CHAPTER
25

Development and remote management of projects using virtual methodologies in times of Covid-19: Case study in the industrial pole of Manaus, state of Amazonas, Brazil

https://doi.org/10.56238/emerrelcovid19-025

Antonio Claudio Kieling
PhD in Business Administration and Biotechnology
Department of Mechanical Engineering / University of the State of Amazonas – UEA

Ricardo da Silva Barboza
PhD in Electrical Engineering
Department of Computer Engineering / University of the State of Amazonas – UEA

Raymond Correa de Oliveira
PhD in Electrical Engineering
Department of Computer Engineering / University of the State of Amazonas – UEA

Jucimar Maia da Silva Junior
PhD in Electrical Engineering
Department of Computer Engineering / University of the State of Amazonas – UEA

Gabriel de Lima e Silva
Master in Physics
Department of Physics / University of the State of Amazonas – UEA

Rafael Dueire Lins
PhD in Computing
Department of Computer Engineering / University of the State of Amazonas – UEA

Rodrigo Barros Bernardino
Master in Electrical Engineering
Department of Computer Engineering / University of the State of Amazonas – UEA

Emmerson Santa Rita da Silva
Master in Electrical Engineering and Industrial Informatics
Academic Department of Information and Communication
Federal Institute of Amazonas – IFAM

Acursio Ypiranga Benevides Junior
Master in Law, Design, Industrial Property and Technology Transfer for Innovation
AGIN / Innovation Agency / University of the State of Amazonas – UEA

ABSTRACT
The Covid-19 pandemic has forced the use of means of interaction and project management in an iterative and non-face-to-face manner. Virtual interaction and monitoring tools were evidenced as a solution in this context. The legislation requires companies that manufacture computer goods in the region of the Manaus Free Trade Zone (ZFM), Amazonas, Brazil, to invest part of their revenues in Research, Development and Innovation (RD&I) activities. A project to create and develop applications for means of payment via card was executed through the joint action of Science and Technology Institutions (ICTs) in the Industrial Pole of Manaus (PIM) between University of the State of Amazonas (UEA), Federal University of Amazonas (UFAM) and Federal Institute of Amazonas (IFAM). Resources such as Google Meet, Jamboard, Scrum, Git, GitHub, GitHub Classroom, GitKraken, Google Sheets, Android Studio, Information Architecture, UML enabled the collective virtual work not in person between research professors and scholarship students in the development of 15 Android applications, allowing various sectors of the economy to manage their business in the palm of their hand.

Keywords: Computer Law, Suframa, Manaus Free Trade Zone, Android Applications, Research and Development, Innovation.

1 INTRODUCTION

The Manaus Free Trade Zone (ZFM), created by Decree-Law No. 288/1967, is an area of free trade of import and export with the strategic purpose of creating in the interior of the Brazilian Amazon an industrial, commercial and agricultural center. The regime of tax benefits (reduction/suspension of federal, state and municipal taxes) existing in the ZFM is a central point in attracting investments in

the Brazilian Amazon region. The Industrial Pole of Manaus (PIM) has more than 500 companies, among them many multinationals. The creation of the Industrial Policy of Informatics - Law 8.387/1991 of the ZFM, granted tax incentives to stimulate the competition and technical capacity of Brazilian companies that produce computer, automation and telecommunications goods in the Amazon. Suframa (Superintendence of the Manaus Free Trade Zone) coordinates the activities of ZFM (SUFRAMA, 2021, AMAZONAS, 2020).

Decree-Law 10.521/2020 defined RD&I activities as: basic research, applied research, experimental development and technological innovation, which are activities defined in the Frascati and Oslo manuals (OECD, 2015, OECD, 2018). Professional training or qualification and innovation management activities were also added and correlated. According to the Frascati manual, R&D is only one step in the innovation process including the creative work carried out systematically to increase the fields of knowledge and the use of these to create new applications (OECD, 2015). In this perspective, technological innovation encompasses both formal RD&I, carried out in RD&I laboratories, and informal or occasional RD&I, produced in other units and in different activities.

The Information Technology Law requires that all companies in the ZFM of this sector apply annually at least 5% of their gross revenues in the domestic market in RD&I activities in Science and Technology Institutions (ICTs) in the Amazon, being 2.3% in RD&I external to the company, in ICTs accredited with Suframa, and 2.7% to be applied in RD&I carried out internally in the company itself. Regarding the percentage of 2.3%, there is a requirement that at least 0.4% be applied in public ICTs (SUFRAMA, 2016).

The company Transire da Amazônia, leader in the production of electronic means of payment in card machines, especially the A910 payment terminal, is a pioneer in using the Android system in the design of interconnection with the largest operating system in the data transfer area (TRANSIRE, 2021). The company allocated resources related to the portion of 0.4% for the development of specific applications for the A910, aiming to provide various commercial sectors with the opportunity to use it in a personalized way and appropriate to their usual activities, through a financial contribution from the University of the State of Amazonas – UEA, the public ICT chosen for the project.

In UEA the place chosen for the development of the project was the School of Technology (EST / UEA) in Manaus and the Center for Higher Studies of Tefé (CEST / UEA) of UEA in Tefé, in the interior of the state. Professors from UEA Manaus-Tefé, students from UEA Manaus-Tefé, formed the majority of the team of this project, also counting on the support of professors and students from UFAM and IFAM. The project was managed by a research professor from UEA.

It is known that the human being is intrinsically a gregarious and social animal, and this characteristic is reflected in the most diverse human activities from leisure to work. The current stage

of computing makes software development a complex and laborious task, rarely able to be carried out by a single person. How could shared "shoulder-to-shoulder" tasks be developed in a pandemic context that required social distancing?

In this way, this work presents how the project was managed and developed in a context of pandemic that required social distancing, whose general objective is the development of 15 Android applications for the A910 machine, through the use of "non-face-to-face" virtual interaction means between participants due to the Covid-19 pandemic.

2 METHODOLOGY

The bibliographic research for the theoretical foundation involved initially knowing how project management is in times of the Covid-19 pandemic using the keywords "Project Management" and "Covid-19 Pandemic", searching for articles in the bases of Google Scholar and Web of Science. The articles were filtered and the most relevant were considered, as well as for the terms "Google Meet", "Entrepreneurship and Innovation", "Jamboard", "Scrum", "Git/Github", "Android Studio", "Information Architecture", "Kotlin Language", "UML", "DevOps" and "Iterative Virtual Development".

This is a case study, evidencing the experiences experienced in the remote development of the 15 Transire applications from virtual experiences developed in conjunction with collective assertive tools in teamwork (YIN, 2015). Initially, it will address the paradigm of project management under the Covid-19 pandemic and the collaborative non-face-to-face virtual tools used in the development of project applications. Subsequently, the development process of the applications developed for the A910 Transire card payment machine and the conclusions about this virtual project management experience will be presented.

3 THEORETICAL FOUNDATION

3.1 PROJECT MANAGEMENT IN THE COVID-19 PANDEMIC

The Covid-19 pandemic has forced the adoption of non-face-to-face medical care, overcoming difficulties and prejudices. Patient data was collected and stored in a database and analyzed by a team of physicians gathered virtually to determine the best treatments. Through telemedicine, 91% of infected patients were treated safely, with no increase in mortality related to medical decisions, while ensuring optimal medical treatment for infected patients (CASSAR et al., 2021).

New approaches in the treatment of diabetes were employed at the University of North Carolina (USA) in reducing the use of personal protective equipment and the exposure of patients and care teams, in a project of remote care of hospitalized patients, starting in July 2019 and moving to 100%

virtual in March 2020. The 15-week data suggested that the use of care through virtual doctor-patient interaction in diabetes management in the hospital is feasible and provided similar results to traditional face-to-face care (JONES et al., 2020).

The pandemic has accelerated the integration of digital technologies and healthcare. Cases in China, Europe and the US using digital technologies, such as the use of *big data*, artificial intelligence, cloud computing and 5G, are reported as effective combat weapons playing an irreplaceable role. It turned out that the key in China in avoiding the second wave of the pandemic was the integration of digital technologies and large-scale public health without hesitation. (WANG et al., 2021).

Projects in civil construction required a combination of remote project management principles with the use of sanitary measures to protect professionals in the field. Operations were divided into three phases: pre-construction, construction and post-construction. The FIDIC (International Federation of Consulting Engineers) guidelines regarding the working conditions and organizational risks of project teams during and after the spread of Covid-19 now follow determinations of local health agencies of prevention and care (CHAISAARD; NGOWTANASUWAN; DOUNGPAN, 2020).

Supply chain is essential to business continuity during the pandemic. A mathematical model was developed predicting expansion scenarios and a better supply forecast dependent on time, cost and risk. By tracking the *status* of the pandemic, managers can alter or update their decisions based on changing conditions of the pandemic outbreak (HAJIAGHA et al., 2021).

RD&I projects drive innovation and need to operate within a framework defined by companies. In times of crisis, such as the Covid-19 pandemic, additional conditions such as those determined by health authorities become relevant leading project managers to reorganize work packages in non-face-to-face environments. The use of IT allows teams to follow guidelines and use pertinent information, adapting work and distance learning to the home environment, avoiding the feeling of isolation by frequent virtual contact (KUHN, 2020, DĂNILĂ; ADAM, 2020).

The challenges faced in the pandemic in reorganizing people training programs and suggesting strategies to improve learning are significant. Problems such as lower completion rates of the course, pressures to deliver the curricular elements and decisions about distance learning format, whether synchronous, with online interaction, or asynchronous, with the recording of content and subsequent availability, are evidenced. The challenge of the asynchronous format is to provide solid foundations for students on meaningful tasks without direct support from teachers. The USA and Canada are pioneers in the asynchronous format in areas of knowledge where practical content is reduced, but in other countries *e-learning* is not very widespread and viewed in a prejudiced way. The synchronous format, even with direct support and instruction from facilitators, presents challenges such as involving

students with active participation in the content, considering limited communication. It is necessary to develop interesting content in an interactive way (SANTOS et al., 2021).

Educational institutions in several countries have launched large-scale online course modalities in response to the pandemic. In China, colleges and universities have adopted *online* learning platforms and the overall learning satisfaction of students is significant. Educators say online learning makes up for the absence of traditional face-to-face teaching. The Ministry of Education has adopted the method of "suspending face-to-face classes without stopping learning" by encouraging students in *online* courses or private lessons at home, with teachers selecting appropriate and interactive course platforms and teaching materials to attract students to their pedagogical content (WANG; LIN; SU, 2021).

The access to and use of *online* learning resources and their link to student satisfaction in the pandemic calls for deeper evaluation. In June 2020 a study among students in Pakistan and Brunei showed a positive relationship between student satisfaction with accessing and using online learning. Living in the urban area in relation to the rural one contributes to the satisfaction of access and the use of online learning for both. Bruneians are better suited to *Internet* access and accessibility of computing applications than Pakistanis. It is crucial that educational policies provide access to and use of consistent online learning resources amid the pandemic (QAZI et al., 2020).

Small and medium-sized enterprises (SMEs) generate more than 80% of the financial revenues from society's products and services. The pandemic has caused reductions in production and operations, requiring skilled human resources, methodologies and tools with agile and standardized processes for teams to support critical business activities with the right planning cadence for the delivery of critical projects more quickly. Virtual digital applications provide real-time project controls and information, allowing them to control activities and update their internal systems on new and achievable schedules, updating activities and their workflows and work plans, improving communication with customers (VICHOVA; TARABA, 2020).

The pandemic has created unprecedented challenges for project management, with 95% of the workforce becoming remote on platforms such as *Google Meet, Zoom, Microsoft Teams, Webex and Amazon Connect*. Phones go from commercial to mobile phones. *Google Meet* and *Zoom* are used in most educational institutions. The new normal features daily *check-in*, *company happy hours* and virtual training *workshops*, emerging alternative and hybrid work schedules, rotations and newly formed collaborations with partners and contractors (SEALS et al., 2020).

The identification of critical factors affecting the use of e-learning by college students during the pandemic was evaluated for the future of online learning systems post-pandemic, evidencing: (1) The easier it was to navigate an *online learning* platform the more students were willing to use it. (2) Ease of use and usefulness were associated with teachers' choice of platform and their ability to tailor

course design and navigation on the platform. (3) The positive attitude of teachers towards teaching increased students' perception of the use of *online* learning. (4) Family support is key, serving as support to teachers in online teaching, parents encourage students to learn and complete tasks *online* (MO et al., 2021).

In general terms, teachers began to use *online* teaching in early 2020 in the maintenance of school activities. The impact of online learning during the pandemic on students' attitude and behavior was evaluated, verifying that the effects of pushing (perceived safety risk, learning convenience and quality of service), pulling (utility, ease of use, teacher's teaching attitude, technology involved in the task) and anchoring (cost of change, habit), influence the change of users from face-to-face courses to *online* learning (LIN et al., 2021).

Training partnerships between Harvard and California Universities with Tulane Medical School (USA) and two international assistance programs – Uganda and India – have been established with virtual meetings through *the Zoom* platform. Didactic topics in palliative care, establishing global partnerships, access to essential medicines, access policies, resilience and well-being in global medicine were taught by both U.S. professors and professionals from local units, generating positive results (GLASS et al., 2020).

In times of pandemic, people's satisfaction in virtual teams depends on: (1) ensuring adequate technology, (2) work-life balance, and (3) clarity in the direction of activities, including leadership. Low-quality virtual tools generate frustration. Virtual teams are highly flexible, making it challenging to find a work-life balance. Clear communication and leadership diminish the feeling of isolation. (BERNEHJÄLT; CARLBOM, 2020).

The "new normal" is global virtual teams, groups of people from different continents or countries who interact through various forms of communication technology and rarely if ever see each other in person, and who operate in different time zones with common purposes in space, time and organizational boundaries. The success of projects can be achieved by making sure that appropriate training and access to computing and communication technologies are available and, above all, that members' effectiveness and willingness to communicate are actively encouraged (ADEWOLE, 2020).

Studies conducted in Germany and the U.S. indicate that project work under the pandemic fosters feelings of emotional exhaustion through the accumulation of unfinished tasks in function and related constraints. Identifying organizational resources useful for the mental health of employees is important, and agile management through Scrum is fundamental in the process allowing understanding between everyone (KOCH; Schermuly, 2021).

The sheer volume of *fake* information in the face of the pandemic, filled with rumors and speculation, has created an atmosphere of fear and panic-endemic. The basis of the changes lies in the

change of the decision-making paradigm in the management of projects and programs in the infodemic-pandemic system, considering the mutual and fruitful cooperation in the accomplishment of tasks, definition of the context and principles, clear interpretation of the mission, tasks, functions and professional terms, definition of norms and professional language, availability of professional skills adhering to the work and the creation of common space fostering professionalism and engagement (BUSHUYEV, BUSHUIEV, BUSHUIVA, 2020).

The future of project management sees a lot of money invested by organizations seeking significant change in recovering from hardship and governments that will promote economic recovery through fiscal stimulus. This injection of funds will lead to more and more projects, with acceleration of digitization and virtual work. A reminder to engineering faculty to continually value the principles of sustainable development with their students during the pandemic. (MÜLLER; KLEIN, 2020).

The problems of financial management of companies currently evidenced by the media, can lead university students to believe that companies survive only from the financial aspects, neglecting the environmental and social aspects. The training of professionals to consider the aspects of sustainability is evidenced now and should be used as learning in the implementation of projects (ANHOLON et al., 2020).

The pandemic has affected many aspects of the industry, most notably productivity. Due to safety regulations and new protocols in place, productivity levels at each job have changed. Whether in the field or in the office, productivity has certainly been affected, especially in the scheduling and financing of projects. Changes are envisioned in offices and the field to keep employees safe as the virus continues to spread around the world. Companies will begin to have their employees, from the perspective of management and projects, working from home, adapting ways to keep employees safe and productive (GONZALEZ, 2020).

Online learning supports educational continuity in the face of the pandemic and associated social isolation by altering the jobs of academic teachers, affecting the potential of their motivating work which has been found to have diminished during Covid-19 e-learning compared to previous periods, suggesting that *e-learning* Socially sustainable requires not only concentration on students but also on improving teachers' motivating work potential (KULIKOWSKI; PRZYTUŁA; SUŁKOWSKI, 2021).

A master's degree in project management and innovation has built a new educational program including the continuous use of IT, a virtual practical simulator of plastic injection process and also in the use of catapults and paper helicopters, in theoretical concepts of Six Sigma. The program and simulator used have successfully replaced the practices previously used in a face-to-face environment,

allowing students to acquire related competencies in a practical way in a non-face-to-face environment (UNZUETA; EGUREN, 2021).

Moroccan universities have been forced to convert face-to-face education into an *online* context in the pandemic. An implementation experiment in remote project management of undergraduate students was conducted, considering (1) communication and collaboration, and (2) data centralization and efficient monitoring, resulting that the integration of the agile Scrum strategy has a significant positive impact on student performance in *online* projects , using the digital tool Trello as the main interface in the coordination and sharing of knowledge among the members of the project team (MAHFOUD, 2020).

3.2 POTENTIAL TOOLS IN THE DEVELOPMENT OF PROJECTS ON A NON-FACE-TO-FACE BASIS

3.2.1 Google Meet

Google Meet, a Google Workspace (https://workspace.google.com/intl/) tool designed to address the need for real-time interaction between geographically separated members of work or study teams. This tool provides several benefits to the enterprises, enabling high-quality audio and video calls, as well as supporting large numbers of participants. Among the main advantages, we can highlight: (a) Great portability - allows remote use on mobile devices or computers, (b) Its free version allows up to 100 members participating simultaneously in a call of up to an hour in duration, (c) To hold a meeting, the administrator simply creates the room and sends the "invitations", a specific *link*, (d) It has *chat* tool , a space intended for the exchange of text messages, and (e) Enables screen sharing (videos, slides, data and other relevant documents) from one to the other participants.

In India, regulations have impacted on all aspects of the economy promoting the adoption of digital technology during the pandemic, accelerating the uptake of online platforms in the process of quality teaching and learning. The democratization of IT has been a critical and significant issue, with a transformation from chalkboards to Google Meet, enabling significant advances and paradigm shifts in college student learning (MAITY; SAHU; SEM, 2021). An online study conducted with 1,069 undergraduate students at a Brazilian university revealed a preference for the dynamics of group work and the Google Meet platform, especially for students of exact sciences (LAGO et al, 2021)

3.2.2 Entrepreneurship and Innovation

In a search on the portal of Capes journals in Brazil, articles were selected by the combination of search terms in English and Portuguese such as "*entrepreneurship*", "*innovation*", "education"; "Engineering" with the aim of approaching technological innovation from an educational perspective

and seeking to evaluate entrepreneurship in engineering education. Knowledge of the reality of innovative companies, encouragement to work in multidisciplinary teams, professional development with emphasis on the future with a critical and expanded view of social dynamics are key elements. Technological innovation and entrepreneurship are topics rarely discussed by students in general. (PEREIRA; HAYASHI; FERRARI, 2016). In higher education institutions, learning entrepreneurship on the basis of successful models encourages education for sustainable development. Entrepreneurship education related to students' entrepreneurial intentions, providing appropriate knowledge and skills, motivates them to develop entrepreneurial careers. It was evidenced in graduate students in Romania that entrepreneurial education based on successful models positively influences students' entrepreneurial attitudes and intentions for the social benefits of entrepreneurship (new jobs) compared to financial ones (profitability) (BOLDUREANU et al., 2020).

3.2.3 Jamboard

Jamboard is a *web-based* whiteboard system initially launched in 2017 as a combination of *hardware* and *software*, incorporating a 55" touchscreen and an annual maintenance fee. The app allows real-time co-authoring using a browser on any *laptop, tablet* or *smartphone*. Creating a new Jamboard is easy and can be automatically stored and updated in the user's Google Drive. To share with a group of learners, you duplicate the master version by selecting the share in the new copy, for anyone with the *link*. Writing tools include pen, highlighter, eraser, shape tool, and text box. Offers versatile collaborative experience modeled for use in higher education and with additional potential in research, professional development workshops or other creative environments (SWEENEY; BEGER; REID, 2021). A study in a public school in Brazil involving the teaching of mathematics with the use of Jamboard and Google Meet applications in remote learning concluded that the use of these applications enabled mediation, intervention and interaction, in real time, with students who demonstrated their mathematical thoughts on Jamboard boards and in the dialogues established by Google Meet with colleagues and the teacher (SILVA, 2021).

3.2.4 Project Management with Scrum

The last decade is characterized by the shift of the IT systems development lifecycle methodology from classic waterfall or prototype methods to the agile Scrum development methodology. The agile methodology that encourages software development was introduced in 2001 based on four values: (1) Individuals and interactions about processes and tools, (2) *Working software* on comprehensive documentation, (3) Customer collaboration in contract negotiation, and (4) Responding to change by following a plan. His main roles include the development team, the *Scrum*

master and the *Product Owner* who represents the customer and users. Effective communication with the various stakeholders in the development of a new product or *software* is essential. Scrum defines a series of *sprints*, two to four weeks, in which the team performs the tasks to be completed. The importance of communication in the management of IT projects that impact on the success of the project is highlighted, identifying and correcting its weaknesses (HOLZMANN; PANIZEL, 2013). Scrum is a structure in which teams work together and highly integrated where each member has a defined role, eliminating unnecessary, inadequate and bureaucratic controls, focusing on the essence of the systems or software development process. The practices of the PMBoK Guide can complement Scrum, even if the purposes are different (DA SILVA; LOVATO, 2016). New product development (NPD) is a sophisticated and necessary process for the successful introduction of the product to the market, generating customer satisfaction, benefits to the organization, new organizational and personal skills and experiences. Many authors use the classic PMI project management tools in the management of NPD processes. Recently, there is a growing interest in the agile Scrum methodology, initially introduced in IT project management, in other areas such as health, finance, consulting and education, giving good results (BETTA et al., 2019).

3.2.5 Github

Software developers use and contribute to repositories on GitHub. The documentation present in the repositories serves as an important source, helping developers to understand, maintain and contribute to the project (VENIGALLA; CHIMALAKONDA, 2021). The open source software (OSS) community plays a key role in the development of contemporary *software*. Different types of knowledge sharing affect an individual's contribution to open source projects. Collecting data from GitHub – the largest *online* platform for hosting open source software development, and Gitter – an instant messaging and chat room app designed for developers, it was found that sharing tacit knowledge has a positive relationship with the contribution of open source. In addition, sharing helps *OSS* platform designers gain a better understanding of the symbiosis between the different existing platforms (SHING, CHAKRABORTY; KADIAN, 2020).

3.2.6 Android Studio

Android Studio is the main tool that one can use to write *the software* of *Android* applications. Although there are a variety of other reliable software, the Integrated Development Environment (IDE) of Android Studio is fundamental to bring to life the most varied ideas in Android (ALLEN, 2021). Self-service can meet consumers' daily shopping needs. Many ordering and delivery systems are still done over the phone, with customers unaware of price lists and products from minimarkets, for

example. Self-service applications can be built using Android Studio software so that order delivery and delivery information is done quickly and accurately, allowing *online* purchases through *smartphones* (RIFAI; SARI; NURYADI, 2020).

3.2.7 Information Architecture

Information architecture plays an important role in how information should be captured in the user interface (UI). It takes into account the user's experiences with the interface – UX, defined as the relationship before, during and after the interaction with the product or service, allowing a fluid integration and communication in the interface. In UX, the user-product-service relationship needs to consider a heterogeneous audience, including people with physical and visual disabilities. It is very important that the UI is visual, auditory and tactile to find the interpretation of the data in an appropriate way (REYES; RODRIGUEZ; MUÑOZ, 2020). Persons with disabilities have the right to exercise their civil, political, social, economic and cultural rights on an equal basis with others. The process of designing the information architecture in the *e-learning* interface for users with disabilities allows these users to realize their right of access to education on an equal footing with other people (VELJANOVSKA, 2020).

3.2.8 Kotlin Programming Language

Google announced Kotlin in 2017 as one of the official languages for Android development. It's concise, easy to understand and adopt, expressive, and designed to be secure and compatible with Java and run on the Java Virtual Machine (JVM). Developers consider that Kotlin increases the quality of the code produced due to its security guarantees. Kotlin requires care, but its benefits seem to bring many advantages, especially in the aspect of adopting a modern language, consolidating the Java-based development environment (OLIVEIRA; TEIXEIRA; EBERT, 2020). An experiment performed on maintenance tasks (fixing defects and adding features) in Android apps written in Java and Kotlin, considering the number of defects fixed, effort, and code size, verified participants' perceptions of how to avoid known pitfalls. It turned out that Kotlin required fewer codes. The transition to Kotlin can provide some advantages to Java developers, especially in relation to the conciseness of the code (ARDITO et al., 2020).

3.2.9 UML

UML – Unified Modeling Language, is a standard language in the elaboration of the structure of software projects, employed for the visualization, specification, construction and documentation of artifacts of complex *software* systems. It allows you to represent a system in a standardized way, from

the modeling of corporate information systems to complex systems in real time. It is a very expressive language, encompassing all the visions necessary for the development and implementation of these systems (BOOCH RUMBAUGH; Jacobson, 2012). Its objectives are the specification, documentation, structuring for a secondary or subsidiary vision and greater logical visualization of the complete development of an information system. The architects of UML have stated that the accuracy of syntax and semantics is their primary goal (FRANCE et al., 1998).

3.2.10 DevOps

DevOps (Development and Operations) is one of the solutions to increase the quality of *software* development, focusing on increasing the speed, frequency and quality of its deployment. It is a mix of different developments and operations in the *software* industries, involving metrics at different stages to evaluate performance, culture and practices in quality assurance and factors such as usability, efficiency, maintainability and portability. Its goal is to eliminate the gaps between an organization's development and operations (MISHRA; OTAIWI, 2020). DevOps involves a set of activities and practices integrated in the development of automation *software*, for example. It allows developers to build, test and release deliverables quickly and reliably. Even if the various activities or steps *loop* and flow sequentially, iteration indicates that the flow must be constantly collaborative and repetitive to improve the entire lifecycle. (YARLAGADDA, 2021).

3.2.11 Iterative Virtual Development

In advancing strategies for digitization and downsizing of the workforce in organizations, knowledge management is central to building an evolving digital strategy. It highlights the way organizations achieve agility, innovation and competitiveness in the digital world. Virtual teams create possibilities and challenges in knowledge sharing in organizations. Knowledge transfer is key to effective management in a fast-paced digital world (SHEPHERD; COOPER, 2020). Virtual teams of global companies in Taiwan and China that have high integration and international cooperation, show that organizational proximity influences technical innovation through the contribution of knowledge, and that cognitive proximity influences technical innovation through the absorption of knowledge (HUNG et al., 2021).

4 CASE PRESENTATION

The development of the project called "Transire MyPay" for the company Transire da Amazônia, focusing on the development of 15 Android applications for the A910 payment machine,

the first device created in an Android environment in the Brazilian national market, required a multifunctional and interinstitutional work team.

The work team was selected from the interaction of the Innovation Agency – AGIN of UEA with research professors of UEA with students of the School of Technology EST-UEA, Center for Higher Studies of Tefé CEST-Tefé. By requirement of the legislation, UEA initially through FUEA – Fundação Universitas de Estudos Amazônicos and later through the Muraki Foundation controlled the resources, acquisitions and other financial activities of the project, as well as the subsequent process of accountability and technical report of the project with Suframa, always under the supervision of the UEA professor coordinator of the project. If the project is not executed in accordance with the legislation, there will be punitive consequences through fines and other sanctions.

It was initially determined in the project, the training of scholarship students and *designers* in programming language and methods of development of Android-based applications, as well as the development of applications that aim to allow different segments of entrepreneurs to use the A910 machine with specific application and parameterized basically for their branch of business. Two teams were created, one in the city of Manaus (with the goal of developing 10 applications) and another in the city of Tefé (with the goal of developing 5 applications).

It is verified that more qualified professionals with access to technological resources suffer less impact in the Covid-19 pandemic (MONGEY; PILOSSOPH; Weinberg, 2021). This is exactly the case for the project participants, where each of the members received a state-of-the-art hardware platform (IntelCore i7-10750H CPU @ 2.60GHz 2.59 GHz, 32 GB RAM), with the Windows 10 operating system factory installed and Internet access. In 2020, the year of the beginning of this project and the Covid-19 pandemic, there were already several tools that allowed video calls since Skype, launched in 2003 and today has about 560 million users around the world, to Zoom, through Google Meet, the iterative platform chosen to support the team of this project.

The tools and technologies described below were used in the development and management of the project, based on the academic literature review research initially carried out in this work.

4.1 GOOGLE MEET

As a virtual interaction tool, Google Meet was used in: entrepreneurship training; course on the Android operating system; Kotlin language training; meetings with the Scrum-master; daily meetings between the technical coordinator and the teams of programmers and designers; meetings between teams of developers, including for joint code development; meetings of the design staff, etc. Google Meet proved to be an efficient tool meeting the expectations and needs of distance interaction in this project.

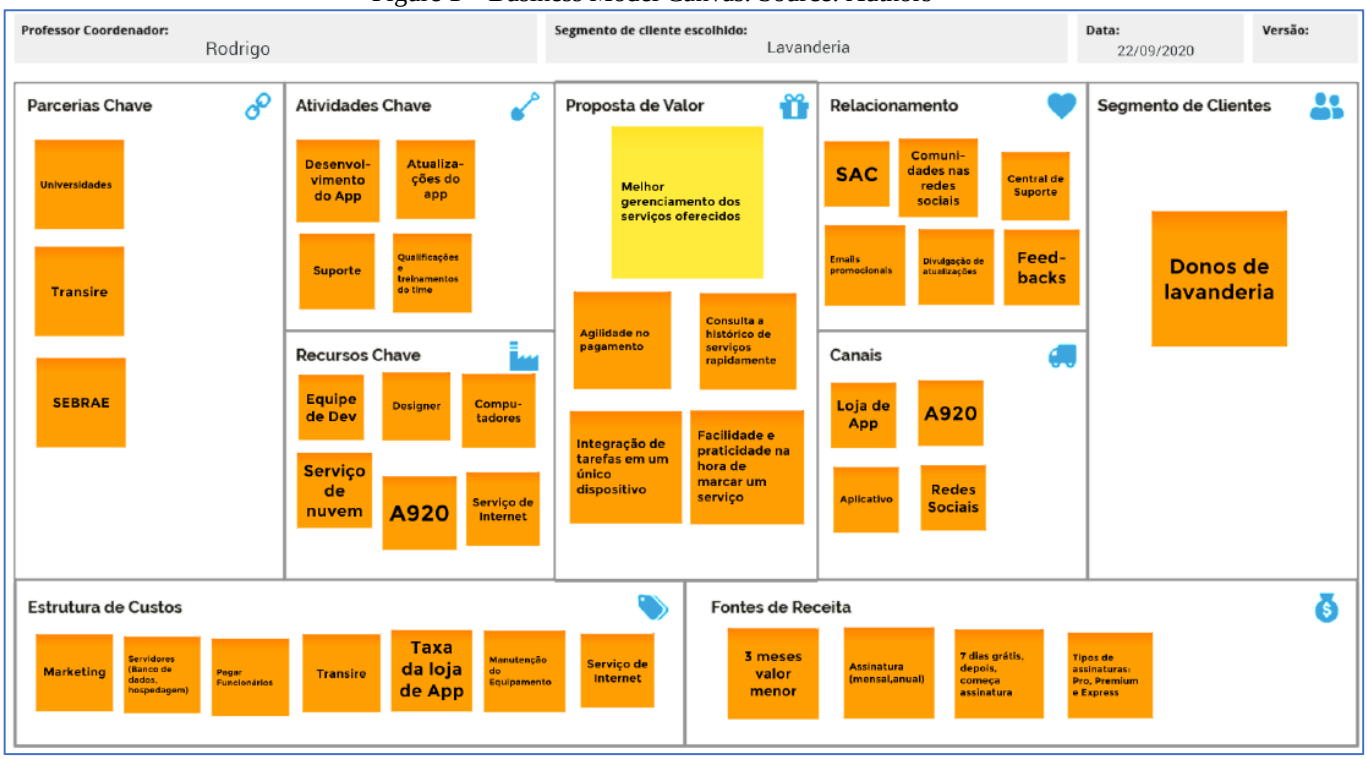
4.2 ENTREPRENEURSHIP AND INNOVATION – JAMBOARD

To start the activities of the teams, an entrepreneurship course was held, divided into a theoretical exposition with varied examples of the associated contents and group dynamics, which boosted the teams in the direction of the entrepreneurial profile and in the definition of potential applications to be developed, directing the company's RD&I efforts in the creation of a network of high-level human resources and competitive capacity in the development of Android applications for use in the A910 Transire payment terminals on the market. The contents were divided into 15 topics:

1. What does it mean without an Entrepreneur? Lost in Life? It's never too late to (re)start. Successful entrepreneurs. 2. Entrepreneurship is more happiness than money. Multiple intelligences. Level test intelligences. Types of entrepreneurship: high and low impact, internalization. 3. Entrepreneurship ecosystem. Entrepreneurship in Brazil. Dynamics - proposals to improve the entrepreneurial environment of the Amazon. 4. What is it to be creative? Exercising creativity. Dynamics – different product uses, toothbrushes and thimble. Factors that influence creativity. 5. What is it to be innovative? Innovation and creativity. Value Innovation. Blue Ocean Strategy. Case Cirque du Soleil. 6. Value Assessment Matrix: Cirque du Soleil and the Wine Industry. Dynamics – set up a value assessment matrix of innovative companies. Video Surfing in Opportunities – Endeavor Classics. 7. Opportunity analysis. Jeffry Timmons model (opportunity, resources, team). Scott Shane's model (industry dimensions and markets). Dynamics – multipurpose robot. 8. Sources of innovative opportunities. Peter Drucker and Josef Schumpeter. Changes that provide opportunities. Management team – human resources. Dynamics – Nortex case. 9. What is strategy? Strategic, tactical and operational planning. Balanced Scorecars (BSC). Mission, vision and values. Scientific method. Dynamics – use of the scientific method. Successful innovative project. Job to be done (JTBD). 10. What Job do the products actually perform? What would be the substitute products? Dynamics – customer, problem, solution, Job to be done, real case. The 4 phases of customer development. Minimum viable product (MVP). 11. User Experience (UX) and User Interface (UI). Business model. Introduction Customer empathy canvas, value proposition canvas, business model canvas. Presentation of Ipod and Facebook case. 12. User Experience (UX) and User Interface (UI). Customer empathy canvas. How do you feel? What do you hear? What do you see? What do you say and do? What are your pains and gains? Dynamics – Empathy Canvas modeling. 13. User Experience (UX) and User Interface (UI). Value proposition canvas. Customer Profile: gains, pains, tasks to perform. Value proposition: pain enablers, earnings creators, products and services. Example skateboard. Dynamics – Canvas modeling of Value Proposition. 14. User Experience (UX) and User Interface (UI). Business Model Canvas. Customer Segments. Value proposition. Relationship with customers. Key Activities. Key features. Cost structure. Sources of revenue. Dynamics – Business Model Canvas

modeling. 15. Dynamics – collective discussion and "questions raised". Presentation of application proposals (Mobile Recharge, Delivery Drivers, Doctors and Dentists, Cinemas, Pet Shop, Gas Station), presented from interactions made of the Empathy, Value Proposition and Business Model canvases (see Figure 1), developed virtually through the use of Jamboard. A brainstorming of ideas for potential applications was generated and a scoring/scoring spreadsheet was generated, choosing the 15 ideas with the highest score based on the model available in the academic literature, (KIELING et al., 2021).

Figure 1 – Business Model Canvas. Source: Authors



4.3 SCRUM

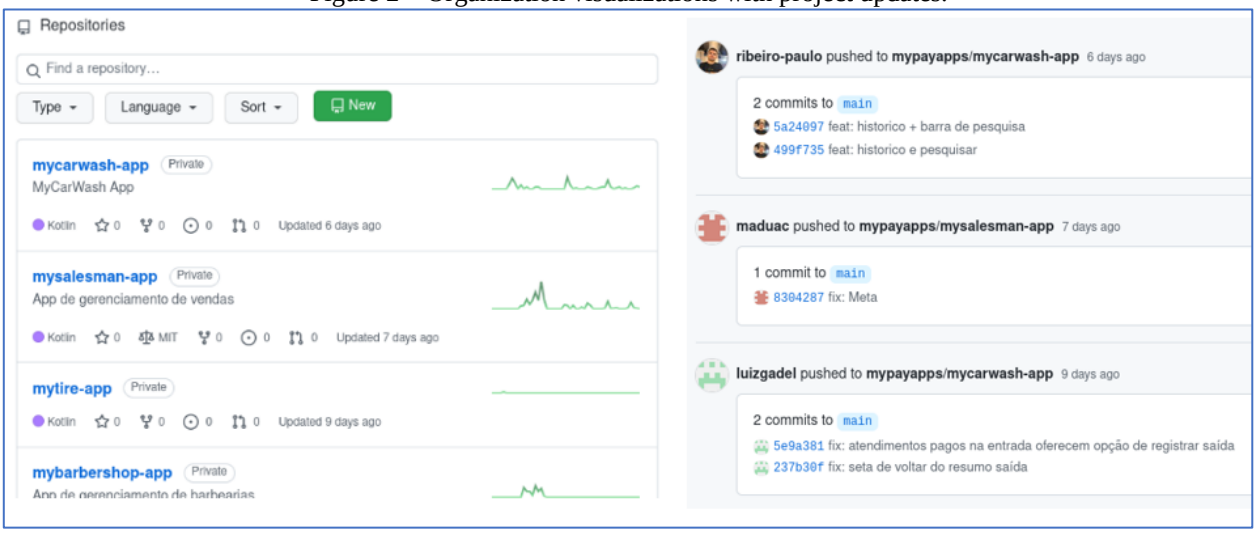
The agile Scrum methodology was used by defining 14-day sprints in conjunction with the Trello activity control tool, thus monitoring in real time the evolution of the tasks performed by the team members, making adjustments when necessary directed towards the achievement of the project objectives.

4.4 GIT – GITHUB – GITHUB CLASSROOM – GITKRAKEN – GOOGLE SHEETS

The Git tool is a version control system, which allows you to record changes inthe source code of a program and organizes r into versions. For Manaus students, more experienced and computer students, the tool allowed more than one student to work on different parts of the same program, because it has features of merging changes and conflict resolution. For Tefé's students, it was defined that only a single student would make changes to each team's application code.

The Git tool, in this case, was used as a centralizer of the source code, so that students who were not performing the programming could update the version on their machine and test the program being developed. GitHub is a Git server and project management tool. It was used for three purposes: to centralize the projects of the teams in a group, to monitor the progress in the course of Android and in the development of the applications. The platform allows you to group users into teams and a group of teams in an organization, with control of access permissions and update reports on projects. Figure 2 shows an example of a page where you can track the progress of teams.

Figure 2 – Organization visualizations with project updates.



Source: Authors

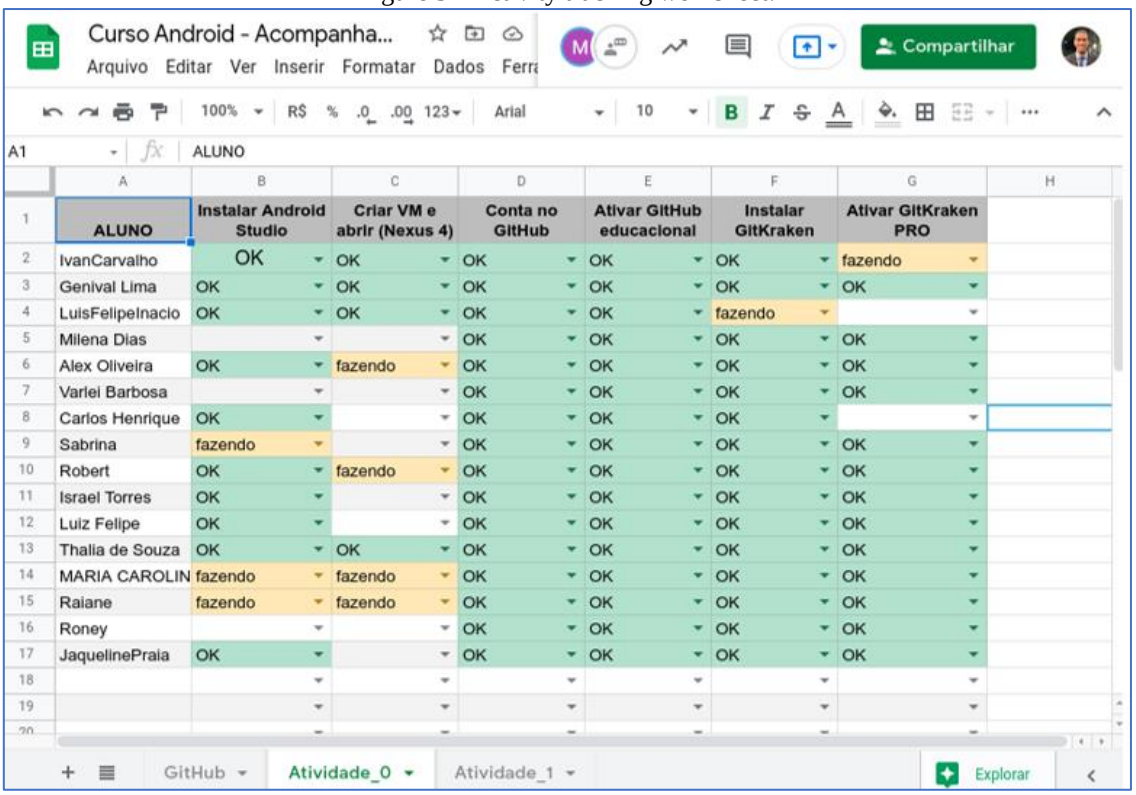
Using this platform, it was also possible to verify the most active students and projects. Progress was assessed periodically by identifying which teams needed the most help. In each activity of the Android course, students submitted solutions to Git projects that were accessible to all students in the class, being able to track in real time the progress of each student and share the solutions of the problems among them.

The GitHub Classroom platform was used to facilitate the configuration of Android projects used as an exercise during the Android course. When you accept the activity, a Git project with a starter code is created. This project is automatically added to the Github organization corresponding to the classes. This tool allowed an efficient control of the progress of each student and automated the process of configuring each activity on the students' machines.

The Git tool is a command-line program with no graphical interface. To facilitate understanding and accelerate learning, the GitKraken program was recommended to students. It has a graphical view of Git projects, where you can see in detail what has changed in each new version of the source code, as well as submit new versions and resolve conflicts when merging changes made by different students.

The Google Sheets tool was used as a way to track the progress of students during live tutorials in class, as well as to check the progress of past activities in class. It was especially helpful with Tefé's students, who had poor internet connectivity. A greater number of activities were worked to the students of Tefé, establishing an accessible and efficient way to check the progress. An example of a tracking worksheet is in Figure 3.

Figure 3 - Activity tracking worksheet.



	A	B	C	D	E	F	G	H
1	ALUNO	Instalar Android Studio	Criar VM e abrir (Nexus 4)	Conta no GitHub	Ativar GitHub educacional	Instalar GitKraken	Ativar GitKraken PRO	
2	IvanCarvalho	OK	OK	OK	OK	OK	fazendo	
3	Genival Lima	OK	OK	OK	OK	OK	OK	
4	LuisFelipeInacio	OK	OK	OK	OK	fazendo		
5	Milena Dias			OK	OK	OK	OK	
6	Alex Oliveira	OK	fazendo	OK	OK	OK	OK	
7	Varlei Barbosa			OK	OK	OK	OK	
8	Carlos Henrique	OK		OK	OK	OK		
9	Sabrina	fazendo		OK	OK	OK	OK	
10	Robert	OK	fazendo	OK	OK	OK	OK	
11	Israel Torres	OK		OK	OK	OK	OK	
12	Luiz Felipe	OK		OK	OK	OK	OK	
13	Thalia de Souza	OK	OK	OK	OK	OK	OK	
14	MARIA CAROLIN	fazendo	fazendo	OK	OK	OK	OK	
15	Raiane	fazendo	fazendo	OK	OK	OK	OK	
16	Roney			OK	OK	OK	OK	
17	JaquelinePraia	OK		OK	OK	OK	OK	
18								
19								

Source: Authors

4.5 ANDROID STUDIO

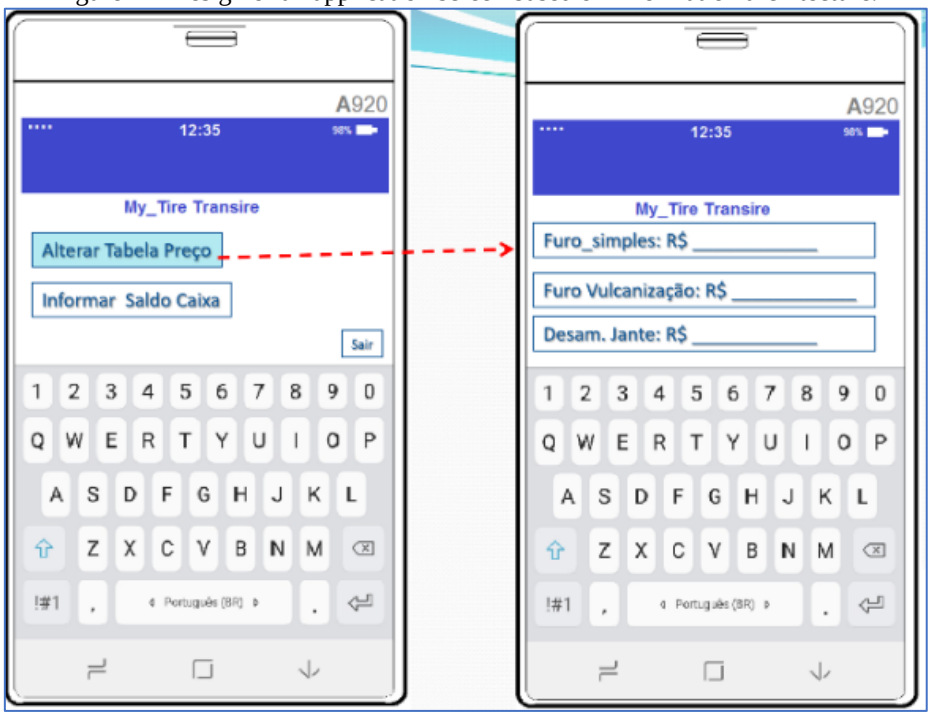
Android Studio is Google's recommended tool for Android development. The screen editor with graphical interface was the feature that most contributed to the success of student learning, especially in Tefé. The integration with the Android emulator also contributed a lot in testing solutions and advancing the project. Because it is a tool with many features, these were presented gradually, from an initial contact with few explanations and a lot of practice, to the presentation of several shortcuts and small features in more detail later.

4.6 INFORMATION ARCHITECTURE

An *online* course on UX Design for the students and teachers of the Transire project was taught, initially for the Manaus team and in another opportunity for the Tefé scholarship holders. In the first class the course had nine meetings held from 19:00 to 22:00 from Monday to Thursday, in the second

class the course had six meetings held from 7:30 to 13h on Saturdays. About 80 people participated. The learning reinforcement activities of the course were carried out with the application projects under development by the students themselves. They conducted *brainstorming* dynamics with the technique of face-to-face design, prototype development, heuristic analysis and usability testing. With this they assimilated with practice the concepts presented in the course. The class showed great commitment and participation during the course and took the opportunity to improve the usability of the applications under development. At the last meeting, each group presented the interface of their applications under development with several improvements in UX.

Figure 4 – Design of an application screen based on information architecture.



Source: Authors.

4.7 UML

The studies related to the technical training in application development carried out in the UEA-Transire Project, offered by UEA, also aimed at the Technical training of a group of teachers from the area of Licentiate (Mathematics, Physics and Chemistry) of CEST-UEA and engineering of EST-UEA with the possibility of professionalization for the area of Systems development.

The studies were developed relating theory and practice, introducing concepts from the area of Systems development, such as: Programming Logic, Object-Oriented Programming Language, Database Modeling and Systems Analysis, Entrepreneurship and Advanced Programming. These studies culminated in several reports of experiences on the training processes of these teachers.

Theoretical-practical workshops were also given in order to develop new skills, in view of the set of experiences present in the students, not all of them from the technological area. The concepts were presented in order to confront these experiences of the students to the understanding of basic concepts of programming and systems development. New technologies and tools to facilitate the absorption of knowledge in the shortest possible time were considered, since students would have to develop applications based on their own ideas.

The students were divided into groups with a teacher coordinating the team. Each team generated a Project Canvas and this model served as the basis for modeling the problem they wanted to solve using a mobile app. Each team studied and set up its business model and proposed an application to solve a certain demand. Thus, the students created an initial theoretical model and verified its practical application for the solution of a problem through information and communication technologies.

During the workshops, the concepts of Programming Logic were introduced. It was verified difficulties in the understanding of the concepts of programming logic and its materialization in executable codes in the Kotlin language by the students who were not of the computer courses. However, many of these difficulties were remedied from the meetings via meet and the discussion of solutions between the various teams. It is noteworthy that of the contents worked on in the project, programming logic was the most difficult to assimilate by students who were not from the computer courses.

Subsequently, they were presented to the UML (Unified Modeling Language) and Data Modeling (Entity-Relationship Model and Relational Model) systems modeling diagrams. Compared to the study of logic the problems were smaller, since the modeling represents a simplified view of the problem that is intended to be solved in a visual way.

To streamline and direct the work of each team, we focused on modeling the teams' applications instead of dummy examples. The intention was to make them work on their solutions and verify the understanding of the modeling diagrams. The teams did very well in this task, because the result of this step was the creation of the use case diagrams and their description, class diagrams, sequence diagrams, entity-relationship model and its mapping to the relational model, as well as the low-fidelity and high-fidelity prototype of the applications.

To perform these tasks, they met every day and discussed among themselves and with the guiding teacher to resolve their doubts and make adjustments to the models. They were also presented with tools to facilitate the modeling of systems, such as: Astah Community for UML and Argo UML modeling, MySQL for database creation, Git for versioning and shared code development, SQL

Language, Kotlin Language, Visual Studio Code for writing code and Intelij IDEA, Adobe XD for prototyping.

The work with this set of tools facilitated the design of the *software* and showed how the application would look after its implementation, as well as enabled the understanding of shared and collaborative work, since the concepts of code versioning were introduced, allowing to manage changes in files, including texts and images. Through code versioning it is possible to know whenever a change is made, who made it and why.

4.8 DEVOPS

The set of practices for integration between software development teams, called Devops, allowed the adoption of automated processes for the fast and safe production of application models. It was observed that the teams understood the purpose of the training and sought through the sharing of knowledge and mutual help and technical growth. It is important to note that the time to mature knowledge was not long, but it was observed that it is possible to train multidisciplinary teams to develop systems. It was also proven that the daily meetings and the focus on a goal, even with the difficulties notably verified, added with the help of the coordinating teachers of the teams to direct the work, enabled the discovery of talents by the students themselves that were not of their own knowledge.

4.9 APP INTERFACE

Regarding the activities linked to the interface, a *design* methodology based on the User Experience, or UX – User Experience, was followed, so some initial procedures were necessary even before proceeding with the configuration of a graphic structure, such as research, technical investigations and other approaches to the possible actors of the process.

Thus, for the interface, nine steps were defined a priori, namely: (1) CSD Matrix; (2) User Journey; (3) *Low fidelity wireframes* ; (4) *High-fidelity wireframes* (Adobe Xd); (5) Navigable prototype; (6) User Surveys; (7) Roadmap for Usability Testing; (8) Usability testing; and (9) UX/UI documentation.

In the CSD matrix, certainties, assumptions and doubts about the audience of each application were described, an initial stage that led to *insights* into what problems were to be solved with the apps, then moving on to the user's journey, where the step-by-step work of the user was documented, recording what he does, thinks and feels at each stage, as well as possible opportunities (*insights*) in the process.

The construction activity of low-fidelity Wireframes consists of the design of screens on paper, without great concern with details, with subsequent transfer to the Marvel application, where the screens were "linked" so that the team could visualize how the navigation would be, passing, later, to the activities of high-fidelity *Wireframes*, using Adobe Xd, to build screens with a greater aesthetic concern and with details.

After the construction of the *Wireframes*, we set out to structure navigable Prototypes, connecting the screens to each other to generate links of the interfaces to be submitted to the User Surveys, to verify if what was developed in the apps met the pains of the users. In addition, it was a form of recruitment for usability testing.

Initially, a roadmap for usability tests was developed to guide the performance of the tests. Then, the tests themselves were applied, where users tested the navigable prototype generated in Adobe Xd. At the end, after the adjustments made, some errors were corrected, some functionalities of the applications were modified and it was passed to the UX/UI documentation activities, where all the screens and all the activity flows within the applications were registered.

4.10 ITERATIVE VIRTUAL DEVELOPMENT

All activities related to the development of the applications were carried out remotely, using the virtual and iterative tools presented in this work. The mission, effort and practices in sustaining and leveraging a diverse and iterative workplace in virtual teams was fundamental and important of success in the project with the development of the 15 apps, with geographically dispersed people united towards the goal working in an integrated and targeted way, evidencing a competitive advantage to be exploited in future projects.

5 CONCLUSIVE SUMMARY

There were achievements in meeting project requirements and training application developers with knowledge of project management, programming language, design, entrepreneurship and innovation, among other technologies, even under difficulties imposed by the Covid-19 pandemic.

It was very important to distribute *home office kits* at the beginning of the pandemic with high-performance *laptops*, wireless *mice*, *mouse pad* and *quality head sets*.

The teams were instructed to set up a place at home reserved for the performance of the project activities and inform the family that at a certain time they would be working, aiming at a calm and tranquil environment.

We tried to follow Scrum in its entirety, even in the virtual environment, with the tools of Google Meet, Trello, among others. Updates were checked daily and each team/application leader acted in conflict situations addressing an appropriate solution together with team members.

For the creation of the UML diagrams we used the https://www.lucidchart.com/ where in a Google Meet room in integration meetings and monitoring in the lucidchart tool the interaction diagrams were created, it was very productive.

On days when there was a great intensity of working together, a room was created in the https://discord.com/ where members could come in and ask questions, for example a junior member could come in and ask something to some senior, giving the impression of a job in the same room.

The team of *designers* used the adobe XD tool, greatly improving the collaborative and remote work in the sense of planning the interfaces, wireframes and sharing the viable interface prototypes with the team.

Features such as Google Meet, Jamboard, Scrum, Git, GitHub, GitHub Classroom, GitKraken, Google Sheets, Android Studio, Information Architecture, UML, among others, have enabled collective virtual work not in person with absolute success.

15 applications were developed for the A910 payment terminals for the following economic sectors: Rubber Shops, Direct Sales, Parking, Grocery Stores, Laundries, Events, Coffee Shops, Car Washes, Aesthetic Clinics, Barbershops, Boat Tickets, Gas Stations, Ice Cream Shops, Petshops, Dental Clinics.

ACKNOWLEDGMENT

The authors thank the University of the State of Amazonas – UEA, LUDUS laboratory of the School of Technology EST / UEA andthe companys TRANSIRE and TECTOY (MyPay Project) for the support provided in the development of this work.

REFERENCES

Adewole, k. F. Lived experiences of project leaders who successfully managed projects while working with virtual teams. A dissertation presented in partial fulfillment of the requirements for the degree doctor of information technology, capella university, march 2020.

Allen, g. Android for absolute beginnersgetting started with mobile apps development using the android java sdko. 2021.

Amazonas (estado). História de manaus, 2020.

Anholon, r.; rampasso, i. S.; silva, d. A. L.; filho, w. L., quelhas, o. L. G. The covid-19 pandemic and the growing need to train engineers aligned to the sustainable development goals. International journal of sustainability in higher education, vol. 21 no. 6, 2020, pp. 1269-1275, © emerald publishing limited, 1467-6370, doi 10.1108/ijshe-06-2020-0217.

Ardito, l.; coppola, r.; malnati, g.; torchiano, m. Effectiveness of kotlin vs. Java in android app development tasks. Information and software technology, volume 127, 2020.

Bernehjält, m.; carlbom, i. How global and virtual teams are efficiently managed by project managers. Royal institute of technology, department of real estate and construction management, stockholm, sweden, 2020.

Betta j.; chlebus t.; kuchta d.; skomra a. Applying scrum in new product development process. In: trojanowska j., ciszak o., machado j., pavlenko i. (eds) advances in manufacturing ii. Manufacturing 2019. Lecture notes in mechanical engineering. Springer, cham. Https://doi.org/10.1007/978-3-030-18715-6_16, 2019.

Boldureanu, g.; ionescu, a.m.; bercu, a.-m.; bedrule-grigoruță, m.v.; boldureanu, d. Entrepreneurship education through successful entrepreneurial models in higher education institutions. Sustainability, 12, 1267. Https://doi.org/10.3390/su12031267, 2020.
Booch, g.; rumbaugh, j.; jacobson, i. Uml, guia do usuário: tradução; fábio freitas da silva, rio de janeiro, campus, 2012.

Bushuyev, s.; bushuiev, d.; bushuiva, v. Project management during infodemic of the covid-19 pandemic. Innovative technologies and scientific solutions for industries. 2020. No. 2 (12). Doi: https://doi.org/10.30837/2522-9818.2020.12.013.

Cassar, m. R.; borg, d.; camilleri, l.; schembri, a.; anastasi, e. A.; buhagiar, k.; callus, c.; grech, m. A novel use of telemedicine during the covid-19 pandemic. International journal of infectious diseases 103: 182–187, 2021.

Chaisaard, d.; ngowtanasuwan, g.; doungpan, s. A review of construction project management guidelines under the impact of covid-19 epidemic dispersal: a case study of thai construction projects. Conference: sut international virtual conference on science and technology nakhon-ratchasima, thailandat: nakhon-ratchasima, thailand, 2020.

Da silva, e. C.; lovato, l. A. Scrum framework: efficiency in software projects. Revista de gestao e projetos, volume7, issue2, page1-15, doi10.5585/gep.v7i2.330, 2016.

Dănilă, d. S.; adam, o. A. International academic conference - eighth edition - bucharest, october 15-16, 2020. Strategica. Section 10:909. (b) challenges in project management during covid-19 crisis, 2020.

France, r.; evans, a.; lano, k.; rumpe, b. The uml as a formal modeling notation. Computer standards & interfaces, volume 19, issue 7, pages 325-334, 1998.

Glass, m.; rana, s.; msc, coghlan, r.; lerner, z. I.; harrison, j. D.; stoltenberg, m.; namukwaya, e.; humphreys, j. Global palliative care education in the time of covid-19. E14 journal of pain and symptom management vol. 60 no. 4 october 2020.

Gonzalez, e. L. The effects of covid-19 on productivity in project management a case study. California polytechnic state university san luis obispo, ca, 2020.

Hajiagha, s. H. R; mahdiraji, h. A. M.; behnam, m.; nekoughadirli, b.; joshi, r. A scenario-based robust time–cost tradeoff model to handle the effect of covid-19 on supply chains project management. Operations management research, may 2021.

Holzmann, v; panizel, i. Communications management in scrum projects. Proceedings of the 7th european conference on is management and evaluation (ecime 2013), page67-74, 2013.

Hung, s.w.; cheng, m. J.; hou, c. E.; chen, n. R. Inclusion in global virtual teams: exploring non-spatial proximity and knowledge sharing on innovation. Journal of business research, volume 128, pages 599-610, 2021.

Ibge- instituto brasileiro de geografia e estatística. Cidades e estados, 2021.

Jones, m. S.; goley, a. L.; alexander, b. E.; keller, s. B.; caldwell, m. M.; buse, j. B. Inpatient transition to virtual care during covid-19 pandemic. Diabetes technology & therapeutics, volume 22, number 6, 2020, mary ann liebert, inc. Doi: 10.1089/dia.2020.0206.

Kieling, a. C.; bentes, t. K.; lima, r. P.; silva, e. S. R.; barboza, r. S.; oliveira, r. C.; lins, r. D. Priorização de projetos utilizando o modelo de pontuação/scoring: um estudo de caso. European academic research, v. Viii, p. 6892-6908, 2021.

Koch, j.; schermuly, c. C. Managing the crisis how covid-19 demands interact with agile project management in predicting employee exhaustion. British journal of management, vol. 0, 1–19 (2021), doi: 10.1111/1467-8551.12536.

Kuhn, e. International academic conference - eighth edition - bucharest, october 15-16, 2020. Strategica. Section 10:896. (a) challenges of project management. How do the due to the pandemic revised frame conditions influence project management? 2020.

Kulikowski, k.; przytuła, s.; sułkowski, l. The motivation of academics in remote teaching during the covid-19 pandemic in polish universities – opening the debate on a new equilibrium in e-learning. Sustainability, 2021, 13, 2752. Https://doi.org/10.3390/su13052752.

Lago, n. C.; terra, s. X.; ten caten, c. S.; ribeiro, j. L. D. Emergency remote teaching: investigation of learning factors in higher education. Revista ibero-americana de estudos em educacao, volume16, issue2, page391-406, doi10.21723/riaee.v16i2.14439, 2021.

Lin, c.-h, jin, y. Q, zhao, q.; yu, s.-w.; su, y. -s. Factors influence students' switching behavior to online learning under covid-19 pandemic: a push–pull–mooring model perspective. Asia-pacific edu res (2021) 30(3):229–245. Https://doi.org/10.1007/s40299-021-00570-0. (lin; jin; zhao; yu; su, 2021).

Mahfoud, h. What can we learn about educational project management in times of covid 19. International journal of educational research review,6(2),75-81, 2020.

Maity, s.: sahu, t. N.; sen, n. Panoramic view of digital education in covid-19: a new explored avenue. Review of education, volume9, issue2, page405-423, doi10.1002/rev3.3250, 2021.

Mishra, a.; otaiwi, z. Devops and software quality: a systematic mapping. Computer science review, volume 38, 2020.

Mo, c.-y.; hsieh, t.-h.; lin, c.-l.; jin, y.q.; su, y.-s. Exploring the critical factors, the online learning continuance usage during covid-19 pandemic. Sustainability 2021, 13, 5471. Https://doi.org/10.3390/su13105471

Mongey, s.; pilossoph, l.; weinberg, a. Which workers bear the burden of social distancing? Journal of economical inequality 19, 509–526, 2021.

Müller, r; klein, g. The covid-19 pandemic and project management research. Project management journal, 2020, vol. 51(6) 579–581, © 2020 project management institute, doi: 10.1177/87569728 20963316.

Oecd. Organisation for economic co-operation and development. Directorate for science, technology and innovation science, technology and innovation policy, frascati manual, 2015.

Oecd. Organisation for economic co-operation and development. Science and technology, guidelines for collecting, reporting and using data on innovation, 4th edition - en, oslo manual, 2018.

Oliveira, v.; teixeira, l.; ebert, f. On the adoption of kotlin on android development: a triangulation study. 2020 ieee 27th international conference on software analysis, evolution and reengineering (saner), 2020, pp. 206-216, doi: 10.1109/saner48275.2020.9054859.

Pereira, v. R. D.; hayashi, c. R. M.; ferrari, r. Engineering education and technological innovation: how to stimulate the ability to innovate? Revista tecnologia e sociedade, volume 12, issue 25, page111-128, doi10.3895/rts.v12n25.3654, published may-aug 2016.

Qazi, t.; naseer, k.; qazi, j.; alsalman, h.; naseem, h.; yang, s.; hardaker, g.; gumaei, a. Conventional to online education during covid-19 pandemic: do develop and underdeveloped nations cope alike. Children and youth services review 119 (2020) 105582. Https://doi.org/10.1016/j.childyouth.2020.105582

Reyes, j. M.; rodríguez, p. J.; muñoz, i. K. Characterization of tangible user interface elements to define their information architecture. Revista ibérica de sistemas e tecnologias de informação. Risti, n.º e32, 08/2020.

Rifai, b.; sari, y. R.; nuryadi, n. (2020) "design of online shopping application based on mobile devices and android studio in pt. Midi utama indonesia: design of online shopping application based on mobile devices and android studio in pt. Midi utama indonesia", jurnal mantik, 4(1), pp. 392-398.

Santos, f.; cardoso, a.; pereira, p.; strachan, l. Coach training within the covid-19 pandemic challenges and potential pathways. Frontiers in psychology, www.frontiersin.org. April 2021. Volume 12. Article 570706, 2021.

Seals, m.; pareek, j. D.; taylor, m.; sumner, m. "panel: covid-19 challenges to project management" (2020). International research workshop on it project management (irwitpm), 2020.

Shepherd, a.; cooper, j. Knowledge management for virtual teams. Issues in information systems. 2020, vol. 21 issue 1, p62-68. 7p.

Silva, c. C. R. O aprender e ensinar matemática em tempos de covid-19: uma experiência de ensino com o uso do jamboard e meet no ensino remoto. Xxvi profmat – encontro nacional de professores de matemática, 2021.

Singh, v; k.; chakraborty, s.; kadian, a. The effect of knowledge sharing on open source contribution: a multiplatform perspective. Proceedings of the 53rd hawaii international conference on system sciences, 2020.

Suframa. Superintendência da zona franca de manaus. Pd&i / lei de informática. 2016.

Suframa. Superintendência da zona franca de manaus. Portal da legislação, 2021.

Sweeney, e. M., beger, a. W.; reid, l. (2021). Google jamboard for virtual anatomy education. The clinical teacher. Https://doi.org/10.1111/tct.13389, 2021.

Transire. Transire eletrônicos ltda. 2021. Disponível em https://transire.com.br/. Acesso em 05/07/21.

Uea. Universidade do estado do amazonas. Portal de informações gerais, 2021.

Unzueta, g.; eguren, j. A. Training in higher education in the covid-19 context a case study of operation management training in a business innovation and project management master. 7th international conference on higher education advances (head'21) universitat politécnica de valència, valència, 2021. Doi: http://dx.doi.org/10.4995/head21.2021.12896.

Veljanovska, k. Information architecture analysis for user interface design (case study: e-learning platform for users with disability). International journal of science and engineering investigations, 9 (106). Pp. 23-28. Issn 2251-8843, 2020.

Venigalla, a. S. M.; chimalakonda, s. What's in a github repository? -- a software documentation perspective. Computer science - software engineering. Cornell university. 2021.

Vichova, k.; taraba, p. Covid-19 and the project management in sme. Sgem scientific elibrary. 20th international multidisciplinary scientific geoconference sgem 2020. Section environmental economics. Https://doi.org/10.5593/sgem2020/5.2/s21.017.

Wang, q.; su, m.; zhang, m.; li, r. Integrating digital technologies and public health to fight covid-19 pandemic: key technologies, applications, challenges and outlook of digital healthcare. Int. J. Environ. Res. Public health, 2021, 18, 6053. Https://doi.org/10.3390/ijerph18116053

Wang, t.; lin, c. H.; su, y. S. Continuance intention of university students and online learning during the covid-19 pandemic a: modified expectation confirmation model perspective. Sustainability;13(8):4586, 2021.

Yarlagadda, r. T. Devops and its practices. International journal of creative research thoughts (ijcrt), volume 9, issue 3. March 2021.

Yin, r. K. Estudo de caso: planejamento e métodos, 2015.