Lessons Learned from Persona Usage in Requirements Engineering Practice

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Abstract—Personas, as a tool for characterising end-users, are widely utilised in requirements engineering (RE), primarily to enhance the understanding of end-users and their needs. However, the efficacy of persona usage in RE practice remains inadequately explored. To bridge this gap, we conducted an interview-based study with 22 international RE experts. These experts shared their experiences in utilising personas for RE-related tasks. Through thematic analysis of the collected insights, we propose recommendations for the effective creation and integration of personas in RE tasks. Our suggestions for efficient persona usage in RE emphasise the necessity of direct human interaction throughout persona development, while also considering project constraints. We recommend creating personas that reflect the needs and preferences of persona consumers regarding the information included and the presentation style. Additionally, fostering organisational awareness of the benefits of personas in understanding targeted end-users is crucial. Lastly, we highlight the importance of the interpersonal skills required by requirements engineers to support the successful incorporation of personas in RE.

Index Terms—personas, requirements engineering, interviews, recommendations

I. INTRODUCTION

Requirements engineering (RE) is a crucial part of the software development process [1]. It involves understanding and specifying the services required from software, as well as defining any constraints on its operation and evolution. RE-related tasks encompass discovering, defining, and validating end-users' requirements. A significant challenge in RE is the tendency of requirements engineers to project their own viewpoints onto a system, rather than focusing on the needs of its intended users [2], [3]. This poses a considerable risk to software development, underscoring the need for a deep understanding of end-users and their key requirements to inform software solutions.

Regular access to representative end-users and clear communication with them can pose challenges during interactions between requirements engineers and the end-users [3]–[6]. These challenges can impact the outcomes of RE-related tasks and may lead to reluctance from targeted users, ultimately resulting in dissatisfaction with the final product. The creation and use of *personas*, serving as representative archetypes of actual users, can partially address these issues [7]–[9].

Personas are valuable in requirements elicitation and analysis activities, providing insights into end-users' key requirements by identifying the beneficiaries of proposed products and articulating their perspectives [10]–[13]. They are effective in identifying user requirements [14], uncovering previously unidentified requirements [15]–[17], detecting potential requirements issues [15], and resolving conflicts among developers [16].

Despite their potential benefits, there is limited research on the actual use of personas in real-world settings during RE-related activities [11], [13], [18]. Our study aims to investigate the incorporation of personas in requirements elicitation tasks, with a particular focus on understanding end-users and their needs. We conducted an in-depth interview study with RE experts who have employed and studied personas to address real-world challenges. The study provided insights into RE practice perspectives, the persona crafting process in practical settings (including creation, review, and refinement), and the role of personas in comprehending end-users and their needs.

These insights informed the formulation of best practices for the actual application, benefiting both RE researchers and practitioners in effectively leveraging personas.

The remainder of this paper is structured as follows. In Section II, we detail the demographics of our participants and describe our research methods. Section III explores how the RE community perceives personas within RE, while Section IV examines the practical application of personas in RE. The crafting of personas in practice is discussed in Section V. Section VI delves into how RE experts utilise personas in RE-related tasks and shares insights gained from this practical application. Recommendations for effective persona usage in RE, derived from these insights, are presented in Section VII. Section IX offers a summary of research papers related to our study. Our study's limitations are summarised in Section VIII. Finally, the paper concludes with Section X.

II. METHODOLOGY

A. Participants

A total of 22 RE experts from five different countries (Australia, Canada, Indonesia, Sri Lanka, and the USA) were interviewed for this study. The interviewees hold various current roles, such as RE Researcher, Software Engineers, Product Designer, UX Designer, UX Researcher, and Product Manager. Most of the experts had less than 10 years of industry experience. Among the participants, the majority employed agile software development methodologies. Table I shows participant details. In order to respect their confidentiality, we refer to our participants by numbers P1 to P22. We recruited participants based on personal networks, advertisements to social media, and referrals by other participants/personal networks. We selected a range of participants from very experienced requirements engineers to those who mainly use requirements personas vs. create them. We did not attempt to achieve participant saturation in terms of location, experience, use of personas in RE, domain of expertise, though did recruit more than one participant in most of these dimensions.

B. Data collection and analysis

We conducted one-to-one semi-structured interviews with RE experts, with ethical approval from Monash University Human Research Ethics Committee (Approval #35897) to ensure compliance with ethical research practices. Participants were recruited through a variety of methods, including social media advertising on platforms such as Twitter and LinkedIn, as well as through direct outreach within the investigators' personal and professional networks

The interviews were conducted to understand how RE experts craft and use personas to gain a better understanding of end-users and their requirements. These broader aims were distilled into a set of key research questions, guiding our discussions with the experts to elicit insights into the crafting and usage of personas, as expressed in their own words. Before the interview, participants were asked to complete a pre-interview questionnaire to gather demographic information[1]. All participants were presented with the same set of questions[2]. Through the interviews we aimed to answer the following key research questions:

RQ1. How does the RE community perceive personas for RE? We want to explore the perceived value and benefits of personas in RE-related activities within the RE community.

RQ2. In what ways do RE experts use personas in requirements elicitation tasks? We aim to uncover how RE experts leverage personas to gain insights into their end-users and different aspects of their requirements.

RQ3. How are personas crafted within a practical setting for RE? We ask about the processes and methods employed by diverse RE experts to create, review, and refine personas.

RQ4. How can persona usage for RE in practice be improved? We aim to identify any expert recommendations for requirements engineers to more effectively use personas in their RE-related tasks.

To analyse the interview data, we utilised a commercial transcription service for transcribing the recorded interviews, subsequently organising them using NVivo. Our approach commenced with a reflexive thematic analysis [19], beginning by familiarising ourselves with the data through active listening to the recordings prior to transcription. This step was crucial in recalling interviewees' mannerisms, thereby aiding our understanding of the areas they considered important. The ensuing stage involved coding the data to capture significant elements. We applied both semantic and latent coding during this phase, aiming to uncover not only the explicit content but also to interpret the underlying assumptions beneath these surface meanings. For instance, the phrase *"So keep it simple, keep it very concise"* was semantically coded as *"persona should be concise"*, while the statement *"I mean, yeah, it makes sense to keep my bias in check. But my question would be, what will be the impact of not doing that? Why do we want to keep my bias out of it?"* was latently coded as *"bias is not harmful"*.

The process then moved to generating themes by amalgamating similar codes. This was followed by the meticulous task of reviewing and refining these themes. To further deepen our analysis, we created theme levels, grouping similar codes into sub-themes and then assembling these into overarching themes. For example, codes like *"never make assumptions"* and *"stick to the data to minimise bias"* were grouped into the sub-theme *"ways to deal with bias or assumptions"*, which in turn formed part of the larger theme *"bias and assumptions in persona incorporation"*. We visually organised our themes using a thematic map[3]. The final phase involved producing the report and verifying whether our analysis addressed our research questions. We conducted an inductive analysis across our generated themes, aiming to draw conclusions by being as reflective as possible towards our data and remaining free from any preconceived theory or conceptual framework.

[1]https://doi.org/10.5281/zenodo.10937846
[2]https://zenodo.org/records/10485758
[3]https://zenodo.org/records/10508044

ID	Current Role	Location	Year of Experience in Industry	Method	RE Experience		Domain(s)	Persona usage experience			
					Years	Persona Usage Frequency		Craft persona	Incorporate Personas in RE Tasks	Software dev.	Other
P1	UX Designer	Canada	1 - 4	Structured, Agile	1 - 4	Weekly	Government Services	Yes	Yes	Yes	N/A
P2	Company Owner	Australia	> 15	N/A	1 - 4	Rarely	N/A	Yes	Yes	Yes	N/A
P3	Product Manager	Australia	5 - 10	Agile	1 - 4	Daily	Property	Yes	Yes	Yes	N/A
P4	Research Fellow	Australia	1 - 4	Co-Design	1 - 4	Monthly	Health	Yes	No	No	N/A
P5	Senior Engineer	Australia	5 - 10	Agile	1 - 4	Monthly	Human Resources, FinTech	No	Yes	Yes	N/A
P6	Project Manager	Australia	1 - 4	Structured, Agile	1 - 4	Monthly	Legal	No	Yes	No	N/A
P7	Senior UX Designer	Canada	> 15	Agile	11 - 15	Daily	Energy	Yes	Yes	Yes	N/A
P8	UX Researcher	Sri Lanka	5 - 10	N/A	1 - 4	Daily	Health	Yes	Yes	Yes	N/A
P9	Owner	Canada	> 15	Structured	11 - 15	Yearly	Cyber-physical systems	No	No	No	Concept
P10	PhD Researcher	Australia	1 - 4	Agile	1 - 4	Daily	Health, Education, Government Services	Yes	Yes	Yes	N/A
P11	Business Systems Analyst	Canada	5 - 10	Agile	5 - 10	Weekly	Telecommunication	No	Yes	No	N/A
P12	Senior UX Researcher	Canada	5 - 10	Agile	< 1	Yearly	Legal	Yes	No	No	N/A
P13	Research Assistant	Australia	1 - 4	Structured	1 - 4	Monthly	Health	Yes	No	Yes	N/A
P14	Research Engineer	Australia	1 - 4	Structured, Agile	1 - 4	Weekly	Finance, Business Services, Health	Yes	No	No	N/A
P15	Front-end Developer	Australia	1 - 4	Agile	1 - 4	Monthly	Health	Yes	Yes	No	N/A
P16	Digital UX Specialist	Indonesia	1 - 4	Structured, Agile	1 - 4	Weekly	Food and Beverage, Logistic, FinTech, E-Commerce	Yes	No	Yes	N/A
P17	Product Designer	Sri Lanka	5 - 10	Agile	1 - 4	Weekly	Education, Government Services	Yes	Yes	No	N/A
P18	Product Manager	US	5 - 10	Structured, Agile	1 - 4	Daily	Field Service	Yes	No	No	N/A
P19	Product Designer	Indonesia	1 - 4	Agile	1 - 4	Daily	Logistic	No	Yes	No	N/A
P20	Software Company Owner	Indonesia	5 - 10	Structured, Agile	1 - 4	Yearly	Government Services	Yes	No	Yes	N/A
P21	UX Researcher	Indonesia	1 - 4	Structured, Agile	1 - 4	Yearly	Government Services	No	Yes	Yes	N/A
P22	UX Researcher	Australia	11 - 15	Structured, Agile	5 - 10	Monthly	Education, Learning Management System	Yes	No	No	Audience

TABLE I
SOME KEY DETAILS OF OUR INTERVIEW PARTICIPANTS

III. RQ1 – WHAT IS AN RE PERSONA?

We asked our participants about their perspectives on *personas* as a concept. Nine participants defined personas as **holistic user characterisations** that include not just end-users' demographics but also their personal stories (P2, P9, P13, P14, P15, P16, P17, P20, P21). As P14 explained, *"My definition of persona, for myself, is like the story of the user, which we can use to further analyse and generate requirements."*

Six participants (P1, P9, P13, P20, P21, P22) expressed that personas should represent the human beneficiaries of the proposed software, hence it is **essential to incorporate a richness of human traits into personas** that goes beyond mere formulaic representations. P1 stated, *"Persona is not about preferences. Persona is that underneath layer of human needs."* Well-rounded personas thus have the capacity to **convey authenticity** and **foster believability**, which two participants (P9, P22) said is subsequently beneficial for requirements engineers and other stakeholders in understanding end-users. P22 highlighted this, stating, *"Having richness in personas helps them [clients] interpret and better understand the information that I have presented."*

Moreover, eight participants (P2, P3, P5, P8, P15, P16, P18, P19) said that personas should go beyond mere user representation; they should serve as valuable **reminders** that consistently prompt requirements engineers to **consider the individuals** for whom they are developing the software. This practice prevents their over-reliance on assumptions about the needs of end-users. P2 echoed this sentiment by stating, *"If we do not have this lighthouse that is actually guiding us towards who we actually serve, chances are that we will work towards solving what we think is important for us personally, instead of what is important for the customers, the users that we design products and services for."*

Four participants said that it is essential to acknowledge that personas are **research-driven products** (P1, P3, P7, P10). Conducting proper stakeholder-related **research is fundamental to creating well-rounded personas**. They said that it is also important to keep in mind that the research itself is a continuous process of discovery to gather more information about the end-users. P1 emphasised this, stating, *"It [persona] is a product of research. Without research, how would you even create personas that accurately reflect your user group's needs, wants, and pain points, right?"*

Furthermore, four participants (P1, P3, P7, P10) stated that it is important to acknowledge that personas are **not standalone tools**. They serve as a starting point that leads requirements engineers to gain a better understanding of end-users, rather than being the sole tool for understanding them. P7 emphasised, *"The persona itself will help you initiate the conversation, but you really need to complement it with other techniques."*

IV. RQ2 – HOW DO REQUIREMENTS ENGINEERS USE PERSONAS?

We asked participants how they use personas in their projects, specifically around eliciting end-users' requirements.

Based on our analysis, we discovered several benefits of incorporating personas into requirements elicitation activities.

1) A proper user representation: Our participants said that personas can be a powerful method for representing users for four key reasons that we identified from our interviews. Firstly, three participants claimed that a persona is able to **portray human characteristics** with all of their complexity (P10, P13, P22). P13 expressed, *"...and it [persona] also imitates different personalities when you use them."*. Secondly, a persona can provide **a concise formalisation of human characteristics** (P22) where the persona is able *" ... to convey this information [resulting from user research] in a concise way, in an easy to understand way to the people that consume the research"*. Thirdly, four participants (P4, P10, P13, P22) said that personas are capable of **representing a diverse group of end-users**, as noted by P10, *"...and especially, different people, or groups of people, they have different challenges depends on their experience, their characteristics."*. Lastly, personas **offer anonymity to the end-users** (P5), *" ...they [persona creators] collect the requests from the end-users, the actual clients, sometimes they, you know, need to kind of like have some anonymous level."*.

2) Conveys user needs and expectations: In addition to the portrayal of human characteristics, personas can also be helpful in communicating end-user needs and expectations. Ten participants (P2, P4, P6, P11, P13, P18, P19, P20, P21, P22) said that one of the strengths of a persona lies in its ability to **articulate the attributes of end-users**, especially their needs and expectations. As highlighted by P18 *"... but we have to use them [personas] to convey like, here's what this person wants, here's their desires, and it helps keep people honest, or trying to make sure we're building the right thing."* Our analysis suggests that personas not only depict end-users needs and expectations but also help requirements engineers to **identify potential gaps** in requirements (P18), *"As we walked through the flow, and then tried to figure out: 'Where are the holes we missed?'. And sometimes that's just as simple as like missing a requirement, or maybe missing an outcome that we didn't think of."*

3) Support the discovery of potential beneficiaries: In the course of our analysis, it became evident that personas play a pivotal role in **identifying potential end-users** for the proposed software (P5, P11, P15, P18). As highlighted by P11, *"I think it [persona] basically would help us to identify the user groups that will be using a product. That's why I'm using personas."* Furthermore, P18 argued that personas can also be used during software development to facilitate the **discovery of previously unidentified end-user groups**, *"... so here's the new type of user we're going after, here's what they need, here's their challenges, and then that helps set the stage for the future development we did."* Importantly, P15 noted that personas can be used to effectively introduce the identified end-user groups to other project stakeholders: *"Later, for a meeting with client, we will propose our persona to see this is a typical type of users, ...because sometimes clients are not sure what kind of users they want."*

4) A communication tool: Six participants (P1, P5, P7, P15, P16, P22) highlighted another benefit of personas - that they can serve as an effective communication tool among many of our participants' software development teams, facilitating a shared understanding of who the end-users are and their needs. Furthermore, it was noted that personas can also serve the purpose of **convincing** other stakeholders regarding the proposed software's viability. P22 told us, *"So having the persona is a lot more richness and helps them [other stakeholders] to interpret and better understand the information that I have presented. And yes, I think it opens up a much better conversation."*

5) Maintain project focus: Eight participants (P2, P3, P5, P8, P15, P16, P18, P19) noted a final key strength of personas was their capacity to heighten the project team's awareness of their end-users. P18 articulated, *"... it [persona] helps keep people honest, or trying to make sure we're building the right thing."*

V. RQ3 – How are RE personas crafted?

We asked our participants to tell us how they create RE personas, how they capture different human aspects, and how they review and refine these RE personas.

A. Persona creation

1) Phases to creation: We identified four phases commonly used by RE experts in creating personas for RE: (1) pre-construction activity; (2) data collection; (3) data synthesis and analysis; and (4) persona drafting.

Phase 1 - Pre-construction activity: Three participants (P4, P11, P14) mentioned conducting preliminary activities before data collection. We discerned two primary reasons for this. Firstly, it enables them to **acquire prior knowledge** about the intended end-users, which is particularly valuable when these users come from diverse backgrounds. Such knowledge facilitates smoother interactions during direct engagement with end-users in the data collection phase. Furthermore, it assists requirements engineers in selecting appropriate participants for data collection. Secondly, participants undertake preliminary activities to **establish initial assumptions** about the target end-users. These assumptions are instrumental in shaping data collection strategies, including formulating interview questions and creating preliminary personas. These initial personas are crucial for requirements engineers in developing proto-personas – preliminary versions based on initial assumptions. The creation of proto-personas typically involves conducting **literature reviews** or **analysing user feedback** on similar existing solutions. P14 stated, *"Sometimes we will use that [user review analysis] to further interview the candidates."*

Phase 2 - Data collection: This phase focuses on gathering data about the represented individuals. Our interview analysis revealed that data about these individuals can be **sourced directly from them** (as noted by 11 participants: P1, P4, P6, P8, P10, P11, P13, P14, P15, P17, P22), or from **alternative resources** (as mentioned by eight participants: P5, P6, P7, P10, P14, P16, P20, P21). Common approaches for directly

collecting data include user interviews, group discussions, observations, workshops, and surveys, tapping various groups such as targeted end-users, project owners, and experts. P11 stated *"There were instances where we talked to the client [project owner] then get the requirements from them and see what their expectation is."*

The rationale behind direct data collection is that it **enables requirements engineers to develop a deeper understanding of their users**. This understanding is crucial for validating initial assumptions about end-users and reducing bias. However, it's important to note that direct involvement with represented individuals can be a **time-intensive process**, and not every project can afford this due to time constraints (P22). Therefore, carefully selecting targeted user groups is essential. P1 emphasised, *"Recruitment is always a challenge. And I think if that's the case, I always try to think the the participants you have. If they're not representing your target group, how are they different? You know, the key differences that could break the deal."*

Alternative sources for data collection identified by participants include relevant literature, data analytics tools (e.g., Bandel, Hotjar, Google Analytics), user reviews, social media posts, news articles, or existing company data. These **alternative resources can act as primary sources** when time is limited (P14), or **complement data** collected directly from users (P16). P14 explained, *"If we don't have a large budget to interview people, there are some resources on the internet that we can use to analyse the behaviour of the user. Then from that, we are doing some data analysis, when we (are) collecting the reviews and then building on the character of the product."* Additionally, P5 noted, *"Also the news, like what's happening in a big country. They definitely have certain culture happening there. How do they use technology in there?"*

However, P7 warned of the limitations of these resources, such as **not providing all necessary data** for a comprehensive understanding of end-users. Additionally, **confidentiality issues** may prevent data providers from sharing essential information: *"The hardest part because sometimes they [data providers] either don't have that information, or they don't want to say share it out."*

Phase 3 - Data synthesis & analysis: In this phase, requirements engineers engage in the analysis and synthesis of the collected data, with a focus on **identifying emerging patterns** in end-users' demographics, motivations, goals, concerns, and other pertinent human characteristics (as identified by P1, P5, P7, P10, P11, P13, P17, P19, P22). This process entails grouping human traits based on similarities and **discerning potential end-user groups** from the synthesis outcomes. If necessary, requirements engineers then **select specific user groups to target**. P5 described their method for identifying similarities and making strategic decisions, stating, *"When we start getting those similarities, we try to match and see which one we can adopt, or we can facilitate with a new feature. And then we just make a decision."*

Stage 4 - Persona drafting: Upon identifying the end-user groups and their characteristics, nine participants (P3, P5, P7, P8, P9, P11, P16, P17, P22) indicated that requirements engineers proceed to draft **main persona(s)**. These personas are also known by various terms such as primary personas, generic personas, and proto-personas. Main personas typically serve as **simplified representations of the primary end-user groups**. P17 observed, *"I usually start by creating one main persona as a representation of most of the user groups."*

To pinpoint the primary end-user groups, our analysis suggests that **focusing on recurring characteristics** is crucial. These are traits frequently observed among the end-users. P5 elaborated, *"When we usually find that there is an interesting group of users that potentially can use this and it just keeps popping up there, that's definitely something that we can target or we can help with."* This focus on primary end-user groups in the industry is due to the labour-intensive nature of creating personas for every identified user group (P5, P17, P18).

If necessary, requirements engineers can later **expand on these main personas** (P3, P5, P17, P22). The persona creation process, as an ongoing activity, allows for the development of main personas when new end-user groups or unique characteristics emerge, or when specific features need to be introduced. P5 explained, *"Sometimes we identify new traits to the market and we need to prop them up. Then we figure out how do we fit in that new idea for our existing users? That's when we found that this is actually a group of users of persona. So we create a subset of that persona."*

2) Number of personas created: A few of our participants (P1, P4) highlighted that there is no specific guideline regarding the number of personas to develop or use in a project. P4 remarked, *"I don't think that is any magical number."* However, most participants typically incorporate **between two to five personas** per project (P1, P3, P6, P11, P14, P15, P17, P18, P19, P20, P21, P22), with P18 sharing, *"I've never done more than four personas for a given project. And if I had my way, I would probably keep it around two."*

We explored the reasoning behind practitioners' decisions on the number of personas in their projects. Our analysis indicates that the choice depends on two main factors: (1) the population of end-users; and (2) the project's constraints.

A larger and more diverse **population** requires a greater number of personas compared to a smaller, more homogeneous group (P1, P2, P4, P5, P8, P11, P13, P14, P15, P16, P17, P18, P20, P21, P22). This ensures a well-rounded representation of different user segments. P8 emphasised, *"So out of the stakeholders, we can ascertain who are actively involved in the workflow. And based on that, we can determine the number of personas that we should create."*

Furthermore, our participants consider **project constraints** like time, cost, and scope when deciding on the number of personas (P2, P5, P10, P15). P15 pointed out that the *'scale and scope'* of the project significantly influence this decision. Larger projects, which often have a wide range of users and features, typically require more personas to accurately reflect the diversity of users and the variety of solutions offered. P2 added, *"In many cases, it depends on the on the product that you're working on. For instance, in a startup with a simple*

business model, you serve just one customer. But in digital products, such as double or triple-sided marketplaces, you may need one persona for each party involved in the decision-making process."

B. Human aspects in persona

While there is no standardised set of human aspects for personas [13], nine participants underscored the importance of **relevance** in incorporating human characteristics into a persona (P3, P5, P9, P10, P11, P13, P15, P18, P22). They also highlighted that each human aspect should be **interconnected** and **consistent** to ensure the persona is **believable**. This alignment not only enhances the persona's credibility but also **fosters its acceptance**. As P9 pointed out, *"It [persona] has to be consistent. If it is not consistent, it is not going to ring true."* Similarly, P22 emphasised the importance of prioritisation in the persona's description, *"In the persona description itself, there is obviously a prioritisation that you, as the creator of the persona, need to do in the given context. If it is really important, whether in how people take certain actions and what they think when they take these actions, then you need to write it down, and it needs to be part of the persona."*

Additionally, five participants (P3, P9, P13, P18, P22) mentioned that including pertinent and coherent human characteristics allows the persona's audience to **empathise** and gain **a deeper understanding** of the personas. P3 explained, *"Every persona would probably have a pain point that you could relate to."* This enhanced understanding aids in comprehending the personas' needs, which subsequently facilitates decision-making in developing solutions to address their challenges (P6, P15, P16, P22). P6 illustrated this with an example, *"They [persona consumers] just want to know where the things they need are and how they can access them quickly and easily. So, that information collection [human aspects] really helped us put together solutions and similar things."*

C. Persona review and refinement

In our previous research, we found a limited number of studies offering methods for reviewing and refining personas [13]. We explored this further by asking our participants about the evaluation and evolution of their personas.

1) Is it necessary?: The evaluation and refinement of personas elicited two contrasting viewpoints. Five participants opted not to evaluate their personas, citing various reasons (P1, P5, P16, P17, P18). Firstly, they recognised that personas primarily serve to establish initial empathy and connection with end-users. Additionally, personas are viewed as a stepping stone to more extensive research and integration with other user-centred methodologies. As a result, **the accuracy of personas was not considered critical**. P1 explained, *"The purpose of a persona is to initiate that initial empathy. So, as long as I can achieve that, that's all that matters."*

Secondly, the choice to forego persona evaluation depends on **awareness of user-centred approaches** within the organisation. As P16 observed, *"It actually depends on the*

company's culture. There are companies that really have a supportive side of you on the UX side, they will support you to create persona. There are companies where you have to do it [user research] by yourself."* P1 added, *"Because for stakeholders and clients, they don't really care about that much of detail. They don't care about those people's age, language, if they have kids or not. That kind of dimension doesn't matter (for them). What really matter is they start to see them [personas]. So if they [stakeholders and clients] start to see them [personas] as human, that's all that matters."*

Thirdly, some participants mentioned that they sometimes cannot afford to review and refine personas due to **project constraints**, prioritising other project tasks within the time frame. P17 mentioned, *"We didn't evolve the persona because we were focusing on completing the project. We didn't like had time to like evolve the initial persona."*

Conversely, six participants highlighted the importance of reviewing and refining personas (P3, P5, P11, P13, P16, P22). Their rationale centred on **ensuring personas remain aligned with the evolving nature of humans**. Since persona creation is an iterative process, subsequent iterations often uncover new insights about end-users, necessitating updates to the personas. P3 remarked, *"You build out a rough persona, and at the end of the discovery period, you've learned so much more. Then you've got to make sure that you're updating the persona."*

2) Means to review and refine personas: Our participants provided insights into their practices for revisiting and updating created personas. Five participants emphasised their commitment to evaluating and refining personas through ongoing research to integrate new information (P2, P3, P7, P11, P16). This practice is considered essential due to the evolving nature of end-users and technology, which necessitates that personas adapt correspondingly. They highlighted that conducting **further user research** offers fresh perspectives. For example, P3 stated, *"In terms of information that I would get to change it [persona], it would just be further user interviews or further conversations that I've had with users."* P2 added, *"Let's say after the first iteration, you're already 70% or 80% right with your persona. Then you go out, create your quantitative research, and feed that back into the persona."*

Moreover, to verify if the created personas accurately represent end-users, some participants suggested an alternative approach — **seeking a second opinion**. It is believed that feedback from fellow human beings is an effective way to review personas. P22 stressed, *"There is no automated way. It's nothing a machine can help you with. So you need other people to validate this thing."* In practice, requirements engineers can engage with **individuals represented by the personas** for confirmation (P4, P10, P14, P20, P21, P22). P4 remarked, *"I would prefer to evaluate it with the actual end-user to make sure that it best represents them."*

Additionally, personas can be reviewed by **other team members** (P4, P5, P6, P15, P17, P18) and **the project's owner** (P8, P15, P17), offering valuable insights for refinement. P17 noted the collaborative effort, saying, *"My team mates were instrumental in helping me review and refine the persona.*

Whenever I encountered issues with the persona, they were always there to assist me."

3) Representative personas: We delved into how practitioners ensure their created personas accurately represent their end-users. Three participants voiced that **striving for perfection in persona development is unrealistic** (P1, P7, P22). They believe that as long as personas successfully establish a connection with the people they represent, they achieve their primary purpose. P22 explained, *"You don't have to capture everything because, at the end of the day, I create the persona to solve the problem. I only look for those traits that are immediately important. Of course, I might miss something. And as I said, that's the industry. I'm not trying to find the truth; I try to solve the problem as best as I can."*

Four participants described their method of determining whether personas sufficiently reflect end-users after several rounds of review and refinement (P5, P6, P18, P22). This process includes **collaborative discussions** with team members, critically examining the personas until a **consensus** is reached. The validation of personas often relies on data obtained from direct user interactions, such as interviews and observations, to ensure their authenticity. P6 mentioned, *"So it was more like a verbal agreement within the people that were developing them [personas]."*

VI. RQ4 – CAN PERSONA USE IN RE PRACTICE BE IMPROVED?

In RE-related tasks, personas play a significant role in gaining insights into end-users and their needs. We asked our participants about their experiences with incorporating personas into RE processes, any key limitations and issues they have with using personas in RE, and any ways that they address these.

A. Through the persona lens

1) Humanising the humans: Our participants emphasised the importance of **human characteristics** in personas as a means to gain deeper insights into diverse end-users and their requirements. A range of personal characteristics deemed important was identified, along with the insights these attributes can provide.

Characteristics such as **motivation** (P1, P2, P4, P6, P14, P15, P17), **goals** (P1, P3, P2, P5, P6, P8, P11, P13, P14, P17, P18, P20, P21), and **concerns** (P1, P2, P3, P6, P7, P8, P11, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22) are considered crucial for personas [20]. These attributes help requirements engineers to understand end-users' behaviour, objectives, and challenges. *"We evaluate whether the behaviour is correct or not correct with their [end-users'] motivations."* P11 added, *"Mostly, it'll be what they're trying to accomplish, what their expectation is."* P17 highlighted the importance of understanding pain points, *"Pain points are the main thing that I'm concerned of because that's what we are trying to: make their [end-users'] lives easier."*

Our participants also indicated that **personal stories** in personas (P2, P5, P8, P13, P14, P15, P16, P17, P19) provide valuable insights. These stories reveal how personas lead their lives and behave in different situations. P16 explained, *"It [personal story] actually gives us insights about them [end-users]. This is where we are not specifically talking about [project's context], but we want to know them as a person."*

Furthermore, the **personality** of personas (P9, P13, P17) is pivotal in forming impressions and understanding responses to various situations. P9 observed, *"Whenever you meet somebody for the first time, how do you form your first impressions? And that's something to think about when thinking about how do I design persona, like I say, is this somebody who is a neat person? Is this somebody who is very talkative, or maybe somebody who's very reticent. That kind of stuff would be part of my conceptualisation of the persona."*

Demographic information such as name, age, gender, and occupation (P1, P4, P5, P8, P9, P13, P14, P16, P17) aids in establishing a human connection. P1 found, *"... and a very realistic name, I find that that's really surprisingly useful. Because once you have a name for the persona, the client starts to address the persona as a real person."* Additionally, **preferences** (P3, P13, P19, P20, P21) help in understanding inclinations. P3 stated, *"So somebody who likes [application's name] might be a younger person, like, someone who likes [application's name] might be an older person. That's how you can use some of those interesting bits of information in personas to show how they might fit within that persona or in that industry."*

Other helpful human characteristics include **social interaction** (P22) and the persona's **living environment** (P5, P14, P16). Observing interactions gives insights into personality, as P22 commented, *"You can also talk about how they [personas] interact with their peers. So you can learn a little bit about their personality."* The living environment provides context for behaviour, as P14 explained, *"The environment can be used as context to express or describe another information on the persona. Because the information in that persona can be correct within this environment, but it might change in another environment."*

2) Other avenues to understanding: Our study reveals that merely depicting human characteristics in personas does not suffice for a profound understanding of end-users. Various approaches can enhance our comprehension of personas.

Our participants strongly recommend **involving end-users** in the persona development process, facilitating direct interaction (P1, P3, P4, P5, P6, P7, P10, P11, P13, P15, P17). Engaging end-users through participatory design activities like interviews, observations, workshops, and group discussions allows them to contribute to personas that represent themselves. These interactions help requirements engineers discover insights beyond predefined questions or tasks. P5 reflected on gaining understanding through *"the actual interactions with them during the initial interview."* P4 added, *"So it's not only the persona that contributed to my understanding of their needs; it's also the context of the observations that played a significant role in shaping my interpretation of the persona."*

After gathering information, various techniques and frame-

works assist requirements engineers in deepening their understanding of end-users. A **literature study** can provide initial knowledge about end-users and guide question formulation (P8), especially useful in bridging cultural gaps. P8 noted, *"So in that case, what we normally do is research about their [end-users'] society. We read a lot."*

There are also frameworks to facilitate comprehension of end-users and their requirements (P7, P12). The **Business Model** and **Value Proposition Canvas**, part of the Business Model Canvas [21], is favoured by P7 for its utility in organising complex information. P7 stated, *"There is this Value Proposition design that I really like. And also Business Model Generation, I find it really useful. I use it to organise my information because it's excellent at helping me structure information in a larger complex."* Another useful framework is **Jobs-to-be-Done** [22], which focuses on understanding end-users' problems and needs. P12 mentioned, *"So this person has a certain jobs to be done as a responsibility."* P7 concurred, *"Another model that I could recommend is Jobs-to-be-Done. I think it is also very useful. I like this because it's a straightforward framework, and it's easy to connect with multiple stakeholders."*

3) Where the understanding leads: Our study participants highlighted the importance of truly understanding end-users as individuals. A profound comprehension of end-users fosters empathy, which in turn creates a meaningful **connection** between requirements engineers and end-users (P1, P6, P17). This connection enhances effective communication and promotes **trust**, especially in sensitive contexts such as cultural or health-related projects. P10 emphasised the significance of this bond, *"They [end-users] really feel comfortable talking about their experiences. So, rapport and trust are key."*

Understanding end-users deeply ultimately leads to a clearer grasp of their needs. This in-depth knowledge of what end-users want and seek to avoid empowers requirements engineers to make well-informed decisions when defining software requirements (P3, P5, P6, P11, P15, P16, P17, P18, P22). It ensures that these requirements **adequately satisfy** the end-users' needs and preferences. P17 highlighted the criticality of this understanding, *"Without understanding users perspective, needs and motivation and all those things from users' end, I believe, personally, the end goal that we are trying to target to achieve from our product will not be usable for the users."*

B. Walk in the "persona's shoes"

Given that personas are inherently subjective tools, the issues of bias and assumptions naturally arise when integrating them into RE-related tasks. Our study delves into RE experts' perspectives on these challenges, aiming to understand their views, stances, and strategies for mitigating bias and assumptions within personas.

1) Bias and assumptions in personas: Our analysis indicates that the presence of bias and personal assumptions is an intrinsic part of incorporating personas in RE-related tasks (P4, P8, P9, P18). Our past experiences and acquired knowledge subtly influence our approach when integrating personas into our projects. *"My bias tends to sneak into that really easily because I have my own biases."* P8 reinforced, *"We can't fully eliminate it [bias]."*

2) Attitudes towards bias and assumptions: Recognising the inevitability of bias and assumptions in persona incorporation, we explored RE experts' views on these issues. Our findings reveal two distinct attitudes.

Some experts, like P1 and P22, believe that bias and assumptions **are not pressing concerns**. P1 questioned the impact of unchecked bias, *"I mean, yeah, make sense to keep my bias in check. But my question would be, what will be the impact of not doing that? Why do we want to keep my bias out of it?"* P22 suggested an innovative approach, *"Maybe it would be beneficial to craft a persona [built upon our assumptions] capable of articulating viewpoints that do not entirely align with reality. This characteristic could, in certain situations, facilitate collective awareness without revealing specific identities."*

On the other hand, several participants emphasised the importance of being mindful of biases and assumptions (P4, P8, P9, P11, P15). They cautioned that these factors might lead to **misinterpretation and the omission of key requirements**. P11 highlighted the risk of developers imposing their perspective, *"Sometimes the developers could just look at it [the problem] from their perspective, and there are requirements missing at the end."*

3) Dealing with bias and assumptions: Participants in our study shared their strategies for addressing bias and assumptions. Firstly, **acknowledging our lack of prior knowledge about end-users** is crucial to prevent assumptions (P6, P10, P15, P16). Treating every piece of information from end-users as new is essential, even if we already have insights about them. Additionally, maintaining **respect** for the represented individuals is key. By valuing their stories, we can minimise bias and assumptions in our approach. P16 noted, *"I usually start to think like I'm such an empty glass of water. You don't know anything, so every insight that comes from our participant is considered as new insights. You have to think like you know nothing about them [end-users]."* P10 stressed, *"Their stories [end-users'] are their stories, so I keep the story very unbiased and objective."*

Secondly, **establishing a connection with human beneficiaries** of the software is vital (P1, P2, P5, P6, P7, P10, P11, P13, P20, P21). Participatory design activities are recommended for creating this connection, allowing requirements engineers to engage directly with the individuals they represent. The goal of these activities should be understanding the end-users. P6 said, *"Getting to know them [end-users] is essential. Absolutely essential."* P5 emphasised that a better understanding of end-users is established through *"the actual interactions with them [end-users] during the initial interview."* Establishing connections with individuals enables requirements engineers to empathise with the represented personas and think more closely as they do, as described by P2, *"Don't fall in love with the solution. Fall in love with the problem. So 'fall in love' with the person that you're designing*

for and get as closely into their life as possible."

Thirdly, when biases and assumptions are noticed, it is important to **double-check** them (P4, P5, P6, P13, P20, P21, P22). Seeking second opinions helps validate these biases. Feedback from end-users interviewed during persona creation can be insightful, as P20 illustrated, *"We asked our targeted end-users, are these their goals, is this their motivation."* P13 suggested, *"I would consult the personas with people who have the characteristics of the persona, and I would act accordingly."*

VII. Effective persona usage in RE practice

From our interview analysis, we identified several practices that aid effective persona usage in RE (summarised in Figure 1), and some avenues for future research in this area.

Direct human interaction in persona development: Incorporating personas to represent end-users is invaluable for addressing accessibility challenges in software development. However, it is crucial to recognise that direct interaction with end-users remains essential, as shown in earlier studies on RE and Design Thinking [23]. Such interactions provide valuable insights into the traits and behaviours of end-users in different scenarios, enabling requirements engineers to create well-rounded personas. These personas are particularly useful for team members who cannot interact directly with end-users, thereby enhancing their understanding and effectiveness in their tasks. As P1 noted, *"Persona is created to put it there for people who don't have an opportunity to interact with them directly."*

Direct human interaction helps to **bridge gaps** between requirements engineers and end-users, fostering empathy among engineers, as also shown in previous studies [24], [25]. This leads to a deeper understanding of end-users' perspectives, reducing bias and unwarranted assumptions in persona creation. Understanding the end-users equips requirements engineers to articulate software requirements that align with the users' objectives, addressing their challenges and pain points effectively. P2 emphasised, *"The longer you physically disconnect from that person, the more your own bias comes into play again. You have to, on a regular base, go back to your customer, to your persona, in some way or another and actually talk to them. Don't wait until you are too far down the rabbit hole."*

Requirements engineers can incorporate real human interactions into persona development through methods like user interviews, group discussions, workshops, or observations [26], [27]. These activities **yield insights** beyond predefined questions, often uncovering elements crucial to end-users, such as needs, pain points and emotions of end users, as shown in previous studies [28]. P22 explained, *"If you do UX research, you basically interview or observe a group of people. But aside from all of this, what you're really trying to do is to understand the needs, pain points, and emotions that are created by using the software."* Additionally, P2 highlighted the practice of designating an end-user closely aligned with the primary persona as a 'living persona' with

Fig. 1. Key takeaways for effective personas in RE practice

whom regular communication is maintained, *"I create an artificial one [persona]. Then I try to find a living person that is as close as possible to that artificial persona."*

Adhering to project constraints: Software and UX practitioners acknowledge persona creation as a research-intensive task. Numerous studies have been conducted to explore persona development through various techniques [29]–[31] and frameworks [32]–[34]. However, the depth of research required for persona creation can impact project timelines and budgets, often due to resource constraints and lengthy processes [35], [36]. This constraint may result in the omission of crucial steps, such as the persona review and refinement phase [13].

In light of these challenges, Section V-A offers practical recommendations, such as employing a pre-construction activity to streamline the persona creation process, and suggests alternative methods that requirements engineers can adopt under tight project constraints. Moreover, Section V-C provides pragmatic insights into the persona review and refinement phase, facilitating the enhancement of personas even when faced with project limitations.

Considering persona consumers' needs: It is imperative to develop personas that effectively aid requirements engineers in their core RE tasks. Personas are extensively used to enhance the understanding of end-users and their requirements, leading creators to primarily focus on the software's end-users. However, acknowledging the requirements and preferences of the personas' consumers—those who will use the personas—is equally important. For instance, reluctance to use personas can be attributed to the content of the personas, which may be either scant or cluttered with irrelevant information [37].

To ensure that personas are genuinely beneficial, persona creators must take into account not only the needs of end-users but also those of the persona consumers. The experience of persona consumers significantly influences their willingness to engage with personas [38]. Therefore, careful consideration is required in selecting the information to include in personas and in deciding how to present it, as detailed in Section VI-A.

It is essential to acknowledge that personas are used not only as instruments for conveying user needs but are also instrumental for software developers, business analysts, and project managers in their various tasks [39]. This underscores the necessity to **find a balance in both content and presen-**

tation, ensuring that personas are not just representative of end-users but are also user-friendly and practically beneficial for those who utilise them in their professional roles.

Organisational support: One significant challenge in the incorporation of personas within RE arises from the organisational culture itself [40]. The study further reveals a tendency among software practitioners to prioritise functional requirements over personas.

Consequently, to effectively integrate personas into the software development, it is vital for all project team members to share a common awareness of their value. This collective understanding aids in seamlessly embedding personas within the workflow. Six participants in our study underscored **the importance of making personas a visible and integral part of the project** (P1, P3, P7, P20, P21, P22). For instance, P1 explained, *"How do we use the persona to create human connection? To do that, you have to socialise the idea, you have to tell the story of this person. You can even just impact one or two people. That's already pretty good. I don't think process for persona stops at creating one, but also about how to sustain it in a long run."*

Furthermore, as delineated in Section III, **personas are beyond user requirements**; they act as continuous reminders, illuminating the end-users for whom the software is being developed.

Team dynamics: Interpersonal skills are fundamental in RE, a phase inherently dependent on interactions with stakeholders [41]. For the effective integration of personas, these skills are particularly essential when determining the appropriate staffing for requirements engineers in a project team.

Empathy is pivotal in RE as it involves putting oneself in other people's perspectives, as shown also in several previous studies [24], [25], [42]–[44]. P17 emphasised, *"The main thing is being able to empathise with one another. Because you always have to think from other person's shoe."*

Empathy is closely linked to **active listening** and **effective communication** skills. Since persona development is reliant on human interaction, these skills are crucial for requirements engineers to understand and gather comprehensive information about end-users. P1 noted, *"You need to be able to listen carefully to the people. Because without listening to them, you cannot get the information that you really want to add to the persona."*

Additionally, effective communication skills are necessary for requirements engineers to convey the stories of target end-users to other stakeholders, whether verbally or in writing. This was emphasised by three participants, with P11 stating, *"As a Business Analyst, it's really important that I make sure the details are communicated properly."* P22 also highlighted the importance of choosing the right words, *"A really good skill to use wording as well. That connects you to to the audience that is meant to consume the persona."*

Future research directions in persona usage in RE: There is a compelling need for future research to delve into how persona presentation can be tailored to specific consumers, particularly focusing on the level of detail necessary for understanding end-users effectively. An exploration into how company culture and team dynamics influence the successful integration of personas in RE is also crucial. Additionally, examining the impact of persona creators' interpersonal skills on the effectiveness of persona incorporation is vital. Finally, future studies should concentrate on methodologies that involve end-users directly in the development of personas, while also addressing project constraints. This would provide valuable guidance to practitioners facing challenges in creating personas under such limitations.

VIII. LIMITATIONS

In the industry context, 'requirements engineers' are often not distinctly assigned to specific RE tasks. Instead, roles such as UX designers, Business Analysts, Product Managers, or even Software Company Owners typically handle these tasks, depending on company size and structure. To maintain consistency, we employ Sommerville's definition of requirements elicitation and analysis [1] and consistently use 'requirements engineers' term throughout this paper.

We acknowledge that our interview-derived data may exhibit bias, as interviews were conducted and primarily coded by the lead author. To mitigate this, we engaged in team discussions during open coding and deliberated on the emerging codes. While 22 interviewees is a substantial number, in some dimensions we only recruited 1-2 participants e.g. US location, rare use of personas on RE tasks, and legal and logistics domains of practice. Thus conducting further surveys and interviews would be beneficial to see if there are various in persona usage in RE in terms of these dimensions. Such additional interviews could help ascertain the extent to which our results are generalisable and whether further useful insights and recommendations can be developed.

Some of our findings e.g. importance of inclusion of real end user input into persona development; importance of empathy in the requirements engineers; consideration of persona consumer needs in persona construction and usage; and effort involved in persona construction have been found in various prior studies (e.g. [24], [38], [40], [43]). However, our findings provide further supporting evidence of effective use of personas for RE related activities, persona elements, persona construction, and more effective RE persona usage in practice.

IX. RELATED WORK

The concept of personas, when initially introduced for use in software engineering, was primarily defined as "user representation" [7]. Over time, this definition evolved into a more comprehensive understanding of personas as user characterisations, encompassing aspects of human thinking, behaviour, and goals [8].

In the context of user-centered design, design thinking (DT) is a methodology fundamentally aimed at uncovering human needs. DT frequently employs personas as a tool to foster empathy towards end-users [24]. Subsequently, this approach has been integrated into RE to foster a more human-centered approach in software engineering [23], [26]. Within

this integrated framework, personas are pivotal in gaining a deeper understanding of end-users and their requirements in the software development process.

In RE, personas have been predominantly used in requirements elicitation and analysis activities, especially to help requirements engineers understand end-users [13], [35], [45], [46] and their needs [17], [28], [47], [48]. Personas can also be used to promote greater empathy towards end-users [16], [49]. Utilising personas can help requirements engineers share a common understanding of their software end-users [50], so that even if disagreements emerge among the team, personas enable the requirements engineers to have a unified vision about who their end-users are [33].

As personas aim to represent different archetypes representing software end-users, a wide range of human aspects should be captured in the personas [13], [20]. Currently though there is no universal standard for determining the specific human aspects that should be portrayed in personas. Several studies provide guidelines for the inclusion of human aspects in personas; for example, the GenderMag method incorporates five human facets linked to gender differences [51], [52]. Similarly, studies focused on specific age groups, such as children [53] and older adults [54], offer recommendations for persona attributes, and another study suggests five persona attributes to assist designers in understanding the range of potential users' digital comfort [55].

Given personas help requirements engineers to understand end-users and their needs [13], personas have to be able to effectively "deliver" the stories of represented individuals to persona consumers (i.e., those who use personas in their tasks). Persona presentation style and the skills of persona consumers contribute to persona usage [56]. Empathy of persona consumers towards their personas has also been investigated [42], [43]. Salminen et al. investigated the correlation between persona consumers' experience to persona incorporation (i.e., willingness to use, empathy, likability, clarity, completeness) [38]. Matthews et al. [57] explored perspectives of designers and user experience professionals regarding use of personas and identified four key problems with personas: too abstract, too impersonal, potentially misleading, and can be distracting.

Personas have been shown to be useful for RE-related activities in a number of predominantly academic-based studies. However, to-date, few studies have reported on usage of personas for RE-related tasks in industry practice [?], [?], [11], [13].

A study by Wang et al. [40] involves empirical research on the use of personas in RE practice. Their study investigates the correlation between the scale of the company or project and the effectiveness of persona usage in RE tasks, including the methods commonly used to create personas, and the challenges associated with their use in RE. However, the study did not delve deeply into strategies for effectively creating personas within the constraints of the real world, nor did it explore how to overcome the challenges associated with persona usage in RE. Therefore, our research aims to fill this gap by examining how RE experts perceive and implement personas in their RE practices, and how these processes can be improved.

X. Summary

Personas are instrumental in RE-related tasks, significantly aiding the understanding of end-users and their requirements. While traditionally focused on representing end-users, it is equally crucial to account for the preferences of persona consumers. We interviewed 22 RE experts from five countries, harnessing their insights from applying personas in various real-world scenarios. These experts brought valuable perspectives to the study. Their contributions have led to practical recommendations for integrating personas more effectively into RE tasks. These include fostering direct human interaction throughout persona development, while balancing project constraints. We advise creating personas that cater to the preferences and requirements of both end-users and persona consumers. It is also important to ensure organisational awareness of the benefits of personas, enhancing comprehension of targeted end-users. Additionally, our findings highlight the need for requirements engineers to develop strong interpersonal skills to better support the integration of personas in RE. These recommendations, drawn from real-world applications by diverse experts, offer valuable guidance for both researchers and practitioners in the field of RE.

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