MSC IN USER EXPERIENCE DESIGN – MASTER THESIS

Investor Perception of Risk and UX: The Effect of Aggregating and Visualizing Liquid and Illiquid Assets in a Wealth Management App

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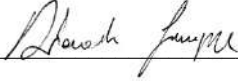Institute of Art, Design + Technology

Supervisor: John Dempsey

Date: 2 May 2025

Declaration

I declare that this submission is my own work.

Where I have read, consulted, and used the work of others I have acknowledged this in the text.

Word count: 21,194

Signed:_____

Date: 02/05/2025

Acknowledgments

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Abbreviations

MPT	Modern Portfolio Theory
IA	Information Architecture
ESG	Environmental, Social and Governance
AUM	Assets Under Management
SUS	System Usability Scale
ETF	Exchange-Traded Fund
API	Application Programming Interface
2FA	Two-Factor Authentication
NPS	Net Promoter Score
PCA	Principal Component Analysis
GDPR	General Data Protection Regulation
UX	User Experience
UI	User Interface
IA	Information Architecture
AI	Artificial Intelligence

Abstract

Investors in modern times hold portfolios which combine liquid assets, including stocks and bonds, with illiquid assets such as real estate, collectibles, and private equity. The focus of traditional wealth management applications on liquid holdings produces inaccurate risk perception and prevents proper portfolio diversification. The research examines how investors perceive risk when liquid and illiquid assets are combined and displayed through a unified wealth management app prototype while assessing the application's usability. The research adopted a user-centered design method based on the Double Diamond model to collect mixed-methods data from twelve participants through semi-structured interviews and a UX workshop with investors. The insights that were obtained led to the creation of the high-fidelity wealth management app prototype "Aetas Wallet." This prototype was subject to 3 sessions of iterative usability testing with recruited users (N=15). Active investors (N=7) participated in the final usability testing which included pre- and post-interaction questionnaires for data collection. The assessment of portfolio risk relied on adapted psychometric scales and the System Usability Scale (SUS) measured usability. The research shows that participants experienced a statistically significant change (p=0.012) in their perception of portfolio risk following use of the prototype which demonstrates that complete visualization affects risk assessment. The hi-fi prototype showed satisfactory usability because users scored it 95.36 on the System Usability Scale. The research demonstrates that investors need comprehensive wealth management tools and shows that displaying illiquid assets in portfolios leads to substantial changes in risk perception.

Keywords

Investment app,

risk perception,

portfolio diversification,

user experience,

illiquid assets,

Introduction

Investors frequently own a variety of assets in today's financial environment, from conventional liquid assets like stocks and bonds to less readily traded illiquid assets like real estate, private equity, venture capital, collectibles, and family heirlooms.

Often referred to as "the only free lunch in finance" (Fernholz, 2002), diversification is a basic financial idea that aims to lower risk by carefully allocating assets. To accomplish this diversification, investors frequently turn to mean-variance analysis or the Modern Portfolio Theory (Markowitz, 1952). This mathematical framework is used to put together an asset portfolio so that, for a given level of risk, the expected return is maximized. Given two portfolios with the same expected return, investors will favor the less risky one, according to MPT's assumption that investors are risk averse.

According to the MPT an investor can reduce portfolio risk simply by holding combinations of assets that are not perfectly positively correlated. Correlation is simply the relationship that two variables share, and it is measured using the correlation coefficient, which lies between $-1 \leq \rho_{ij} < 1$). For example, suppose a portfolio consists of assets A and B. The correlation coefficient for A and B is -0.9. A loss in A is likely to be offset by a gain in B. This is the advantage of owning a diversified portfolio.

In other words, investors can reduce their exposure to individual asset risk by holding a diversified portfolio of assets. Diversification may allow for the same portfolio expected return with reduced risk.

Investing and portfolio theory emphasises diversification, but empirically there is a large gap between these theoretical recommendations and how individual investors invest (Brad M Barber and Terrance Odean, 2013). While adequate diversification is possible even with 30 assets (Statman, 1987), individual investors typically only invest in 4 (Barber & Odean, 2013).

Because people value risk reduction (Bernoulli 1738/1954, Holt and Laury 2005), it is puzzling that so many people are undiversified (Campbell, 2006; Goetzmann & Kumar, 2008). One explanation for this discrepancy may lie in liquid assets' ease of trading and pricing transparency (Koren, 2002; Damodaran, 2005). Conversely, illiquid assets often involve infrequent or subjective valuations and limited trading opportunities, making their risk contribution harder to track and potentially less salient in investors' day-to-day perception.

Smartphone apps such as Robinhood and Stash that promise to "unlock investing potential" and "smart financial decisions" have risen in popularity over the past few years. These apps allow individual investors, who often possess little prior investing experience, to trade stocks, bonds, options and other liquid securities easily and inexpensively, commission-free. It seems plausible that the portfolio visualisation on these apps may significantly influence investors' risk perception. The focus on illiquid assets, in fact, could potentially overshadow the contribution of illiquid holdings, influencing investors' overall risk assessment and diversification strategies.

The study aims to determine whether including illiquid assets in a wealth management app's portfolio visualisation changes the investor's perceived risk.

Literature and Practice Review

The purpose of the conducted thematic literature review was to establish the feasibility, desirability and viability of the study by exploring: possible methods to measure perceived risk in a usability test of an app; existing research around the user experience of individual investors seeking to manage a diversified portfolio of investments; design research of the user interface user experience of fintech and investment apps; relevant cognitive biases. Gaps in research were identified.

User experience of fintech and investment apps

Personal finance management has become increasingly important in today's society, with individuals seeking better control over their finances and improving their financial well-being. Traditional methods of managing personal finances, such as spreadsheets and manual tracking, are often cumbersome and time-consuming. As a result, there has been a growing interest in using technology, such as mobile apps and artificial intelligence (AI), to streamline the personal finance management process.

Several studies have explored the use of mobile apps for personal finance management, highlighting the benefits and limitations of these tools. A study by Du et al. (2019) evaluated the impact of mobile apps on individuals' financial behaviour and found that they could help users reduce expenses, increase savings, and improve financial literacy. However, the study also highlighted the importance of app design and user

engagement, as users were less likely to use apps that were difficult to navigate or lacked engaging features.

Other studies have explored the potential of AI for personal finance management. Khaleghi and Kaviani (2019) developed an AI-based personal finance management system that could predict users' future expenses based on their historical data. The system provided personalised recommendations for expense reduction and savings optimisation, contributing to improved financial outcomes.

Quah et al. (2020) evaluated the effectiveness of an AI-based financial advisor that used natural language processing (NLP) to understand users' financial queries and provide personalised recommendations. The system's recommendations were accurate and helpful, increasing user satisfaction and financial well-being.

Sayan Chaudhry and Chinmay Kulkarni's (2021) research paper introduced a set of design guidelines for encouraging healthy investing behaviours by drawing on three bodies of related work:

1) findings from finance and economics literature on healthy investment practices,

2) the dual process theory from behavioural sciences,

3) design metaphors used in interfaces with uncertain rewards.

The qualitative analysis of the user interface of some popular finance apps revealed that popular trading apps do not follow design patterns and encourage healthier trading behaviour (S. Chaudhry, 2021).

Suzanne Malhotra (2020) investigates the key features of mobile trading apps and their impact on consumer choices and preferences for specific trading apps from a user perspective. This study finds that investors prioritise app ease of use, security, and privacy when selecting mobile trading apps.

An online survey to study customer perceptions of the service quality provided by financial services apps on their smart devices revealed that users expect the financial services app on their smartphones to be user-friendly, personalised to their specific needs and visually appealing (Bredican J., 2016).

A preliminary survey of college students explored how gamification principles incorporated into money-savings/personal finance smartphone apps could improve financial well-being. It revealed that those who have already used a financial app tend to exhibit higher subjective (though not objective) knowledge and want both "social" and "economic" features of financial applications. In contrast, those with no experience are more motivated by economic features (Julia Bayuk and Suzanne Aurora Altobello, 2019).

In a study to assess whether smartphone apps can improve financially capable behaviours, a group of users was asked to use different types of financial apps: a loan interest comparison app, an expenditure comparison app, a cash calendar app, and a debt management app (French, McKillop, Stewart, 2021). The results showed statistically significant improvements in several measures designed to gauge 'financial knowledge, understanding and basic skills' and 'attitudes and motivations'. These improvements translated into better financially capable behaviours; the participants were more likely to keep track of their income and expenditure and were more resilient when faced with a financial shock.

While general app usability and design are crucial (Malhotra, 2020; Bredican, 2016), research addressing the UX challenges and perceptual impacts of visualising heterogeneous (liquid/illiquid) asset portfolios within a single interface remains limited.

Content design and Data visualisation

When communicating risk, visuals provide a greater impact on the audience than numerical data (Braasch, 2013; Retchless, 2014). This effect on the audience is an important aspect of emotional design, as the purpose of these visuals is to incite an emotional response from the viewer.

Data visualisation techniques are crucial in enhancing user experience and understanding investment performances.
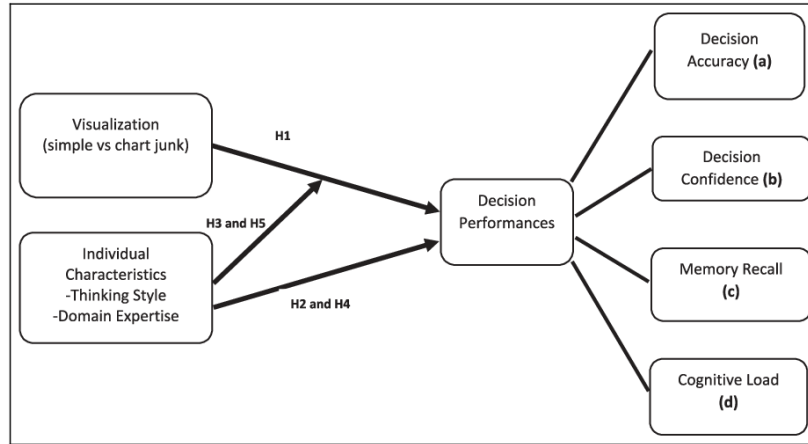
Figure 1 - Research framework published in Information Visualization 2023

Tomasi' (2023) study on data visualization confirmed that simple visualisations can improve decision accuracy and reduce cognitive load, especially for analytical thinkers. This was done using the theoretical research framework summarized in Figure 1. Results suggest that simple visualisations enhance decision accuracy and reduce cognitive load (Tomasi et al., 2023). It is also found that cognitive load is further reduced when analytical thinkers are presented with simple visualisations. These findings can help designers understand how user characteristics may be considered when designing and evaluating visualisations for decision makers (Ward, M, Grinstein, G., Keim, D., 2015). The connection between information overloading and data visualization is also confirmed by Jakob Nielsen (1995).

However, traditional financial analysis often relies on statistical measures and line charts, which may produce misleading results (Museth et al., 2007).

Table 1 - Capabilities of visualisation techniques on the dataset under analysis

Visualization technique	Outliers detection	Dependency analysis	Clustering	Cluster description	Class description	Comparison
Line graphs	✓	✓			✓	✓
Permutation matrix	✓	✓				✓
Survey plot	✓	✓			✓	✓
Scatter plot matrix	✓	✓				✓
Parallel coordinates	✓	✓				✓
Treemaps	✓				✓	✓
PCA	✓	✓	✓	✓		✓
Sammon's mapping					✓*	
SOM – scatter plot	✓		✓		✓**	
SOM – U-matrix			✓			
SOM – clustering			✓			
SOM – feature planes		✓	✓	✓		✓
SOM – all views combined	✓	✓	✓	✓	✓	✓

* Sammon's mapping is capable of organizing the dataset so that different classes are distinguishable but does not provide a means to interpret and describe the classes.

Researchers have proposed techniques for visualising financial time series data that offer a more comprehensive view of asset performance. Some of these visualization techniques are described in the Table 1 with their capabilities. These techniques incorporate relevance and weighting functions based on user preferences (Museth et al., 2007).
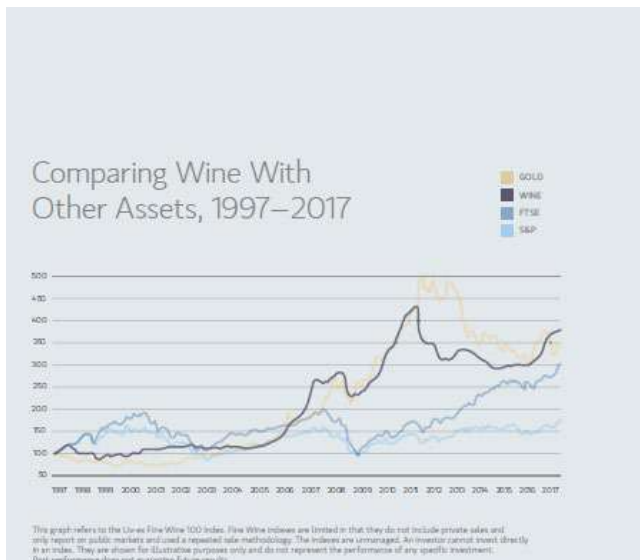
Figure 2 - Line chart comparing liquid returns (stock, ETF, gold) and illiquid assets (wine) over 10 years.

A key question during the literature review of this study is whether visualisation techniques traditionally used for liquid assets are effective when applied to mixed portfolios including illiquid assets, and how different representations impact user perception and can generate insights. A line chart is an example of a standard visualization technique used to depict price movements of liquid assets that can be applied to illiquid assets offering potential for richer data exploration and pattern detection (as shown in Figure 2).

The knowledge generation model proposed by Sacha et al. (2014) describes individual segments of the overall visual analytic process and provides a useful guidelines when developing and evaluating such systems (Sacha, 2014) . As described in Figure 2 the model consist of computer and human parts. The left hand side illustrates a visual analytics system, whereas the right hand side illustrates the knowledge generation process of the human. The latter is a reasoning process composed of exploration, verification, and knowledge generation loops. Visual analytics pursues a tight integration of human and machine by enabling the user to interact with the system.

Figure 3 - Knowledge generation model for Visual Analytics – Extracted from Sungahn Ko, 2016, "A Survey on Visual Analysis Approaches for Financial Data"

Richard Arias-Hernandez discusses the ways in which visual analytics research contributes to ongoing efforts in Human-Computer Interaction (HCI) that address cognitive task performance and how it is affected by highly "interactive human-information discourse" with visualization of data, information and knowledge. The concept of ""interactive human-information discourse" is central to understanding how investors engage with wealth management applications. The visualisations within the app serve as a medium for this discourse. Investors interact with these visualisations (e.g., by zooming, filtering, or viewing different timeframes), and the system responds by updating the displays. This interaction forms a dialogue between the investor and the information, ultimately shaping the investor's understanding and knowledge.

Multi-dimensional visualisation techniques can effectively explore financial performance data, detect outliers, and identify patterns (Marghescu, 2007).

Recent studies have also focused on evaluating visualisations beyond usability and performance metrics, considering user experience goals such as memorability, engagement, and enjoyment (Saket et al., 2016). These advancements in visualisation techniques contribute to improved decision-making and user experience in financial analysis.

Cognitive biases

Availability bias

Byunghwan Lee's (2008) study sought to analyse the role of the availability heuristic in financial markets. The research pointed out that under the availability heuristic, humans are unreliable because they assess probabilities by giving more weight to current or easily recalled information instead of processing all relevant information. Since information regarding the current state of the economy is readily available, researchers attempted to expose the properties of business cycles to predict the availability bias in analysts' growth forecasts. They showed the availability heuristic to play a role in the analysis of forecasts and influence investments because of this. The availability heuristic bias makes an investor overestimate the importance of information that is easily accessible or readily available to us. If a finance app prominently features stocks and bonds and makes them very easy to trade, those options will feel more "available" to the investor. Other asset classes, even if potentially suitable, might be neglected because they are less visible within the app.

Anchoring bias

Bingqing Wang (2023) researched the impact of the anchoring bias on financial-decision making. The research highlights the "Importance of Diversification" to mitigate the effect of the bias by helping individuals to consider a broader range of information, perspectives, and potential outcomes, rather than relying solely on an initial anchor. If the app introduces stocks and bonds first during onboarding or prominently displays them on the main dashboard, these options can become an "anchor" for the investor. Later, even if they encounter other asset classes, they might still be disproportionately influenced by their initial focus on stocks and bonds.

Confirmation bias

Robert Johnson (2013) studied behavioural biases to explain why investors do not diversify enough. He found that investors exhibit confirmation bias when they process information from apps. If an app primarily focuses on stocks and bonds, investors with a pre-existing belief that these are the "best" investments will have their belief reinforced. They might selectively seek information within the app that confirms this (e.g., positive stock market news) and ignore the potential benefits of other asset classes, even if the app offers them.

The research above suggests that an app's design can influence investor behaviour without malicious intent. By limiting the visible options or making some options easier to access, an app can inadvertently trigger cognitive biases that lead to under-diversification and a focus on a limited range of assets.

Perceived Risk

Pidgeon et al. (1992) state that "risk perception involves people's beliefs, attitudes, judgments, feelings, and broader social or cultural values and dispositions." As risk perception is highly subjective and affected by societal influences and cognitive biases, a particular hazard will mean different things to different people and contexts. Risk perception is an idiosyncratic process of interpretation, making sense of a complex world to plan, choose and act in that world.

Fischhoff *et al.* (1978) conducted a study on the usefulness of psychometric procedures to elicit quantitative judgments of perceived risk, acceptable risk, and perceived benefit. In evaluating perceived risk, participants were asked to rate each activity or technology on nine seven-point scales, each representing a dimension hypothesised to influence perceptions of actual or acceptable risk. These scales were: Voluntariness of Risk, Immediacy of effect, Knowledge about risk, Science knowledge about risk, Control over risk, Newness, Chronic-catastrophic, Common-dread, and Severity of consequences. The results showed that the nine scales hypothesized to influence judgments of perceived risk were highly intercorrelated. Therefore these can be used to "measure perceived risk levels".

Brachinger and Weber [1997] reviewed the naïve risk measurement used in the earlier economic literature. They developed economic or psychological theories of perceived risk that rely on the axiomatic approach of modern measurement. They found that it is difficult to select any risk measurement as superior by convincing a priori arguments among the reviewed approaches. However, the study highlights that skewness, semi-variance, below-the-target return, expected value of loss, and probability of loss more closely reflect the perceived risks. These scales are considered in the construction of the questionnaire to measure the effect of the app user experience on perceived risk. The study defines function R which numerically represent the perceived risk in accordance to the conception of standard measurement theory.

Diacon and Ennew [2001] presented the results of a detailed investigation of the factors that characterise the perceived risk in various personal financial services, pensions, life insurance and banking products available to individual savers in the United Kingdom. His analysis of financial risk perceptions is based on the well-known psychometric paradigm and uses psychometric scaling methods to produce quantitative measures of perceived risk and benefit. The results showed that individual perceptions of risk in personal financial services can be grouped into five main dimensions: distrust of the product and/or provider; the seriousness of adverse consequences; volatility of return; poor knowledge and/or observability; and failure of regulation. In order to assess the characteristics of perceived risk and the extent of risk perceptions, the research uses data from a detailed questionnaire administered to a convenience sample of U.K. individual savers in 1997 and 1998. For each personal financial services product, respondents were asked to scale the degree of risk associated with holding wealth in that particular form using 25 different seven-point Likert scales. As usual in such studies, a definition of "risk" was not provided to elicit people's understanding of the concept. Respondents were asked about various aspects of financial risk (such as severity, immediacy of effect, degree of control, knowledge, etc.) and aspects of the products (such as importance of trust, tangibility, and quality). Respondents were also asked to scale products in terms of expected return, so that the perceived risk/return trade-off might be investigated.

Mei Wang et al. (2011) conducted a survey on risk perceptions of investment products. They found that respondents perceived those easier-to-understand products as less risky, which was likely driven by the familiarity bias. In the study participants were asked to judge the perceived risk of each product by answering questions adapted from the empirical and theoretical work on risk perception of the other studies mentioned in this literature review (Fischhoff et al. [1978], Brachinger and Weber [1997], Diacon and Ennew [2001]). The results were then analysed calculating mean rating of perceived risk.

MacGregor et al. (1999) comment that several qualitative factors can influence risk perceptions, including the potential for significant catastrophic losses, the unpredictability of outcomes, knowledge or familiarity and affective or emotional reactions.

The review of the studies cited above found that most of the studies analysed the factors influencing risk perception using psychometric methods, often focusing on specific hazards or financial products.

The literature still lacks a comprehensive study establishing the influence of portfolio visualisation on the investor risk perception. The present study is designed based on this background.

Perceived Risk and Usability

Jacobson's (2015) study explicitly investigates how usability influences risk perception. The results gather qualitative data associated with risk perception through pre-test and post-test interviews with participants who used an interactive tool to analyse sea level rise. The study also observed and recorded user emotion and response as potential indicators related to how risk information was perceived. The finding that negative emotional responses correlated to a negative perception of usability suggest an indirect link between UX (usability) and perceived risk. This concept is supported by both Norman's (2004) findings on the impact of product design on user emotion and Jokinen's (2014) study on the relationship between user emotion and task performance.

Agustinus' (2023) research examines the impact of usability on purchase intention in the context of an online marketplace, with perceived risk acting as a mediating variable. The study explicitly formulated a hypothesis (H3) stating that perceived risk hurts purchase intention. The research methodology involved distributing questionnaires to investigate the research questions, indicating that perceived risk was likely measured through specific items within the questionnaire.

Prayoga (2023) research aimed to analyse the effect of UI and UX on consumers' purchase decisions and perceived risk in a online marketplace. Data was collected using structured questionnaires with items tested for validity and reliability. A correlation analysis was conducted to determine the relationship between UI, UX, and purchase decisions via the mediation of perceived risk measurements.
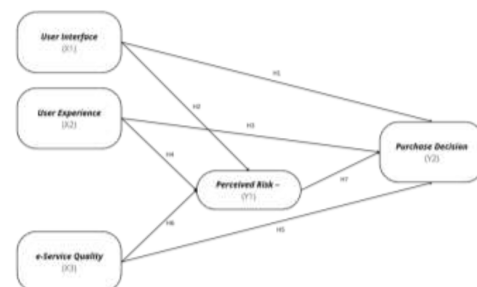
In the study, perceived risk is measured using 3 indicators that can measure how much risk the user feels when using the app. Based on the results: the relationship between UI Design and Perceived Risk is positive but not significant; the relationship between UX Design and Perceived Risk is positive and significative.

Abreu (2010) studied the impact of financial literacy on portfolio diversification. The results suggest that investors' educational levels and their financial knowledge have a positive impact on investor diversification. The study participants are asked to identify their assets and securities and the researcher uses this information to calculate the variable PORTFDIVST. In the study the PORTDIVST variable is used as a proxy of perceived diversification. This is calculated by summing the number of assets and securities.

Luigi Guiso and Tulio Jappelli (2009) explored the role of poor financial literacy as a potential factor explaining the lack of portfolio diversification among investors. They utilized the 2007 Unicredit Customers' Survey (UCS), which includes detailed information on portfolio choices, financial literacy, and demographic characteristics of investors. The variables constructed from survey responses were based on questions like: Do you think that financial diversification is: Hold stocks and bonds / Don't hold too long the same asset / To invest in as many assets as possible / To Invest in assets to limit risk exposure / To Avoid high-risk assets. The results showed that the measures of financial literacy were strongly correlated with the degree of portfolio diversification.

Liquid and Illiquid Assets

Rohner & Uhl[i] (2018) research on how innovative technologies will offer the tools investors need to understand and manage their holistic wealth situation, showed that most banks and advisors do not have the tools to understand a client's holistic wealth situation. Due to their primary focus on AUM[1], they neither have incentives nor the aspiration to consider a client's total wealth, as nonbankable assets do not generate revenues in an AUM-based business model. Furthermore, most traditional independent investment advisors and consultants lack an efficient infrastructure to provide an accurate, holistic wealth overview for clients with complex wealth structures. As a result, private individuals who do not have a dedicated holistic wealth advisor often struggle to understand and fully control their holistic wealth situation. The research results indicated that a comprehensive wealth overview combined with goal-based investing leads to improved wealth management and increased investor satisfaction.

Zaker (2022) envisions a new "Wealth OS" dedicated to the specific needs of wealth management advisors and clients, moving beyond traditional pension fund-oriented frameworks. The paper proposes a new investor framework for personalised wealth management that unifies liquid and illiquid assets, alternative investments, and financial insights.

Bekkers' (2009) study explored which asset classes add value to a traditional portfolio of stocks, bonds and cash. The study determined the optimal weights of all asset classes in the optimal portfolio and distinguished ten different investment categories simultaneously in a mean-variance analysis and a market portfolio approach. The results suggest incorporating real estate, commodities, and high-yield investments can significantly enhance portfolio performance (Bekkers, 2009).

The papers above investigate strategic asset allocation with illiquid alternatives. However, the literature lacks insight into the user needs, expectations, and pain points of individual investors and family offices seeking to manage a diversified portfolio of investments.

This highlights a gap in understanding user perspectives on how portfolios containing illiquid assets should be evaluated relatively within a unified framework.

Research questions

In the development of the literature review and the construction of the research report, specific questions were considered and answers were sought:

Primary questions

- Would the user-perceived risk change after using an holistic wealth management app with various liquid and illiquid asset classes?
- How does the user-perceived diversification change after using a holistic wealth management app?

Secondary questions

- How easy and usable is a holistic wealth management app from a user's perspective? What is the user experience of adding illiquid assets to an investment portfolio management app? Did the user find it easy? Would the user consider using this feature in a live app?

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[1] Assets under management (AUM) is the total market value of the investments managed by a person or entity on behalf of investors.

Hypotheses

Based on the initial research, the hypothesis (H_n) formulated for the study are the following:

- H1: The perceived risk profile of the investor portfolio (measured using a Likert scale analysis of 17 risk-related questions to determine the function R, which numerically represent the perceived risk[2]) will differ significantly after the user registers and visualizes his whole portfolio on the app compared to the portfolio risk perception before using the app.

I further explored the correlation between the System Usability Scale and the function R.

Methodology

This research adopted a user-centred approach (Donald A. Norman, 1987) and was conducted between November 2024 and March 2025[3]. The framework followed the Double Diamond Process Model (British Design Council, 2005) and was carried out in four distinct phases of research. The Double Diamond framework allows to explore a wide range of ideas, narrow down to focus on the best ones and iterate quickly (Möller Ola, 2015) with the given timeline.
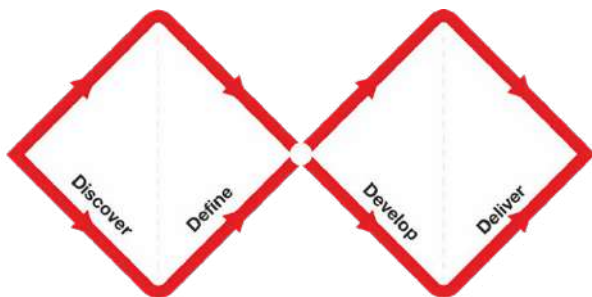
Figure 4 - The Double Diamond by the Design Council

The Double Diamond framework strong emphasis on a user-centric approach was key to the development of an app that truly resonate with the target audience. From the very beginning, the framework encouraged a deep exploration of user needs, behaviours, and pain points through comprehensive research and analysis during the Discover phase (Design Council, 2007. This focus on understanding the user ensured that the subsequent phases of development were grounded in real-world insights rather than assumptions, leading to solutions that were more likely to meet the actual needs of the end users. As the process moved into the Define and Develop phases, this user-centric approach continued to guide decision-making, with ongoing validation and testing of ideas and prototypes to ensure they aligned with user expectations.

The study was conducted using a mixed methods research methodology combining both quantitative and qualitative approaches.

Phase 1 involved a review of the fundamental literature from behavioural finance, psychology (focusing on risk perception) perceived portfolio diversification, investors behaviours with fintech apps and design relevant to financial decision making. A user panel composed of 11 individual investors and 1 professional investor was available for user interviews and surveys were sent to understand common use case scenarios, financial literacy, understand app usage & preferences, segmenting participants for usability testing and further research.

Phase 2 included a moderated UX Workshop with a selection of key participants to reveal the target audience's preferences, lived experiences and investor user journey. The qualitative data sourced from the UX workshop were consolidated to propose an initial list of UX requirements for the wealth management app. A Heuristic evaluation and competitor benchmarking with portfolio management apps like Google Finance, Yahoo Finance, Empower and other wealth management apps will be conducted to identify gaps in the functionalities, identify best practices and set key dimensions. Personas, empathy maps, user need statements, and user journey maps were created based on desk research and survey answers to inform the design phase.

Phase 3 defined the Information Architecture and user flow of the app to facilitate the prototyping. Service blueprint, low-fidelity prototypes (paper and digital wireframes), and high-fidelity prototypes were developed.

Phase 4 involved usability testing of the low-fidelity and high-fidelity prototypes, which were iterated based on user feedback in an exploratory sequential design that allowed quantitative data collection and analysis. The final rounds of usability testing elicited users' perceptions of risk in the context of the app and the inclusion of illiquid assets.

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[2] Mei Wang [2011]; Fischhoff et al. [1978], Brachinger and Weber [1997], Diacon and Ennew [2001]

[3] Surveys and usability tests were collected between November 2024 and March 2025. This period have been characterised by high market volatility for certain assets such as stocks and crypto, which could have influenced participants' risk perceptions [Madhumarthi, 1998; Diacon and Ennew, 2001; Wang et al., 2011]. As volatility reflects the unpredictability of returns and the potential for loss, it is a key factor affecting how investors perceive the risk associated with investments [Madhumarthi, 1998]. Media coverage and discussions surrounding market fluctuations during this time may have further heightened the salience of risk for the participating investors.

The phases are illustrated in the diagram (Figure 5) and Gantt chart (Figure 6) below.
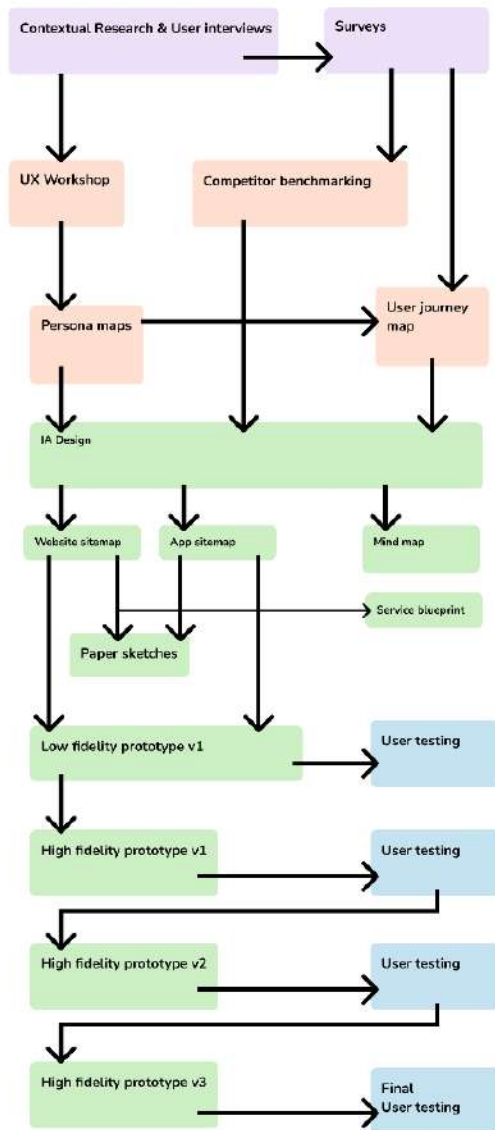
Figure 5 - Design process flowchart of the research. The diagram adopts the "Double-Diamond design thinking model
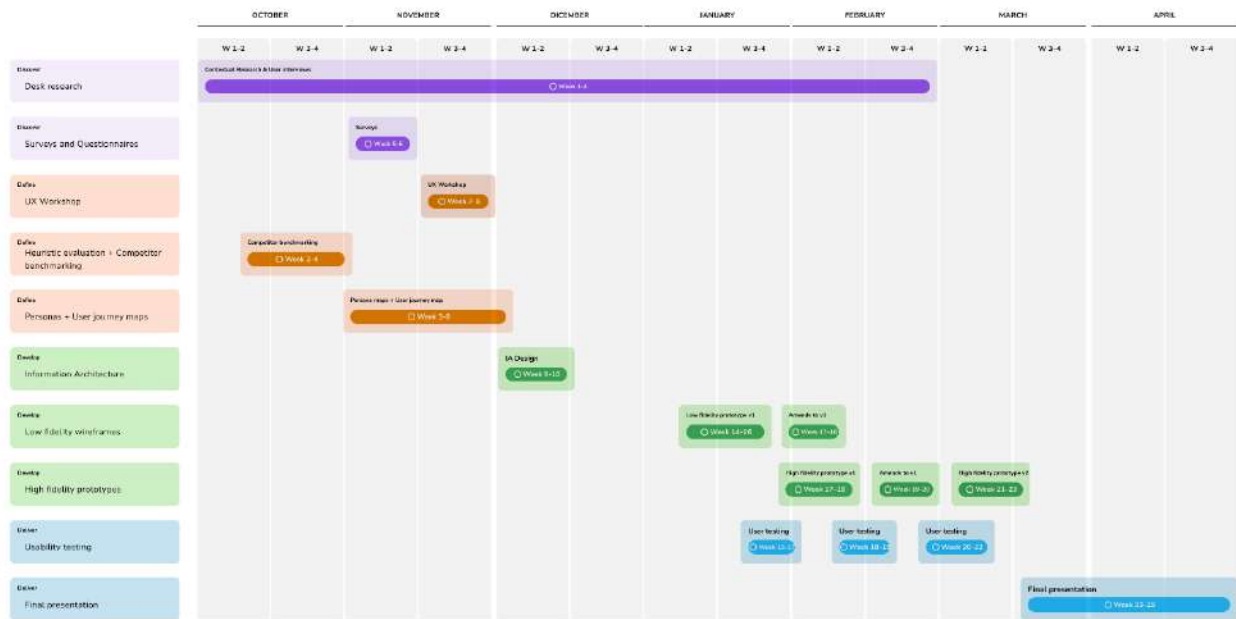
Figure 6 - Research activities Gantt chart

Phase 1: Discover
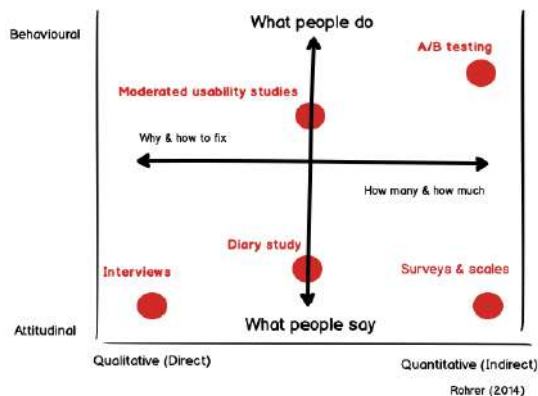
Figure 7 - Research methods

The research phase opted for qualitative and quantitative methods from a landscape of options (Rohrer, 2104) to provide data into attitudes and behaviour.

Desk research

A systematic review of the fundamental literature from behavioural finance, psychology, and user experience design relevant to financial decision-making was conducted to extract recommendations that are actionable through interaction design interventions.

Semi structured user interviews and questionnaire.

In Phase 1 of the research study, semi-structured face-to-face interviews were undertaken with individual investors. These conversations between the researcher and the participant aimed to reveal the participant's perceptions and experiences within a specific subject area (Koumou, 2020). A pilot interview was conducted to identify what tweaks were needed before running all interviews (Maria Rosala & Kara Pernice, 2023). The user interview script can be found in the Appendix B.

Prior to each interview, basic user information was gathered for each participant in a questionnaire. The interviews and pre-interview questionnaire were designed to collect demographics, psychographic data, financial literacy and portfolio composition. The questions were selected based on previous research (Chaudri & Kulkarni, 2021; JaeHong Park, 2010; Nagarjuna, 2023) using a mix of open-ended and close-ended questions. A list of the questions can be found in the Appendix B.

Open questions were asked and interviews were held face to face to help foster a sense of trust, which may impact the quality of the responses given (Baxter, 2015). This information was then be used to inform the creation of the survey and the design of the investor portfolio management app in the form of a prototype, which was then tested with users. Baxter et al (2015), recommends interviewing between six and ten users per target user group, in a qualitative interview study (Baxter, 2015).

Participants

Prior to recruitment of participants, ethical approval was sought from the Department of Technology and Psychology Ethics Committee at IADT.

The recruitment strategy utilised to find and select participants for the study leveraged a collaboration with a community gatekeeper. This strategy is particularly useful for studies focused on underserved or traditionally hard-to-reach populations like high-net worth individuals and investors (Crawford Shearer et al., 2010; Lovato et al., 1997). The community is a private group of active investors who are investing on a monthly basis. The participants were recruited via purposive sampling.

Inclusion criteria included investors that have been investing for more than 2 years and that owns illiquid assets such as real estate, premium cars, watches and other luxury commodities.

A total of 20 participants participated to the research, comprised of nine-teen individual investors and one professional investor.

During the pilot testing phase with the Dun Laoghaire Institute of Art Design + Technology, 3 participants with poor financial literacy participated in the study. These participants are not removed; if they were removed, the results would be almost identical.

Phase 2: Define

UX Workshop / Focus group

In this study, a UX discovery workshop/focus group with the target audience was undertaken to understand user perceptions about portfolio management (Maddie Brown, 2023). The goal of the workshop was to gain in-depth insights into individual investors' user journey, gather opinions on existing products, understand user motivations and generate ideas for new features, particularly concerning the management of both liquid and illiquid assets.

The questions focused on understanding their current methods for managing and tracking their investments, their understanding of diversification, their experiences (if any) with illiquid assets, and their needs and expectations for a wealth management app that aggregates and visualises these assets (Sindhu K., 2014). These questions were carefully framed to avoid causing discomfort or embarrassment to participants. See Appendix C for the Workshop agenda and questions.

The list of developed questions and workshop plan can be found in the Appendix E.

6 participants were selected and invited based on the responses to the survey sent during the Discovery phase prioritizing participants with more types of assets. Best practice recommendations state that a UX workshop should involve between 6-12 participants (Jake Knapp, 2016). This range tends to be large enough to catalyse engagement and interaction, while not being so large that facilitation and maintaining focus become unmanageable.

The workshop was conducted in real-time via video conferencing platform and included the following activities: icebreaker, personas mapping, user journey mapping, app benchmarking, MoSCoW exercise (Dai Clegg, 1994).

The insights gathered were analysed used to inform the later design of the prototype.

Competitor Analysis & Benchmarking

An analysis of popular wealth management and trading apps was done to identify how they handled asset aggregation and communicated risk to users.

The analysis was a focused comparison of features, content and design elements across apps and websites. (Neusesser, 2024). The evaluation was done in the form of an expert review where the UX researcher reviewed the design based on his UX expertise.

The apps were selected based on the ones mentioned during the UX Workshop, semi-structured interviews and in the initial survey.

The review focused on the onboarding process, portfolio visualization, assets price tracking of the selected apps.

The criteria for the comparison were: number and types of assets supported, use of AI and other automations, number of integrations (through Open Banking).

This helped build a picture of behaviour patterns and current interventions (Cooper et al., 2014, p20). It also informed the design of our prototype and helped identify UI Design, as the benchmarking analysis gave us a good idea of the sort of things that the users want to do when they use the IA (Jesmond Allen, 2012). Design patterns (Chaudhry, 2021) and usability aspects (Jacobson, 2015) were documented.

Personas

Personas (Cooper, 2020) were created outlining typical goals, behaviour, content, and pain points to humanize the types of investors personas. The persona creation method followed a qualitative persona creation approach (Salminen, 2021). A primary personas was selected to prioritize design features and user flows.

For each personas an empathy map and a user need statement was created (Sarah Gibbons, 2019).

Scenario and User journey maps

Using the persona and by creating usage stories, a user journey diagram (Gibbons, 2017), emotions, behaviours, goals, and needs was created, mapping current usage and identifying possible solutions. User scenarios were created "to understand users' motivations, needs, barriers and more in the context of how they would use a design, and to help ideate, iterate, and usability-test optimal solutions" (Interaction Design Foundation, 2020). Possible scenarios were researched and validated by users.

Phase 3: Develop

Information Architecture

A sitemap and user flow diagram was created in Miro to design the Information Architecture (Rosenfeld, 2015) of the website and app. The first draft was created through a card sorting exercise during the UX Workshop and was subject of 2 iterations. The versions are available in the Appendix J. The IA defined the asset classes at a reasonable level of depth. Information architecture is about organizing and simplifying information, designing and integrating information spaces/systems, and creating ways for people to find and interact with information (Wei Ding, 2009).

Service Blueprint

A service blueprint mapping user actions, frontend interactions, backstage interaction and support processes was created to avoid ignoring the impact that backstage processes (such as linking a bank account to the portfolio) have on user experiences (Shostack, G. L., 1984). This assured that the user flow for the testing was systematic and customer-oriented (Myre, M. 2023).

Paper sketches

A hand-drawn prototype of the main user flow was created before investing time in a sophisticated digital prototype. This allowed to have a good idea of the elements that the digital design should include (Kelley Gordon, 2021).

Low fidelity prototype

The first digital iteration of the proposed design was created in the form a low fidelity prototype in Figma. This low fidelity prototype was created through an hypothesis-driven development (F. Lorig, 2017) and included the key user tasks for the purpose of this research study and hypothesis validation. Low-fidelity prototypes are simplified, early-stage representations of a product or interface that prioritize functionality over visual design. They are usually created using basic digital tools and help visualize the core functions and flow of a product (Peter Manzo, 2008).

Designers use low-fidelity prototypes to quickly test and iterate ideas before investing time and resources in high-fidelity development (Tom Kelley, 2013).

Phase 4: Deliver

High Fidelity Prototypes

An app icon and name was created for the purpose of the research[4]. A UI Design System composed of logo Design System, Colour Design System, Typography Design System and Iconography Design System was created to achieve a consistent look and feel (Kurniawan, 2024) and facilitate the prototyping process. An existing library of components was used (Kelley G, 2024) to speed up the prototyping.

The Design System was applied to an amended version of the wireframes following the first usability tests to create the first high fidelity prototype.

Design guidelines for investing apps (Chaudry, 2021) that encourage healthy investing behaviours were employed in the design of the app prototype with a particular focus on Guideline B1: "Encourage Diversification".

Table 2: Design guidelines for investing apps that encourage healthy investing behaviors.

	Guideline	Robinhood	E-Trade
V1	**Focus on the Potential Instead of the Past** Display information that helps investors make investment decisions based on how the security will perform in the future, not how it has performed in the past.	Prominently features performance charts while all information relevant to future performance is below the fold.	Easy access to metrics such as analyst recommendations, price targets, income statements, etc. in addition to past performance.
V2	**Expose Risks** Help the investors understand exactly what they stand to lose or gain with the investments they make.	Highlights the systematic risks of investing in the stock market but not specific risks for individual securities.	Provides tools to calculate probability of a security reaching a certain price by a certain date. Displays beta values.
B1	**Encourage Diversification** Help investors put their money in a variety of financial instruments and industries.	Each position mentions its position diversity. Overall asset composition data is buried in account settings.	Shows the asset composition of a portfolio and compares it to sample portfolios. Security selection metrics are missing.
B2	**Encourage Deliberate Trading** Make it easy for investors to make well-thought out trades based on knowledge of market fundamentals.	One-click access to trading allows making trades despite lack of time, focus, or background or in the presence of stress and other distractions.	The website modality and interface complexity forces investors to take their time while making trades. Orders can be saved for later.
B3	**Encourage Long-Term Trading** Help investors think of trading as a long-term activity and discourage them from trying to catch minute-to-minute market movements.	Default time range in charts is one day, which can incentivize trying to catch the day-to-day market movements.	Default time range in charts is in the order of years. Gains are classified as long and short-term.
B4	**Discourage Active Trading** Limit investors' ability making frequent trades unless they understand risks associated with it.	Proceeds from sale are instantly immediately available to reinvest. Obeys SEC-mandated day trade restrictions.	Trades take upto 2 days to settle for cash accounts. Obeys SEC-mandated pattern day trade restriction for margin accounts.
B5	**Discourage Overreactions to Market News** Help investors interpret market news in a manner consistent with market fundamentals instead of acting on hype and behavioral factors.	Prominently features market news. Sends push notifications close to earning events. Highlights securities whose price moved the most.	Market news and top movers list is available but not the centerpiece of the home screen.
F1	**Minimize Roundtrip Costs** Minimize the amount investors have to pay for each trade in transaction costs and ensure these are transparent to the user.	Does not charge commissions or transaction fees for any type of security.	Does not charge commissions or transaction fees for most securities. Some contracts have a flat fee.

These guidelines are based on fundamental insights from finance, behavioural sciences, and design metaphors used in interfaces with uncertain rewards (Brad M Barber, 2013).

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[4] A familiar name was used for the app to build trust and a sense of familiarity (Balapour et al., 2020; Levenson, 2016) This can make potential participants feel more comfortable engaging with the app and providing honest feedback. It is critical that the researcher gain the trust of gatekeepers and fully explain the purpose, procedures, and public health impact of the study. If a gatekeeper is not convinced that the researcher is genuine and trustworthy, and that the project will ultimately benefit his/her community, then there is a high likelihood that he/she will not endorse the project and assist with recruitment efforts (Rodney, 2012) .

Universal Design Principles were employed in the design of the app prototype. Products that are designed using Universal Design Principles consider user preferences and abilities, effectively convey necessary information, regardless of the environment or the user's sensory capabilities, are approachable, reachable and usable by anyone (Dalton, 2019). These principles lead to products that are more usable by everyone, not just those with disabilities. Implementing these principles should ensure that these users and their needs, preferences and abilities are considered.

The use of a desktop-first prototype is justified for the complexity of the interface, goals of the research, common user scenarios, and to avoid the gamification effect of mobile trading apps[5] Which stimulates risk taking (Chapkovski, 2021).

Usability testing

A usability script and a test plan were prepared for the usability testing phase and can be found in the Appendix N – Usability Testing.

Usability testing involved users interacting with both low-fidelity and high-fidelity prototypes. This practice aligns with the principles of prototyping, where multiple pre-production versions of a product are constructed and evaluated to identify necessary changes before final production. (Karl T. Ulrich, 2015). In the context of the wealth management application, these prototypes served as tangible representations of the design concepts, allowing empirical data on user interaction and perceptions to be gathered.
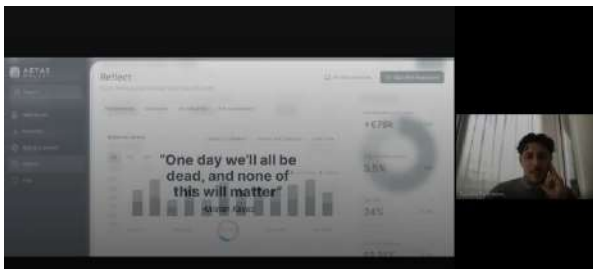
Figure 8: Participant interacting with the Aetas Wallet hi-fi prototype during the usability test

Informed consent was obtained through a consent form (Therese Fessenden, 2022) that included an high-level purpose of the study, format of the study, voluntary-participation clause, participant data-handling and a consent statement (Oliver K. Burmeister).

Sampling methodology

The study adopted a convenience sampling method and used Google Forms to send the online forms, due to the accessibility and ease of gathering data within the available time frame. Convenience sampling involves selecting participants based on their availability and willingness to respond, which is suitable for exploratory studies.

Sample size: 25 respondents
Sampling technique: Convenience sampling
Platform: Google Forms

The usability test participants were recruited from the private group of investors with varying demographics, including age, gender, income level, and investing experience ranging from novice to seasoned. The participant's portfolio composition won't be shared during the user research. Invitations were sent to 25 users obtained from the group of investors.

Tasks scenarios

The user goals identified during the personas mapping, empathy mapping were prioritized and turned into task scenarios for the usability test (McCloskey, 2014). These task scenarios and related user goals are described in the table below.

User goal	Task scenario for usability testing
• Simplify portfolio management by consolidating all investments into a single platform. • Seamlessly integrate with his various bank accounts and brokerage firms, automating data aggregation. • User-friendly interface with intuitive navigation and reporting features.	You are looking for a Wealth Management App to visualize all your assets and investments (Liquid and Illiquid). You have heard about the Aetas Wallet and are interested in adding your portfolio of assets there. Visit the website and register. During the user testing session, please complete all steps until the point of having a full overview of your portfolio.
• He's trying to reach a specific target amount. • Rebalance the portfolio based on real data	You decided you want to retire early with an amount of 700k. Set a target goal for your portfolio.
• Visualize the entire portfolio, trends and key stats on the go	Scan the QR code to download the app on your mobile, login and

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[5] 'Gamified' apps push DIY traders to make riskier investments: Study https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3971868

	add the widget to the Home Screen.

Pre test and Post test surveys

The mixed-method testing methodology incorporated pre-test and post-test surveys aimed to measure the change in investor perceived risk after users interacted with the prototype. These can be found in the Appendix M. The approach of measuring changes in user attitudes or perceptions through pre- and post-exposure questionnaires is a common practice in usability studies and social science research (Jacobson, 2015; Jeff Rubin, 2008).

Question 1 is included to measure a general self-reported financial ability of the participant (Luigi Guiso & Tullio Jappelli, 2008).

Question 2 and 3 were included to measure the Perceived Financial Sophistication and the Financial Literacy which are closely correlated to Diversification (Luigi Guiso & Tullio Jappelli, 2008).

Question 4 ask participants to identify their assets (real estate, current account, stocks, bonds, ETFs or other assets) to calculate the PORTFDIVST variable (Abreu, 2010). For this study PORTFDIVST ranges from 1 to 11 meaning that the most diversified portfolio has 11 assets/security/issuers.

The Risks questions (Q5-Q13) , on the other side, are adapted by the UX Researcher from empirical and theoretical work on risk perception (the psychometric paradigm adopted by Fischhoff et al. [1978] and the work of Brachinger and Weber [1997], Diacon and Ennew [2001]). These were used to assess the characteristics of perceived risk, the extent of risk perceptions of the investors and to determine the function R. Table 3 illustrates the names and descriptions of the five factors scales (Diacon & Ennew, 2001).

Table 3: Description of rating scales/factors influencing perceived risk

Factor 1: distrust of assets and/or providers	Factor 2: adverse consequences	Factor 3: volatility of return	Factor 4: poor knowledge or information	Factor 5: regulatory failure
Question 15 (Is there a risk that you will be unable to cash in your investments at short notice without a substantial penalty?)	Question 23 (Do individual investors spend a lot of time monitoring this investment?)	Question 26 (How great is the risk that the return from your investment might fall below expectations?)	Question 7 (Are the risks from your investment products known to financial experts?	Question 17 (To what extent will the government protect investors if something goes wrong with the types of assets in your portfolio?)
Question 5 (To what extent are any losses from your assets known immediately?)	Question 25 (How great is the risk that you will be ruined as a result of this investment?)	Question 19 (Is there a risk of losing money because the value of the investment may not rise in line with inflation?)	Question 6 (Would a typical investor know about the risks involved in your assets?)	
Question 12 (Do you think your assets are easy or complex to understand?)	Question 3 (How serious could the consequences of owning this product be, should it prove unsatisfactory?)	Question 2 (How much uncertainty is there in terms of the expected return for your investments ?)	Question 11 (To what extent can any losses from your investments be observed by individual investors?)	
	Question 10 (Could large losses or failure of this product have effects for the EU economy?)	Question 27 (How great is the risk that the return from this investment will go down as well as up?)		
	Question 9 (How great is the risk of losing all the money you put into this investment product?)			

Questions were adapted by the UX Researcher for a portfolio including liquid and illiquid assets using questions of a detailed questionnaire distributed to U.K Investors to measure risk perception of investment products (Diacon, 2001). For simplicity, this study used the same factor analysis and factors identified by Diacon in 2001 – Table 4.

Table 4: Factor analysis: rotated component matrix used in the study (Diacon, 2001)

	Component				
	1	2	3	4	5
Q2 Uncertainty	0.1287	0.2052	**0.6631**	0.1459	0.0637
Q3 Seriousness	0.4642	**0.5351**	0.1544	0.1785	−0.0836
Q5 Losses delayed	**0.6452**	−0.0513	0.1366	0.3520	−0.1006
Q6 Not known to investors	0.4677	−0.1023	0.0274	**0.6483**	0.0736
Q7 Not known to experts	0.0098	0.1667	0.0200	**0.8051**	0.1288
Q9 Lose all money	0.2524	**0.4712**	0.3921	0.3075	0.1794
Q10 Adverse effect on economy	0.0738	**0.4736**	0.0678	0.1533	−0.4670
Q11 Losses unobservable	0.4326	−0.1466	0.0498	**0.5264**	−0.2568
Q12 Complex to understand	**0.5607**	0.2923	0.3775	0.2926	0.0421
Q13 Unacceptable sales pressure	**0.7356**	0.2787	0.1174	0.0682	0.1668
Q14 Unsound advice	**0.7120**	0.2886	0.2153	0.0751	0.1905
Q15 Cash-in penalty	**0.6859**	0.3418	0.1240	0.0377	−0.0003
Q16 Hidden charges	**0.7002**	−0.0203	0.2020	0.1211	0.1381
Q17 Poor investor protection	0.2769	0.1164	0.1847	−0.0164	**0.6626**
Q18 No regulation	0.0526	0.2397	0.2360	0.2775	**0.6585**
Q19 Less than inflation	0.1307	−0.0033	**0.7789**	−0.0344	0.0575
Q20 Unethical	**0.5154**	0.2702	0.2724	−0.0408	0.2763
Q23 Monitoring time	0.0171	**0.7059**	0.2170	−0.0451	0.1539
Q24 Information prior to purchase	0.1866	**0.7119**	0.0116	−0.1949	0.1578
Q25 Ruin	0.2876	**0.5880**	0.2780	0.2465	0.0412
Q26 Return below expectations	0.2543	0.1296	**0.7974**	0.0019	0.0882
Q27 Value goes down	0.2098	0.3251	**0.6030**	0.0110	0.2459

Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser Normalization. Rotation converged in 16 iterations.

A trial version of the questionnaire was piloted with a professional investor. Participants were asked to rate their portfolio on the 5 scales. Each participant also judged the perceived risk of their portfolio by answering the following question: "How would you classify the risk of your total portfolio of assets on a scale from 1 to 7? (1 = very low; 7 = very high) " The investor portfolio was rated on one scale before going to the next scale.

The questions were presented using a Shuffle Rotation method in order to reduce systematic biases that can arise from the order in which questions are presented (Bergelson I, 2022).

As usual in such studies, a definition of ``risk'' was not provided in order to elicit people's own understandings of the concept. Respondents were asked about a variety of different aspects of financial risk (such as severity, immediacy of effect, degree of control, knowledge, etc.) and aspects of the products (such as importance of trust, tangibility, and quality).

The use of pre-test and post-test surveys, allowed to capture quantitative measures of perceived risk before they interacted with the prototype and then to measure any changes in these perceptions after their experience.

Any significant changes observed between the pre-test and post-test responses can be attributed, at least in part, to the design and features of the prototype (Mei Wang, 2011).

A copy of the questionnaire is included in the Appendix E.

System Usability Scale

The SUS was administered to participants in the post test survey immediately after the interaction with the prototype (John Brooke, 1995). This was to minimise priming effects on usability and to prevent that risk perceptions could skew usability ratings[6]. It is also it is logical to first gather their overall subjective impressions of the interaction (via the SUS) before delving into more specific aspects like perceived risk (Jeff Rubin, 2008.

The SUS was included by providing 10 questions which were calculated using a score calculation scale of strongly agree, agree, disagree, strongly disagree and neutral. The results of the answers are then calculated by calculating the answers using the following calculation formula:

$$SUS = ((\textstyle\sum(OP-1) + (\sum(5\text{-}EP))) \times 2,5 \ (1)$$

Description:
OP = Score with odd sequence number
EP = Score with even sequence number

Evaluation of the final score of the calculation with the System Usability Scale (SUS) method is carried out based on the general guidelines of the SUS scale. Table 5 shows the grade ranking, adjectives, acceptability and NPS categories associated with raw SUS scores (J.T. Miller, 2009).

Table 5: System Usability System (SUS) Score Scale

Grade	SUS	%	Adjective	Acceptable	NPS
A+	84.1 – 100	96-100	Best Imaginable		
A	80.8 – 84.0	90-95			Promoter
A-	78.9 – 80.7	85-89			
B+	77.2 – 78.8	80-84	Excellent	Acceptable	
B	74.1 – 77.1	70-79			
B-	72.6 – 72.5	65-69			
C+	71.1 – 72.5	60-64			Passive
C	65.0 – 71.0	41-59	Good		
C-	62.7 – 64.9	35-40		Marginal	
D	51.7 – 62.6	15-34	Ok		Detractore

Usability testing reports were created to document findings and results.

Pilot study and usability testing of the prototypes

Three usability tests were carried out before the final usability test. A total of 5 participants participated to the pilot and were observed using the prototype. The prototype was iterated, the task list refined and the pre and post test survey were also amended the pilot usability test.

Procedure

The final usability testing was conducted over a four-hour session. All participants followed the same procedure. The participants were not recorded to avoid sharing sensitive data and the portfolio composition during the prototype testing.

A Calendly link was shared with the participants to book the usability test.

Two days before the testing a consent form was shared and signed by the participants who booked a meeting. On the day of the testing the user researcher shared a Google Meet link with the participants.

An automatic reminder was sent 1 day before the meeting with a link to the Pre-test survey.

Participants were welcomed by the user researcher and reminded they could withdraw from the study at any time and that responses will be kept confidential and used solely for the purpose of this academic research project.

Participants were asked to share their screen and open the link to the prototype. A personalized prototype was shared with each participant in order to reflect the individual portfolio composition and diversification based on the survey responses and pre-test survey.

Participants were introduced to the Usability task list and invited to begin using the Aetas Wallet. The researcher observed each participant. After the completion of the three task the participant were asked to stop scree-sharing, to complete the post-test survey + SUS and thanked for taking part in the study.

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[6] If users are first asked detailed questions about the risks associated with the wealth management product, this could create a cognitive frame through which they then evaluate the prototype's usability. They might focus more on how the interface helps them understand or manage these risks, potentially overlooking or overemphasising other aspects of usability such as efficiency or learnability. By administering the SUS first, it's more likely to get a purer reflection of the user's interaction experience, less contaminated by pre-existing or newly activated risk concerns (K. Wolff, 2019).

User research

The key findings of the systematic review of the fundamental literature are broken down in the Literature Review of this document. The findings from the other user research phases can be found below.

Semi structured User Interviews and UX Workshop

The key themes and insights identified during the semi-structured user interviews and UX workshop guided the personas and user journey mapping in relation to the app design. The full Thematic Analysis of user interviews and workshop can be found in the Appendix D.

1. As in previous studies, the majority of the participants (6 out of 8) hold mainly liquid assets, with minor exposure to illiquid assets.
2. The majority of the participants (7 out of 8) mentioned that they don't have a clear overview of the structure of their wealth
3. The majority of the participants (6 out of 8) considered positively the inclusion of illiquid assets in a portfolio.
4. A minority of the participants (2 out of 8) assess the diversification of their portfolio manually or via an Excel spreadsheet
5. The majority of the participants (7 out of 8) use between 3 and 5 apps to track and manage their wealth.
6. Most participants (5 out of 8) mentioned they are satisfied or very satisfied with their current investment apps.
7. Several participants (6 out of 8) agreed that a wealth management app with liquid and illiquid assets could be useful. *"An all in one platform could be useful if you own many things…" – Participant to the UX Workshop*
8. The popular features that the participants mentioned that they would like to see on a holistic wealth management platform are the following:
   a) Personalized experience and onboarding. *"The registration is important on the app to build the trust factor…needs to be similar to 1-to-1 at the bank" – Participant during a semi structured interview*
   b) Security – Participants verbalizations indicate their concerns around data exposure and share of data.
   c) Automation – The participants verbalizations indicate that they would use an app that provides automatic notifications for price variations or other AI-powered functions.

Participants mentioned that Artificial intelligence could provide recommendations based on their personal situation and portfolio.
   d) Open banking – As result of point 5 the participants indicated the need of an app that connect all their existing fintech apps on one platform.

Questionnaire

The questionnaire results from the questions obtained from 17 respondents regarding current investment habits, perceived portfolio diversification, apps in use and user satisfaction.

Gender: 70.6% of the respondents are male. [7]
Education: 35.3% hold a bachelor's degree, 23.5% have some college experience.
Marital Status: 47.1% married, 41.2% single.
Employment: 76.5% are employed full-time.
The age range of respondents is diverse, spanning from 18-24 to 65+. The 25-34 age represent 47.1% of the respondents.
The demographics above are used to map the primary personas.

In relation to the question "How important is portfolio diversification to you?" The average importance rating is 3.94 out of 5, with the most frequent response being 5.

The average self-reported diversification level is 3.12 out of 5, with the most frequent response being 3.

Top features users look for in a wealth management app based on the responses are:

- Portfolio visualization (76.5%).
- Performance reporting (47.1%).
- Clear financial visualization (41.2%).
- Security & privacy (52.9%).
- Low fees (41.2%).

Most users are likely to rebalance their portfolios in the next 2 years: The average likelihood rating is 3.00 out of 5, with the most frequent response being 3. The key factors influencing rebalancing of the portfolio are:

- Changes in personal financial situation (52.9%).
- Market conditions (52.9%).
- New investment opportunities (41.2%).

Participants mentioned features like "User-friendly interface," "Portfolio tracking and performance reporting," "Clear visualization of financial data and

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[7] Historically, investing has been a male-dominated field (Charley Ross, 2023).

charts," and "Budgeting and financial planning tools" as important features for a wealth management app.

88.24% of respondents currently invest their money.

70.59% of respondents currently use a wealth management or investment app.

Most popular apps among users: Binance, Degiro, Trade Republic, Interactive Brokers. These apps have been included in the App Benchmarking analysis.

See Appendix F for Questionnaire/Survey Results.

App Benchmarking

A total of 22 apps were benchmarked to identify design patterns and key features.

The key dimensions of the User Experience identified during the analysis are the following:

- Login and security
- Onboarding
- Profile setup
- Dashboard setup
- Customization
- Portfolio tracking and analysis
- Portfolio visualization
- Reporting
- Analysis
- Automation
- Integrations and open banking

A comparative table matrix of the types of assets tracked on each app was created.

Figure 9 - Comparative matrix of bechmarked apps

The full benchmarking analysis conducted on Miro can be found in the Appendix G.

Personas

Based on the user research findings, the following primary persona was developed:

- **John – The All-Weather Investor - PRIMARY**

Figure 10 - Personas mapping of the primary personas

The need for a "all-in-one platform" with clear overview of the portfolio, the use of multiple apps, the desire for automation and security identified on the survey and thematic analysis are reflected in the primary personas profile.

The survey results provided demographic, and psychographic data that informed the personas demographic. The primary personas behaviours, pain points, needs & goals reflect the most frequent participants statements. The user researcher made informed assumptions to fill in gaps and add details to create a realistic personas for traits that were not mentioned by the participants.

An empathy map and user need statement (see Figure 10) were created for the persona. The personas map, empathy map, and user need statement for the proto-personas can be found in the Appendix H.

As a busy CEO and balanced investor, I need a single, consolidated platform that provides a holistic view of my entire portfolio, including both liquid assets like stocks and bonds *and* illiquid assets like real estate and collectibles, so I can efficiently monitor performance, assess asset allocation, and make informed strategic decisions to achieve my long-term financial goals without the hassle of managing multiple, disconnected systems.

Figure 11 - User needs statement for the primary personas

User journey

A user scenario for the primary persona was created based on the user interviews, workshop, survey and desk research. The scenario is resulting mainly from the frustration mentioned by several participants with using multiple apps to track their investments.

Primary personas user scenario

"John wants to optimize his investment strategy and rebalance his portfolio to include a wider range of asset classes. He's looking for an app that can give him a comprehensive view of his investments, including both liquid and illiquid assets."

A user journey underpinned by the user research (user interviews, workshop, survey, desk research) for the primary personas was created for the identified user scenario and primary persona (John S. Prutt, 2006). The full user journey is shown in the Appendix I.

The user journey was divided into the following phases:

1. Trigger,
2. Exploration,
3. Evaluation,
4. Decisional Challenge,
5. Onboarding,
6. Portfolio Overview,
7. Rebalancing,
8. Ongoing management.

The table below shows the linking between the user journey phases and the thematic analysis[8].

User Journey Phase	User Journey Element	Relevant Themes	Specific Insight(s)	Evidence (Quote/Summary)
Trigger	User experiences the pain of using multiple apps.	App usage and features, Needs a clear portfolio overview	Users use 3-5 apps to track wealth. Users express the need for a single platform.	P2: 'It's a nightmare trying to track everything across three different apps...' Conclusion 2: Needs a clear portfolio overview
Exploration	User researches potential solutions.	App ideas, Platforms, App usage and features	Desire for "all-in-one" platform. Emphasis on security and trust.	P5: '...a all in one platform could be useful if you own many things...' P4:' The registration is important on the app to build the trust factor'
Evaluation	User evalutate potential solutions.	App ideas, App usage and features	Need for a desktop website and a mobile app.	P2. ' I mainly review and track performances on mobile app but I prefer to use the desktop app to buy/sell '
Decisional challenge	User decide to download / sign up.	Platforms	Need for a desktop website and a mobile app. Trust factor.	P1: "Trust factors for an investment app: 2FA, speed, ease of use, recognized by the industry"
Onboarding	User's first experience with the app.	App usage and features, Personalized experience	Importance of easy and trustworthy registration. App security is important.	P4: 'The registration is important on the app to build the trust factor...' P2: Personalized experience; registration needs to be similar to 1-to-1 at the bank

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[8] Some user thoughts and actions on the user journey are assumptions of the User Researcher.

Portfolio Overview	User wants to see all his assets (liquid and illiquid).	Liquid assets, Illiquid assets, Needs a clear portfolio overview	Users hold both liquid and illiquid assets. Difficulty in tracking illiquid assets. Users expect a seamless integration and open banking.	P1: 'Portfolio Composition: holds both liquid and illiquid assets' P3: 'tracks illiquid assets value on Immobiliare.it'
Rebalancing	User uses the app to inform his rebalancing decisions.	Investing style, App ideas	Need for clear data visualization. Desire for AI-powered insights.	P1: Prefers minimalist charts with actionable insights Conclusion 6: AI could give insights and personalized recommendations.
Ongoing management	User regularly monitor portfolio perfomances and review news about investments.	App usage and features, App ideas	Need to implement Automation and AI. Focus on Sustainability.	P1: "Wants alerts for price drops; buys when others sell" P5: "knowing you're having an impact on the world"

Based on the user journey (user thoughts, actions, tasks and touchpoints), the empathy map, benchmarking analysis the following functions were prioritized for the app:

- Portfolio dashboard
    - Investment breakdowns / portfolio segments
    - Performance summary
    - Set up alert
    - Export Net worth
    - Sustainability score
    - News about your investments
- Reflect
    - Investment goals
    - Forecast
    - Investment analysis
    - Generate scenarios
    - Review results
    - Risk tolerance assessment
    - Export report
- AI
    - AI Real Estate valuer
    - AI Car valuer
    - AI Asset valuer

Design

This section analyses how the exploratory research findings directly shaped the design strategy and the resulting artefact.

Information Architecture

To organize the app's content logically based on user mental models identified in interviews , an Information Architecture was developed. This was done in Miro and Figma.

Mind map

A mind map was created to visually organise the information around the wealth management app. Initial ideas, thoughts and concepts mentioned during the UX Workshop and interviews were structured into a coherent framework. This helped generate a wide range of potential features , content and functionalities that were organized and connected in the following groups: Registration, Portfolio, Goals, Performances, Notifications, Profile and Settings.
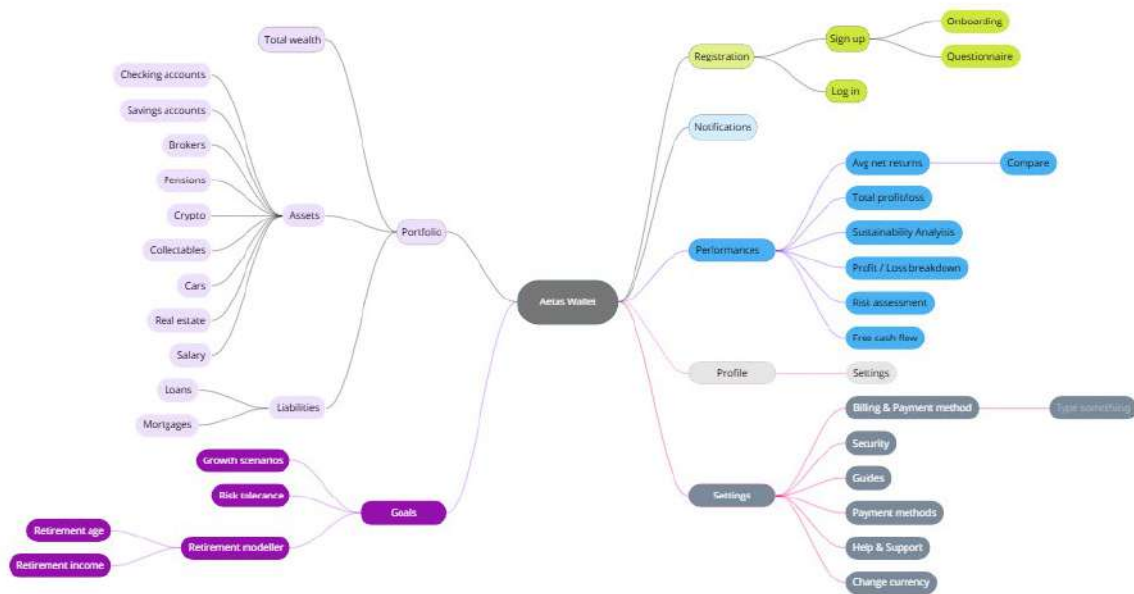
Figure 12 - Mindmap of the wealth management app

Website sitemap

A website sitemap was created for the Trigger, Exploration, Evaluation, and Decisional Challenge phases of the user journey mapped in the Define phase. The sitemap includes an overview of the asset classes to communicate the "holistic" concept.

About us pages are added to the IA in order to communicate transparency and security, key elements mentioned during the user research. The Open banking section reflects the user's need to link existing finance apps to automate the portfolio uploading. A pricing section is added to reflect the user's need for the primary personas ("I prefer to pay with my money rather than with my personal data" – participant in *the UX Workshop*). The Login and Get started pages are the connection points between the website and the app sitemap.

Information Architecture - Website
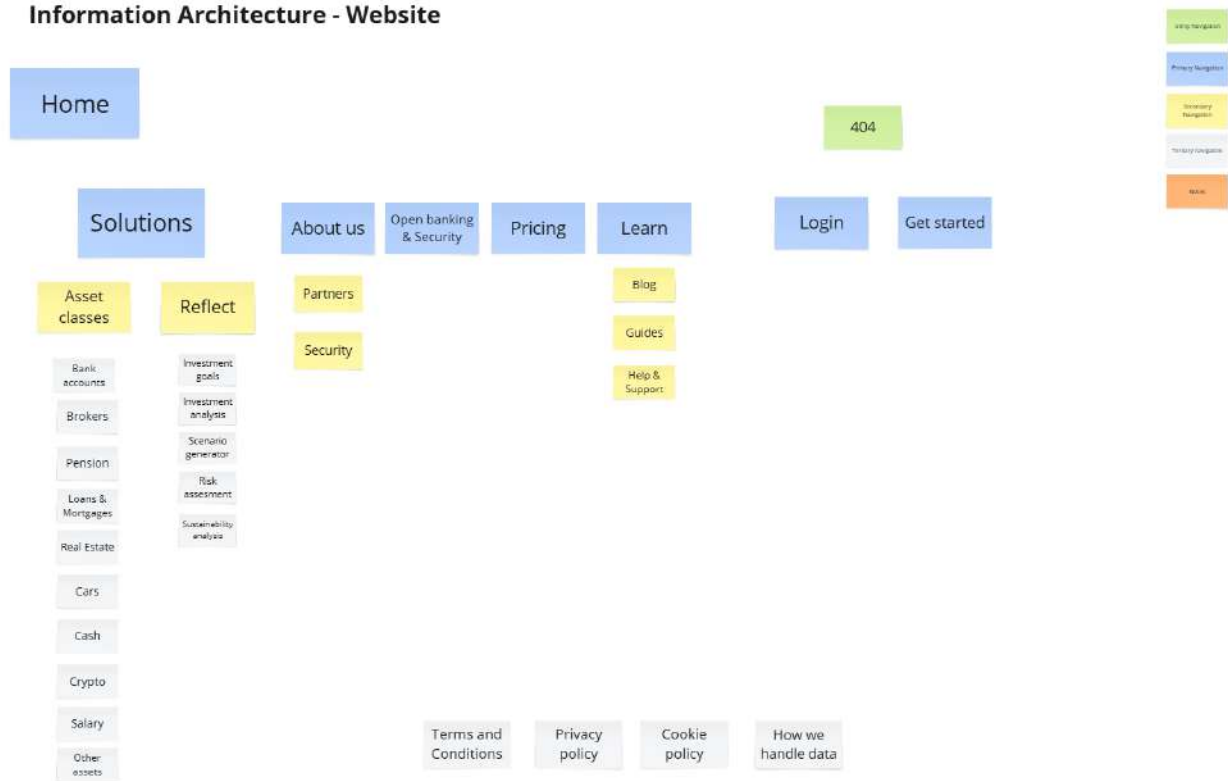
Figure 13 - Website sitemap

App sitemap

The app sitemap was created for the Onboarding, Portfolio Overview, Rebalancing, and Ongoing management. phases of the user journey mapped in the Define phase. The benchmarking analysis revealed that a few apps effectively integrated illiquid assets, confirming the opportunity identified in the literature (Bekkers, 2009). Therefore, the following liquid and illiquid entities: Banks, Brokerages, Pension, Loans & Mortgages, Crypto, Collectibles, Cars, Real Estate, Pension. An "Other assets" option was added to allow the user to add a manual entry of a not listed asset type.

An indication of the financial sophistication of respondents can be gleaned from their ownership of various investment products: all person owned a bank cheque account, two-thirds possessed individual stocks, 61 per cent had individual funds and ETFs, and 22 per cent Real Estate. A summary of the respondent characteristics is provided in the Appendix J.
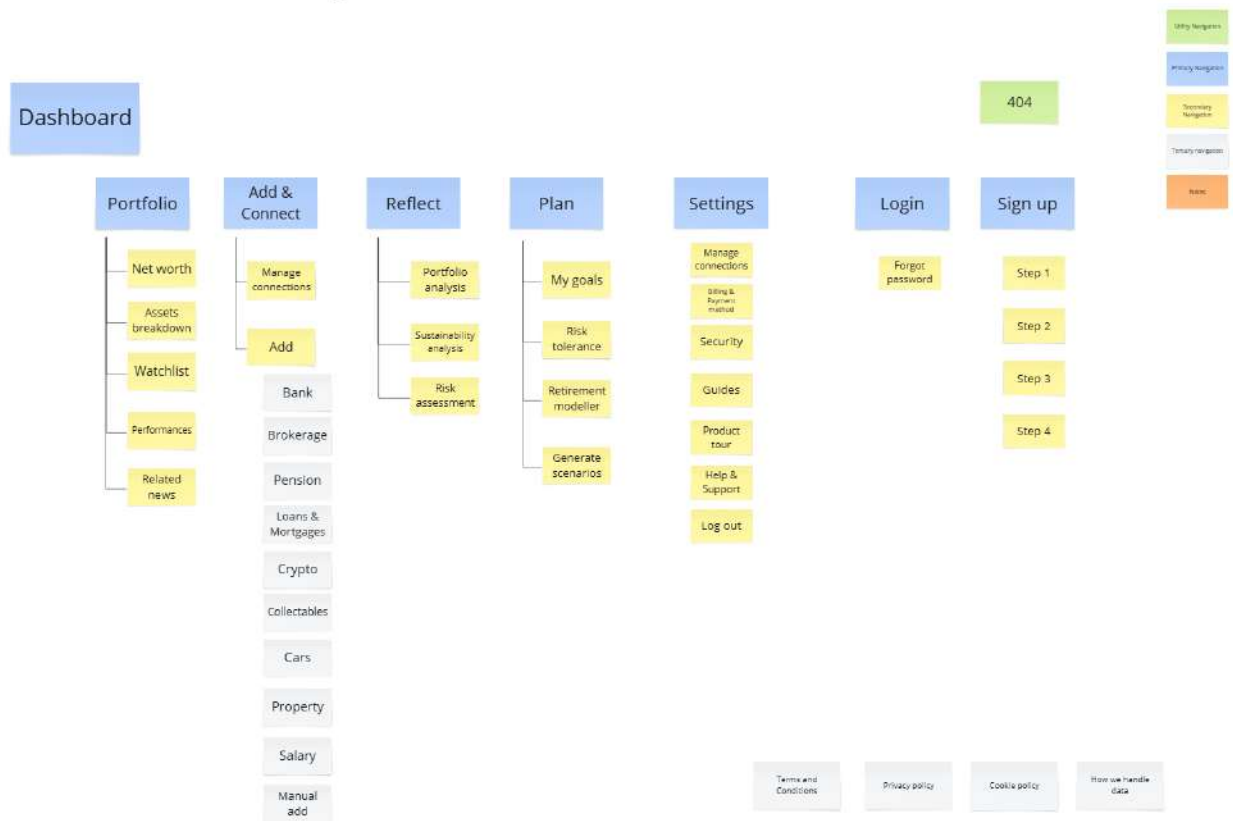
Figure 14 - App Information Architecture

User flow

A user flow was created based on the mind map and sitemaps, which map pages, tabs within a page, questions, decisions, actions, notes, triggers, and search filters.

The signup user flow was divided into seven main steps based on the registration process of similar apps in the fintech industry (see Benchmarking Analysis). The flow incorporates steps to gather necessary user information identified as relevant from the literature and initial surveys, such as demographics and potentially financial literacy or initial holdings based on the identified assets during the user research phase.

A Dashboard approach was chosen to serve as the central hub for the user, directly addressing the strong user need for a clear, holistic overview of their entire wealth situation – a significant pain point identified in interviews where 7 out of 8 participants mentioned lacking such clarity. This aligns with the primary persona's (John - The All Weather Investor) goal of optimising his strategy based on a comprehensive view.

Throughout the design, the flow aimed to be intuitive and user-friendly, reflecting user expectations for ease of use in financial apps identified in the literature and user research. It avoided unnecessary extra steps. Figure 14 shows an overview of the user flow and a PDF to see the details can be downloaded here.

Figure 15 - A screenshot of the full user flow on the app

Service Blueprint

The service blueprint mapped the physical evidence, system users, front-end and backstage interactions.

This was vital to understanding how the app communicated to third-party tools via an API, how risk and performance scores could be calculated, and how the experience could be personalised based on user goals.

For instance, when a user initiates connecting a bank account or broker, the blueprint would map the flow from the button click, through frontend validation, to the backstage API calls to Plaid for secure Open Banking authorisation, and the subsequent data retrieval. This was done to respond to the user's need for automation and a holistic view expressed in the workshop. The system blueprint showed the process points where calculations for key metrics (e.g., total wealth, asset allocation percentages, performance returns) would occur before being displayed cohesively on the user-facing dashboard. Figure 14 shows an overview of the service blueprint and a PDF to see the details can be downloaded here.

Figure 16 - Service blueprint of the wealth management app

Prototypes

Sketches

In the early stages, layout and core ideas were explored on paper to visualise concepts, and the key user flow was quickly identified in the Define phase. Figure 15 shows the sketch of a version of the Dashboard.
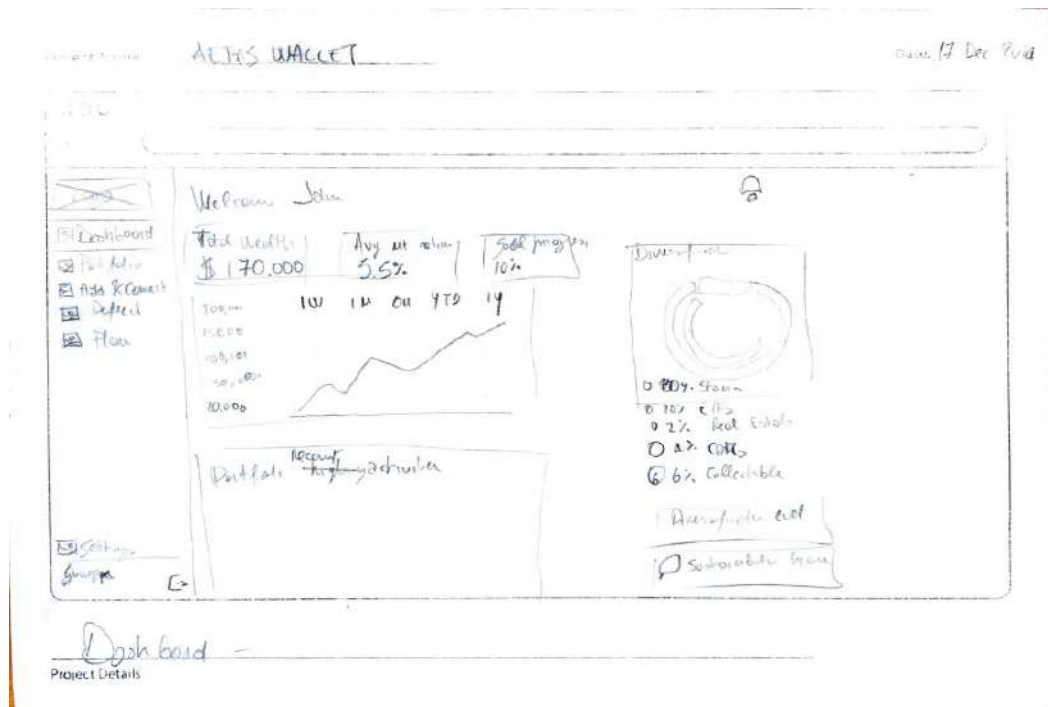
Figure 17 - Early sketches of the wealth management app – Dashboard page

The sketches focused on the main pages of the user flow, the subject of user testing, and the study's objectives. For each step of the user journey, a key page was sketched.

Table 6Correlation between user journey steps and app pages

User journey step(s)	Correlated Page(s)
Exploration phase, Evaluation phase	Homepage
Onboarding	Sign up page, Sign-up steps
Portfolio Overview	Add a new asset pop-up, Preloader, Dashboard, Add & Connect page,
Rebalancing	Reflect page
Ongoing management	Plan page

A complete overview of the pages sketched can be found in the Appendix K.

Wireframes

Early wireframes explored different ways to visualise liquid and illiquid assets on the main dashboard (See Figure 12 and Figure 13). The iterations focused on guiding the user through the onboarding process while personalizing the experience based on the benchmarking analysis, which outlined that " a clear and engaging onboarding flow to guide users" is a regular pattern in fintech apps. This is also based on user feedback that "the registration needs to be similar

to 1-to-1 at the bank."
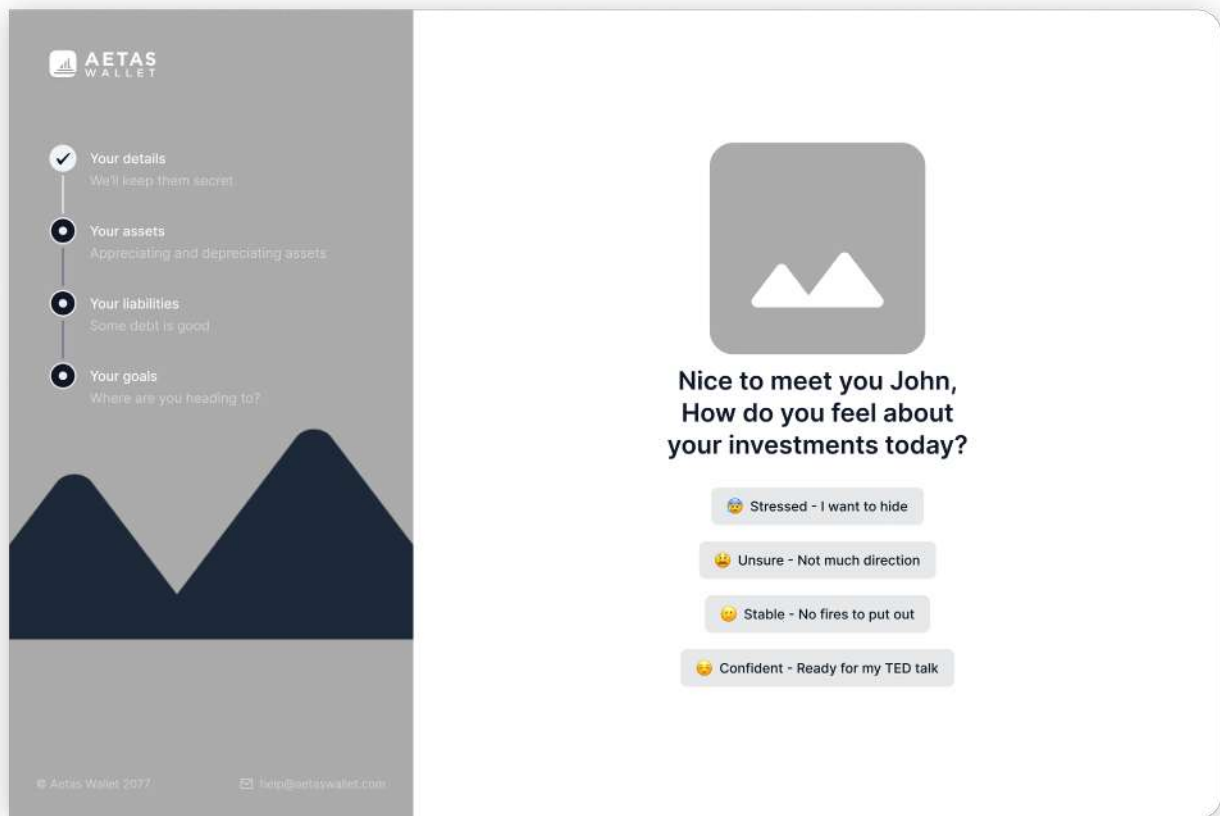
Figure 18 - Wireframe of a step during registration

A multistep form was chosen for the registration process as this was the most frequent registration process observed during the benchmarking analysis. Various research confirms that this improves completion rates and provides a better user experience in this specific scenario (Jakob Nielsen, 2005). This is also based on the user feedback that when registering, study participants did not like facing a long, daunting list of fields but preferred a form that included smaller, more digestible steps.

To mitigate the availability heuristic highlighted by Lee (2008) and observed in user preference for liquid assets, the Dashboard (See Figure 14) was designed to provide balanced visibility for both liquid and illiquid assets.

Based on Diacon & Ennew's (2001) findings on 'distrust' and 'poor knowledge' influencing risk perception, the onboarding process included clear explanations (See Figure Y) and security reassurances, as also requested by workshop participants."

Based on Sayan Chaudhry (2021), a sidebar navigation was implemented to ensure clear and intuitive navigation to the other sections of the app. This choice was also based on user feedback ("I prefer user-friendly interfaces with intuitive navigation."—Participant in the usability testing). The use of iconography was done based on the benchmarking analysis. The low fidelity prototype can be played here and the screens are included in the Appendix K.

UI Design System

The use of font size, color, and spacing guided the user's eye to the app's most important elements. The UI Design System avoided using too many colours. The Full UI Design System can be found in the Appendix K. -
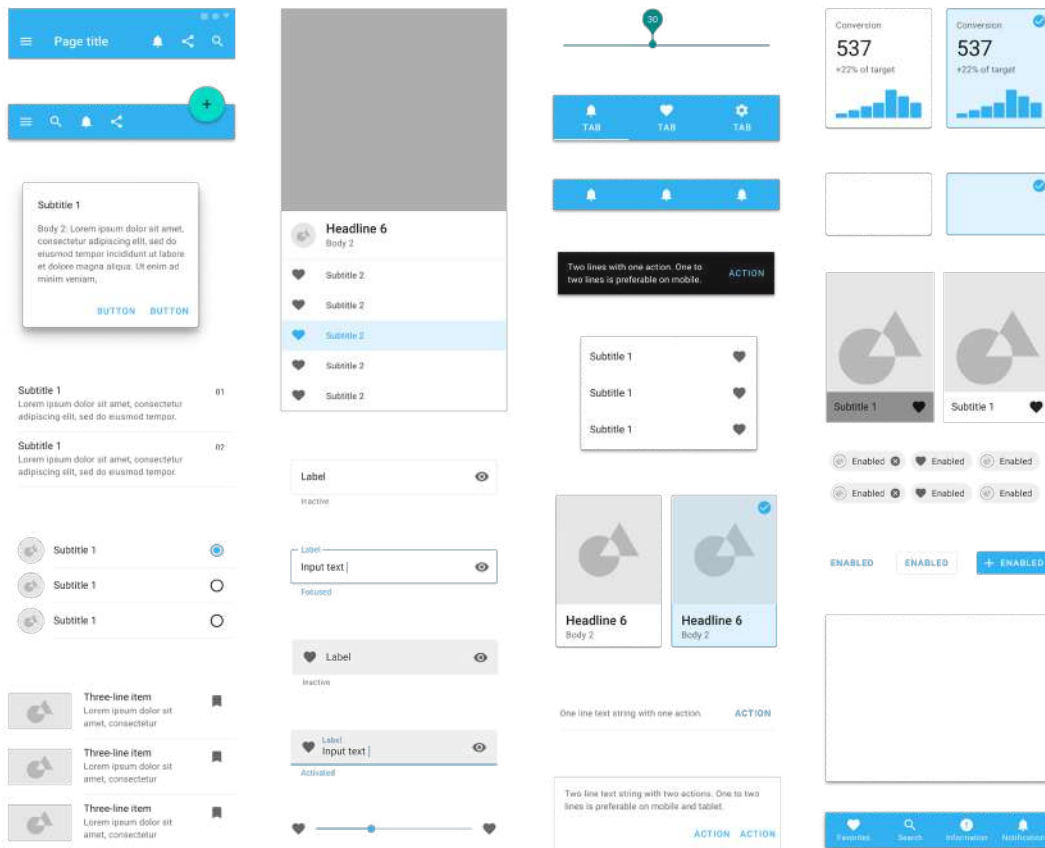
High-fidelity prototype
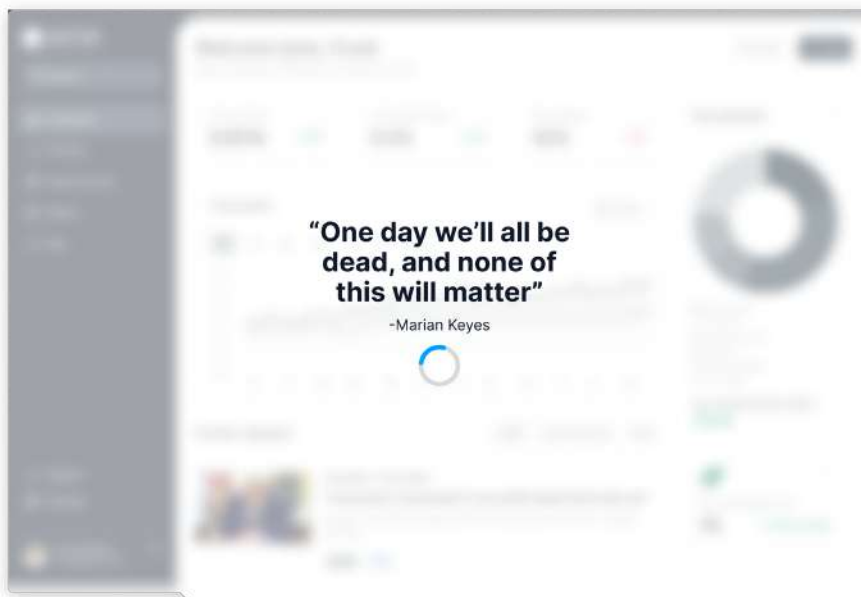
The high-fidelity prototype incorporated features identified as important in the workshop, such as customizable alerts and sliders to adjust the risk tolerance. It represents the culmination of the previous design steps, applying the visual design defined in the UI Design System to the black-and-white wireframes.

Interactive elements were designed to test the ease of adding diverse asset types.

A progress bar was used in the multistep registration process to communicate visibility of system status.
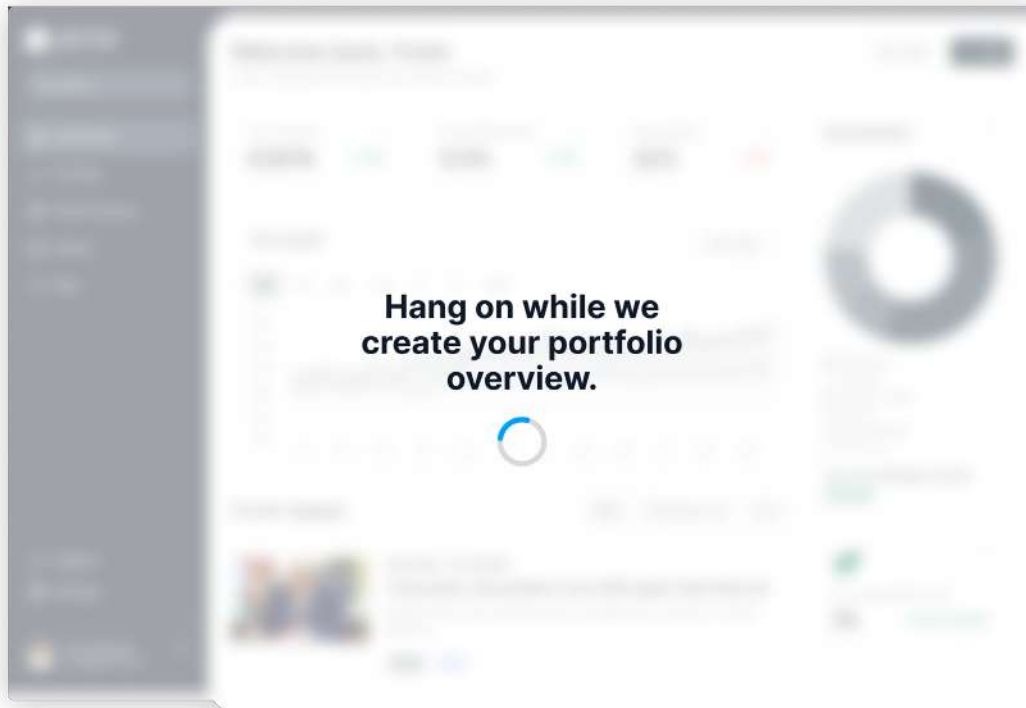
One of the user's feedback was that "it is frustrating to wait for the dashboard to load." A preloader was implemented to reduce the perceived waiting time. In order to make the waiting process feel less tedious and more engaging, a funny quote was shown to the user.
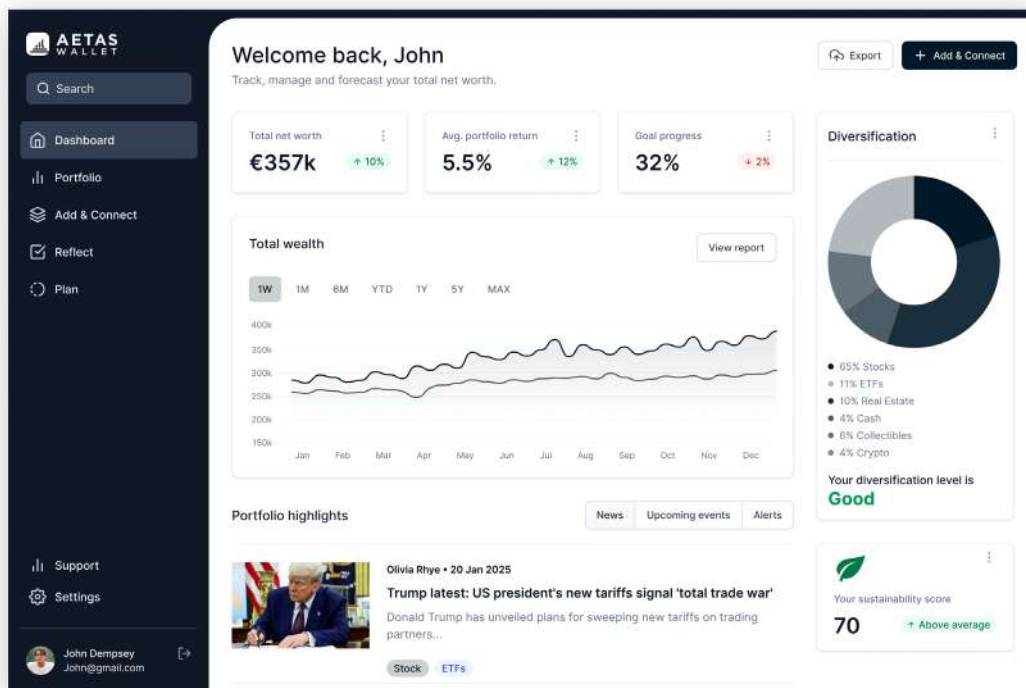
As one of the participants mentioned, when trying to "get a quick overview of the portfolio, he was bombarded with so much data, and it was hard to focus on what is important." The app dashboard was simplified, and key information was highlighted. A progressive disclosure was implemented to reveal less important details only when needed. An appropriate visualisation based on best practices (e.g., pie charts on Google Finance, the bar graph layout from Degiro, line charts from Yahoo Finance) was identified during the benchmarking analysis to represent portfolio allocation and performance.
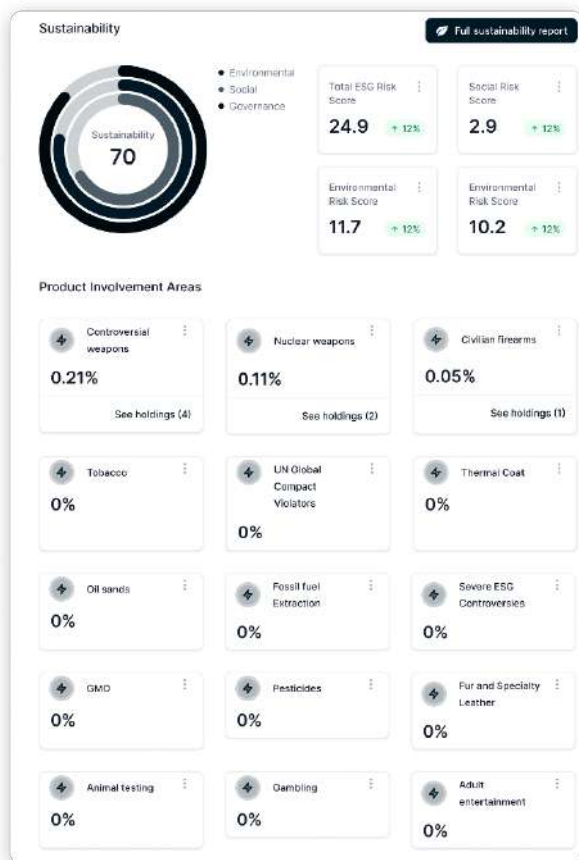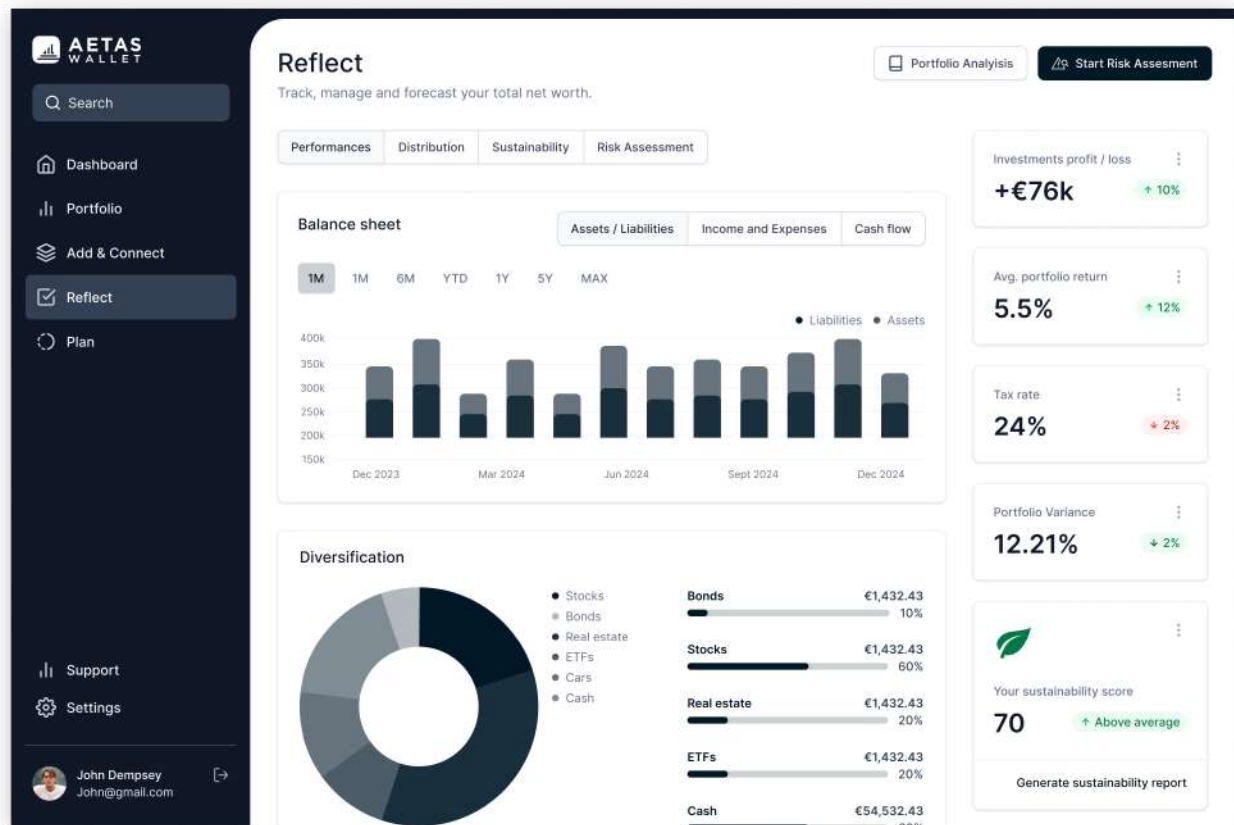
One of the user feedbacks focused on the sustainable investing of an investment, and one of the goals of the primary personas of our study research was to generate long-term value by investing in companies that demonstrate sustainable practices and responsible business conduct. As a result, a Sustainable score and several sustainability metrics were implemented to measure the total ESG Risk Score, Social Risk Score, Environmental Risk Score and the product involvement areas. These KPIs are extracted from the benchmarked analysis conducted in the exploratory phase.

The Add & Connect section is a page where users can easily add and monitor the linked and unlinked assets that send data to the portfolio. This was based on the user's goal of "being able to manage connections and linked accounts".

"
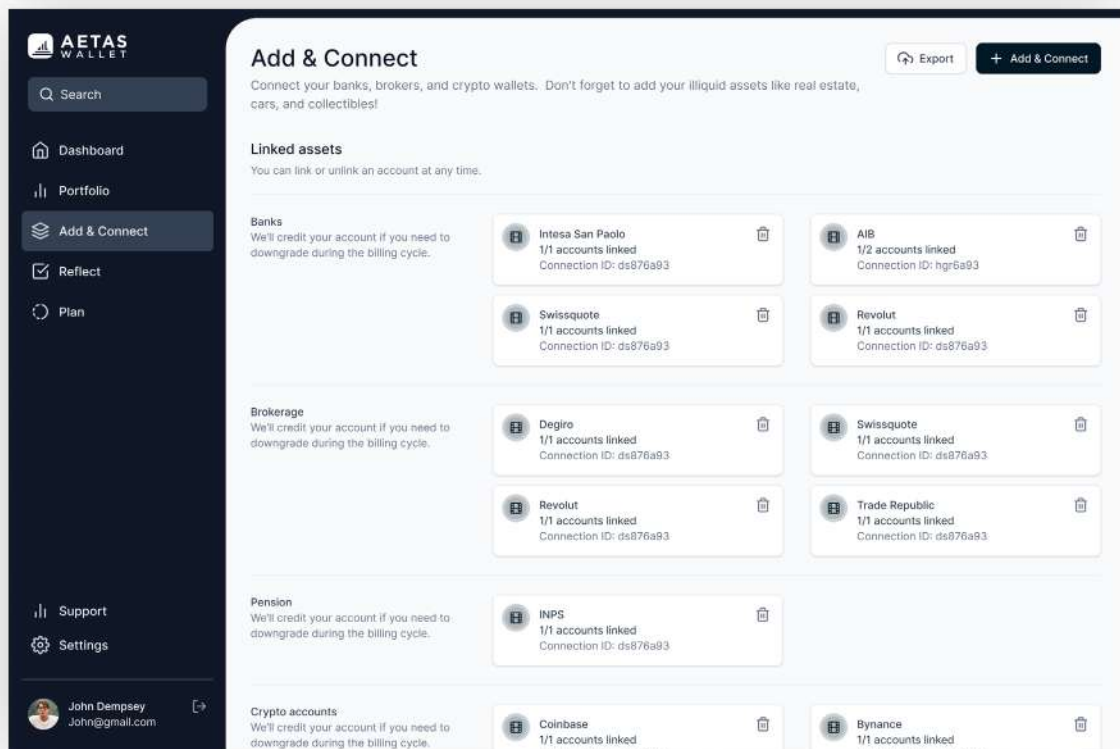
A plan section was created to track, manage, and forecast the total net worth of the primary personas. This is based on the user goal of being able to: analyse profit/loss breakdown, generate growth scenarios, and view most and least performing asset types. This also encourage the users of thinking about the long-term instead of focusing on short term results and therefore reasonate with the primary personas user need statement "*As a busy CEO and balanced investor, I need a single platform that provides a holistic view of my entire portfolio, including both liquid assets like stocks, bonds and illiquid assets like real estate and cars, so I can efficiently monitor performance, assess asset allocation, and make informed strategic decisions **to achieve my long-term financial goals** without the hassle of managing multiple, disconnected systems.*"

Tools that visualise long-term growth scenarios and overall net worth trends can help users look beyond immediate fluctuations and focus on their long-term financial goals (Nagarjuna K, 2023).
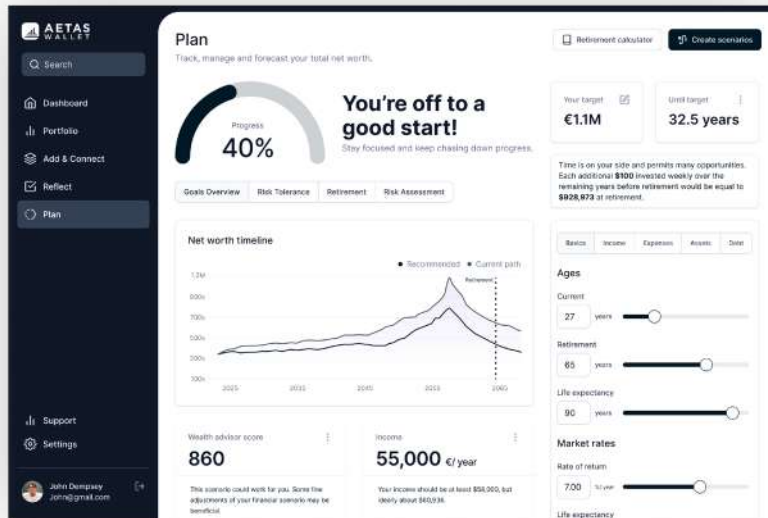
Figure 19 - Screenshot of the Plan section of the wealth management app

Add Assets user flow.

The prototyping of the Add asset functionality is based on the app's user flow. Users can add a new asset by selecting a category from the available options: bank, brokerage, pension, crypto, loans and mortgages, collectibles, car, real estate, salary, and other assets.

To simplify the categories, similar asset types were merged into groups (e.g., checking and savings accounts are merged using the label "Banks, "Bonds, Stocks, and ETFs are merged using the label "Brokerage"). Each asset category had a separate user flow, user actions, and required input. Specific inputs and actions were extracted from benchmarking analysis.

Figure 20 - Different input and user validation are required for different illiquid assets.
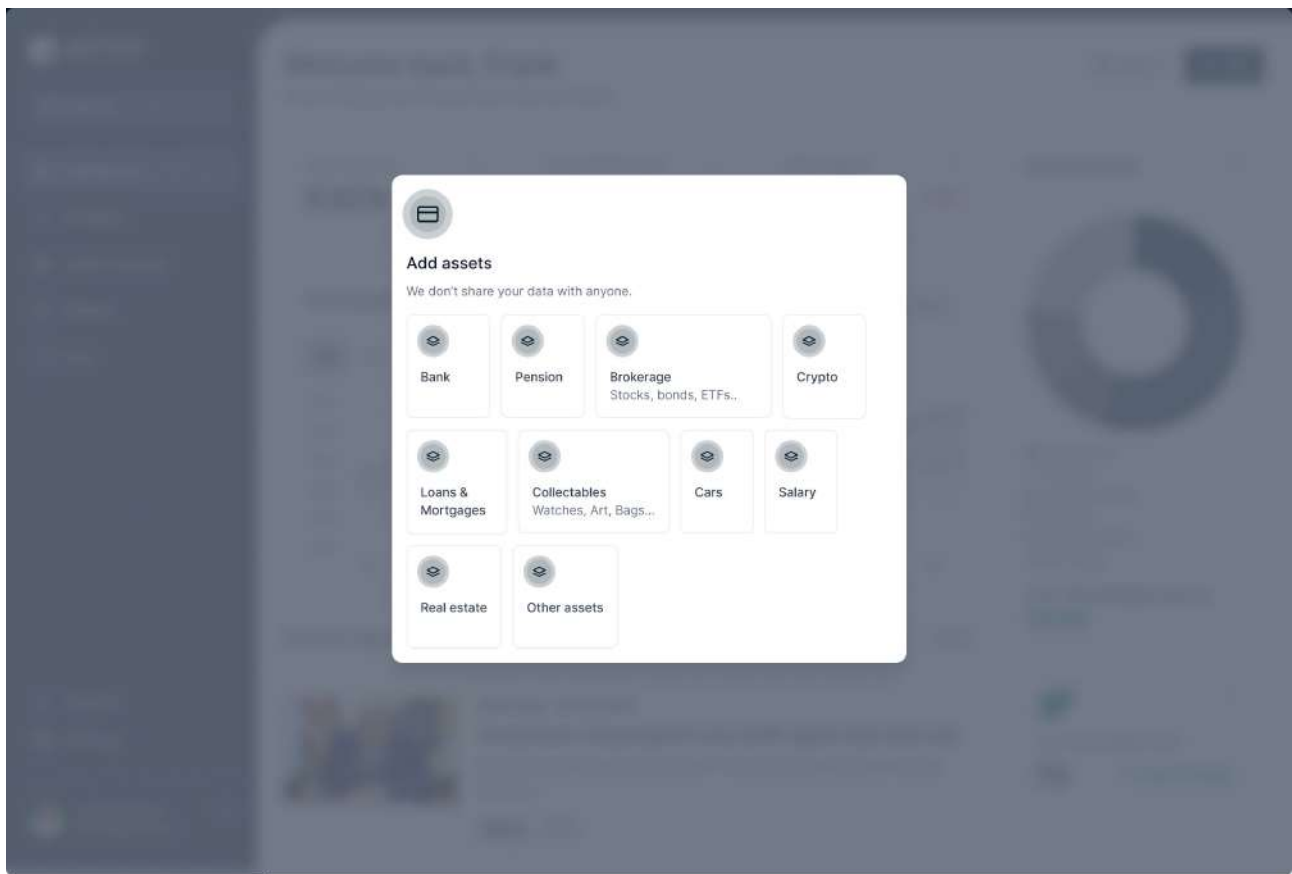
Monitoring liquid assets

A user can connect his/her banking app or broker to add it to the portfolio mix. The connection is powered by Plaid (an open banking API provider). Two-factor authentication is needed to connect the two apps to securely authorise the link between them, safeguarding the user's financial data during the connection process. Implementing this verification step addresses the substantial user value placed on security and data privacy.
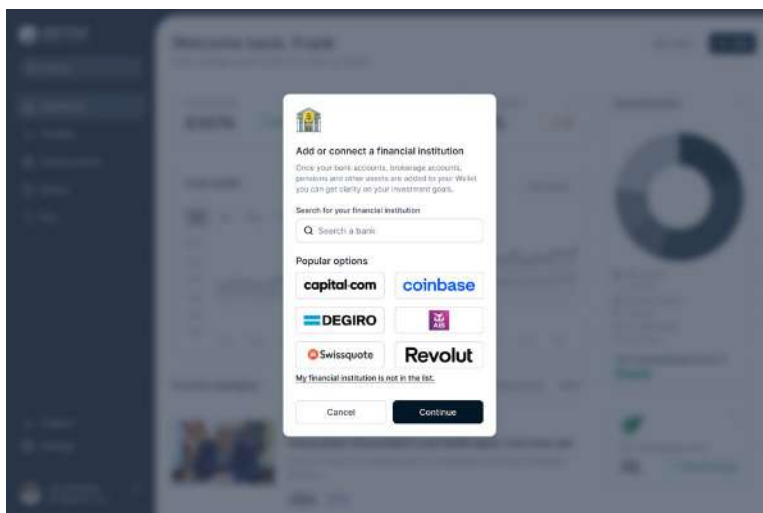
Monitoring illiquid assets through AI and market trends

Using 3rd software and AI, the wealth management platform can quickly evaluate the price of an illiquid asset based on minimum user input. The user can then confim the proposed price and estimated yearly appreciation/depreciation.

In this study is proposed using repeat sales data to construct a more accurate price index for residential real estate, overcoming limitations of mean price measures. AI can overcome these challenges for other illiquid asset classes (Nashed & Baron, 2023).

Artificial intelligence (AI) is increasingly applied to asset pricing, particularly in real estate markets. AI models can improve real estate valuation by incorporating global economic factors and individual property characteristics (Kabaivanov & Markovska, 2021).

Figure 1. RedFin combines hundreds of data points about the market, neighborhood, and home to provide an accurate home valuation.

Based on desk research and benchmarking analysis Artificial Intelligence (AI) in the pricing process is being applied in business practice and research to a variety of other pricing use cases (cars, watches, commodities) that can be augmented or automated, providing opportunities as a forecasting tool or for price optimisation (Erdmann, 2024).
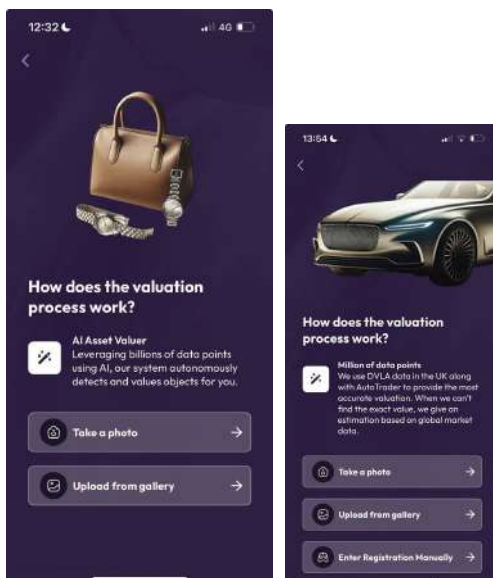
Figure 2. Figg Wealth App uses an AI Asset Valuer to detect and evaluate objects and cars.

High-fidelity prototype
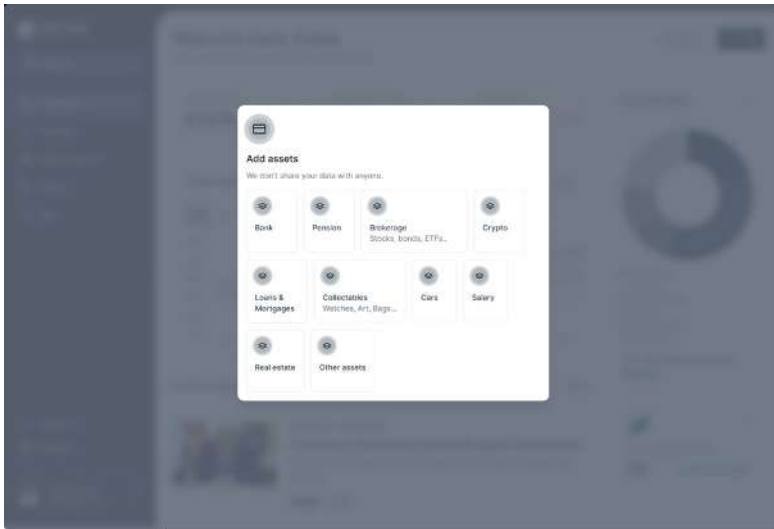
The first high-fidelity prototype was created by applying the UI Design System to the wireframes. This set the basis for the iterative design process.

Iteration 1 – High fidelity prototype

Link
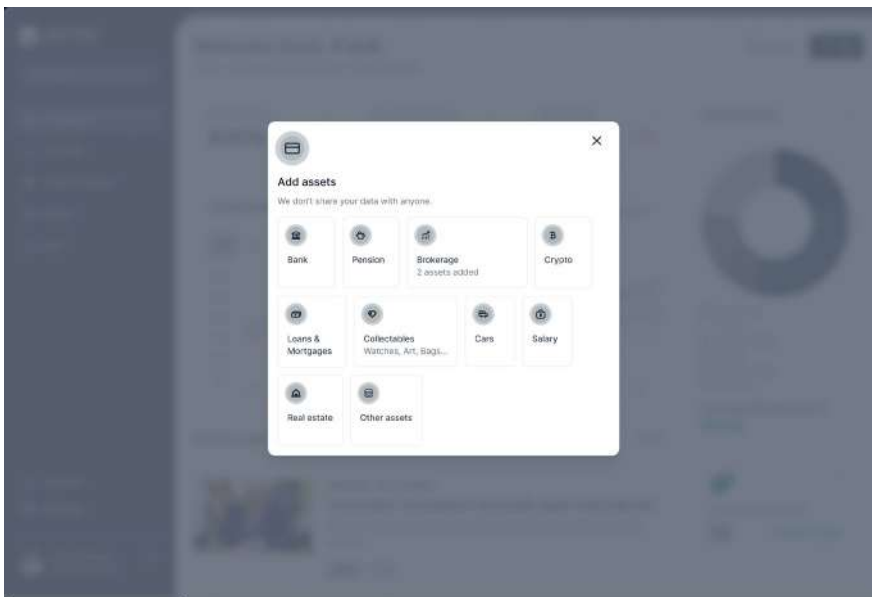
The second iteration 2 of the high-fidelity prototype focused on improving the "Add assets" user flow.
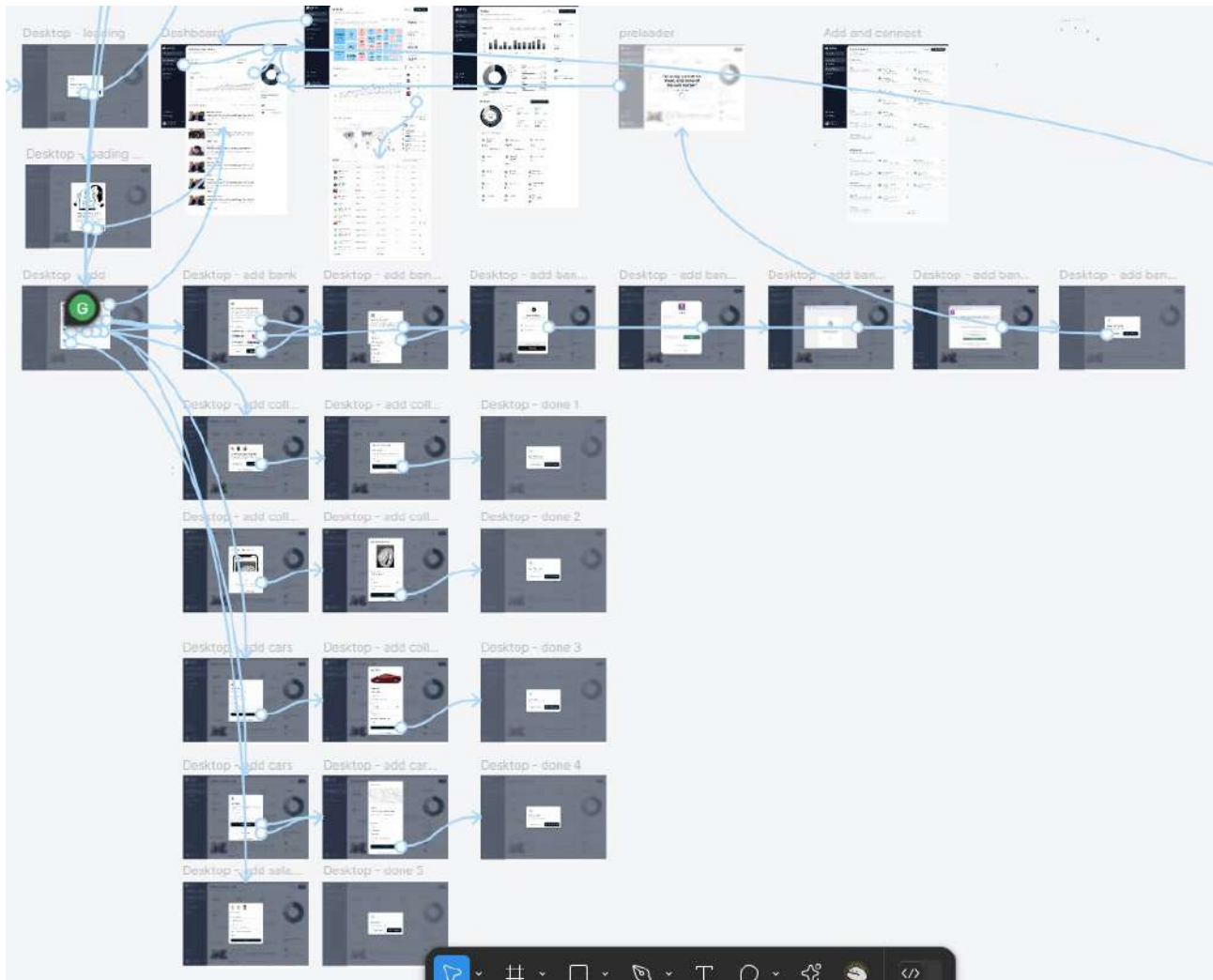
The main issues identified during the usability test and expert review were the following:

- Content hierarchy and strategy;
- Information overloading on particular pages;
- Missing links;
- Not clear microcopy on the registration user flow;

The top improvements implemented were the following:

- Improved portfolio visualisation;
- Improved diversification visualisation;
- Improved terminology and UX microcopy;
- Introduction of a preloader to reduce the perceived waiting times;
- Introduction of a 2FA when connecting a bank or broker through Plaid;
- Implementation of social media login/sign up to speed up the registration process;
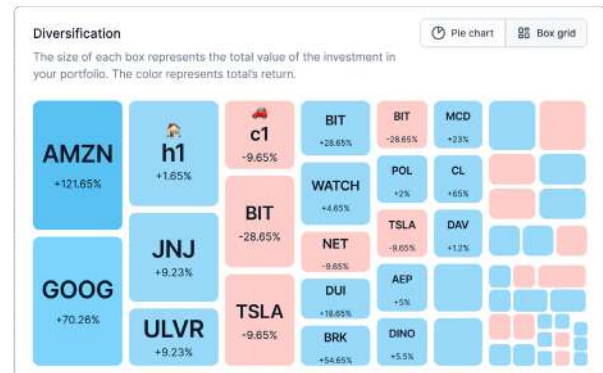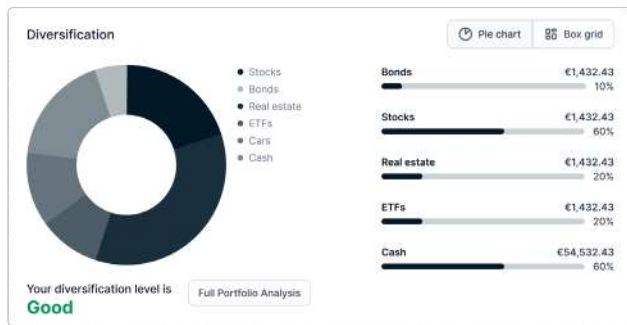
Iteration 2 – High-fidelity prototype
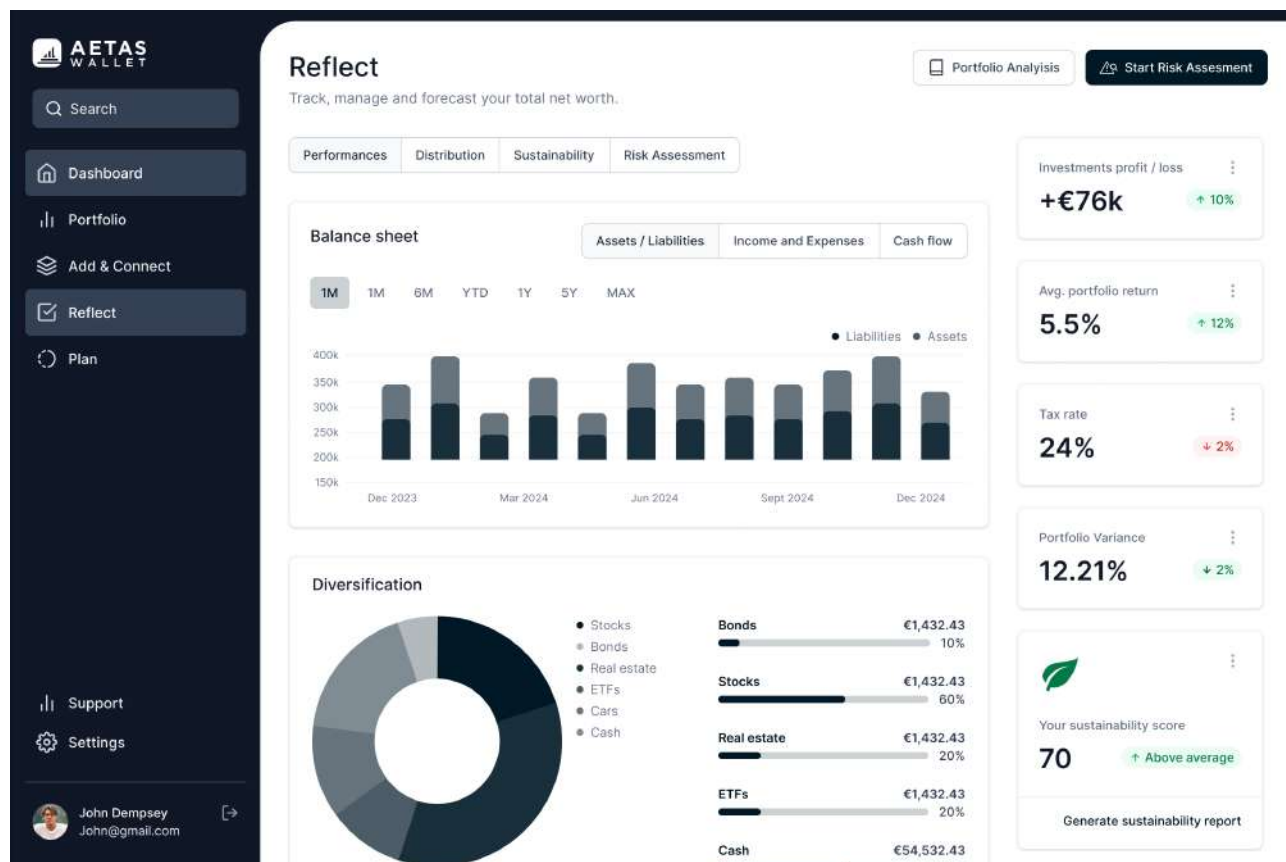
The main issues identified during the usability test and expert review were the following:

- Infinite loop on the Add asset pop-up;
- Bugs on the dropdown;
- Some users did not understand the question in the registration process, "What else do you want to include - without stress or guilt?".
- Information overloading

The top improvements implemented were the following:

- Improved geographic distribution visualisation;
- Improv "Set a goal" user flow by implementing slider controllers;
- Improved "Add Asset" user flow by reducing the minimum inputs required;
- Improved content hierarchy by better use of white space.

A mobile prototype was created for Task 3 in the Usability test. The prototype can be tested here.
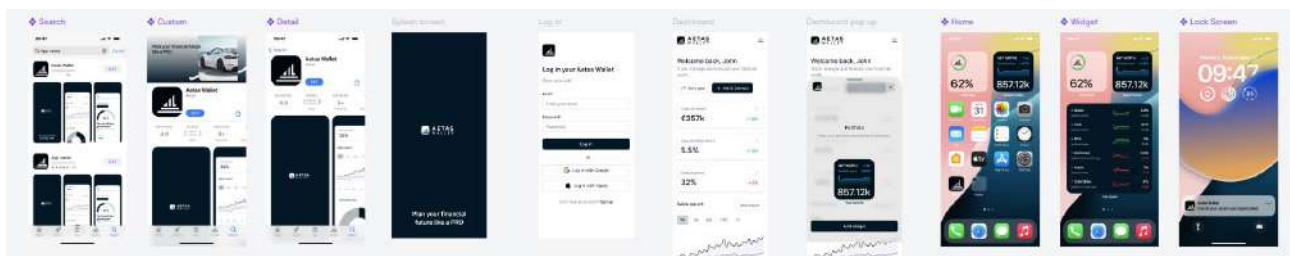
Results and findings

The participants to the final test consisted of 7 adults (7 males) with good self-reported financial ability and good perceived Financial Sophistication/Financial literacy.

Perceived Risk Variation

An analysis of the variation of the perceived risk pre and post usability testing revealed significant differences in perceived risk ratings for the investor portfolio, M= 0.7731092437, S.D. 0.32623. A paired t-test was performed to analyse the change in perceived risk for the same group of participants before and after testing[9].

Hypotheses:

- Null Hypothesis (H_0): There is no significant difference in the mean perceived risk before and after the usability test ($\mu\_post - \mu\_pre = 0$).
- Alternative Hypothesis (H_1): There is a significant difference in the mean perceived risk before and after the intervention ($\mu\_post - \mu\_pre \neq 0$).

The paired t-test results (see Appendix M) confirmed statistically significant differences in perceived risk ratings for the investor portfolio (t-test: 3.553, p-value: 0.012). The p-value (0.012) is less than the significance level of 0.05. Therefore, the null hypothesis is rejected, and it is confirmed that there is a statistically significant difference in perceived risk between the pre-test and post-test. Based on the data, the perceived risk changed after the intervention.

The responses collected from the respondent investors during the final test were analysed and presented in Tables 7 and 8 in the Appendix M.

Table 9 demonstrates the investors' perceived risk variation by reporting the variation and standard deviation in perceived risk for all 17 risk-related questions. In all cases, a positive score denotes a variation in perceived risk.

The results indicate that the variation in perceived risk is 12.89%.

ΔR (Total Perceived Risk Variation on Likert Scale)	(%)	S.D.
0.7731092437	12.89%	0.3262312

Across the measured dimension of risk perception, Factor 1 (Distrust of assets and/or providers) and Factor 4 (Poor knowledge or information) were the dimension who saw the most significant shift after participants used the prototype.

ΔF1 (Distrust of assets and/or providers)	(%)	S.D.
1.047619048	17.46%	0.262555

ΔF4 (Poor knowledge or information)	(%)	S.D.
1.285714286	21.43%	0.1725386

The alternative hypothesis of the t-test and the p-value under 5% confirms the conclusion that the observed difference is statistically significant. Data and calculations using the individual participants scores of the paired samples t-test can be found in the Appendix M.

Therefore, it can be concluded that this study's H1 Hypothesis is confirmed. The perceived risk profile of the investor portfolio (measured using a Likert-scale analysis of 17 risk-related questions to determine the function R, which numerically represents the perceived risk) differs significantly after the user register and visualises his whole portfolio on the app, compared to the portfolio risk perception before using it.

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[9] Since the study is looking at the change within the same participants, a paired t-test is appropriate.

System Usability

The final aspect of user response examined was the wealth management app's system usability.

Observed usability

Issues during the usability testing of the low fidelity prototype, high fidelity prototypes v1 and v2 were reported. The most frequently reported issues were on the Add an asset and the Sign up pages. See Figure 19 – 21 for recorded issues by prototype iteration.
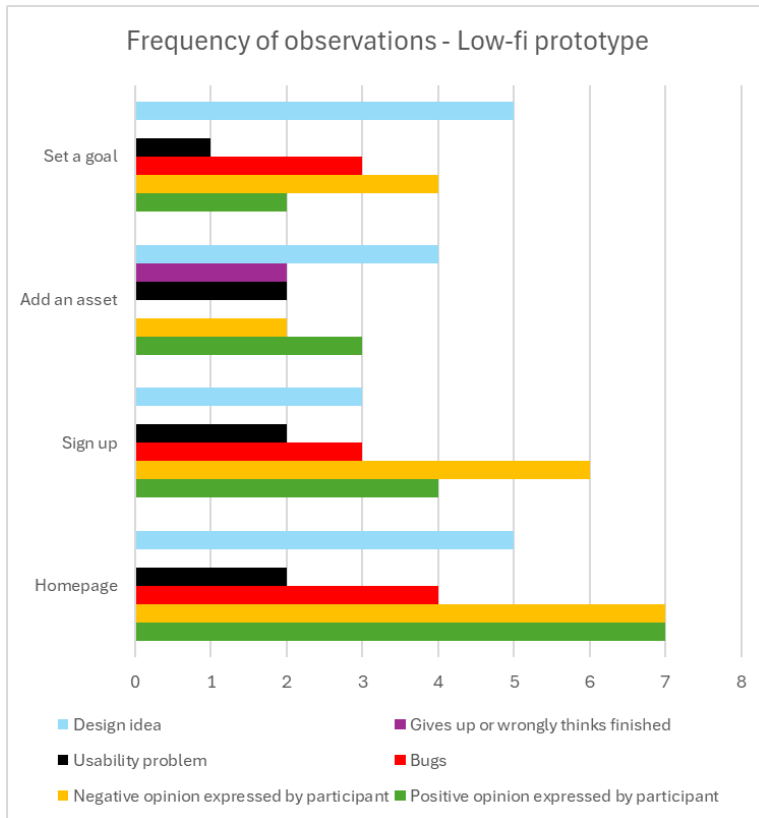
Figure 21 - Frequency of usability observations on the low fi prototype by task
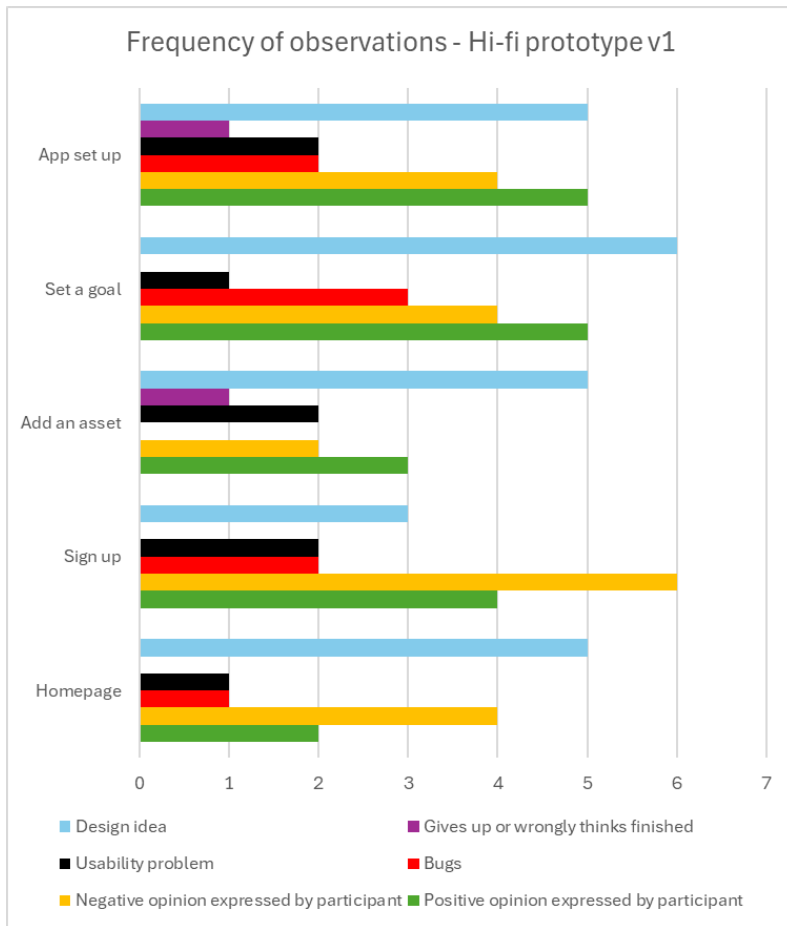
Figure 22 - Frequency of usability observations on the hi fi prototype v1 by task
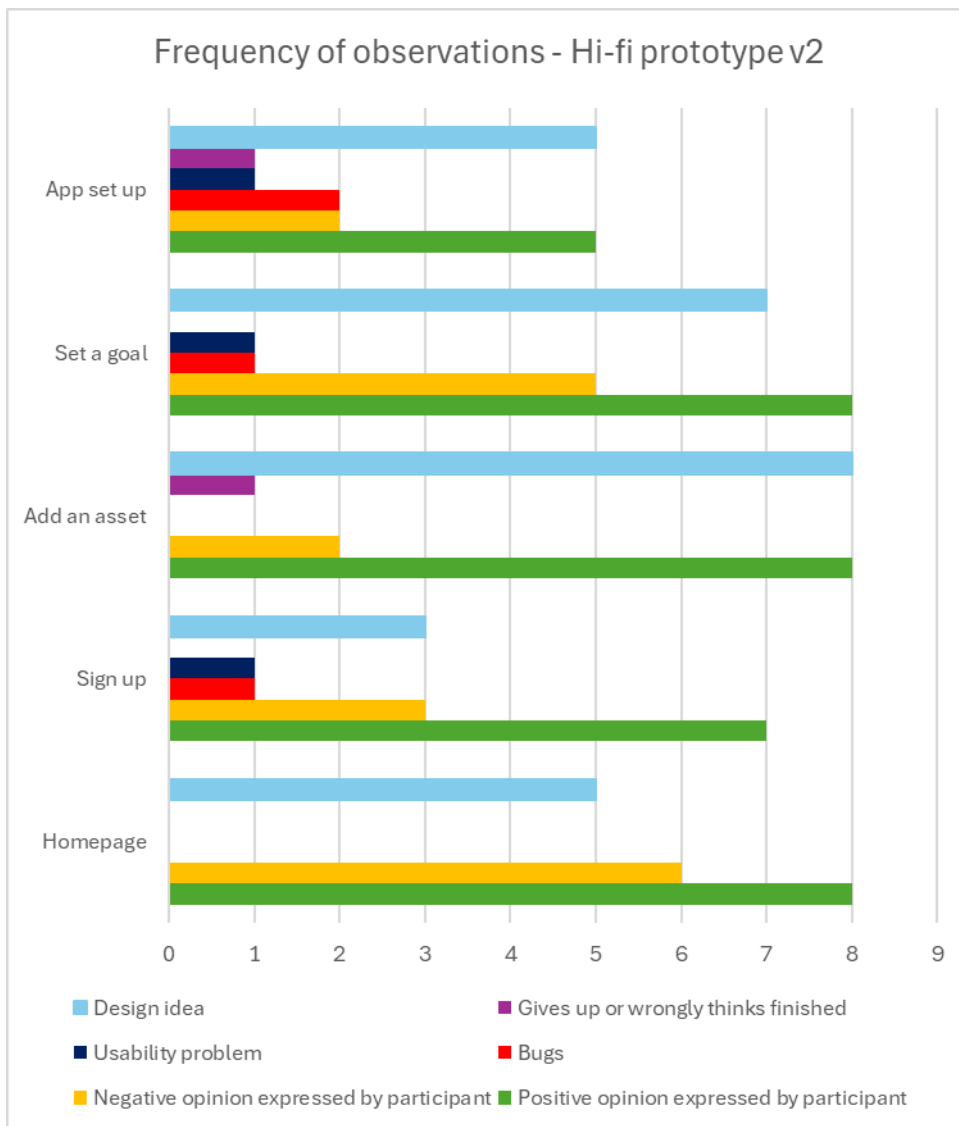
Figure 23 - Frequency of usability observations on the hi fi v2 prototype by task

Reported Usability

During the last round of testing participants were asked to complete a SUS form. All the reported usability experiences were positive.

Table 10 shows the results of the System Usability Scale questionnaire.

Table 7 - Results of the SUS questionnaire on the hi-fi prototype v3

	Task 1	*Task 2*	*Task 3*	*SUS Score*
	Completion rate (0=not completed; 1=completed)	***Completion rate*** (0=not completed; 1=completed)	***Completion rate*** (0=not completed; 1=completed)	
Participant 1	*1*	*1*	*1*	*95*
Participant 2	*1*	*1*	*1*	*95*
Participant 3	*1*	*1*	*1*	*92.5*
Participant 4	*1*	*1*	*1*	*95*

Participant 5	*1*	*1*	*1*	*95*
Participant 6	*1*	*1*	*1*	*100*
Participant 7	*1*	*1*	*1*	*95*
Average	*1*	*1*	*1*	*95.35714286*

The High Fidelity prototype – Iteration 3 produced an average SUS score of 95.

Users agreed that the Wealth Management App was easy to use, as evidenced by the Observational Analysis and Affinity Map – See Appendix L.
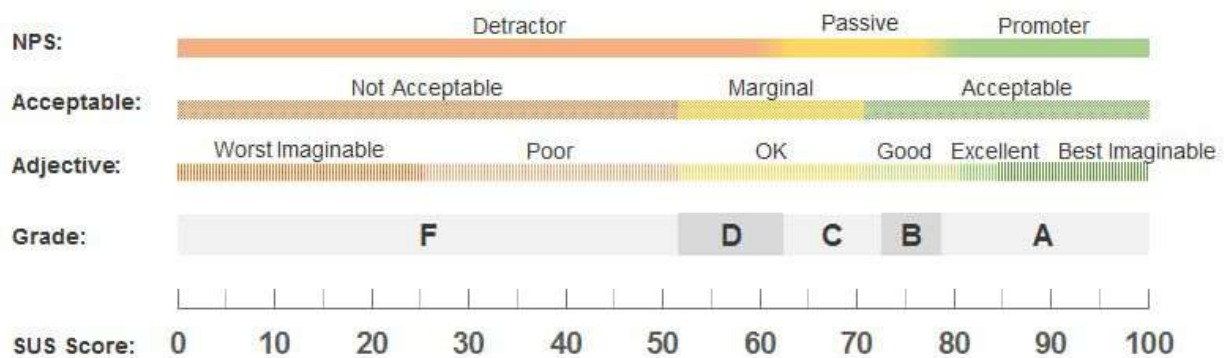
Figure 24 - Grades, adjectives, acceptability, and NPS categories associated with raw SUS scores.

The holistic wealth management app prototype achieved excellent usability, as indicated by System Usability Scale (SUS) scores above the established acceptance threshold, reflecting user satisfaction with the app's usability.

The usability study results prove that the user experience of adding illiquid assets to an investment portfolio management app influences the perceived risk, and the user would consider using this feature in a live app.

Discussion

This study aimed to investigate how aggregating and visualising both liquid and illiquid assets within a wealth management application prototype affects investors' perception of risk and diversification, and evaluate the usability of such a tool. The research employed a mixed-methods approach, grounded in user-centred design principles, culminating in developing and testing a high-fidelity prototype, "Aetas Wallet." The findings provide valuable insights into the complex interplay between portfolio visualisation, risk perception, and user experience in modern wealth management.

Primary Question: Change in User-Perceived Risk

The first primary research question asked whether user-perceived risk would change after using a holistic wealth management app. The results strongly support an affirmative answer. The paired t-test revealed a statistically significant difference ($p = 0.012$) in the overall perceived risk score ($\Delta R = 0.7731$, representing a 12.89% variation) between the

pre-test and post-test measurements. This indicates that interacting with the prototype, which presented a consolidated view of liquid and illiquid assets, sligthly altered how participants perceived the risk profile of their holdings. While the overall measure showed a significant change, the variation across individual risk factor questions (Table 9) was diverse, suggesting the app's impact was not uniform across all dimensions of risk perception (e.g., distrust, consequences, volatility, knowledge, regulation, as adapted from Diacon & Ennew, 2001). The visualisation of previously less salient illiquid assets alongside more frequently tracked liquid ones likely forced a re-evaluation of the overall portfolio's characteristics, potentially highlighting risks like lack of liquidity (Q15 variation) or complexity (Q12 variation), or perhaps providing a sense of more excellent stability depending on the asset mix. This aligns with literature suggesting visualisation impacts cognitive load and decision accuracy (Tomasi et al., 2023) and that risk perception is multi-faceted (Fischhoff et al., 1978; Diacon & Ennew, 2001).

The results highlight that Factor 4 – Poor knowledge or informations, significantly changed after using the app. This suggest that the application was effective in improving the user knowledge regarding the risks associated with their full portfolio. This change in perceived knowledge gaps resonates with findings like Wang et al. (2011), who noted that easier-to-understand investment products were perceived as less risky. By improving users' subjective understanding of their complete portfolio through better information design, the Aetas Wallet may have increased their confidence and reduced the specific risk perception associated with lack of knowledge or observability.

Secondary Question: Usability, UX of Adding Illiquid Assets to a Wealth Management App

The secondary questions focused on the usability and user experience of the holistic app. The results were unequivocally positive. The prototype achieved an average System Usability Scale (SUS) score of 95.36, which falls into the 'Excellent' category and significantly surpasses the 'Acceptable' threshold of 68 (Bangor et al., 2009). This, coupled with the 100% task completion rate across all usability testing scenarios (including registration, setting goals, and adding assets), demonstrates that the app was perceived as highly usable and easy to navigate. The user experience of adding illiquid assets, a core feature tested, was successful, implying users found the designed flow (including AI-assisted valuation concepts) intuitive and manageable within the prototype context. The high usability scores and positive qualitative feedback ("an all-in-one platform could be useful...") suggest that users would indeed consider using such a feature in a live application, provided security and automation needs (highlighted in the workshop) are met.

The study contributes to the policy debate on the impact of UI on risk perception. The study provides empirical evidence supporting the notion that the presentation and aggregation of financial information significantly impact investor perception, specifically risk perception (linking to (Tomasi et al., 2023; Ward et al., 2015). This study extends the investigation beyond the typical focus on liquid securities by including illiquid assets often managed outside traditional brokerage apps. The observed change in risk perception aligns with the psychometric paradigm (Fischhoff et al., 1978; Diacon & Ennew, 2001), demonstrating that making different facets of the portfolio (like illiquidity or complexity of valuation for non-traditional assets) more salient can shift the overall assessment.

In addition, the study addresses the practical challenge Rohner & Uhl (2018) and Zaker (2022) highlighted regarding the lack of holistic wealth management tools that integrate non-bankable assets. The positive user response and high usability suggest an apparent demand and feasibility for such solutions.

Furthermore, the exceptional SUS score reinforces the critical role of usability and user experience in adopting fintech applications (Malhotra, 2020; Jacobson, 2015; Bredican, 2016).

Internal validity

The researcher of this study is part of the same private investor group from which participants were recruited. Even if the majority of the private investors in the group don't know each other potential bias needs to be discussed. Participants could have felt implicit pressure to provide positive feedback (social desirability bias) or may share similar investment philosophies or biases with the researcher, potentially influencing their responses and interaction with the prototype. The researcher's pre-existing group knowledge could also subconsciously shape data interpretation. While efforts were made to use standardised instruments (SUS, risk questionnaire), the researcher-participant relationship could temper the objectivity of the findings. Repeating the research with unknown participants could reduce the social desirability bias and this could lead to potentially more objective feedback on the prototype and risk perception responses. However it's also acknowledged that the user researcher effort to keep a formal environment and using techniques like the Shuffle Rotation in the test surveys might have mitigated the bias effect.

Furthermore, as mentioned in the literature review, "risk perception involves people's beliefs, attitudes, judgments, feelings, and broader social or cultural values and dispositions" and therefore it's a highly subjective concept. The methodology of this study to measure perceived risk uses the so-called psychometric paradigm pioneered by the Decision Research Group in Oregon (Slovic, 1972; Slovic et al. 1985) that is frequently used to map the qualitative characteristics of hazards that influence risk perception (Fischoff, 1978; Diacon & Ennew, 2001; Mei Wang, 2011; Brachinger & Weber, 1997). The questions and analysis are also based on existing literature (Fischhoff et al. [1978] and the work of Brachinger and Weber [1997], Diacon and Ennew [2001]. For example questions about the potential for losing all money directly address the "seriousness of adverse consequences" rating scale identified by Diacon & Ennew (2001) – See Table 3. The type of risk being measured in the research paper it's a perception of the risk associated of the entire portfolio as visualized in the app. By focusing on this specific context (the user's portfolio as presented in the app), the researcher made sure that the measurement is relevant to the study's objectives.

External validity

Recruiting participants exclusively from a private group of active investors significantly limits the generalizability of the findings. This group likely possesses higher-than-average financial literacy, engagement levels, and net worth. It may have specific investment habits (e.g., predisposition towards certain asset classes, including illiquid ones) compared to the broader population of individual investors or novice investors. Therefore, the observed change in risk perception and the high usability scores might not replicate in different investor segments. The results directly apply to experienced, engaged investors like those in the studied community.

While the prototype SUS score was 95.36 with experienced investors, novice investors might find the concepts or interface more challenging. However, during the pilot testing phase with the Dun Laoghaire Institute of Art Design + Technology, 3 participants with poor financial literacy participated in the study. The results suggest that the SUS score could hold up with less financial literate users, but this needs to be confirmed with a larger group of novice investors.

Conclusions & Future Work

This paper provides a qualitative analysis of the perceived risk hypothesis by studying how investors evaluate their portfolio diversification under the assumption that they do not factor all the illiquid assets when evaluating their portfolio diversification and that a complete overview is not possible with the apps they usually use because they focalise the user attention to the assets available on the app.

The primary research *question "• Would the user-perceived risk change after using an holistic wealth management app with various liquid and illiquid asset classes?"* was directly addressed and answered. The study found a statistically significant change (p=0.012) in participants' perceived portfolio risk after interacting with the "Aetas Wallet" prototype. The discussion suggests that presenting a consolidated view of both asset types prompted a re-evaluation of the overall risk profile

The question *"How does the user-perceived diversification change after using a holistic wealth management app?"* was not directly answered with results in this master thesis. While the study collected data on participants' initial views on diversification and assumed that users often don't fully account for illiquid assets when evaluating diversification, it did not present a pre- and post-test analysis comparing perceived diversification levels like it did for perceived risk. The document explicitly identifies measuring this change as a "key next step" for future research.

The secondary research question *"What is the user experience of adding illiquid assets to an investment portfolio management app? Did the user find it easy?"* was addressed. The usability testing included tasks specifically related to adding illiquid assets. Although some issues were identified and addressed in earlier prototype iterations, the overall high usability scores and successful task completion in the final test suggest that participants found the process of adding illiquid a positive experience and wand would consider using this feature in a live app.

Future work

Investigating if the perceived risk increases or decreases based on the portfolio composition of the investor could be considered.

A longitudinal study should be considered to **track if the observed changes in perceived risk actually translate in investment behaviours and portfolio re-balancing**.

As many participants wanted to visit the homepage on mobile a mobile prototype could be created and the usability of it tested.

When considering the design of wealth management apps, integrating gamification elements warrants careful evaluation and a balanced approach. As highlighted by Chaudhry and Kulkarni, design patterns in investing apps, particularly hedonic gamification elements like confetti and reward animations, can blur the lines between investing and gambling. This is a concern echoed by regulators (Chapkovski, 2023). Such features, while potentially increasing user engagement, may inadvertently reduce investors' perception of the inherent risks associated with financial products. Therefore, if gamification inadvertently lowers the perceived risk without a corresponding increase in investor understanding, it could lead to individuals taking on more risk than is appropriate for their financial goals and risk tolerance (Bingqing Wang, 2023). As a result, **it would be interesting to measure how the perceived risk changes after introducing a gamification mechanism in a trading or wealth management app.**

If time and budget are available for future studies it is recommended to recruit a more diverse sample of participants, including novice investors with different levels of financial literacy. This would enhance the external validity and generalizability of the results.

Reflections

In retrospect, the user researcher should have add more depth to the qualitative reporting during the usability test. A more detailed thematic analysis could have provided richer context for the identified usability issues and the rational behind subsequent design changes.

Adding peer review and user testing at this stage might have been explored more fully.

Ultimately a live application importing the investor portfolio more accurately will provide more accurate results.

Critical reflections on methodology

As discussed in the literature review, usability and user experience can affect a user's emotional state and potentially their perception of risk. If version v2 has improved usability or more reassuring features compared to version v1, the user researcher might observe a decrease in perceived risk after users interact with it.

In addition to this, The user researcher could investigate the Role of Familiarity and Understanding: If version v2 is designed to be more precise, more intuitive, or provides better explanations than version v1, using it could increase users' familiarity and understanding, potentially leading to a change in their risk perception. Wang et al.'s (2011) study indicated that easier-to-understand investment products were perceived as less risky. Similarly, a more user-friendly version of your app might be perceived as less risky due to increased user confidence and comprehension.

Learning Outcomes

Reflecting on the research study the following key takeaways are identified:

- Conducting this research highlighted the distinct approaches and priorities inherent in academic versus business research contexts, particularly regarding the formulation and testing of hypotheses.
- The importance of a well-thought user research plan.
- UX Copy and the app language should be carefully written
- The use of a UI Design System for consistency and appeal
- The pros and cons of using a community gatekeeper during the recruitment process
- The value of iterative design to achieve an high usability score
- The complexity of measuring subjective metrics (perceived risk) and the influence of external factors during the measurement of the same
- The challenges of integrating heterogeneous assets (liquid vs illiquid) on a dashboard

Appendix

Full Appendix here

Appendix A – User interview consent form

PDF can be downloaded here

User Interview Consent Form

STUDY DETAILS

The purpose of this study is to better understand the user experience of a Wealth management app app, specifically focusing on liquid and illiquid assets. Your participation will help us modify, develop, or otherwise improve the current user experience. This study will consist of a one-on-one session with a UX Researcher.

FINANCIAL DISCLAIMER

The research focuses on the design of an app that manages diversified portfolios; it does not inherently advocate for diversification as the universally optimal investment strategy.
There are risks associated with investing in securities. Investing in stocks, bonds, exchange-traded funds, mutual funds, and money market funds involves risk of loss. Loss of principal is possible. Some high-risk investments may use leverage, which accentuate gains & losses. Foreign investing carries unique risks, including heightened volatility, political, economic, and currency fluctuations, as well as differences in accounting standards. Past performance of a security or firm is no indication of future results.

DATA WE WILL COLLECT

We will ask you questions about your use of our products and services. We will record the session and we will take notes to record your comments. We will not request, and you should not provide, any sensitive personal information in this study.

HOW WE WILL USE YOUR DATA

Any data, recording or other personal information collected about you will be treated confidentially. The recording will not be published or shared publicly, and it will only be used for research and educational purposes.

YOUR RIGHTS

Your participation in this study is voluntary. You can take a break or discontinue participation at any time without giving a reason.

YOUR CONSENT

I give my consent:

- For the session to be recorded and trascribed

- For IADT students Giuseppe Ditaranto to use this recording for the purpose of improving the designs being tested.

By signing below, you acknowledge that you are 18 years of age or older and have read and understood the information in this Research Consent Form.

Signature: _____

Print name: _____

Date: _____

Appendix B - Semi-structured user interview script

[Link](#)

Hello NAME, thank you for taking the time to speak with me today.

My name is Giuseppe, and I am conducting research on the user experience of wealth management apps, particularly those that include both liquid and illiquid assets.

This interview will take about 15 minutes, and your insights will help improve the design and usability of a new portfolio management app. There are no right or wrong answers—I'm just interested in your personal experience and opinions.

Before we start, do you have any questions?

Consent & Confidentiality

Just to confirm, do you consent to participating in this interview? All responses will remain confidential, and you are free to stop at any time.

Background & Investment Experience

QUESTION: "Can you tell me a little about yourself and your background in investing?"

QUESTION: "How long have you been investing, and what types of assets do you typically invest in?"

Current Investment Management

QUESTION: "Which tools or apps do you currently use to track and manage your investments?"

QUESTION: "What do you like about these tools? What do you find frustrating?"

Portfolio Composition

QUESTION: "Do you hold both liquid (e.g., stocks, bonds) and illiquid assets (e.g., real estate, collectibles, private equity)?"

QUESTION: "How do you currently track the value of your illiquid assets?"

QUESTION: "Would you find it beneficial to have a single app that consolidates both liquid and illiquid assets? Why or why not?"

User Needs & Expectations

6. Decision-Making & Portfolio Diversification

QUESTION: "How do you assess the diversification of your portfolio?"

QUESTION: "What information do you need to feel confident in your investment decisions?"

Data Visualization & Usability

QUESTION: "How important is visual representation (charts, graphs, summaries) in understanding your investments?"

QUESTION: "What types of visualizations do you find most helpful?"

Push Notifications & Alerts

QUESTION: "Do you receive investment-related notifications on your mobile devices? If so, how do you feel about them?"

QUESTION: "What kind of alerts would you find useful, and what would you find overwhelming or unnecessary?"

Trust & Security

QUESTION: "What factors make you trust an investment management app?"

QUESTION: "Are there any security concerns that might prevent you from using a new wealth management tool?"

App Features

Feature Reactions

QUESTION: "If you were using an app that integrated liquid and illiquid assets, what features would be most important to you?"

QUESTION: "How would you like to input or update the value of illiquid assets?"

QUESTION: "Would you want the app to provide automated insights or recommendations?"

Closing Questions & Wrap-Up

QUESTION: "Is there anything else you wish a wealth management app could do that existing apps don't?"

QUESTION: "What would make an app like this indispensable for your financial management?"

Thank You & Next Steps

QUESTION: "Thank you so much for your time and insights. Your feedback is incredibly valuable to this research. If you'd like, I can share updates on the project with you as we move forward. Would you be interested in that?"

QUESTION: "If you have any additional thoughts after this interview, feel free to reach out. Thanks again, and have a great day!"

Appendix C - UX Workshop Plan & Questions

Link

Conducted November 2024

Mode: Online video conference

Participants: 6

Workshop plan

- Send invitation to selected participants
- Preparation of Miro Board
  - Development of questions
  - Development of activities
- Moderate discussion
- Analyze data

Questions:

- What motivates you to invest?
- What are your current investment habits?
- What apps do you use for investing?
- How satisfied are you with your current investment apps?
- Do you understand the concept of portfolio diversification?
- How do you currently judge the diversification of your portfolio?
- What are your thoughts on including illiquid assets in a portfolio?
- Do you think including illiquid assets would make your portfolio more diversified?
- Would you be more likely to rebalance your portfolio if you could see all of your assets in one place?
- What features would you like to see in an investment app that helps you visualize your entire portfolio, including illiquid assets?

Workshop agenda

a) Introduction - 10 min
b) Icebreaker - 10 min
c) Questions - 30 min
d) Brainwriting - 20 min
   In this exercise each participant was asked to write down 10 app ideas in 10 minutes. The ideas were then discussed among the group.
e) How might we? - 20 min
   In this exercise the UX researcher presented the key issues found during the desk research. These were turned into opportunities by using the introduction "How might we…?"
f) App IA card sorting - 10 min

In this activity the participants were asked to brainstorm the screens for the app using a card sorting exercise.

g) Wrap-up - 10 min

Appendix D – Thematic analysis of user interviews and workshop

Thematic analysis of user interviews and workshop

Appendix E – Survey

Link

Conducted November 2024

Title: Wealth management app - User Experience Research

Introduction: A wealth management app is a digital platform designed and created to help individuals and organizations manage their finances, investments and overall wealth. These apps typically offer features like portfolio management, financial planning tools, budgeting, and personalized investment recommendations.

The purpose of this survey is to understand your general motivation towards investing, your current investment habits, apps in use, measure your perceived portfolio diversification and user satisfaction.

There are only 3 sections and all the questions are optional.

All responses are anonymous.

Estimated completion time: 5-10 mins

Question 1: Gender

a) Male
b) Female
c) Prefer not to say

Question 2: Age

a) Under 18
b) 18-24
c) 25-34
d) 35-44
e) 45-54
f) 55-64
g) 65+

Question 3: Education

a) Less than high school
b) High School
c) Some college (no degree)

d) Associate degree (2 year)
e) Bachelor's degree (4 year)
f) Master's degree
g) Doctoral degree
h) Professional degree

Question 4: Marital status

a) Married
b) Widowed
c) Divorced
d) Single
e) Prefer not to say

Question 5: Employment

a) Full time
b) Part time
c) Contract
d) Retired
e) Unemployed
f) Other: _____

Question 6: Do you currently invest your money?

a) Yes
b) No

Question 7: If Yes, what types of assets and wealth do you hold?

☐ Stocks
☐ Bonds
☐ Mutual funds
☐ ETFs
☐ Real Estate
☐ Cryptocurrencies
☐ ETC, Commodities
☐ Private business
☐ Currencies
☐ Cars
☐ Alternative investments (private equity, venture capital)
☐ Other: _____

Question 8: How important is portfolio diversification to you?

(Not at all important)   1 2 3 4 5 (Extremely important)

Question 9: How diversified do you believe your investment portfolio is?

(Not)   1 2 3 4 5   (Very diversified)

Question 10: How likely are you to rebalance your investment portfolio in the next 2 years?

(Very unlikely)   1 2 3 4 5   (Very likely)

Question 11: If you are likely to rebalance, what factors are most likely to trigger that decision?

☐ Changes in my personal financial situation
☐ Changes in market conditions
☐ Recommendations from my financial advisor
☐ Time-based rebalancing
☐ New investment opportunities
☐ Other: _____

Question 12: If you are likely to rebalance, what factors are most likely to trigger that decision?

a) Changes in my personal financial situation
b) Changes in market conditions
c) Recommendations from my financial advisor
d) Time-based rebalancing
e) New investment opportunities
f) Other: _____

Question 13: Are you a professional investor?

a) Yes
b) No

Question 14: Do you currently use any wealth management or investment apps?

a) Yes
b) No

Question 15: If yes, which apps do you use?

List specific app names

_____

Question 16: What are the most important features you look for in a wealth management / Fintech app? Select all that apply

☐ Portfolio visualization
☐ Portfolio performance reporting
☐ Clear visualization of financial data and charts
☐ Budgeting and financial planning tools
☐ Goal setting and tracking
☐ Personalized investment recommendations
☐ Low fees

☐ User-friendly interface
☐ Educational resources
☐ Security and privacy
☐ Customer support
☐ Other: _____

Appendix F - Survey results (n=17)

Q1

Gender
17 responses

- Male
- Female
- Prefer not to say

23.5%

70.6%

Q2

Age
17 responses

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

11.8%

47.1%

29.4%
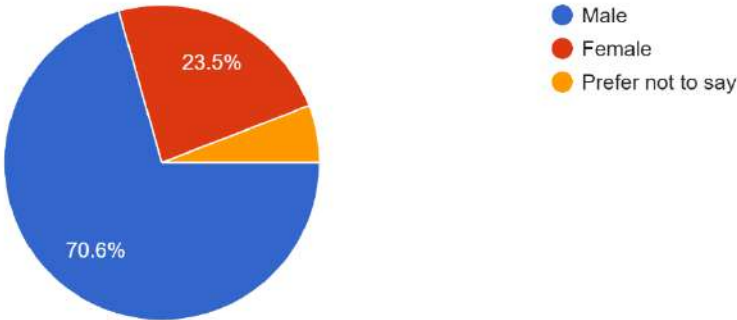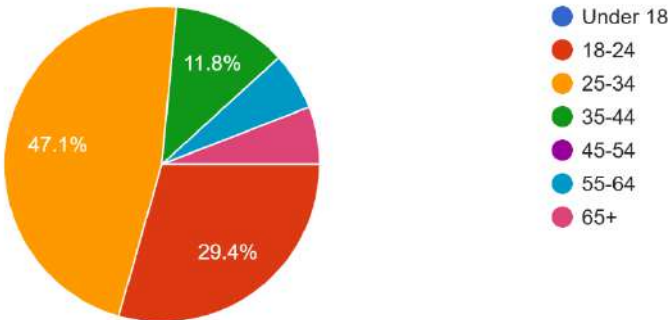
Q3

Education

17 responses
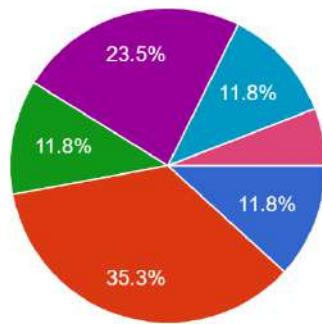
- ● Less than high school
- ● High School
- ● Some college (no degree)
- ● Associate degree (2 year)
- ● Bachelor's degree (4 year)
- ● Master's degree
- ● Doctoral degree
- ● Professional degree

Q4

Marital status

17 responses
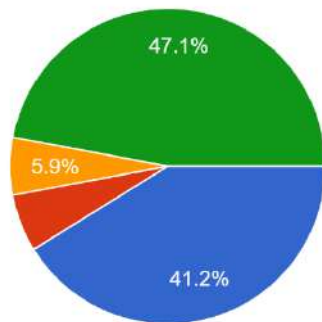
- ● Married
- ● Widowed
- ● Divorced
- ● Single
- ● Prefer not to say

Q5

Marital status

17 responses
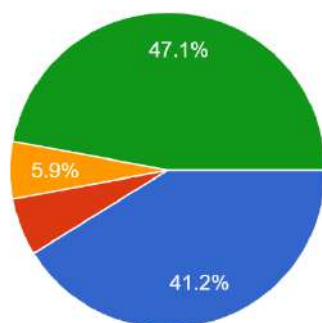
- ● Married
- ● Widowed
- ● Divorced
- ● Single
- ● Prefer not to say

Q6

Employment

17 responses

- Full time
- Part time
- Contract
- Retired
- Unemployed

76.5%
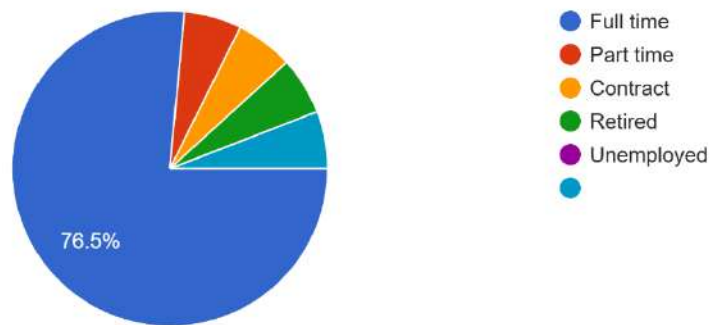
Q7

Do you currently invest your money?

17 responses

- Yes
- No

11.8%

88.2%
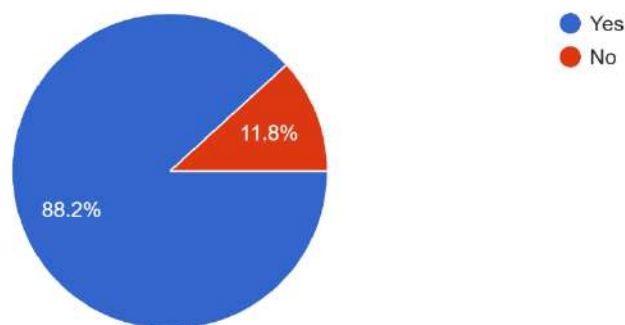
Q8

If Yes, what types of investments and wealth do you hold?

15 responses

Category	Value
Stocks	10 (66.7%)
Bonds	3 (20%)
Mutual funds	3 (20%)
ETFs	5 (33.3%)
Real Estate	7 (46.7%)
Cryptocurrencies	8 (53.3%)
ETC, Commodities	1 (6.7%)
Private business	6 (40%)
Currencies	2 (13.3%)
Cars	4 (26.7%)
Alternative investments (private…	2 (13.3%)
Hedge fund	1 (6.7%)
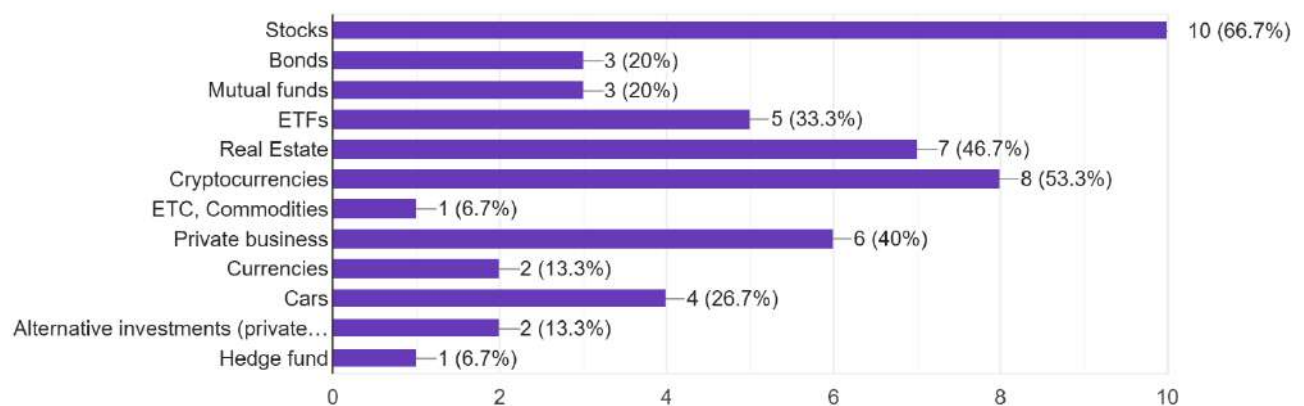
Q9

How important is portfolio diversification to you?

17 responses
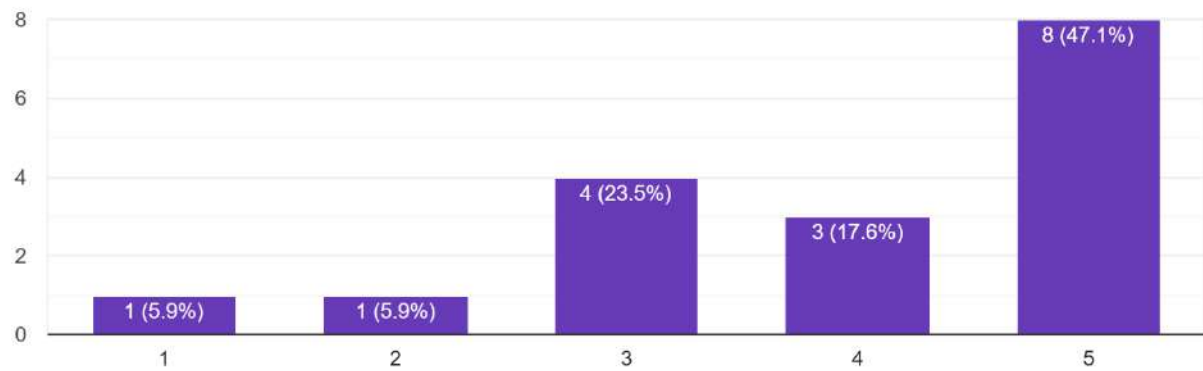
Q10

How diversified do you believe your investment portfolio is?

17 responses
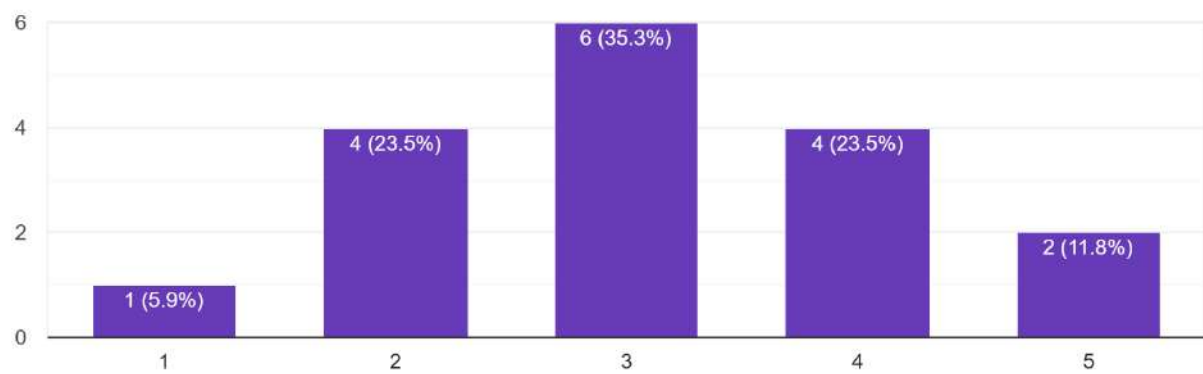
Q11

How likely are you to rebalance your investment portfolio in the next 2 years?

17 responses
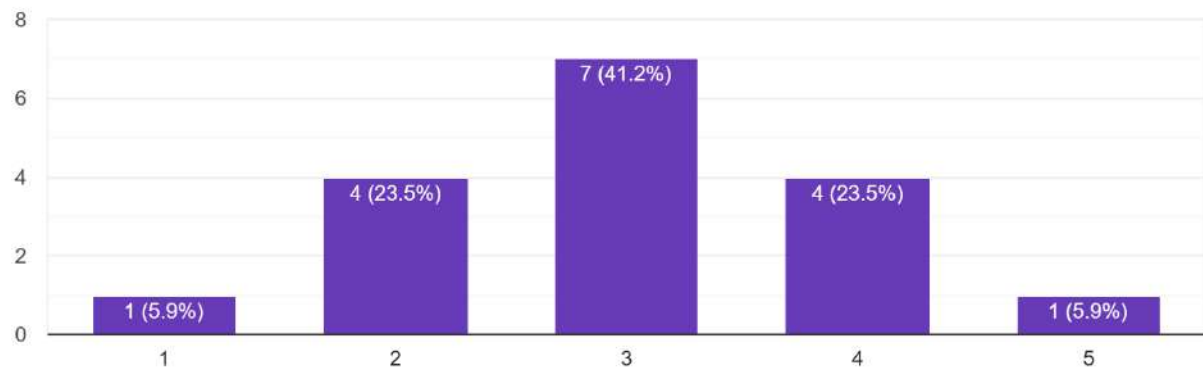
Q12

If you are likely to rebalance, what factors are most likely to trigger that decision?

17 responses
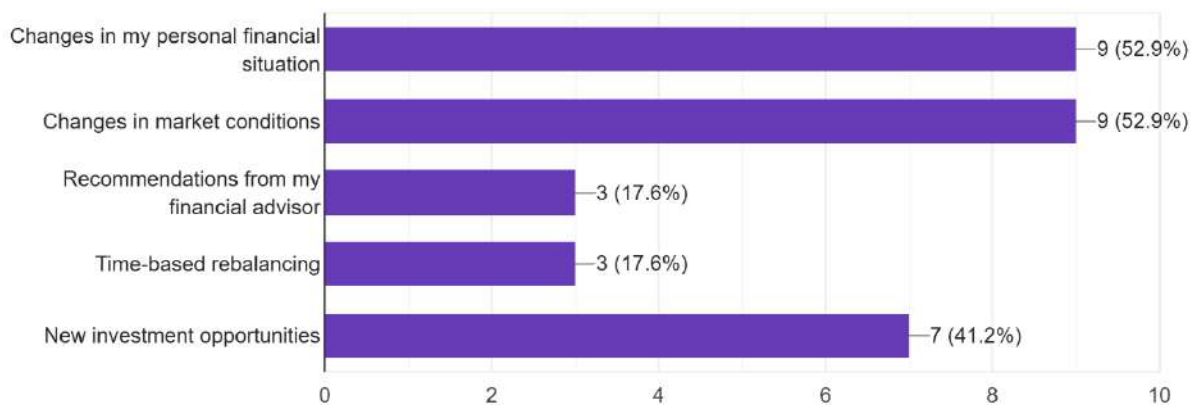
Q13

Are you a professional investor?

14 responses

- Yes
- No

85.7%

14.3%

Q14

Do you currently use any wealth management or investment apps?

17 responses

- Yes
- No

29.4%

70.6%

Q15

If yes, which apps do you use?

13 responses

Binance	1 (7.7%)
Degiro	3 (23.1%)
Degiro, Swissquot...	1 (7.7%)
Fp market, binanc...	1 (7.7%)
Google finance	1 (7.7%)
Interactive brokers	1 (7.7%)
Previously: Coinb...	1 (7.7%)
Revolut	1 (7.7%)
Smart Trading BP...	1 (7.7%)
Trade Republic	1 (7.7%)
fineco e...	1 (7.7%)

Q16

If yes, which apps do you use?

13 responses

Chart data:
- Binance: 1 (7.7%)
- Degiro: 3 (23.1%)
- Degiro, Swissquot...: 1 (7.7%)
- Fp market, binanc...: 1 (7.7%)
- Google finance: 1 (7.7%)
- Interactive brokers: 1 (7.7%)
- Previously: Coinb...: 1 (7.7%)
- Revolut: 1 (7.7%)
- Smart Trading BP...: 1 (7.7%)
- Trade Republic: 1 (7.7%)
- fineco e...: 1 (7.7%)

Q17

What are the most important features you look for in a wealth management / Fintech app? Select all that apply

17 responses

Chart data:
- Portfolio visualization: 13 (76.5%)
- Portfolio performance reporting: 8 (47.1%)
- Clear visualization of financi...: 7 (41.2%)
- Budgeting and financial plan...: 7 (41.2%)
- Goal setting and tracking: 6 (35.3%)
- Personalized investment rec...: 4 (23.5%)
- Low fees: 7 (41.2%)
- User-friendly interface: 9 (52.9%)
- Educational resources: 4 (23.5%)
- Security and privacy: 5 (29.4%)
- Customer support: 4 (23.5%)
- Portfolio tracking and perfor...: 3 (17.6%)
- (unlabeled): 1 (5.9%)

Appendix G - Benchmarking analysis

Link

Benchmarking analysis - Wealth management app.pdf

	Stocks	Bonds	ETFs	Currency	Crypto	Cars	Private business	Mutual funds	Real estate	Private equity	Collectibles	Loan	Mortgage
DEGIRO	●	●	●	●								●	
PayPal	●	●	●	●									
Revolut	●	●	●	●	●							●	
BINANCE	●	●	●	●	●								
Swissquote	●	●	●	●								●	
capital	●	●	●	●	●								
fpmarkets	●	●	●	●	●								
BYBIT					●								
eToro	●	●	●	●	●								
Google Finance	●	●	●	●	●								
Robinhood	●	●	●	●	●								
MERRILL	●	●	●	●								●	●
Aurora	●	●	●	●								●	●
BPER	●	●	●	●								●	●
mintos		●	●	●								●	
figs	●	●	●	●	●	●	●		●		●	●	●
yahoo finance	●	●	●	●									
YNAB	●	●	●	●		●		●				●	●

Peers benchmarking matrix Comparison table.pdf

Login
Onboarding
Tracking

Portfolio visualization
AI and Automation
Integrations
Security

Features to be prioritized

Portfolio visualization	AI and Automation	User Onboarding
Value overview	risk slider	product tour

Thematic Analysis and features to be prioritized.pdf

Appendix H – Personas map and user need statement

Link

Persona Template

Name: John Murphy
Age: 32
Gender: Male
Location: Zurich
Occupation: Manager
Income: €100,000

John Murphy is a driven and successful Manager of a thriving tech startup in Zurich. At 35, he's achieved significant financial success, but he's also keenly aware of the volatile nature of the business world. He's a balanced investor who understands the importance of diversification across various asset classes, seeking long-term growth while mitigating risk.

Prefers user-friendly interfaces with intuitive navigation.

Proficient in using various financial and investment apps.

Values security and data privacy.

dedicates time each month (or quarter) to review his portfolio's performance and rebalance as needed.

Device

Desktop

John is a data-driven decision-maker who demands rich, robust technical reporting to inform his investment strategies. He values efficiency and convenience, seeking a centralized platform to manage his entire portfolio and avoid the hassle of juggling multiple apps. In his free time, John enjoys staying informed about global economic trends, attending industry conferences, and spending time with his family.

John stays informed about market trends and economic news

John - The All Weather Investor

Demographics
(e.g. name, age, role, location)

Behaviours and habits
(e.g. hobbies, likes, dislikes)

Pain Points & Frustrations
(e.g. what they're struggling with)

Needs & Goals
(e.g. wants, hopes)

Quote: "I need a comprehensive view of my investments and data-driven insights to confidently navigate any market condition."

Make informed investment decisions based on comprehensive data and personalized insights.

Difficulty in obtaining comprehensive, consolidated reports across all asset classes.

John is frustrated by existing solutions that require manual data entry for illiquid assets and don't provide a holistic portfolio view.

Lack of personalized insights tailored to his specific portfolio and risk tolerance.

He needs the app to seamlessly integrate with his various bank accounts and brokerage firms, automating data aggregation.

Simplify portfolio management by consolidating all investments into a single platform.

Seamless integration with existing financial institutions and data sources.

Juggling multiple apps and platforms to manage different investments.

Lack of a comprehensive overview of his portfolio's performance.

Time-consuming manual data consolidation and analysis.

Personalized insights and recommendations based on his investment goals and risk profile.

User-friendly interface with intuitive navigation and reporting features.

He's trying to reach 1 million

Wealth Management app - Primary personas

John - The All Weather Investor

Wealth Management app - Primary user personas - User need statement.pdf

As a busy CEO and balanced investor, I need a single, consolidated platform that provides a holistic view of my entire portfolio, including both liquid assets like stocks and bonds *and* illiquid assets like real estate and collectibles, so I can efficiently monitor performance, assess asset allocation, and make informed strategic decisions to achieve my long-term financial goals without the hassle of managing multiple, disconnected systems.

Wealth Management app - Primary personas - Empathy map.pdf

Appendix I - User journey

Link

Wealth management app - Primary personas - User journey.pdf

Appendix J - Information Architecture & Sitemaps

Link

App Information Architecture - Version 1

Website Information Architecture - Version 1

Information Architecture - Website

Home

Solutions

Company | **Blog** | **Contact us** | **Login** | **Sign up**

Investments | **Reflect**

Current account	Real Estate	Goals
Saving account	Cars	Analysis
Broker	Crypto	
Cash		

Terms and Conditions | Privacy policy | Cookie policy

Utility Navigation

Primary Navigation

Secondary Navigation

Tertiary navigation

Notes

App IA - Version 2

Information Architecture - App

Dashboard

Portfolio
- Net worth
- Assets breakdown
- Watchlist
- Performances
- Related news

Add & Connect
- Manage connections
- Add
  - Bank
  - Brokerage
  - Pension
  - Loans & Mortgages
  - Crypto
  - Collectables
  - Cars
  - Property
  - Salary
  - Manual add

Reflect
- Portfolio analysis
- Sustainability analysis
- Risk assessment

Plan
- My goals
- Risk tolerance
- Retirement modeller
- Generate scenarios

Settings
- Manage connections
- Billing & Payment method
- Security
- Guides
- Product tour
- Help & Support
- Log out

Login
- Forgot password

Sign up
- Step 1
- Step 2
- Step 3
- Step 4

404

Utility Navigation
Primary Navigation
Secondary Navigation
Tertiary navigation
None

Terms and Conditions
Privacy policy
Cookie policy
How we handle data

Website IA - Version 2

Information Architecture - Website

Home

Solutions
- Asset classes
  - Bank accounts
  - Brokers
  - Pension
  - Loans & Mortgages
  - Real Estate
  - Cars
  - Cash
  - Crypto
  - Salary
  - Other assets
- Reflect
  - Investment goals
  - Investment analysis
  - Scenario generator
  - Risk assesment
  - Sustainability analysis

About us
- Partners
- Security

Open banking & Security

Pricing

Learn
- Blog
- Guides
- Help & Support

Login

Get started

404

utility navigation
Primary Navigation
Secondary Navigation
Tertiary navigation
None

Terms and Conditions
Privacy policy
Cookie policy
How we handle data

Appendix K – Design artefacts

Sketches
See Appendix K – Design artefacts/Sketches [here](#).

Wireframes
See Appendix K – Design artefacts/Wireframes [here](#).

UI Design System
See Appendix K – Design artefacts/UI Design System [here](#).

High fidelity prototype
See Appendix K – Design artefacts/High fidelity prototype [here](#).

Appendix L – Usability testing
[Link](#)

Low fidelity prototype Usability testing - Observational analysis & Affinity mapping
A significant number of usability issues were observed. The most frequently recorded issues were: '*process too long*, and'*confused,/unsure how to proceed*'. See the Observational analysis & Affinity mapping for insights, pain points and opportunities observations by task.

[Link](#)

High fidelity prototype v1 Usability testing - Observational analysis & Affinity mapping
[Link](#)

High fidelity prototype v2 Usability testing - Observational analysis & Affinity mapping
[Link](#)

Appendix M – Final test

Pre usability test survey

This is the version used in the final usability test.

Title: Aetas Wallet Usability test - pre test questionnaire

Description:

Thank you for agreeing to participate in the usability test for the Aetas Wallet prototype. This short pre-test questionnaire helps me understand your background, experience with digital technologies and investing, and your general views on the risks associated with your portfolio before you interact with the prototype. Please answer all the following questions.

Estimated completion time: 5 minutes

Your responses will be kept confidential and used solely for the purpose of this academic research project. The participation is voluntary, and you can withdraw at any time without providing a reason.

If you have any questions about this questionnaire or the study, please feel free to contact me at giuseppeditaranto98@gmail.com.

Question 1: Do you feel up-to-date with digital technologies?

a) Yes
b) No

Question 2: Do you currently invest your money?

a) Yes
b) No

Question 3: Have you ever used an app to track your investments, cash and/or your other assets?

a) Yes
b) No

Question 4: Do you think that financial diversification is:

a) Hold stocks and bonds
b) Don't hold too long the same asset
c) To invest in as many assets as possible
d) To Invest in assets to limit risk exposure
e) To Avoid high-risk assets
f) Do not know

Question 5: Which of these portfolios is better diversified?

a) 70% T-bills, 15% European equity fund, 15% in 2-3 stocks
b) 70% T-bills, 30% European equity fund
c) 70% T-bills, 30% in 2-3 stocks
d) 70% T-bills, 30% in stocks of companies I know well
e) Do not know

Question 6: What type of assets and holdings do you own?

_____

Question 7: Think about your ability in managing your portfolio. Compared to the average investor, do you think that you have

a) Much superior ability
b) Slight superior ability
c) About average
d) Slightly below average
e) Much below average

Question 8: How would you classify the risk of your total portfolio of assets on a scale from 1 to 7?

(Very low)   1 2 3 4 5 6 7   (Very high)

Question 9: To what extent are the risks associated to your holdings known precisely by you?

(Known precisely)   1 2 3 4 5 6 7   (Not known)

Question 10: Do you have the feeling that your investments and assets are easy or difficult to understand?

(Easy)   1 2 3 4 5 6 7   (Difficult)

Question 11: How high is the risk of your total investments and portfolio that all the invested money will be lost?

(Very low)   1 2 3 4 5 6 7   (Very high)

Question 12: Could a typical investor control the risks involved in your portfolio of assets?

(Full control)   1 2 3 4 5 6 7   (No control)

Question 13: Is there a risk of losing money because the value of your assets and holdings may not rise in line with inflation?

(No risk)   1 2 3 4 5 6 7   (High risk)

Question 14: How high is the risk that the return of your total investments and portfolio will be lower than expected?

(No risk of lower return)　　1 2 3 4 5 6 7　　(High risk of lower than expected return)

Question 15: How great is the risk that the value of your assets and holdings will go down as well as up?

(No risk)　　1 2 3 4 5 6 7　　(Substantial risk)

Post usability test survey
This is the version used in the final usability test

Title: Aetas Wallet Usability test - post test questionnaire

Description:

Thank you for completing the usability test of the Aetas Wallet prototype!

This short pre-test questionnaire helps me understand your background, investing experience, and your general views on the risks associated with your portfolio after you interacted with the prototype. Please answer all the following questions.

Estimated completion time: 5 minutes

Your responses will be kept confidential and used solely for the purpose of this academic research project. The participation is voluntary, and you can withdraw at any time without providing a reason.

If you have any questions about this questionnaire or the study, please feel free to contact me at giuseppeditaranto98@gmail.com.

Question 1: Do you think that financial diversification is:

- g) Hold stocks and bonds
- h) Don't hold too long the same asset
- i) To invest in as many assets as possible
- j) To Invest in assets to limit risk exposure
- k) To Avoid high-risk assets
- l) Do not know

Question 2: Which of these portfolios is better diversified?

- f) 70% T-bills, 15% European equity fund, 15% in 2-3 stocks
- g) 70% T-bills, 30% European equity fund
- h) 70% Tbills, 30% in 2-3 stocks
- i) 70% T-bills, 30% in stocks of companies I know well
- j) Do not know

Question 3: What type of assets and holdings do you own?

_____

Question 4: Think about your ability in managing your portfolio. Compared to the average investor, do you think that you have

- f) Much superior ability
- g) Slight superior ability
- h) About average
- i) Slightly below average
- j) Much below average

Question 5: How would you classify the risk of your total portfolio of assets on a scale from 1 to 7?

(Very low)　　1 2 3 4 5 6 7　　(Very high)

Question 6: To what extent are the risks associated to your holdings known precisely by you?

(Known precisely)　　1 2 3 4 5 6 7　　(Not known)

Question 7: Do you have the feeling that your investments and assets are easy or difficult to understand?

(Easy)　　1 2 3 4 5 6 7　　(Difficult)

Question 8: How high is the risk of your total investments and portfolio that all the invested money will be lost?

(Very low)　　1 2 3 4 5 6 7　　(Very high)

Question 9: Could a typical investor control the risks involved in your portfolio of assets?

(Full control)　　1 2 3 4 5 6 7　　(No control)

Question 10: Is there a risk of losing money because the value of your assets and holdings may not rise in line with inflation?

(No risk)　　1 2 3 4 5 6 7　　(High risk)

Question 11: How high is the risk that the return of your total investments and portfolio will be lower than expected?

(No risk of lower return)　　1 2 3 4 5 6 7　　(High risk of lower than expected return)

Question 12: How great is the risk that the value of your assets and holdings will go down as well as up?

(No risk)　　1 2 3 4 5 6 7　　(Substantial risk)

SUS Questionnaire

For each of the following statements, mark one box that best describes your reaction to the Aetas Wallet app today.

S1: I think that I would like to use this system frequently.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

S2:I found the system unnecessarily complex.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

S3:I thought the system was easy to use.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

S4:I think that I would need the support of a technical person to be able to use this system.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

S5:I found the various functions in this system were well integrated.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

S6:I thought there was too much inconsistency in this system.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

S7:I would imagine that most people would learn to use this system very quickly.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

S8:I found the system very cumbersome to use.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

S9:I felt very confident using the system.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

S10:I needed to learn a lot of things before I could get going with this system.

(Strongly disagree) 1 2 3 4 5 (Strongly agree)

Usability test survey results

Table 8 - Pre-usability test survey results – 3rd round

	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7
Do you feel up-to-date with digital technologies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Do you currently invest your money?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Have you ever used an app to track your investments, cash, and/or other assets?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Do you think that financial diversification is:	To invest in assets to limit risk exposure	Hold stocks and bonds	To invest in assets to limit risk exposure	To invest in assets to limit risk exposure	To invest in assets to limit risk exposure	To invest in assets to limit risk exposure	To invest in assets to limit risk exposure
Which of these portfolios is better diversified?	70% T-bills, 30% European equity fund	Do not know	70% T-bills, 15% European equity fund, 15% in 2-3 stocks	70% T-bills, 15% European equity fund, 15% in 2-3 stocks	70% T-bills, 15% European equity fund, 15% in 2-3 stocks	70% T-bills, 15% European equity fund, 15% in 2-3 stocks	70% T-bills, 15% European equity fund, 15% in 2-3 stocks
What type of assets and holdings do you own?	Cash, Collectibles, Private equity	Cash, Stocks, Funds, Real estate, pension	Cash, Futures, Car,	Stocks, Funds, Pension	Stocks, ETFs, Crypto, Pension	Stocks, cash and real estate	Real estate, cash, stocks, crypto
Think about your ability to manage your portfolio. Compared to the average investor, do you think that you have	Much below average	Much below average	Much below average	About average	Slightly below average	About average	Slight superior ability
How would you classify the risk of your total portfolio of assets on a scale from 1 to 7?	3	2	2	3	3	3	3
Question 15 (Is there a risk that you will be unable to cash in your investments at short notice without a substantial penalty?)	2	4	3	4	2	3	2
Question 5 (To what extent are any losses from your assets known immediately?)	2	2	1	2	2	3	2
Question 12 (Do you think your assets are easy or complex to understand?)	2	1	2	3	2	2	2
Question 23 (Do individual investors spend much time monitoring this investment?)	2	2	1	2	3	3	2
Question 25 (How great is the risk that you will be ruined due to this investment?)	2	3	2	3	3	2	3
Question 3 (How severe could the consequences of owning this product be, should it prove unsatisfactory?)	2	3	2	2	2	3	2
Question 10 (Could significant losses or failure of the assets you own affect the EU economy?)	3	2	2	3	4	3	3
Question 9 (How great is the risk of losing all the money you put into this investment product?)	2	3	2	3	3	2	3
Question 26 (How great is the risk that the return from your investment might fall below expectations?)	3	2	3	2	2	3	2
Question 19 (Is there a risk of losing money because the investment's value may not match inflation?)	4	2	3	3	3	4	5
Question 2 (How much uncertainty is there regarding the expected return for your investments ?)	3	5	3	2	2	3	6

Question 27 (How great is the risk that the return from this investment will go down and up?)	4	4	3	1	5	1	1
Question 7 (Are the risks from your investment products known to financial experts?	2	3	2	3	4	3	2
Question 6 (Would a typical investor know about the risks involved in your assets?)	3	2	2	3	2	4	3
Question 11 (To what extent can individual investors observe any losses from your investments?)	4	2	1	3	1	1	2
Question 17 (To what extent will the government protect investors if something goes wrong with the types of assets in your portfolio?)	3	4	3	3	2	3	3

Table 9Post usability test survey results

	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7
Do you think that financial diversification is:	To invest in assets to limit risk exposure	Hold stocks and bonds	To invest in assets to limit risk exposure	To invest in assets to limit risk exposure	To invest in assets to limit risk exposure	To invest in assets to limit risk exposure	To invest in assets to limit risk exposure
Which of these portfolios is better diversified?	70% T-bills, 30% European equity fund	Do not know	70% T-bills, 15% European equity fund, 15% in 2-3 stocks	70% T-bills, 15% European equity fund, 15% in 2-3 stocks	70% T-bills, 15% European equity fund, 15% in 2-3 stocks	70% T-bills, 15% European equity fund, 15% in 2-3 stocks	70% T-bills, 15% European equity fund, 15% in 2-3 stocks
What type of assets and holdings do you own?	Cash, Collectibles, Private equity	Cash, Stocks, Funds, Real estate, pension, cars	Cash, Futures, Car, pension	Stocks, Funds, Pension, cars	Stocks, ETFs, Crypto, Pension,	Stocks, bonds, cash and real estate	Real estate, cash, stocks, crypto, pension
Think about your ability to manage your portfolio. Compared to the average investor, do you think that you have	Much below average	Much below average	Much below average	About average	Slightly below average	About average	Slight superior ability
How would you classify the risk of your total portfolio of assets on a scale from 1 to 7?	3	2	1	4	4	2	3
Question 15 (Is there a risk that you will be unable to cash in your investments at short notice without a substantial penalty?)	1	5	2	2	3	4	3
Question 5 (To what extent are any losses from your assets known immediately?)	3	4	3	2	3	3	4
Question 12 (Do you think your assets are easy or complex to understand?)	2	1	2	4	3	2	3
Question 23 (Do individual investors spend much time monitoring this investment?)	2	3	1	4	4	3	2
Question 25 (How great is the risk that you will be ruined due to this investment?)	1	3	2	2	3	2	3
Question 3 (How severe could the consequences of owning	2	4	1	2	2	3	2

this product be, should it prove unsatisfactory?)							
Question 10 (Could significant losses or failure of the assets you own affect the EU economy?)	4	4	1	6	6	5	4
Question 9 (How great is the risk of losing all the money you put into this investment product?)	2	3	3	4	3	2	3
Question 26 (How great is the risk that the return from your investment might fall below expectations?)	4	2	3	4	3	2	2
Question 19 (Is there a risk of losing money because the investment's value may not match inflation?)	4	3	3	5	3	4	6
Question 2 (How much uncertainty is there regarding the expected return for your investments ?)	3	4	3	2	2	3	5
Question 27 (How great is the risk that the return from this investment will go down and up?)	5	4	3	1	4	2	1
Question 7 (Are the risks from your investment products known to financial experts?	3	1	7	3	2	3	3
Question 6 (Would a typical investor know about the risks involved in your assets?)	2	3	1	2	1	2	2
Question 11 (To what extent can individual investors observe any losses from your investments?)	1	3	1	3	3	2	1
Question 17 (To what extent will the government protect investors if something goes wrong with the types of assets in your portfolio?)	3	3	4	1	3	3	4

Table 10 - Risk Perception Variation of Investors Pre and Post Usability Testing

	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7	Mean	Standard deviation
Δq-risk	0	0	1	1	1	1	0	0.5714285714	0.5345224838
Δq15	1	1	1	2	1	1	1	1.142857143	0.377964473
Δq5	1	2	2	0	1	0	2	1.142857143	0.8997354108
Δq12	0	0	0	1	1	0	1	0.4285714286	0.5345224838
Δq23	0	1	0	2	1	0	0	0.5714285714	0.7867957925
Δq25	1	0	0	1	0	0	0	0.2857142857	0.4879500365
Δq3	0	1	1	0	0	0	0	0.2857142857	0.4879500365
Δq10	1	2	1	3	2	2	1	1.714285714	0.755928946
Δq9	0	0	1	1	0	0	0	0.2857142857	0.4879500365

Δq26	1	0	0	2	1	1	0	0.7142857143	0.755928946
Δq19	0	1	0	2	0	0	1	0.5714285714	0.7867957925
Δq2	0	1	0	0	0	0	1	0.2857142857	0.4879500365
Δq27	1	0	0	0	1	1	0	0.4285714286	0.5345224838
Δq7	1	2	5	0	2	0	1	1.571428571	1.718249386
Δq6	1	1	1	1	1	2	1	1.142857143	0.377964473
Δq11	3	1	0	0	2	1	1	1.142857143	1.069044968
Δq17	0	1	1	2	1	0	1	0.8571428571	0.6900655593

Table 11 - Total perceived risk variation on Likert scale

ΔR (Total Perceived Risk Variation on Likert Scale)	(%)	S.D.
0.7731092437	12.89%	0.3262312

Paired samples t-test

A paired samples t-test was done to compare the means of the same group of participants at two different time points (pre-test and post-test). The individual participant scores were used to calculate the differences between pre-test and post-test for each participant, as the paired t-test analyzed these differences.

- **Participants (N):** 7

- **Pre-test Scores (rounded):** 2.7059, 2.7059, 2.1765, 2.6471, 2.6471, 2.7059, 2.7059

- **Post-test Scores (rounded) :** 2.6471, 3.1250, 2.4118, 3.0000, 3.0588, 2.7647, 3.0000

- **Alternative Hypothesis (H₁):** There is a significant difference in the mean perceived risk score between the pre-test and the post-test ($\mu\_diff \neq 0$). This is a two-tailed test as the study is looking for *any* change, not specifically an increase or decrease.

- **Null Hypothesis (H₀):** There is no significant difference in the mean perceived risk score between the pre-test and the post-test ($\mu\_diff = 0$).

The post test score and pre test score differences were calculated for each participant.

	Post test score	Pre test score	Δ
P1	2.6471	2.7059	0.0588
P2	3.1250	2.7059	0.4191
P3	2.4118	2.1765	0.2353
P4	3.0000	2.6471	0.3529
P5	3.0588	2.6471	0.4117
P6	2.7647	2.7059	0.0588
P7	3.0000	2.7059	0.2941

The mean of the Differences (M_diff) is 0.2447.

Standard Deviation of the Differences is then calculated:

- Variance (s_diff²): Σ(difference - M_diff)² / (N-1) ≈ 0.1993 / 6 ≈ 0.0332
- Standard Deviation (SD_diff): √0.0332 ≈ 0.1822

T-statistic

Standard Error of the Mean Difference (SE_diff): SD_diff / √N = 0.1822 / √7 ≈ 0.1822 / 2.6458 ≈ 0.0689

t-statistic: M_diff / SE_diff = 0.2447 / 0.0689 ≈ 3.553

Degrees of Freedom (df): df = N - 1 = 7 - 1 = 6

P-value

The t-statistic (3.553) with 6 degrees of freedom is used for a two-tailed test.

The p-value associated with t(6) = 3.553 is approximately p = 0.0119.

Since the p-value is less than the significance level (α = 0.05 > p=0.0119) the null hypothesis (H_0) is rejected.

Appendix N - Ethical and legal considerations

Link

Money managers, investment consultants, and financial planners are regulated in the United States as "investment advisers" under the U.S. Investment Advisers Act of 1940 ("Advisers Act" or "Act") or similar state statutes.

As requested by the Act a financial disclaimer was included in different deliverables to state that the content of the research is for informational purposes only, any reader should not construe any such information as investment, financial or other advice.

The research focuses on the design of an app that manages diversified portfolios; it does not inherently advocate for diversification as the universally optimal investment strategy.

There are risks associated with investing in securities. Investing in stocks, bonds, exchange-traded funds, mutual funds, and money market funds involves risk of loss. Loss of principal is possible. Some high-risk investments may use leverage, which accentuate gains & losses. Foreign investing carries unique risks, including heightened volatility, political, economic, and currency fluctuations, as well as differences in accounting standards. Past performance of a security or firm is no indication of future results.

While the research focuses on design, interacting with financial concepts or reflecting on one's financial situation could potentially cause some participants mild distress. To mitigate this it was ensured that the research tasks are not overly sensitive or likely to evoke negative emotions, although this is less likely in a design-focused study than one directly investigating financial well-being.

This proposal is submitted in line with IDEO (IDEO & Fulton Siri, 2015), Baxter, Courage, and Caine (2015), and IADT DTPEC (2021-2022) application form requirements. Ethically, all participants were required to sign a consent form for their participation and data collection and publication. No personal identifiable information was published. All respondents were over the age of 18. All participation was voluntary, though reminders may be sent as agreed. Respondents can withdraw their data and participation at any time. Research and design were performed openly and candidly using positive means only. No deception or misleading of research subjects or reviewers was permitted. No inducements or prizes were offered, though a copy of the final published research can be shared if desired.

GDPR requirements concerning the capture, storage, and sharing of information were adhered to. Data capture and storage were done within the IADT platform and tools unless user preference overrides the feasibility of collection. Respondents were not be asked to disclose any images or devices, but only provide image descriptive and quantitative data.

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