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Case Study

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Applying directed qualitative content analysis for data-driven persona creation: a case study on user-centered digital marketplace development

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Abstract

This paper presents a case study to illustrate the application of the directed qualitative content analysis (DQCA) technique to focus group transcriptions for data-driven qualitative persona creation, with broader applicability in human–computer interaction and software development. Using a case study from a project focused on creating an e-grocery marketplace for facilitating short agrifood supply chain trade in the Portuguese context, we demonstrate and validate how DQCA can systematically generate personas that reflect real user needs. For the focus group session, we involved one of the project's stakeholders: family farmers. Furthermore, we propose how these personas can be integrated into the Rational Unified Process software development methodology, guiding decision-making, user-centered design, and prioritization throughout all its phases. Despite being rooted in the e-grocery domain, this paper's methodological approach and insights into generating and integrating user-centered personas in software development processes apply to a broader range of industries and projects, offering guidelines for practitioners and researchers in diverse contexts.

RESEARCH HIGHLIGHTS

- This paper presents the first empirical application of Directed Qualitative Content Analysis (DQCA) to data-driven user persona development, strengthening persona rigour through a theory-aligned, flexible coding framework.
- Using a case study on user-centred digital marketplace development for Portuguese family farmers, the study shows how DQCA can systematically capture user needs, goals, and behaviours without discarding the accommodation of emergent insights.
- The findings are triangulated with an online questionnaire, which corroborates core themes and adds quantitative nuance about operational concerns tied to digital adoption.
- Finally, the paper evaluates DQCA's practical performance in terms of accuracy, efficiency, and depth/actionability, and offers actionable guidance on using the resulting personas to support requirements, design decisions, and evaluation across the Rational Unified Process (RUP) lifecycle.

Keywords focus groups, user persona, directed qualitative content analysis, agrifood systems, Rationale Unified Process

Creating user-centered software solutions requires systematic methods for deriving actionable insights from user research (Bak et al., 2008; Billestrup et al., 2014; Couto & Curado Malta, 2024). In human–computer interaction (HCI), personas—fictional, detailed representations of end users—are a technique used to capture and communicate user needs, behaviors, and goals in design and development processes (Cooper, 1999; Pruitt & Adlin, 2006), but these entail practical difficulties (Salminen et al., 2024) and often lack methodological rigor (Chapman & Milham, 2006; Salminen et al., 2024).

While personas are recognized as important and valid tools for user-centered design (Dotan et al., 2009; Grudin & Pruitt, 2002), there is a knowledge gap regarding the practical application and testing of the directed qualitative content analysis (DQCA) technique to analyze data for the process of user persona development (Couto & Curado Malta, 2024; Jansen et al., 2022), a technique hitherto used in health and nursing contexts (Kim et al., 2024; Ma et al., 2024; Montazeri et al., 2024; Pusey-Reid et al., 2024; Shahabi et al., 2024), communication studies (Alyaqoub et al., 2024; Cagnoli, 2024; Darshika, 2024; del Caz Pérez et al., 2024), HCI studies—more specifically usability, technology acceptance, use, and user experience (UX) (Eggeling et al., 2022; Goodarzi et al., 2024; Ngelambong et al., 2024; Qiu et al., 2020), psychology (Kibiswa, 2019; Waldron et al., 2024), sociology

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(Atteberry-Ash et al., 2024; Schimmer & Bergmark, 2024), digital media (Bourgonjon et al., 2016; Uleanya & Prinsloo, 2024), education (Curtis & Larsen, 2024), business studies (Hasan & Ojala, 2024), and informatics (Staes et al., 2024).

Although already used in the HCI context, the DQCA had not yet been tested for its specific application in data-driven user persona development. Therefore, the research question that guides this paper is "Can the DQCA be applied in the HCI field to generate qualitative data-driven personas?" To answer this question, we derive the following Research Objective: to test the DQCA approach in a real-world setting of qualitative data-driven persona creation.

We demonstrate (and then validate) how DQCA—a structured qualitative data analysis method—can be applied to focus groups (or other qualitative data collection techniques such as interviews) to uncover user insights systematically, thus enhancing the creation of qualitative data-driven personas. We also briefly explore how the generated personas can be integrated into all software development phases of the Rational Unified Process (RUP), a software development methodology (Anwar, 2014).

Our proposal is generalizable to other contexts beyond the case study (e-grocery). It aims to aid data-driven persona creation processes, i.e., grounded in empirical data, ultimately generating a persona cast that reflects user needs and supports user-centered design practices in HCI.

To validate our approach, we applied DQCA to focus group data collected as part of a nationally funded research project aimed at developing a digital marketplace in the context of short agrifood supply chains to bridge the gap between family farmers and consumers. We then collected additional data through questionnaires to validate our insights.

The paper is organized as follows: first, the Background section is presented, and then the Research Methodology, including context and the data analysis technique. The following section presents the Results, including the findings from applying the DQCA to focus groups and the outcomes of the data analysis. Lastly, the paper ends with a Discussion and a Conclusion.

1 Background

The DQCA technique has been used in health and nursing contexts (Kim et al., 2024; Ma et al., 2024; Montazeri et al., 2024; Pusey-Reid et al., 2024; Shahabi et al., 2024), communication studies (Alyaqoub et al., 2024; Cagnoli, 2024; Darshika, 2024; del Caz Pérez et al., 2024), HCI studies (Eggeling et al., 2022; Goodarzi et al., 2024; Ngelambong et al., 2024; Qiu et al., 2020), psychology (Kibiswa, 2019; Waldron et al., 2024), sociology (Atteberry-Ash et al., 2024; Schimmer & Bergmark, 2024), digital media (Bourgonjon et al., 2016; Uleanya & Prinsloo, 2024), education (Curtis & Larsen, 2024), business (Hasan & Ojala, 2024), and informatics (Staes et al., 2024), but not in persona development processes (Jansen et al., 2022; Nielsen et al., 2022; Putri & Windasari, 2022; Rasca et al., 2023; Salminen et al., 2024; Van den Bogaert et al., 2024; Zhang et al., 2023). Even though the recent contribution by Couto and Curado Malta (2024) already mentions techniques like DQCA, no academic contributions demonstrate its empirical application and effectiveness in persona development processes.

Jansen et al. (2022) describe three persona creation methodologies: qualitative, quantitative, and mixed. In the qualitative persona creation methodology, the authors suggest the grounded theory approach for qualitative data analysis, which contains three main steps: open coding, axial coding, and selective coding (Turner, 1981). The objective here is to extract categories from the data, identify connections between categories, and then identify the central theme that unifies the categories using an inductive approach (Turner, 1981).

Contrary to grounded theory's data analysis method, the DQCA process starts by developing a coding scheme (Mayring, 2000), guiding the data collection and analysis (Hsieh & Shannon, 2005; Kibiswa, 2019). The coding scheme defines attributes, variables, coding rules, and theme definitions, which guide the analysis of the textual data (Boyatzis, 1998; Kibiswa, 2019; Mayring, 2000; Potter & Levine-Donnerstein, 1999). It can be paired with qualitative data collection techniques like interviews or focus groups (Couto & Curado Malta, 2024).

Additionally, the DQCA employs a deductive approach, utilizing predefined categories derived from existing theories, which enables researchers to systematically validate or extend theoretical constructs while also accommodating emergent findings (Assarroudi et al., 2018). In contrast, the grounded theory employs an inductive process, generating new theories directly from raw data through open, axial, and selective coding (Turner, 1981). While grounded theory excels in the development of new theories (Turner, 1981), DQCA's strength lies in validating predefined constructs (Assarroudi et al., 2018), making it suitable for research that combines theory-driven objectives with practical application (de Abreu Santos & van der Borg, 2023), such as user-centered design and, by extension, personas (Miaskiewicz & Kozar, 2011).

Based on Turner (1981) and Assarroudi et al. (2018), we synthesize the main differences between the qualitative data analysis processes inherent to grounded theory and DQCA in Table 1.

Despite both grounded theory and DQCA being valid approaches to qualitative persona construction, their suitability depends on the research context and objectives. Starting with grounded theory, it excels in exploratory studies where limited prior knowledge exists, and the goal is to generate entirely new theoretical constructs from raw data (Turner, 1981). Its inductive process allows for the incorporation of unexpected user insights, making it markedly effective in contexts where user needs are unknown or under-researched. However, this approach is resource intensive, iterative, and less aligned with theory-driven objectives.

By contrast, DQCA begins with predefined categories derived from theory or prior research, supporting a structured, efficient analysis process that systematically validates or extends existing constructs (Assarroudi et al., 2018). This deductive orientation is advantageous in applied research, such as persona development, where the aim is to ensure that user representations are consistent with established concepts while still leaving space for emergent themes to emerge. In our study, this was particularly important, as personas were intended to inform a practical design intervention instead of a new theoretical framework. The trade-off, however, is that DQCA carries a greater risk of overlooking unexpected findings if overly reliant on predefined codes during data analysis.

Furthermore, Nielsen et al. (2022) highlight that personas can be data driven, i.e., built with secondary data or data specific to a project (Nielsen et al., 2021) or not, i.e., personas could be built with fictitious or no data, like assumptions, and not necessarily from real data. Additionally, among data-driven approaches to personas, methods based on automatic persona generation via quantitative data have emerged (Zhang et al., 2023), as they provide timely, comprehensible, and testable attributes of behaviors (Jansen et al., 2022). However,

Table 1 Synthesis of differences between qualitative data analysis processes in grounded theory and DQCA.

Parameter	Grounded theory	DQCA
Theoretical approach	Inductive: develops new theories directly from data without relying on prior frameworks.	Deductive: starts with predefined categories based on existing theories.
Goal	Generate novel theories or concepts from unexplored phenomena.	Systematically validate or extend existing theoretical constructs.
Coding process	Open coding, axial coding, and selective coding. Focuses on emergent patterns.	Predefined categories guide the initial analysis. Allows emergent codes as needed.
Flexibility	Fully emergent. No predefined structure.	Structured yet flexible.
Efficiency	Time-intensive and iterative. Requires continuous data comparison and refinement.	Efficient for focused research questions with theoretical alignment.
Application context	Exploratory studies with little prior research or when no existing frameworks are available.	Applied research validating or extending frameworks.
Output	Data-grounded novel theories or frameworks.	Insights aligned with theoretical constructs and practical goals.
Strengths	Excels in uncovering new phenomena. Generates detailed, data-driven theories.	Aligns data analysis with existing theories. Systematic and time efficient.
Limitations	Resource-intensive and generally slower. May lack focus when there are predefined goals.	Risk of overlooking unexpected insights if limited to predefined codes.

Table 2 Persona technique integrated into the RUP methodology.

Persona usage ID	Persona usage(s)	Source(s)	RUP phase
1	Understand target users and solution requirements	Bordin and De Angeli (2016), Karolita et al. (2023)	Inception
2.1	Provide insights into specific user interactions and scenarios	Haikara (2007), Fabijan et al. (2016)	Elaboration
2.2	Prioritize features and functionalities		
3.1	Guide the development and implementation of user-centered designs	Haikara, (2007), Bordin and De Angeli (2016), Karolita et al. (2023)	Construction
3.2	Guide the usability testing strategies	Blomquist and Arvola (2002), Pruitt and Grudin (2003)	
3.3.	Inform training materials and support documentation	Tsyganok (2016), Duan et al. (2022), Salminen et al. (2022)	
4	Benchmark for assessing if the solution meets users' needs and expectations	Haikara (2007)	Transition

limitations include the loss of user immersion, data privacy, algorithmic transparency, and lack of diversity (Salminen et al., 2020).

The mixed-methods persona creation approach mixes qualitative and quantitative data, offering more refined results (Couto & Curado Malta, 2024; Jansen et al., 2022) but making it harder to integrate data collected from each approach (Jansen et al., 2022).

When compared to quantitative or mixed-methods persona creation approaches, qualitative methods enable more nuanced and detailed insights, but at the same time, they are more time-consuming (Jansen et al., 2022).

However, although DQCA can support or develop existing theories, it has limitations, such as research bias, as it is improbable that a researcher will find data to refute their theories (Hsieh & Shannon, 2005).

In the research project, an e-grocery marketplace will be developed, and to do that, the project's software development team follows the RUP methodology (Kruchten, 2004). Rational Unified Process is a software development methodology structured along two axes: a dynamic axis representing time, showcasing cycles, phases, iterations, and milestones, and a static axis representing activities, artifacts, workers, and workflows (Anwar, 2014). The methodology encompasses four phases: inception, elaboration, construction, and transition (Kruchten, 2004).

When developing new solutions, software developers tend to need more knowledge and insight into the users they are designing for, their tasks, and their objectives (Bak et al., 2008; Billestrup et al., 2014). The adoption of personas is a valuable solution to developing knowledge and awareness regarding the user base (Cooper et al., 2003; Salminen et al., 2022), as studies have proven (Dotan et al., 2009; Grudin & Pruitt, 2002). Nevertheless, the persona technique is not universally integrated into the toolkit of the software development industry (Billestrup et al., 2014; Matthews et al., 2012), and there may be hurdles in its implementation (Billestrup et al., 2014; Blomquist & Arvola, 2002).

As Haikara (2007) demonstrates, personas can be used throughout the entire software development lifecycle. Considering that the project's software development team follows the RUP methodology, and based on the literature (Table 2), we will build and use personas during the entire project lifecycle (Figure 1).

2 Methods

2.1 Context

The research project team conducted a series of focus groups to define a business model for a digital marketplace, allowing for the definition of marketplace functionalities while also building personas.

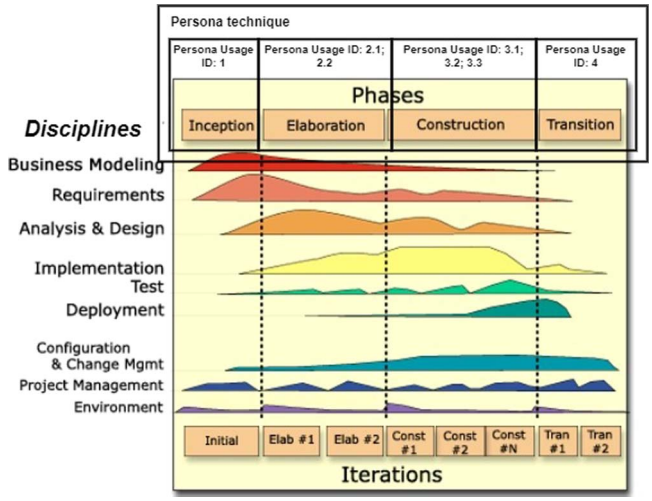

Figure 1 RUP methodology with persona technique integration. Adapted from Kruchten (2004).

As the project's goal is to create qualitative personas, the qualitative content analysis (Elo & Kyngäs, 2008; Hsieh & Shannon, 2005; Wildemuth & Zhang, 2009) approach is considered the most appropriate. The data are analyzed based on an existing framework (Crabtree & Miller, 1999; Patton, 2002; Sandelowski, 1995), which derives from theory (Mousali et al., 2020); that framework is showcased in Couto and Curado Malta (2024). Compared to other qualitative analysis techniques, the DQCA is more structured, as there are established processes and procedures for data analysis (Hickey & Kipping, 1996; Hsieh & Shannon, 2005). This approach aligns with our objective to deeply understand and represent the nuances of user experiences, attitudes, and behaviors by identifying meaningful data within the focus group transcripts that could feed the persona templates and their constructs (Assarroudi et al., 2018; Couto & Curado Malta, 2024; Kibiswa, 2019). In contrast, a quantitative approach focusing on numerical values and statistical analysis would be less practical for our purposes. Although quantitative methods can provide insights into the frequency of terms or concepts, they may fail to include the depth and richness of user experiences essential for creating authentic and empathetic personas (Jansen et al., 2022).

A focus group was held with family farmers to gather information on how their businesses operate and to get to know the participants.

The focus group was conducted by two PhD researchers, both of whom are university professors and researchers and are also part of the project team. The choice for these facilitators relates to their expertise with focus groups and proximity to the contexts of farming and social economy. Besides the facilitators, more project members were present during the focus group session, namely the data coder.

The communication and invitation procedures were the responsibility of a local project partner, who was already familiar with the farmers and had worked with them on previous projects. The farmers were contacted by phone and informed about the goals of the focus group and the context of the research project. Fourteen (14) family farmers participated in the focus group without dropouts.

The meeting lasted 2 hr and was held and recorded in a room with video and audio. After the meeting, one data coder transcribed and analyzed the recording using *Microsoft Word*. The transcriptions were not sent back to the participants, nor did they provide feedback on the findings. To improve the reliability of the coding and mitigate potential bias, we adopted a peer debriefing strategy (Barber & Walczak, 2009): a second researcher, who was not involved in the initial coding, independently reviewed approximately 25% of the coded material and provided feedback on the coding process; discrepancies were discussed until consensus was reached, and adjustments were made accordingly. This procedure served to attenuate single-coder limitations, thus contributing to methodological robustness in the research process.

As we aimed to gather more insights and achieve data saturation (Guest et al., 2020), we conducted additional focus groups in other regions of the country, according to NUTS II (Nomenclature of Territorial Units for Statistical Purposes). This was done to collect and identify idiosyncrasies of family farmers in different geographical locations and ensure representativeness. However, this paper focuses on only one of the focus group sessions.

Moreover, to evaluate the validity of the data initially derived from focus groups, we conducted an additional online questionnaire, which collected 11 Portuguese family farmers' entries from diverse geographical locations within Portugal. Whilst smaller in scale, the questionnaire provided individual-level perspectives that complemented the group dynamics of the focus groups, allowing for a triangulation of results to evaluate the effectiveness of DQCA.

Finally, we proceed with a critical analysis of DQCA, drawing on three criteria: accuracy (a) understood as credibility or trustworthiness in representing participants' experiences (Johnson et al., 2020); efficiency (b), which reflects the timeliness and resource-sensitivity of the analytical process (Kowalski et al., 2024); depth of insights and actionability (c) referring to the generation of findings that are heuristically relevant, conceptually connected, and applicable in practice (Burns, 1989).

2.2 Technique used for qualitative data analysis

The technique used to analyze the focus group data was the DQCA by Assarroudi et al. (2018), as it includes the most recent literature compared to other proposals identified, such as the work of Kibiswa (2019). Even though Kibiswa (2019) is a more recent work, it analyses older contributions, whereas Assarroudi et al. (2018) also analyses more recent contributions. The DQCA technique by Assarroudi et al. (2018) defines the steps presented in Table 3.

Furthermore, we follow the *Consolidated Criteria for Reporting Qualitative Research (COREQ)* (Tong et al., 2007). More information regarding the COREQ is disclosed in Annex 1.

2.3 Technique used for quantitative data triangulation

The family farmer questionnaires employed Likert-type scales to capture preferences regarding product quality, pricing, and sustainability (Joshi et al., 2015) besides validating the DQCA-retrieved persona data, and incorporating open-ended questions when necessary (Smyth et al., 2009). The purposive sampling method (Tongco, 2007) was chosen to target participants who were Portuguese small-scale family farmers in the context of Short Agrifood Supply Chains. Quantitative data were analyzed using descriptive statistics to determine key trends (Kaur et al., 2018).

The initial questions aimed to gather demographic data, including age, gender, location, education, dedication to business (part-time

Table 3 Steps suggested by Assarroudi et al. (2018) for DQCA.

Preparation phase	
P#1	Acquisition of general skills
P#2	Selection of the appropriate sampling strategy
P#3	Deciding on the analysis of manifest and latent content
P#4	Developing an interview guide
P#5	Conducting and transcribing interviews
P#6	Specifying the unit of analysis
P#7	Immersion in Data
Organization phase	
P#8	Developing a formative categorization matrix
P#9	Theoretical definition of the main attributes and subattributes
P#10	Determination of the coding rules for main attributes
P#11	Pre-testing of the categorization matrix
P#12	Choosing and specifying the anchor samples for each main attribute
P#13	Performing the primary data analysis
P#14	The inductive abstraction of main attributes from preliminary codes
P#15	The establishment of links between generic attributes and main attributes
Reporting phase	
P#16	Reporting all steps of DQCA and findings

or full-time), and the type of produce. The questionnaire was created using LimeSurvey, and its structure is outlined in Appendix C (Table A3.1).

To gather answers, we relied on the support of project partners, ranging from higher education institutions to NGOs and public sector organizations, to help disseminate information to the target audience via social media and email. More answers to the questionnaire meant a more robust analysis of variations and convergences with the qualitative data retrieved from the focus groups (Skjuve et al., 2023). Quantitative data collection occurred from September 2024 to October 2024.

For data analysis, we utilize *LimeSurvey* and *IBM SPSS Statistics*. We filtered nine unfinished entries, and the final sample consisted of 11 complete entries. Family farmers are typically very busy individuals, and it was a challenge to collect answers to the questionnaire. Additionally, farmers with lower digital literacy levels were less likely to respond to the questionnaire (as it was an online questionnaire), which may lead to a tendency to collect perspectives from more digitally literate farmers.

3 Results

3.1 Results of the application of the DQCA technique

3.1.1 P#1

We analyze both manifest and latent content.

3.1.2 P#2

The research team involved in the focus group has extensive experience, as two members are university professors with over 15 years of experience in teaching and research. One team member is working on their PhD thesis and has several years of professional experience abroad.

3.1.3 P#3

The sampling strategy is purposive sampling, more specifically homogeneous sampling. The participants were selected based on their occupation and location, specifically as local family farmers from Torres Vedras.

3.1.4 P#4

The focus group interview guide was developed based on the information the project team wanted to obtain. We needed to know about the participants' businesses, their main difficulties, digital presence, and potential interest in the digital marketplace. Some of these questions were designed to identify requirements (nonfunctional, functional, and informational), while others focused on their business practices and operations. Furthermore, the questions were organized as follows: opening questions, introductory questions, transition questions, key questions, and ending questions (Krueger et al., 2001). The focus group interview guide is depicted in Table 4.

3.1.5 P#5

Focus group transcriptions and content analysis are available at Zenodo.org.[1]

3.1.6 P#6

The units of analysis are the focus group transcription, field notes taken during the focus group and the attendance sheet.

3.1.7 P#7

The data were collected on July 8, 2023, and the focus group took place in Torres Vedras, Portugal, specifically at the *Centro de Educação Ambiental de Torres Vedras*. We selected local family farmers to understand their business models and how we could assist them in selling their products through a digital marketplace that is currently under development.

3.1.8 P#8 and P#9

The formative categorization matrix is the family farmer persona template built by applying the method for creating persona templates (MCPT) (Couto & Curado Malta, 2024) depicted in Figure 2. We proceed to describe the process.

[1] See https://shorturl.at/z28ga.

Table 4 Focus group interview guide.

Focus group interview guide	
Opening question	
1.1.	Ask each farmer to present themselves (with the relevant information) and their business (location, business size, main productions, production method, selling channels, main customers . . .).
Introductory questions	
2.1.	What are the difficulties faced in the marketing of products (sales price, seasonality, logistics, customer acquisition/loyalty, etc.)?
2.2.	If you could, what would you change in customer behavior?
2.3.	How much time do you spend per week in the sales process? What percentage of working time does that process represent?
Transition questions	
2.4.	Do you monitor production and marketing costs (storage, transport, waste)? If not, why? Would you be able to do that? What do you think about these costs being visible as part of the product information?
2.5.	What seems more advantageous to you, lowering the price of a product so that you can sell or let it spoil? To what extent would you be available to lower the price?
Key questions	
2.6.	A short circuit can be defined as . . . (define short circuit). What advantages and disadvantages do you see in using this type of circuit?
2.7.	Would you be open to selling collectively, that is, in baskets that integrate your products and those of other producers?
2.8.	Have you ever used social networks, websites, or other digital tools to market your products? What are the main advantages and difficulties you have encountered in the process?
2.9.	Would you find it interesting to integrate an online platform with several producers and consumers, constituting an online direct-selling marketplace? What would it take you to join us?
Ending questions	
3.1.	If this platform included its own page to present your business, what information would you like to provide? (Business name, slogan, number of people who work, images, products/categories they market, partners.)
4.1.	Do you want to tell us more about the characteristics that a platform of this type should have to contribute effectively to improving your business?

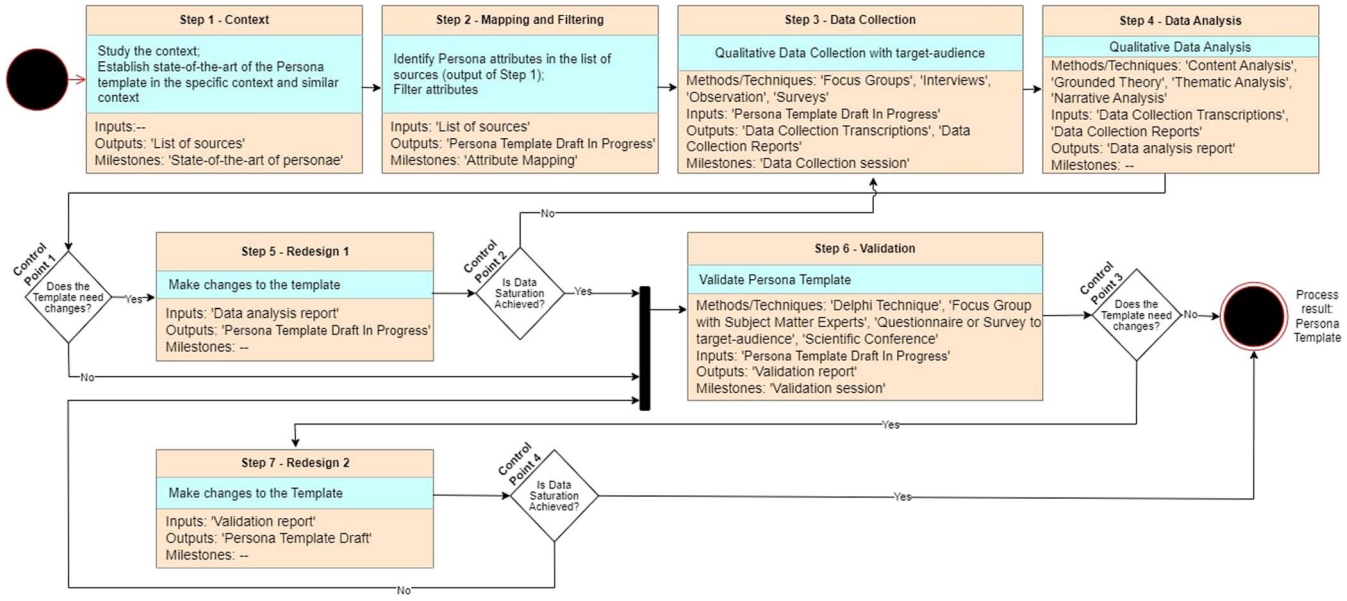

Figure 2 Method for creating persona templates (MCPT) (Couto & Curado Malta, 2024).

The searches for family farmer persona templates (Step 1 of MCPT) were made in July 2023. In this context, queries were made in the *Web of Science* (WoS) to identify the academic articles, and in the *Google Search Engine* (GSE) to identify industry sources. The keywords used in the WoS were "family farmer persona," "company persona," "farmer persona," "persona construction," "persona creation," "persona data," "persona descriptions," "persona ontology," "proto persona." The keywords used in the GSE were: "family farmer persona."

In the WoS, searches using the keyword "family farmer persona" did not yield results, as we were unable to retrieve papers that proposed family farmer templates. However, on GSE, that same keyword returned a considerable number of results. Therefore, on

Table 5 Family farmer persona attributes with $n > 1$ (draft 1).

Family farmer persona attributes $n > 1$
Demographic data
Personality
Channels
Goals
Frustrations
Motivation
Needs
Routine
Digital tools
Photo
Quote
Aspirations
Digital literacy
Attitude
Pain points
Biography
Interests
Challenges
Opportunities
Values

GSE, we did not expand the scope of the queries by using broader keywords.

The searches resulted in 64 academic articles and 149 *Google* results.

These results were analyzed as follows. We exclude the documents that were not in English and those that were not available (paywalled).

The academic articles were then filtered by "research area" in WoS, as the concept of "persona" exists in multiple contexts, such as literature (Clay, 1998), philosophy (Schönher, 2021), psychology (Giles, 2020), and sociology (Formilan & Stark, 2021), and these areas are not relevant for our needs. We thus select the "business & economics", "communication," "computer science," "engineering," "information science," and "science technology" research areas from the WoS filters.

The next phase involved reading the titles and abstracts for a relevancy analysis. After that, the relevant papers were selected, and we studied their full texts (excluding duplicates) to gain a comprehensive understanding of the documents.

The analysis of the academic articles also included a backward[2] and forward[3] reference search; 12 final articles remained.

The search results in GSE were analyzed, and only those which included graphical representations of persona templates were selected. Furthermore, contributions from industry sources that did not propose a persona within the context of farmers were not considered.

After reviewing GSE search results, 14 items from white papers and gray literature were selected. Twelve academic articles and 14 industry contributions were collected (26 documents in total).

We followed Step 2 of MCPT, in which we identify the persona attributes in each of the 26 documents (see Appendix D, Table A4.1; Appendix E, Table A5.1; and Appendix F, Table A6.1), and the attributes identified in more than one document ($n > 1$) were included in the initial family farmer persona template draft (Table 5).

For the qualitative data collection in Step 3 of MCPT, we conduct focus groups with family farmers and analyze the results (Step 4 of MCPT) through DQCA. The template required changes (Control Point 1 of MCPT) because some of the initial attributes with $n > 1$ were not suitable for our context, for example, due to the addition of redundant information. Therefore, we proceed to Step 5 of MCPT.

In Step 5 of MCPT, we exclude the attributes "frustrations," "pain points," "challenges," and "opportunities" as they would be addressed in empathy maps and thus would add repeated information. Following these modifications, the second draft of the template is represented in Table 6.

Table 6 Second draft of the persona template attributes.

Family farmer persona attributes (draft 2)
Demographic data
Personality
Channels
Goals
Motivation
Needs
Routine
Digital tools
Photo
Quote
Aspirations
Digital literacy
Attitude
Biography
Interests
Values

Table 7 Calculation of data saturation.

Calculation of data saturation	
No. changes	4
Base attributes	20
Quotient	20%

Since these changes amount to 20% of the differences in relation to the previous draft (Table 7), data saturation was not achieved (Control Point 2 of MCPT), meaning we entered the first iteration cycle, going back to Step 3 of MCPT.

Following the results obtained in the next focus group (Step 4 of MCPT), it was not deemed necessary to modify our second draft (Control Point 1 of MCPT), so we advance to Step 6 of MCPT.

In Step 6 of MCPT, and taking into consideration the project constraints, we adopt the mini-Delphi technique (Barabino et al., 2021; Ogbeifun et al., 2016; Pan et al., 1996; Strasser, 2017). The members of the panel of experts were contacted via e-mail, through which they indicate the most relevant attributes for their area of expertise, thus sharing which information would be more beneficial to develop their activities within the R&D project (they were all members of the project team); they were also invited to share any other suggestions or considerations they could have regarding the persona template. Attributes with zero mentions would be excluded. By contacting the members of the panel individually and by e-mail, they had time to reflect on their answers, and we eliminate any potential pressures resulting from a group meeting, as their answers were anonymized (Barabino et al., 2021; Pan et al., 1996; Strasser, 2017). Even though members of the panel knew each other, they all went through individual answering processes (Day & Bobeva, 2005; Donohoe & Needham, 2009; Ogbeifun et al., 2016), meaning the contributions are not traceable.

[2] To review the citations in the articles analyzed to determine prior articles that should be considered (Webster and Watson, 2002).

[3] To identify articles citing the articles selected hitherto (Webster and Watson, 2002).

Table 8 Information regarding the members of the panel of experts.

Experience	Qualifications	Expertise				
		Information systems	Management	Marketing	Entrepreneurship	Business innovation
Academia	PhD	X				
Academia	PhD		X	X		
Academia	PhD		X		X	
Industry/Academia	PhD candidate				X	X

Table 9 Family farmer persona template attributes (third draft).

Family farmer persona attributes
Demographic data
Personality
Channels
Goals
Motivation
Needs
Photo
Quote
Digital literacy
Routine
Operation details
Devices
Digital tools

Table 10 Additional family farmer persona subattributes (third draft).

Attribute	Subattribute
Demographic data	Age
	Name
	Education
	Work regime
	Sex
Operation details	Type of product
	Sales channels
	Delivery
Digital tools	Website
	Facebook
	Instagram
	LinkedIn
	Order management system
	Delivery management software

Table 11 Second calculation of data saturation.

Second calculation of data saturation	
No. changes	8
Base attributes	16
Quotient	50%

Table 12 Personality trait list extracted from Norman (1963).

Personality trait list		
Factor	**Pole A**	**Pole B**
Extroversion or Surgency	Talkative	Silent
	Frank, open	Secretive
	Adventurous	Cautious
	Sociable	Reclusive
Agreeableness	Good-natured	Irritable
	Not jealous	Jealous
	Mild, gentle	Headstrong
	Cooperative	Negativistic
Conscientiousness	Fussy, tidy	Careless
	Responsible	Undependable
	Scrupulous	Unscrupulous
	Persevering	Quitting, fickle
Emotional stability	Poised	Nervous, tense
	Calm	Anxious
	Composed	Excitable
	Not hypochondriacal	Hypochondriacal
Culture	Artistically sensitive	Artistically insensitive
	Intellectual	Unreflective, narrow
	Polished, refined	Crude, boorish
	Imaginative	Simple, direct

Regarding the composition of the panel of experts, there are four project members with different expertise and experience with research or industry projects; there is no agreement in the literature regarding the standard panel size (Ogbeifun et al., 2016; Pan et al., 1996; Paré et al., 2013; Skinner et al., 2015; Strasser, 2017), with authors stating it could be somewhere between 3 and 80 participants (Grisham, 2009; Mullen, 2003; Ogbeifun et al., 2016). The information regarding the panel of experts is disclosed in Table 8, demonstrating the representative nature of its members.

Based on the feedback from the panel of experts (Control Point 3 of MCPT—see Appendix G, Table A7.1), the following changes to the template were made (Step 7 of MCPT):

- The "aspirations," "biography," "interests," "attitude," and "values" attributes were removed;
- Two experts mentioned that the "demographic data" and "digital tools" attributes, per se, were too broad, as they could include a wide range of information, so subattributes were added;
- The "operation details" and "devices" attributes were added.

The changes made to the attribute and subattribute lists are represented in Tables 9 and 10, respectively (third draft of the persona template).

We proceed with the modifications and, since data saturation was not achieved (Control Point 4 of MCPT), as the changes amounted to 50% (Table 11), iterated back to the panel of experts with the new (third) version of the template (Step 6 of MCPT). The experts were asked if any other changes were suggested; this time, no other changes were deemed necessary (Control Point 3 of MCPT), except for the suggestion of concrete personality traits made by one of the members in the Delphi panel, which did not affect the attribute list and indicated that data saturation had been achieved.

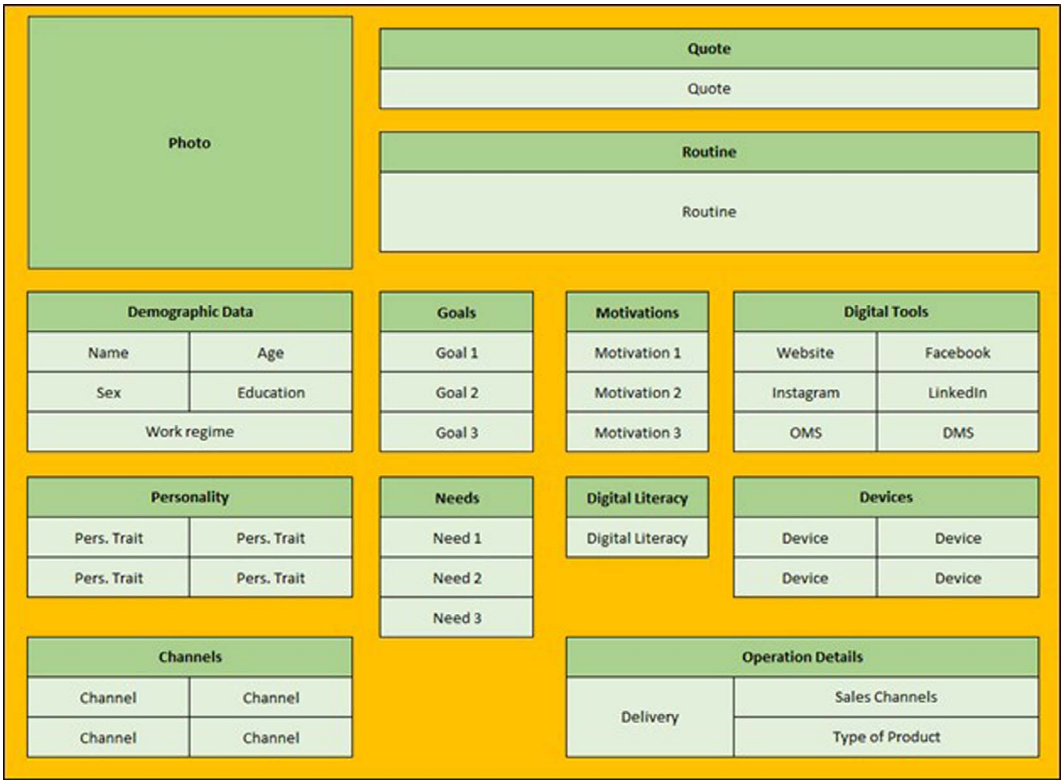

Figure 3 Family farmer persona template.

To limit the scope of personality traits to be used in the "personality" attribute, as per the Delphi participants' suggestion, a set of personality traits from the work of Norman (1963) was extracted and are represented in Table 12.

The family farmer persona template is demonstrated in Figure 3. The template design is provided for illustrative purposes only and may not accurately represent the final design.

The definitions of attributes and subattributes are available in Table 13.

3.1.9 P#10

The coding rules for the main attributes are presented in Table 14.

3.1.10 P#11

According to MCPT's stages, the categorization matrix (the persona template) was already refined and tested. Notwithstanding, during this phase, the project team opted to create empathy maps for the focus group participants, in addition to the personas. In the empathy maps, one should examine frustrations and pain points. To provide more accurate empathy maps, we gather frustrations and pain points directly from focus group transcriptions, hence the need to add another coding rule.

Table 15 presents the theoretical definition (P#9) of "frustrations/-pain points" and its coding rules.

3.1.11 P#12

Specification of anchor samples for attributes, both in their original language (Portuguese) and translated into English (Table 16).

3.1.12 P#13, P#14, P#15

Primary data analysis examples include the inductive abstraction of main attributes from preliminary codes and establishing links between generic and main attributes (see Appendix A, Table A1.1 and Table A1.2).

The coding process began with a deductive framework (see P#8 and P#9), which provided an initial set of categories (attributes and subattributes), e.g., goals, motivations, needs, digital literacy, and frustrations. The specific codes that populate the categories emerged inductively from the data analysis. As an example of this hybrid approach, within the "needs" category (a pre-defined attribute), inductive codes such as "logistics" or "legal support" emerged.

3.1.13 P#16

The reporting of all steps of DQCA and findings of its application to the focus group are available in this paper, complemented by the raw transcript data (see Footnote 3).

3.2 Results of the qualitative data analysis

We disclose the findings of the data analysis in Appendix B (Table A2.1 and Table A2.2). The table presents the analysis framework defined based on MCPT, applied to the focus group with family farmers. Furthermore, it contains each attribute and subattribute presented in the previous section of this paper. The family farmers were anonymized and given the name of P*x*. Lastly, the hyphen ("-") in some attributes or subattributes indicates that the information could not be retrieved because the participant did not mention it.

Regarding participant characteristics and representativeness, the focus group included 14 Portuguese family farmers, aged between 31

Table 13 Definition of attributes and subattributes.

Attribute/subattribute	Attribute/subattribute definition	Definition source
Demographic data	Relating to human populations and the information collected about them, such as their size, growth, ages, and education.	Cambridge Dictionary (2024)
Name	A word or words that a person is known by	
Age	The period of time someone has been alive	
Education	The process of learning in a school or higher education institution	
Work regime	Amount of time dedicated to the business	
Sex	The physical state of being either male, female, or intersex	
Personality	The type of person you are, shown by the way you behave, feel and think	
Channels	A channel where the farmer is most active and is more likely to engage when sent a communication	Netcore (2024)
Goals	A purpose or something that you want to achieve	Cambridge Dictionary, (2024)
Motivation	Willingness to do something or something that causes such willingness	
Needs	The things you must have for a satisfactory life	
Photo	A photograph	
Quote	To repeat words that someone else has said or written	
Digital literacy	The basic skill or ability to use a computer confidently, safely and effectively	UNESCO-UNEVOC (2018)
Routine	A usual or fixed way of doing things	Cambridge Dictionary (2024)
Operation details	Specific information relating to a professional activity	
Type of product	Different kinds of items that businesses produce and sell to consumers and other companies	Indeed (2022)
Sales channels	One of the ways in which a company provides customers with a particular product	Cambridge Dictionary (2024)
Delivery	The supply of something or the way that it is supplied	
Devices	A machine, for example, a phone or computer that can be used to connect to the internet	
Digital tools	Software, websites, applications, and other internet and computerized resources that facilitate, enhance and execute digital processes	Walkme, (2023)
Website	A set of pages of information on the internet about a particular subject published by a single person or organization	Cambridge Dictionary (2024)
Facebook	A social networking site on the internet	
Instagram	Social media service for taking, changing, and sharing photographs and video	
LinkedIn	Social networking website for businesspeople to communicate, find new job opportunities, share information, etc.	
Order management system	A digital way to manage the lifecycle of an order	IBM (2018)
Delivery management software	A software that contains tools for automating the delivery process from start to finish	Elogii (2023)

Table 14 Coding rules for main attributes.

Attribute	Coding rules
Demographic data	Personal data of the focus group participants, taken from Attendance Sheet
Goals	References as to what the participant wants to accomplish
Motivation	References as to why the participant wants to accomplish the goals
Needs	References as to what the participant needs to achieve their goals while surpassing their frustrations
Digital literacy	Proficiency level in the usage of IT, taken from latent content
Routine	References to the working day routine
Operation details	References to business operation details
Personality	Based on participant behavior, taken from latent content. Personality traits taken from Norman (1963)
Channels	The personal digital presence of the focus group participant, taken from the latent content
Devices	Digital devices used by the participant, taken from latent content
Digital tools	References to digital tools used for business purposes

and 53, with the majority being over 40. This is a developmentally significant age range, given that the average age of farm managers in regions such as Alentejo and Centro ranges from approximately 50 to 58 years (Costa-Pereira et al., 2025). This alignment provides confidence that the sample reflects the national trend of an aging farmer population.

Of the 14 participants, 9 were male and 5 were female. By comparison, women hold around 30% of farm-manager positions in Portugal and provide nearly half of agricultural labor (Gomes et al., 2022). Educational levels varied as one had basic schooling, seven had secondary education, and six had higher education. This mirrors regional disparities at a national level, e.g., farmers in the North tend to have

Table 15 Definition and coding rules for the frustrations/pain points attribute.

Attribute	Definition	Definition source	Coding rules
Frustrations/pain points	A part of a process or system that causes problems or obstructions	(Oxford English Dictionary, n.d.)	What is stopping the participant from achieving their goals

Table 16 Specification of anchor samples.

Attribute	Anchor sample
Demographic data	Name: P1; Age: 34; Sex: masculino/male; Education: ensino superior/higher education; work regime: tempo inteiro/full-time
Goals	"[. . .] ainda não tenho a possibilidade legal de ser considerado agricultor familiar." "[. . .] I still do not have the legal possibility of being considered a family farmer."
Motivation	"[. . .] tentar perceber até que ponto é que isto se torna sustentável em termos económicos [. . .]" "[. . .] trying to understand to what extent this becomes sustainable in economic terms [. . .]"
Needs	"[. . .] no momento em que eu tiver a minha atividade regulamentada e certificada, eu terei de distribuir o meu pão utilizando intermediários." "[. . .] the moment I have my activity regulated and certified, I will have to distribute my bread using intermediaries."
Digital literacy	Uses e-mail quite often via Smartphone; is acquainted with social media. This demonstrates at least a medium level of digital literacy.
Routine	"[. . .] começava a recolha logo pela manhã e entregava ao final do dia [. . .]" "[. . .] I would start collecting first thing in the morning and deliver it at the end of the day [. . .]"
Operation details	"[. . .] produzo cogumelo biológico." "[. . .] utilizo a minha propriedade para vender algum pão ou pego na carrinha e entrego." "Tenho um negócio de boca-a-boca." "[. . .] I produce organic mushrooms." "[. . .] I use my property to sell some bread or take the van and deliver it." "I have a word-of-mouth business."
Personality	Adventurous, Frank, Cooperative, Sociable, Mild
Channels	E-mail
Devices	Smartphone and Computer: The participant used his smartphone during the focus group and carried a backpack with a laptop
Digital tools	"[. . .] e fizemos este grupo no Face e num website [. . .]" "[. . .] and we made this group on Face [short for Facebook] and on a website [. . .]"
Frustrations/pain points	"Estou dependente do desenlace deste impedimento [. . .]" "I am dependent on the outcome of this impediment [. . .]"

higher average education levels, in contrast to those in the Lisbon area (Costa-Pereira et al., 2025).

About 60% of participants were full-time farmers, with the rest combining agriculture with other work, which is also in line with the broader Portuguese pattern, where only around 13% rely exclusively on agriculture for income, and most farm households have alternative revenue streams (Costa-Pereira et al., 2025). The types of production ranged from horticultural/multiproduct to niche specialties, providing a broad representation of family farm models across the country.

Digital proficiency among participants also varied, with some participants reporting low literacy and using only basic mobile phones. In contrast, others demonstrated high proficiency and utilized Facebook, WhatsApp, Google Maps, Shopify, and more advanced digital tools. Although broad national statistics on farmer digital literacy are limited, Portugal overall boasts a strong broadband infrastructure and fiber coverage. However, the adoption of agricultural technology, particularly among older farmers, lags due to implementation costs and training gaps (Magesa et al., 2023), meaning our sample captures the whole spectrum, from hesitant technology adopters to early adopters of technology.

3.3 Results of the quantitative data triangulation

The raw data regarding questionnaire results is available on Zenodo.org.[4] Table 17 demonstrates the triangulation of data by comparing trends from focus groups and questionnaires.

3.4 Persona integration in RUP

To illustrate the practical integration of personas into the RUP, Table 18 provides concrete examples from the e-grocery marketplace project, showing how personas informed decisions across each RUP phase.

In the inception phase (Usage ID 1), distinct farmer profiles were brought into requirement workshops to surface core user needs, so that early requirements were grounded in observed goals and real user constraints. In elaboration (Usage ID 2), the personas were translated into scenario-driven use-case narratives, which directly informed wireframes and user flows. The same persona evidence was also used to support feature prioritization, implementing broadly critical pain points first and deferring lower-priority functionalities. During construction (Usage ID 3), developers repeatedly referenced

[4] Raw questionnaire data available at https://shorturl.at/z28ga.

Table 17 Data triangulation.

Topic(s)	Subtopic(s)	Triangulation	Result	Rationale
Demographics	Age	Focus groups included participants in their 30s–50s (P1–P14, ages 31–53). Questionnaire results also show that most are 40–59 (≈70%).	Validation	Both datasets confirm that the "typical farmer" in our study is middle-aged
	Sex	Focus groups show a majority of participating farmers are male (69%). The questionnaire demonstrates that the majority of participants are also male (57%).	Validation	Both datasets confirm that there are typically more male than female farmers
	Education	Focus groups show a mix of secondary and higher education (with one Basic). Questionnaire: 69% higher education, 23% secondary, 8% no education.	Complementary but slightly divergent	The survey's sample has higher education levels than the focus group. But both highlight that many small-scale farmers are not low-educated, countering stereotypes.
Work regime and production type		Focus groups: mix of full- and part-time, with single and multiproduct producers. Questionnaire: 62% full-time, 38% part-time; majority horticultural, with some variety.	Validation	Both sources show diversity in work regime and production, though horticulture/ multiproduct farming dominates.
Sales channels and delivery		Focus groups: sales mainly offline (direct, pick-up at producer), with some online. Questionnaire: direct-to-consumer (69%), resellers (62%), own online channels (46%). Deliveries mostly home deliveries (62%) and pick-up at farm (69%). No reliance on third-party logistics.	Validation	Both datasets emphasize offline/direct channels and farmer-controlled logistics. The survey adds nuance: most deliveries are self-managed, confirming the "logistics burden" frustration noted in focus groups.
Digital literacy		Focus groups: reported variability (low, medium, high). Some use WhatsApp, Google Maps, Shopify. Questionnaire: 46% high proficiency, 15% proficiency, 31% reasonable, only 8% no proficiency.	Validation	Confirms diversity in digital literacy, with a solid minority being digitally skilled, but not universally.
Motivations and needs		Focus groups: farmers want business growth, fair pricing, disintermediation, partnerships, logistics support, legal support, training. Questionnaire: top-rated items as "very important": fair pricing (100%), logistics support (62%), product valuation (77%), market visibility (62%), transparency (69%).	Validation	Questionnaire data echoes the priorities from focus groups. Logistics and fair pricing are repeatedly central in both.
Frustrations and pain points		Focus groups: frequent pain points = logistics, unfair contracts, poor intermediation, lack of product variety, labeling, lack of time. Questionnaire: strong fears about online selling: small business volume (77% fearful), high operational costs (54% fearful), delivery quality by third parties (62% fearful), packaging (31% fearful).	Validation	Questionnaire results largely converge with focus group results. Logistics (high operational costs, delivery quality), poor intermediation (small business volume), and labeling/packaging are the main frustrations and pains.
Satisfaction and outlook		Focus groups: mixed optimism (growth vs. legal barriers). Questionnaire: majority satisfied with current business (54%), but 15% unsatisfied/very unsatisfied.	Divergent	Both show cautious optimism, tempered by challenges. But questionnaire respondents are mainly satisfied with current business *status quo*, whilst focus group participants were more cautious.

the personas to justify UI decisions, to structure usability tests around persona-framed tasks, and to adapt support materials to different digital literacy levels and device contexts. Finally, in transition (Usage ID 4), the personas become an evaluation benchmark in stakeholder workshops, helping evaluate whether the deployed digital platform delivers on persona needs.

4 Discussion

Personas are a valuable tool for developing user-centric solutions, as they improve user understanding and foster empathy among a project team (Nielsen, 2018). The results show the application of all the steps suggested by the DQCA framework developed by Assarroudi et al. (2018), thereby testing this technique in a real-world setting as per the research objective.

Although the DQCA technique has already been applied in a wide range of contexts, including health and nursing, communication, HCI, psychology, sociology, digital media, education, business, and informatics, it has not been previously applied in the process of data-driven persona development. With this paper, we confirmed that DQCA can be combined with qualitative data collection techniques, such as focus groups, to inform the process of building data-driven qualitative

Table 18 Practical examples of persona integration in RUP.

RUP phase	Persona usage ID	Practical example
Inception	1	Personas representing different farmer profiles (e.g., full-time horticultural producer vs. part-time regenerative farmer) were used during requirement workshops to identify core platform needs (e.g., fair pricing, easy product listing, transparent payment dates). This grounded requirements in real user data and goals instead of assumptions.
Elaboration	2.1	During scenario modeling, personas informed use-case narratives (e.g., "Maria, a farmer with limited digital literacy, uploads her products weekly via smartphone"). These scenarios shaped interface wireframes and user flows.
	2.2	Personas helped the team prioritize features: logistics support and transparent pricing were implemented first, as these were highlighted as critical pain points for multiple personas. Less critical features (e.g., advanced analytics dashboard) were deferred.
Construction	3.1	Developers referred back to personas when implementing UI design choices. E.g., certifying that navigation was mobile-first to fit the reality of farmers who mainly rely on smartphones (as revealed by the persona data).
	3.2	Personas informed usability test scenarios: test participants were asked to perform tasks framed through persona stories (e.g., "You are Joaquim, a farmer with medium digital literacy, try to update your delivery options on the platform").
	3.3	Personas guided support documentation: training materials were tailored to different farmer profiles (e.g., step-by-step mobile tutorials with images and icons for low-literacy farmers; FAQ sections for advanced users).
Transition	4	Personas serve as a benchmark in evaluation workshops, where stakeholders assess whether the deployed platform addresses key persona needs (e.g., improved negotiation power, simplified delivery coordination).

personas, demonstrating its application in a business technology research project. In brief, and in response to this paper's research question, we hereby confirm that the DQCA can be applied to the HCI field in the development of qualitative, data-driven personas.

When compared to the grounded theory data analysis process, the DQCA offers alignment with existing theories, as it begins with a set of predefined categories derived from established theories or frameworks, ensuring that persona development is rooted in validated concepts. The structured nature of DQCA enables researchers to focus their analysis on specific constructs of interest, such as user needs, behaviors, and goals, making it an alternative to grounded theory when time is scarce. Additionally, DQCA is prepared for the emergence of new insights, as it allows for the introduction of new codes (or even categories) as needed, which enables the capture of unexpected user data without compromising theoretical alignment. The DQCA's flexibility and ability to test and refine hypotheses and frameworks ensure the persona cast is actionable and theoretically robust, making it a valid option for HCI tasks in the realm of software development and UX design. Finally, compared to grounded theory, which requires extensive iterations to identify and refine categories, DQCA simplifies the process by providing a clear starting framework, thereby improving its accessibility to researchers and practitioners who may lack expertise in highly abstract qualitative techniques, such as grounded theory.

However, the process of developing the formative categorization matrix or the persona template categories that will guide the qualitative data analysis can be time-consuming, especially when methodological rigor is necessary (Couto & Curado Malta, 2024).

The questionnaire data confirmed the core themes identified in the focus groups and general characteristics of Portuguese family farmers. In both datasets, farmers were predominantly middle-aged and engaged in horticultural or multiproduct farming, combining full- and part-time work regimes. Direct-to-consumer sales and farmer-managed deliveries emerged consistently as the dominant channels, reinforcing the importance of proximity-based marketing and the logistical burden borne by producers. Similarly, logistics support, fair pricing, product valuation, and market visibility were rated as "very important" in the survey, echoing the key needs and motivations articulated during focus groups.

The questionnaire could also enrich the personas by quantifying operational fears associated with digital adoption. For example, a majority expressed concern over small business volume, operational costs, and delivery quality by third parties, all of which are issues that complement the structural and legal barriers (e.g., bureaucracy, unfair contracts) highlighted in the focus groups.

Some divergences were also observed. The survey sample showed a higher proportion of respondents with higher education compared to the focus groups. While the focus groups stressed legal and contractual frustrations, the survey accentuated cost-related concerns about digital selling (e-commerce).

Although the sample is not statistically generalizable, it is analytically diverse, encompassing demographic and functional variations such as age, gender, educational level, farming model, or digital usage, which reflects the broader population of Portuguese family farmers. This alignment enhances the external validity of the personas to be created, as the underlying data aligns with the broader context, while also validating the adequacy of DQCA for qualitative persona creation.

By utilizing the DQCA in the context of personas, we add rigor and trustworthiness to the data analysis and the persona method (Assarroudi et al., 2018; Couto & Curado Malta, 2024). We also add transparency to the data collection process by complying with COREQ guidelines (Tong et al., 2007).

Beyond confirming that DQCA can be applied successfully to persona creation, this paper provides a critical reflection on how well the method performed in practice. To achieve this, the performance of DQCA is evaluated against three key criteria: accuracy, efficiency, and depth of insights and actionability.

Table 19 Comparative analysis of DQCA, grounded theory, and traditional content analysis.

Criterion	DQCA	Grounded theory	Traditional content analysis
Accuracy	Anchored in predefined theoretical categories, safeguarding conceptual validity; openness to emergent codes.	Builds categories inductively from raw data, maximizing openness but risking inconsistent coding.	Relies heavily on deductive coding schemes, which may overlook emergent themes.
Efficiency	Moderate: time-consuming to design the categorization matrix, but systematic once applied.	Low: requires extensive iterations and coding cycles, resource intensive.	High: quick application of predefined codes, but at the expense of nuance.
Depth of insights	Balanced: captures predefined and emergent insights, though less exploratory than grounded theory.	Very high: generates rich, novel theoretical insights, but less immediately actionable.	Low to moderate: descriptive summaries of frequency/patterns, limited explanatory depth.
Actionability for persona creation	High: produces structured, theory-informed *personae* directly usable in design and development.	Moderate: insights are rich but require further abstraction to translate into *personae*.	Low: may produce descriptive categories but lacks the depth or structure for actionable *personae*.
Best suited for	Applied research and design projects needing rigor, transparency, and usability.	Exploratory studies aiming to build new theory.	Studies focusing on surface-level content patterns or quick categorization.

(a) Accuracy: DQCA ensured that the personas were grounded in established theoretical categories (user needs, goals, behaviors) but allowed for the introduction of new codes, which reduced the risk of producing idiosyncratic or overly anecdotal personas; questionnaire data also corroborated the accuracy of DQCA. Compared to grounded theory, which builds categories inductively from scratch, DQCA was less open-ended but provided greater conceptual validity by aligning with existing constructs.

(b) Efficiency: The structured coding scheme made the analysis process faster and more accessible to less experienced researchers with highly iterative approaches like grounded theory. Developing the formative categorization matrix was time-consuming, but once established, coding and clustering proceeded systematically, which was especially useful in the context of software development, where time and resources are limited.

(c) Depth of insights and actionability: grounded theory may culminate in richer emergent theory, but it requires extensive iterations and is less directly actionable in design contexts. In contrast, DQCA provided a balance between theoretical grounding and practical usability, facilitating data extraction to build personas that could immediately inform requirements, design decisions, and RUP phases.

DQCA functioned as a middle ground between exploratory depth and applied usability. Table 19 contrasts DQCA with grounded theory and traditional content analysis.

This paper is, to the best of our knowledge, the first application of DQCA to persona development, addressing the long-standing critique that personas lack rigor and transparency (Salminen et al., 2024). By grounding personas in a structured coding framework aligned with theoretical constructs, we demonstrate how persona creation can be made more systematic, reproducible, and analytically robust.

Substantively, the study generates new insights into the digital adoption challenges faced by Portuguese family farmers, showing how systemic barriers (e.g., bureaucracy, unfair contracts, limited negotiation power) interact with operational concerns (e.g., delivery logistics, costs, business volume). This dual perspective enriches the literature on HCI in agriculture and provides a strong evidence base for user-centered digital platform design.

Practically, the study offers guidelines for integrating personas into the RUP, providing practical examples of how personas can inform requirement gathering, feature prioritization, usability testing, and evaluation throughout the software development lifecycle. Moreover, the insights and methods described in this paper can be extended to broader applications in HCI and software development across various contexts, including those beyond e-grocery marketplace development. Future applications of this methodology can be invaluable in industries where understanding and incorporating user behaviors and needs are critical to achieving user-centered design success.

5 Limitations of the study

Several limitations should be acknowledged. First, the focus group participants were recruited using purposive sampling, targeting family farmers engaged in short agri-food supply chains. This option limits statistical representativeness: even if the resulting personas capture meaningful archetypes, they may not fully reflect the perspectives of all Portuguese family farmers, principally those less inclined to participate in collaborative or innovation-oriented projects (e.g., older family farmers).

Second, the data coding process was primarily conducted by a single coder, complemented by peer debriefing. Although this increased consistency and provided an external check, it does not reach the robustness of a multicoder strategy with intercoder reliability checks. As such, the coders' own perspectives may have influenced the categorization and clustering of user data into persona attributes.

Third, focus groups as a method introduce group dynamics effects: some participants may dominate the discussion, whereas others contribute less, potentially skewing the themes. To mitigate this, we triangulated the findings with questionnaire data, which offered independent, individual-level responses. Nonetheless, additional qualitative methods, such as diary studies or in-depth interviews, could provide richer, longitudinal perspectives in future work.

Finally, the data are context specific, reflecting Portuguese family farmers in short agri-food supply chains. Although many challenges,

such as logistics, fair pricing, digital literacy, and negotiating power, have been identified as relevant to smallholder contexts elsewhere, adaptation may be necessary before applying them in different socio-economic or cultural settings.

6 Conclusion

This paper reports on research work developed within the context of a nationally funded research project, which aims to create a digital marketplace for family farmers within a short supply chain. The project follows the RUP (Kruchten, 2004) as a methodological framework.

The stakeholders in the digital marketplace are family farmers, end customers, and a series of actors who facilitate the realization of the business, such as delivery drivers. To develop this software (the marketplace), the development team implemented a series of focus groups with the main stakeholders. The output of a focus group is a set of data that must be analyzed to unveil the marketplace's personas and inform RUP's phases.

This paper presents a case study on applying DQCA to focus group transcriptions for persona creation. Although it was conducted in an agrifood context, it offers broader implications for user-centered design processes across different contexts. Additionally, by suggesting the integration of personas into the RUP methodology, we provide guidelines for a better understanding, prioritization, and validation of user needs in software development.

The contribution of this paper extends beyond the context of the research project; it represents another milestone in the HCI literature, demonstrating the effectiveness of DQCA for data analysis and user-persona creation in various contexts. This approach supports user-centered software solutions by providing an innovative methodological framework for data analysis and persona creation.

Future research can build on this study in several directions. First, further work on pattern identification and clustering would enable the data analysis findings to be systematically translated into a comprehensive persona cast. Exploring clustering techniques could support the detection of patterns across attributes and enhance the analytical robustness of persona development.

Second, expanding data collection methods is necessary to reach farmers with lower digital literacy levels, whose perspectives may be underrepresented in online questionnaires and focus groups; in-person questionnaires, semistructured interviews, or diary studies could provide richer, more individualized accounts that complement the focus group data and further validate DQCA outcomes.

Third, methodological robustness could be strengthened by adopting a multicoder strategy, thereby reducing researcher bias and increasing reliability in the coding process.

Finally, comparative research across different national settings would shed light on how the challenges of family farming vary across regions, including similarities and context-specific differences; such work would help determine the transferability of the personas to different geographical contexts.

Researchers and practitioners are encouraged to adopt and adapt the DQCA-based approach presented here, combining it with diverse qualitative data collection techniques to optimize software development processes and better align digital solutions with end-user expectations.

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Data availability

The data underlying this article are available in Zenodo.org, at https://dx.doi.org/10.5281/zenodo.16966842.

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Conflits of interest

None declared.

References

Ali, F., Stewart, R., Boks, C. and Bey, N. (2019) Exploring "company personas" for informing design for sustainability implementation in companies. *Sustainability*, **11**, 2. https://doi.org/10.3390/su11020463.

Alyaqoub, R., Alsharairi, A. and Aslam, M. Z. (2024) Elaboration of underpinning methods and data analysis process of directed qualitative content analysis for communication studies. *Journal of Intercultural Communication*, **24**, 108–116. https://doi.org/10.36923/jicc.v24i2.573.

Anvari, F., & Tran, H. M. T. (2013). Persona ontology for user centred design professionals. In J. Blooma, M. Nkhoma, & N. Leung (Eds.), *Proceedings of the 4th International Conference on Information Systems Management and Evaluation, 4* (pp. 35–44). Academic Conferences and Publishing International.

Anwar, A. (2014) A review of RUP (Rational Unified Process). *International Journal of Software Engineering (IJSE)*, **5**, 8–24.

Arla B2B. (n.d.). Retrieved 12 July 2023 https://www.mihaelauzunova.com/arla-b2b/.

Assarroudi, A., Heshmati Nabavi, F., Armat, M. R., Ebadi, A. and Vaismoradi, M. (2018) Directed qualitative content analysis: the description and elaboration of its underpinning methods and data analysis process. *Journal of Research in Nursing*, **23**, 42–55. https://doi.org/10.1177/1744987117741667.

Atteberry-Ash, B., Williams, J. R., DuBois, H. T. and Pearson, B. (2024) Belongingness, connectedness & engagement: the impacts of an LGBTQ + residential learning community. *Journal of LGBT Youth*, **21**, 369–387. https://doi.org/10.1080/19361653.2024.2310655.

Bak, J. O., Nguyen, K., Risgaard, P., & Stage, J. (2008). Obstacles to usability evaluation in practice: a survey of software development organizations. In S. Bakker, P. Markopoulos, & Y. de Kort (Eds.), *Proceedings*

of the 5th Nordic Conference on Human–Computer Interaction: Building Bridges (pp. 23–32). Association for Computing Machinery (ACM). https://doi.org/10.1145/1463160.1463164.

Barabino, S., Aragona, P., di Zazzo, A., Rolando, M. and with the contribution of selected ocular surface experts from the Società Italiana di Dacriologia e Superficie Oculare (2021) Updated definition and classification of dry eye disease: renewed proposals using the nominal group and Delphi techniques. *European Journal of Ophthalmology*, **31**, 42–48. https://doi.org/10.1177/1120672120960586.

Barber, J. P., & Walczak, K. K. (2009). Conscience and critic: peer debriefing strategies in grounded theory research. In L. McDonnell & M. Feuer (Eds.), *Annual Meeting of the American Educational Research Association, San Diego, California*. American Educational Research Association. https://www.researchgate.net/publication/242479874_Conscience_and_Critic_Peer_Debriefing_Strategies_in_Grounded_Theory_Research. Accessed 22 Aug. 2025.

Billestrup, J., Stage, J., Nielsen, L., & Hansen, K. S. (2014). Persona usage in software development: advantages and obstacles. In L. Miller (Ed.), *Proceedings of ACHI 2014, 7*. IARIA XPS Press. https://www.semanticscholar.org/paper/Persona-Usage-in-Software-Development%3A-Advantages-Billestrup-Stage/2d7c0b230b8c7338edcd21ac0dafad95eddec72e. Accessed 16 May 2024.

Blomquist, Å., & Arvola, M. (2002). Personas in action: ethnography in an interaction design team. In O. Bertelsen, S. Bødker, & K. Kuutti (Eds.), *Proceedings of the Second Nordic Conference on Human–Computer Interaction* (pp. 197–200). Association for Computing Machinery (ACM). https://doi.org/10.1145/572020.572044.

Bordin, S. and De Angeli, A. (2016) Focal points for a more user-centred agile development. In Sharp, H., Hall, T. (eds), *Agile processes, in software engineering, and extreme programming*, pp. 3–15. Springer International Publishing.

Bourgonjon, J., Vandermeersche, G., De Wever, B., Soetaert, R. and Valcke, M. (2016) Players' perspectives on the positive impact of video games: a qualitative content analysis of online forum discussions. *New Media & Society*, **18**, 1732–1749. https://doi.org/10.1177/1461444815569723.

Boyatzis, R. E. (1998) *Transforming qualitative information: thematic analysis and code development*. SAGE.

Burns, N. (1989) Standards for qualitative research. *Nursing Science Quarterly*, **2**, 44–52. https://doi.org/10.1177/089431848900200112.

Cagnoli, F. (2024) Citizen science and science communication: toward a more inclusive pattern? *Journal of Science Communication*, **23**, N03. https://doi.org/10.22323/2.23050803.

Cambridge Dictionary. (2024). *Cambridge Dictionary | English Dictionary, Translations & Thesaurus*. https://dictionary.cambridge.org/. Accessed 16 May 2024.

Chapman, C. N. and Milham, R. P. (2006) The personas' new clothes: methodological and practical arguments against a popular method. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, **50**, 634–636. https://doi.org/10.1177/154193120605000503.

Clay, D. (1998) The theory of the literary persona in antiquity. *Materiali e Discussioni per l'analisi Dei Testi Classici*, **40**, 9–40. https://doi.org/10.2307/40236116.

Cooper, A. (1999). The Inmates are running the asylum. In *Software-Ergonomie '99*, Vol. 53. Vieweg+Teubner Verlag, Wiesbaden.

Cooper, A., Reimann, R. and Dubberly, H. (2003) *About face 2.0: the essentials of interaction design (1st ed.)*. John Wiley & Sons, Inc.

Costa-Pereira, I., Aguiar, A. A. R. M., Delgado, F. and Costa, C. A. (2025) Recognizing diversity to enable an agroecological transition: understanding the potential of family farmers in Portugal. *Frontiers in Sustainable Food Systems*, **9**. https://doi.org/10.3389/fsufs.2025.1604961.

Couto, F., & Curado Malta, M. (2024). Contributions for the development of personae: method for creating persona templates (MCPT). In M. Kurosu, A. Hashizume, H. Mori, D.D. Schmorrow, & C.M. Fidopiastis (Eds.), *HCI International 2024—Late Breaking Papers, 15374*, 3–22. Springer, Cham. https://doi.org/10.1007/978-3-031-76803-3_1.

Crabtree, B. and Miller, W. (1999) Using codes and code manuals: a template organizing style of interpretation. In *Doing qualitative research* (2nd), pp. 163–177.

Curtis, E. and Larsen, E. (2024) "I need more help, but everyone expects me to know it": perceived mentoring needs of contemporary second-year early career teachers. *Professional Development in Education*, 1–17. https://doi.org/10.1080/19415257.2024.2377997.

Darshika, W. I. (2024) Development of learners' intercultural communicative competence through English language textbooks: a directed qualitative content analysis. *OUSL Journal*, **19**. https://doi.org/10.4038/ouslj.v19i1.7557.

Day, J. and Bobeva, M. (2005) A generic toolkit for the successful management of Delphi studies. *Electronic Journal of Business Research Methods*, **3**, 2.

de Abreu Santos, V. Á. and van der Borg, J. (2023) Cultural mapping tools and co-design process: a content analysis to layering perspectives on the creative production of space. *Sustainability*, **15**, 6. https://doi.org/10.3390/su15065335.

Deb. (2018). *Designing innovation: empathy maps and personas—the lovely ferns*. https://www.thelovelyferns.com/designing-innovation-empathy-maps-personas/. Accessed 12 Jul 2023.

del Caz Pérez, B., Moral Martin, F. J. and Canet Centellas, F. J. (2024) User reviews of the impact of immersive media experiences: a qualitative content analysis of user comments about traveling while black. *Journal of Communication*, **28**, 65–84. https://doi.org/10.48047/fjc.28.01.08.

Digital Green. (n.d.). Retrieved 12 July 2023 https://www.anele.design/digitalgreen.

Donohoe, H. M. and Needham, R. D. (2009) Moving best practice forward: Delphi characteristics, advantages, potential problems, and solutions. *International Journal of Tourism Research*, **11**, 415–437. https://doi.org/10.1002/jtr.709.

Dotan, A., Maiden, N., Lichtner, V. and Germanovich, L. (2009) Designing with only four people in mind?—a case study of using personas to redesign a work-integrated learning support system. In Gross, T., Gulliksen, J., Kotzé, P., Oestreicher, L., Palanque, P., Prates, R. O., Winckler, M. (eds), *Human–computer interaction—INTERACT 2009*, pp. 497–509. Springer.

Duan, P., Zhou, J. and Fan, W. (2022) Safety tag generation and training material recommendation for construction workers: a persona-based approach. *Engineering Construction and Architectural Management*, **31**, 115–135. https://doi.org/10.1108/ECAM-12-2021-1143.

Eggeling, J., Rydenfält, C., Kingma, B., Toftum, J. and Gao, C. (2022) The usability of ClimApp: a personalized thermal stress warning tool. *Climate Services*, **27**, 100310. https://doi.org/10.1016/j.cliser.2022.100310.

Elo, S. and Kyngäs, H. (2008) The qualitative content analysis process. *Journal of Advanced Nursing*, **62**, 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x.

Elogii. (2023). *What is delivery management software? [+ How It Works]*. https://elogii.com/blog/what-is-delivery-management-software.

Fabijan, A., Olsson, H. H. and Bosch, J. (2016) The lack of sharing of customer data in large software organizations: challenges and implications. In Sharp, H., Hall, T. (eds), *Agile processes, in software engineering, and extreme programming*, pp. 39–52. Springer International Publishing.

Farm To Table: Wildwolf.io: (n.d.). Retrieved 12 July 2023, https://wildwolf.io/farmtotable/.

Farmer's Business Network—mobile Personas and User Flows. (2016). SlideShare. https://www.slideshare.net/slideshow/farmers-business-network-mobile-personas-and-user-flows/61228568. Accessed 12 Jul 2023.

FARMRISE Case Study—Providing Argonomic Solutions to Farmers. (2021). *Product management simplified*. https://pankajbisht.com/2021/05/29/farmrise-case-study-providing-argonomic-solutions-to-farmers/. Accessed 12 Jul 2023.

Formilan, G. and Stark, D. (2021) Moments of identity: dynamics of artist, persona, and audience in electronic music. *Theory and Society*, **52**, 35–64. https://doi.org/10.1007/s11186-021-09458-w.

Giles, D. C. (2020) A typology of persona as suggested by Jungian theory and the evolving persona studies literature. *Persona Studies*, **6**, 1. https://doi.org/10.21153/psj2020vol6no1art997.

Goh, C. H. and Romainoor, N. H. (2019) User goals, behaviours and attitudes: developing web user personas of art and design students. *Art and Design Review*, **7**, 1–9. https://doi.org/10.4236/adr.2019.71001.

Gomes, D., Jesus, M., Rosa, R., Bandeira, C. and da Costa, C. A. (2022) Women in family farming: evidence from a qualitative study in two Portuguese inner regions. *Frontiers in Sociology*, **7**, 939590. https://doi.org/10.3389/fsoc.2022.939590.

Goodarzi, F., Barati, M., Bashirian, S., Ayubi, E., Rahbar, S. and Cheraghi, P. (2024) The experiences of the elderly regarding the use of rehabilitation assistive technologies: a directed qualitative content analysis. *Disability and Rehabilitation. Assistive Technology*, **19**, 2857–2868. https://doi.org/10.1080/17483107.2024.2313081.

Granular. (n.d.). Malia Eugenio. Retrieved 12 July 2023 http://www.maliaeugenio.com/granular.

Grisham, T. (2009) The Delphi technique: a method for testing complex and multifaceted topics. *International Journal of Managing Projects in Business*, **2**, 112–130. https://doi.org/10.1108/17538370910930545.

Grudin, J., & Pruitt, J. (2002). Personas. Participatory design and product development: an infrastructure for engagement. In T. Binder (Ed.), *PDC 02 Proceedings of the Participatory Design Conference* (pp. 144–161). Association for Computing Machinery (ACM).

Guest, G., Namey, E. and Chen, M. (2020) A simple method to assess and report thematic saturation in qualitative research. *PLoS One*, **15**. https://doi.org/10.1371/journal.pone.0232076.

Haikara, J. (2007) Usability in agile software development: extending the interaction design process with personas approach. In Concas, G., Damiani, E., Scotto, M., Succi, G. (eds), *Agile processes in software engineering and extreme programming* (pp. 153–156). Springer.

Hasan, R. and Ojala, A. (2024) Managing artificial intelligence in international business: toward a research agenda on sustainable production and consumption. *Thunderbird International Business Review*, **66**, 151–170. https://doi.org/10.1002/tie.22369.

Hickey, G. and Kipping, C. (1996) A multi-stage approach to the coding of data from open-ended questions. *Nurse Researcher*, **4**, 81–91. https://doi.org/10.7748/nr.4.1.81.s9.

Hsieh, H.-F. and Shannon, S. (2005) Three approaches to qualitative content analysis. *Qualitative Health Research*, **15**, 1277–1288. https://doi.org/10.1177/1049732305276687.

IBM. (2018). *What is order management?* IBM. https://www.ibm.com/topics/order-management. Accessed 16 May 2024.

Indeed. (2022). *Types of products (with definition and list of products)*. Indeed Career Guide. https://ca.indeed.com/career-advice/career-development/types-of-products.

Jansen, B. J., Jung, S.-G., Nielsen, L., Guan, K. W. and Salminen, J. (2022) How to create personas: three persona creation methodologies with implications for practical employment. *Pacific Asia Journal of the Association for Information Systems*, **14**, 1–28. https://doi.org/10.177d05/1pais.14301.

Johnson, J. L., Adkins, D. and Chauvin, S. (2020) A review of the quality indicators of rigor in qualitative research. *American Journal of Pharmaceutical Education*, **84**, 7120. https://doi.org/10.5688/ajpe7120.

Joshi, A., Kale, S., Chandel, S. and Pal, D. K. (2015) Likert scale: explored and explained. *British Journal of Applied Science and Technology*, **7**, 4. https://doi.org/10.9734/BJAST/2015/14975.

Karolita, D., McIntosh, J., Kanij, T., Grundy, J. and Obie, H. O. (2023) Use of personas in requirements engineering: a systematic mapping study. *Information and Software Technology*, **162**, 107264. https://doi.org/10.1016/j.infsof.2023.107264.

Kaur, P., Stoltzfus, J. and Yellapu, V. (2018) Descriptive statistics. *International Journal of Academic Medicine*, **4**, 60. https://doi.org/10.4103/IJAM.IJAM_7_18.

Kibiswa, N. (2019) Directed qualitative content analysis (DQlCA): a tool for conflict analysis. *The Qualitative Report*, **24**, 2059–2079. https://doi.org/10.46743/2160-3715/2019.3778.

Kim, E. J., Cho, K. M. and Song, S. S. (2024) Child nursing simulation scenario content analysis: a directed qualitative content analysis. *Clinical Simulation in Nursing*, **87**, 101488. https://doi.org/10.1016/j.ecns.2023.101488.

Kowalski, C. P., Nevedal, A. L., Finley, E. P., Young, J. P., Lewinski, A. A., Midboe, A. M. and Hamilton, A. B. (2024) Planning for and assessing rigor in rapid qualitative analysis (PARRQA): a consensus-based framework for designing, conducting, and reporting. *Implementation Science*, **19**, 71. https://doi.org/10.1186/s13012-024-01397-1.

Kruchten, P. (2004) *The rational unified process: an introduction*. Addison-Wesley Professional.

Krueger, R., Casey, M. A., Donner, J., Kirsch, S., & Maack, J. (2001). *Social analysis: selected tools and techniques* (Vol. **36**). Social Development Department, The World Bank.

Local Food Mobile App. (n.d.). Jocelyne Le Léannec. Retrieved 12 July 2023 https://jocelyneleleannec.com/localfood.

Luz, F. G., Ferreira, P. A., & Neves, J. S. (2021). Developing personas and proto personas to enhance the art museum visitor experience. In P. Guerra, & A. Bennett (Eds.), *KISMIF Conference 2021* (pp. 440–447). Universidade do Porto. Faculdade de Letras.

Ma, X., Yang, Y., Qian, S., Ding, Y., Lin, Q. and Wang, N. (2024) Perceptions of Chinese women with a history of gestational diabetes regarding health behaviors and related factors: a directed qualitative content analysis. *BMC Public Health*, **24**, 1237. https://doi.org/10.1186/s12889-024-18731-3.

Magesa, M., Jonathan, J. and Urassa, J. (2023) Digital literacy of smallholder farmers in Tanzania. *Sustainability*, **15**, 13149. https://doi.org/10.3390/su151713149.

Mahamuni, R., Khambete, P., Punekar, R. M., Lobo, S., Sharma, S., & Hirom, U. (2018). Concise personas based on tacit knowledge—how representative are they? In N. Bagakolt, & R. Sheikh (Eds.), *Proceedings of the 9th Indian Conference on Human–Computer Interaction* (pp. 53–62). Association for Computing Machinery (ACM). https://doi.org/10.1145/3297121.3297126.

Matthews, T., Judje, T., & Whittaker, S. (2012). How do designers and user experience professionals actually perceive and use personas? In J. Konstan, E. Chi & K. Höök (Eds.), *Proceedings of the SIGCHI Conference on Human s*, 1219–1228. Association for Computing Machinery (ACM). https://doi.org/10.1145/2207676.2208573.

Mayring, P. (2000) Qualitative content analysis. *Forum: Qualitative Social Research*, **1**. https://doi.org/10.17169/fqs-1.2.1089.

Meloncon, L. (2017) Embodied personas for a mobile world. *Society for Technical Communication*, **64**.

Miaskiewicz, T. and Kozar, K. (2011) Personas and user-centered design: how can personas benefit product design processes? *Design Studies*, **32**, 417–430. https://doi.org/10.1016/j.destud.2011.03.003.

Montazeri, A. S., Khoddam, H., Borhani, F. and Kolagari, S. (2024) Moral reckoning among nurses: a directed qualitative content analysis. *Nursing Ethics*, **32**, 321–335. https://doi.org/10.1177/09697330241255937.

Mousali, A., Moradveisi, L., Barati, M., Moeini, B., Bashirian, S., Sharma, M. and Mohammadi, Y. (2020) Male addicts' experiences on predictors of relapse to drug use: a directed qualitative content analysis. *Addicta: The Turkish Journal on Addictions*, **7**, 166–173. https://doi.org/10.5152/ADDICTA.2020.20039.

MoreBusiness (2023). 5 Powerful buyer persona examples for MSP marketing. https://www.morebusiness.com/buyer-persona-examples/. Accessed 12 Jul 2023.

Mullen, P. M. (2003) Delphi: myths and reality. *Journal of Health Organization and Management*, **17**, 37–52. https://doi.org/10.1108/14777260310469319.

Netcore. (2024). *Preferred Channel*. CEE. https://cedocs.netcorecloud.com/docs/channel-preference.

Ngelambong, A., Salim, S. N., Kamal, S. B. M. and Miranti, M. G. (2024) When tech goes sour: a directed qualitative content analysis of negative user experiences in food and beverage Mobile apps. *International Journal of Research and Innovation in Social Science*, **8**, 1620–1635. https://doi.org/10.51244/IJRSI.2024.1106009.

Nielsen, L. (2018) Design personas—new ways, new contexts. *Persona Studies*, **4**, 2. https://doi.org/10.21153/psj2018vol4no2art799.

Nielsen, L., Larusdottir, M. and Larsen, L. B. (2021) Understanding users through three types of personas. In C. Ardito, R. Lanzilotti, A. Malizia, H. Petrie, A. Piccinno, G. Desolda, & K. Inkpen (Eds.), *Human–Computer Interaction—INTERACT 2021* (pp. 330–348). Springer, Cham. https://doi.org/10.1007/978-3-030-85616-8_20.

Nielsen, L., Jansen, B. J., Salminen, J., Abdelnour Nocera, J., & Jung, S.-G. (2022). Personas: new data, new trends. In S. Barbosa, C. Lampe, C. Appert, & D. Shamma (Eds.), *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems* (pp. 1–3). Association for Computing Machinery (ACM). https://doi.org/10.1145/3491101.3503772.

Norman, W. (1963) Toward an adequate taxonomy of personality attributes: replicated factor structure in peer nomination personality ratings. *Journal of Abnormal and Social Psychology*, **66**, 574–583. https://doi.org/10.1037/h0040291.

Ogbeifun, E., Agwa-Ejon, J., Mbohwa, C., & Pretorius, J. H. C. (2016). The Delphi technique: a credible research methodology. In A. Ali, & A. Bon (Eds.), *Proceedings of the 2016 International Conference on Industrial Engineering and Operations Management Kuala Lumpur, Malaysia*. IEOM Society International. https://index.ieomsociety.org/index.cfm/article/view/ID/2888.

Oxford English Dictionary. (n.d.). *Pain point, n. meanings, etymology and more* Oxford English Dictionary. Retrieved 16 May 2024, https://www.oed.com/dictionary/pain-point_n.

Pan, S. Q., Vega, M., Vella, A. J., Archer, B. H. and Parlett, G. R. (1996) A mini-Delphi approach: an improvement on single round techniques. *Progress in Tourism and Hospitality Research*, **2**, 27–39. https://doi.org/10.1002/(SICI)1099-1603(199603)2:1<27::AID-PTH29>3.0.CO;2-P.

Paré, G., Cameron, A.-F., Poba-Nzaou, P. and Templier, M. (2013) A systematic assessment of rigor in information systems ranking-type Delphi studies. *Information & Management*, **50**, 207–217. https://doi.org/10.1016/j.im.2013.03.003.

Patton, M. Q. (2002) *Qualitative research & evaluation methods (3rd ed.)*. SAGE.

Personas and user journeys. (n.d.). Eureka. Retrieved 12 July 2023 https://h2020eureka.eu/personas-and-user-journeys.

Pinheiro, E. G., Lopes, L. A., Conte, T. U. and Zaina, L. A. M. (2019) On the contributions of non-technical stakeholders to describing UX requirements by applying proto-persona. *Journal of Software Engineering Research and Development*, **7**, 8. https://doi.org/10.5753/jserd.2019.155.

Potter, W. J. and Levine-Donnerstein, D. (1999) Rethinking validity and reliability in content analysis. *Journal of Applied Communication Research*, **27**, 258–284. https://doi.org/10.1080/00909889909365539.

Pruitt, J., & Adlin, T. (2006). *The Persona Lifecycle*. The Persona Lifecycle. https://doi.org/10.1016/B978-0-12-566251-2.X5000-X.

Pruitt, J., & Grudin, J. (2003). Personas: practice and theory. In J. Arnowitz, A. Chalmers, T. Swack, R. Anderson, J. Zapolskin (Eds.), *Proceedings of the 2003 Conference on Designing for User Experiences* (pp. 1–15). Association for Computing Machinery (ACM). https://doi.org/10.1145/997078.997089.

Pusey-Reid, E. *et al.* (2024) Examining fundamental nursing textbooks for inclusivity and exclusivity content: a directed qualitative content analysis. *Journal of Professional Nursing*, **55**, 40–51. https://doi.org/10.1016/j.profnurs.2024.08.013.

Putri, A. R. and Windasari, N. A. (2022) Developing persona for used car buyers in Indonesia. https://doi.org/10.5281/ZENODO.7486463.

Qiu, S., An, P., Hu, J., Han, T. and Rauterberg, M. (2020) Understanding visually impaired people's experiences of social signal perception in face-to-face communication. *Universal Access in the Information Society*, **19**, 873–890. https://doi.org/10.1007/s10209-019-00698-3.

Rasca, S. I., Markvica, K. and Biesinger, B. (2023) Persona design methodology for work-commute travel behaviour using latent class cluster analysis. *Multimodal Transportation*, **2**, 100095. https://doi.org/10.1016/j.multra.2023.100095.

Salma, G., Eddine, M. E. K., & Sabin, M. C. B. (2012). Use of ontologies in modeling persona. In J. Lu, & L. López (Eds.), *2012 IEEE International Conference on Complex Systems (ICCS)* (pp. 1–9). Institute of Electrical and Electronics Engineers (IEEE). https://doi.org/10.1109/ICoCS.2012.6458521.

Salminen, J., Guan, K., Jung, S.-G., Chowdhury, S. A., & Jansen, B. J. (2020). A literature review of quantitative persona creation. In R. Bernhaupt, L. Mueller, D. Verweij, & J. Andres (Eds.), *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1–14). Association for Computing Machinery (ACM). https://doi.org/10.1145/3313831.3376502.

Salminen, J., Şengün, S., Santos, J. M., Jung, S.-G. and Jansen, B. (2022) Can unhappy pictures enhance the effect of personas? A user experiment. *ACM Transactions on Computer-Human Interaction*, **29**, 14. https://doi.org/10.1145/3485872.

Salminen, J., Nielsen, L., Bahloul, M., Jørgensen, R. G., Santos, J. M., Jung, S.-G. and Jansen, B. J. (2024) Persona preparedness: a survey instrument for measuring the organizational readiness for deploying personas. *Information Technology and Management*, **25**, 1–26. https://doi.org/10.1007/s10799-022-00373-9.

Sandelowski, M. (1995) Qualitative analysis: what it is and how to begin. *Research in Nursing & Health*, **18**, 371–375. https://doi.org/10.1002/nur.4770180411.

Schimmer, R., & Bergmark, M. (2024). *Automated economic support: implementation challenges in social work : a case study*. https://urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-227711.

Schönher, M. (2021) Deleuze and Guattari's conceptual persona revisited: the list of character traits as a table of categories. *Cosmos and History: The Journal of Natural and Social Philosophy*, **3**, 309–339.

Shahabi, N., Hosseini, Z., Aghamolaei, T., Behzad, A., Ghanbarnejad, A. and Dadipoor, S. (2024) Determinants of adherence to treatment in type 2 diabetic patients: a directed qualitative content analysis based on Pender's health promotion model. *Qualitative Health Research*, **34**, 114–125. https://doi.org/10.1177/10497323231206964.

Singh, Harsh Vardhan. (2020). *Phyto, a hackathon case study*. https://uxplanet.org/phyto-a-hackathon-case-study-17a8db01e795. Accessed 12 Jul 2023.

Skinner, R., Nelson, R. R., Chin, W. and Land, L. (2015) The Delphi method research strategy in studies of information systems. *Communications of the Association for Information Systems*, **37**. https://doi.org/10.17705/1CAIS.03702.

Skjuve, M., Følstad, A., & Brandtzaeg, P. B. (2023). The user experience of ChatGPT: findings from a questionnaire study of early users. In M. Lee, C. Munteanu, M. Porcheron, J. Trippas, & S. Völkel (Eds.), *Proceedings of the 5th International Conference on Conversational User Interfaces* (pp. 1–10). Association for Computing Machinery (ACM). https://doi.org/10.1145/3571884.3597144.

Smith, F., Dodds, L., L'Henaff, P., Day, C., Musker, R. and Parr, M. (2018) Understanding personas in agricultural data ecosystems. *Gates Open Research*, **2**, 43. https://doi.org/10.21955/gatesopenres.1114887.1.

Smyth, J. D., Dillman, D. A., Christian, L. M. and McBride, M. (2009) Open-ended questions in web surveys: can increasing the size of answer boxes and providing extra verbal instructions improve response quality? *Public Opinion Quarterly*, **73**, 325–337. https://doi.org/10.1093/poq/nfp029.

Staes, C. J., Beck, A. C., Chalkidis, G., Scheese, C. H., Taft, T., Guo, J.-W., Newman, M. G., Kawamoto, K., Sloss, E. A. and McPherson, J. P. (2024) Design of an interface to communicate artificial intelligence-based prognosis for patients with advanced solid tumors: a user-centered approach. *Journal of the American Medical Informatics Association*, **31**, 174–187. https://doi.org/10.1093/jamia/ocad201.

Strasser, A. (2017) Delphi method variants in information systems research: taxonomy development and application. *The Electronic Journal of Business Research Methods*, **15**, 120.

Tong, A., Sainsbury, P. and Craig, J. (2007) Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, **19**, 349–357. https://doi.org/10.1093/intqhc/mzm042.

Tongco, M. D. C. (2007) Purposive sampling as a tool for informant selection. *Ethnobotany Research and Applications*, **5**, 147–158.

Tsyganok, I. (2016) Pair-programming from a beginner's perspective. In Sharp, H., Hall, T. (eds), *Agile processes, in software engineering, and extreme programming*, pp. 270–277. Springer International Publishing.

Turner, B. A. (1981) Some practical aspects of qualitative data analysis: one way of organising the cognitive processes associated with the generation of grounded theory. *Quality and Quantity*, **15**, 225–247. https://doi.org/10.1007/BF00164639.

Uleanya, C. and Prinsloo, P. (2024) Mapping the imaginary of information communication technologies (ICTs) in education: the case of Botswana. *Learning, Media and Technology*, 1–19. https://doi.org/10.1080/17439884.2024.2306553.

UNESCO-UNEVOC. (2018). *TVETipedia glossary*. https://unevoc.unesco.org/home/TVETipedia+Glossary/show=term/term=Digital+literacy. Accessed 16 May 2024.

User Persona. (n.d.). Dribbble. Retrieved 12 July 2023 https://dribbble.com/shots/14895243-User-Persona

User Profile Persona. (n.d.). Sanika Deshpande. Retrieved 12 July 2023 http://www.sanikadeshpande.us/user-profile-persona.html.

Van den Bogaert, L., Geerts, D. and Harambam, J. (2024) Putting a human face on the algorithm: co-designing recommender personae to democratize news recommender systems. *Digital Journalism*, **12**, 1097–1117. https://doi.org/10.1080/21670811.2022.2097101.

Waldron, E. M. *et al.* (2024) Perceptions of and preferences for PrEP use among African American women and providers in the U.S. south: a qualitative study. *Psychology & Health*, **40**, 1443–1462. https://doi.org/10.1080/08870446.2024.2322079.

Walkme. (2023). *Digital tools*. WalkMe™—digital adoption platform. https://www.walkme.com/glossary/digital-tools/.

Webster, J. and Watson, R. (2002) Analyzing the past to prepare for the future: writing a literature review. *MIS Quarterly*, **26**, 2. https://doi.org/10.2307/4132319.

Wildemuth, B. M. and Zhang, Y. (2009) *Applications of social research methods to questions in information and library science*. Libraries Unlimited.

Yu, D.-J. and Lin, W.-C. (2009) Facilitating idea generation using personas. *Human Centered Design*, **5619**, 381–388. https://doi.org/10.1007/978-3-642-02806-9_44.

Zhang, X., Liu, L., Wang, Y., Liu, X., Wang, H., Ren, A., & Arora, C. (2023). PersonaGen: a tool for generating personas from user feedback. In K. Schneider (Ed.), *2023 IEEE 31st International Requirements Engineering Conference (RE)* (pp. 353–354). Institute of Electrical and Electronics Engineers (IEEE). https://doi.org/10.1109/RE57278.2023.00048.

Zhong, R., Han, S. and Wang, Z. (2023) *Developing personas for live streaming commerce platforms with user survey data*. Springer Nature.

Annex 1

Table An1.1 COREQ checklist (Tong et al., 2007).

Topic	Item no.	Guide questions/description	Reported on
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	Research Methodology section
Credentials	2	What were the researcher's credentials? E.g., PhD, MD	
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	
Experience and training	5	What experience or training did the researcher have?	Research Methodology section and section P#2
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	Research Methodology section
Participant knowledge of the interviewer	7	What did the participants know about the researcher? E.g., personal goals, reasons for doing the research	
Interviewer characteristics	8	What characteristics were reported about the interviewer/facilitator? E.g., bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientation and theory	9	What methodological orientation was stated to underpin the study? E.g., grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Research Methodology section
Participant selection			
Sampling	10	How were participants selected? E.g., purposive, convenience, consecutive, snowball	Section P#3
Method of approach	11	How were participants approached? E.g., face-to-face, telephone, mail, email	Research Methodology section
Sample size	12	How many participants were in the study?	
Non-participation	13	How many people refused to participate or dropped out? Reasons?	
Setting			
Setting of data collection	14	Where was the data collected? E.g., home, clinic, workplace	Section P#7
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	Research Methodology section
Description of sample	16	What are the important characteristics of the sample? E.g., demographic data, date	Section P#3
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Section P#4
Repeat interviews	18	Were repeat interviews carried out? If yes, how many?	Research Methodology section
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	
Field notes	20	Were field notes made during and/or after the interview or focus group?	Section P#6
Duration	21	What was the duration of the interviews or focus group?	Research Methodology section
Data saturation	22	Was data saturation discussed?	
Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	Research Methodology section
Description of the coding tree	25	Did authors provide a description of the coding tree?	Results section
Derivation of themes	26	Were themes identified in advance or derived from the data?	Section P#8 and P#9
Software	27	What software, if applicable, was used to manage the data?	Research Methodology section

(Continued)

Table An1.1 Continued

Topic	Item no.	Guide questions/description	Reported on
Participant checking	28	Did participants provide feedback on the findings?	
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? E.g., participant number	Section P#12 and Section P#13, P#14, P#15
Data and findings consistent	30	Was there consistency between the data presented and the findings?	Section P#5
Clarity of major themes	31	Were major themes clearly presented in the findings?	
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	

Appendix A

Table A1.1 Data analysis example: results of P#13, P#14 and P#15.

Theme	Attribute	Subattribute	Code	Meaning unit
Farmer persona	Demographic data	Name	P1	Nome: P1
		Age	34	Idade: 34
		Sex	Male	Sexo: masculino
			Female	Sexo: feminino
		Education	Higher education	Educação: Ensino superior
			Secondary education	Educação: Ensino secundário
			Basic education	Educação: Ensino primário
		Work regime	Full-time	Dedicação: tempo inteiro
			Part-time	Dedicação: tempo parcial
	Goals	N/A (not applicable)	Sales	"E justamente era isso que a gente estava a pedir, alguma rede que estimulasse a produzir [. . .]" "And that is exactly what we were asking for, some kind of network to stimulate production [. . .]"
			Time for produce	"[. . .] se dedicarmos todo o tempo necessário para a venda e distribuição do produto, não temos tempo para produzir bem os produtos." "[. . .] if we devote all the time necessary to selling and distributing the product, we do not have time to produce the products well."
			Financing	"[. . .] o pequeno produtor [. . .] onde é que ele vai buscar tempo para ir buscar os fundos dos seus projetos? Isso também é importante." "[. . .] the small producer [. . .] where is he going to find the time to get the funds for his projects? That is important, too."
			Legal situation resolved	"Nós queremos pôr em prática coisas e é muito complicado, temos muitas burocracias [. . .]" "We want to put things into practice, which is very complicated. There is much bureaucracy [. . .]"
			Product variety	"[. . .] embora o nosso esforço seja no sentido de ter a maior variedade possível de hortícolas, nem sempre isso é possível [. . .]" "[. . .] although we endeavor to have the greatest possible variety of vegetables, this is not always possible [. . .]"
	Motivation	N/A	Business growth	"O mercado é enorme e existe a possibilidade de expandir [. . .]" "The market is huge, and there is the possibility of expanding [. . .]"
			Offer quality	"A dificuldade na agricultura é então produzir bem." "The difficulty in agriculture is then to produce well."
			Fair pricing	"[. . .] e quando chegamos à parte do preço, não achei uma atitude muito correta [. . .] tentamos acordar um preço mais justo, ou preços minimamente decentes." "[. . .] and when we got to the price part, I did not think it was a correct attitude [. . .] we tried to agree on a fairer price or minimally reasonable prices."

(Continued)

Table A1.1 Continued

Theme	Attribute	Subattribute	Code	Meaning unit
	Needs	N/A	Financing support	"E esses fundos, quando aparecem, nós quando sabemos deles, eles já desapareceram." "And when these funds appear, they have already disappeared by the time we hear about them."
			Legal support	"[. . .] vou falar dos meus problemas [. . .] ou seja, existe os problemas ao nível da [. . .] legislação [. . .]" "[. . .] I'm going to talk about my problems [. . .] in other words, there are problems with [. . .] legislation [. . .]"
			Clients	"[. . .] vocês querem nos pôr em contacto com as mercearias e as distribuições [. . .]? E justamente era isso que a gente estava a pedir [. . .]" "[. . .] you want to put us in touch with the grocery stores and the distribution centers [. . .]? And that is exactly what we were asking for [. . .]"
			Disintermediation	"A dificuldade está nos intermediários." "The difficulty lies with the middlemen."
			Logistics	"[. . .] tem alguns problemas de custos logísticos." "[. . .] there are some logistical cost problems."
			Training	"[. . .] pode ser uma ajuda sobre a tecnologia [. . .]" "[. . .] it can help with technology [. . .]"
			Partnerships with producers	"Nós tentamos apoiar diversos agricultores da área [. . .]" "We try to support various farmers in the area [. . .]"
	Digital literacy	N/A	High	Was seen using a Smartphone uses social media daily. Works in an IT-related context/role.
			Medium	Uses e-mail quite often via Smartphone; is acquainted with social media.
			Low	Does not have an e-mail account and no social media either. Was seen using a mobile phone.
	Routine	N/A	Picks product in the morning and delivers at the end of the day	"[. . .] começava a recolha logo pela manhã e entregava ao final do dia [. . .]" "[. . .] I would start collecting first thing in the morning and deliver it at the end of the day [. . .]"
			Farms the whole day; spends minimum possible time on deliveries.	"[. . .] passo o dia a produzir e sobra pouco." "[. . .] I spend all day producing, and there is little left over."
	Operation details	Type of product	Multiproduct	"[. . .] produzo principalmente hortícolas [. . .]" "[. . .] I mainly produce vegetables [. . .]"
			Single product	"[. . .] estou na produção de trigo barbela biológico [. . .]" "[. . .] I am producing organic barbel wheat [. . .]"
		Sales channel	Online	"[. . .] no WhatsApp [. . .] fazem a sua encomenda por lá [. . .]" "[. . .] on WhatsApp [. . .] they place their order there [. . .]"
			Offline	"[. . .] voltamos aos contactos diretos." "[. . .] we are back to direct contacts."

(Continued)

Table A1.1 Continued

Theme	Attribute	Subattribute	Code	Meaning unit
		Delivery	Pickup at the producer's	"[. . .] ou levantam na nossa quinta [. . .]" "[. . .] or they pick it up on our farm [. . .]"
			Direct	"[. . .] irmos entregar a Lisboa diretamente [. . .]" "[. . .] we are going to deliver to Lisbon directly [. . .]"
			Pickup point	"Eu utilizo pontos de recolha [. . .]" "I use pick-up points [. . .]"
	Personality	N/A	Personality traits taken from Norman (1963)	Composed, Persevering, Calm, Frank
	Channels	N/A	E-mail	E-mail: p4@hotmail.com
			Facebook	Facebook.com/p4
			Instagram	Instagram.com/p4
			LinkedIn	Linkedin.com/p4
			Pinterest	Pinterest.com/p4
	Devices	N/A	Smartphone	Used a smartphone during the focus group session
			Computer	Used a computer during the focus group session; has an online selling channel; mentioned the use of a computer during the focus group session
			Mobile phone	Used a mobile phone during the focus group session
	Digital tools	Website	Yes	"Começamos então pelos cabazes num site [. . .]" "So we started with the baskets on a website [. . .]"
			No	No mentions of a website
		Facebook	Yes	"Para promover é o Face [. . .]" "To promote is Face [short for Facebook] [. . .]"
			No	Did not make any mention of a Facebook page
		Instagram	Yes	"[. . .] através de um post no Instagram [. . .]" "[. . .] through a post on Instagram [. . .]"
			No	Did not make any mention of an Instagram page
		LinkedIn	Yes	"[. . .] tendo presença no LinkedIn." "[. . .] having a presence on LinkedIn."
			No	Did not make any mention of a LinkedIn page
		Order management system (OMS)	WhatsApp	"[. . .] recebem semanalmente no WhatsApp [. . .]" "[. . .] they receive it weekly on WhatsApp [. . .]"
			Google Forms	"Também preenchem às vezes um Google Form [. . .]" "They also sometimes fill in a Google Form [. . .]"
			Shopify	"No meu site [. . .] mas gasta-se muito tempo no Shopify." "On my website [. . .], but much time is spent on Shopify."
			No	Did not make any mention of an OMS
		Delivery management software (DMS)	Google Maps	"[. . .] ficou muito difícil com o Maps [. . .]" "[. . .] it became tough with Maps [. . .]"
			No	Did not make any mention of a DMS

(Continued)

Table A1.1 Continued

Theme	Attribute	Subattribute	Code	Meaning unit
Empathy maps	Frustrations/pain points	N/A	Certifications	"[. . .] e depois eu tinha de andar sempre a pedir certificados novos [. . .]" "[. . .] and then I had to ask for new certificates all the time [. . .]"
			Lack of product variety	"Eu para não fazer um cabaz só de batata-doce, tenho de fazer 4 ou 5 viagens." "To not make a basket of only sweet potatoes, I must make four or five trips."
			Problems with logistics	"[. . .] as dificuldades e os custos associados a logística [. . .]" "[. . .] the difficulties and costs associated with logistics [. . .]"
			Customer loyalty	"[. . .] as pessoas assim como aderem, cancelam e não voltam." "[. . .] people join, cancel and do not return."
			Selling the produce	"[. . .] e se não forem este tipo de circuitos, [. . .] estes produtos vão acabar por se perder." "[. . .] and if there are not these kinds of circuits, [. . .] these products will end up being lost."
			Poor contracts	"[. . .] os contratos agroalimentares foram uma lástima [. . .]" "[. . .] the agri-food contracts were a disgrace [. . .]"
			Intermediation	"A dificuldade está nos intermediários." "The difficulty lies with the middlemen."
			Legal bureaucracies	"[. . .] ajuda sobre [. . .] os fundos e leis [. . .]" "[. . .] help with [. . .] funds and laws [. . .]"
			Labeling	"[. . .] de momento temos uma dificuldade em relação à rotulagem [. . .]" "[. . .] at the moment we have difficulties with labeling [. . .]"
			Unfair prices	"[. . .] e que a esse pão diferente se tenha de dar um preço mais justo [. . .]" "[. . .] and that this different bread should be given a fairer price [. . .]"
			Lack of time	"A melhor coisa que o produtor faz é produzir, e o melhor que pode acontecer ao produtor é lhe poder retirar aquele peso de ter de distribuir, vender, de ser comerciante." "The best thing a producer can do is produce, and the best thing that can happen to a producer is to be able to take away the burden of having to distribute, sell and be a trader."

Appendix B

Table A2.1 Results of the data analysis (part 1).

Demographic data					Goals	Motivation	Needs	Digital literacy	Routine	Operation details		
Name	Age	Sex	Education	Work regime						Type of product	Sales channel	Delivery
P1	33	M	Higher education	Full-time	Legal situation resolved	Business growth	Legal support; logistics	Medium	–	Multiproduct	Offline	Direct; pickup at producer's
P2	48	F	Secondary education	Full-time	Product variety; time for produce	Offer quality	Partnerships with producers	High	Picks product in the morning and delivers at the end of the day	Multiproduct	Offline; online	Pickup point
P3	41	M	Secondary education	Full-time	Time for produce	Business growth; offer quality	Logistics	Low	–	Single product	Offline	Direct
P4	31	F	Higher education	Part-time	Sales; time for produce	Business growth; offer quality	Clients; logistics	High	–	Multiproduct	Offline; online	Direct; Pickup at producer's
P5	32	M	Higher education	Part-time	Sales; time for produce	Business growth; offer quality	Clients; logistics; partnerships with producers	High	Picks product in the morning and delivers at the end of the day	Multiproduct	Offline; online	Direct; pickup at producer's
P6	35	M	Higher education	Full-time	Sales	Business growth; offer quality	Logistics	High	Picks product in the morning and delivers at the end of the day	Multiproduct	Offline; online	Direct; pickup at producer's
P7	40	M	Secondary education	Full-time	Sales; legal situation resolved	Business growth	Clients; legal support; logistics; partnerships with producers	Low	–	Single product	Offline	Direct
P8	35	F	Secondary education	Full-time	Sales	Fair pricing	Clients; disinter-mediation; legal support	High	Picks product in the morning and delivers at the end of the day	Multiproduct	Offline	Pickup at producer's; pickup point
P9	52	F	Secondary education	Full-time	Sales; time for produce	Fair pricing; offer quality	Disintermedia-tion; legal support; logistics	Medium	–	Multiproduct	Offline	Pickup point
P10	53	F	Higher education	Part-time	Sales	Business growth	Training	Medium	–	Multiproduct	–	–
P11	50	M	Secondary education	Part-time	Financing; Sales	Business growth	Financial support; training	High	–	Multiproduct	–	–
P12	39	F	Secondary education	Part-time	Financing; sales; time for produce	Business growth	Clients; financing support; logistics	Medium	Picks product in the morning and delivers at the end of the day	Multiproduct	Offline	Direct; pickup at producer's
P13	52	M	Basic education	Full-time	Product variety; Sales	Business growth; offer quality	Logistics	Low	Farms the whole day; spends minimum possible time on deliveries	Single product	Offline	Direct; pickup point
P14	45	M	Higher education	Full-time	Sales; time for produce	Fair pricing; offer quality	Clients; partnerships with producers	Medium	–	Single product	Offline; online	Direct; pickup at producer's

Table A2.2 Results of the data analysis (part 2).

Name	Personality	Channels	Devices	Digital tools						Frustrations/pain point
				Website	Facebook	Instagram	LinkedIn	OMS	DMS	
P1	Adventurous, frank, cooperative, sociable, mild	E-mail	Computer; smartphone	No	No	No	No	No	No	Certifications; logistics
P2	Calm, responsible, direct, good-natured	E-mail; Facebook; LinkedIn	Computer; smartphone	No	Yes	Yes	No	Google Forms; WhatsApp	No	Product variety
P3	Cooperative, mild, intellectual, responsible, composed, cautious	–	Mobile phone	No	No	No	No	No	No	Logistics
P4	Composed, persevering, calm, frank	E-mail; Facebook; Instagram; LinkedIn; Pinterest	Computer; smartphone	Yes	No	No	Yes	No	Google Maps	Customer loyalty; logistics
P5	Direct, talkative, excitable	E-mail; Facebook; LinkedIn	Computer; smartphone	Yes	No	No	Yes	No	Google Maps	Customer loyalty; logistics
P6	Polished, talkative, calm, adventurous, cooperative, frank	E-mail; Facebook	Computer; smartphone	Yes	Yes	Yes	No	Shopify	Google Maps	Logistics
P7	Cooperative, silent, secretive	–	Smartphone	No	No	No	No	No	No	Logistics
P8	Good-natured, composed, persevering, active, direct, sociable, mild, open, cooperative	Facebook	Computer; smartphone	Yes	Yes	No	No	No	No	Intermediation; legal bureaucracies; poor contracts; selling the produce
P9	Polished, talkative, calm, good-natured, sociable, mild	E-mail; Facebook	Smartphone	Yes	Yes	No	No	No	No	Certifications; logistics
P10	Open, polished, mild, cooperative	E-mail; Facebook; Instagram; LinkedIn	Computer; smartphone	No	No	No	No	No	No	Labeling
P11	Direct, frank, adventurous, tense	E-mail; Facebook; LinkedIn	Computer; smartphone	No	No	No	No	No	No	Labeling; legal bureaucracies
P12	Polished, responsible, sociable, cooperative, mild	E-mail; Facebook; LinkedIn	Computer; smartphone	No	Yes	Yes	No	No	No	Logistics
P13	Frank, mild, silent	–	Mobile phone	No	No	No	No	No	No	Lack of product variety
P14	Talkative, polished, cooperative, persevering, composed, responsible	E-mail; Facebook; Instagram; LinkedIn	Computer, Smartphone	Yes	Yes	Yes	No	No	No	Lack of time; unfair prices

Appendix C

Table A3.1 Structure of the questionnaire.

Question group	Question		Answers
Demographic data Group 1	Q.1.1	Age	18–29; 30–39; 40–49; 50–59; 60–69; ≥70
	Q.1.2	Gender	Male; female; other
	Q.1.3	Location	North; Center; Lisbon MA; Alentejo; Algarve; Açores; Madeira
	Q.1.4	Education	No education; basic education; secondary education; higher education
	Q.1.5	Dedication to business	Full-time; part-time
	Q.1.6	Type of produce	Horticultural; fruticultural; horto-fructure; meat; other
Selling behavior and digital literacy Group 2	Q.2.1	By which channels do you sell your produce?	Online—own channels; online—third parties; offline—local markets; offline—resellers; offline—direct to consumer
	Q.2.2	How do you deliver your produce?	Pickup points; home deliveries; local markets; other; pickup at my farm
	Q.2.3	Digital literacy	High proficiency; proficiency; reasonable proficiency; little proficiency; no proficiency
Importance given to each topic Group 3	Q.3.1	Price paid to the producer	Very important; important; reasonably important; less important; not important
	Q.3.2	Logistic support	
	Q.3.3	Payment date	
	Q.3.4	Market visibility	
	Q.3.5	Product valuation	
	Q.3.6	Negotiating power	
	Q.3.7	Sales volume	
	Q.3.8	Social responsibility	
	Q.3.9	Business model transparency	
	Q.3.10	Valuation of farming cycles	
	Q.3.11	Customer support	
	Q.3.12	Publicity	
Online sales and business Group 4	Q.4.1	Frequency of online sales	Very frequently; frequently; occasionally; rarely; never
	Q.4.2	Satisfaction with your business currently	Very satisfied; satisfied; no opinion; unsatisfied; very unsatisfied
Concerns in selling the produce online Group 5	Q.5.1	Data security	Very fearful; fearful; neutral; less fearful; not fearful
	Q.5.2	Payment security	
	Q.5.3	Operational costs	
	Q.5.4	Package preparation	
	Q.5.5	Delivery quality by third parties	
	Q.5.6	Delivering the orders	
	Q.5.7	Communication with the consumer	
	Q.5.8	Insignificant business volume	
	Q.5.9	Complexity of the app	
	Q.5.10	Time expenditure	
Probability of joining *AgroVila* in each of the scenarios Group 6	Q.6.1	Home delivery from up to 3€ (by third parties)	Very high; high; neutral; low; very low
	Q.6.2	Home delivery from up to 5€ (by third parties)	
	Q.6.3	Home delivery from up to 10€ (by third parties)	
	Q.6.4	Delivery in pickup points from up to 3€	
	Q.6.5	Delivery in pickup points from up to 5€	
	Q.6.6	Delivery in pickup points from up to 10€	
	Q.6.7	Free pickup at the producer's farm	
	Q.6.8	Annual subscription of 15€ for access to logistics support (packaging and delivery)	
	Q.6.9	Annual subscription of 30€ for access to logistics support (packaging and delivery)	
	Q.6.10	Annual subscription of 45€ for access to logistics support (packaging and delivery)	

(Continued)

Table A3.1 Continued

Question group	Question		Answers
Q.6.11	Pay for the optional services of a logistics facilitator (helps with order preparation)		
Q.6.12	Pay for the optional services of an agricultural facilitator (helps with farming)		
Q.6.13	Pay for the optional services of a digital facilitator (helps managing digital presence)		
Acceptance of *AgroVila*'s revenue streams Group 7	Q.7.1	Monthly subscription to sell in the app	Totally agree; agree; neutral; disagree; totally disagree
	Q.7.2	Third-party ads inside the app	
	Q.7.3	Commission on sales	
	Q.7.4	Annual share	
	Q.7.5	Other(s)	

Q.2.2 would trigger Q.2.2.1 "With which resources?"/"Which other delivery method do you use?" and how often they used them (Q.2.2.1). Furthermore, Question Group 7 (Q.7.*x*) would trigger Q.7.*x*.1 "How much?"/"Which kind of adds?"/"Which other ones?" whenever the answer was either "Totally Agree" or "Agree."

Appendix D

Table A4.1 Mapping of attributes for the family farmer persona template.

Source Attribute	S.1	S.2	S.3	S.4	S.5	S.6	S.7	S.8	S.9	S.10	S.11	S.12	S.13	S.14	S.15	S.16	S.17	S.18	S.19	S.20	S.21	S.22	S.23	S.24	S.25	S.26	Total
A.1		x	x	x	x			x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x		*n* = 21
A.2		x	x									x	x								x				x		*n* = 6
A.3			x	x	x							x							x				x				*n* = 6
A.4	x		x	x	x	x	x	x	x		x	x	x		x		x		x	x	x		x		x	x	*n* = 19
A.5			x	x	x	x	x					x											x			x	*n* = 8
A.6			x				x		x		x			x								x	x		x		*n* = 8
A.7	x		x	x	x	x		x																			*n* = 6
A.8	x		x		x										x				x		x	x		x		x	*n* = 9
A.9	x		x	x					x																		*n* = 4
A.10		x	x	x				x		x						x											*n* = 6
A.11				x		x		x		x														x			*n* = 5
A.12	x		x	x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	*n* = 23
A.13				x				x			x				x	x				x	x			x	x	x	*n* = 10
A.14				x						x		x															*n* = 3
A.15																					x						*n* = 1
A.16	x																										*n* = 1
A.17		x																									*n* = 1
A.18		x																									*n* = 1
A.19				x																							*n* = 1
A.20				x																							*n* = 1
A.21				x																							*n* = 1
A.22				x																							*n* = 1
A.23								x																			*n* = 1
A.24								x																			*n* = 1
A.25									x																		*n* = 1
A.26									x																		*n* = 1
A.27										x																	*n* = 1
A.28											x																*n* = 1
A.29											x																*n* = 1
A.30											x																*n* = 1
A.31											x																*n* = 1
A.32												x															*n* = 1
A.33												x															*n* = 1
A.34												x															*n* = 1
A.35												x															*n* = 1
A.36													x	x	x				x	x	x	x			x		*n* = 8
A.37														x		x					x	x	x			x	*n* = 6
A.38														x		x			x								*n* = 3
A.39																x	x										*n* = 2
A.40																x		x									*n* = 2
A.41														x													*n* = 1
A.42														x													*n* = 1
A.43																	x										*n* = 1
A.44																			x								*n* = 1
A.45																		x									*n* = 1
A.46																			x								*n* = 1
A.47																										x	*n* = 1
A.48																		x									*n* = 1
A.49																				x							*n* = 1
A.50																x											*n* = 1
A.51																		x									*n* = 1
A.52																				x							*n* = 1
A.53																	x		x								*n* = 2

Appendix E

Table A5.1 List of sources for the attribute mapping of the family farmer persona template.

Family farmer persona template—list of sources (accessed in July 2023)	
S.1	**Yu and Lin (2009)**
S.2	Anvari and Tran (2013)
S.3	Nielsen et al. (2021)
S.4	Grudin and Pruitt (2002)
S.5	Pinheiro et al. (2019)
S.6	Goh and Romainoor (2019)
S.7	Luz et al. (2021)
S.8	Salma et al. (2012)
S.9	Zhong et al. (2023)
S.10	Ali et al. (2019)
S.11	Meloncon, (2017)
S.12	Mahamuni et al. (2018)
S.13	User Persona (n.d.)
S.14	User Profile Persona (n.d.)
S.15	Smith et al. (2018)
S.16	Personas and User Journeys (n.d.)
S.17	MoreBusiness (2023)
S.18	Farmer's Business Network—Mobile Personas and User Flows (2016)
S.19	Arla B2B (n.d.)
S.20	Digital Green (n.d.)
S.21	Deb (2018)
S.22	Singh (2020)
S.23	FARMRISE Case Study—Providing Argonomic Solutions To Farmers (2021)
S.24	Granular (n.d.)
S.25	Farm To Table (n.d.)
S.26	Local Food Mobile App (n.d.)

Appendix F

Table A6.1 List of family farmer persona attributes analyzed in the attribute mapping.

Family farmer persona template—list of persona attributes identified in the sources	
A.1	Demographic data
A.2	Personality
A.3	Channels
A.4	Goals
A.5	Frustrations
A.6	Motivation
A.7	Routine
A.8	Needs
A.9	Digital tools
A.10	Digital literacy
A.11	Attitude
A.12	Photo
A.13	Quote
A.14	Aspirations
A.15	Brands
A.16	Methods
A.17	Intelligent dimension
A.18	Cognitive process dimension
A.19	Hobbies
A.20	Influences
A.21	International considerations
A.22	References
A.23	Environment
A.24	Scenarios
A.25	Degree of interest
A.26	Opinions
A.27	Societal factors
A.28	Project and organizational goals
A.29	Persona development
A.30	Mobility
A.31	Ethical considerations
A.32	Free time
A.33	Job skills
A.34	Financial responsibilities
A.35	Work-life balance
A.36	Pain points
A.37	Biography
A.38	Interests
A.39	Challenges
A.40	Opportunities
A.41	Wishes
A.42	Seasonal sales
A.43	Information resources
A.44	Gains
A.45	Operation details
A.46	Devices
A.47	Behaviors
A.48	Avoids
A.49	Uses for the app
A.50	Touchpoints
A.51	Desires
A.52	Thinking/feeling
A.53	Values

Appendix G

Table A7.1 Results of the application of the mini-Delphi technique.

	Participant 01	Participant 02	Participant 03	Participant 04	Total
Aspirations	–	–	–	–	0
Attitude	–	–	–	–	0
Biography	–	–	–	–	0
Channels	X	X	–	–	2
Demographic data	X	X	X	X	4
Digital literacy	X	X	–	X	3
Digital tools	X	X	X	X	4
Goals	–	X	X	X	3
Interests	–	–	–	–	0
Motivation	X	X	–	X	3
Needs	X	X	X	X	4
Personality	X	–	–	–	1
Photo	X	–	X	X	3
Quote	–	–	–	X	1
Routine	–	X	–	X	2
Values	–	–	–	–	0
Additional considerations	"Demographic Data is relevant, but if we don't specify which data will be included here, it is just too broad of a term. Something similar applies to Personality . . . there should be a controlled input to delimit the options."	"Maybe specify the Digital Tools. Like social media, and for example operational tools like Order Management Systems and Delivery Management Software. Also, it will be useful to add Operation Details, like type of produce, e-commerce usage or how they handle deliveries."	–	"Demographic Data could be subdivided into more specific subattributes. What about adding a "Devices" attribute? To see which digital means the farmers are more accustomed to . . . . It would complement the Digital Literacy level!"	

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Case Study