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CAPES

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THE PERCEPTION OF SERVICE MANAGEMENT IN APPLICATION DEVELOPMENT: A SYSTEMATIC LITERATURE REVIEW.

A PERPCEPÇÃO DA GESTÃO DE SERVIÇOS NO DESENVOLVIMENTO DE APLICATIVOS: UMA REVISÃO SISTEMÁTICA DA LITERATURA

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ABSTRACT

The development of applications is a topic of high relevance in recent decades, especially given the level of integration of this technological tool in the various sectors of the economy, more specifically in the service sector, with a focus on transport, food and convenience services. In the meantime, this work has carried out a systematic literature review (SLR), with the aim of understanding the development of mobile

applications, the main means of structuring, the programming languages used and the relationship of the topic with the perspective of service management. The results show that there is a preference for developing applications using the *Android Studio framework*, in addition to the *JAVA* programming language, with a 45% recurrence rate in the papers that declared the programming language used, although there are alternative solutions, such as *PHP in* conjunction with *HTML* and *CSS*. This also shows the viability of using mobile applications in the service sector and a growing trend towards integrating applications into economic matrices and the management of organizations, supporting decision-making and management and sharing information more optimally.

Keywords: Services. Application. Review. Development.

RESUMO

O desenvolvimento de aplicações é um tema de elevada relevância nas últimas décadas, especialmente dado o nível de integração desta ferramenta tecnológica nos vários setores da economia, mais especificamente no setor dos serviços, com destaque para os serviços de transporte, alimentação e conveniência. Assim, neste trabalho foi realizada uma revisão sistemática da literatura (RSL), com o objetivo de compreender o desenvolvimento de aplicações móveis, os principais meios de estruturação, as linguagens de programação utilizadas e a relação do tema com a perspectiva da gestão de serviços. Os resultados mostram que há preferência pelo desenvolvimento de aplicações utilizando o framework Android Studio, além da linguagem de programação JAVA, com taxa de recorrência de 45% nos artigos que declararam a linguagem de programação utilizada, embora existam soluções alternativas, como PHP em conjunto com HTML e CSS. Isto mostra também a viabilidade da utilização de aplicações móveis no setor dos serviços e uma tendência crescente para integração das aplicações nas matrizes econômicas e na gestão das organizações, apoiando a tomada de decisões e a gestão e partilhando informação de forma mais otimizada.

Palavras-chave: Serviços. Aplicativos. Revisão. Desenvolvimento.

INTRODUCTION

The development of new technologies, especially in the area of information, is growing exponentially all over the world. According to Kagermann *et al* (2013) the term Industry 4.0 first appeared publicly at the Hannover Fair in Germany. This new approach emerged with the aim of making German industry more competitive, seeking means of innovation to achieve this goal.

Within this new technological dynamic, are the first mobile applications - digital tools available on *smartphones.* According to Shamsujjoha (2021) in 2021, more than 43% of the world's population owned at least one *smartphone* and another 13% had at least one mobile device such as cell phones and *tablets*. The *Ericsson Mobility Report* (2021) also projected that by 2022 there will be more than 6.5 billion *smartphones* worldwide, reaching 7.69 billion by 2027.

In Brazil, an annual survey carried out in 2022 showed that there are more than 242 million *smartphones* in the country, in contrast to an expected population of 214 million inhabitants, leading the average ownership of mobile devices to be more than one per inhabitant (FGV, 2022). This data suggests that the use of mobile applications for intelligent solutions is viable in Brazil, given the favorable conditions for this model of information consumption.

Mobile applications can be applied to contracting services, integrating customer and service provider on the same platform. With the aim of explaining the dynamics of building applications from the integrated perspective of Service Management, this paper proposes a Systematic Literature Review (SLR) in order to relate the main concepts and works published between 2017 and 2022. This SLR will serve as the basis for proposing an intelligent service management application in a city in the eastern Brazilian Amazon, seeking to identify existing relationships and gaps in order to assess the current state of the art on the subject from observing trends in the segment.

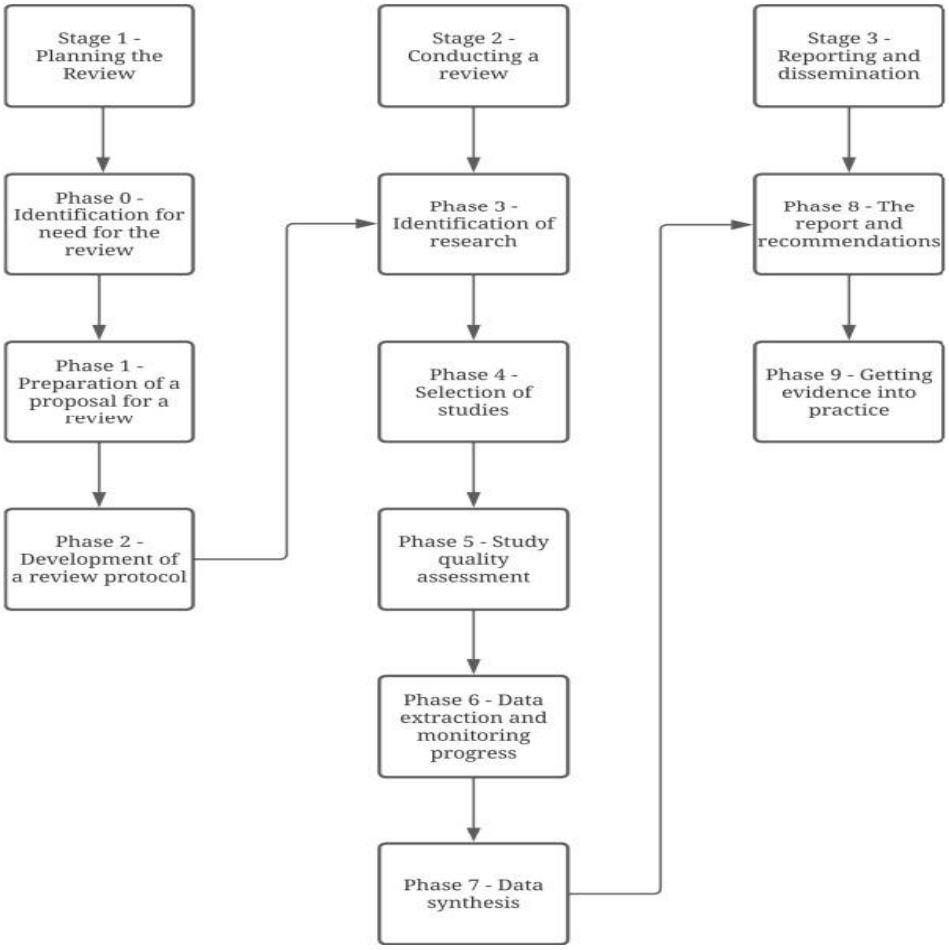
METHODOLOGY

Systematic literature review (SBR)

For Kitchenham and Charters (2007) a systematic literature review is a means by which it is possible to identify, evaluate and synthesize all the relevant research available on certain topics, phenomena or areas of interest.

An RSL discusses a specific issue, using explicit and transparent methods in order to produce a literature search and critically evaluate various studies, drawing conclusions about what is known and what is currently being done and what we don't know about a particular subject or research topic (Denyer and Tranfield, 2009). It is therefore important for the researcher to systematically plan the research process, from defining the topic to deciding how it will be communicated and disseminated (Boccato, 2006). To develop the methodology for this research, we adopted the stages and phases proposed by Tranfield, Denyer and Smart (2003). Therefore, the proposed RSL was carried out following 3 stages, divided into 10 phases, as shown in Figure 1.

Figure 1 - RSL stages.

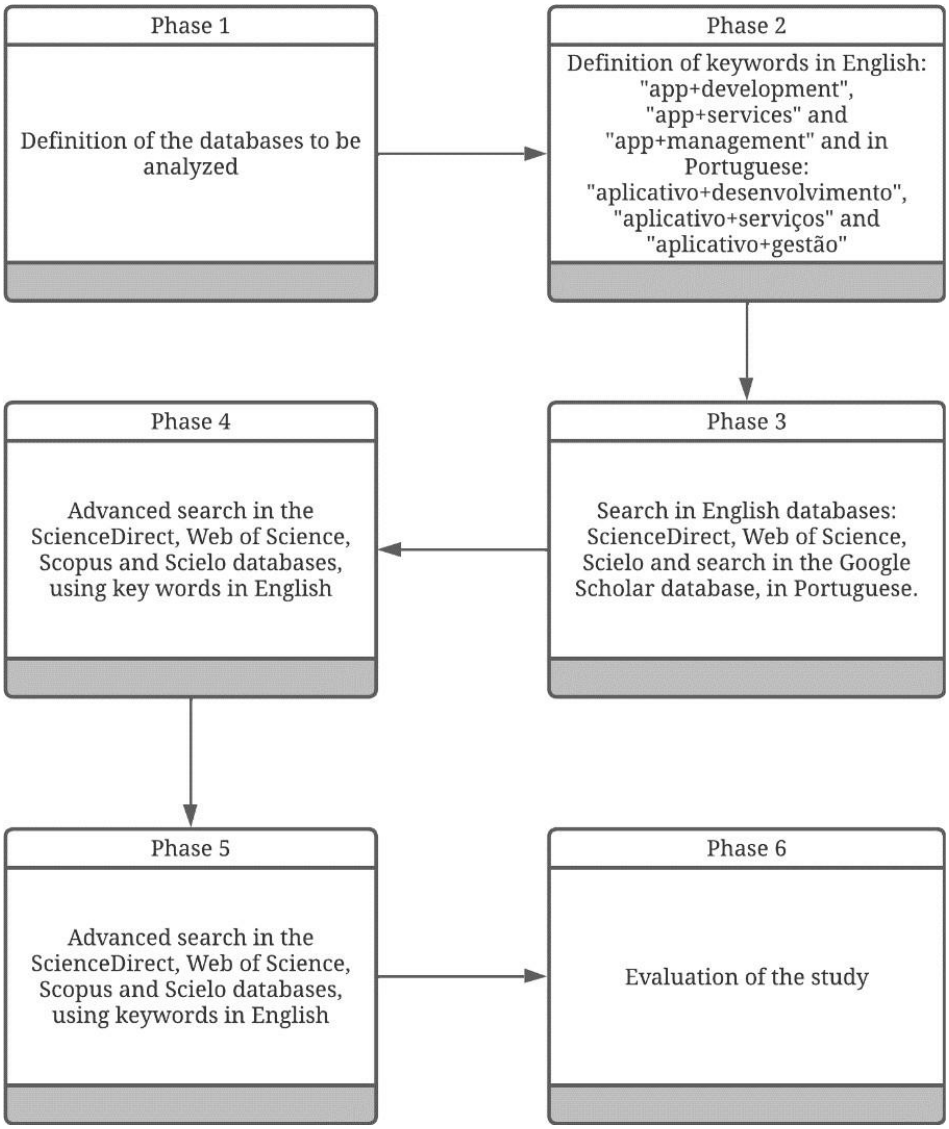


Source: Adapted from Tranfield, Denyer and Smart (2003).

Stage I - Planning the review

This stage of the RSL includes three phases. Identify the needs of the review in question, preparation of the review proposal and development of the review protocol. In this sense, a search protocol was drawn up for scientific articles related to the topic of this work. In addition, search methods for the papers to be reviewed were defined, as well as the criteria for including or excluding the papers, based on characteristics such as: publication period, language and keywords. Figure 2 represents a *framework*, produced according to the stages of the search protocol defined.

Figure 2. *Framework* based on the search protocol.



Source: Authors.

Stage II - Identification and evaluation of studies

The search began for papers in the databases initially selected. First, the English-language databases *ScienceDirect*, *Web of Science*, *Scopus* and *SciELO* were consulted, using the keywords defined in the search protocol: "*app+development*", "*app+services"* and "*app+management"*, filtering the search so that these terms were present in the title, abstract or keywords of the articles. *Open access* articles were searched for, i.e. articles with open access, which allow their content to be read in full.

As a parameter of anteriority, a previous interval of 5 years was defined, including the years between 2017 and 2022, as the period in which the research papers were published. This choice was made because information technology with regard to application development is constantly changing, with application development methods and tools changing in relatively short periods of time. Thus, the choice of a shorter search period was aimed at finding more recent work, using more modern application development procedures. The search for papers in the English language databases returned 57 articles removing duplicate papers, as shown in Figure 4.

Figure 4. Search results in English databases

English Keywords	Scientific Articles by Database			
	ScienceDirect	Clarivate Web of Science	Scopus	SciELO
app+development	13	8	2	4
app+services	9	3	5	0
app+management	9	2	2	0

Source: Authors.

Next, to complement the search for papers in English databases, which returned the results shown in Figure 4, another search was carried out for articles in databases that returned articles on the subject in Portuguese, using the same parameters and respective linguistic equivalences. The search was therefore carried out in the Google *Scholar* database, using the same advanced search filters that were considered in the international databases. According to the search criteria established for the research, 19 articles were found that met the requirements.

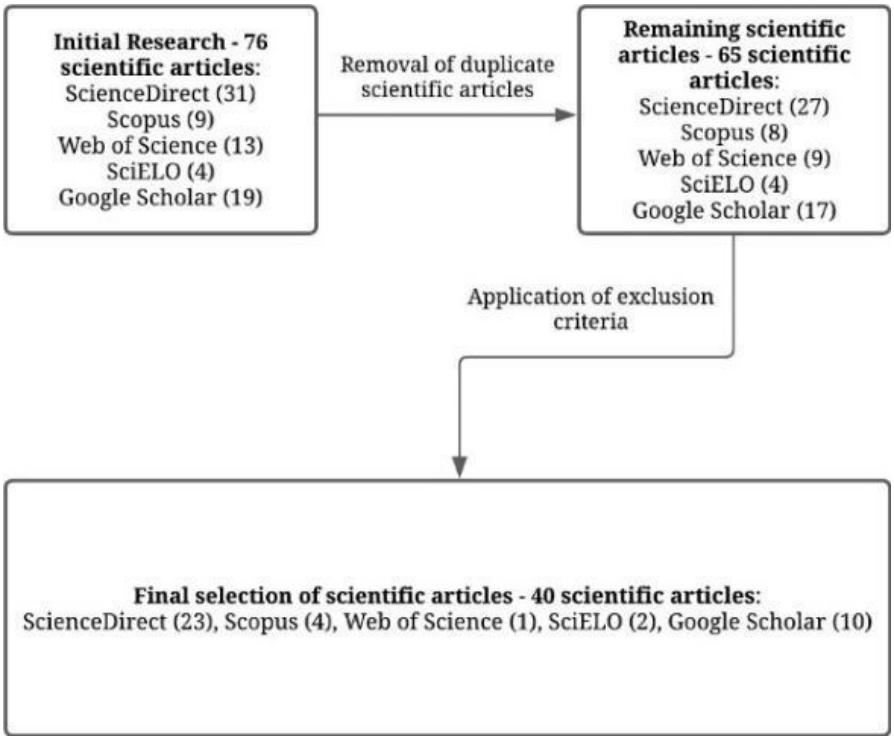
Figure 5. Portuguese database search results.

Portuguese Keywords	Scientific Articles by Database
	Google
aplicativo+desenvolvimento	8
aplicativo+serviços	8
aplicativo+gestão	3

Source: Authors

The search returned 76 articles, from databases in English and Portuguese. The title, abstract, methodology and conclusion of each article were then read, checking that they met the objective of the RSL. After reading the articles and excluding those that didn't meet the requirements, a new count of the articles considered was carried out, reaching a total of 40 articles.

Figure 6. Final table of selected articles.



Source: Authors.

Internship III - Report and dissemination

After the steps carried out in stage II of the RSL model used, searching for articles, analyzing the works and making the final selection of what would be investigated, the articles that served as the basis for the next sections were selected,

relating to the development of applications, the relationship between applications and services and applications and management.

Therefore, the articles that were used as a basis for section 3.1 refer to application development. The articles used in section 3.2 relate to applications and services and in section 3.3 we used the articles that highlight the main tools, methods and innovations present in the most recent work, always relating mobile application development and service management.

APPLICATION MANAGEMENT

Application development

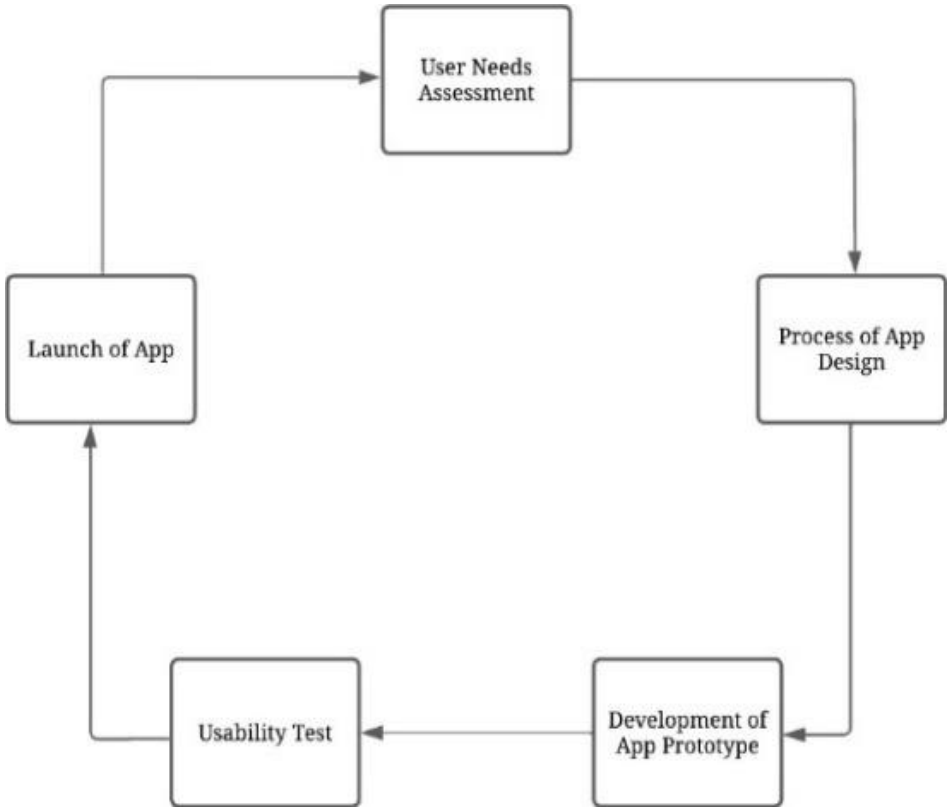
The cell phone has established itself as the main means of exchanging information between individuals, since its diffusion has considerably expanded the notion of instantaneity in contemporary communications, especially due to the easy and frequent access to *smartphones* and *tablets.* To operationalize this communication, *online* stores offer a huge variety of app options, seeking to meet society's varied demands for services (Vêscovi *et al*, 2017).

The afore mentioned authors make an important point when they state that the development of an application in a coherent and appropriate manner is essential, because recognizing the needs of the end user, implies that the development should be in accordance with specific demands, tested in research and implemented in practice, requiring a well-structured method for creating applications. Santos, Lima and Pires (2020) reinforce this understanding by commenting that an application should meet the user's needs in the shortest possible time, without requiring a high level of knowledge of its use or a long learning process, generating notoriety for the application on the market.

Regard the development of application projects, Yuan and Marques (2018) and Ghozali *et al* (2021) advocated the use of a 5-stage prototyping paradigm, which has a user-centered *design* philosophy, which actively involves the user in all phases of app development, as seen in Figure 6. The stages involve analyzing the content of the *software* and defining objectives; user interface *design*; prototyping the application; testing and modifying the prototype; and building the product. Similarly, Madrigal-

Cadavid *et al* (2020) take a 4-stage approach, namely: identification of needs; requirements gathering for the application; interface *design* and prototyping; and usability testing.

Figure 6. Main phases of application development.



Source: Adapted from Ghozali *et al* (2021).

Lima *et al* (2022) consider an alternative way of using agile methodology tools in the mobile application development process, breaking down the process into 4 main stages: conception, prototype planning, mobile application development and mobile application availability.

Wilson, Fouts and Brown (2021) and Duarte and Mandetta (2022), on the other hand, present the Delphi method as beneficial in the application development process, as it facilitates iterative rounds of substantive *feedback* during development to improve the overall usability of the application before user implementation, in order to make improvements before launch.

Yuan and Marques (2018) and Meankaew *et al* (2022) use a set of open questions in a semi-structured interview to obtain the requirements and objectives of

the *software*. Similarly, Ghozali *et al* (2021) use a questionnaire with free-form or multiple-choice questions. Alvarez-Moya *et al* (2021) carry out a needs analysis using the *Business Model Canvas*, which qualitatively assesses the real needs of the end user.

Regard prototyping, this phase is little explored during the construction of the app, and it is more common for the app to be developed directly after the needs assessment. However, Madrigal-Cadavid *et al* (2020) point out the need to make initial sketches of the graphic interface before implementing the application, as in the *Lucidchart Online* platform. Yuan and Marques (2018) in turn, proceeded with digital prototyping using *Axure RP Pro* 7.0 software, creating preliminary *layouts* for users to evaluate in terms of quality.

In the meantime, mobile applications can be developed for various platforms, such as *Apple iOS*, *Google Android*, *WebOS* (Wilson, Fouts, Brown, 2021) and with a view to interoperability between operating systems, there are both individual solutions and the use of *frameworks* that produce multiplatform code, optimizing programming time.

As for programming *frameworks*, it is very common to use the *Android Studio* tool, as seen in Yuan and Marques (2018), Xiaohui *et al* (2018), Moreira *et al* (2021), Lima *et al* (2019) and Lima *et al* (2022). The *software* has dedicated tools to support the necessary functions with an organized code structure (MOHD *et al*, 2019). In relation to this development platform, Ghozali *et al* (2021) comment that its use, in conjunction with *JAVA*, provides a set of tools that allow its users to develop an *Android* application in a short period. This practice can be observed in Kuck *et al* (2022) where *JAVA* is used as the programming language. In addition, the *Android Studio software* also is flexible and capable of integrating well with other programming languages. Xiaohui *et al* (2018) cited that, in the *Android Studio* programming environment, it is possible to use programming languages other than *JAVA*, such as C++.

There is also the possibility of developing a mobile application that works adaptively for both the *web* and mobile devices, where it is possible to access the interface of these applications both through *browsers* on desktops and on *smartphones*. In this sense, seeking greater integration with the computing and mobile environment, Gama and Tavares (2019) state make use of *HTML5*, *Cascading Style Sheets* - CSS - and *JavaScript* languages, using a *framework* aimed at *web* systems and mobile devices. Similarly, Bernardi and Motta (2018) used the same programming strategy with open

source technologies such as HTML, CCS, JavaScript and PHP. Here we explore the concept of the PWA (*Progressive Web App*), which, according to Biørn-Hansen, Majchrzak and Grønli (2018) is an application development technology that combines the advantages of *web* browsers and cell phones.

On the other hand, there is an additional alternative for developing mobile applications, whose method involves the use of interactive block programming. On this subject, Medeiros, Bergmann and Wangenheim (2020) point out the possibility of developing an application using the *AppInventor* platform, created by *Google* and currently maintained by the *Massachusetts Institute of Technology* - MIT. This type of application development makes it easier to focus on the logic and structures of mobile programming, without wasting human resources and time on programming syntax.

The last phase converges in the usability test and the evaluation of the result. For Madrigal-Cadavid *et al* (2020) usability was assessed using the usability test to record information from the user's interaction with the mobile application, so that users could score the mobile application. Similarly, Kuck *et al* (2022) carried out tests of the developed application with a sample of users and completed a diagnostic survey and user experience questionnaires. Similarly, Ghozali *et al* (2021) carried out usability testing with 30 users, within the app's target audience, where participants carried out tasks such as installing and operating the app prototype, providing *feedback* at the end.

Applications and services

In recent years, accelerated technological development has made it possible to offer services at a faster pace, via mobile devices, in various sectors. Along these lines, Sharma *et al* (2018) cite that advanced mobile devices, such as *smartphones* and *tablets*, offer great opportunities for both public and private institutions. Thus, the importance of technology for people and, especially, in the professional environment, which in addition to bringing new ways of working, offer help in automating tasks, providing resources to achieve a higher level of productivity (Ferreira, Silva, Borges, 2019).

From the perspective of service consumers, Malathi and Jasim (2022) point out that several studies show that service quality, especially in mobile applications, positively affects customer satisfaction. In general, customer satisfaction can be referred to the evaluation of customers' perceptions of their expectations of the quality

of a particular service and the actual quality that the service offers (Abdullah *et al*, 2021). Thus, mobile service quality can be interpreted as customers' judgment of the service delivery condition in the mobile computing environment (CHAN, CHIU, HO, 2022).

As Irawan and Belgiawan (2022) regarding the intersection between applications and services, there is a growing trend towards digital and *online* services, especially after the global health crisis caused by the coronavirus - COVID-19. Schulz *et al* (2021) state in their work that, in recent years, a shift in business logic from the dominant logic of goods to the dominant logic of service has gained relevance.

Schulz *et al* (2021) continues this thought by saying that technological progress, such as the collection and analysis of *big data* and the rise of the platform economy, has affected almost all sectors, changing production and service processes. What's more, in the future, smartphone apps, bundling access to services may further drive this development, causing organizations to reduce their costs and make their services more attractive to customers.

In this way, it can be inferred that consumers' search for practicality, ease of communication and service provision has increased, but at the same time, consumers have sought excellence and quality services, leaving the service provider to mitigate possible failures. In this sense, some examples of service failures are technical faults in the service provider's application, delivery of the wrong service and unacceptable delays in delivery, among others (Kaur *et al*, 2022).

Kaur *et al* (2022) corroborate the thinking of Schulz *et al* (2021) by citing in their work on a food delivery app that apps have transformed how and where people use services around the world, but that any form of service failure can unbalance the relationship between the service provider and the customer. Sobolewski (2021), in his work on navigation services, adds that digital services, especially through apps, undoubtedly contribute to consumer well-being, the value of this contribution is difficult to quantify rigorously. Along the same lines, Liu *et al* (2019) state that the mobile app ecosystem has achieved huge success in providing services on mobile devices to facilitate almost every aspect of our daily lives.

Shah and Hisashi (2022) cite in their work that with the unprecedented growth of new technologies, advances in information and communication technology have

allowed people to use services in real time and detail that, in transportation service applications alone, more than 5 million users have already been attracted to use this type of application. In this way, technological advances have enriched consumers' lives, increased their mobility and brought satisfaction (Chen *et al*, 2019).

Applications and management

The use of mobile tools related to management is a recent movement and one of the fruits of technological development in recent years. Michels, Bonke and Musshoff (2019) cite that the use of *smartphone* applications helps to improve eventual decision-making. The authors go on to say that perceived ease of use and perceived usefulness in the use of mobile applications positively influence the adoption of this technology.

When it comes to management, the use of technological tools is usually linked to decision-making and, for this, the interaction between man and technology needs to be made as easy and practical as possible. In this vein, Corso (2019) states that the use of mobile applications for *smartphones to* serve as a basis for decision-making is essential due to 3 main factors: portability, which is the ability to make a decision at any time and from anywhere; interactivity, which is the possibility of communication between a human actor and a device in a facilitated way; and maneuverability, which implies ease of physical access to the devices that support decision-making.

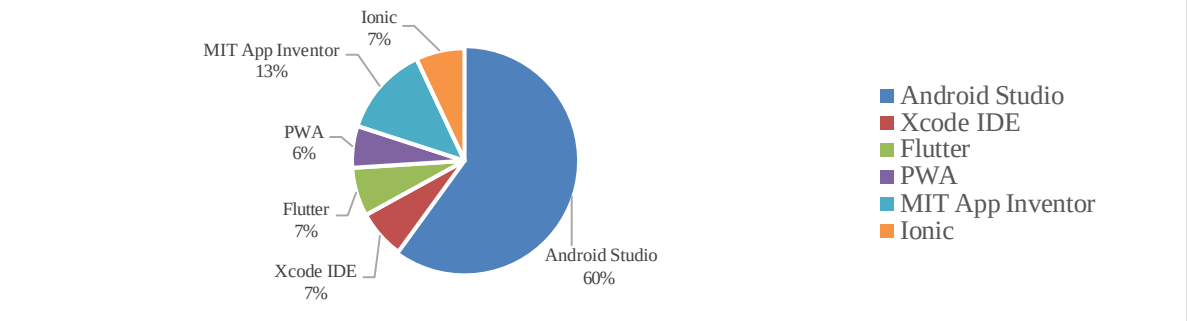
In this context, information management, through management applications, tends to be facilitated by greater integration between the sectors of an organization. Ehrler *et al* (2021) report that a digital communication channel can improve the efficiency of information sharing. In addition to the field of organizations, mobile applications have been used to support people's self-management, especially in the area of health, in the control or mitigation of various effects caused by diseases and associated factors, emotional control, fatigue, among other problems, as seen in Nicolaidou, Tozzi and Antoniades (2021) Bhattarai, Newton-John and Phillips (2020), Babbage *et al* (2019), Ossai and Wickramasinghe (2021) and Cenamor (2022).

However, despite studies showing the potential positive impact of apps on organizational processes, Levi-Bliech *et al* (2019) cite that the literature is still limited when it comes to empirically studying the organizational consequences of mobile apps deployed on *smartphones*.

DATA ANALYSIS

With regard to the results of application development, it was first noted that it is common to use several phases in the design of applications, the most common phases being the identification of needs, prototyping, development, usability testing and, finally, the launch and evaluation of the application. In addition, it was possible to observe that there are a number of commonly used tools for creating applications. As for the IDE (*Integrated Development Environment*), the most frequently used was the *Android Studio framework*, corresponding to 60% of the descriptions of IDEs used, as seen in Figure 7, in a survey of all the works where the authors identified the IDEs used.

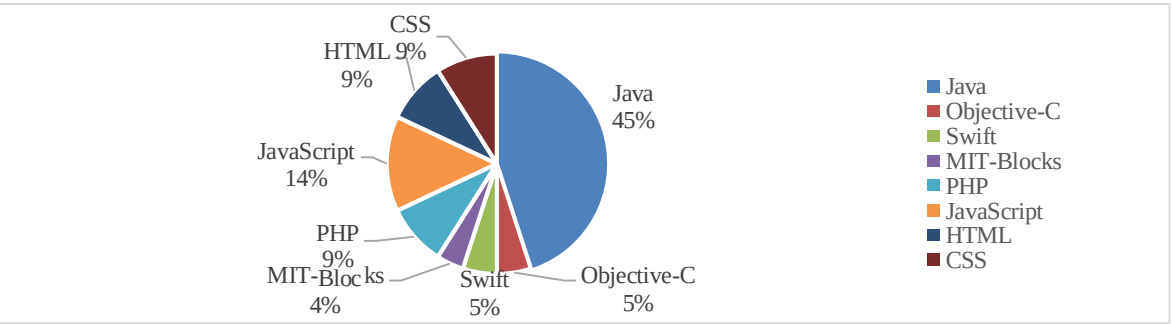
Figure 7. Percentage of recurrent use of SDIs.



Source: Authors.

The most common programming language used in application development is *JAVA*. Despite the widespread use of *JAVA*, alternative programming languages such as *JavaScript* and the association of *PHP* with *HTML* and *CSS have also been used*. From this point of view, it was observed that at least 45% of the works analyzed, where the authors indicate the programming language used, rely on the use of *JAVA,* as seen in Figure 8.

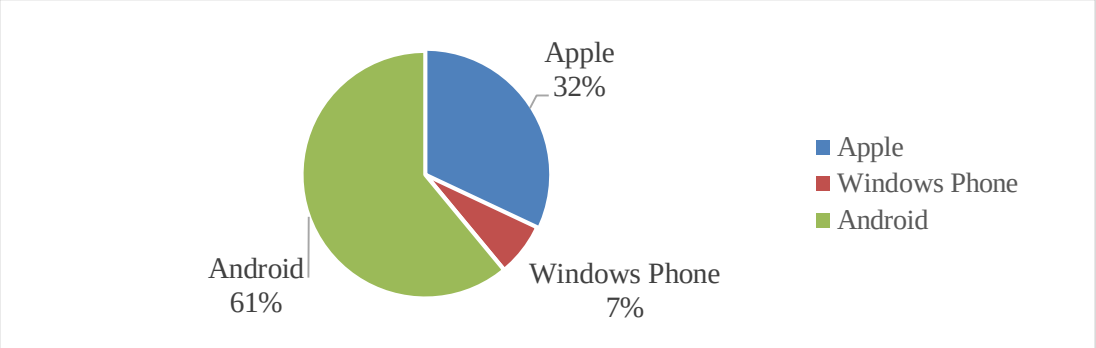
Figure 8. Percentage of recurrent use of programming languages.



Source: Authors.

Starting from the point of view of which operating systems the applications are developed for most often, we observed the highest incidence of development for the *Android operating* system, being cited in 61% of the works, where the authors identified which operating system they were developing an application for, as seen in Figure 9.

Figure 9. Recurrence of operating systems for application development.



Source: Authors.

CONCLUSION

After analyzing the articles selected during the RSL, concepts, methods and relationships between the topics targeted by this research were presented, as well as the importance of these studies and the impact they can have on society. In addition, the main points targeted in this literature search were raised, such as the main concepts and tools to support the development of applications and the relationship between these technological tools and the areas of management and services, which are common themes in production engineering.

As noted, the most common programming language for developing mobile applications is *Java, in* addition to the use of the *Android Studio* IDE, although in recent years new possibilities have emerged, both in terms of programming languages and IDEs. It was also found that the *Android* operating system is the priority target when developing applications, given its popularity and diffusion in the *smartphone* market, while development for *iOS is* common, but to a lesser extent.

As for the relationship between apps and services, there is the possibility of using mobile apps for various service segments. The use of this technology in services

is likely to grow over the next few years, especially after the great development of this dynamic following the coronavirus pandemic, leading to greater integration between virtual services, through apps, and customers. The main convergence of ideas regarding the use of service applications is the ease, practicality and convenience of these tools for the user, which tends to add value to the services provided.

Finally, analyzing the relationship between apps and management, it can be seen that this connection has a more specific focus on the use of technological tools, specifically apps, to make decisions and share information, supporting the management of various processes in an agile way, through data processing, which can result in indices and other information that lead to improved productivity of procedures. In addition, it was possible to observe the integration of apps and self-management, as in the case of medical apps, which can be adapted for self-management in organizations, among other functions given the flexibility of mobile apps. It is therefore possible to integrate the development of applications with services and management, so that the use of mobile application technology is currently accessible and viable for integration with services in various segments, offering practicality for the user.

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