Czech University of Life Sciences Prague

Faculty of Economics and Management

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Diploma Thesis

Design of a Progressive Web App for On-Demand Translation Service

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Faculty of Economics and Management

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Thesis title

Design of a progressive web app for on-demand translation service

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Objectives of thesis

The main objective of the thesis is to design a prototype of a Progressive Web App (PWA) for a translation service on-demand in Prague. This study aims to analyze whether this app can be feasible in the everyday life of foreign people living in or visiting Prague, as well as to create a base for higher interaction with the locals.

Partial objectives of the thesis are:
- To analyze the development of PWAs and the latest market trends in on-demand services;
- To conduct a market research so as to evaluate the product viability;
- To evaluate the feasibility of the proposed application and formulate recommendations.

Methodology

The first part of the current work is focused on the PWAs Technology, which expands to both mobile web and desktop. The literature review will be conducted with the use of the latest resources related to the topic. Android technology and older generation responsive web design will be compared.

The second and last part of this study is the conduction of market research, to evaluate the product viability and feasibility study to evaluate the proposed application. The application prototype will be done with a prototyping tool following User-Centered Design (UCD). Final recommendations and conclusion will be formulated based on the findings in the literature review and outputs of the practical part.

The proposed extent of the thesis
60 – 80 pages

Keywords
Progressive Web Apps, PWA, service workers, on-demand app, translation service, User-Centered Design, User Experience, prototype.

Recommended information sources

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Declaration

I declare that I have worked on my diploma thesis titled " Design of a Progressive Web App for On-Demand Translation Service" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 29/3/2019 _____

Acknowledgement

I would have never been able to finish my dissertation without the guidance of my supervisor, support from my family, and help from my friends.

I would like to express my deepest gratitude to my supervisor, Ing. Milos Ulman, Ph.D. for giving me the opportunity to complete my thesis in the Czech University of Life Sciences. Without his encouragement, support and dedicated involvement in every step throughout the process, this paper would have never been accomplished.

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Design of a Progressive Web App for on-demand translation service

Abstract

One of the currently blooming industries mainly based on the globalization and migration, is the translation industry and since there is space for improvement and area for investment in this field, this study aims to provide a design of a prototype for an on-demand translation service in Prague. The idea is based on the difficulties that foreign people often face when trying to get a service in Prague due to language and communication problems and the integration issues which arise accordingly. Moreover, the on-demand economy as a result of technology companies introducing on-demand mobile applications is explained. The design of the prototype was based on User Research as part of the User Centred Design (UCD) Strategy and further research regarding UCD, User Research methods and prototyping tools are presented. The strategy of Progressive Web Apps (PWAs) is suggested in this study for the development of the above described application and the technology of PWAs is further analysed. The practical part of the current study includes the conduction of a feasibility study to evaluate the viability of the above described application, as well as interviews as a qualitative method of User Research, based on which the final prototype is designed. According to the main results of the market research, there is no PWA like the one described above in the Czech market. Moreover, an online survey which included 86 participants and was also part of the market research was conducted, and the main results indicated that 90.7% of the participants have faced difficulties in getting a service in Prague due to language difficulties and 52.3% replied that they had often faced these difficulties. Furthermore, 95.3% seem to believe that it is important for foreigners that this problem will be solved, 79.1% replied that they would use an application like the one suggested in this study and 44.2% replied that they agree that an application like the one described, can create a base for further interaction between locals and foreigners. Based on the results, future recommendations for the further development of the described application as an ultimate platform for the integration of foreign residents are suggested, as well as ways for generating profit and financially motivate the service providers. Finally, the main conclusions are presented.

Keywords: Progressive Web Apps, PWA, service workers, on-demand app, translation service, User-Centred Design, User Experience, prototype

Návrh progresivní webové aplikace pro překladači služby

Abstrakt

Jedním z ekonomických odvětví rozvíjejících se v prostředí globalizace a migrace jsou služby spojené s překládáním a tlumočením. I tento perspektivní obor je vhodný pro zlepšení a investice. Cílem této práce je načrtnout možnosti vylepšení poskytování služby překladu – navržení prototypu poptávkové služby překladů v Praze. Nabídka má vycházet z potřeb cizinců pobývajících v České republice (Praze), kteří mohou čelit řadě komplikací při obstarávání služeb zejména v důsledku jazykové a integrační (kulturní) bariery. Studie rovněž obsahuje vysvětlení vztahu poptávkou tažené ekonomiky a poptávkou vytvořených mobilních aplikací. Návrh prototypu byl založen na spotřebitelském výzkumu jakožto součásti strategie UCD. Předmětem této studie jsou rovněž samotný výzkum UCD, metody spotřebitelského výzkumu a prototypy nástrojů. Pro rozvoj předmětné aplikace jsou navrhovány PWAs. tyto nástroje jsou rovněž v rámci studie blíže analyzovány. Praktická část studie obsahuje analýzu proveditelnosti, která má prokázat životnost zkoumané aplikace. Zakládá se na rozhovorech (jakožto kvalitativní metodě spotřebitelského výzkumu). Na podkladě těchto výstupů je navržen finální prototyp. Na základě provedeného průzkumu trhu neexistuje na českém trhu v současnosti obdobná PWA. To potvrzuje rovněž dotazníkové šetření na 86 osobách, podle jehož výstupů se 90,7 % dotazovaných setkalo s komplikacemi při zajišťování služeb v souvislosti s jazykovou barierou a 52,3 % se s takovýmito komplikacemi potýkalo často. 95,3 % respondentů rovněž uvedlo, že by tyto komplikace cizinců žijících v Praze měly být řešeny. 79,1 % se vyjádřilo, že by navrhovanou aplikaci využili. 44,2 % se navíc domnívá, že by tato platforma mohla dále napomáhat další interakci místních obyvatel a cizinců. Z výsledků vzešla doporučení pro další rozvoj popsané aplikace jako platformy pro integraci cizinců. Kromě toho je předmětná aplikace potenciálně rentabilní a způsobilá k finanční stimulaci poskytovatelů služeb. Závěrem jsou prezentovány hlavní výstupy studie.

Klíčová slova: progresivní webová aplikace, PWA, služby, aplikace na požadavek, překladači služby, User-Centred Design, uživatelská zkušenost, prototyp

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1   Introduction

On-demand application is a platform for the customers which clusters their demands on mobile devices and fulfil those demands by providing immediate services based on the customer's requirements. By on-demand applications, customers are provided with a platform which enables them to approach the desired service provider more conveniently, receive faster services and narrow the communication barrier. There are many types of service oriented mobile on-demand applications like Uber and Airbnb, which have helped the on-demand economy model to arise (peerbits, 2019).

One of the currently blooming industries mainly based on the globalization and migration, is the translation industry and there is space for improvement, area for investment and possibility to move towards the on-demand economy model in a slightly different way than what currently exists.

Progressive Web Apps (PWAs) are not one specific technology, new framework or language, instead, they are a set of strategies, techniques, and APIs that provide the developers with the ability to build faster, more resilient, and more engaging websites that can be accessed by billions around the world and allow them to give users the native mobile-like experience they are used to (Sheppard, 2017). The Progressive Web Apps concept initiated by Google in the late 2015, was based on researches which showed that mobile web audiences are almost three times the size and growing twice as fast as applications audiences. However, even though it was indicated that half of smartphone users do not download any applications in a month, and the average user downloads two, mobile time spent continues to be dominated by applications and not the web (Birch, 2017). That is because native applications are much more engaging since they have access to features like push notifications and icons on the home screen.

In this study we provide the design of a prototype of a progressive web app for an on-demand translation service in Prague, as well as the evaluation of the feasibility of the proposed application and we formulate further recommendations. The prototype is based on User Centred Design as part of the product development life cycle and more specifically on User Research.

2 Objectives and Methodology

In this chapter we present the research motivations, the main and partial objectives of the thesis as well as the methodology used to produce the results and make further recommendations and final conclusion.

2.1 Research Motivation

The structure of current societies is based on free trade and free capital mobility (globalization), the increasing significance of international trade and international relations (internationalization), labour migration and big waves of immigration. Subsequently, the act of combining into one whole (integration) is of great importance. Foreign residents need to feel secure when living abroad, to have access in services without facing difficulties and accordingly to further interact with the locals, without creating marginal groups due to lack of integration.

Accordingly, the motivation of the current study was based on complications that foreigners living in Prague face when they need to be provided with a service, due to language difficulties. Finally, since foreigners tend to create marginal groups, another motivation was to formulate future recommendations through this research and provide suggestions for the further development of a product, that could potentially partially help in the integration process.

2.2 Objectives

The main objective of the thesis is to design a prototype of a Progressive Web App (PWA) for on-demand translation (interpretation) service in Prague. The goal of the current research is to analyse whether this application can be feasible in the everyday life of foreign people living in or visiting Prague, as well as to create a base for further interaction with the locals. Partial objectives of the thesis are:

- To examine the significance of User Centred Design and the User Research as a fundamental part of Product Development life cycle.
- To analyse the Progressive Web Apps Strategy and the reasons that the discussed application is suggested to be developed as a PWA.
- To study the arise of the on-demand economy model as a result of the applications offering on-demand services.

- To conduct a Feasibility Study including market research to evaluate the product viability.
- To conduct a User Research to evaluate the product accessibility, usability, design and its potential of success in the Czech market.

2.3 Methodology

The Methodology used in the Practical Part of the thesis consists of two main parts. The first main part is the conduction of a Feasibility Study in order to analyse the product viability and consists of six modules:

1. Description
2. Goal
3. SWOT Analysis
4. Market Research
5. Timeline - Roadmap
6. Financial plan for the average monthly minimum cost and suggestions for resources

The market research consists of two parts. The first part includes a research which was conducted in order to examine if a similar application exists in Prague based on three main criteria:

- To be a Progressive Web App
- To offer on-demand translation/interpretation service
- To be free of charge

The second part of the market research consists of an online survey which included 86 participants and was conducted in order to analyse the problem in detail and to figure the first reactions of the participants (potential users) regarding the suggested application.

Finally, the second main part of the methodology includes the conduction of three rounds of interviews as a qualitative method of User Research and the design of the final prototype.

3 Literature Review

3.1 User Centred Design

User Centred Design (UCD), Interaction Design, Participatory Design, User Experience Design (UX) are interconnected concepts and usually mixed, but they all involve the user as the main factor in product/service development.

User-centred design (UCD) is an approach that aims to create interfaces, artefacts, products, and services that are applicable, appropriate, and accessible to as many users as possible within the constraints of the design specification and it is usually based on a combination of research and UX design activities (Wilkinson, et al., 2014). User-centred design is usually determined by ISO (International Organization of Standardization) 9241-210 which is considered to be the best and most concise management guide currently available for Usability (Chammas, et al., 2015). At this point, it is important to mention the widely accepted definition of usability which would be; *"the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"* (Callejas, et al.).

Moreover, UCD is stated to be one of the four main approaches that have been used in the design process of successful interactive Product Development and the most critical one, since it basically shows that the user participation in all stages is the most critical parameter (Chammas, et al., 2015). Interaction Design is what makes the interfaces entertaining, able to be used and easy to use. Similarly, participatory design aims to develop technologies with the close involvement of stakeholders and end-users through cycles of requirements gathering, prototype development, implementation, and evaluation (Wilkinson, et al., 2014).

Arguments as that the design process is an expensive luxury that is not always necessary and that the users do not know what they want, are often used. Moreover, most of the time there is lack of diversity in the target market groups, as older people, disabled or children are often excluded, or the products do not actually really meet their needs, which does not benefit a large part of society and does not make commercial or ethical sense. However, it is important to understand that there is no person who knows better than the user himself and that involving users and diversity within the process can potentially reduce development risk and increase the long-term profitability.

UCD is a repetitive process and is usually defined by four specific phases: first, the designers attempt to get a deep understanding of the users of the specified system, as well as the context of use. Then, the user requirements are pointed out, so as the design phase can follow. At the end, there is the evaluation phase, where after it, the designers make further iterations of these four phases (Hudson, n.d.). In the Figure 1: four phase UCD approach (Hudson, n.d.), below, we can see the four-phase UCD approach.
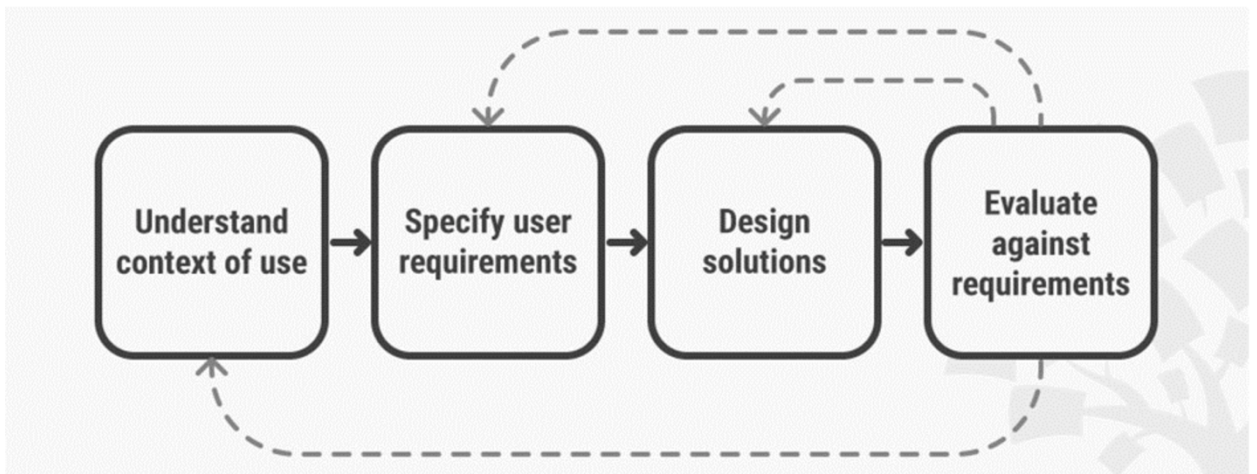
Figure 1: four phase UCD approach (Hudson, n.d.)

Furthermore, the design process in human-centred systems development is based on the use of multidisciplinary expertise since the collective ideas and the cooperation in a diverse team can contribute different perspectives and skills to the project.

As we mentioned before, UCD is usually based on a combination of research and UX design activities. One of the most important steps in the design process, which also keeps the UX design focused on users, is prototyping.

3.1.1 User (Experience) Research

The main way to place the user in the centre of the design process as we mentioned before, is user experience research (UX research) which is currently considered to have the same meaning with user research. "*User experience research is the process of understanding user behaviours, needs and attitudes using different observation and feedback collection methods*" (Ghazaryan, 2015).

Before moving on, it is important to clarify that UX and market research are two different processes and should not be mixed - though, they can be combined since their results complete each other and play the key role in product development. UX research uses smaller sample of people, it is focused on the user, the design of the product and the satisfaction that comes from it and the usability, whereas market research uses broad data and it is focused on the business and the success of the product in the market (Jecan, 2018). Also, market research is usually conducted during the early stages of product development cycle so as to assess its profitability, whereas user research will take place after the initial market research has started, so as to understand deeply the different aspects of the product. It is true though, that after the initial point in product development that we just described, both processes continue interchangeably so that the product will keep being successful on the market and at the same time the design, accessibility and usability will keep following the changing user needs (Jecan, 2018). Obviously, the order can always change according to the type of product and its life cycle (Ghazaryan, 2015).

UX research is part of the User Centred Design strategy and consists of both qualitative and quantitative methods. Qualitative tools are used to get an in-depth understanding of the experiences and everyday lives of individual users or user groups, whereas quantitative methods are used for measuring the user's behaviour (Mortensen, 2018). Specifically, qualitative methods of user research in mobile application development are interviews, lab studies, journal/diary studies and observational/field studies. Quantitative methods include online surveys, behavioural analysis, automated logging activity and experience sample methods. Qualitative research offers a direct assessment of the usability of a system, whereas quantitative data offer an indirect assessment of the usability of a design (Budiu, 2017).

3.2 Prototyping

A simple definition of prototype is *"A simulation or sample version of a final product, which is used for testing prior to launch"* (Cao, 2016). Prototypes are critical artefacts in the design process, helping designers and design teams progress towards a finalized product (Menold, et al., 2017). As it has been demonstrated in different studies, prototypes usually enable more discussions inside the teams regarding design concepts and provide the designers with deeper understanding of the context, more realistic understanding of technical and functional constraints and to quickly identify problems.

Furthermore, except that prototypes are considered a fundamental step in the optimization of product planning and development, they also serve as means in the engagement of designers and customers (users), since they are tools for interaction, better communication and gathering important information and feedback from the stake-holders, customers, sponsors and everyone who is involved in the product development process. In the Figure 2: Prototype for X structure and integration into the design process (Menold, et al., 2017), below we can see an example from the study of Menold et al. where a prototype for product X is proposed as a novel framework to guide product design during prototyping activities throughout the design process (Menold, et al., 2017).
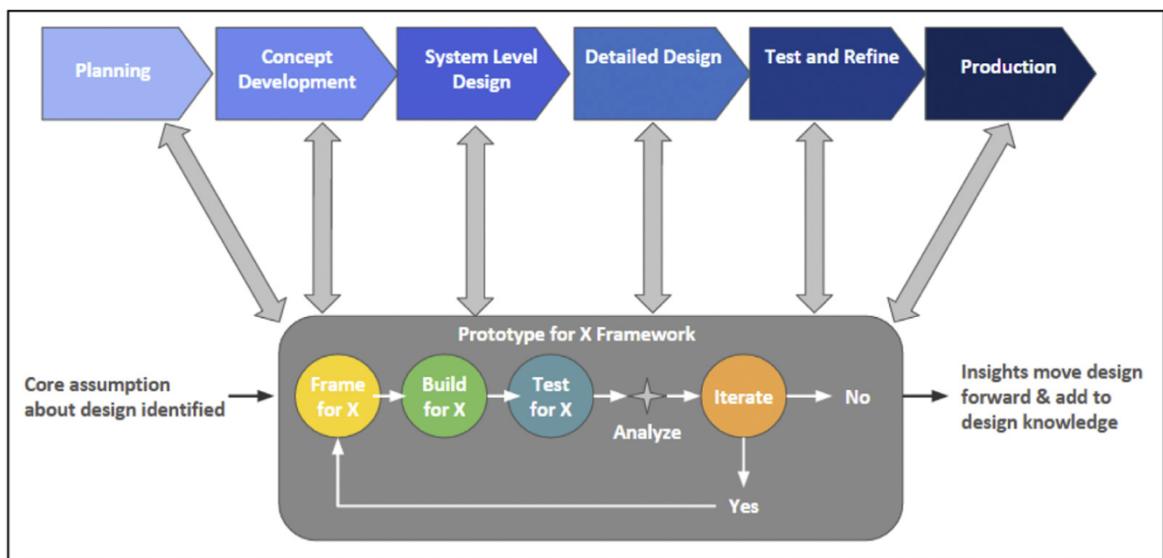
Figure 2: Prototype for X structure and integration into the design process (Menold, et al., 2017)

At this point it is important to clarify wireframe, mockup and prototype. Wireframes are focused on the layout of the content and they are basically blueprints representing only the product's structure and are of low fidelity. They can be either sketches on paper or can be made by using wireframing tools like Balsamiq. A visualized way to represent the product is the mockup which shows how the product looks like – colours, design, some UI elements – but without interaction. It is easier at this step to communicate with the users who will have a relatively clear idea of how the product will look like and it is still easy to make necessary changes. A prototype is usually a high fidelity – colours, content, general usability – representation of the final product and it simulates user interaction (Mkrtchyan, 2018). In the Figure 3: Example of wireframe on paper

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and with tool, mockup and prototype (Mkrtchyan, 2018), (Palliyaguru, 2018), below, we can see a wireframe, mockup and prototype example.

Figure 3: Example of wireframe on paper and with tool, mockup and prototype (Mkrtchyan, 2018), (Palliyaguru, 2018)

Some great prototyping tools currently in the industry are; InVision which is promoted by big companies like Uber, Netflix and Twitter, Adobe XD, proto.io, Sketch, Axure, Framer, Flinto, Keynote, Figma, Marvel, Pop and UXPin. In the Figure 4: Example of Adobe XD (top) and InVision Studio, below we can see an example from Adobe XD (on top) and InVision Studio, which were both used in the current study.
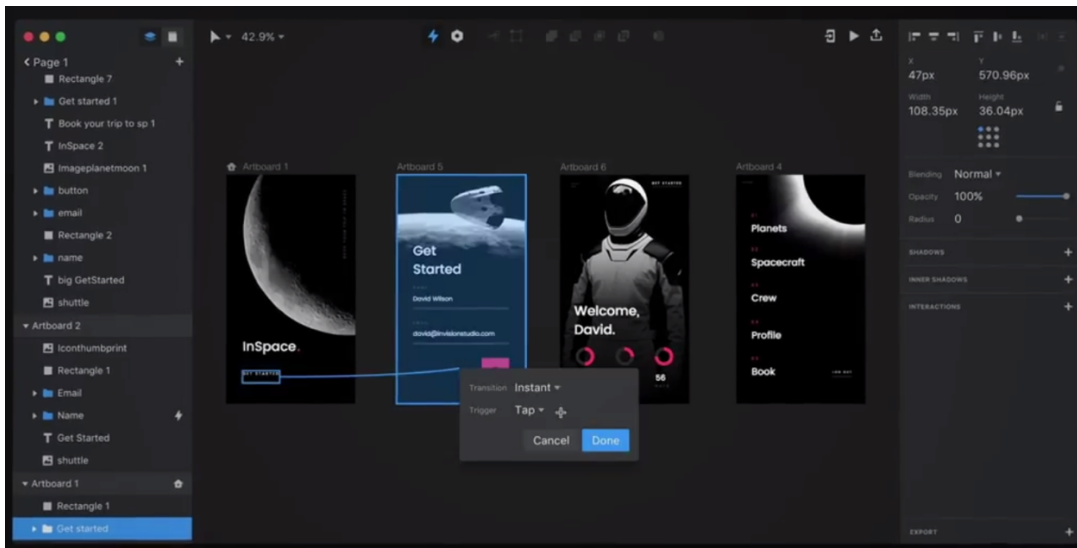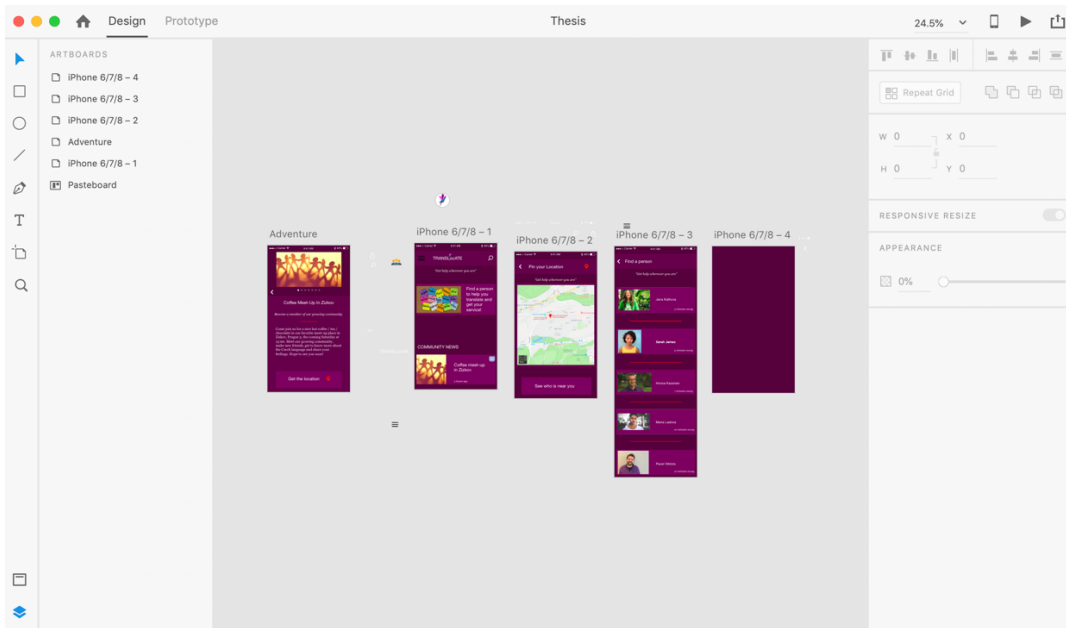
Figure 4: Example of Adobe XD (top) and InVision Studio

When prototyping, it is important to use tools that let the designers collaborate with the developers. Tools like Zeplin and InVision Studio provide the opportunity for (online) collaboration, by letting the developers of the application to "grab" assets like icons and images used in the design, see which colours were used, the exact dimensions and they even provide them with snippets of code, like CSS, xml, React and Swift making the process much easier. Moreover, there are features like writing comments and drawing. In the Figure 5: Example using Zeplin collaborative tool, below we can see an example with Zeplin.
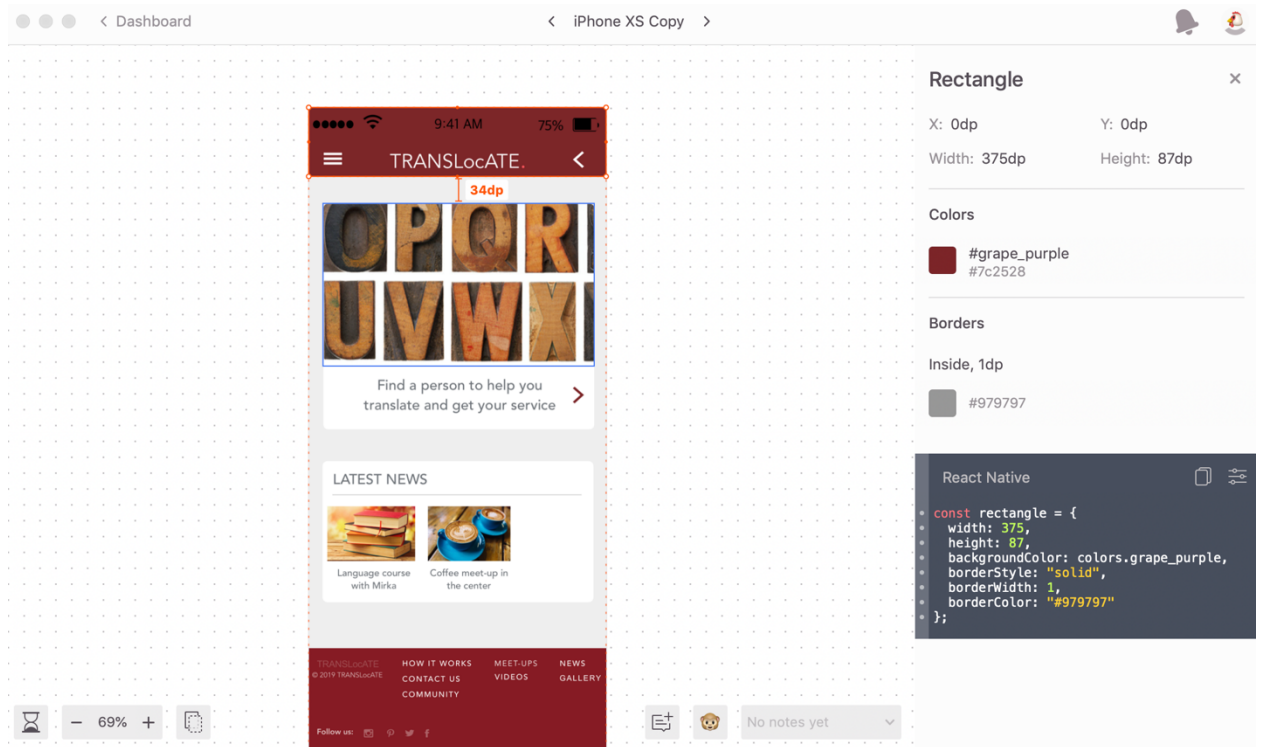
Figure 5: Example using Zeplin collaborative tool

3.3 Progressive Web Apps

3.3.1 From *mobile-first* to Progressive Web Apps

According to Hootsuite and We Are Social's new Q4 Global Digital Statshot report, there are almost 4.2 billion (55% of the total population) internet users around the world in October 2018 and more than 5.1 billion people now use a mobile phone, with most using a smartphone (Kemp, 2018). However, it is important to mention that the mobile audience growth is being driven more by mobile web properties, rather than mobile applications (Lazar, 2017). The results derived from the 2016 U.S. Mobile App Report as indicated in the Figure 27: Top 1000 web apps vs. top 1000 web properties (comScoreMobileMetrix, 2016), Appendix, are significant: the comparison of the monthly unique visitors to the top thousand applications and websites shows that mobile web audiences are almost three times the size and growing two times as fast as applications audiences (comScoreMobileMetrix, 2016).

Moreover, as we can notice in the Figure 28: Smartphone users' number of app downloads per month (comScoreMobileMetrix, 2016), Appendix, the results from the same report show that nearly half of smartphone users do not download any applications in a month, and the average user downloads two.

However, as it is explained in the Annual Developer Conference held by Google in 2017 (Google I/O '17), mobile time spent continues to be dominated by applications and not the web (Birch, 2017). Users usually type a URL when they need to search something "on the spot" or they need information fast, read an article or watch a video, but it is unlikely that they will come back later. On the other hand, native applications are much more engaging since they have access to features like push notifications and icons on the home screen.

Therefore, it became necessary to find a way of giving users a deeply engaging experience as soon as they landed on a website, rather than asking them to take the extra step of downloading an application. That is how the Progressive Web Applications (PWAs) concept came up.

3.3.2   Defining Progressive Web Apps

"Progressive web apps are a new breed of web apps that combine the benefits of a native app with the low friction of the web" (Ater, 2017). PWAs are not one specific technology, new framework or language, instead, they are a set of strategies, techniques, and APIs (Application Programme Interface) that provide the developers with the ability to build faster, more resilient, and more engaging websites that can be accessed by billions around the world and allow them to give users the native mobile-like experience they are used to (Sheppard, 2017). As it turns out, they are websites built in the already well-known technologies of HTML, CSS and JavaScript but they go a few steps further and offer users an enhanced experience. According to Google I/O '17, Progressive Web Apps are "*radically better web experiences"* and they are:

- *Reliable*, since technologies like service workers are used, which enable the PWA to load instantly regardless of the network state.
- *Fast*, loading on the user's device in less than a couple of seconds.
- *Engaging*, since they enable push notifications, placement on the home screen and they offer an immersive full screen experience.

3.3.2.1 Progressive Enhancement

Progressive Web Apps start as simple websites and as the user engages, more features become available and gradually/progressively transform into a native app-like experience – what is known as *progressive enhancement* (Sheppard, 2017). Progressive enhancement refers also to the idea of building an experience that works in most environments and then enhance the experience for devices that support more advanced features. For example, as we can see in the Figure 29: Visiting lancome-usa.com on mobile for the first time, Appendix, which shows an experiment with Lancôme's PWA on a personal smartphone, when the user visits a PWA for the first time and starts to browse (typing Lancôme USA on Google search and visiting the website for the first time), after just a few seconds he/she will be asked to add this application to home screen. Later, when the user comes back by tapping the icon placed on home screen, the website launches as full screen window – a stand-alone item, like a native application. As the user starts to engage with the application, he/she will be asked to receive notifications. What follows is the background sync and better offline experience.

3.3.2.2 Service Workers

"*Think of your web requests as planes taking off. Service Worker is the air traffic controller that routes the requests. It can load from the network or even off the cache*" (Hume, 2017). Service worker is a script that runs in the background of the web application, and it differs from the standard JavaScript file that is connected to the app since it does not have access to the DOM (Document Object Model) – so it sits outside of any single browser window or tab and it is not blocking (Gaunt, 2018). Before service workers there was code running either on the server or in the browser window. There were a number of issues with the previous APIs which used to give users offline experience (like the AppCache API), that service workers were designed to avoid. Service workers introduce another layer, as it is indicated in the Figure 6: Service Worker Layer (Hume, 2017), below:
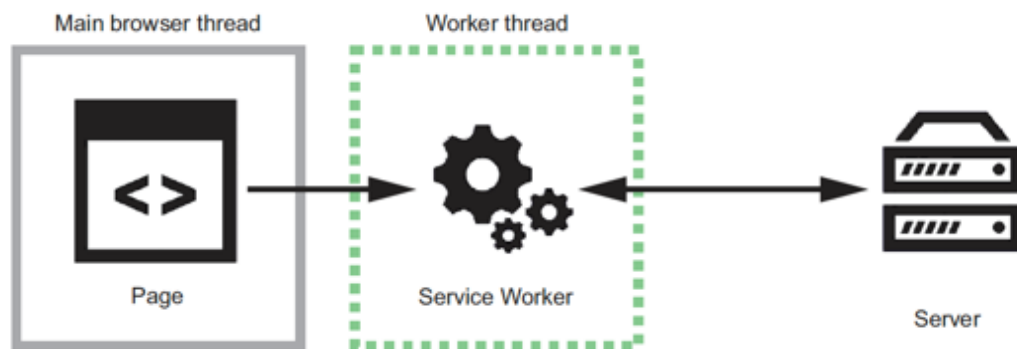
Figure 6: Service Worker Layer (Hume, 2017)

As we can see, service worker acts as an intermediary between the app and the Internet. It can listen and act on events from all pages under its control. Events such as requests for files from the web can be intercepted, modified, passed on, and returned to the page. All traffic for the app must run over HTTPS to protect the integrity of the website and for privacy and security of the users (Basques, 2018). This means that there is a layer between the page and the web that can respond to requests independently of a network connection. This layer works even when the user is offline and can detect an offline state or slow responses from the server and return cached content instead. Cached defines that the shell files are loaded once over the network and then saved to the local device. As an example, we continued with the same Lancôme PWA, just on airplane mode. In the Figure 30: Cached version of the already visited Lancôme PWA on smartphone, Appendix, we can see that when launching the app offline, users can see a cached version of a page they have already visited. Moreover, the app notifies that the browsing is in offline mode and we can also notice the app shell in places where the content could not be loaded. In total, we must admit that this is a much better web experience for the user.

There is still a layer that can communicate with the server, despite that the user closes all the tabs running the application in the browser. This layer can receive and display push notifications, or make sure any actions performed by the user get delivered to the server *("even if the user stepped into the elevator just as he/she took that action and then closed the app before regaining connectivity"*) (Ater, 2017). Up to now, if the user hits "send" on a message they have to stare at a spinner until it completes. If they try to navigate away or close the tab or if there is no connection, the user must come back later

and try again (Archibald, 2018). In the Emojoy demo video by Google for introducing background sync, we can actually see how this problem is solved. In the demo, which is a simple emoji-only chat, when the user gets in airplane mode, he/she sends the message, then leaves the app by closing all related tabs, and the moment the connection is back, the message is being sent and received by the other user, without the need of going back to the app and re-send the message.

To summarize, getting notified when online regarding information searched when offline, or user's messages to be sent when getting back connectivity without the need to go back to the application and resend it, are background sync features. According to Google's Developer Jake Archibald, "*Background sync is a new web API that lets you defer actions until the user has stable connectivity*". Since March 2016, background sync is available in Chrome from version 49 and above.

3.3.2.3 Application Shell Architecture

An application shell architecture or app shell architecture is a set of standards that focus on rendering fast and reliable performance, even on a slow connection or while offline (Hernandez, 2018). To be even more accurate, "*the app shell is the minimal HTML, CSS and JavaScript required to power the user interface of a progressive web app and when cached offline can ensure instant, reliably good performance to users on repeat visits*" (Osmani, 2018). As it was mentioned before, service worker is the tool to let us cache the User Interface (UI) shell of the website. The first time the website is loaded, the load should be fast (it should take only a few seconds) and instantly cached, so that every following time the user opens the application, the shell files are loaded from the local device's cache. Subsequently, this results in immediate startup times (Dutton, 2016). This allows us to give our PWAs similar properties of native apps. In the Figure 31: Service Workers to cache the UI shell and once it is loaded, the dynamic content is added to the page (Hume, 2017), Appendix, we can see an example with Google's Inbox, where first the cached UI shell, in this case header, footer and navigation, is loaded immediately and the dynamic content is loaded into the page later.

According to Google's engineering manager Addy Osmani, the benefits of an app shell architecture include:

- *Reliable performance which is consistently fast*
- *Native-like interactions*

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- *Economical use of data*

At this point it is important to mention the meaning of economical use of data. An application shell is designed to use minimum data and caches only the essential files for the application. This is important because even though data is relatively cheap in western countries, this is not the case in emerging markets where connectivity is expensive, and data is costly.

3.3.2.4 Lighthouse

Even though it is not necessary to build a progressive web application from the very beginning, but it is possible to add the features of a PWA in an existing web application, it is important to use tools that guide us in building progressive web apps and audits for performance, accessibility and more. Lighthouse is an open-source tool from Google that helps to improve the quality of the web application, not just PWA but general web practices and it also helps to maintain the quality of the app (Eric Bidelman, 2017). We can run Lighthouse in Chrome Developer Tools as it is indicated in Figure 32: Lighthouse in Chrome DevTools, Appendix, from the command line, or as a Node module. The user can give Lighthouse a URL to audit, it runs a series of audits against the page, and then it generates a report on how well the page did. Lighthouse Chrome Extension can be downloaded from the Chrome Web Store. In the Figure 33: Lighthouse report example, Appendix, we can see an example of how a report looks like.

3.3.3 Why Progressive Web Apps

Dozens of major brands are moving from native apps to PWAs (Gazdecki, 2018). AliExpress, The Washington Post, The Weather Channel which is a top-20 forecasting site in the United States, Forbes, Lancôme, Twitter, George.com which is a leading UK clothing brand and Nikkei which is one of the most authoritative media businesses in Japan, are just few of the examples of companies which decided to provide a better user experience and accelerate their business on the web and got great results.

However, in this study we will focus in two examples that indicate the importance of progressive web apps in the emerging markets. The first company is Flipkart, India's largest e-commerce site, that decided to combine their web presence and native app into a Progressive Web Application (Nagaram, 2015). In the beginning of 2015, Flipkart decided to temporarily shut down their mobile website since they found it hard to provide a user

experience that was as fast and engaging as that of its mobile app. At this point, it is important to mention that 81% of first-time internet users are only on mobile and India became the second largest smartphone market in 2017 (Punjani, 2017). The results of their PWA, Flipkart Lite, were immediate as shown on the case study: three times more time spent on site, 40% higher re-engagement rate, 60% of all visits to Flipkart Lite come from people launching the site from the home screen icon and three times lower data usage (Flipkart, 2016).

As we can notice, thinking about *offline-first* capabilities of PWAs, is also of a high priority for the emerging markets where network connectivity can be a problem and data are expensive. Similarly to India's Flipkart, another great example is Konga.com, the leading e-commerce website in Nigeria, that decided to build the first Progressive Web App at a major e-commerce website in Africa. In Nigeria, there are 185 million people, 97 million internet users, 64% are on 2G network and only 20% are on 3G (Mori, 2016). Moreover, the monthly minimum wage is 90$ and the data package cost is 0.50$ per 1MB of data. As Andrew Mori, Konga's Director Technology explains, responsive web design works well with Wi-Fi and 3G networks and native applications did not fit their evolving business model, which as a start-up they had to change often. Consequently, they could not produce a native app and expect it to last the duration of their business model. Moreover, by changing features continuously, they had to release new versions of the app and that was an upgrade cost for their users. In the Figure 7: Comparing responsive web and native app (Mori, 2016) below, we can see the restrictions of responsive web design and native apps and why konga.com decided to build a progressive web application instead.

Responsive Web	Native Application
Built to work on Wifi/3G +	Fast paced business changes
Average CDN transfer rate 250 kb/s	Upgrade costs
Homepage size 2.5 Mb	Degradation under network failures

Figure 7: Comparing responsive web and native app (Mori, 2016)

3.3.4 Transition of real-time apps to PWAs

One great example regarding on-demand services and applications using real-time data transitioning to Progressive Web Apps strategy, is the Tinder case study regarding web app performance. With the main goal being the adoption of the brand-new market trend (PWAs), Tinder Online PWA is currently available on both desktop and mobile web (Osmani, 2017). Similarly to the mainly e-commerce service providing companies previously mentioned, the results from converting Tinder to Tinder Online PWA, indicated that the same experience was offered in 10% of the data investment costs and loading times were reduced by half. Subsequently, the advanced user experience, which was also derived from the device independency, offered enhanced user re-engagement (Gazdecki, 2018). Other similar applications transitioning to PWAs which except the fact that they stream real-time data, they also offer services on demand are Uber and Lyft. Both apps are similar to their native applications' version and offer full functionality, but they use less data and come at a significantly lighter weight. Moreover, as it is indicated in Uber PWA case study, it is faster and works even on 2G networks with very fast loading times (Croll, 2017).

3.4 On-demand Economy

3.4.1 Definition

The on-demand economy also sometimes referred to as the "access economy," is already large and it keeps on expanding. It is basically driven by *companies with technology platforms that allow them to cater to consumer needs by immediately providing goods and services* (Sachdev, et al., 2015). According to the results of the latest National Technology Readiness Survey (NTRS) conducted in October 2015, which surveyed 933 U.S. adults sampled at random from a consumer research panel, he on-demand economy attracts 22.4 million consumers annually, who spend $57.6 billion on them (Colby, et al., 2016). Moreover, from these results as it is indicated in the Figure 34 : On-demand economy consumers by age group (Colby, et al., 2016), Appendix, 49% of on-demand consumers are between 18 and 34 (millennials) 30% are between 35 and 54, and 22% are 55 or older.

Furthermore, from the same report, the results indicate that the on-demand economy isn't just for the wealthy, since 46% of on-demand consumers have an annual

household income of less than $50,000, whereas 22% have an annual household income of $100,000 or more.

3.4.1.1 Advantages and disadvantages of the on-demand economy

It is important to consider the benefits and downfalls that result from this new type of business model. Primarily, consumers' needs are satisfied by the businesses in a cost-effective, scalable, and efficient way. In particular, businesses have the possibility to offer services without all the high costs related with common, long-established labour models. There is no need of hiring, training and providing benefits for staff and furthermore, since work is usually based on service, there are as well no costs related to materials. Moreover, another benefit especially for service providers, would be that the on-demand economy gives people the opportunity to use their free time in order to generate additional income. Basically, according to the working hours they choose to spend on providing services, they more than often get paid the same day. Also, since the application is designed to deliver a steady supply of customers, there is no need to be concerned about attracting consumers.

However, there are also challenges that are often faced in the on-demand economy model, as for instance the assurance for user privacy. Anticipating hacking and cyber-attacks is usually a high cost, but it is fundamental for building trust with the customers. In addition, one more drawback of the on-demand economy for service providers, is the difficulty to secure a set amount of work, which can accordingly create budgeting challenges (Paine, 2017). Another important issue to be considered, is that service providers are considered independent contractors for the sake of gross income before income tax is calculated, and as such, complete their personal income tax return, which can become troublesome if they are working with numerous concerns (Murray, 2019).

3.4.2 On-demand applications

On-Demand economy is the result of technology companies thriving on the consumer demand by providing them with the immediate goods and services via on demand mobile applications. Particularly, on-demand application is a platform for the customers which clusters their demands on mobile devices and fulfil those demands by providing offline services (peerbits, 2019). In the Figure 8: Flow of on-demand service application (peerbits, 2019), below, we can see the flow of on-demand service application and in Figure 35: User flow of on-demand service application (peerbits, 2019), Appendix, and

Figure 36: Service provider flow of on-demand service application (peerbits, 2019), Appendix, we can see the user and service provider flow.

It is important to mention that nowadays almost everything from medicines, food, groceries, to services, are booked through mobile apps. Some of the leading industries are transportation, home services and various other professional services like electrician, plumbing and baby-sitting, food delivery, logistics, healthcare, eCommerce, and travel (specifically platform for the travellers and the host like Airbnb) (Mansuri, 2019).
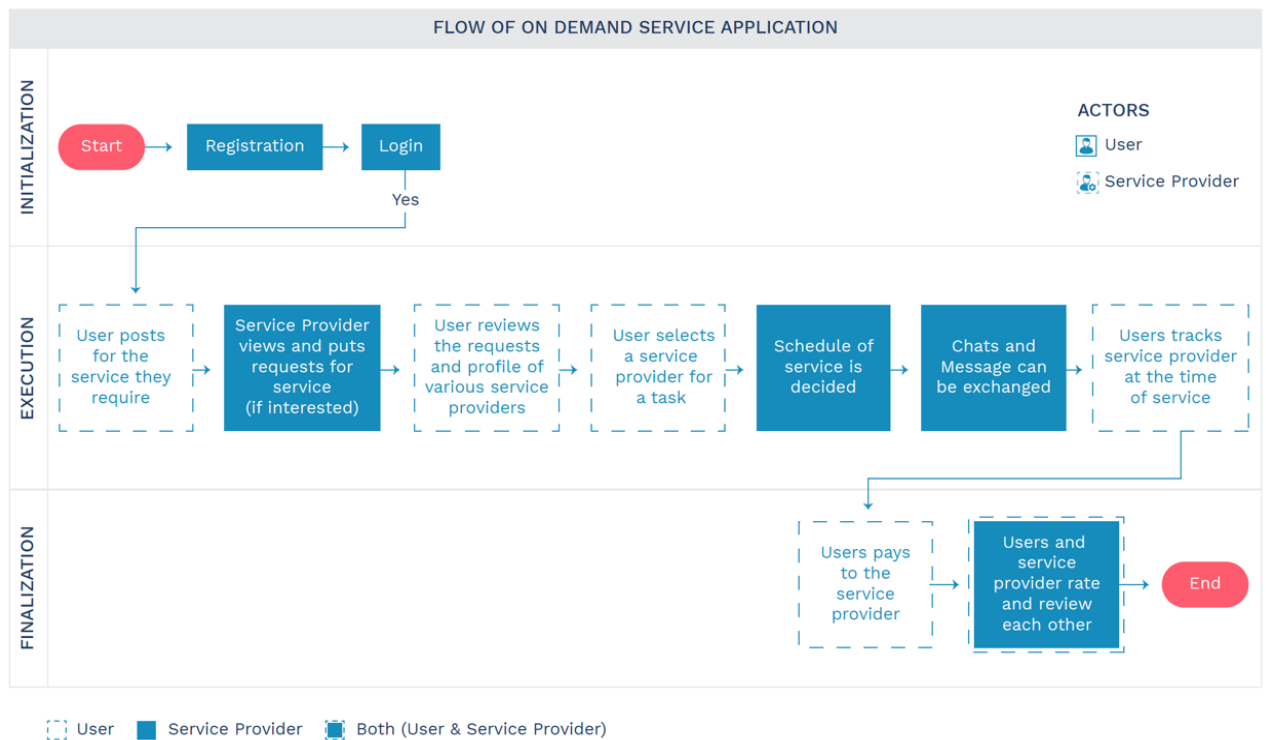
Figure 8: Flow of on-demand service application (peerbits, 2019)

3.4.3 Translation Industry

The translation market is growing with an incredibly fast rate, since the migration and the number of companies connecting with each other globally is increasing, making the need for language translation essential. As a part of globalization, there is a wide number of languages spoken and as subsequently, localization and translation is an industry that is currently blooming. According to recently conducted researches, the translation industry will expand in the future and to be more specific, the global marketing

for language and technology will overcome the $49.8 billion. As a consequence, translation and localization companies are forced to use current technology and to provide quality services for companies globally (Shakti, 2017).

Up to now, the industry mainly provides services which include translation of documents (translation of paper-based or digital documents), translation of software as well as website translation (localization), and interpretation.

As we understand, based on the necessity of translation services, there is space for improvement, area for investment and possibility to move towards the on-demand economy model in a slightly different way than what currently exists. This is what we will discuss in detail as we go further in our research.

3.5 The language barrier in the Czech Republic

3.5.1 Defining the problem

According to the US Foreign Service Institute estimates on language difficulty, an educated, native English-speaking adult would require roughly 1,100 classroom hours to reach a professional level of reading and speaking Czech, which practically means that if a person takes a one-hour lesson every week, this would take 22 years. A more dedicated student could reach this by taking class five hours a week for about four and a half years (without holidays). On the other hand, learning Spanish, Dutch or German require around 600 classroom hours (Thompson, 2014).

According to the Czech Republic in Data 2015 report, there are nearly 460,000 registered foreigners living in the Czech Republic, with 166,000 residing Prague (Park, 2015) and the number keeps increasing. Moreover, as the economy in the Czech Republic is one of the most stable in the European Union (EU) and since it maintains a high-income welfare state as well as the lowest unemployment rate (1.9% in November 2018), there is space for investment from start-up companies and attracts plenty of multinational corporations. Therefore, in most of the international companies along with many start-ups, the official language is English, even though some of them offer optional introductory language classes, which does not make it a necessity for the foreigners to study the language intensively.

On the other hand, it is necessary also, to analyse the development of the English language skills of the Czech population. According to the Foreign language learning statistics article from Eurostat (data extracted in 2018), many of the eastern and northern

European Member States that joined the EU in 2004 or 2007 had a tremendous increase (between 69 % and 85 %) in 2016 in the proportion of pupils learning English within primary education (Eurostat, 2018). In the Figure 37: Proportion of pupils in primary education learning foreign language in 2016 (Eurostat, 2018), Appendix and in the Figure 9: Foreign language learnt per pupil in upper secondary education in 2011 and 2016 (Eurostat, 2018) below, we can see the two figures showing the proportion of pupils in the EU Member States who learn English in both primary and upper secondary education in 2016.

	Pupils learning English		Pupils learning French		Pupils learning German		Pupils learning Spanish	
	2011	2016	2011	2016	2011	2016	2011	2016
EU-28 (¹)	93.8	94.0	23.0	16.4	21.1	17.2	18.3	21.5
Belgium	94.5	98.6	49.2	50.3	27.7	26.3	5.1	5.2
Bulgaria	88.4	91.0	13.4	11.3	33.7	35.7	8.9	9.8
Czechia	100.0	99.2	22.5	14.8	66.9	60.1	10.1	12.8
Denmark	91.0	81.7	9.1	7.9	33.7	28.1	24.5	19.6
Germany	92.8	94.5	26.5	22.6	–	–	19.4	19.9
Estonia	96.0	98.4	6.4	7.4	36.4	24.6	1.9	4.0
Ireland	–	–	57.2	57.3	16.0	19.3	12.4	17.0
Greece (²)	90.9	91.2	6.7	4.6	3.3	3.9	:	0.0
Spain	93.1	99.7	21.0	24.5	0.9	2.2	–	–
France	99.6	99.9	–	–	21.9	20.8	65.7	73.0
Croatia	99.1	99.6	3.2	4.8	62.4	63.6	2.9	3.6
Italy	97.6	98.5	18.2	16.1	6.5	9.3	8.3	14.0
Cyprus	89.3	89.9	36.0	37.6	3.9	6.5	16.8	16.1
Latvia	99.1	98.7	5.1	5.9	30.2	26.5	0.3	1.5
Lithuania	92.9	96.4	3.3	2.8	13.4	7.1	0.4	0.5
Luxembourg	97.9	96.9	100.0	100.0	100.0	100.0	5.4	3.7
Hungary	78.5	83.9	5.9	5.3	44.4	46.2	2.6	3.1
Malta	66.5	100.0	4.9	21.6	1.3	6.9	1.8	6.2
Netherlands	100.0	95.0	33.0	27.6	43.3	41.4	0.0	5.0
Austria	99.4	99.9	43.3	35.4	–	–	15.7	19.6
Poland	93.4	96.2	8.4	8.4	50.4	46.7	2.2	6.2
Portugal	47.0	63.3	3.5	2.5	0.7	1.7	8.2	6.9
Romania	99.1	100.0	86.3	82.5	11.2	13.8	1.0	3.0
Slovenia	99.6	93.7	10.7	8.0	67.9	64.9	12.4	11.3
Slovakia	98.7	98.6	17.2	9.9	61.5	58.6	8.9	10.9
Finland	99.6	99.9	16.7	10.3	24.8	16.2	15.7	12.7
Sweden	100.0	100.1	21.7	15.7	26.4	19.3	45.3	40.4
United Kingdom	–	:	24.7	:	9.2	:	9.3	:
Iceland	73.2	74.0	13.4	9.9	25.8	23.2	23.3	25.5
Liechtenstein	100.0	100.0	100.0	92.7	–	–	0.0	0.0
Norway	42.0	36.5	10.1	9.1	18.8	21.4	22.5	24.4
The former Yugoslav Republic of Macedonia	:	100.0	:	23.3	:	25.4	0.0	0.0
Turkey	99.4	:	0.3	:	0.5	:	0.0	:

Note: refer to the internet metadata file (https://ec.europa.eu/eurostat/cache/metadata/en/educ_uoe_enr_esms.htm).
(:) not available
(-) not applicable
(¹) 2016: excluding the United Kingdom.
(²) 2011: Spanish, negligible.
Source: Eurostat (online data codes: educ_ilang and educ_uoe_lang01)

eurostat ☐

Figure 9: Foreign language learnt per pupil in upper secondary education in 2011 and 2016 (Eurostat, 2018)

Even though the data show a great improvement in Czechia regarding the English language, there are also researches indicating the difference regarding the acquisition of

language knowledge compared to the ability of an only very basic communication in an everyday situation (just making oneself understood) (Klimova, 2014).

According to the same research, the language skills are usually divided according to the type of the communicative process into receptive (listening and reading) and productive (speaking and writing). However, the aim of English language teaching is not to use these language skills separately but, in their integration, which means that the quality of the knowledge is the most important aspect. In the Figure 10: Distribution of language skills, Czech language and translation in English classes at Czech elementary schools (Klimova, 2014), below, the distribution of language skills in Czech elementary schools is indicated.
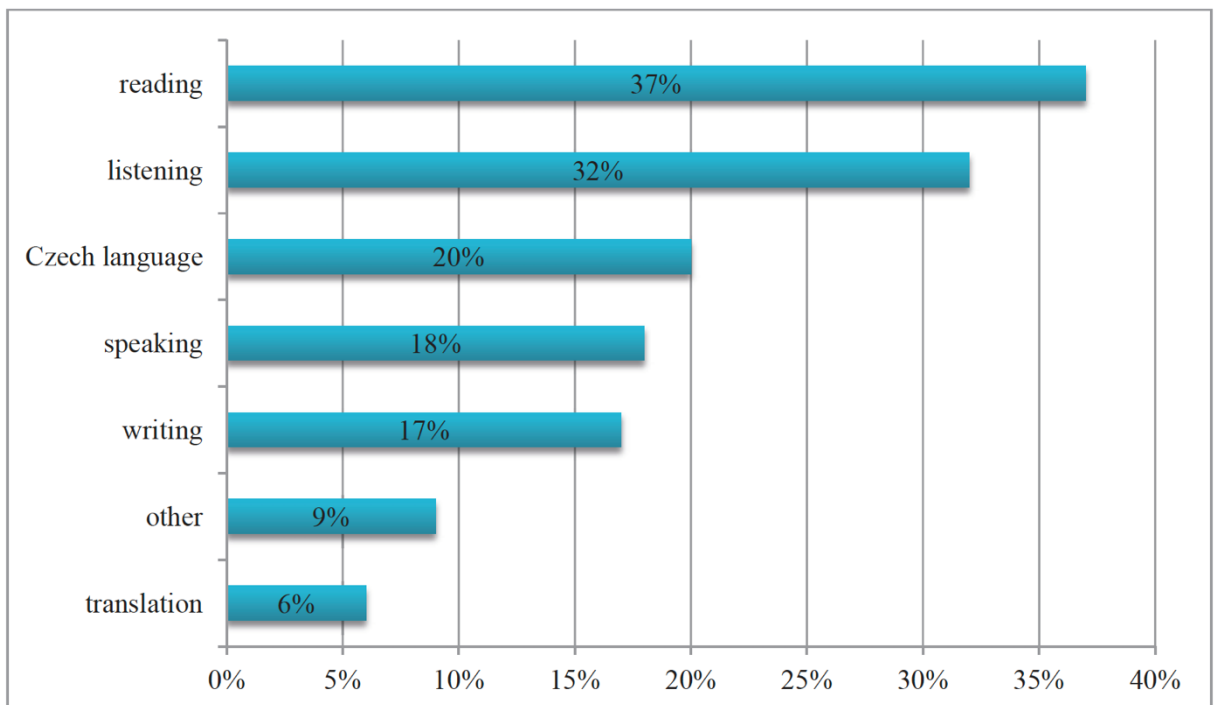
Figure 10: Distribution of language skills, Czech language and translation in English classes at Czech elementary schools (Klimova, 2014)

Furthermore, according to the findings of other articles, there are also cultural and linguistic considerations that affect the learning of English in the Czech Republic, which we also need to take into consideration. Based on some brief questionnaires that were distributed to some of the students of the English Language Department at the VSB-Technical University of Ostrava, except the students' opinions and perspectives on both

Czech and English languages as well as the advantages and disadvantages of each one, students were asked how much time they spent on the net using Czech and English accordingly, and the results are shown in the Figure 11: language comparison study (Landry, et al., 2016), below.
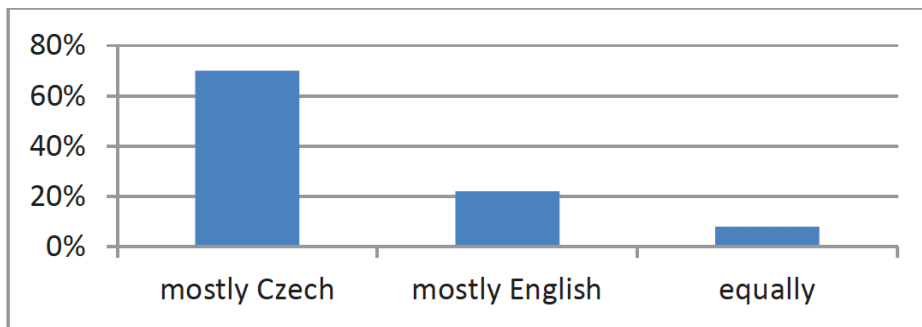
Figure 11: language comparison study (Landry, et al., 2016)

According to the responses 140 students (that is 70%) mostly use Czech, 44 (22%) indicated that they mostly use English, and 16 wrote that they use both languages equally.

As we can realize from all the above, since a big percentage of foreign people in Czech Republic do not acquire the Czech language skills and on the other hand the locals do not advanced English language skills, there is a language barrier that is created. The language barrier affects the country's trade, tourism, as well as many more socioeconomic factors. According to many studies, linguistic dissimilarities between countries may inhibit trade for a variety of reasons, the most obvious being the cost associated with communicating in foreign languages (Lohmann, 2010).

However, between two countries that speak more similar languages, as for example Spanish and Portuguese, the trade can be facilitated, since languages similar to one's own are more easily acquired and it is less costly to learn them. Therefore, this high degree of similarity increases the potential number of speakers of the foreign language in the home country, reducing translation costs. Yet, most of these studies regarding the language barriers in trade, do not take into consideration the possibility that potential trading partners would communicate via a non-native language. As it is argued in other researches, the acquisition of English language skills can promote foreign trade primarily by

improving communication between different countries, since English is a *lingua franca,* a vehicle language (same way we use dollar in most international transactions) (Ku, et al., 2010).

Finally, if we take all the above into account, we will realize that it is important to overcome the language barrier, which extends partially to a difficulty in the integration of foreign people and accordingly creates a big gap between locals and foreigners. This means that we might achieve a small change in these problems by creating a platform, which by using the translation service on-demand as a tool, can accordingly bring closer the locals and the foreigners.

4 Practical Part

4.1 Feasibility Study

To assess the viability of the proposed application and its success in the Czech market, it is fundamental to conduct a feasibility study prior to investing and launching. In our study we will include our application description, our goal, SWOT analysis, market research, the timeline, a financial plan for the average monthly minimum cost and suggestions for resources.

4.1.1 Description

The suggested application is called TRANSLocATE and it is an "uber-like" application for translation (interpretation) service on-demand in Prague. If users face an issue when getting a service for example in a tax office, or a hospital, they can pin their location on the map, see who is "near them" (usually locals or any person who can speak both the Czech and English language), choose the person and start a chat to explain their problem and either by arranging an immediate phone call, or the "translator" to come directly to the place to help with the interpretation, the service will be provided to our users on the spot.

4.1.2 Goal

The main goal of the suggested application is to provide a free on-demand translation tool to the foreigners living in Prague (could be used even by the tourists), so their daily routine can partially become easier and they can feel more secure.

4.1.3 SWOT Analysis

We will use SWOT analysis as our strategic planning technique to help us understand our strengths and weaknesses and to identify our opportunities and threats. We can see the analysis presented at the Figure 12: SWOT Analysis for the TRANSLocATE application, below:

Strengths	Weaknesses
1. Technology used for the application (PWA) makes it independent of any platform (Android, iOS) 2. The non-existence of similar app in Prague 3. Social app – no cost for the users 4. First app to provide translation (interpretation) service on-demand in Prague	1. Lack of financial incentive for the users. 2. Limited resources (in terms of providing steady supply of "customers" to the service providers and vice versa) 3. Limited financial resources (in terms of employing junior developers and designers for the software development process)
Opportunities	Threats
1. Ultimate integration tool for foreigners and tourists in Prague 2. Increasing number of foreigners and tourists in Prague 3. Improvement of the services offered to foreigners and tourists 4. Organizing events, meet-ups for better communication between foreigners and locals 5. Organizing Czech language courses	1. Minimizing the number of users in case of application fees in the future 2. Entry of new competitors in the market. 3. Development and improvement of speech translating applications (real time speech translations)

Figure 12: SWOT Analysis for the TRANSLocATE application

4.1.4 Market Research

A market research was conducted in order to analyse and interpret information about the Czech market, regarding the suggested application to be offered and be successful.

The first part was to research in case there is a similar application in Prague. The basic criteria for our research were:

- to be a Progressive Web App,
- to offer translation service on-demand
- and to be free of charge

First, none of the researched applications were Progressive Web Apps, so they would either have just a website, or a website and the android/iOS version of application. Moreover, none of the found applications were similar, as most of them were offering translation services from certified translators, but not on-demand and with usually high costs. To be more accurate, there are possibilities to book a translator with appointment in order to get a service, but not with immediate availability, like the Skrivanek website.

A website found to have similar scope with TRANSLocATE, is the Integration Centre Prague (ICP), which is a public service company founded by the Prague City Council in 2012 (ICP, 2018). As it is mentioned on the native application called Praguer, it is intended primarily for non-EU migrants living in Prague and the goal is to provide them support in resolving everyday difficulties connected with the life in Prague. Specifically, it provides information and contacts for various organizations, institutions and their departments. At the same time, the ICP website offers free consultation and possibility to arrange an appointment to accompany the person in a hospital or any other service (the interpretation service is provided by appointment so it is not on-demand service) and it also provides free language courses with a small deposit, as well as activities for further interaction between the locals and the foreigners and activities only for locals. At this point, it is important to mention that the above described website and application are not well advertised, since when we performed a simple Google search for the "must-have applications in Prague as a foreigner", they did not appear and the first articles of expats.cz and Prague morning were mentioning Pubtran, IDOS, Dame Jidlo, Airbnb, Duolingo etc. They appeared only in a PragueTV article and in YouTube promo video after further research.

Also, other applications researched regarding the translation industry usually provide document or website translation, again not on-demand and with cost, like Translatus, Idioma and Fox Translation websites. Other applications which offer Czech language courses like Duolingo were not in our scope and applications similar to Google translate and Microsoft Translator are not capable of providing the mentioned services that our users would like to have, since they were tested and proved not that advanced yet to offer correct text or speech interpretation services.

In the Figure 13: Sample of translation service providing apps and websites available in Prague below, we can see 20 examples of the most well-known translation websites in Prague, as well as speech and text translation applications and websites which where researched. The criteria where to check if they are Progressive Web Apps (PWA), if they are free of charge and if the offered translation/interpretation service is on-demand. Any website offering "express" translation services (not free of charge) had a timeline of 24 hours so we do not consider them as on-demand.

Translation - Interpreting service (or Documents, Websites and more)	PWA	Free of Charge	On-demand
ICP (Praguer app)	No	Yes	No
Skrivanek	No	No	No
Hero Translating	No	No	No
Grabmuller	No	No	No
I.L.T.S.	No	No	No
A. Prospect	No	No	No
the BEST translation	No	No	No
Unicom Praha	No	No	No
Orange Tree	No	No	No
Presto	No	No	No
Translation Factory	No	No	No
JSV International Assistant Service	No	No	No
Spark Interpreting and Translation	No	No	No

Translation - Speech/Text (Documents, Photos and more)	PWA	Free of charge	On-demand
Google Translate	No	Yes	Yes
iTranslate	No	No	Yes
Translator!!	No	No	Yes
Microsoft Translator	No	Yes	Yes
Lindat Translation	No	Yes	Yes
TripLingo	No	Yes	Yes
Voice Translator	No	Yes	Yes

Figure 13: Sample of translation service providing apps and websites available in Prague

The second part was to make an online Google Survey, which included 86 participants mainly currently working and studying in Prague, Erasmus students of this and the previous year (2016-2018) and foreigners who had long stayed in and/or visited Prague plenty of times. The goal of the research was to see if indeed there is a difficulty of foreigners in getting some services in Prague due to language issues, to understand how often this problem is faced and to detect if the participants believe that an application like TRANSLocATE could partially solve their problem and potentially become a tool for further interaction between the foreigners and the locals. Some of the results are indicated in the Figures 14-21 below.

As it is indicated in the Figure 14: Question 1, online survey, below, 55.8% of the participants are people currently living in Prague or have lived in/visited Prague before.

1.
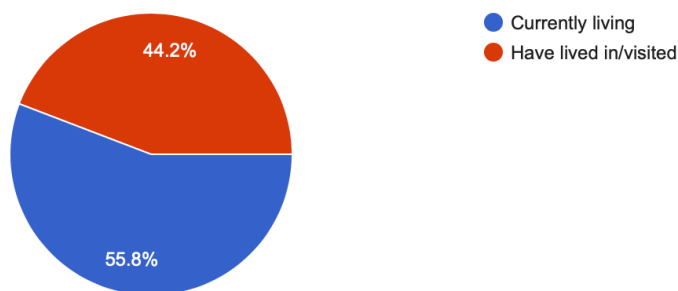
Figure 14: Question 1, online survey

Also, we can see in the Figure 15: Question 2, online survey, below, 52.3% rated the level of English language of the locals providing services with a medium level (3), whereas 30.2% with even lower (2).

2.
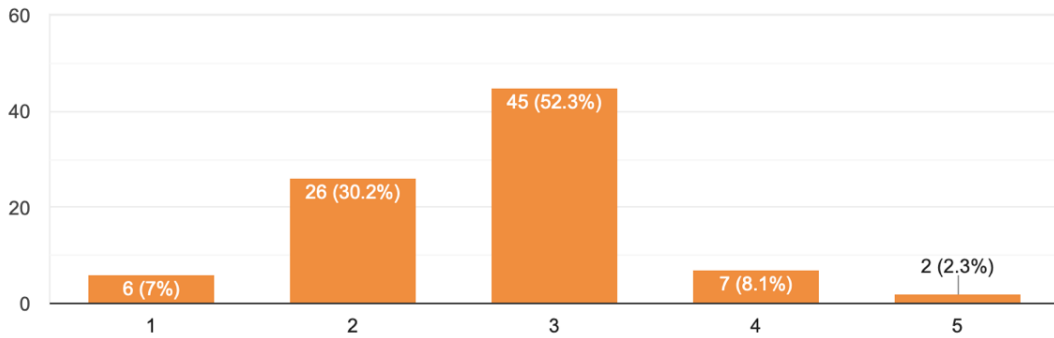
Figure 15: Question 2, online survey

As it is indicated in the Figure 16: Question 3, online survey, below, 90.7% of the participants have faced difficulties in getting a service due to language problems.

3.

Replies	Percentage(%)
Yes	90.7
No	9.3

Figure 16: Question 3, online survey

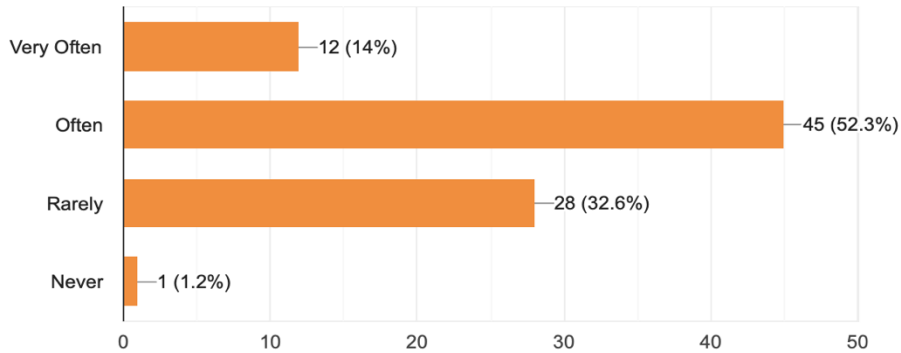In the Figure 17: Question 4, online survey, below, we can see that 52.3% replied that they have often faced these difficulties.

4.

Figure 17: Question 4, online survey

Furthermore, as it is indicated in the Figure 18: Question 5, online survey, below, 95.3% seem to believe that it is important for foreigners that this problem will be solved.

5.

Replies	Percentage(%)
Yes	95.3
No	4.7

Figure 18: Question 5, online survey

Moreover, as we can see in the Figure 19: Question 6, online survey, below, 79.1% replied that they would use an application like TRANSLocATE.

6.

Replies	Percentage(%)
Yes	79.1
No	20.9

Figure 19: Question 6, online survey

As it is indicated in the Figure 20: Question 7, online survey, below, in the question if this application could partially solve the language problem that foreigners face when getting services, 36% replied maybe and 34.9% agreed.
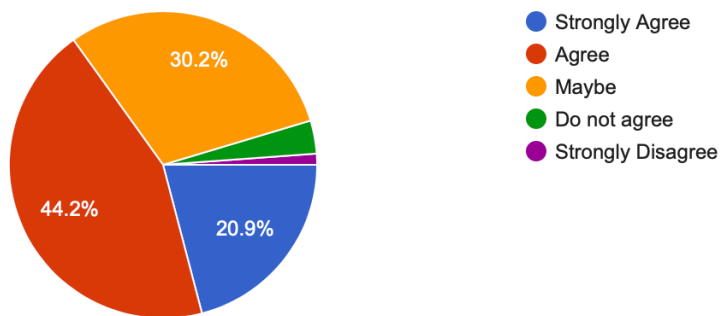
7.
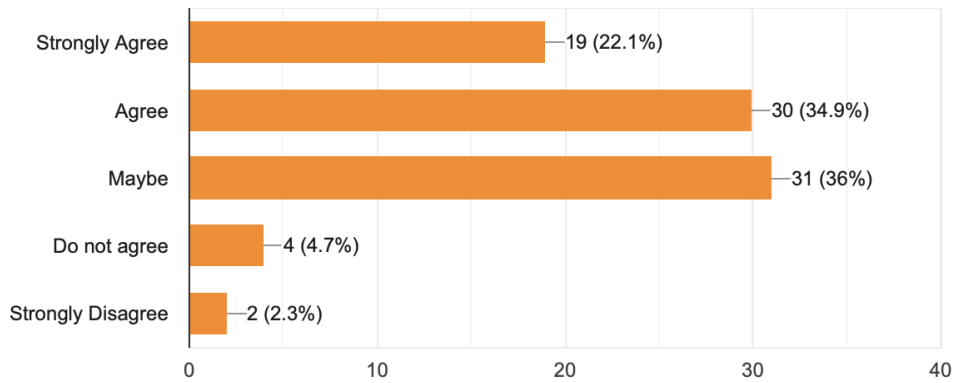
Figure 20: Question 7, online survey

Finally, in the last question if this application could create a base for further interaction between locals and foreigners, which is indicated in the Figure 21: Question 8, online survey, below, 44.2% replied that they agreed, 30.2% said maybe and 20.9% strongly agreed.

8.

Figure 21: Question 8, online survey

4.1.5 Timeline and financial plan

The timeline to create the application before launching, will be 3 months (as an example we used April 1st to June 29th). The roadmap of our software development project consists of eight main parts:

- Preliminary Analysis
- Systems Analysis & Requirements
- Design
- Development
- Testing
- Acceptance, Installation & Deployment
- Maintenance
- Marketing

Each main part consists of its modules and we can see them in detail in the Figure 22: Roadmap of TRANSLocATE application, below. Finally, in the Figure 38: Visual Representation of the TRANSLocATE Roadmap, Appendix, we can see the visual representation of the application development.

Preliminary Analysis	
Modules	**Timeline**
Market Research	Apr 1-14
User Research	Apr 6-12
Cost Analysis	Apr 1-7
Initial Investment	Apr 8-14

System Analysis, Requirements	
Modules	**Timeline**
Functional Requirements	Apr 14-27
Non Functional Requirements	Apr 14-20
Documentation	Apr 21-27

Design	
Modules	**Timeline**
UML Diagrams	Apr 28 - May 1
UX/UI Design	Apr 30 - May 7

Development	
Modules	**Timeline**
Divide the work into modules/units	May 4-7
Front End Development	May 8-28
Create DB	May 8-28
Back End Development	May 8-38
Deploy Application	May 29 - June 2

Testing	
Modules	**Timeline**
System Test	June 3-9
Security Test	June 3-9

Acceptance, Installation, Deployment	
Module	**Timeline**
Acceptance, Installation, Deployment	June 10-14

Maintenance	
Module	**Timeline**
Maintenance	June 15-29

Marketing	
Modules	**Timeline**
Social Media and Communication	June 10-29
Opening Event	June 27-29

Figure 22: Roadmap of TRANSLocATE application

The financial plan for the average minimum cost per month is indicated in the Figure 23: Financial plan for the average minimum cost per month for TRANSLocATE, below, where we can see the type and number of employees (UX/UI Designer, Developers, Social Media Administrator and Market Analyst), the type of research that needs to be conducting during the process (Market and User Research), the purchased software and the campaign to advertise our application (Social Media and Event). At this point we must add that UX/UI Designers and developers cost per hour is calculated assuming that they are graduates or juniors.

The prices calculated for the social media were regarding Facebook, Instagram, Pinterest, YouTube as well as the PragueTV, Prague Morning and Expats.cz websites. At the same financial plan, the total hours per month and the total cost for the whole month in Czech crowns are indicated as well.

Budget (CZK/Month)				
Work Packages	Number	Hours	Cost (CZK)	Total Costs
Contracting				
UX/UI Designers	1	160	250	40000
Developers	2	160	250	80000
Social media administrator	2	160	200	64000
Market analyst	1	160	200	32000
Research				
Market research	-	50	200	10000
User research	-	50	200	10000
Purchase				
Software	1	-	1000	1000
Advertisement campaign				
Social media and communication	-	20	800	16000
Opening event		48	120	5760
				258760

Figure 23: Financial plan for the average minimum cost per month for TRANSLocATE

Another important aspect is that for our initial investment we will apply for governmental, European, any grant funding for Innovative Products (R&D projects), or start-Up investors. Finally, we also suggest that the first release of this application in the

market will be without any cost for the users and suggestions for future revenues will be formed in the Results and Discussion part of this study.

4.2   User Research and Prototype

For our User Research we used qualitative tools and more specifically we conducted interviews. It is common in product development to use both qualitative and quantitative tools for the user research, though, qualitative research has the advantage of requiring less resources and time and provide an in-depth understanding of the potential users, since there are always new follow-up questions for more details. By using interview as a UX research tool we tried to observe potential users' behaviour, get a deeper understanding of what they want to achieve, what is their motivation to keep using our application, but primarily to figure if the need of a product like the one we envision exists. Moreover, we received valuable information regarding the design of our application, the features and navigation, so as to improve our prototype and get to its final design version which will be easy and satisfactory to use. The main goal was to have a design relevant to its target audience, so that it can be successful and to understand the return on investment of our UX design.

4.2.1   First Interview

As our target group, we used a diverse group of fifteen people who were part of our market research survey as well. The group was formed from people of different age, nationality, gender, working experience and knowledge background. Every session lasted twenty to thirty minutes and a script was used as a guide for the interview questions. In total, three rounds of interviews were conducted until we came up with the final version of our prototype. In each round a different prototyping tool was used to create the new demo as it will be explained accordingly. The demo (video of the application) that was used to be presented to the potential users during the first round of interviews, was designed with Adobe XD prototyping tool and it is indicated in the Figure 39: First prototype using Adobe XD tool, home page and location page, and the Figure 40: First prototype using Adobe XD tool, people around the user on the map and meet-up section, Appendix.

4.2.2 Questionnaire

At this point, it is important to provide more details regarding the questions asked to the participants. Every interview session was divided in 8 parts.

- Customer Introduction questions: At the beginning, the questions were introductory so that we get some general information about the person and making it easier to start the conversation. Those questions were regarding the name, the age, the everyday life in Prague, if they are students or working and in which field, what is their relationship with technology and if they have IT background.

- Real-life stories: The next part was more personal, and the users were asked regarding their real-life stories. First the questions were topic-specific like if they ever faced difficulties when getting a service due to language problems, how often did they face this problem and in which kind of services, for example in a hospital, clinic, foreign police, tax office etc. After that, they were asked what kind of alternative solutions to our application they might have used, for example other translations services and which, if they had to pay, how long did it take until they finally got the service they needed, which of the similar applications was their favourite, what did they like on the interface, was it easy to use etc.

- Product opportunity questions: After we provided them with a general description of the application, we asked them how they expected it looked like and then we showed them the demo. Then, we asked them to speak about their first impression and if it was similar with what they had in mind.

- Product reaction questions: Later, we focused on their first reactions and the questions asked were for example what was most appealing in this product, if there was anything unexpected or surprising in this application, if there was anything missing, anything that they would expect to happen but it did not happen and if they would continue to use this application after they saw it.

- Design: The questions that followed were focused on the design aspect, as for example the colours used, the size of the letters and the fonts, the buttons and the navigation and if everything was clear and simple enough to understand.

- Feedback: What followed was a more detailed feedback to help us evaluate the product. At this point we asked them if they would use this particular application, if they would trust it and what problem would this application help them to solve (if any), or what they would hope to get out of it.

- Recommendations: The final part was mostly a discussion regarding their further recommendations and expectations.

4.2.3 Second Interview

In the next two rounds of interviews the same people were interviewed so the sessions were slightly different and shorter in time (10-15 minutes), since the audience was already familiar with the application and the new demos were based on their feedback and recommendations, meaning that the focus was on the last 3 modules of the questionnaire.

As we also mentioned before, after every round of interviews the demo was updated by using different prototyping tools. Regarding the second round, the main reason was the feedback of the users regarding the design. More specifically, even though the users found the logic behind the application clear and simple and the navigation was understandable, there was feedback regarding the colour and the buttons since it was not clear were exactly to tap and the way the photos of the people that were around the user on the map were appearing, as it was suggested that they should have a round shape and not a rectangle shape. Furthermore, the second main reason was to improve the quality of the prototype and have access in more advanced features of more professional prototyping tools.

For the second round of interviews we used InVision Studio as our prototyping tool. InVision Studio includes live collaboration with other designers in the team, comments, details regarding the dimensions, distances, images icons and snippets of code for collaboration with the developers as well. The prototype is indicated in the Figure 41: Second prototype using InVision Studio, home page and location page, Figure 42: Second prototype using InVision Studio, people around the user on the map and chat and Figure 43: Second prototype using InVision Studio, videos section at the footer, Appendix.

4.2.4   Third Interview

During the third round of interviews, the same people were interviewed, and the discussion was based on the last three modules of the questionnaire.

The feedback from the second round had to do again with the colours used, as for example people of older age mentioned that they did not have a clear view of the red colour on top of the purple, but also that in general the letters were small to read, that the footer was overcrowded with information, even though the footer itself had a satisfactory impact as well as the arrows that made the buttons more clear. Moreover, there were plenty of comments regarding the font family and the combination of colours of the main body which were both thought to be more joyful than professional. Also, the feedback included recommendations for ratings at the section of people around the users on the map. Finally, there were also comments regarding the logo and the moto and recommendations for a more "to the point" moto than the previous "Get help wherever you are".

According to the feedback we created a slightly different design version of the application – the logic and navigation were left as they were since they were clear and easy to use. We used different colour, different font-family and size of letters and we changed the logo and the moto as well. We also included a landing page apart from the home page for better user experience, but the footer, the arrows at the buttons and the ribbon including information (in this case Latest News) were part of the third prototype as well since the feedback was positive regarding those features.

To create the third prototype, we used Sketch app which is a very professional paid tool with the most advanced features compared to the previous two tools used and it is compatible with very well-known collaboration tools like Zeplin, which is also a professional tool used by many international companies and has many more plugins and options for snippets of code for the developers. Finally, another reason was that there were also some bugs in the InVision Studio regarding some of its features like the preview feature. In the Figure 24: Third prototype using Sketch, landing and home page, Figure 25: Third prototype using Sketch, location page and people around the user on the map section, Figure 26: Third prototype using Sketch, chat section, the third prototype is indicated.

The feedback from the third round of interviews was positive and our prototype was considered successful. There were only recommendations for its more complete version were all the sections will be shown, like all the links at the footer, the latest news, full sight of the dropdown menu etc.
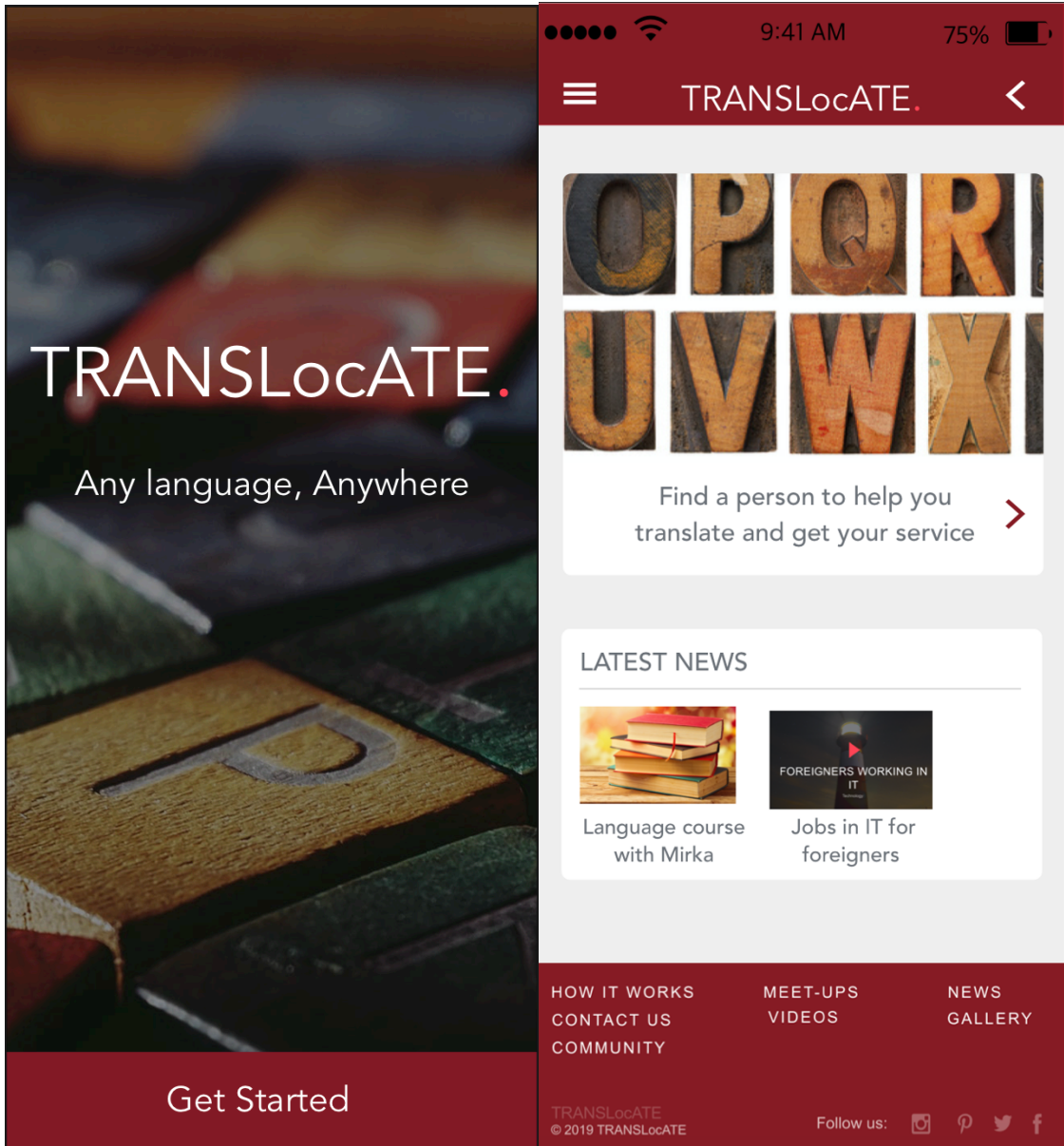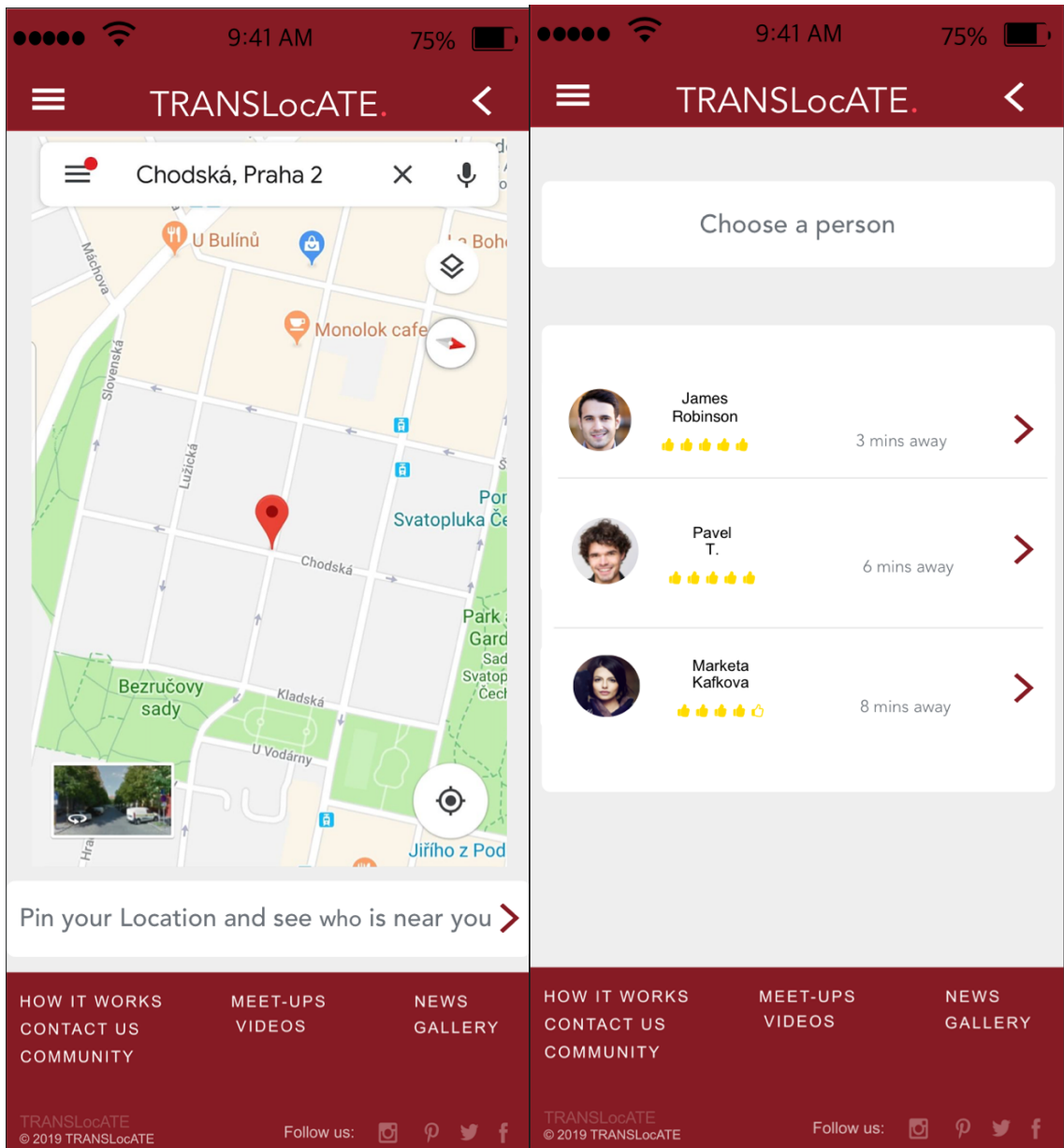
Figure 24: Third prototype using Sketch, landing and home page

Figure 25: Third prototype using Sketch, location page and people around the user on the map section
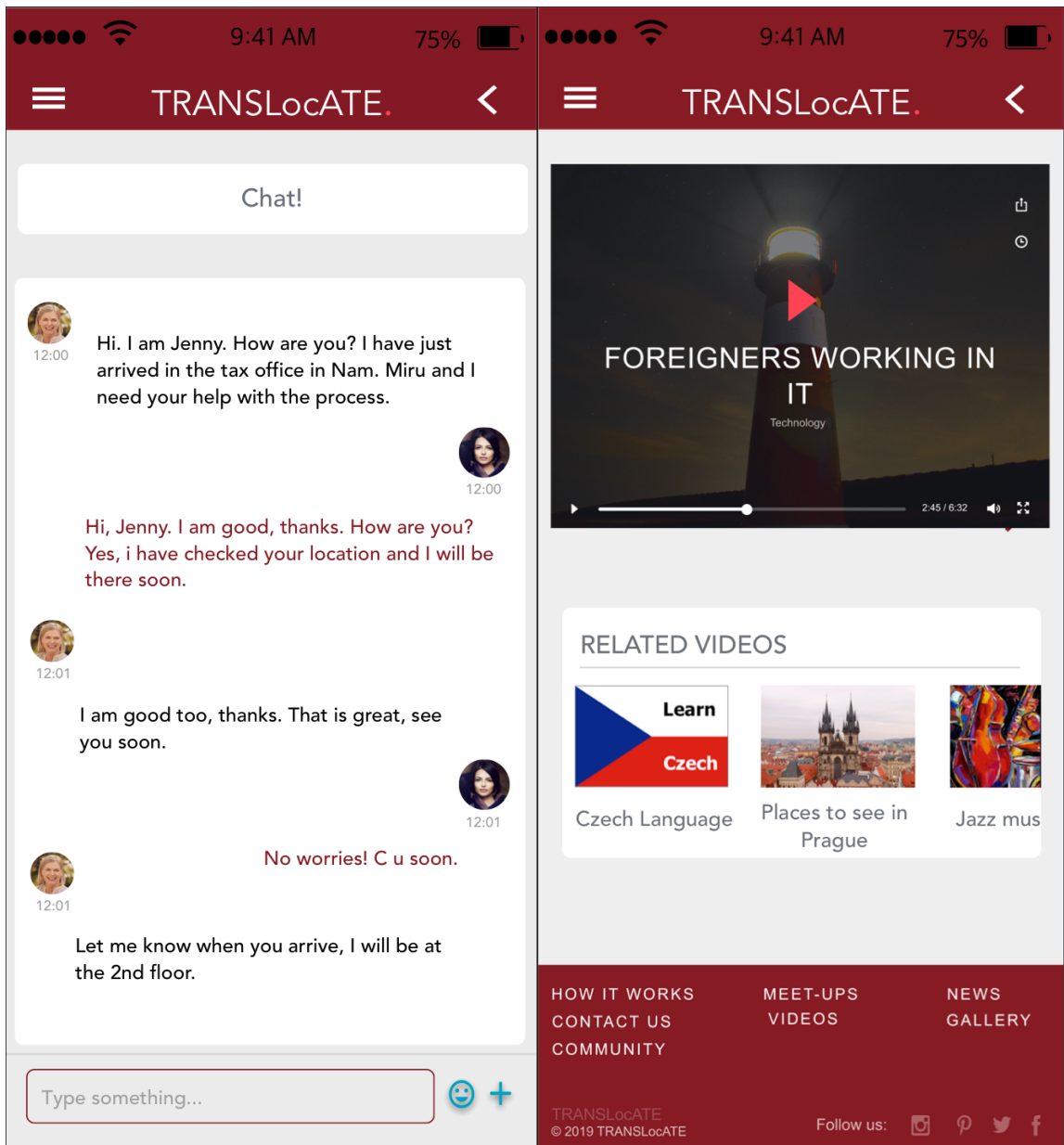
Figure 26: Third prototype using Sketch, chat section and videos section from the latest news

5 Results and Discussion

5.1 Market Research Results – Similar Applications in Prague

Based primarily on the conducted market research, it is interesting to analyse the provided results. First, the attempt to find a similar Progressive Web App for on-demand translation service in Prague, was based on three main criteria:

1. to be a PWA
2. to be free of charge
3. to provide the translation/interpretation service on-demand

Our findings indicated that a similar application does not exist in Prague. Even though some websites/apps meet some of the above described criteria (but not all three of them simultaneously), none of them meets the Progressive Web App one. As it was mentioned in the Literature part of the current study, already existing websites can be transformed into PWAs with some adjustments, although it is highly recommended to rebuild them. Either way, it is important for the translation industry to follow the current trend of the PWA. Progressive Web Apps are radically better web experiences which are reliable, fast and engaging and as it was mentioned in the third chapter of the thesis, they can be applied in diverse groups of users, like in the emerging markets, mainly due to the *offline-first* capabilities (connectivity independent), as well as their fast loading times even in 2G networks and the independency of any device (Croll, 2017). They work on-demand and without taking up a smartphone's valuable memory or data. Furthermore, as it was also mentioned before, this strategy is important in evolving business models with frequent changes, since there are no costs of upgrades, a factor which can benefit the start-ups as well. PWAs, can offer better user experience (push notifications, placement on home screen, native app-like interactions combined with the low friction of web, safe) and increase the revenues (Mori, 2016). Therefore, the hybridisation of mobile websites, which are fast and easy to get to, but they tend to be less engaging regarding user experience, and native apps, which provide a pleasant user experience but are limited to specific devices and have high barriers in terms of adoption, are the PWAs solution. Progressive Web Apps is the strategy which Google, Microsoft and Apple are transitioning to, and since these companies are the basis in terms of application distribution, we can argue that PWAs are the future in mobile industry (Gazdecki, 2018). Finally, there is still a big gap in on-demand services regarding their transition to PWAs, in comparison for example to e-

commerce services. There are not many currently available examples regarding the transition of an on-demand application using real-time data to a PWA and the most important as we mentioned in the third chapter are Uber, Lyft and Tinder. Accordingly, we can argue that our research regarding further development of our product (TRANSLocATE) following PWA strategy, will be a valuable resource, as well as an up to date market trend.

Moreover, none of the interpretation services was found to be free of charge since the people offering the service are professionals, except the ICP public organization, where it was based on volunteering. Finally, none of the websites/applications researched, provided interpretations service on-demand, meaning that any interpretation service is offered by appointment. Accordingly, we can suggest the investment in on-demand translation and interpretation services, since the Czech translation industry does not follow yet the on-demand economy model. As it is a blooming industry due to the current globalized societies, we believe that it has the potential to become a leading industry in on-demand services.

5.2 Market Research Results – Online Survey

The second part of the market research was the conduction of an online survey which included 86 participants mainly currently working and studying in Prague, Erasmus students of this and the previous year and foreigners who had long stayed in and/or visited Prague plenty of times. The goal of the survey was to provide a general understanding of the difficulties that foreigners have when they want to be provided with a service in Prague due to language issues, as well as to receive a first feedback regarding the need of the suggested application. The eight questions of the online survey are presented below:

1. Are you a foreigner currently living in Prague or have you lived in/visited Prague before?

2. How would you rate the level of English language of the local people providing services (touristic, hospital, immigration offices, tax offices etc.)?

3. Have you ever faced any difficulties in getting any kind of services due to poor knowledge of English language of the local population?

4. How often have you faced these difficulties?

5. Do you believe that it is important for foreign people this problem to be solved?

6. Would you use an application, which allows you to track people "around you" on the map, who speak both Czech and English (or your native language) and would be quickly available to provide you with the translation service you need?

7. Would you say that an application like the one described above, could partially solve this particular problem foreign residents and tourists face?

8. Do you believe that an application like the above could create a base for further interaction between foreigners and locals?

According to the results, 52.3% of the participants rated the level of English language of the locals providing services with a 3 (medium level), whereas the 30.2% rated with a level 2 (lower than medium). Based on the provided answers, we can argue that there is plenty of space for improving the language skills of the local employees working in services or hiring people who will be available to provide services only for foreigners. Another important result that needs to be highlighted is that 90.7% of the participants replied that during their stay in Prague, they have faced difficulties in getting some kind of service due to language difficulties and 52.3% said that this had happened often which if we add to the 14% who replied that this had happened very often is a large percentage. At this point we can argue that this is an existing problem which can create insecurity feelings to the foreign people living in Prague, since 95.3% replied accordingly that this is a problem that needs to be solved.

The last three questions where focused on the suggested application called TRANSLocATE. More specifically, the participants were asked if they would use an application, which allows them to track people "around them" on the map, who speak both Czech and English (or their native language) and would be quickly available to provide them with the translation service they need. To this question, 79.1% replied that they would use it, which is a fairly large percentage and show the potential of the suggested application to succeed in the Czech market. In the second application-based question in which we asked the participants to provide us with their opinion if an application like the suggested one could partially solve the problem that foreign residents face, 22.1% strongly agreed, 34.9% agreed and 36% replied maybe, percentages which again indicate the potential of the TRANSLocATE to be successful in the market. The final application-based question of the survey was mostly related to the further development of TRANSLocATE to an ultimate platform, which can create a base for further interaction

between the locals and the foreigners. To that question, 44.2% said that they agree and 30.2% replied maybe, percentages which can create a base for the future recommendations suggested in the current study regarding further development of the application.

5.3 Importance of UCD

Another important factor regarding the creation of the prototype introduced in the Practical part of the current study, is the conduction of User Research as part of the User Centred Design. As it was mentioned in the Literature part, including the user in the design process is a fundamental step in the software development process. The interviews conducted in this study as a qualitative tool of the User Research, were the stepping stone for the prototype's final design especially regarding the logic of the navigation, the logos, the colours and the whole design process in general. Participatory Design and User Experience Research is the ultimate way to know if our product is satisfactory, accessible, useful and has higher potential to be successful in the market.

5.4 Further Discussion and Future Recommendations

Based on the results from the Market Research, the Feasibility Study and the User Research presented on the Practical Part of this study, we believe that there is potentiality for investment in a product like the one suggested and we would like to formulate recommendations for further development of the TRANSLocATE Progressive Web Application.

To be more accurate, we believe that it has the potentiality to become a tool for assisting both foreigners and tourists in getting any kind of service without any difficulty. A solution where all important information for foreign residents will be provided, together with all the available links to groups in Facebook, websites and platforms that foreigners use, as well as to become an ultimate platform for integration, especially through meet-ups, activities and language courses.

Furthermore, we assume that a solution like this could be feasible in the everyday life of foreign people living or visiting other countries with different characteristics than Czech Republic, except the common fact of English not being the official language. For example, countries in Europe where there are large waves of immigration and the need of integration is highly important, or with organizational complications in the public sector making the process of getting a service a slow and painful procedure. Moreover, in the emerging

markets where there are usually many official languages spoken by different ethnicities, a platform like the one described above, can also be a tool for further integration, used by foreign people migrating there or tourists.

Finally, since in this study we assumed that the first release of our Progressive Web App will be free of charge and that the service provided will be without any cost, as the main motivation for the users will be the further interaction, we can introduce some suggestions for future revenues and/or financial motivation for the service providers.

- The first suggestion is to have a type of "reward" recommended also from the app, when one user helps another user with the interpretation (service providers). This could be a small tip or a "friendly action", like to offer a coffee as a good gesture.
- Second suggestion is to include advertisements in our application.
- A third option is to include a small fee for subscription.
- Another option is to offer different plans: a free and a paid plan of the application.

Based on the two last options, (subscription fees and plans) we can suggest that some percentage of the profit generated, will be offered to the users providing the translation service, according to their rate and number of people they helped.

6 Conclusion

The main objectives of the current research are to design a prototype of a PWA for a translation/interpretation service on-demand in Prague, as well as to analyse whether this application can be feasible in the everyday life of foreign people living in or visiting Prague and to create a base for higher interaction with the local population.

The statement of the problem, the research motivations, the main and partial objectives, as well as the methodology used to produce the results, are presented in detail in the second chapter of the study.

The third chapter of the thesis included literature research regarding User Centred Design as part of the product development life cycle and the development of Progressive Web Apps. Moreover, the on-demand economy model which arise from the development of on-demand applications is presented and the potentiality of the translation industry to follow this strategy is analysed. Finally, researches regarding the acquisition of English language skills of the Czech population are introduced.

In the fourth chapter, the practical part of the study is presented and consists of two main parts: the feasibility study and the final prototype. Specifically, in the feasibility study the description, main goals, SWOT analysis, market research, timeline/roadmap and financial plan for the minimum average monthly cost are introduced, in order to evaluate the product viability and feasibility. The second main part included three rounds of interviews as a qualitative method of User Research, in order to evaluate the accessibility, usability, satisfactory effect, navigation and design of the prototype and all the three different prototypes (and different prototyping tools) used in the interview sessions are presented with the focus on the final one. The questionnaire structure is also introduced.

Based on the available literature and the results, future recommendations for further development of TRANSLocATE to an ultimate platform for foreigners living in Prague or other countries are suggested, together with ideas for revenues and financial motivations for the service providers.

Based on the output of the current study, we can argue that the TRANSLocATE Progressive Web App has the potential to be viable and successful in the Czech market, but since this cannot be a final statement, we suggest that further research is demonstrated in order to make adequate conclusions.

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8 Appendix
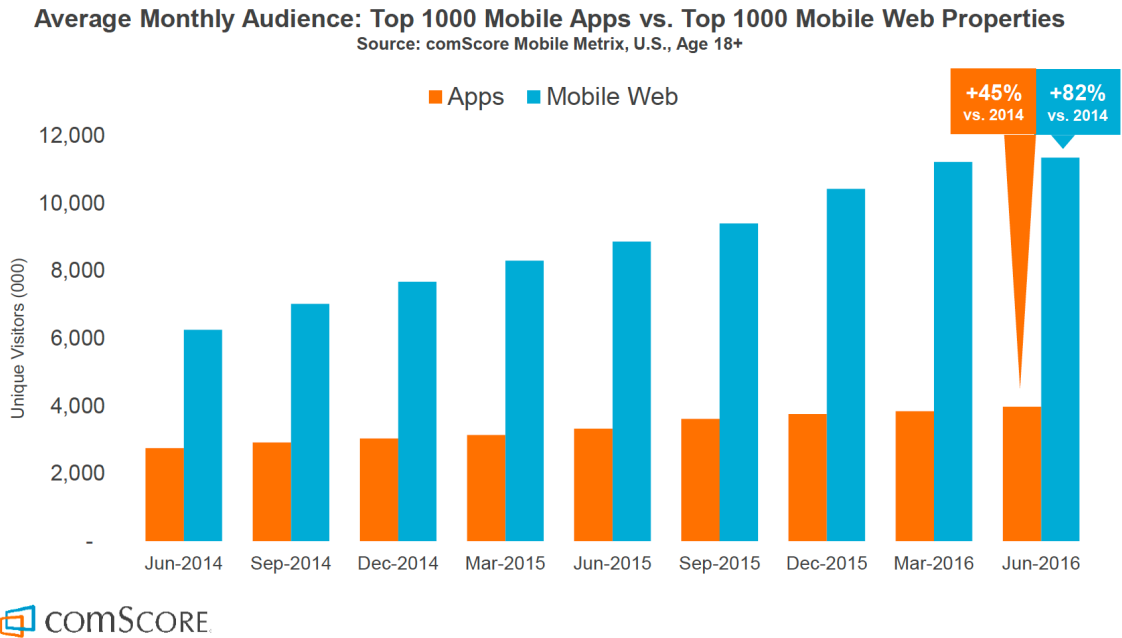
Figure 27: Top 1000 web apps vs. top 1000 web properties (comScoreMobileMetrix, 2016)
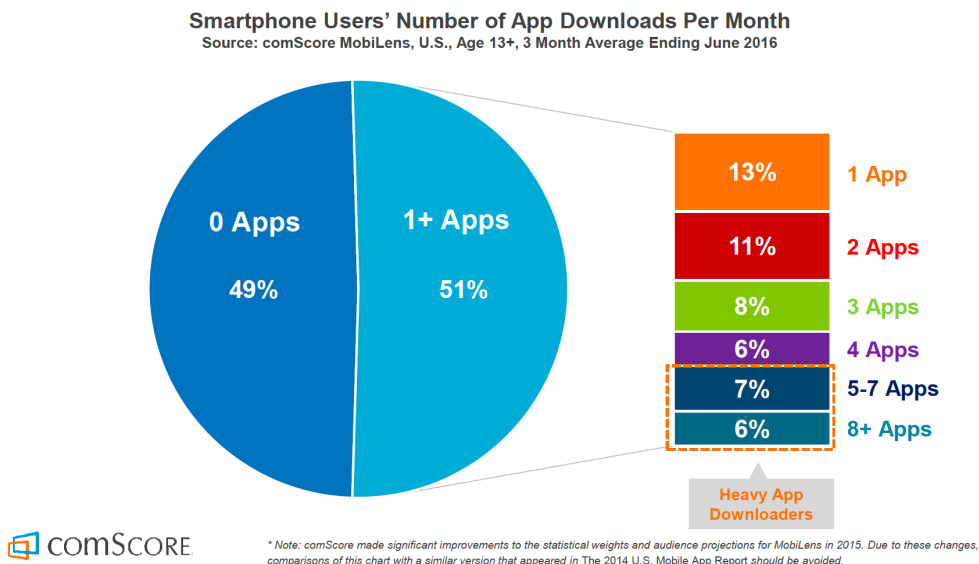
Figure 28: Smartphone users' number of app downloads per month (comScoreMobileMetrix, 2016)
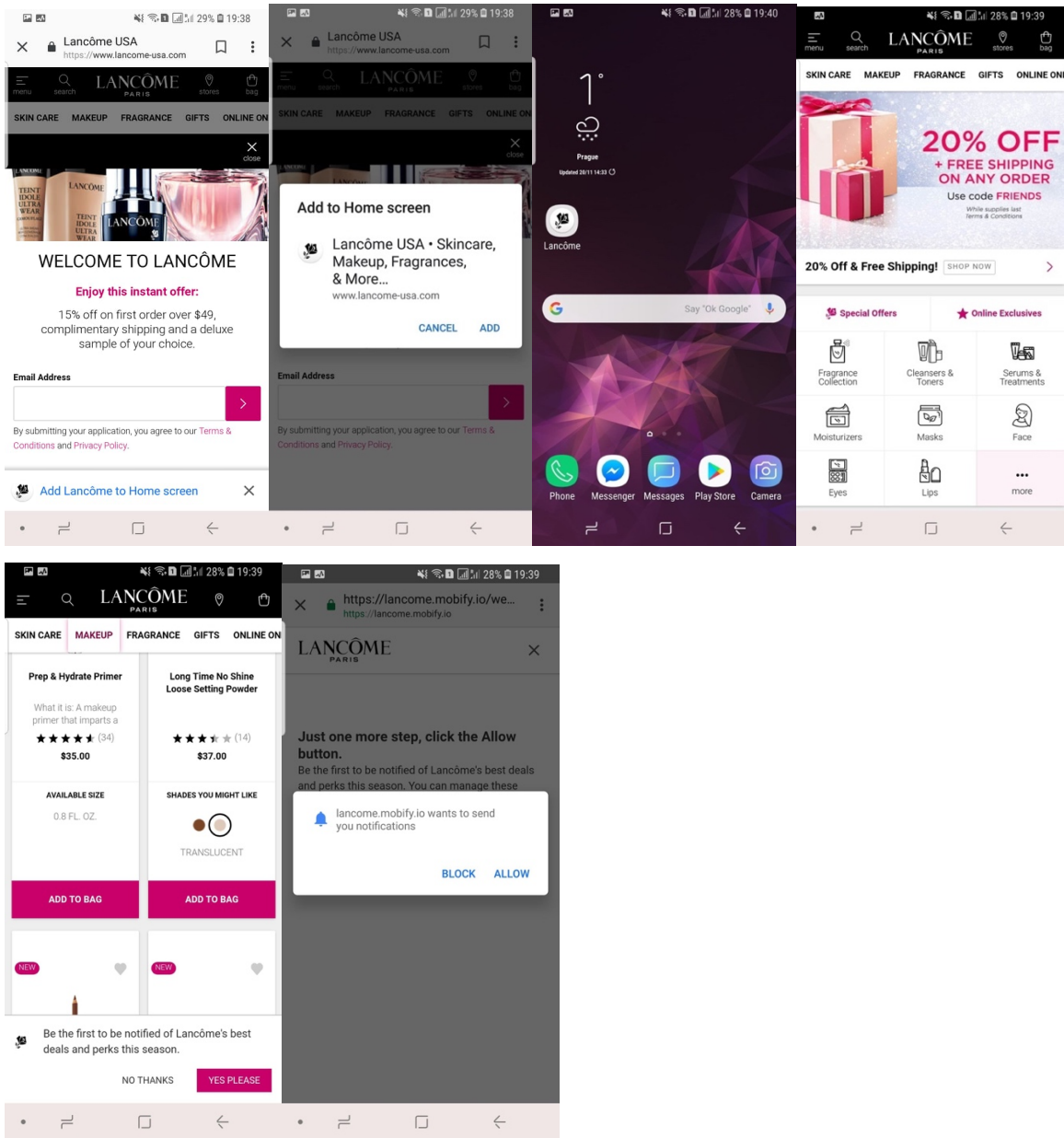
Figure 29: Visiting lancome-usa.com on mobile for the first time
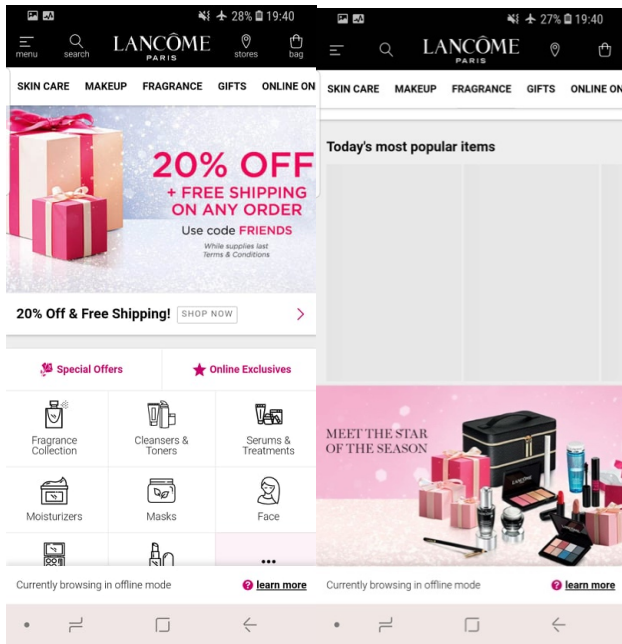
Figure 30: Cached version of the already visited Lancôme PWA on smartphone
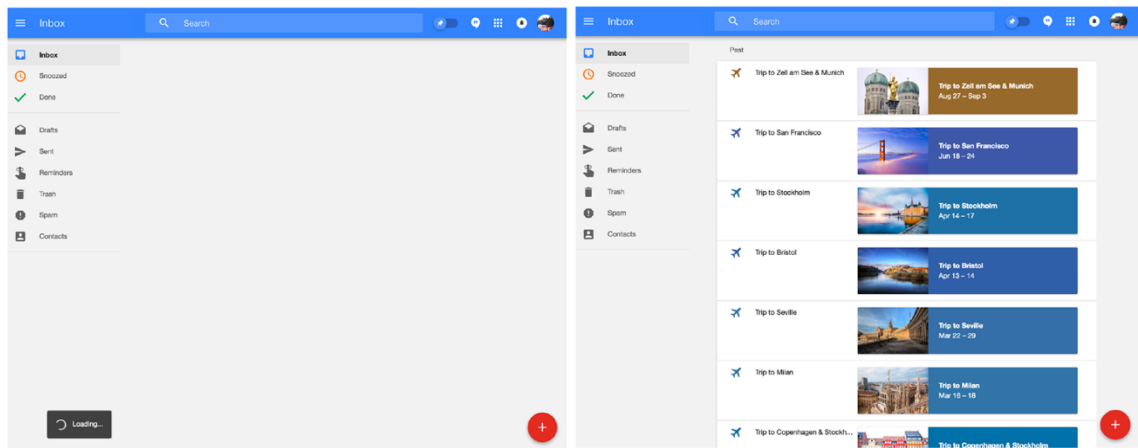
Figure 31: Service Workers to cache the UI shell and once it is loaded, the dynamic content is added to the page (Hume, 2017)

Figure 32: Lighthouse in Chrome DevTools

Figure 33: Lighthouse report example

On-Demand Economy Consumers by Age Group

Millennials make up nearly half of on-demand consumers.

55 and older 22

Age 18 to 34 49%

35 to 54 29
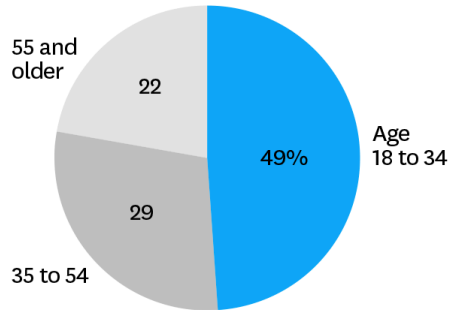
SOURCE NATIONAL TECHNOLOGY READINESS SURVEY (2015)   © HBR.ORG

Figure 34 : On-demand economy consumers by age group (Colby, et al., 2016)
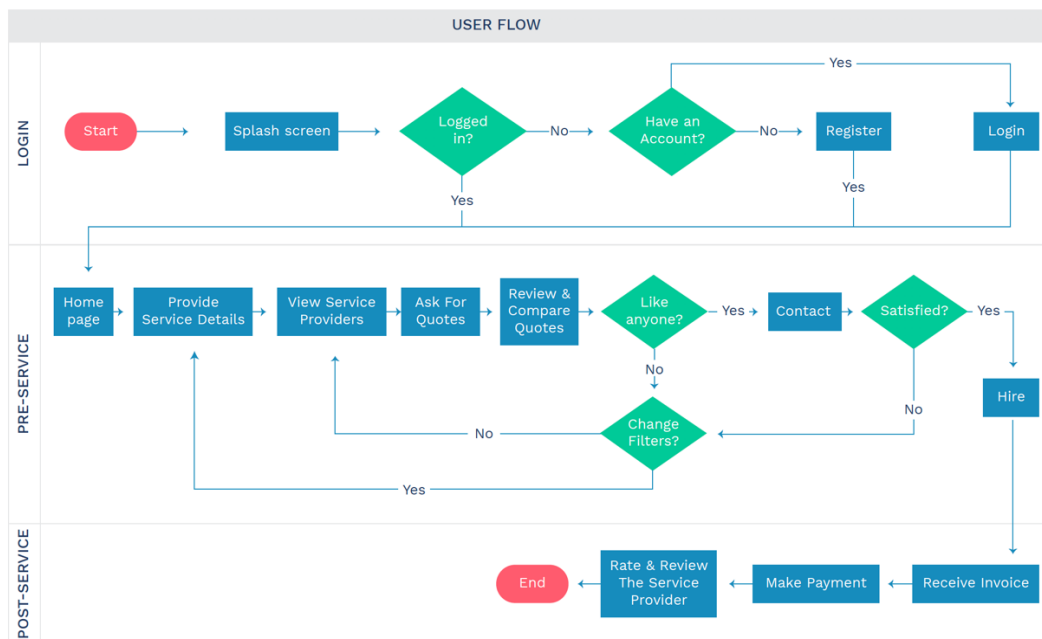
Figure 35: User flow of on-demand service application (peerbits, 2019)
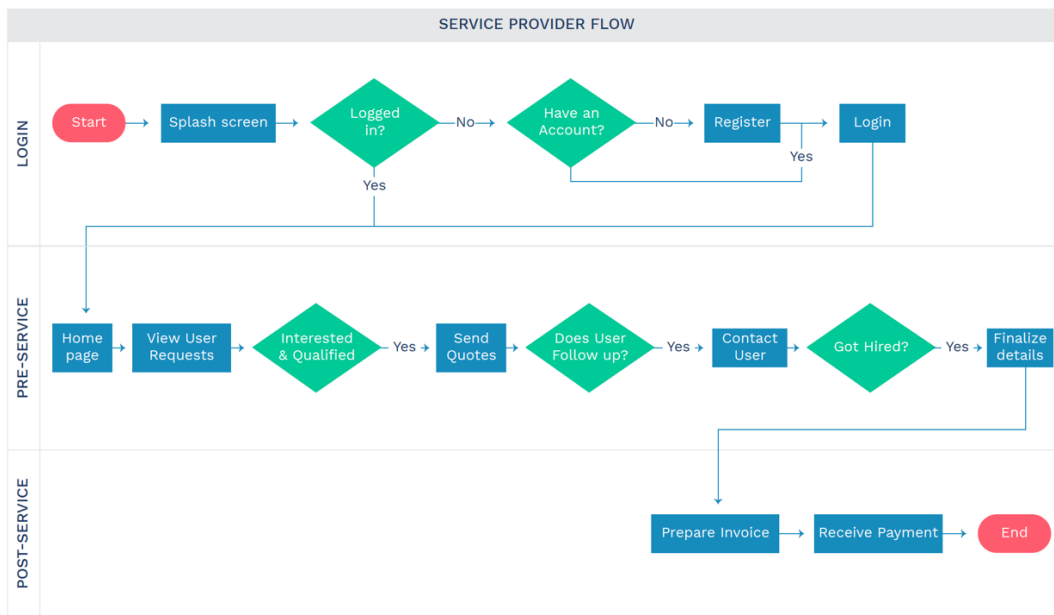
Figure 36: Service provider flow of on-demand service application (peerbits, 2019)
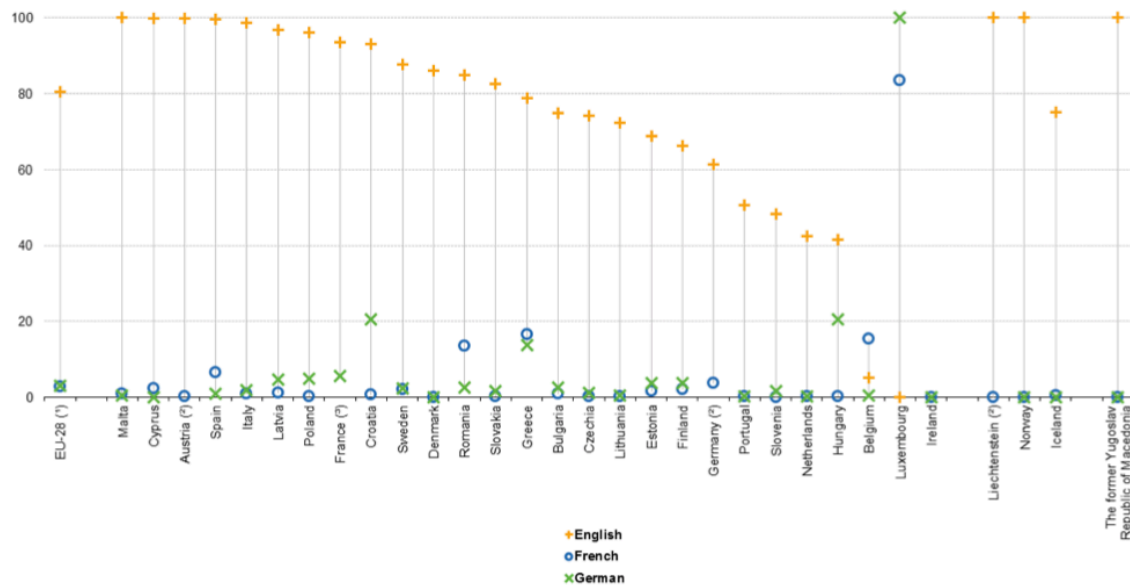
Note: ranked on English. Refer to the internet metadata file (http://ec.europa.eu/eurostat/cache/metadata/en/educ_uoe_enr_esms.htm). The United Kingdom: not available.
(¹) Excluding the United Kingdom.
(²) German: not applicable.
(³) French: not applicable.
Source: Eurostat (online data code: educ_uoe_lang01)

Figure 37: Proportion of pupils in primary education learning foreign language in 2016 (Eurostat, 2018)

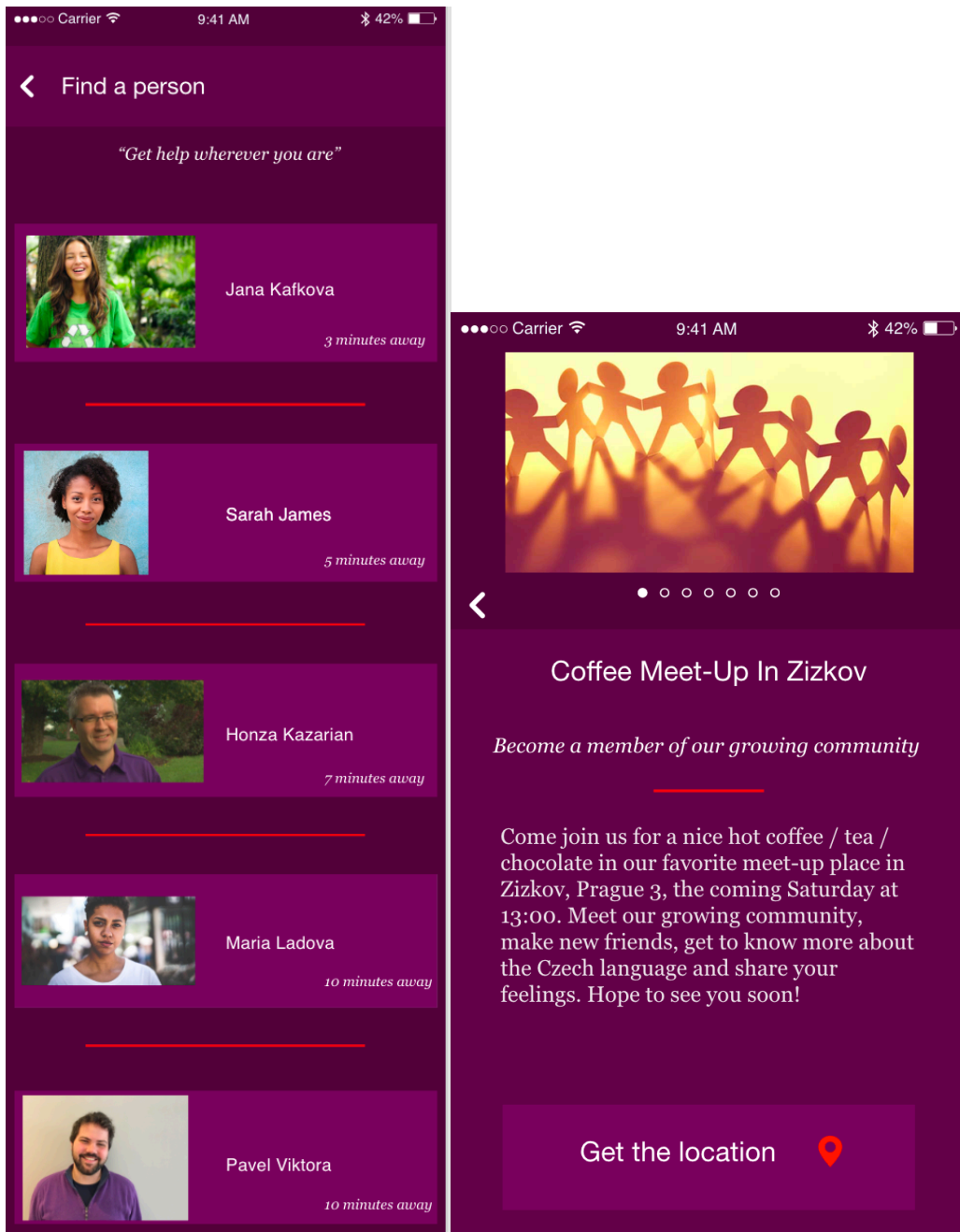**Figure 38: Visual Representation of the TRANSLocATE Roadmap**
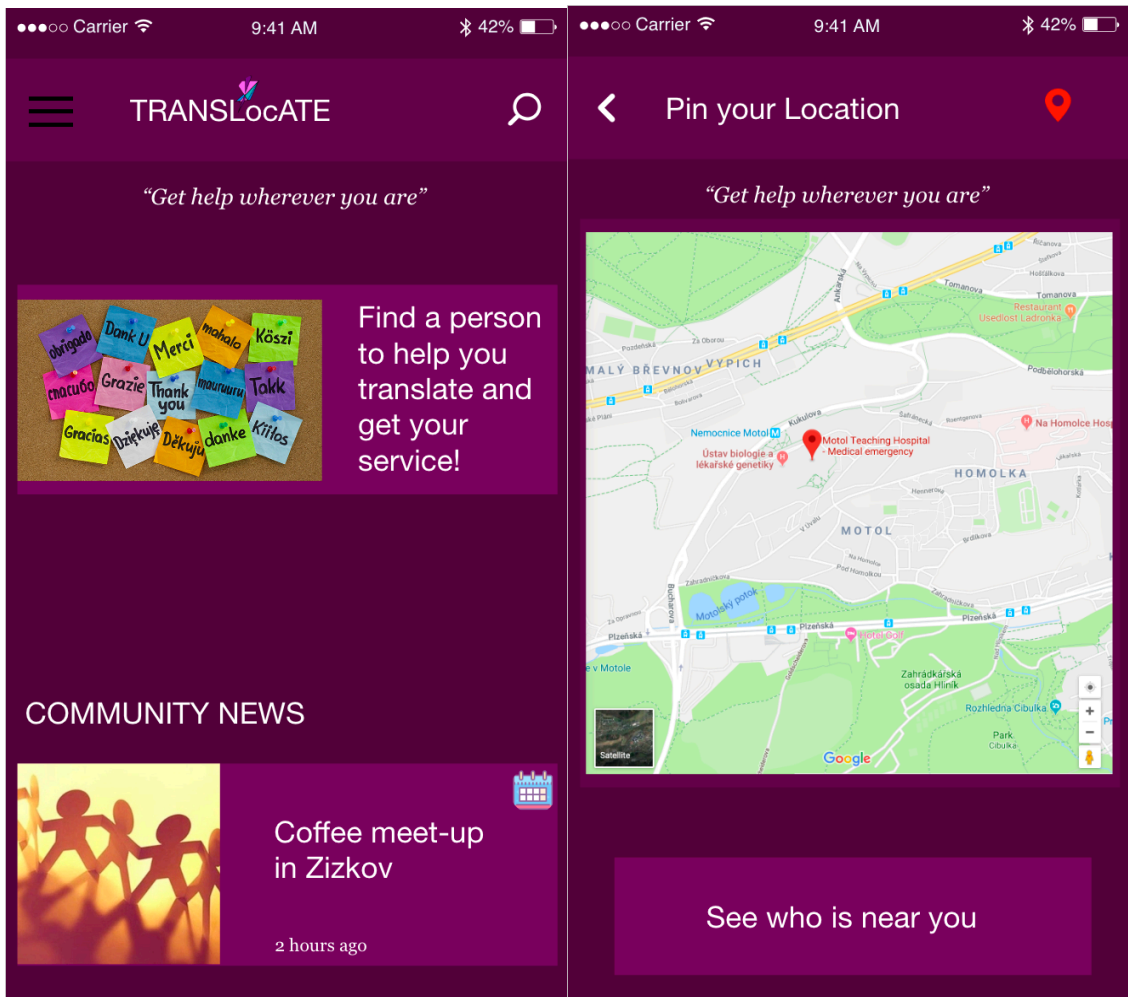
Figure 39: First prototype using Adobe XD tool, home page and location page

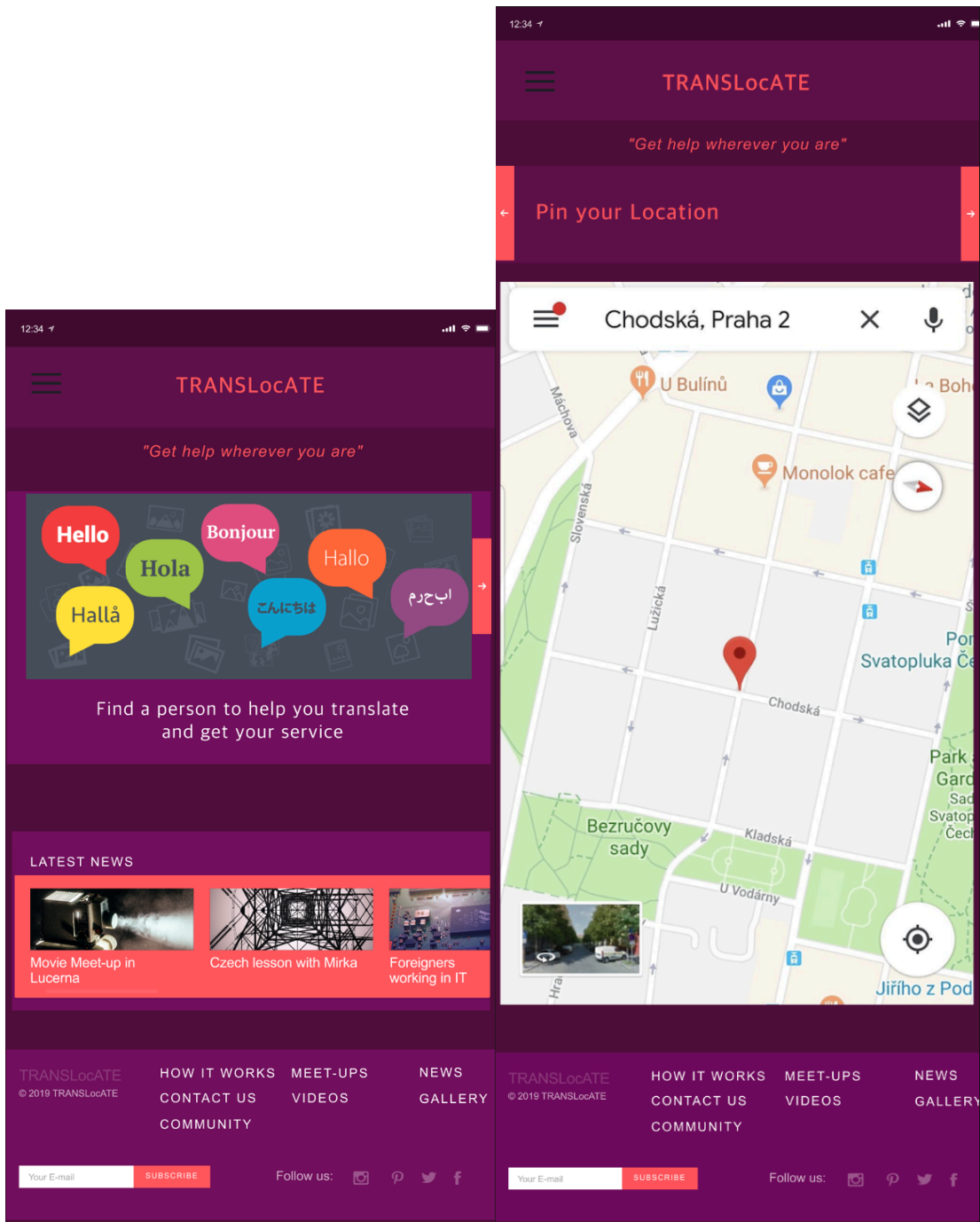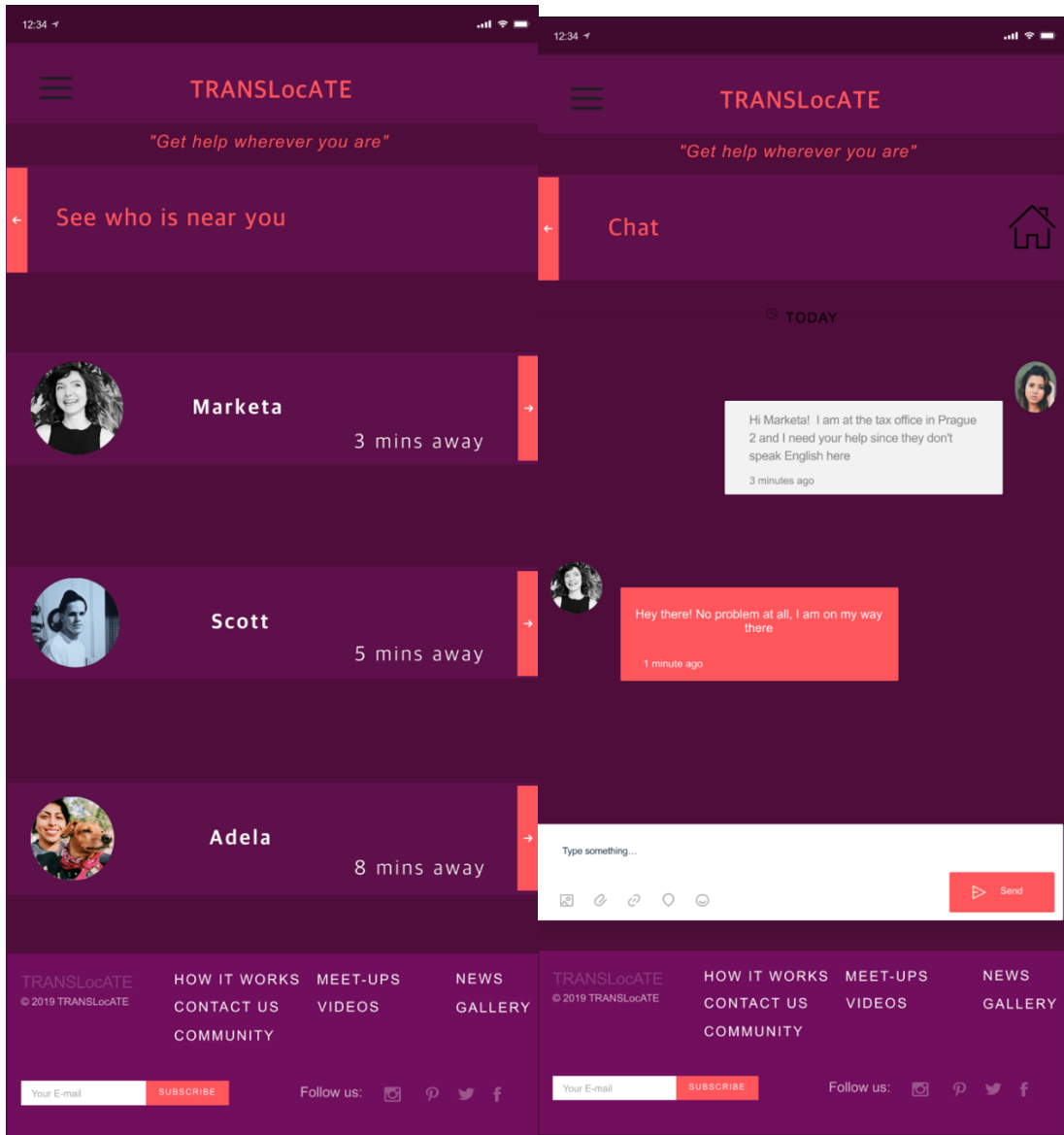**Figure 40: First prototype using Adobe XD tool, people around the user on the map and meet-up section**
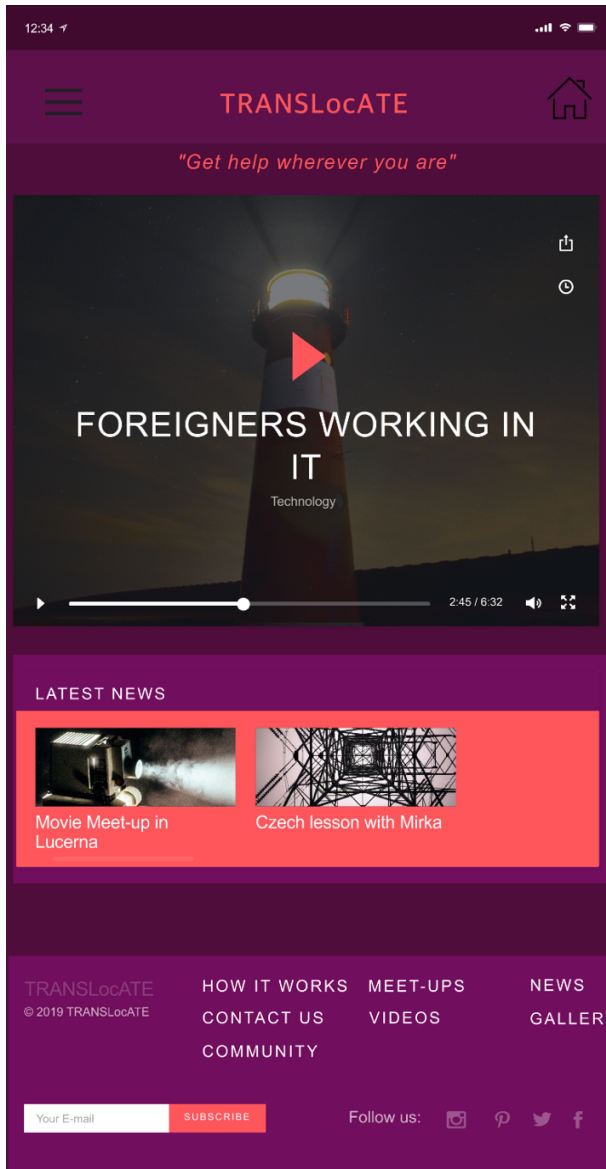
Figure 41: Second prototype using InVision Studio, home page and location page

Figure 42: Second prototype using InVision Studio, people around the user on the map and chat

Figure 43: Second prototype using InVision Studio, videos section at the footer