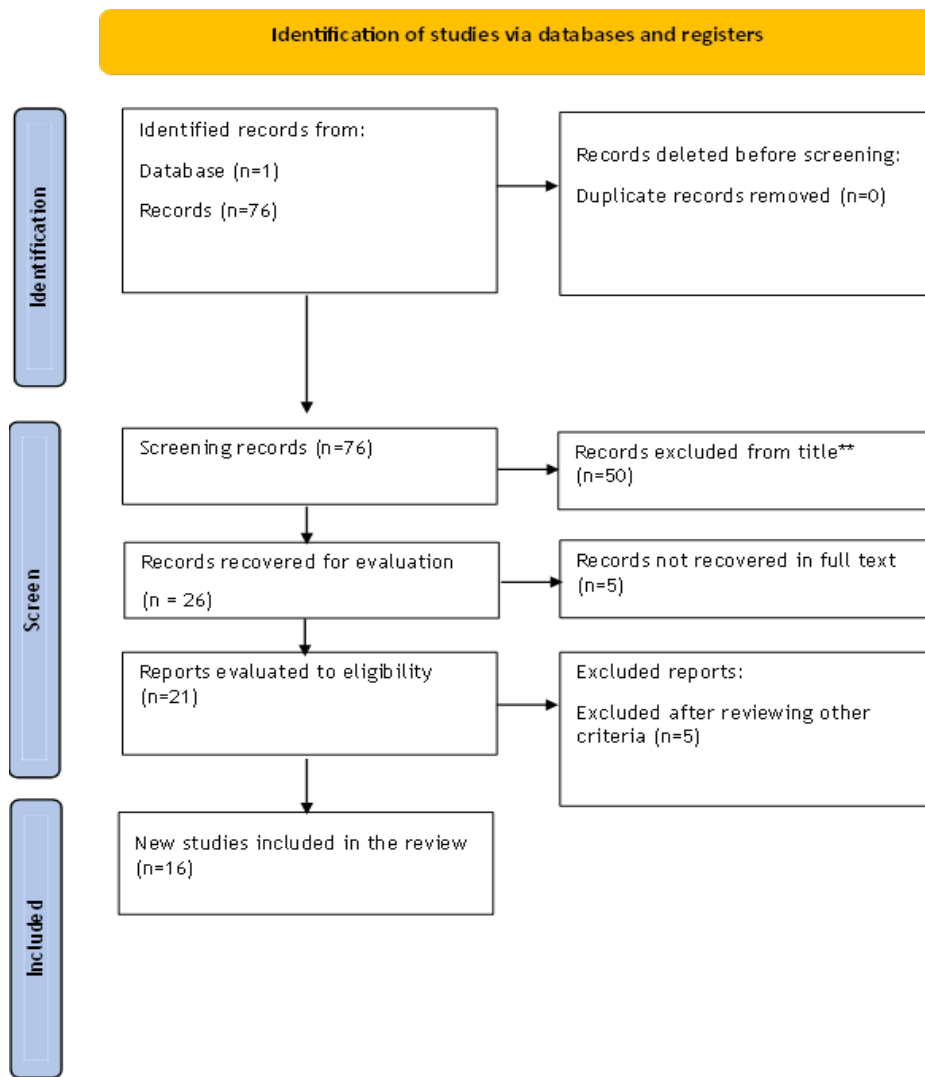
Figure 1. PRISM diagram

Table 5. Studies analyzed			
Ref.	**Title**	**Study problem**	**Type**
Botha et al.[7]	A cyclic approach to business Continuity planning.	Address business continuity plans only to large companies, ignoring small and medium-sized companies	Article
Ashrafi et al.[8]	A framework for IS/IT Disaster Recovery Planning.	Lack of a work methodology for disaster recovery planning	Article
Kang et al.[9]	A knowledge rich similarity measure for improving IT incident resolution process.	Repetitive IT incidents and the complexity of their resolution	Conference Paper
Kobayashi[10]	A study on the causes of information system failure.	Failures in IT systems	Conference Paper
Xie et al.[11]	Ambula: Build communication lifeline of corporation during emergency.	The need for companies to be self-sufficient in recovering from disruptions.	Conference Paper
Podaras[12]	An ontological framework towards unplanned information system outage.	Communication gaps between technicians and managers for decision making and their application for business continuity.	Conference Paper

Bajgoric[13]	Business Continuity Management: A systemic framework for implementation.	Development of a methodology that ensures business continuity in IT.	Article
Antonucci[14]	Business Continuity Management and Cybersecurity.	The non-inclusion of incidents due to cyber attacks in BCM.	Book Chapter
Miller et al.[15]	Business Continuity Management in Data Center environments.	How BCM methodologies can be used in crisis events.	Article
Abdullah et al.[16]	Contributing factors to IT Service disruptions – A case of Malaysia.	The origin of IT disruptions in the public sector in Malaysia.	Article
Ueno et al.[17]	Gaia maturity model to Deploy IT services Continuity.	IT disruptions in loss-making businesses.	Conference Paper
Aziz et al.[18]	Information Management procedures for Business Continuity Plan Maintenance.	Lack of updating business continuity plans resulting in errors at the time of critical business interruptions.	Conference Paper
Podaras et al.[19]	Information Management tools for implementing an effective Enterprise business Continuity strategy.	Lack of precision in the continuity plans that are usually applied.	Article
Niemimaa et al.[20]	IT Services Continuity: Achieving embeddedness through planning.	No prevention planning, only response planning.	Conference Paper
Winkler et al.[21]	Models and methodology for automated business Continuity analysis.	Identify disruptions to IT services.	Conference Paper
Adeshiyan et al.[22]	Using virtualization for high availivility and Disaster Recovery.	Implementing solutions for disruptions in IT services.	Article

Of the selected studies, a bibliometric analysis was carried out both on the origin of the studies and their provenance (publishers where they were recovered). According to the inclusion criteria set out in this study, original articles and Conference Paper were selected, since they are the sources that provided us with the best information on the topic of study. Articles are those that come from journals or magazines, while Conference Papers are generally published in scientific conferences, scientific congresses, etc. In general, both were a great contribution to the present systematic literature review. It is also important to highlight the publication dates of the selected articles, in which we can observe that during these century service interruptions in information technologies were already being investigated, although in an incipient manner. In figure 2 we can see that, reaching the decade of 2010, studies on business continuity plans were increasing, this as a consequence of the fact that, over the years, more companies offer and consume services that are increasingly more dependent on Information Technologies (IT) by Botha et al.[7], Kobayashi[10], Bajgoric[13], Ueno et al.[17], Niemimaa et al.[20] and Winkler et al.[21] ; therefore, if a service interruption incident materializes, it would represent a significant impact on business results, which could generate economic losses, a bad image of the company among its clients, loss of clients, etc.[16] Figure 2 also shows the studies grouped according to the type of document they represent.ç

In this study, the information has been organized following the research questions posed, which allowed us to analyze the objective of the study, the main research problem posed and the methodology proposed by the studies. Next, we have the following:

RQ1: What are the main unplanned interruptions in IT services that a company is exposed to?

In response to the first research question posed, table 6 shows a synthesis of the studies grouped by the type of interruptions studied in the selected research articles for which a response methodology will be proposed, as follows: manner:

It is observed that 69 % of the articles analyzed coincide in highlighting logical or software failures as one of the main causes of business interruptions in IT services, by Botha et al.[7], Ashrafi et al.[8], Kang et al.[9], Kobayashi[10], Podaras[12], Bajgoric[13], Aziz et al.[18], Podaras et al.[19], Niemimaa et al.[20], Winkler et al.[21] and Adeshiyan et al.[22]; according to studies, logical errors represent the greatest threat to companies' IT services. On the other hand, 56 % of articles studied in this research mention that the origin of business interruptions in IT services can be caused by natural disasters. Therefore, it is important to mention that natural disasters usually cause total interruption of service, either due to destruction of the main site or due to interruption in the implemented communications systems.
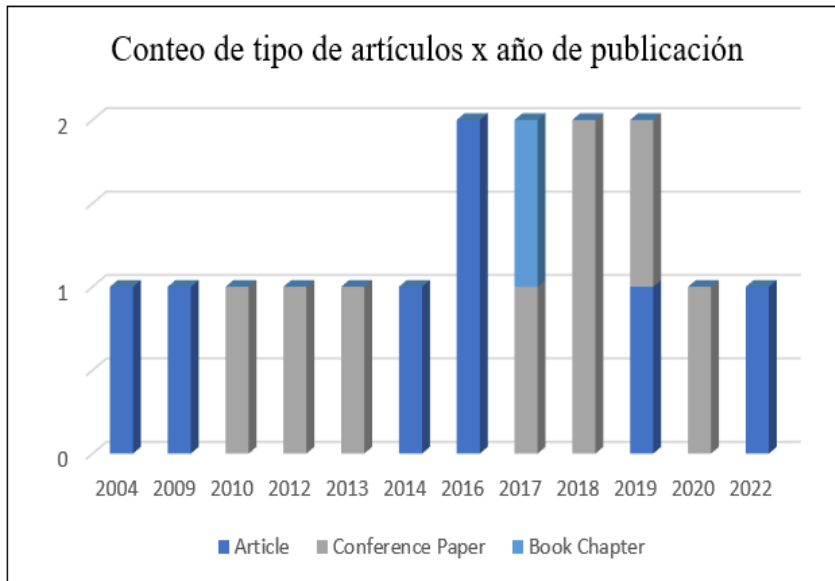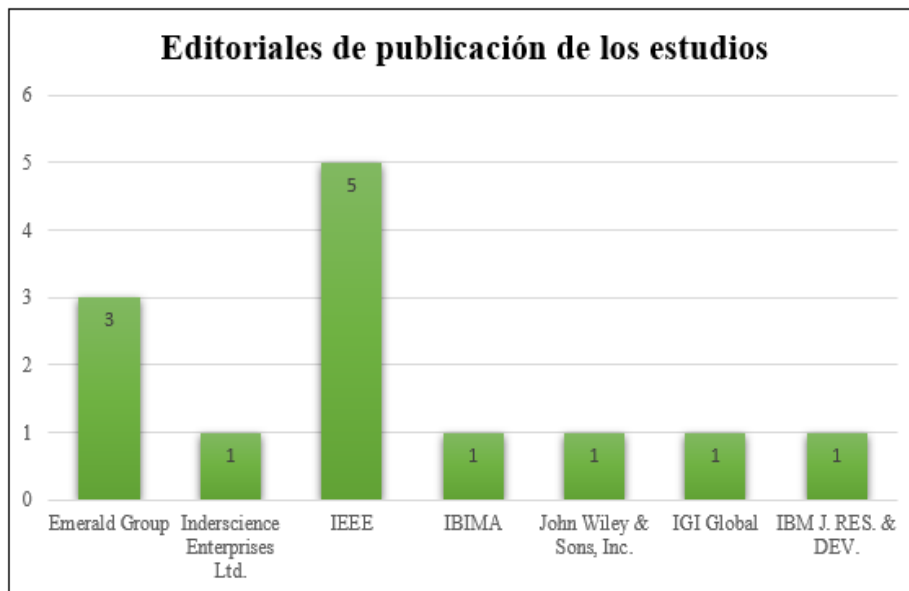
Figure 2. Types of study and year of publication

Figure 3. Article publication editorials

Table 6. Studies that address the origin of business interruption					
Ref.	**Natural disasters**	**Software or logical errors**	**Hardware or physical failures**	**Cyberattacks**	**Human error**
Botha et al.[7]	Yes	Yes	-	-	Yes
Ashrafi et al.[8]	-	Yes	-	-	-
Kang et al.[9]	-	Yes	-	-	-
Kobayashi[10]	-	Yes	-	-	-
Xie et al.[11]	Yes	-	-	-	-
Podaras[12]	-	Yes	-	-	-
Bajgoric[13]	Yes	Yes	Yes	-	Yes
Antonucci[14]	-	-	-	Yes	-
Miller et al.[15]	Yes	-	Yes	-	-

Abdullah et al.[16]	-	-	-	-	Yes
Ueno et al.[17]	Yes	-	-	-	Yes
Aziz et al.[18]	-	Yes	Yes	-	-
Podaras et al.[19]	Yes	Yes	Yes	-	Yes
Niemimaa et al.[20]	Yes	Yes	Yes	-	Yes
Winkler et al.[21]	Yes	Yes	Yes	-	Yes
Adeshiyan et al.[22]	Yes	Yes	Yes	-	Yes

RQ2: What business continuity systems are proposed for companies?

In the results of the study, you can see different methodologies that have been proposed to mitigate the negative impact that business interruptions usually generate, mostly they can be seen in the economic and reputational aspect of the company.[16] Table number 7 summarizes the results according to the proposals provided in the articles and the study objective that said research seeks to cover.

Table 7. Types of proposed methodologies		
Articles	**Type of Methodology proposed**	**Objective**
Ashrafi et al. [8], Kang et al.[9], Kobayashi[10]	Methodology based on studies of previous results and knowledge bases	They propose the study of results applied in previous continuity plans and results of incident resolution, with the purpose of generating a knowledge base that allows – for future incidents – to reduce exposure to errors and reduce RTO and RPO.
Botha et al.[7], Podaras[12], Abdullah et al.[16], Ueno et al.[17], Aziz et al.[18], Niemimaa et al.[20] and Winkler et al.[21]	Methodology for applying business continuity plans based on continuous improvement	These studies propose the complete testing of business continuity plans, as well as a constant evaluation to guarantee the best results.
Xie et al.[11], Bajgoric[13], Antonucci[14], Miller et al.[15], Podaras et al.[19] and Adeshiyan[22]	Methodology for applying business continuity plans based on ensuring high availability of systems	These articles propose methodologies for prioritizing processes and services, commonly called "mission critical" for their backup and recovery, as well as the application of technology to apply high availability to systems.

On the other hand, the results found in the articles selected for this systematic review also propose methodologies that allow us to deal with business interruptions according to the nature of the origin of the failures or interruptions. These studies have been organized into two sectors according to the type of methodology they propose: Preventive or reactive.

Mostly, 12 studies out of 16, which represent 75 % of the studies, propose business continuity plans with a preventive approach, based on different procedures such as business impact analysis (BIA), risk management and the application of backup solutions, replication and even the use of virtualization, to achieve high availability solutions and establish a low-cost means of communication in the event of disasters. In contrast, business continuity plans with a reactive approach propose disaster recovery methodologies, such as automated incident response systems, use of redundancy platforms, and contingency sites.

RQ3: What outcomes could ensure the implementation of business continuity plans?

Based on the first organization of the articles by the methodology proposed in each of them, the results can be obtained. In general, the articles that have been studied in this systematic review propose qualitative studies of the problem presented, so the results presented are mainly related to the reduction of response times. Table 8 displays the analysis applied to the first sector of the articles, which offer a study of the contextualization of the origin of interruptions, analysis of previous results and incident management, to based on experiences and knowledge bases. allows reducing response time to incidents and making their resolution more accessible. By Kang et al.[9] , generally these recovery processes can be exposed to errors and long response times, due to the volatility of the systems, which is why a knowledge base is suggested that allows certain incidents to be recognized for better crisis management.

Table 8. Results of the first segmentation			
Reference	Problematic	Proposal	Results
Ashrafi et al.[8]	The lack of a work methodology for disaster recovery planning.	Establish a framework that is based on previously analyzed success stories to improve the planning of business continuity systems.	Improve the effectiveness of business continuity plans, as well as the definition of the most relevant items at the time of their implementation.
Kang et al.[9]	IT incidents that generate disruptions and whose solutions consume excessive response times and are exposed to errors	Use of ITIL for crisis management, especially the application of the incident management process.	The application of the new similarity measures found allows for better segmentation and association of IT incidents, thereby reducing response times.
Kobayashi[10]	Errors in IT systems	Contextual evaluation of incidents and perform a quantitative and qualitative analysis to evaluate the origin of IT incidents.	Resolve the knowledge gaps detected, in addition to providing solutions to establish and help prevent errors in the development of IT solutions.

Now, in the case of studies that propose a framework that is based on the continuous improvement of business continuity plans, they generally propose methods that ensure IT processes by improving both knowledge or human management and that specify who operate the technologies and this area is not usually given adequate importance by Kobayashi[10], since human error is also one of the main causes of interruption by Botha et al.[7], Bajgoric[13], Abdullah et al.[16], Ueno et al.[17], Podaras et al.[19], Niemimaa et al.[20], Winkler et al.[21] and Adeshiyan et al.[22] not only for IT systems, but also when performing recovery in incident cases. On the other hand, they also suggest as part of the continuous improvement process the ability to maintain correct communication in crisis by Podaras[12], which allows the best decisions to be made at those times and these can guarantee the best results for companies, whether in reduce recovery times, reduce economic losses, etc. Finally, it is a proposal of the studies to make a continuous evaluation of the business continuity management method that has been implemented, which can in turn suggest a managed and quantifiable maturity model by Ueno et al.[17], which can be continuously improved through of its constant implementation in the daily activities of companies by Botha et al.[7] and Niemimaa et al.[20]; that is, in the IT processes that are executed daily, where their weaknesses can be observed and corrective actions applied. Table 9 summarizes the results for the second segmentation of the selected studies.

Meanwhile, from the studies that propose a framework that is based on guaranteeing the high availability of the systems, it is obtained that the methodology must be based on selecting the critical or most important processes of the company in order to have referenced what the processes should be. first to recover in case of a disaster incidence by Podaras et al.[19], on the side of reactive approaches; on the contrary, those who propose a preventive approach suggest specialized protection of these systems in such cases. Likewise, the studies grouped in this sector suggest methodologies that allow the recovery of systems as soon as an incident of interruption of IT services occurs, using different technologies that ensure the high availability of services by Xie et al.[11], including virtualization. which allows the use of hypervisors to design contingency and high availability systems by Adeshiyan et al.[22], ensuring compliance with recovery time requirements and bringing them closer to zero by Podaras et al.[19]. Table 10 shows the proposed results for the third segmentation.

Table 9. Results of the second segmentation			
Reference	Problem	Proposal	Results
Botha et al.[7]	Business continuity plans are not considered for small businesses.	Proposes application of backup and BIA solutions for small businesses.	The successful application of a 2-phase cyclical methodology for small businesses.
Podaras[12]	The gaps in effective communication between IT technicians and managers who make decisions regarding IT business continuity plans.	It proposes the improvement of communication through the parameterization of terms that facilitate communication between stakeholders.	It was possible to improve decision making regarding the application of business continuity plans with the application of the ontological flowchart proposed in the study.

Abdullah et al.[16]	The origin of critical IT outages in the public sector in Malaysia.	The study suggests the improvement of management skills of IT administrators and is based on the application of the ISO/IEC 27001:2006 standard.	Improving IT services in Malaysia.
Ueno et al.[17]	The losses generated in IT-based businesses.	Proposal for an iterative business continuity model for companies whose operations are based on IT.	The evaluation of the maturity levels of the business continuity methods concluded an efficient result and contributed to improving the maturity levels of the business continuity system in the company.
Niemimaa et al.[20]	Only incident response actions are planned.	A qualitative and quantitative study of business continuity practices applied in IT services is carried out.	The results suggest a positive influence if service continuity plans can be integrated in a planned manner.
Winkler et al.[21]	Identify disruptions to IT services.	Proposal for an automated model that allows improving the management of IT interruptions.	Mejora en las métricas basadas en el control estadístico de procesos para la gestión de continuidad del negocio en los servicios de TI.

Table 10. Results of the third segmentation

Ref.	Problematic	Proposal	Results
Xie et al.[11]	The losses and interruption time that arise from untimely service outages and the need for companies to be self-sufficient in recovering processes.	It proposes a low-cost platform called Ámbula, which acts as a contingency in the event of disasters.	The proposed system is ideal for corporations that require instant recovery, since it ensures a recovery rate of 80 % effectiveness, using up to 5 virtual machines in different geographical locations.
Bajgoric[13]	Considerations to take into account to develop a methodology that allows executing a business continuity plan for IT services.	The integration of various information technologies is proposed to ensure minimum interruption times in IT services.	It made it possible to identify and apply a framework that integrated IT technologies and guarantees the continuity of services.
Antonucci[14]	Business continuity plans are not focused on disruptions caused by cybersecurity breaches.	It proposes data replication and use of an alternate site to prevent the business from being 100 % inoperative.	It proposes good practices for business continuity management and its integration with cybersecurity, using ISO 27001 and 22301.
Miller et al.[15]	How business continuity plan methodologies can be used for crisis management.	It proposes a methodology based on quality standards that seek to prevent interruptions in Data Centers.	The authors highlight that the effective application of business continuity plans in data centers guarantees an adequate response to interruptions and disasters, minimizing the impact.
Podaras et al.[19]	The lack of precision in business continuity plans in IT services that are usually applied in companies.	A methodology in which critical processes are prioritized for recovery and optimization of the time spent in disaster recovery.	The proposed methodology helps reduce response times because it allows recovery strategies to be refined.
Adeshiyan et al.[22]	Implementing solutions for disruptions in IT services.	Application of virtualization technologies based on IBM solutions.	The authors agree that the use of virtualization as a tool to achieve high availability is an effective way to generate contingencies and the use of machine learning of the implemented solutions is a key point to avoid repetitive incidents.

RQ4: In what context were the studies carried out?

In the present study, the origin of the documents was also segmented by the country in which the studies were carried out (context); this information is comparable to be able to review the influence and origin of the proposed models or methodologies, and served to analyze the approach given to crisis management

and business continuity management. In some cases, there is a more preventive approach aimed at natural disasters. For example, in Asia, whose origin represents 38 % of the studies selected in this research, preventive approaches are mostly proposed based on a study of known failures, both due to previous incidents, review of success cases and validation of the context of previously detected failures, while in the segmented studies in Europe, which represents 31 % of articles in the present research, the reactive approaches aim at the implementation of techniques that allow increasing the high availability time of the services, either through the prioritization of processes or the search for continuous improvement, through the constant application of business continuity plans by Bajgoric[13], on a routine basis. Illustration 5 represents what is indicated, the studies that had their contextual origin in Asia come from countries such as China, Japan and Malaysia et al.[10], Xie et al.[11] and Abdullah et al.[16], which suggests that the use of Information Technologies Information is much more recurrent in more developed countries such as those mentioned above, in which a notable influence of IT can be seen in the basic processes of companies, both in the public by Abdullah et al.[16] and private sectors. For South America, only one study from Brazil was observed.[17]
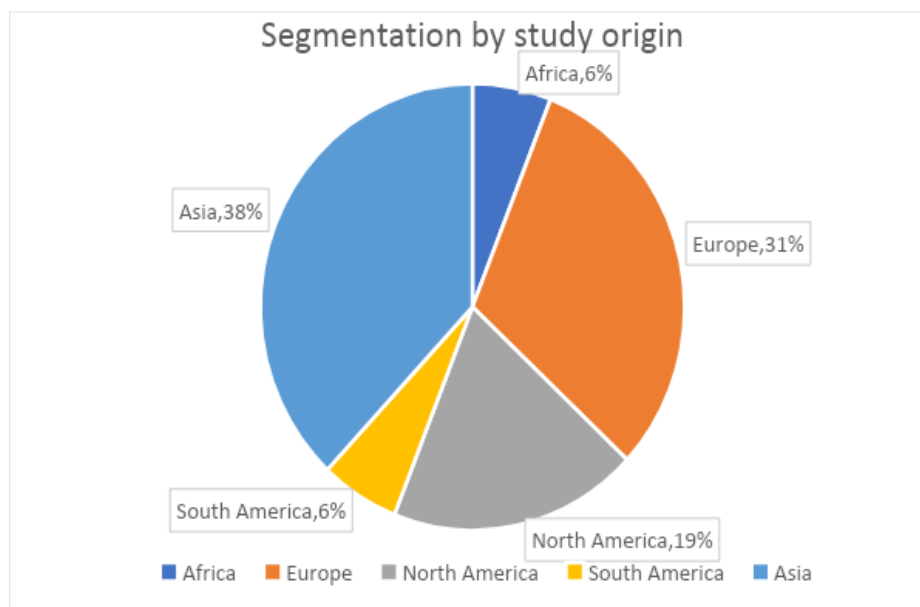

Figure 4. Contextualization of the origin of the articles

DISCUSSION

When conducting a systematic literature review, the main objective is to detect the main results of the articles selected for study, based on the methodologies and frameworks proposed to address business interruptions. The main findings in this research are discussed in this section in which the author's point of view will be given on the analysis of the results raised in the studies selected for this systematic review.

In order to answer the research question, the different proposed methods that helped meet the objective of this research were studied, which consisted of verifying the business continuity methodologies oriented to the most appropriate IT services for their purposes. application. In this review study, it is determined that the origin of IT incidents or interruptions are mostly made up of service interruptions or logical interruptions, as has been considered in this research in comparison with the origins due to cyber attacks, that is, an approach or problem to address by Antonucci[14] since cyberattacks are increasingly recurrent, since they exploit security gaps or vulnerabilities in systems to perpetrate an intrusion, which can generate a total interruption of the service. For example, a Ransomware attack is capable of leaving a company's systems completely inoperative for several days and even weeks, depending on the size of the company and the amount of information compromised, therefore, contingency plans must be in place to be able to confront these crisis scenarios. On the other hand, natural disasters represent the second risk to which companies are exposed; for them, the articles propose business impact analysis (BIA) as a prevention methodology.[21] Although it is true, in the systematic review it was noted that the interruption most addressed by the studies is due to logical or software failures, it can be estimated that natural disaster events can be one of the most impactful due to the severity of the event. that can happen, for example, floods, earthquakes, landslides that are very common in Peru, among others. Nor is cybersecurity given adequate relevance, since many times the perimeter defense or anti-malware mechanisms are not enough and in most cases when these are compromised, it is usually due to some misconfiguration or other, which is considered as human error or anthropogenic causes by Abdullah et al.[16], which is raised by articles as another of the origins of business interruptions.

Now, the proposals found in the studies selected for this systematic review have been consistent with the problem raised. Segmentation by type of methodology allowed us to better observe the proposed methods and relate them to the object of study of each publication. When segmenting the studies by a methodology that is based on studies of previous results and the use of the knowledge base, it was observed that these articles indicate that attention to incidents in short times could guarantee the best results, however, they do not become precise at all, because they are more related to a specific type of interruption, which in this case is the logical interruptions of the systems. Although it is true, applying similarity measures to resolve incidents in the times established in a technique based on the ITIL methodology by Kang et al.[9], it could not be applicable in the event of interruptions due to disasters, for which a contingency system would be more appropriate. that guarantees high availability, which is proposed in a system like Xie et al.[11]; a platform that allows the operation of communication systems to be restored just minutes after the incident occurred.

In what I have called the second segmentation, we can see the articles whose methodology responds to the application of continuous improvement and its integration into the organization's routine processes. This is a favorable approach since it will allow the continuous testing of these business continuity plans and will allow their constant improvement, using the trial and error methodology. This procedure is suggested in order to achieve the maturity of contingency systems and consequently have better results in companies. The results of these studies show a clear positive functioning of this approach, since this method of continuous improvement is generally applicable regardless of the criticality of the processes, among others thanks to its cyclical procedures. For example, in the case of small companies, the application of two stages of these processes was proposed by Botha & Von Solms[7], this refutes the approach about the poor approach of business continuity plans, since it is applicable to each business sector regardless of the category and size of the organization. In addition, the studies cover other problems, generally little considered, for example, effective communication and decision making by Xie et al. and Podaras[11,12]; raising the relationship between this proposal and a correct application of business continuity plans in IT services. Proposals such as the automation of business continuity plans by Winkler et al.[21] or the iteration of business continuity methods by Ueno et al.[17] represent the search for continuous improvement and improvement, with results evident in the constant testing of the methodology.

On the side of studies whose proposal is the high availability of services, it also represents a slight additional investment in security or technologies that allow companies to keep processes up and running during crisis events by Bajgoric[13], however , studies have tried to optimize what was described. Techniques such as virtualization are one of the most used due to the results it offers and its variety of use by Adeshiyan et al. [22]. As an example, a proposed recovery system obtained an effectiveness rate of 80 % for the recovery of media during crises by Xie et al.[11], through the use of virtual machines that come into operation as soon as they detect loss of communication by monitoring the solutions. main. With this it can be expressed that the use of virtualization has been fundamental to guarantee new continuity management methodologies due to the use, application and benefit that can be obtained thanks to its adaptability and that allows the integration of different technologies that operate within a Data Center.

Finally, in the contextualization of the studies, they have been segmented according to their origin, observing that studies from Asia predominate. This demonstrates the influence of technology on processes in Asian countries and can be related to empirical evidence and knowledge to a development superior to other regions of the world with respect to the application of technology. Basically, in Asia, public services are sought to be completely digital and easily accessible to people by Abdullah et al.[16,22], however, this requires very exhaustive planning for business continuity plans, since a slight interruption could stopping the country's production completely, which would be too dangerous, therefore, a proactive or preventive method of business continuity plans must be used. The preventive approach in business continuity plans is the most recommended by the articles, which seeks to create plans and methodologies that allow us to be prepared in the event of an incident. Reactive methods seek to recover business in the shortest time possible, they do not focus on prevention. This approach is the most appropriate and safest as it ensures more precise results and makes it clear which processes can be recovered immediately, with the application of business continuity plans.

In general, it can be stated that there is a growth in interest in the topic, because the number of articles has increased over the years, however, it is seen that there is a lack or gap in knowledge, not only Because the articles do not offer such conclusive results, it was also expected to be able to find comparative metrics on the financial impact of these problems, so that the imminent need to plan adverse scenarios in companies can be highlighted; therefore, in future research it is suggested that the testing of the methodologies proposed in the studies can be put into practice or a real-time evaluation of the results can be carried out and consequently they can provide metrics of the results obtained, both in the optimization of recovery times as well as the resources used for the planning and implementation of business continuity plans in IT services, in large or small companies, as well as the consequences at all levels that are generated after they materialize. a business interruption in companies' IT services.

CONCLUSIONS

In conclusion, this systematic literature review presents a methodological approach for planning plans for business continuity management in IT services to optimize the results obtained when facing critical interruptions in systems that often generate unavailability in companies. for prolonged periods of time, thus causing significant economic, reputational and information losses.

It has been found in this systematic review that 75 % highlight the preventive approach of business continuity plans, since they offer better planning and response capacity and allow adequate management of systems and identification of criticality for prioritization of processes; in addition, approaches based on knowledge bases reduce errors when dealing with incidents and reduce response time. Likewise, it is observed that 38 % suggest approaches based on the continuous improvement of business continuity plans, since they manage to reach a level of maturity of these plans through their continuous application and detection of improvement items, applying the changes in relevant moments, in this way, you can be prepared to mitigate the risks of business interruptions; meanwhile, the methodologies that propose high availability suggest the application of technology to guarantee the greatest uptime of IT services. In the context of the studies, it is determined by both Asian and European origin (38 % and 36 % respectively), which are the most predominant and suggest the ability to plan and respond to incidents, as well as the influence of IT systems. in the most developed countries.

Despite technological advances and the increase in studies on the topic raised in this research, a gap is still observed that shows a need so that in future studies or research the plans or methodologies that are proposed can be implemented so that they can provide quantifiable and decisive results in the sense that they allow identifying the impact of business interruptions on IT, in the different areas covered by an organization.

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