

Using Lean Personas to the Description of UX-related Requirements: A Study with Software Startup Professionals

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Abstract: User experience (UX) is a quality requirement widely discussed by software developers. Organizations have targeted to offer software features that carry value to the audience. For software startups, UX-related requirements can represent a competitive edge in their fast-paced environment with constant time pressures and limited resources. However, software startup professionals often have little experience and lack knowledge about UX techniques. Lean persona technique emerges as a slim form of constructing personas to allow the description of end-users needs. In this paper, we investigated the use of the lean persona technique with 21 software professionals, 10 and 11 from software startups and established companies respectively. We carried out a comparison to see whether the startup professionals use the technique in a different way from the established company professionals. Our results revealed that the professionals of both groups used the technique for similar purposes and wrote up UX-related requirements in different levels of abstraction. They also reported positive feedback about the technique acceptance. We saw that the participants' characteristics as years of experience, prior knowledge about personas technique, or the fact of working in startups did not have an influence on the technique acceptance.

1 INTRODUCTION

User experience (UX) is an important aspect of software quality that affects software acceptance by the users (Ohashi et al., 2018). The interaction needs of the end-users with the software thus have to be taken into account during the software production. Even though there are different definitions of UX, most of them state that UX encompasses both the software functionalities and its quality characteristics that are perceived by end-users during their interaction (Hassenzahl, 2018). Usually, all software products deliver some experience to the end-users that can result in a positive or negative UX (Kashfi et al., 2017; Ohashi et al., 2018; Zaina et al., 2021).

The topic of UX is not new in the software engineering area. Practitioners and researchers have investigated challenges and problems in incorporating UX in software development over the years (Kashfi et al., 2017; Da Silva et al., 2018; Zaina et al., 2021). The literature points out that there is a gap in studies about how tools can effectively help software professionals to deal with UX in software development practices (Da Silva et al., 2018). Recently, Zaina et

al. (2021) discuss the need to adopt techniques and methods that support software professionals in identifying UX information that can aid in the software development. Kashfi et al. (2017) reported that software engineering professionals face barriers to incorporating UX into software processes. The literature has pointed out that software professionals have difficulties in the elicitation activity for UX-related requirements more than for functionality or other quality characteristics (Kashfi et al., 2017; Schön et al., 2017; Choma et al., 2016). UX-related requirements describe and inform user needs (Hassenzahl, 2018).

For software startups, UX-related requirements are relevant due to the experience with the product being a factor that affects the user's decision about the use or not of products (Hokkanen et al., 2016). Startups are companies with a focus on developing innovative products or services (Paternoster et al., 2014). These organizations differ from established companies by searching for a scalable, repeatable, and profitable business model with the aim of growing in the market (Paternoster et al., 2014). Startups can work in different areas; however, they are characterized by producing software or making intense

use of software to manage their activities (Giardino et al., 2014). These companies often operate with a small team of professionals, exploring new technologies, being marked by rapid evolution, high uncertainty about customers and market conditions, and high failure rate (Paternoster et al., 2014). The literature has emphasized the relevance of studies about software development practices to better support the software practitioners in the fast-paced environment where startups operate (Giardino et al., 2014). Moreover, startups software professionals usually are newcomers with little professional experience and due to this they struggle on using different software methods and techniques (Paternoster et al., 2014; Giardino et al., 2014). These difficulties are extended to the use of UX methods and techniques (Hokkanen et al., 2016).

UX-related requirements elicitation has been conducted with the support of different techniques, and the Personas technique is one of them (Faily and Lyle, 2013; Castro et al., 2008). The personas technique provides a process for creating personas artifacts from the analysis of end-user data. These artifacts present fictional characters that represent the different user types that can use a service or product and help the software practitioners to understand users' needs, experiences, behaviors, and goals (Billestrup et al., 2014a). However, the traditional persona construction is often seen as a costly technique in terms of time, and effort (Billestrup et al., 2014b). Gothelf proposes a leaner process for developing personas, called proto-personas and also known as lean personas (Gothelf, 2012). The process allows the creation of personas artifacts based upon prior knowledge that the practitioners have about the target audience (Gothelf, 2012).

Lean personas is a technique that can be suitable for startup needs of adopting leaner practices that demand few resources and time to be used (Paternoster et al., 2014). However, little has been explored about the use of these lean UX practices by startup professionals. To address this, we investigate the following research questions: *(RQ1) What type of UX-related requirements do software startup professionals describe by using lean personas technique?*; and *(RQ2) What are the participants' feedback about the use of lean personas technique?*

To answer the RQs, we conducted a study with 21 software professionals, 11 from established companies, and 10 from software startups, who built lean personas artifacts to describe UX-related requirements. The participants worked in software companies from diverse segments (e.g., financial, health) in Brazil. They occupied development-related positions

(e.g. product owners, software engineers, developers). From the data collected, we compared the results of the two groups to understand whether there were differences in the use and acceptance of the lean persona by professionals from startups and established companies. Our decision of comparison is due to the fact that the literature points out that startup professionals have little experience and usually have demands for techniques and tools that are more adherent to the startup context. We examine the lean personas produced by the participants looking for evidence on descriptions of UX-related requirements to analyze the use of the technique. We also collected participant acceptance of the technique's use from an online questionnaire.

2 BACKGROUND

2.1 User Experience

In general, the literature states UX as the user/customer interaction with the product and company (Lallemand et al., 2015). In a different perspective, Hassenzahl (2018) points out that the user experience is related to the users' motivation when interacting with a product. According to the author, users are motivated by goals they want to achieve, and these goals, in turn, guide the user's interactions with a product.

Hassenzahl formalizes UX definition in a content-oriented model which contains three levels of interaction action, i.e., 'why', 'what' and 'how' and a goal, that is to achieve the "wellbeing" of users (see Figure 1). The "why" level focuses on the meaning that the interaction can provide for users; it discusses the motivations and needs that lead the user to use the product. The "what" level defines the functionalities that the product offers to the users to fulfill their needs. The "how" level explores the concrete actions of the users for interacting with the product, e.g. clicking on a button or reading instructions. We decided to adopt the content-oriented model of UX in our study because our focus is on identifying the specifications about UX that were described from the lean personas. We consider that this model provides concrete elements to support our analysis instead of other abstract definitions of UX.

2.2 Related Work

The personas technique has been used to support software teams in the identification of end-users requirements. An investigation with 60 software com-

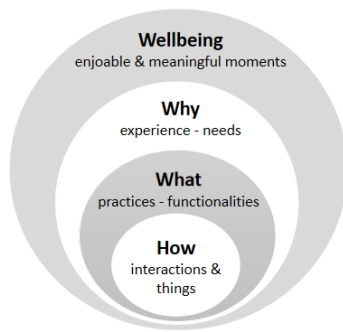


Figure 1: Content-oriented model of UX adapted from (Hassenzahl, 2018).

panies showed that only 7 of them used this technique (Billestrup et al., 2014b). The companies that did not use the technique recognized it as relevant for identifying end-user requirements. However, they reported not being able to use it in their daily work due to problems such as lack of knowledge about how to apply the technique, lack of time, and lack of financial resources (Billestrup et al., 2014b). In another work, software engineers reported that the personas technique not only allows a better understanding of the user's needs, but it also supports these requirements being elicited up-front to the design and coding activities (Sim and Brouse, 2014).

The results about the effectiveness and efficiency of adopting personas artifacts during requirements identification was presented by Salmien et al. (2020). The authors compared the use of personas with requirements elicitation made using available data in an analytics tool (Salminen et al., 2020). The results revealed that the developers spend more time on identifying the requirements which were caused by the need of interpreting a great amount of data and graphics available from the analytics tool. On the other hand, the personas artifacts presented end-user data in a straightway which make the developers work become faster (Salminen et al., 2020).

PATHY technique was proposed to help developers identify requirements (Ferreira et al., 2017). Its focus is to help software engineers recognize user characteristics and present an overview of product functionality. PATHY is an adaptation of the empathy map, which is a variation on the persona technique. Its differential is a set of guideline questions that guide the development team to build personas that adhere to the target audience (Ferreira et al., 2017).

Pinheiro et al. (2019) proposed the Proto-Persona+, which is an extension of the proto-persona technique proposed by Gothelf (2012). Similar to the PATHY, the *Proto-persona+* provides guideline questions to support personas' construction. The authors conducted a study in which the use of proto-

personas proved to be effective for eliciting UX requirements with the participation of software engineers and domain experts. The results also showed that the proposal contributed to both software engineers and domain experts writing UX requirements relevant to software development.

The literature above shows evidence of the relevance of personas technique for requirements elicitation. However, as far as we know, no studies investigate the use of the personas technique by startup software professionals. In particular, we argue that the lean UX techniques such as lean persona are more suitable for software startups where few resources are available, and professionals often have little experience (see discussion in Section 1).

3 LEAN PERSONA

Gothelf (2012) proposes the lean persona technique, also known as proto-persona, as an agile and low-cost alternative for creating personas. The main difference between the traditional persona and the lean persona is the order of executing of the steps for its construction (Gothelf, 2012; Billestrup et al., 2014a). Rather than building the personas based on a broad demographic and profile survey of end-users, lean personas are built by taking into account the prior knowledge that the software professionals have about the end-users (Gothelf, 2012).

The lean personas are constructed during workshops that were conducted by a moderator who is an expert on this technique application with the participation of software professionals. First, the lean personas can be built individually by the software professionals. Later, the workshop participants examine all the lean personas and they together refine them to produce a reduced number of personas. In an extension of Gothelf's proposal, Pinheiro et al. (2019) present the *Proto-Persona+*, an quadrant-based approach proposal to constructing lean personas. *Proto-Persona+* features a four-quadrants template to enhance the description of users' information whereas keeping the characteristic of being a lean artifact.

The four quadrants have the following functions: (*Q1*) *Demographic data* contains the users' characterization relevant to the development of the product, including an image that represents the persona; (*Q2*) *Objectives and needs* presents the users' goals and the needs to achieve these goals; (*Q3*) *Behaviors and preferences* show details of how the user likes to carry out tasks to achieve their goal, and their preferences regarding contents and interaction modes; and (*Q4*) *Difficulties* point out the user's difficulties and frustra-



Figure 2: Lean persona tool.

tions the users can have during their interacting with the product. To guide the personas elaboration, the *Proto-Persona+* approach provides a set of guideline questions for each quadrant.

According to Pinheiro et al.(2019), there is a dilemma about the use of personas technique by software professionals. While the personas technique is recognized as useful by these professionals, they often struggle in putting this technique into practice (Billestrup et al., 2014b). Besides, sometimes the personas present information that was not relevant to the development scope (e.g. hobbies, personas’ pets) which can cause a miscommunication about the core requirements (Billestrup et al., 2014b). In this way, the guideline questions help software professionals to focus on descriptions that fulfill the goals of the quadrants and keep the attention on the important requirements. Pinheiro et al. (2019) state that their proposal is flexible by allowing to the addition of other guideline questions under demand.

In our study, we decided to adopt the proposal of Pinheiro et al. (2019) due to it provides a template and guideline questions which guide the software professionals on the artifacts construction. Besides, the authors proposal have been evaluated to the UX requirements specifications previously. Based on the Pinheiro et al. proposal, we developed the *lean persona tool* (see Figure 2). The tool automates and makes easy the use of the *Proto-Persona+* technique. The *lean persona tool* provides two views, one for the moderator of the session and the other for the participants, i.e. software professionals, to fulfill the template and thus produce the personas artifact.

The tool provides the moderator with a project-based organization (see Figure 2(a)). For each project, the tool delivers the default template which contains the guideline questions (see Figure 2(b)). New guideline questions can be added or the available ones can be modified. After preparing the template, the moder-

ator makes it available for the participants of the session of the lean persona creation from a link generated by the tool (see sharing link field in Figure 2(a)). The participants then create the lean personas, individually or in group ((see Figure 2(c)). The moderator can access all the personas created by the participants (see Figure 2(d)). The tool is available at the link¹.

4 EXPERIMENTAL STUDY

Our study was conducted following the recommendation of Wohlin et al. (2012). Our study was approved by the Federal University of São Carlos ethical committee (CAAE process: 37663220.5.0000.5504).

4.1 Planning

Participants were invited to take part in the study voluntarily via our professional network. Our research group has conducted different investigations about UX in industrial settings, which established contacts with software professionals. The participants were selected by convenience, according to their availability to participate in the study (Wohlin et al., 2012). Both developers from startups and established companies were invited. The participants were divided into two distinct groups, i.e., one with software startup professionals and another composed of software professionals from established companies.

Personas elaboration is tightly associated with the domain of the product; we first determined the software focus in our study. We defined tourism mobile apps as the domain of our study, being TripAdvisor² and Google Maps³ examples of these type of apps. The tourism app was chosen because it represents a common-sense domain. Consequently, the participants could concentrate their efforts on creating the personas artifacts, avoiding the need of learning about the app domain. Considering the app domain, we prepared the *lean persona tool* to support our study. We kept the demographic questions (i.e., Q1 quadrant) suggest by the *lean persona tool* and defined the quadrants guideline questions for the other quadrants (see Table 1).

An online questionnaire was elaborated to gather professionals' profile data (e.g., years of experience, company market segment, position in the company, experience with tourism apps, and knowledge on personas techniques). The questionnaire included the

Informed Consent Form to collect the participants agreement in taking part in the study. We also created an online feedback questionnaire based on the Technology Acceptance Model (TAM) (Davis, 1989) to collect the participants' perceptions about the use of lean persona technique. TAM questions are divided into two dimensions. The perceived usefulness dimension represents how much a person considers that the use of a specific technology may improve their performance. The ease-of-use dimension is related to the perception that technology can be adopted with no effort. We added three open questions about the suitability of the lean persona on the creation of the artifacts in the feedback questionnaire.

Finally, we wrote up a scenario of users' interaction with the tourism app domain. This scenario intended to overview this kind of app to support the participants during the personas elaboration. However, the participants were free to use all their knowledge about this kind of apps. The scenario is described as follow: "A tourist usually uses a mobile application (mobile, tablet, etc.) to plan and guide their trips. The app displays places in a city or region according to the interest and searches made by users. These places can be hotels, monuments, museums, parks, restaurants, among others. For each location, the apps show details such as the location name, photos, addresses, and feedback from other individuals that often is ranked by a score from 0 to 5. Moreover, these apps can present estimates of expenses to spend in the places and also comments to assist the user to decide and plan visits to places that have good ratings".

A senior expert with 10+ years of experience in UX area evaluated our study reviewing and refining the profile questionnaire and the other artifacts. Besides, a pilot test was carried out in our research group with five UX researchers and we concluded that no changes were necessary and the study could be run.

Table 1: Guideline questions for the quadrants Q2 to Q4.

Quadrant	Guideline questions
Q2	(GQ1) What does he/she want to achieve?
	(GQ2) What does he/she need to accomplish his/her goal?
Q3	(GQ3) What does he/she like?
	(GQ4) What is he/she outstanding to do?
	(GQ5) How does he/she like to do it?
Q4	(GQ6) What are the difficulties he/she has?
	(GQ7) What barriers/obstacle can he/she face in a task/an interaction?
	(GQ8) What can disappoint him/her?

4.2 Execution

The study was conducted with 21 software professionals⁴ who work in different companies in Brazil,

⁴Professionals in software development positions as such as developers, interface designers

¹<http://uxtools.uxleris.net/>

²<https://www.tripadvisor.com.br/>

³<https://www.google.com/maps/>

being 10 professionals from *software startups* and 11 from *established companies*. In our previous contact with the participants, we observed that most had little knowledge about the personas techniques. To level off the participants' knowledge, we recommended they watch two videos about persona and lean persona before their participation in the study.

Due to the COVID-19 pandemic, the study took place in online meetings using the Google Meet tool⁵. To attend to the different schedule availability of the participants, we ran 6 sessions distributed on different days and each one lasted about 1 hour and a half. In each session, we had the participation of 2 to 4 professionals. Each participant took part in only one session. A researcher with 1+ year of experience in UX was responsible for running the study. In all sessions, the same script was followed, thus avoiding the insertion of biases in the study conduction.

At the beginning of each session, the researcher welcomed participants and briefly pointed out the study's objective. The participants accepted the term of consent to data and images for academic ends and thus completed the profile questionnaire. Before starting the construction of the lean personas, the participants took part in a warm-up session where the researcher presented a quick review covering the personas and lean personas concepts (i.e., based on the videos watched by the participants previously). The researcher thus carried out hands-on training using the *lean persona tool* to familiarize participants with its resources. After the hands-on training, the participants built the lean personas considering the tourism app scenario. They were oriented to create at least one and up to three personas due to the limitations of the study time slot. In the end, 21 participants produced 24 personas in total. The participants answered the feedback questionnaire (i.e., TAM questions) at the end of the study.

4.3 Analysis

We examined the 24 lean personas produced by the participants and the answers from the feedback questionnaire. We carried out a qualitative analysis on the learn personas artifacts to examine the presence of the different types of UX-related requirements. We explored the Q2, Q3, and Q4 quadrants to search for evidence of UX descriptions. These three quadrants provide descriptions about goals and needs, behavior and preferences, and difficulties, respectively. In our analysis, We did not consider the Q1 quadrant because it only informed personas demographic data and we were interested in the requirements' descriptions.

⁵<https://meet.google.com/>

Figure 3: Example of labeling of lean personas artifact - *why* in red and delimited with circles; *what* in green and delimited with squares; *how* in purple and delimited with triangles.

Our analysis on the lean personas was carried out in three steps. First, one junior researcher (i.e., 1+ year of experience) explored all the lean personas by applying a closed coding technique (Corbin, 1998). Closed coding guides researchers in identifying excerpts of text and labeling them to pre-established codes which belong to a codebook (Corbin, 1998). In our study, the codebook was composed of the UX levels proposed by Hassenzahl (2018), i.e., the codes “*why*”, “*what*” and “*how*”. The respective definitions that each code carries guided the junior researcher to look for evidence about UX specifications that were presented in the learn personas. Figure 3 illustrates our labeling activity in a lean persona that was produced by a startup professional. A senior UX researcher revised and refined all the labels assigned to the 24 lean personas as a second step. After, the two researchers worked together to map all the labeling (“*why*”, “*what*” and “*how*”) to the guideline questions (see Table 1). Consequently, we could see the relationship between the labeling and the lean personas quadrants. Finally, we explored the participants' responses regarding the acceptance of the lean personas technique. We also examined whether the participants' profiles had influenced the technique acceptance.

4.4 Threats to Validity

We followed the recommendations of Wohlin et al. (2012) to discuss the four threats to validity (i.e., conclusion, construct, internal, and external) and how we proceeded to mitigate them.

We use different data sources to give reliability to our *conclusions from the results*. The adoption of UX levels and their definitions to explore the lean per-

sonas avoided the possible bias that could be introduced by the researchers on the qualitative analysis. Moreover, the closed coding process was conducted in three steps with the participation of two different researchers. All the codes assigned to the learn personas have been revised by researchers with experience in qualitative analysis. We also examined the feedback questionnaire to give conclusions about our study. To mitigate *construct* problems, we followed the same script to conduct the study sessions. We used the same artifacts (i.e., the *lean persona tool* and the tourism app scenario) with all the participants to support the construction of the lean personas. We also conducted a warm-up session providing the concepts about lean personas to the participants. A hands-on exercise helped the participants to handle the *lean persona tool*. These two activities allowed us to mitigate the impact of little knowledge of the participants about personas. The *lean persona tool* is fully adherent to the proposed use of the template and the guiding questions for building lean personas.

To mitigate the participants' fatigue, an internal validity threat, we conducted short sessions that lasted no more than 1 hour and a half. By using the *lean persona tool*, the participants employed less effort in handling different artifacts during the creation of the personas. All the information to carry out the activity was available in the tool, i.e., the lean persona template and the guideline questions to fulfill the quadrants. Concerning the external validity, the participants who took part in the study had positions in startups and established companies which led us to consider we had a representative sample to our study goals.

5 FINDINGS

We present our findings in four sections: the participants' profile, the answers to the RQ1 and RQ2 (see in Section 1), the influence of the participants profile in our results.

5.1 Participants' Profile

Table 2 presents an overview of the participants' profile. The profile questionnaire answers reveal that from 10 participants of startups, half of them had < 1 year of professional experience and only one had 4-6 years. Considering the personas and lean personas techniques, we see that more than half had only theoretical knowledge or never heard about the techniques. We also notice that the more experienced professional, i.e. 4-6 years, reported having only theo-

retical knowledge about these techniques. Looking at the established company participants' information, we notice that 7 from 11 had theoretical and practical knowledge about the personas technique; however, a smaller number of participants had the same knowledge about the lean personas. All the participants, i.e. from startups and established companies, have used some kind of tourism app which represents that they had knowledge of the domain as end-users.

5.2 RQ1 - Type of UX-related Requirements

To answer RQ1 (*What type of UX-related requirements do software startup professionals describe by using lean personas technique?*), we examined the 24 personas produced by the 21 participants. We looked for evidence of descriptions related to the three levels of the Hassenzahl model, i.e., "why", "what" and "how" (see Figure 3). We did two granularity levels of mapping, one more general at the level of lean personas quadrants and another more specific at the level of guideline questions (see Table 1).

Figure 4 shows a heat-map chart with the distribution of occurrences of the three levels of the Hassenzahl's model (see Figure 1) by the lean personas quadrants. The results show a concentration on the level "what" in the three quadrants (see Figure 4 (b)) in which product features are described. In Figure 4 (b), we see this results independently of the participants were professionals from startups or established companies. From the level "why" (see Figure 4 (a)), we observe that startup professionals did not give details on the end-users difficulties (i.e., Q4 quadrant). The occurrences in Q4 are low even for established company' professionals. The results also demonstrate that the level "how" (see Figure 4 (c)) has the lowest number of occurrences independently of the quadrant.

By exploring the relationship between the descriptions available in all quadrants, we notice that Q2 presents the most information. It predominantly describes more abstract UX-related requirements which report why and what the users *need* to achieve their *objective*. Q3 provides descriptions of "how" (i.e., *behavior*) to do related to "why" (i.e., *preferences*). In Q4, UX-related requirements appear describing product functionalities (i.e., "what") in a high level of abstraction to provide information on how to mitigate the difficulties that the user could have. The descriptions concretely explain "how" the interaction should occur to minimize issues regarding the use of the software.

We also examined the descriptions in relation to the guideline questions per participants' group, i.e.,

Table 2: Participants profile - Knowledge about the techniques is classified as (1) I've never heard of; (2) I only have theoretical knowledge; (3) I used it a few times; (4) I used it a many times.

(a) Identification					(b) Domain	(c) Knowledge about the techniques	
ID	Group	Company market-segment	Position	Professional Experience	Tourism apps often used	Personas	Lean Persona
P1	Established Company	Software Factory	Product Owner	8+ years	Google Maps, TripAdvisor and Youtube	2	2
P2	Established Company	Finances	UX Research	4-6 years	Google Maps and Youtube	3	2
P3	Established Company	R&D	IT Analyst	< 1 year	Youtube	3	4
P4	Established Company	Education	IT Analyst	8+ years	Google Maps and Youtube	1	1
P5	Established Company	Financial Institution	Software Engineer	8+ years	TripAdvisor and Youtube	3	1
P6	Established Company	Electronics Assembler	IT Analyst	6-8 years	Google Maps and Youtube	2	2
P7	Established Company	Software Factory	Full-stack Developer	1-3 years	Google Maps and Youtube	3	3
P8	Established Company	Software Factory	Internship	< 1 year	Google Maps and Youtube	3	3
P9	Established Company	IT	IT Analyst	1-3 years	Google Maps	3	3
P10	Established Company	Software Factory	Internship	< 1 year	Google Maps	3	3
P11	Established Company	Health	Software Engineer	8+ years	Google Maps, TripAdvisor and Youtube	2	2
P12	Startup	Web Development	Internship	< 1 year	Google Maps	2	3
P13	Startup	Education	Software Engineer	1-3 years	Google Maps and Youtube	1	1
P14	Startup	Software House	Front-end Developer	1-3 years	Google Maps	1	1
P15	Startup	Mobile Device Management	Back-end Developer	< 1 year	Google Maps	4	4
P16	Startup	3D Solutions for real estate	Developer	4-6 years	Google Maps and Youtube	3	2
P17	Startup	Process Mining	IT Analyst	1-3 years	Google Maps and Youtube	4	4
P18	Startup	IT Consulting	Developer	< 1 year	Google Maps	1	1
P19	Startup	Software Factory	Internship	< 1 year	Google Maps	2	2
P20	Startup	Software Factory	Developer	1-3 years	Google Maps	3	3
P21	Startup	Shop Streaming	Front-end Developer	< 1 year	Google Maps and TripAdvisor	2	2

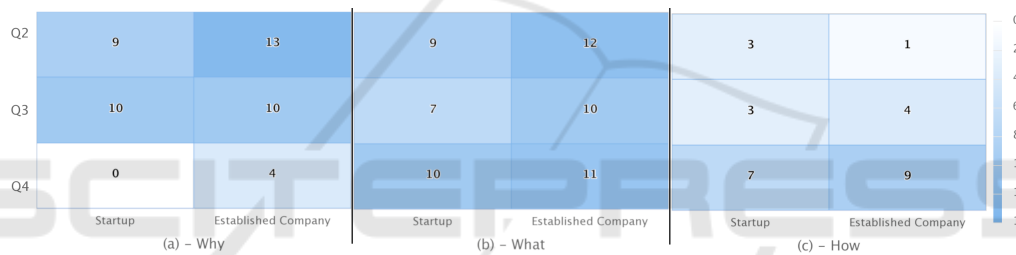


Figure 4: UX-related requirement occurrences mapped by quadrants and Hassenzahl's levels - (Q2) objectives and needs; (Q3) behavior and preferences; (Q4) difficulties.

startups and established companies. However, we saw that the difference in the number of occurrences in each group for each level (i.e., “why”, “what” and “how”) has no impact on our results. Figure 5 presents a Sankey diagram which lists the influence of the guideline questions on the results. Sankey diagram is a flow diagram in which the width of the arrows is shown proportionally to the flow quantity. It helps locate dominant contributions to an overall flow ⁶. We can see the type of UX-related requirements (i.e., based on UX levels) versus the guideline questions.

Figure 5 reflects a greater concentration on the use of guideline questions to describe UX-related requirements of the “what” level regardless of the quadrant. Examples of descriptions found out in the results referring to this level are: “Need to find reviews, information, prices, and locations of places” (referring to question GQ2), and “[...] the lack of filtering for performing searches” (referring to question GQ8). This result confirms what had already been evidenced by

⁶<https://www.r-graph-gallery.com/sankey-diagram.html>

the heat-map chart (see Figure 4). Specifically, we see that guideline questions GQ1 and GQ3 of the quadrants Q2 and Q3, respectively, like the ones that most guided the participants in describing the “why”. In GQ1, we found out answers as for instance: “Plan and guide your [the persona] next trip with friends to an ecological city”; while in GQ3, we also found out description to explain the “why”, for example: “Driving on beautiful roads with many landscapes”. Finally, questions GQ6, GQ7, and GQ8 (Q4) were the ones that were most linked to “how” level, in which we found descriptions as the following “[...]there is limitation of characters to the post my contributions”.

5.3 RQ2 - Feedback about the Use of Lean Persona

Taking into account the responses collected from the online questionnaire, we could answer the RQ2 (What are the participants’ feedback about the use of lean personas technique?). We analyzed the participants’ feedback regarding the perceived usefulness and ease-

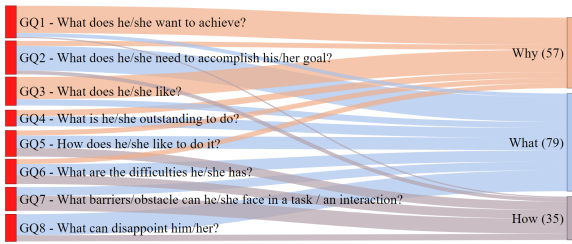


Figure 5: Relation of the guideline questions and the type of UX-related requirements.

of-use of the lean persona technique (see Table 3). We used a four-point Likert scale as answer options, ranging from *strongly disagree* to *totally agree*. Figures 6 and 7 illustrate the results of the acceptance feedback for the two groups, i.e., startups professionals and established companies professionals. We see that the lean persona had a good acceptance for both groups. In particular, P4 and P14 assigned low ratings of acceptance in most of the answers regarding easy of use perception. These participants were from established company and startup, respectively (see Table 2). Looking at their profiles in Table 2, we notice that both declared to “*have never heard about the persona and lean persona techniques*” which can explain their ratings. However, P4 and P14 did not give any suggestion of improvements to technique.

We also considered the comments added by the participants in the three open question of the questionnaire. We asked to the participants to give a justification for their point of view. First, the participants answered about the support of the guideline questions to the lean persona construction. Most of the participants reported that the questions cover the important points to the lean personas construction; they also mentioned the lean characteristics that the template carries as a positive feedback. Unlike, four participants, P7, P9, P14 and P15 reported they wanted to have other questions options to build the lean personas with more details. Looking at to their profile (see Table 2), we see that they all have practical experience with personas techniques which explain their demands of having space for giving more detail about the persona.

The next two questions asked whether questions should be added or removed from the template. The most of suggestions for addition of new questions came from the established company participants. In general, they mentioned that questions about the product brand, more details on the product features, technologies that the personas have expertise, could become the lean persona description more complete. P2 mentioned the wish of having a space on the template to add “[...]a statement that represents the per-

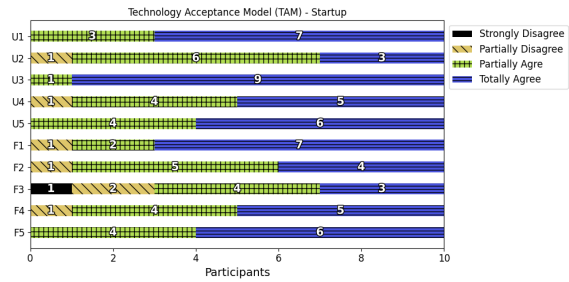


Figure 6: Startup professionals' feedback.

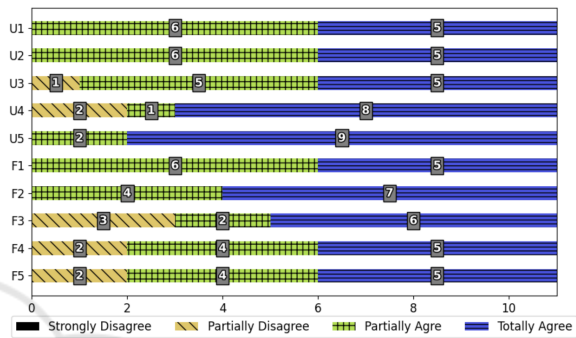


Figure 7: Established company professionals' feedback.

sona to provide more empathy to it”; P2’s answer could be explained by the fact that s/he had more knowledge on persona in which is usual to provide a statement about the persona (see Table 2). For the question of removing guideline questions, we see that the most of suggestions were given by startups’ participants. We observed that the quadrant Q3 was cited by 3 participants from startups. Some the comments are: “*I think the quadrant Q3 makes me to be little confused about the first and third questions (P15) and “[...] when I was filling the quadrant Q3, I have the impression that 2 questions have the same goal (P11)”*”.

Table 3: Feedback questionnaire based on TAM (Davis, 1989).

Dimension	ID	Question
Perceived of Usefulness	U1	I find lean persona useful for supporting the identification of UX-related requirements.
	U2	Using the lean persona technique allowed me to achieve the result I want.
	U3	Using lean personas technique supported me for quickly specifying details about end-users.
	U4	Using lean personas technique allowed me to write characteristics of representative end-users.
	U5	Using lean personas technique made me to getting better in describing end-users’ characteristics.
Perceived of Ease-of-use	F1	It was easy to learn how to use the lean persona technique.
	F2	I find the lean persona technique easy to remember.
	F3	I find it easy to understand the quadrant goals.
	F4	I could use the lean persona technique as I want.
	F5	It was it easy to get ability to use the lean persona technique.

5.4 Influence of Professional' Profile in the Acceptance

We decided to run the Fisher's exact test ⁷ to check whether the participants' profile could have influence on the acceptance of the lean persona technique. We took the Fisher's exact test because it allows comparing categorical data collected from small samples. It calculates the exact significance of the deviation from a null hypothesis using the *p-value*, while other methods use an approximation. In addition to providing a *p-value* with greater accuracy in small samples, the exact significance tests do not require a balanced or well-distributed sample (Mehta and Patel, 1996) which matches our sample's characteristics. A 95% (i.e., 0.05) confidence interval was considered to mitigate errors in the results ⁸. We compiled the data for running three different Fisher exact's testing which are available in Table 4 (a), (b) and (c).

First, we checked whether the company type affected the acceptance results (see data in Table 4 (a)). We thus defined the null and alternative hypothesis, taking into account the answers of all TAM's questions (see Table 3), as follows: *H0* - *The company type where the participant work has no influence in the acceptance*, and *H1* - *The company type where the participant work has influence in the acceptance*. After running the test, we got the results available in column *p-value* in Table 4 (a). The results suggest that there is no statistical evidence to support that the fact of working in startups or established companies influence on the acceptance of the lean personas use.

On our second testing, we defined the null and alternative hypotheses as follow: *H0* - *The previous knowledge of the participant on the Gothelf's lean persona technique has no influence in the acceptance*, and *H1* - *he previous knowledge of the participant on the Gothelf's lean persona technique has influence in the acceptance*. Prior knowledge of the technique was as "yes" for those participants that declared to have already used the technique. We collected this data in the profile questionnaire from the question "Have you ever know the lean persona technique before this study?". Table 4 (b) supported our testings from which we see that all the *p-values* indicate that there is no statistical evidence of influencing of the previous knowledge on the technique upon the acceptance.

Finally, we carried out another testing to see whether the professional's experience could impact on the acceptance. We used the data displayed in Ta-

ble 4 (c). The null and alternative hypotheses were defined as follows: *H0* - *The years of professional's experience have any influence on the technique acceptance*, and *H1* - *The years of professional's experience have influence on the technique acceptance*. We obtained the results of the *p-values* available in Table 4 (c) which lead the rejection of null hypotheses. The results suggest that there is no statistical evidence that professional's experience affect the acceptance on the lean personas technique.

6 DISCUSSION

Taking into account our RQ1 (*What type of UX-related requirements do software startup professionals describe by using lean personas technique?*), the results reveal that the lean persona technique motivated the participants of the two groups, i.e., startup and established company professionals, to the writing up of UX-related requirements which cover all the UX levels, i.e. "why", "what", and "how" (see the results in Section 5.2). Looking at Figure 4, we see a similar distribution in the four quadrants of the lean personas considering the levels of UX. In our understanding, the use of the lean personas technique can stimulate the professionals to describe end-users needs even in cases where the professionals have little experience and little knowledge in the personas technique, which are common in startups.

Our results also showed evidence that the guideline questions encourage the participants in describing "why" the user has a given need in different quadrants (see Figure 4). According to Hassenzahl (2018), the discussion about the reasons for transforming a set of needs into requirements is essential for the software developers to have better insights about the software solutions. This conversation can also lead the software teams to be more conscious in conceiving features that bring value to the audience (i.e., "wellbeing" level of the Hassenzahl's model - see Figure 1). The delivery of valuable products is even more vital in a startups environment where the professionals need to quickly react to new target audience demands in a highly competitive market (Hokkanen et al., 2016; Paternoster et al., 2014). Therefore, we conclude that lean persona can be a helpful technique to support the low experienced software startup professionals on the UX-related requirements specification.

Our results showed a positive acceptance of the technique, i.e., the answer of our RQ2 (*What are the participants' feedback about the use of lean personas technique?*). Regardless of the group, i.e., professionals from startups or established companies, the partic-

⁷<https://www.statstest.com/fischers-exact-test/>

⁸We run tests from this website <https://astatsa.com/FisherTest/>

Table 4: Results of Fisher exact's test - (1) Strongly disagree; (2) Partially disagree; (3) Partially agree; (4) Totally agree;— Group: (G1) Startup; (G2) Established Company.

Influence of the type of company (a)						Influence of the professionals experience (b)						Influence of the knowledge on lean personas technique (c)								
TAM	Group	(1)	(2)	(3)	(4)	p-value	TAM	Professional experience	(1)	(2)	(3)	(4)	p-value	TAM	Knowledge on personas techniques?	(1)	(2)	(3)	(4)	p-value
U1	G1	0	0	3	7	0.387	U1	3+ years	0	0	3	4	1.000	U1	Yes	0	0	2	7	0.184
	G2	0	0	6	5			<=3 years	0	0	6	8			No	0	0	7	5	
U2	G1	0	1	6	3	0.659	U2	3+ years	0	0	4	3	1.000	U2	Yes	0	0	4	5	0.367
	G2	0	0	6	5			<=3 years	0	1	8	5			No	0	1	8	3	
U3	G1	0	0	1	9	0.098	U3	3+ years	0	0	3	4	0.742	U3	Yes	0	0	1	8	0.159
	G2	0	1	5	5			<=3 years	0	1	3	10			No	0	1	5	6	
U4	G1	0	1	4	5	0.380	U4	3+ years	0	1	1	5	0.816	U4	Yes	0	0	3	6	0.314
	G2	0	2	1	8			<=3 years	0	2	4	8			No	0	3	2	7	
U5	G1	0	0	4	6	0.362	U5	3+ years	0	0	1	6	0.613	U5	Yes	0	0	2	7	0.659
	G2	0	0	2	9			<=3 years	0	0	5	9			No	0	0	4	8	
F1	G1	0	1	2	7	0.183	F1	3+ years	0	0	3	4	1.000	F1	Yes	0	0	4	5	1.000
	G2	0	0	6	5			<=3 years	0	1	5	8			No	0	1	4	7	
F2	G1	0	1	5	4	0.505	F2	3+ years	0	0	3	4	1.000	F2	Yes	0	0	3	6	0.519
	G2	0	0	4	7			<=3 years	0	1	6	7			No	0	1	6	5	
F3	G1	1	2	4	3	0.524	F3	3+ years	0	3	0	4	0.117	F3	Yes	0	3	2	4	0.914
	G2	0	3	2	6			<=3 years	1	2	6	5			No	1	2	4	5	
F4	G1	0	1	4	5	1.000	F4	3+ years	0	1	2	4	0.827	F4	Yes	0	0	4	5	0.360
	G2	0	2	4	5			<=3 years	0	2	6	6			No	0	3	4	5	
F5	G1	0	0	4	6	0.565	F5	3+ years	0	2	1	4	0.058	F5	Yes	0	0	3	6	0.557
	G2	0	2	4	5			<=3 years	0	0	7	7			No	0	2	5	5	

ipants considered the technique easy to use and usefulness to writing UX-related requirements (see Section 5.3). Billestrup et al. (2014) had pointed out that software professionals had difficulties in using the personas technique. Our study restates the results of Pinheiro et al. (2019) about the positive acceptance of the lean persona technique. Our positive results can be influenced by the guideline questions, which aided the participants to keep the focus on describing helpful information on the target audience. Ferreira et al. (2017) and Pinheiro et al. (2019) had already highlighted that the guideline questions support developers in a better use of the personas technique.

Nonetheless, our findings allowed us to identify problems with the guideline questions in the Q3 quadrant (*Behavior and preferences* - see Table 1). We conclude that we need to sift through these questions to thus decide about their changes. Considering different profile characteristics, we did different Fisher exact testings to see the influence of the profile participants in the acceptance results (see the results in Section 5.4). We noticed that the participants' characteristics did not have an impact on the acceptance of the lean persona technique.

Based on the related work (see Section 2.2), we see that our study presents important contributions discussing the use of the lean personas technique to support the startup professionals in the writing of UX-related requirements. As far as we know, no other work had carried out a similar investigation. We can state that the works of Pinheiro et al. (2019) and Ferreira et al. (2017) are the closest to ours. Pinheiro et al. (2019) had different purposes in their research: to assess whether non-technical stakeholders, i.e., domain experts, could write UX requirements using the lean persona technique, they called *Proto-Personas+*.

The study conducted by Ferreira et al. (2017) verified the writing of requirements in general without the focus on UX requirements. Although Pinheiro et al. (2019) looked at UX requirements, they did not examine them through theoretical lenses of the UX models proposed by Hassenzahl (2018).

Our results show evidence about the type of UX-related requirement that the technique encourages participants to write up. Besides, our findings can provide insights for future improvements on the quality of UX-related requirements specification. Moreover, software professionals took part in our study, which differed from the studies of Pinheiro et al. (2019) and Ferreira et al. (2017) that carried out evaluations with students.

7 CONCLUSION AND FUTURE WORK

In this paper, we investigated with 21 software professionals the support of lean persona technique in describing UX-related requirements. We developed a web tool to make the creation of lean persona artifacts easier and more automated. The results showed that our lean persona proposal aided both groups of professionals, i.e., software startups and established companies, to focus on writing up end-user needs in different levels of abstraction. The needs described descriptions of features, ways to interact with the product, and the reasons for those specifications existed. Finally, the professionals of both groups showed positive perceptions regarding the ease of use and usefulness of the lean persona technique.

As contributions our study presents evidence that the lean personas technique can help professionals

who have little experience in describing UX-related requirements, which are commonly found in software startups. The use of slim and easy-to-learn techniques is suitable to the low-resource and fast-paced environment of startups. We also contributed by developing the web *lean persona tool* which automated the process of persona construction. As future work, we intend to conduct case studies in software startups settings to see the usefulness of the lean persona technique in the daily work of small software teams.

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