Covid-19 Travel Planner Mobile Application Design with Lean Product Process Framework

Nicha Tavichaiyuth¹ · Nutchanant Foojinphan¹ · Pantira Leelahakorn¹ · Supparanun Kanchanakul¹ · ThitiratSiriborvornratanakul¹

Abstract
Our travel planner mobile application was designed to fit the traveling post to COVID-19 outbreak following the lean product process principle. We intend to develop a travel application that brings back the joy of traveling. The objective of this study is to design a travel planner application that satisfies the user’s needs. In the first stage of the lean product process, we first determine our target customer by interviewing eight millennials. Once the persona was clarified, we explored the problem space, identified underserved customer needs, and prioritized those needs. The features with high importance but were underserved are COVID-19 guideline information, place recommendation, route optimization, and price comparison, which we believe could offer excellent opportunities to create customer value. The value proposition and feature set were also identified before creating the first MVP prototype. The detailed navigation flow and interactive MVP prototype were created and then tested with users. As a result, in the last iteration of usability testing, the value rating was increased from 6 to 9, and the ease of use rating was increased from 6 to 8 compared to the first rounds.

Keywords Human-centered design · Human–computer interaction · Covid-19 · Travel application · Lean product process · User experience · Usability testing

Introduction
Crafting a trip itinerary could be joyful but, at the same time, overwhelming. Therefore, people, especially in metropolitan areas, are turning to mobile devices as their travel companions. It is claimed that mobile applications are one of the best mechanisms to ease the traveling troubles that travelers could encounter. It assists tourists in planning their itinerary in advance and has peace of mind during their travels since they are more prepared [2]. While people love traveling, and tourism has become one of the leading sectors bringing considerable income to several countries, the coronavirus (COVID-19) pandemic has entirely changed global tourism [12]. Therefore, coping strategies of ‘travel fear’ should be conducted at a national if not international level to relieve traveler’s anxiety by ensuring social distancing and COVID-19 travel protection measures. It is also important to employ effective communication at the tourist sites, e.g., the number of tourists at the spots. In addition, easy-to-understand and follow measures could boost confidence in traveling [1]. Our travel planner mobile application was designed to fit the traveling post to COVID-19 outbreak following the lean product process principle. We intend to design a travel application that brings back the joy of traveling. Our hypotheses arise from key features that travelers should look for ahead of the trip, during the holidays, and
afterward. The purpose of this study is to get the design of a travel planner mobile application that suits user needs.

**Literature Review**

Our travel application design follows fundamental design principles, which are described below.

**UX/UI**

**User Experience (UX)**

The purpose of most application or system development is user experience (UX), which stems from the value and meaning of the application or system concept itself. Therefore, it is required to evaluate the ideas of the concept by understanding the user needs and examining the developed application or system’s ability to fulfill the requirements [11]. The concept of user experience (UX) combines well-known characteristics such as efficiency and effectiveness with additional criteria such as aesthetics, joy-of-use, or attractiveness, which may be quantified using a well-designed and validated questionnaire [10].

**User Interface (UI)**

The user interface is that portion of an interactive computer system that communicates with the user. Any facet of the system that is visible to the user is included in the user interface design. A wide range of non-specialists now use computers, and the most popular interface hardware includes keyboards, mice, and graphical displays. The user interface is becoming a larger and larger portion of the software in a computer system, and a more significant portion, as broader groups of people use computers. As computers get powerful, the user interface becomes the primary barrier in deploying computer-based solutions to address issues rather than the computer hardware or software [4]. In this study, we are interested in the user interface on a mobile application that is the graphical layout of an application. It consists of the buttons users click on, the text they read, the images, sliders, text entry fields, and all the other user interacts. This includes screen layout, transitions, and every single micro-interaction. Any visual element, interaction, or animation must all be designed.

**Color-emotion**

One of the critical ideas that aid in creating a user-friendly interactive interface is the rules for using colors in the user interface design. It is a powerful tool that influences many essential factors for easy visual perceptions in the designer’s hands. It aids in recognizing and separating items and stimulates people to react or act in a specific manner. The ability to use colors effectively is a mandatory requirement for anyone working with visual compositions. Color-emotion was observed across previous studies using different methods to understand the nature of colors with the connection to emotions [9]. Red represents energy, love, anger, passion, courage, excitement, anger, and aggressiveness. Blue represents amusement, relaxation, peace of mind, sadness, faith, and freedom. Yellow represents warmth, cheerfulness, hopefulness, optimism, pleasantness, and happiness. Orange represents joy, determination, amity, delight but on the other hand, it conveys the feeling of pain. Green represents peacefulness, safety, balance, hope, relaxation, coolness, calmness, and revitalization. Purple represents relaxation, calmness, happiness, excitement, comfort, romance, power, sadness, tiredness, fear, and boredom. White represents youthfulness, pleasantness, innocence, peace, hope, and simplicity. Black represents sadness, despair, depression, fear, seriousness, anger, and mourning. Grey represents sadness, despair, depression, boredom, confusion, tiredness, loneliness, anger, and anxiety [3].

**Lean Product Process**

The lean product process emphasizes the relevance of the product-market fit when developing a product or service [8]. Product-market fit means that the product matches customer needs and could serve customers better than competitors. Product-market fit is divided into five key components: target customer, underserved needs, value proposition, feature set, and user experience [7]. The lean product process requires repeated efforts to improve hypothesis, design, and product performance to fit the market [8]. The lean product process is divided into six steps. The first step is the definition of target customers by using personas. The second step is identifying underserved customer needs. The third step is to define a value proposition using product value propositions. The fourth step indicates your minimum viable product (MVP) feature set. The fifth stage of the lean product process is to create a minimum viable product prototype. The final step is for customers to test the minimum viable product [7, 8]. Furthermore, not every product or feature necessitates all six steps. Specific procedures are only required when developing a completely new product [7].
Methodology

According to the literature review, this study aims to develop a travel planner mobile application prototype properly. We followed the lean product process while developing our design of the travel planner application.

Targeted User

Throughout the first stage of the lean product process, a persona is used as an archetypal representation of actual users. Furthermore, personas may help in ensuring that our entire team is focused on the same customer. To create our persona, we first hypothesized about the attributes of the target customer, then tested those ideas by conducting online interviews [7]. The millennials, also commonly termed Generation Y, are classified as individuals who were born between 1980 to 1995 (ages 26 to 41 in 2021). Compared to previous generations, millennials have been exposed to more culture and travel opportunities [5]. For these reasons, our persona is the millennial who loves traveling, likes to plan, and values convenience. Her goals are to spend less time booking a reservation, to be able to compare travel dates and times for the best price, and especially to travel with safety during the COVID-19 pandemic. On the other hand, she is usually annoyed by using multiple travel applications and frustrated when researching the places.

Underserved Needs

After target customers have determined to establish and validate our knowledge of the problem space, we clarified underserved customer needs before designing a solution [7].

Hypothesize

Our hypotheses of features that we think would benefit customers are hotel and flight booking, price comparison, itinerary management, travel destination exploration, trip planning, and traveling with safety due to the COVID-19 outbreak. We tested the hypotheses by interviewing eight interviewees.

Interview

We interviewed eight participants between 25 and 41 years old, as in the millennial age group, to identify the key features they would seek in their travel planning. All interviewees preferred traveling on their own rather than with tour groups. Most of them (75%) planned travel schedules in advance. Many of them (62%) faced difficulties in comparing prices between different booking applications, and the same proportion reported that they valued information related to COVID-19, e.g., state quarantine, strictly controlled areas, etc. Furthermore, 50% of the interviewees would like to know where the crowded areas are during a trip to avoid the crowd. In addition, they preferred efficient route planning to save traveling time, and lastly, they would like to know the opening hours of the locations they are traveling to.

Prioritize

The data from the target user was collected through interviews, and the results are presented in Fig. 1. In the Opportunity quadrant, users’ pain points were COVID-19 related information, price comparison, route optimization, and place recommendation features. In the Competitive quadrant, which indicates highly competitive sections, users’ responses were bookings and maps. These features were essential functions users need. Lastly, the Not Worth Going After quadrant can be developed to meet specific customer needs, such as user-generated content and itinerary management.

Value Proposition

The third stage of the lean product process is to determine the value proposition by identifying the specific customer needs that our mobile application will address and comparing them with other alternatives [7]. In this study, both direct and indirect competitors were compared. Direct competitors include metasearch engine for accommodations (e.g., Agoda, Expedia, Traveloka, and Booking.com), metasearch engine for flights (e.g., Skyscanner), lodging rentals site (e.g., Airbnb), and online booking platforms (e.g., KLOOK). While direct competitors try to reach the same market like ours, indirect competitors are alternative solutions that offer different services. Still, they could offer the same needs and reach the same goal. Our indirect competitors include website and mobile applications with user-generated content (e.g., Pantip, Tripadvisor), tour package listing (e.g., Tourkrub, Wonderful Travel).

The customer needs are classified as must-haves, performance benefits, and delighters. In the category of must-have benefits, booking, price comparison, and maps would be considered as they are standard features of travel applications in the market. Meanwhile, the performance benefits as the differentiators that we plan to outperform our competitors are place recommendation, route optimization, and COVID-19 information. Finally, delighters that we plan to provide are a reward system, trip
collaboration, itinerary management, and user-generated content. Table 1 illustrated the must-haves, performance benefits, and delighters relevant to our travel application and our competitors with the intended score that could reflect the features we plan to deliver.

**Feature Sets**

Once we clearly understand our value proposition, the next stage is to decide on the feature set for our MVP. To do this, we split all the features in our value propositions grids into several feature chunks and then organized them by benefit and priority [7]. As a result, our MVP includes all the must-haves and performance benefits that we identified in the previous stage. However, we decided to focus only on the top delighters, which are itinerary management and user-generated content.

**Must-Have Benefit**

Must-have benefits are required, but they are not the core element of our value proposition. The must-have benefits

| Benefits                           | Metasearch Engine for Hotel | Lodging Rentals Site | Metasearch Engine for Flight | Online Booking Platforms | Website/Mobile Apps with User-Generated Content | Tour Package Listing | Ours |
|------------------------------------|-----------------------------|----------------------|------------------------------|--------------------------|-----------------------------------------------|----------------------|------|
| **Must-have benefit**              |                             |                      |                              |                          |                                               |                      |      |
| Booking                            | Y                           | Y                    | Y                            | Y                        | Y                                             | Y                    | Y    |
| Price comparison                   | Y                           | Y                    | Y                            | Y                        | Y                                             | Y                    | Y    |
| Maps                               | Y                           | Y                    | –                            | –                        | –                                             | –                    | –    |
| **Performance benefit**            |                             |                      |                              |                          |                                               |                      |      |
| Route optimization                 | –                           | –                    | –                            | –                        | Low                                           | Med                  | High |
| Place recommendation               | Low                         | Med                  | –                            | High                     | High                                          | Med                  | High |
| COVID-19 information               | Med                         | –                    | –                            | –                        | –                                             | –                    | High |
| **Delighter benefit**              |                             |                      |                              |                          |                                               |                      |      |
| User-generated content             | Y                           | Y                    | Y                            | Y                        | Y                                             | –                    | Y    |
| Rewards system                     | Y                           | –                    | –                            | –                        | –                                             | –                    | –    |
| Trip collaboration                 | –                           | –                    | –                            | –                        | –                                             | –                    | –    |
| Itinerary management               | Y                           | –                    | –                            | –                        | –                                             | –                    | –    |
of our mobile application are booking, price comparison, and maps since most of the travel applications have these features. Booking is a feature that allows users to book a hotel, a flight, or a ticket. Price comparison is the process of comparing hotel, flight, and ticket prices from booking service providers to find the best deals. Moreover, the map shows the location of various places and navigating to that place.

Performance Benefit

The core parts of our mobile application are the performance benefits which are place recommendation, route optimization COVID-19 information. Route optimization is the core feature of our travel planner application. Once the users choose the date and travel destinations, this feature helps them find their shortest route between multiple destinations, considering the opening hours and travel fees. If the users do not know where to go, place recommendations could help them find the place suited to their preference. By selecting the types of vacation and travel styles, users will be offered tons of travel destinations that they would love. The last performance benefits are COVID-19 information which we believe is the key differentiator. The provided information covers an overview of the COVID situation by country and the latest COVID restrictions, including test requirements, required documents, and quarantine rules. Moreover, we use choropleth visualization techniques to illustrate travel options.

Delighter Benefit

To delight customers, we offer itinerary management, which summarizes the travel plan in an inviting-to-use layout using visuals instead of plain text. From our interviews, users informed us that they would prefer to see several visuals instead of a simple tabular presentation which made the travel plan seem dull. The itinerary management also allows users to easily customize the plan, e.g., change travel places, adjust the time of stay at a particular site, etc. Lastly, to endure the joy of traveling, users have a function to share their travel experiences with their friends and followers. This could be termed as a user-generated content feature. While this feature should be fun for users, it could also increase engagement with the application, encouraging users to come back to use the application.

User Experience (UX)

In the fifth stage of the lean product process, the prototype needs to be created to test our hypotheses and gain learning [7]. Prototypes were developed using Figma, which is the design tool for frontend developers.

Design Concepts

When we started creating our prototype in Figma, we started with the color palettes that we considered based on references’ color-emotion and kept those colors as the base colors. The primary colors used for our application are blue and green, inspired by the colors of nature to reflect the personality of the target group. Blue colors mean amusement, relaxation, peace of mind, and freedom, and green has meaning to peacefulness, safety, balance, relaxation, coolness, calmness, and refreshing. Moreover, to increase the fun of travel used to highlight the joy of travel, with yellow for cheerful, optimism, pleasantness, and happiness, and orange for joy, determination, amity, and delight [3].

User Flow

As we planned to create an interactive prototype, a detailed navigation flow that the users would experience was identified before developing the first prototype, as illustrated in Fig. 2. The process flow of the travel planner started from the sign-up/log-in page. After signing up or logging in, users would see the home page, which is the main landing page. Then, users could view their user profile page and the application’s three groups of functions: place recommendation, route optimization, and COVID-19 information.

Within the place recommendation function, the application recommended travel places based on users’ selection of their travel preference styles. Users had options to add the recommended travel places to their personal bucket list, which could be viewed later. Within the route optimization function, travel dates and a summary of the ongoing travel plan were shown. The related booking tasks such as hotel and flight booking were connected to third-party booking service providers. In response to traveling with safety from COVID-19, the intensity of crowdedness was shown in the plan summary. Users may change the time of visit to avoid the peak visiting hours of that particular travel site. Lastly, within the COVID-19 information function, users could select a country that they were interested in visiting from the main page. Moreover, users could check the quarantine guidelines, entry requirements, and COVID-19 situation related to traveling.

Prototype Development

In this study, we developed five prototypes to test with the potential customers. As a low fidelity mockup, our first two versions only show the screen elements and their locations.
without any visual design details to avoid distracting the testers with visual design elements. However, once we got the feedback on the prototype’s components, we developed a high-fidelity version to test with users in the third version. We applied color theory, mainly green and orange. The green color representing peacefulness, calmness, and revitalization aligns with the mood and tone of the prototype. For the contrasting color to call for action, we used orange, representing motivation and determination. We also used several pictures to make the prototype more inviting to use as there were comments from testers that they would like to see pictures, not plain text. In the fourth version, we added images of destinations and changed the placement of buttons. However, test participants then suggested that price and time should be indicated in travel plans since they are essential factors in deciding whether and where to undertake trips. In the final version, we change the color of the COVID-19 button changes its color from black to orange, which is the color that conveys vigilance. It also adds time information for each travel phase to make itinerary planning clearer. Figure 3 shows the transition from the first to the final prototype.

**Test with Customers**

Qualitative product tests can help us to assess and improve our product-market fit [7]. We tested the product-market fit twice, and after we were certain about the product-market fit, we conducted four rounds of usability tests. Prototypes were improved after receiving comments from each iteration.

**Test Participants**

We follow proper guidelines in user testing, which include explaining to the users in advance that their feedback would help improve the product, so they should not worry about hurting our feelings. It is important to think aloud so that we understand their thinking process [6]. In addition, since the test was conducted virtually, we informed users to move the mouse so that we could see the cursor showing...
which part of the screen users are looking at. We also acted as a fly on the wall, keeping no response and no defense during the test [6].

Test Scenarios

Our mobile application used Japan as a sample of the travel destination. Hence, users were asked to plan a trip to Japan. Throughout the testing journey, users could see features that were mainly grouped into “Planning Your Trip,” “Not sure where to go,” and “COVID-19 overview”. Additionally, users could click to browse between features.

Test Results

The results of the usability tests are summarized below. We interviewed five to six different participants in each round. In the first iteration as shown in Table 2, it was clear that users liked the route optimization and COVID-19 travel guideline features. However, there were several negative comments about the user flow while using the application. The user flow was unclear, leading to confusion. The UX and messaging required numerous improvements. In addition, while the route optimization feature itself was functional, the UX was not inviting to use.

Then, we modified the UX and messaging and rearranged the process flow. The booking feature was moved out to be a third-party connection rather than to be built and designed within our own application due to several users’ comments implying that current booking service providers already met their expectations. Moving out the booking feature to merely connect with third-party service providers made it easier for us to design the core features and the key differentiating ones. In addition, this allows us to design an integral process flow within the application.

As a result, users were more clear of each step in the second iteration while using the application. Nevertheless, there were still several comments about the UX, e.g., action buttons are not outstanding, no stepper. In addition, we also found that even though the process flow was clear, we still needed to add linking pages in the application to enable users to understand how the steps were linked.

In the third iteration, there was a significant improvement. Comments were mainly on detail, not the critical features and UX. The average functionality score was improved from six to eight, and the average ease of use score increased from six to seven compared to the scores received in the first round.

In the fourth iteration as shown in Table 3, which was the last round of our usability testing, there were noticeably more positive comments. The average functionality score was nine, which indicated that it was clear for users how to use the application because they understood the functions and benefits. The average ease of use score was eight.

| Table 2 Usability Testing: Iteration 1 |
|--------------------------------------|
| **Feature set**                      |
| + Plan summary is unique; different from other travel apps | 83% |
| + Covid feature makes it easier for me to make a decision | 100% |
| - lack of detail when traveling to several cities, e.g., booking different hotels, etc | 83% |
| **UX**                               |
| + Choosing travel places by pictures make it easy to use | 100% |
| - Should start from a travel destination, then date | 50% |
| - Not enough visuals in the plan summary | 67% |
| - Flow to Plan summary is not clear | 100% |
| - Lack of details in hotel/flight booking | 100% |
| - No steppers indicating which steps they are on | 17% |
| **Messaging**                        |
| + Modern design | 67% |
| + Suitable images for each feature, e.g., hotel room images, etc | 83% |
| - Hard to detect the action button | 67% |
| - Plan summary does not look inviting to use; too dull | 67% |
| - Hard to find the ‘reserve’ button | 50% |
| **Value rating (1–10, median)**      |
| - | 6 |
| **Ease of use rating (1–10, median)**|
| - | 5 |
Conclusion

This research aims to design a travel planner application following the lean product process. In the first stage of the lean product process, we first hypothesized about the attributes of the target customer and tested them by interviewing eight millennials. Once the persona was clarified, we explored the problem space, identified underserved customer needs, and then classified those needs using the importance versus user satisfaction chart. The features with high importance but underserved are COVID-19 guideline information, place recommendation, route optimization, and price comparison, which we believe could offer excellent opportunities to create customer value. The value proposition and feature set were also identified before creating the first MVP prototype. The detailed navigation flow and low fidelity mockup were created. In the first iteration, there were several negative comments about the user flow. Thus, the user flow was redesigned before developing the second prototype. The higher fidelity prototypes were then developed. We added several linking pages to guide users to how each step in the process flow was linked. UX and messaging were fixed, e.g., add steppers, clear action buttons. The effective use of color makes the prototype inviting and easy to use. We could clearly see that implementing a lean product process with several user iterations to test the prototype and applying color theory could increase users’ ratings. To clearly explain in score, in the fourth round of the usability test, the value rating was increased from six to nine, and the ease of use rating was increased from six to eight compared to the first round’s.

For future research, several improvements could be considered to perform. Other methodology could be used to conduct the study, such as in-depth usability evaluations of application designs. In addition, there could be an assessment of the effectiveness of the lean product process framework on touch screen devices and mobile applications. Moreover, the color theory could be applied more extensively. The use of each button’s color would stimulate users’ desire and excitement to travel. The drive urges users to click to book flights, hotels, and tickets. In addition, a detailed study of the feature about situation updates in each travel site would allow users to keep informed about the risks of that place, such as updating the weather forecast, disaster warning information. Finally, it is advisable to test the flow of feature implementation within the application to design a good user experience and not confuse the user experience.

Table 3 Usability Testing:
Iteration 4

| Feature Set                                      | Overall (%) |
|-------------------------------------------------|-------------|
| + Have many features                            | 100         |
| + Like COVID-19                                 | 100         |
| + The overview of My Trip can view detail       | 80          |
| + Like that can link to the detail of each place| 100         |
| + Like the Place Rating                         | 60          |
| + Like My Trip showing clear schedule showing distance and time | 80 |
| + Like that I can find customer route            | 60          |
| + Like the price breakdown                      | 60          |
| UX                                              |             |
| + Beautiful visuals                             | 100         |
| + Like the COVID-19 alert guide on the map      | 80          |
| + Like the country/continent filter help me find what I want easily | 60 |
| + Like the clear category of Wish list          | 80          |
| - Should categorize place recommendation         | 20          |
| Messaging                                       |             |
| + Like that having many pictures                | 100         |
| - Wording on the Home page is difficult to read | 60          |
| - Let’s Start button should have a consistent position and color | 60 |
| - COVID-19 button should have outstanding color | 60          |
| Value rating (1–10, median)                     | 9           |
| Ease of use rating (1–10, median)               | 8           |
Declarations

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Zheng D, Luo Q and Ritchie BW (2020) Afraid to travel after COVID-19? Self-protection, coping and resilience against pandemic travel fear. https://doi.org/10.1016/j.tourman.2020.104261
2. Ismail A, Kadir SA, Aziz A, Mokshin M, Lokman AM (2016) iTourism travel buddy mobile application In 2016 10th International Conference on Next Generation Mobile Applications, Security and Technologies (NGMAST), IEEE, Cardiff, United Kingdom, 82–87 https://doi.org/10.1109/NGMAST.2016.22
3. Ismail UU, Ramli R, Rozzani N (2021) User Experience/User Interface (UX/UI) design for autistic spectrum disorder (ASD) color based emotion detection system: a review. In 2021 IEEE International Conference on Automatic Control Intelligent Systems (I2CACIS), 114–119 https://doi.org/10.1109/I2CACIS52118.2021.949585
4. Jacob RJK (2003) User interface. Encyclopedia of Computer Science. Wiley, GBR, pp 1821–1826
5. KPMG (2021) Meet the Millennials Retrieved December 9, 2021 from https://home.kpmg/content/dam/kpmg/uk/pdf/2017/04/Meet-the-Millennials-Secured.pdf
6. Krug S (2014) Don’t make me think, revisited: a common sense approach to Web usability (Third edition ed) New Riders, Berkeley, Calif
7. Olsen D (2015) The lean product playbook: How to innovate with minimum viable products and rapid customer feedback
8. Perdana RA, Suzianti A, Ardi R (2017) Crowdfunding website design with lean product process framework In Proceedings of the 3rd International Conference on Communication and Information Processing - ICCIP ’17, ACM Press, Tokyo, Japan, 369–374
9. Plutchik R (2001) The nature of emotions. Am Sci 89(4):344. https://doi.org/10.1511/2001.4.344
10. Rauschenberger M, Schrepp M, Pérez Cota M, Olschner S, Thomaschewski J (2013) Efficient measurement of the user experience of interactive products. How to use the User Experience Questionnaire (UEQ). Example: Spanish language version. Int J Interact Multimedia Artif Intell 2:39–45. https://doi.org/10.9781/ijimai.2013.215
11. Roto V, Rantavuo H, Vääｎänen-Vainio-Mattila K (2009) Evaluating user experience of early product concepts Proceeding of the International Conference on Designing Pleasurable Products and Interfaces DPP109 (January 2009)
12. Zenker S, Braun E, Gyimothy S (2021) Too afraid to travel development of a pandemic (COVID-19) anxiety travel scale (PATS). Tourism Manag 84:104286. https://doi.org/10.1016/j.tourman.2021.104286

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.