A Prototype Web Application for the use of Quantitative Analysis in Interactive Product Development

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An exegesis presented in partial fulfillment of the requirements for the degree of Master of Design, Massey University, Wellington, New Zealand. 2022

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Abstract

Great design increasingly requires great research. Similar to other research methods, the field of interactive product research is divided into two broad categories: qualitative research and quantitative research. Researchers can choose different research tools based on their research objectives and the type of data they wish to collect. Qualitative research can answer relatively macro questions such as "what" and "why," but is usually not considered to be a source of statistical data. The quantitative method can answer questions such as “how much” and can accurately present trends related to the problem. To support the design proposal this exegesis surveys practitioners to analyze and summarize current views and methods relating to quantitative research in the field of interactive product design. The survey conducted shows that design practitioners generally have a positive attitude towards quantitative research, but at the same time there is a shortfall in their understanding, for instance, relating to ease of conducting in-depth quantitative studies.

This exegesis introduces the Statiqx quantitative analysis tool to improve user experience designs for interactive products. Statiqx integrates the current mainstream statistical methods and can automatically choose statistical methods based on the user's goals. Users only need to upload the original data, such as a system usability scale (SUS), net promoter score (NPS) questionnaire, or usability test measurements to immediately gather results. The results not only include some common and simple calculations, but also specialist statistical calculations, such as median, confidence interval, confidence, regression analysis, correlation, etc. These statistical analysis results generated by Statiqx aim to help the interactive product team make better decisions or carry out further in-depth analysis. The whole process does not require users to know how to use any mathematical formula in Excel or more complex professional statistical software, nor does it require users to understand the principle and algorithm behind the formula. This greatly reduces the operational difficulty of quantitative analysis. Statiqx is suitable for novice and non-professional user experience practitioners who want to conduct quantitative analysis.

Keywords

Benchmarking, UX, Interaction design, Quantitative research, SUS, A/B test, HCI

Contents

Chapter 1. Introduction

In this chapter, I provide a basic introduction to this research project, including the background of the project, my research objectives and methodology.

1.1 Project Introduction

Alan Cooper brought user research to the software field in 1992 (Krishna, 2015), and ever since, research has played an important role in product development. In user research, two different data types can be obtained based on different research purposes, they include qualitative and quantitative research methods. In practice, qualitative research is more common, as qualitative methods are more flexible, there are more methods available, and a relatively small sample number can be accepted (Cooper, 2014). Quantitative research has some specific limitations, such as requiring a large number of samples in most cases, knowledge barriers relating to the implementation of a study, technical barriers, understanding the results, and so on.

Another possible interpretation is that practitioners are satisfied with the results brought by qualitative analysis, while quantitative analysis does not attract enough attention. For example, Cooper (2014) holds that quantitative analysis can only answer questions like "more and less", and it lacks the rich and diversified questions like "what", "how" and "why" that qualitative research can answer and cannot describe the complex and changeable behavior of human beings.

However, the benefits of quantitative research are obvious. For example, Cooper also believes that quantitative research is the only way to calculate ROI (Return on Investment), which is an important business indicator for measuring user experience. It is believed that quantitative research is helpful for designers and users to establish replicable and valuable user experience (King et al., 2017). While qualitative techniques can provide the designer insight into why people use the product and how some people use the product, they cannot accurately provide the designer with detailed information on the demographics of users and trends in the user population (Goodman et al., 2012). Subjective measurements should be collected as quantitative data, rather than qualitative data as is common today, because quantitative data can be analyzed in combination with objective and subjective measurements "(Brooks & Hestnes, 2010). In a data-driven world, the ability of designers to identify and analyze problems from a data-driven perspective becomes very important.

Cross-functional communication often presents many challenges in real product development. For example, how the design team can convince the engineering team to accept its design proposal, and how to convince the project management team to get more resources. These goals are difficult to achieve with

simple qualitative data. Using quantitative research methods, with the help of the objectivity and intuitiveness of data, can help improve the communication efficiency between different business teams and avoid differences of opinion.

Since 1982, the Association for Computing Machinery in the United States (ACM), recognizing the growing need to consider the user experience in software, formed the Special Interest Group on Human-Computer Interaction (SIGCHI). Soon after, human-computer interaction (HCI) became a sub-discipline of computer science (King, 2016). The range of interactive products is wide, including websites, desktop applications, mobile applications, as well as hardware supporting these software products, which is the industrial design element of the product. At present, there are powerful quantitative research tools available (e.g., Hotjar and Google Analytics) for internet products, which can collect quantitative data through various means. However, there are few research tools for non-internet products.

Some scholars (e.g Sauro and Tullis) have discussed the issue of quantitative research in interactive product development, but these theories are difficult to understand for practitioners who lack the relevant background knowledge. These theories only relate to professional statistical software and lack reference to supportive computer tools for this group. My research is based on this background. I will use the method of user experience design to explore the possibility of easier quantitative analysis in user experience research, so as to help user-experience practitioners who wish to use quantitative analysis in practice to better conduct user research.

1.2 Research Aim

My research objective is to explore the following topics by producing a minimum viable product (MVP) (Lynch et al., 2016):

1. Explore the needs of interactive product practitioners for quantitative research in product research.
2. Design a prototype for a tool with the method of human-centered design to carry out quantitative research in the process of interactive product development, so as to help practitioners make design proposals and communicate with cross-functional teams.
3. Some educational features to be designed to guide new interactive products practitioners in carrying out quantitative research.

1.3 Methodology

1.3.1 Human-Centered Design

In ISO 9241-210 (2019), user-centered design is defined as an "approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques." Marsh (2015) said user experience (UX) designers design for other people's intuitions, not their own. Therefore, adopting human-centered design in user experience design can help to find and analyze problems from the perspective of users, rather than the perspective of a developer, so as to better meet the needs of users.

1.3.2 Double Diamond

The second methodology I adopted is Double Diamond (Design Council, 2019), which summarizes the whole Design development process into four stages, namely Discover, Define, Develop and Deliver. An important feature of design work is the need to explore many options before settling on the final one. The shape of the diamond encapsulates this process, that is, diverging and then converging.

Another significant feature of Double Diamond is that it emphasizes two important stages of design, namely problem definition and problem solution, represented by two diamonds respectively. In practice, for some junior designers, it is easy to focus on problem solving instead of clearly defining the problem, which leads to providing a solution to the wrong requirements. The Double Diamond theory reminds us to put the definition of the problem at the forefront, which is exactly the starting point of my project. The use of the Double Diamond theory helped to make the task focus of each phase clearer in the Statiqx project.

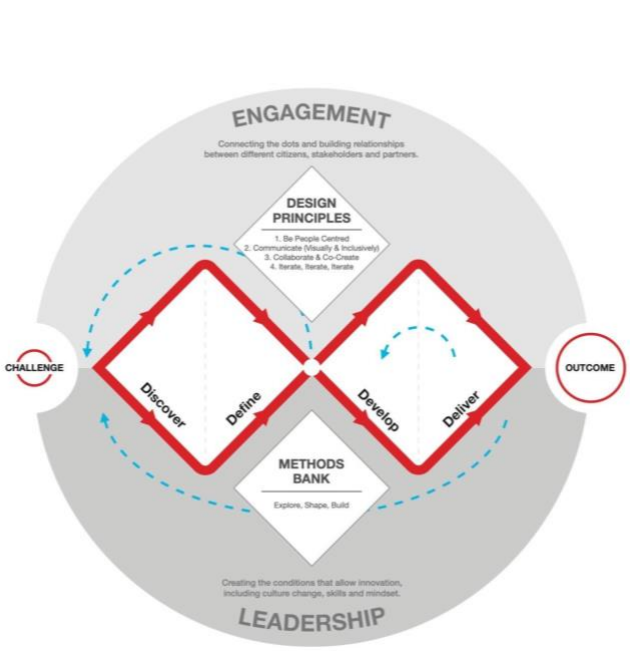


Figure 1: *Double diamond model (Design Council, 2019).*

The following table shows the corresponding relationship between the specific design process of Statiqx and the two major stages of Double Diamond.

Discover	Define	Develop	Deliver	
● Secondary research ● Primary research ○ Survey ○ Competitive audit report ○ Competitive Matrix ○ User requirements definition		● Personas ● Information architecture design ● User journey map ● Low-fidelity wireframes ● High-fidelity prototype ● Use scenario design ● Usability testing		Iteration

Table 1: *Design process mapping to double diamond model.*

1.3.3 Lean UX

The third methodology I use is Lean UX, described in Lean UX by Gothelf and Seiden (2021). It has three foundations: design thinking to solve problems, agile development methods, and Lean entrepreneurship.

User experience is a holistic term that refers to the broad design principles involved in creating useful, usable, and enjoyable systems. User interface (UI) design is just one of them (Rowland et al. 2015).

The origins of Lean UX can be traced back to lean production systems designed to eliminate waste in production -- activities that do not add value to the end customer - at maximum efficiency (Follett, 2017).

The design ideas of Lean UX have guided my research in the following ways:

- The attempt to use design thinking to think about problems in each link.
- A focused attention on core values and delivering a minimum viable product (MVP) in the simplest possible way.
- Working on different tasks simultaneously and trying an iterative approach.
- Constant exploration and elimination of waste. Doing more, less analysis, and getting the first version of an idea done is more valuable than spending half a day debating whether it's good or bad (Gothelf & Seiden 2021).

Of course, cross-functional cooperation is an important aspect of Lean UX, but in the early stage of this research, I mainly completed it independently under the guidance of my supervisor. Cross-functional collaboration is beyond the scope of my research as a Master of Design candidate.

Chapter 2. Research

In this chapter, I combined secondary research, competitive product analysis, and primary research to investigate quantitative user research in the field of interactive product development, sorting out and summarizing academic research and products related to user research of interactive products. It involves different views of different scholars on qualitative and quantitative research, commonly used metrics in quantitative research, summary of mainstream theories and methods, analysis of similar products, and excavation of user needs.

2.1 Qualitative and Quantitative Research in the Field of User Experience Design

For the use of quantitative research in product development, some people strongly advocate quantitative research methods, such as Sauro and Tullis. In Measuring the User Experience, Albert and Tullis (2013) summarized practitioners' misunderstandings of quantitative research into 10 points, which are as follows:

1. Metrics take too much time to collect.
2. User experience metrics cost too much.
3. Quantitative studies are useless when focusing on small improvements.
4. Quantitative research is not helpful for practitioners to understand the causes of problems.
5. Measure excessive noise generated during user experience.
6. Practitioners only trust their instincts.
7. User experience metrics are not appropriate for new products.
8. There is no measure that can be applied to the problem that practitioners are dealing with.
9. Metrics are not understood or appreciated by management.
10. It is difficult to collect reliable data with small samples.

I made a summary of the current views between qualitative and quantitative through the following table.

	Qualitative	Quantitative
Goal	1. Identify usability issues. 2. Find out the cause of the problem. 3. Understand the usage context of the product. 4. Understanding user behavior and attitudes (Cooper et al., 2014).	1. Different schemes are compared before. 2. Comparison with competitors. 3. Calculate ROI (Cooper et al., 2014), (Budiu, 2017). 4. Computational significance (Budiu, 2017).
Methods	1. Persona. 2. Interview. 3. User journey map. 4. Storyboard.	1. Standard usability questionnaire. 2. Quantified data for usability tests. 3. Web analytics tools such as Google Analytics, HotJar (see 3.3).
Methods of identifying problems	Based on the researcher's observation, discovery and interpretation, the process is somewhat subjective.	Based on objective measurements, user-filled scales, system recorded data, etc.
Type of data	A description: Why, what, etc.	A group of numbers: how many/much, etc.
Stages of adoption	Formative and summative (Budiu, 2017).	Formative and summative.
Sample size	No requirement on the number of participants, mostly in small batches.	Quantitative studies often require more than 30 people, using statistical techniques to protect themselves from random events (Budiu, 2017).
Disadvantage	1. Can't describe the scale of the problem. 2. The discovery of problems is subjective to a certain extent. 3. There will be an evaluator effect that is based on the researcher's level of knowledge and experience to promote any and interpret the meaning of user behavior. Different people will identify different problems (Budiu, 2017). 4. Qualitative indicators are usually chaotic, subjective, unstructured, experiential, revealing and difficult to classify (Croll & Yoskovitz, 2013).	1. Data needs to be interpreted in a specific context. 2. If you want to achieve strong statistical significance, most cases rely on large samples, which is slightly more difficult to implement and costs more. 3. Lack of intuitive observation (Croll & Yoskovitz, 2013). 4. Quantitative data is most scarce in the early stages of a startup.
Advantage	1. With flexibility, small samples can also be carried out. 2. Able to know what users are thinking while doing the task by thinking aloud on usability testing. 3. Able to achieve in-depth communication with users. 4. Qualitative can tell users whether they like or dislike using your product to	1. Avoid bias (Travis & Hodgson, 2019). Quantitative research is based on objective data analysis and has its scientific basis. Decision makers do not have to make business decisions based on unnecessary assumptions or intuitions. 2. Structural factors are added to the study (Albert & Tullis, 2013). By controlling variables, increasing or decreasing the sample size, or adjusting and optimizing the metric of the study, the study

	perform tasks. 5. Qualitative is better at predicting negative situations (for example, users won't use a feature) (Klein, 2013). 6. Qualitative data helps to build user empathy and understand users' thoughts or attitudes, concepts and values (King et al., 2017).	becomes more systematic. 3. Integrated subjective and objective factors (Brooks & Hestnes, 2010). For example, Veral's response card evaluation method (Veral & Macías, 2019) uses 118 cards to represent 118 qualitative questions and obtains an overall qualitative quantitative research result based on users' responses to these questions. A combination of objective and subjective variables should better reflect the complexity of the quality experience (Brooks & Hestnes, 2010). 4. Able to understand the scale of a problem. 5. Eliminate noise and save information in objective data to avoid unnecessary arguments. Qualitative studies with small samples are prone to some "random" problems, but cannot predict the scale and generality of the problem, these noise-problems can interfere with the pace of development. Quantitative research usually has a relatively large sample, so as to determine the priority of the problem, and thus has the ability to avoid noise. 6. Quantitative data is easy to use, scientific, easy to classify, extrapolate, and put into tables (Croll & Yoskovitz, 2013).

Table 2: *Comparison between qualitative research and quantitative research.*

Through the above comparison, it is easy to conclude that quantitative research has many advantages in interactive product development research. Of course, the advantages of carrying out two kinds of research at the same time can be complementary. However, compared with different projects, the proportion of the two should be flexibly balanced due to different research purposes and different resource constraints. For example, in collecting data for the Statiqx project, a mixture of qualitative and quantitative methods was adopted.

2.2 Theory and Method

Quantitative research mainly includes the following aspects, namely:

1. Data collection. This includes what methods to collect and what types of Metrics to use, such as scales or user tests.
2. Analysis and reporting. How to process the collected biological data to get the conclusions you want.

2.2.1 Collection of Quantitative Data

The basic steps of quantitative research in user experience are firstly the collection of raw data, then analysis and reporting of data. Data collection methods mainly include the following:

Usability testing. This includes moderated study and unmoderated study. Through a number of tests, users' performance data in the test, such as task time and task success rate, can be collected.

Figure 2: *Moderated usability test, photograph by author (2017).*

Questionnaires and scales. Based on common questionnaires such as SUS and NPS, users' subjective evaluations can be quantified for further analysis. Reaction cards and so on. Or some other professional usability test questionnaire. SUPR-Q, UxUX-Lite, SUPR-QM and so on (Sauro, 2018).

SUS

The System Usability Scale (SUS) is a standardized questionnaire widely used to assess perceived availability (Lewis & Sauro, 2018). In industrial usability studies, SUS accounts for 43% of post-study questionnaire use (Sauro & Lewis, 2009).

Bangor et al. (2008) proposed the results of evaluating numerous products at different stages of development based on the use of uniform criteria for nearly 10 years (based on more than 2300 complete standardized questionnaires collected from more than 200 studies). Their analysis and experience show that SUS is a "highly robust and versatile tool for usability professionals" (p. 574).

	The System Usability Scale Standard Version		Strongly Disagree				Strongly Agree
			1	2	3	4	5

1	I think that I would like to use this system frequently.		o	o	o	o	o
2	I found the system unnecessarily complex.		o	o	o	o	o
3	I thought the system was easy to use.		o	o	o	o	o
4	I think that I would need the support of a technical person to be able to use this system.		o	o	o	o	o
5	I found the various functions in this system were well integrated.		o	o	o	o	o
6	I thought there was too much inconsistency in this system.		o	o	o	o	o
7	I would imagine that most people would learn to use this system very quickly.		o	o	o	o	o
8	I found the system very awkward to use.		o	o	o	o	o
9	I felt very confident using the system.		o	o	o	o	o
10	I needed to learn a lot of things before I could get going with this system.		o	o	o	o	o

Table 3: *The system usability scale standard version.*

SUS still shows itself to be a useful and practical quantitative tool that complements more direct observations or comments about software use (Tullis & Stetson, 2004).

"In and of itself, it makes no sense whether a grade is good or bad. This judgment requires some kind of comparison. One type of comparison is a statistical comparison of two sets of data from different products or different user groups. Another is the comparison with the specification. The basis for the specification is data collected from representative populations with sample sizes large enough to establish percentiles. In the interesting correspondence of these experience-based rating scales, we note that achieving an SUS of 80 is becoming a common industry goal as evidence of an above-average user experience (Lewis, 2018)".

NPS

One of the reasons many organizations use net promoter scores (NPS) as a key indicator of success is that it has been shown to be loosely correlated with revenue growth (Reichheld, 2003).

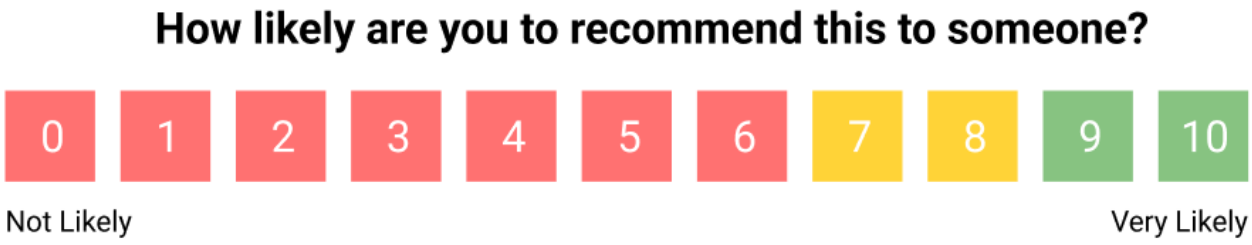


Figure 3: *The net promoter score.*

Other higher tech methods include user click behavior analysis (Dai, 2014), eye tracking (Albert & Tullis, 2013), etc.

User click behavior analysis

By observing and excavating the data generated by users' clicking behaviors on the page and analyzing it, we can judge whether the content and structure of the page design meet the expectation of product design (Dai, 2014).

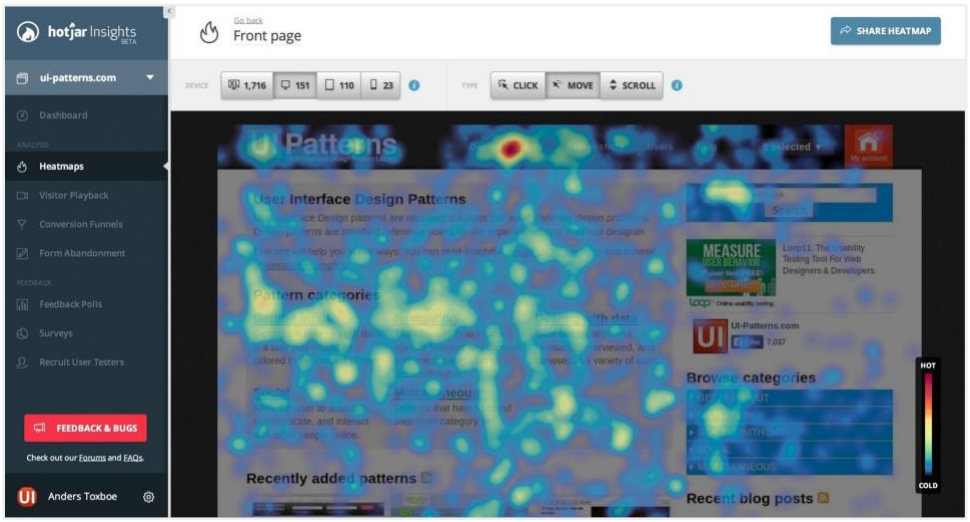


Figure 4: *Mouse-clicking heat map in Hotjar (Toxboe, 2014).*

ROI

Another metric that quantifies user experience is ROI, which measures how much money spent translates into enterprise value. One of the most commonly used measures of return on investment is conversion rate. Another indicator related to ROI is the "incidence of shopping cart abandonment" (Garrett, 2010).

Different metrics can be selected as primary metrics for different purposes or criteria.
In ISO 9214-11 (1998), efficiency, effectiveness, and satisfaction are given as the main indicators for quantifying usability. The indicators of ISO/IEC 9126-1 (2001) include understandability, learnability, operability, depression, and usability compliance with published style guides or conventions for user interfaces.

Measurement types given in *Measuring the User Experience* by Albert & Tullis (2013) include Task success, task-on-time, errors, efficiency, and learnability.

Sauro (2018) classified metrics into study metrics in *Benchmarking the User Experience*, including SUS, SUPR-Q, NPS, satisfaction, brand attitudes, brand lift, UxUx-Lite, Supr-QM, and task metrics include

task completion rate, task time, task ease, single usability metric. Confidence, disasters, open-ended, task specific metrics, and so on.

Different methods have their own advantages or limitations in implementation difficulty and cost. Practitioners can choose different measurement indicators and methods based on different purposes, budgets, conditions, etc. Making clear these commonly used quantitative indicators play an important role in the functional design of Statiqx.

2.2.2 Analysis Methods

In quantitative analysis and reporting, the quantitative contrast analysis method is commonly used (Dai, 2014), including scope, size and degree (Li, 2007). Charts such as pie chart, scatter chart, bar chart, broken line chart, radar chart, and table are mainly used to visualize and present the quantitative comparison relationship (Dai, 2014). These methods are relatively easy to use and can be automatically generated in Excel spreadsheets. They are commonly used by practitioners.

The other method is statistical analysis, which adopts professional analysis methods such as regression analysis, P-value calculation (Albert & Tullis, 2013), reliability analysis and significance test in statistics.

The most famous one is Sauro's (2016) detailed elaboration in *Quantifying the User Experience*, which provides detailed statistical formulas according to different user needs. The figure below summarizes all statistical methods in this paper and the applied scenarios.

<table>
<tr><th colspan="3"></th><th colspan="2">Continuous</th><th colspan="2">Binary</th></tr>
<tr><td colspan="2" rowspan="3">Single design</td><td></td><td>With task</td><td>No task</td><td>Small sample</td><td>Big Sample</td></tr>
<tr><td>Benchmarking</td><td>One Sample t Log</td><td>One Sample t</td><td>One Sample Binomial</td><td>OneSample z Test</td></tr>
<tr><td>No Benchmarking</td><td>Confidence Interval Around Median (large sample size)

t(log) Confidence Interval</td><td>t Confidence Interval</td><td colspan="2">Adjusted Wald Confidence Interval</td></tr>
<tr><td rowspan="4">Multiple design</td><td rowspan="3">Between group</td><td></td><td>Different users</td><td>Same users</td><td>Different users</td><td>Same users</td></tr>
<tr><td>Less than 3</td><td>TwoSampleT</td><td>PairedT</td><td>N-1 Two Proportion Test and Fisher Exact Test</td><td>McNemar ExactTest</td></tr>
<tr><td>More than 3</td><td>Multiple Two Sample T</td><td>PairedT</td><td>Chi-Square & Adjusted wald difference in proportions</td><td>Adjusted Wald CL for difference in matched proportions</td></tr>
<tr><td colspan="2">Not Between group</td><td colspan="2">Correlation & Regression</td><td colspan="2">Phi Correlation</td></tr>
</table>

Table 4: *Summary of statistical methods given by Sauro.*

		Continuous		Binary	
Single design		Mean to Criterion	Proportion to Criterion		
		Same user in each group	Different user in each group	Same user in each group	Different user in each group
Multiple design	Between groups	Two Means	Paired means	Two proportions	Paired proportions
	No between groups	Sample size for linear regression			

Table 5: *Decision table for sample sizes when comparing data.*

Estimating a parameter		Not Estimating a parameter
Continuous	Binary	
Margin of Error Mean	Margin of Error Proportion	Problem discovery sample size

Table 6: *Decision table for sample sizes for estimating precision or detection.*

Sauro provided a very comprehensive and systematic analysis method, raising quantitative research to a professional scientific height. However, it is obviously very difficult for practitioners, who need to have the corresponding mathematical knowledge and grasp of statistical software to correctly apply it. It is only suitable for professionals with relevant backgrounds.

2.3 Competitive Audits

Most products have competing products in the market, so it is very important to analyze them. Competitive product analysis should be conducted early in the product design. One finds out what others are doing and whether they are doing it well or poorly. This gives stakeholders a deep understanding of the strengths and weaknesses of competitors (Allen & Chudley, 2012).

Competitive Audit Goals

The competitive audit is used to analyze the products of competitors who offer similar products, so as to obtain a well-rounded foundation of knowledge about the area of focus.

Key Competitors

After further investigation, I found that some companies' products were related to my project. These companies have become mainstream tools in areas such as online usability testing, qualitative and quantitative analysis.

TryMyUI.com
TryMyUI is a remote user testing platform that offers cross-platform services for testing and improving user experience.

Loop11.com
Loop11 is a self-serve, browser-based solution for usability professionals, web managers and web designers to create their own online, usability testing projects to get the metrics needed to optimize website usability.

Userlytics.com
For Userlytics, its quantitative analysis module is integrated with usability testing functions, including Time on task, System Usability Scale (SUS), Success/Failure ratios, Net Promoter Score (NPS), Single Ease Question (SEQ).

Hotjar.com
Hotjar has HeatMap, Highlights, and Surveys, but it is more of a quantitative information gathering tool than a quantitative analysis or reporting tool.

Analytic.google.com
Google Analytics has real-time detection of the site's user information, user area, user events, users in the site's specific behavior or click path, audience groups, transformation and so on. In order to help website managers to achieve accurate network delivery, the product will be placed in front of any interested crowd. But Google Analytics is only suitable for products connected to the Internet.

The specific principle of Google Analytics is based on the tracking script of Google Analytic embedded in the page code to trigger events, so as to track user click behavior (Lynch et al., 2016). When you sign up for one of these services, the service provides a unique tracking code that contains a page of a website, or code in the application. When a user requests a page or performs an action tracking code, a message is sent to the managed service, which records the action and stores the information on its server (Goodman et al., 2012).

How Do Competitors Position Themselves in the Market?
The functionality they provide is very similar, all being browser-based usability testing.

Competitors' Strengths
The products they provide are rich in functions. This one-stop service basically covers the whole process of usability testing, avoids the cumbersome switching back and forth of users for various tools, ensures the continuity and accuracy of data transmission, and avoids data errors. Their products are applicable to most internet products.

Competitors' Weaknesses

Their usability tests are browser-based and only test computer software and mobile apps. And because analytics are integrated with usability testing, users can't enter their own data, which cannot be done on devices that do not run browsers, such as some specialized devices. Another weakness is that the statistical functions of rival products are relatively simple, in that, they only support basic functions such as variance and average. If users want to carry out in-depth statistical analyses, they have to rely on more professional statistical tools, which requires extra effort from users.

I made a competitiveness matrix as it is a great tool for competitive product analysis. It helps us understand the current competitors and know what work has been done and what has not (Levy, 2015). As HotJar and Google Analytics are web-based internet product analysis tools, they are not included in the competition matrix.

Goal: Compare features and user experience		Statiqx	TryMyUI	Loop11	Userlytics
General information	Competitor type	N/A	Indirect	Indirect	Indirect
	Location	Wellington, NZ	San Mateo, California	South Melbourne	Miami, Florida
	Product offering	Sample size calculator Multiple comparison Benchmark evaluation Overall estimation Usability questionnaire	System usability scores (SUS, PSSUQ, ALPQ, SUPRQ, NPS) Task usability metrics (SEQ) Task completion rates Task duration measurements Crowdsourced, voting-based usability feedback (UXCrowd) Capture actual website sessions and identify frustration points (TryMyUI Stream)	NPS SUS	Time on task System Usability Scale (SUS) Success/Failure ratios Net Promoter Score (NPS) Single Ease Question (SEQ) Pre-test, post-test and embedded survey questions Card Sorting Tree Testing
	Price	N/A	NA	$63/month	NA
	Website	https://www.figma.com/proto/47QnanjmeqUHCQWWtMsy4a/Statiqx-v2?page-id=0%3A1&node-id=109%3A7737&viewport=241%2C48%2C0.75&scaling=min-zoom&starting-point-node-id=2%3A4589	https://www.trymyui.com/	https://www.loop11.com	https://www.userlytics.com
	Business size (Employees on LinkedIn)	1	40	5	53
	Target audience	Designer, researcher, product manager	Designer, researcher, product manager	Designer, researcher, product manager	Designer, researcher, product manager
	Unique value proposition	Statistical analysis feature	Mostly quantitative methods	Easy to use	Complete usability testing process

UX rated	First impressions	Desktop website experience	Good + Visually appealing - Feels dense and overwhelming in places	Okay + Easy to find SUS - Color is too light and bright	Good + Easy to navigate and find information - Missing characters	Okay
		Mobile website experience	Good + Fully responsive - Interaction was not as smooth on mobile	Needs work - Report page is not fully responsive - Fonts are too small	Okay + Key information is present - Not fully responsive	Good + Fully responsive
	Website Interaction	Features	Needs work	Okay Easy to find quantitative score	Easy to find quantitative score	Good
		Accessibility	Good + Website available in two languages	Needs work - Website only available in English - Percentile and letter grade are difficult to understand, needs improved explanation	Needs work - Website only available in English	Needs work + Images of menu items are clear and legible - Website only available in English
		User flow	Good + Easy to find key info (menu, location, hours) - No clear hierarchy, difficult to scan quickly	Needs work Don't know where to find PSSUQ, ALPQ, SUPRQ, NPS	Outstanding + Easy to find key info (test report)	Good
		Navigation	Outstanding + Easy to navigate + Clear indication of clickable elements	Needs work- Somewhat difficult to navigate	Outstanding + Very easy to navigate + Familiar way to navigate	Good
	Website visual design	Brand identity	Good + Clear color scheme, font, and art direction - Inconsistent use of imagery and photography	Okay Color styles are easier to recognize	Good Comfortable font size Provides a custom theme	Okay Too large a font
	Website content	Tone	Serious and direct Friendly in some places	Friendly and indirect	Friendly and indirect	Good
		Descriptiveness	Good + All key info is present - Too descriptive	Okay + All key info is present - Unnecessary details	Outstanding + Easy to follow + Short and to the point	Okay

Table 7: *Competitive matrix.*

2.4 User Requirements Gathering

I conducted a primary research survey of 23 interactive product development practitioners in the Facebook group of UX. The research method mainly adopts a combination of structured and unstructured questions in the form of a mixed questionnaire to collect views, cognition, attitude and needs of target users and summarize the report. For details of the questionnaire, please refer to the appendix.

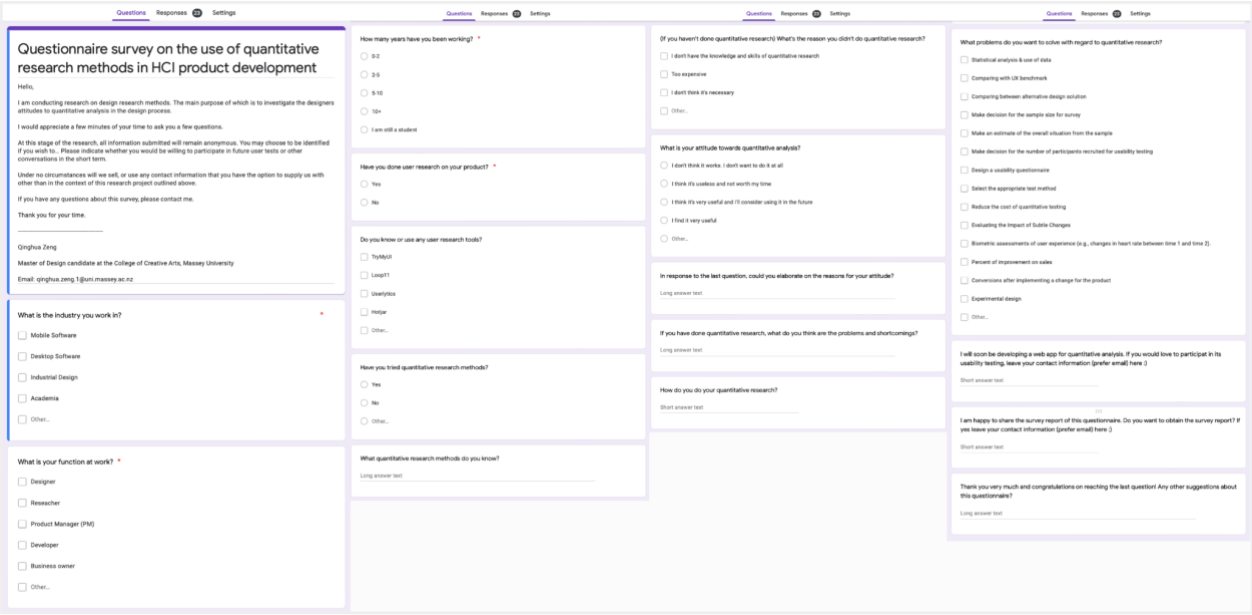


Figure 5: *Survey screenshot on google form.*

2.4.1 Questionnaire Survey Report

QUESTION：What is the industry you are working in?

According to the results, the majority of respondents work in software development, with 56.5% in desktop development and 47.8% in mobile device development (if you find that the two add up to more than 100%, it is because there are a few respondents in both fields), and the small remaining number of respondents come from different fields.

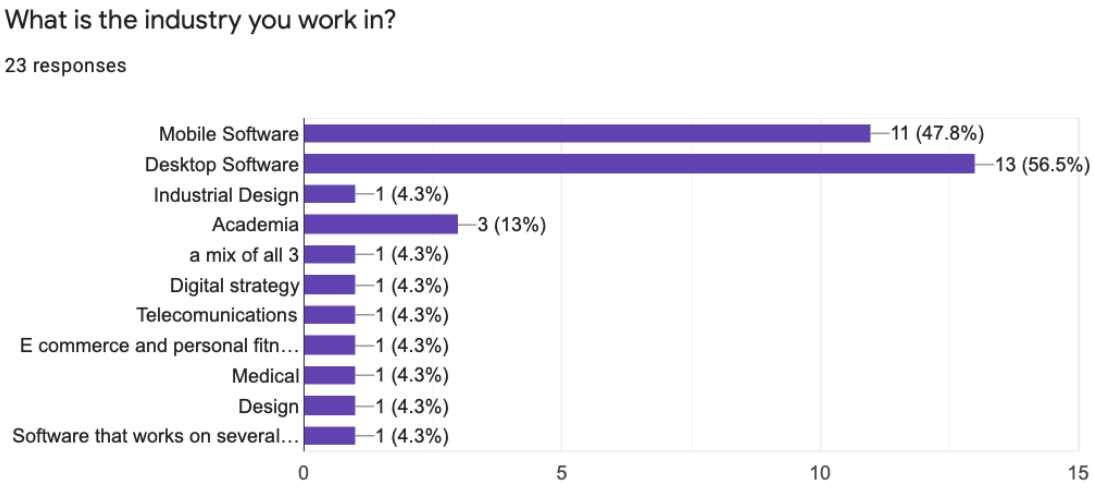


Figure 6: *Survey question: What is the industry you are working in?*

QESTION：What is your function at work?

In terms of job responsibilities, researchers had the highest proportion at 91.3 per cent. The second most popular category was designers, at 21.7 percent. Others include content designers, project managers and business leaders. This figure also reflects the distribution of people who care about product research data.

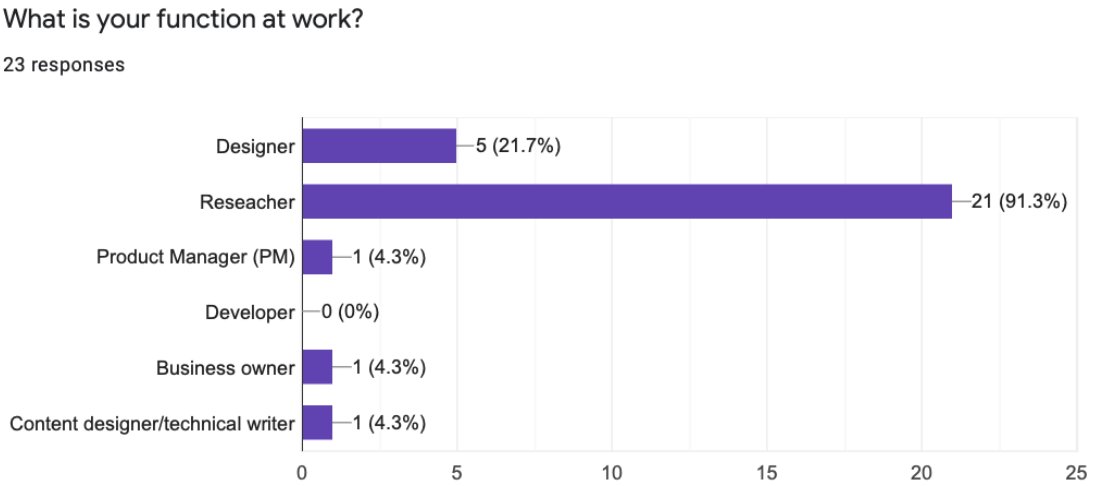


Figure 7: *Survey question: What is your function at work?*

QESTION：How many years have you been working?

In terms of work experience, 39.1% of respondents have more than 10 years of work experience, and 13% have 2-5 years of work experience. These experienced practitioners can provide deeper insight and lend credibility to the results of this survey.

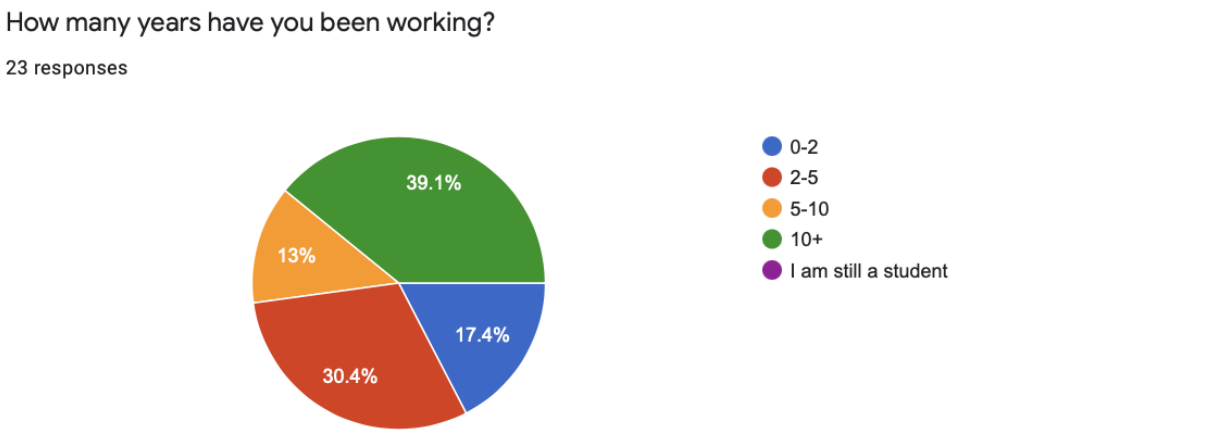


Figure 8: *Survey question: How many years have you been working?*

QUESTION：Have you done user research on your product?

The survey results show that the vast majority of respondents (95.7%) have conducted user research.

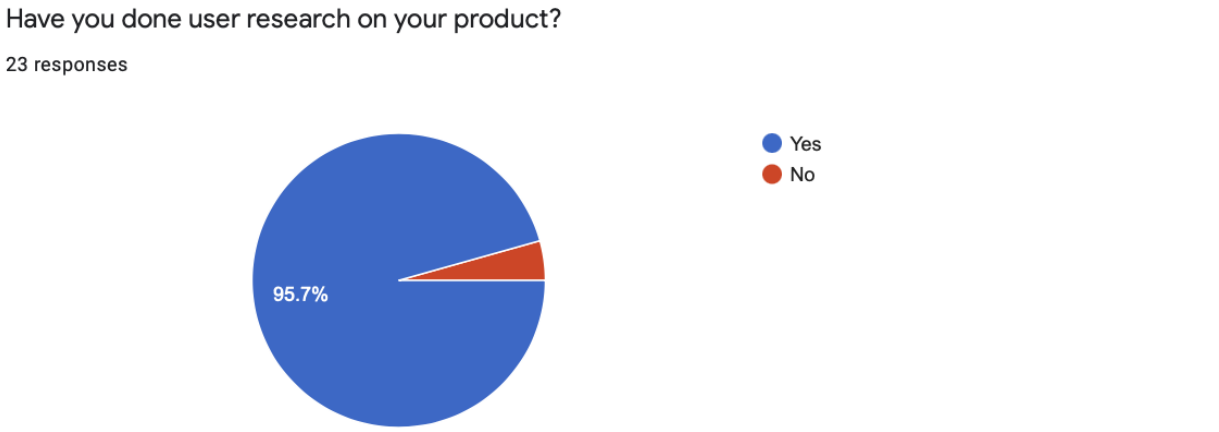


Figure 9: *Survey question: Have you done user research on your product?*

QUESTION：What is your attitude towards quantitative analysis?

As for attitudes toward quantitative analysis, 65.2% thought it was very useful, and 17.4% of practitioners thought it was useful and planned to carry out quantitative research in the future. No one thought of quantitative analysis as useless. A further 4.3% found quantitative analysis useful but difficult. Some thought of it as useful but sometimes prefer qualitative or mixed research methods as it can give a richer picture depending on the product they are working on. It depends on the project and what they are trying to discover. It also depends on the kind of data their stakeholders need and value.

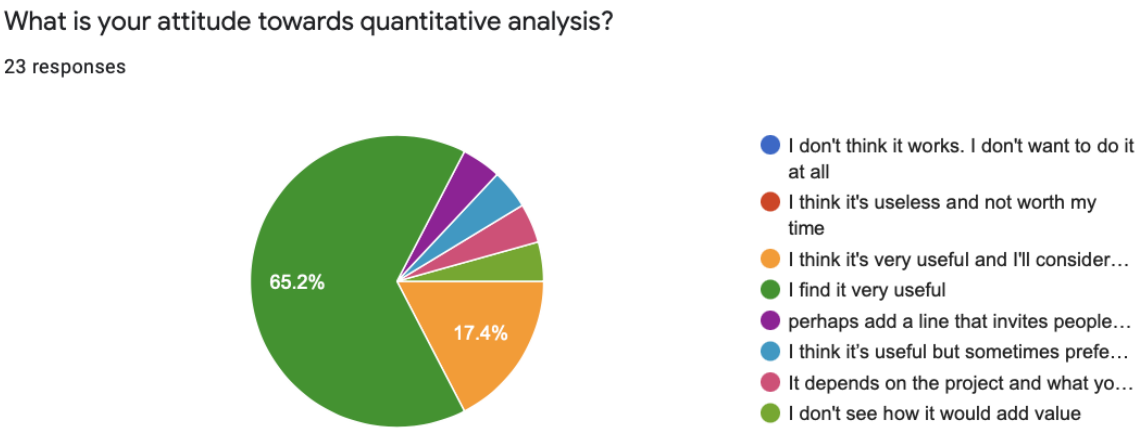


Figure 10: *Survey question: What is your attitude towards quantitative analysis?*

Below are some of these responses:

"As a researcher for mobile and desktop products with many features in it, I find it very helpful to do quantitative research first to see our users' behavior and thoughts on the products. From analytics analysis, we could have some hypotheses for what needs to be improved or validated through deeper research. From surveys, I am able to test a concept and gather user feedback regarding their experience with the product."

"I think it is very useful to know the big picture, and to define variables to use in qualitative data. It complements qualitative research very well."

"I work for a large university and our leadership values quant[sic] data over quality but often when I am conducting quant[sic] studies it consumes a lot of my time and yields very similar findings as qual[sic]."

"Quantitative methods enable you to test assumptions/product performance and (if your product isn't being received as expected) identify areas for further exploratory research (using qualitative methods) or iteration."

"I think quant[sic] and qual[sic] together tell the full story. Quant[sic] shows us trends and allows us to draw conclusions about what is happening and test for statistical significance, while qual[sic] tells us why something is happening and how users feel about it."

"Quant[sic] methods allow us to validate data at scale, and it's really useful for behavior segmentation and feature prioritization."

QUESTION：Have you tried quantitative research methods?

In proportion, 95.7% of respondents have carried out quantitative research in their projects. It can be seen that the acceptance and popularity of quantitative analysis methods are very high.

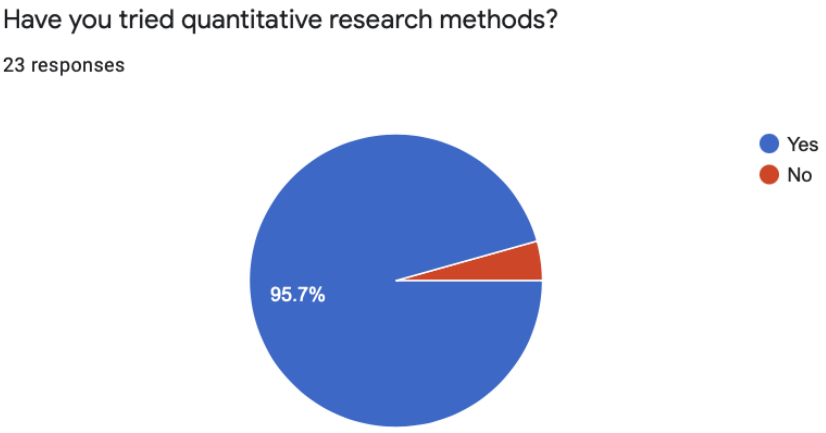


Figure 11: *Survey question: Have you tried quantitative research methods?*

QUESTION : Do you know or use any user research tools?

In terms of related software, the most popular tool is HotJar, which is used by nearly half of the respondents.

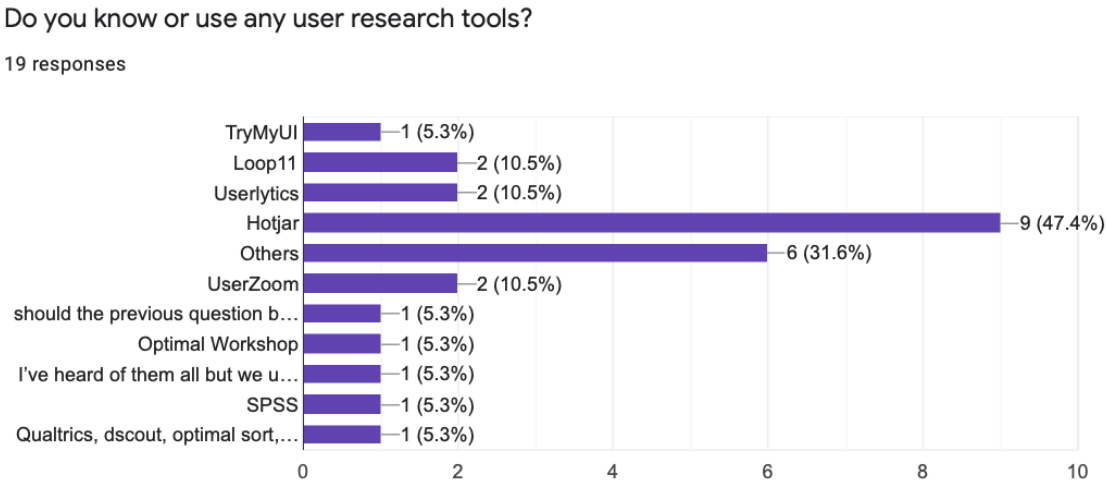


Figure 12: *Survey question: Do you know or use any user research tools?*

QUESTION : What quantitative research methods do you know?

Most practitioners conduct quantitative research using surveys, statistical analysis and A/B testing methods. The pie chart below shows the frequency of occurrence of relevant keywords.

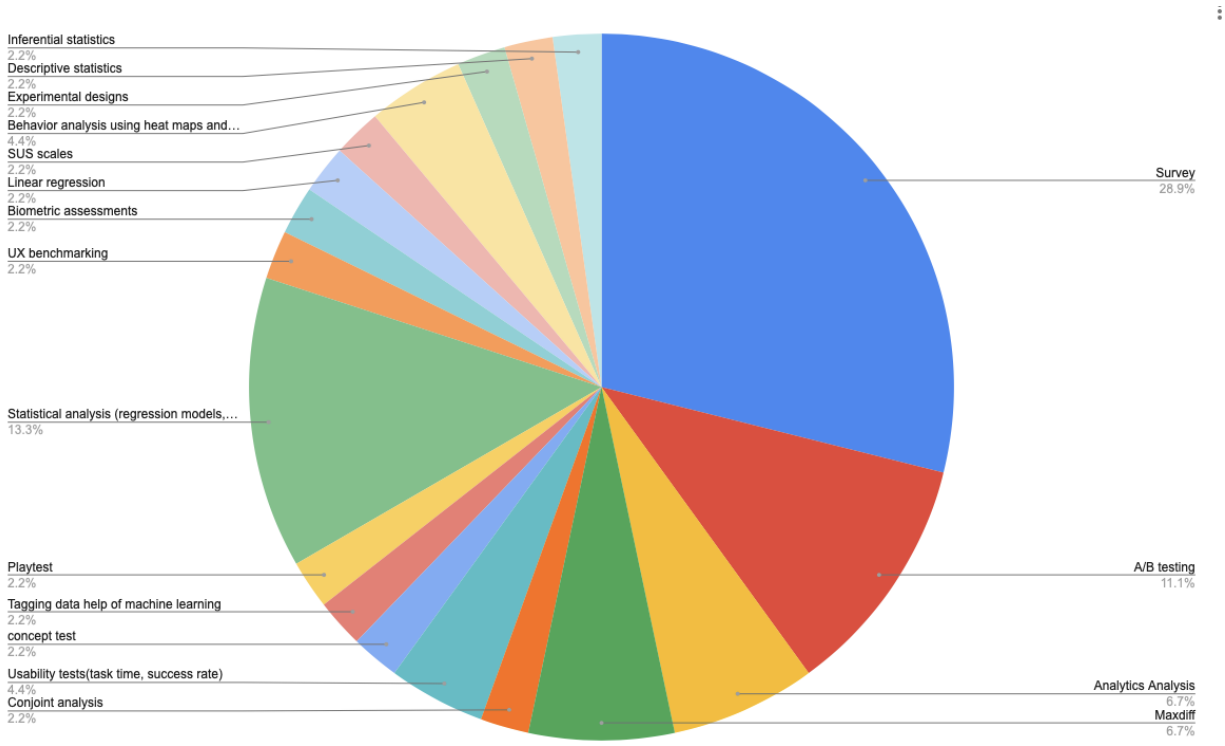


Figure 13: *Survey question: What quantitative research methods do you know?*

`QUESTION:(If you haven't done quantitative research) What's the reason you didn't do quantitative research?`

Only six respondents answered the question, mainly because it was too expensive, unnecessary, and lacked knowledge.

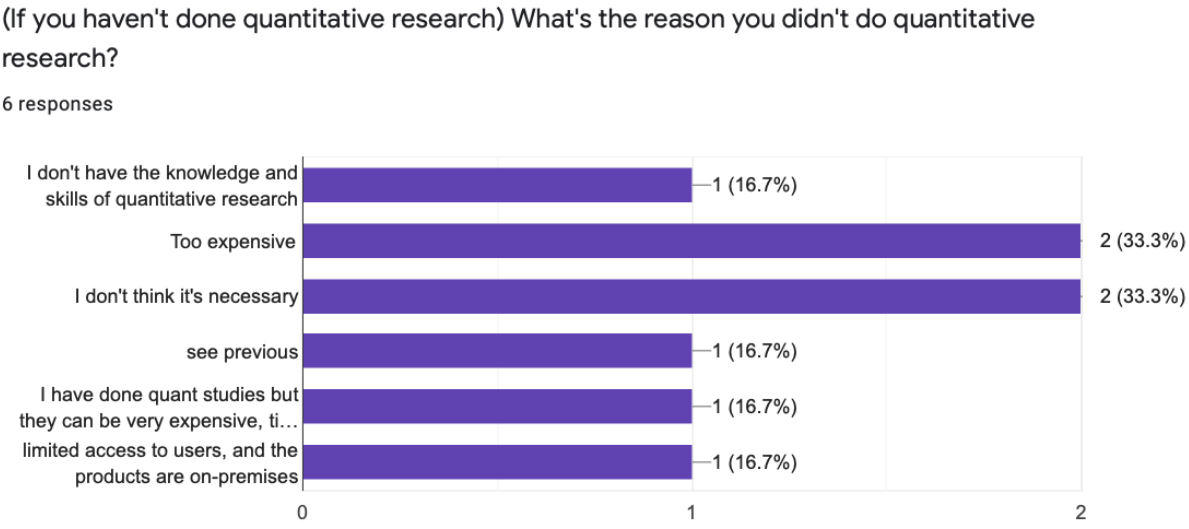


Figure 14: *Survey result for the reason why people do not do quantitative research.*

Below are some of the responses:

“Entry to good quant[sic] skills. It requires more understanding than just reporting mean averages and total count.”

“Need certain skills to execute it properly and interpret the data properly.”

“Data cleanup and visualization can be time consuming, and working with a vendor can be really expensive. Other than that, quant[sic] data often does not tell us about the motivations, perceptions or emotions behind the behaviors collected in the data —but that’s why you run mixed methods studies ;)”

"In my company, sometimes the important analytics/tracker in each feature still has not been implemented although the feature has been released for months. It will be a blocker once the PM or other stakeholders have assumptions that the feature doesn't work and require research to validate it but we don't have any data to see how users use the feature so far. For doing other quant[sic]. research like surveys, the problem I got so far is participants recruitment since it needs to have large sample to minimize the error."

2.4.2 User Requirement from Survey

The bar chart below shows the frequency of key sentences for related requirements, with statistical analysis requirements being the most frequent. Many of the remaining related requirements are also related to more specific statistical analysis.

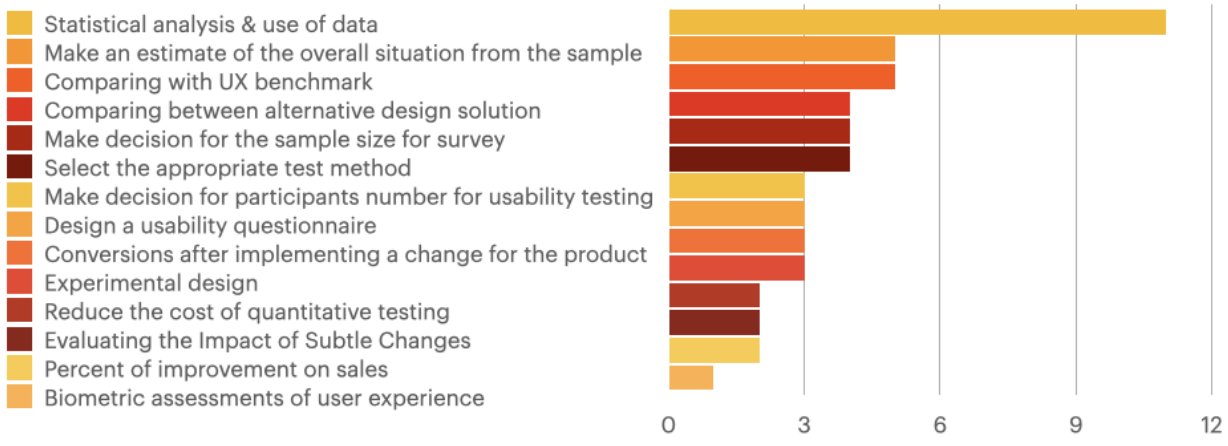


Figure 15: *Requirements ranking list.*

2.5 Opportunities

King (2017) points out that user-centered design and understanding behavior through data practices are both aimed at creating effective, valuable and replicable user experiences for current and potential users of a business or product. In the Statiqx project, I will work on the following specific goals:

- The functional design allows users to perform statistical analysis.
- To be friendly to entry-level practitioners, instructional and educational.

Chapter 3. Design

This chapter is a summary of the main methods used in the design phase. This stage is to explore the scheme based on the research results of chapter 2 and establish a foundation of design solution. This phase also provides input for the next phase of usability testing.

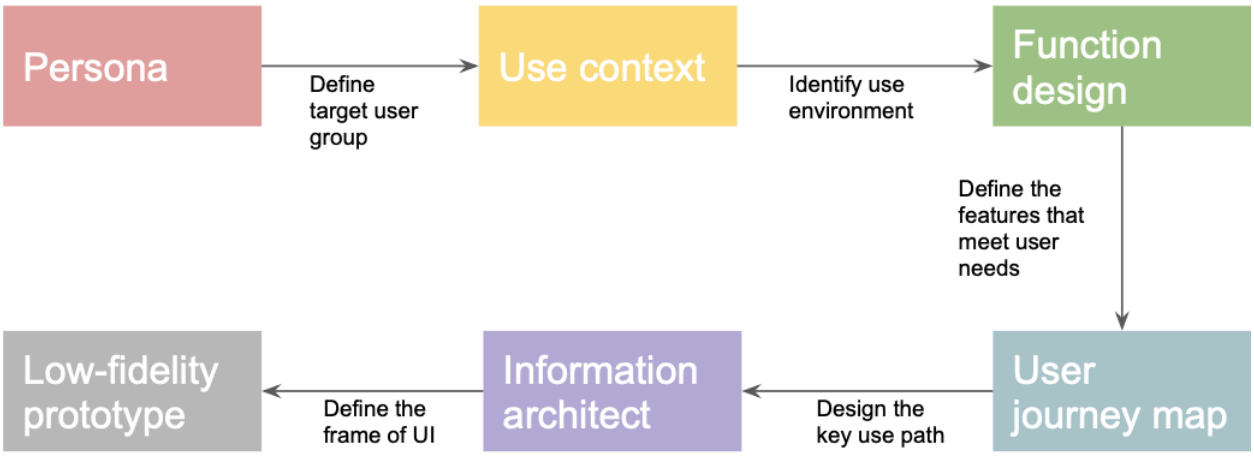


Figure 16: *The relationship between different design methods.*

3.1 Persona

User Persona is a concept developed by Cooper (1999) in *The Inmates Are Running the Asylum*. Cooper designs fictional characters called "persona". Although they are not real people, they represent real people in the design process, they are imaginary prototypes of real people.

Persona represents the user role of the product, and it uses very short descriptions to describe typical user characteristics. The importance of persona lies in the fact that the concept of the "user" is hard to grasp, an obscure vocabulary that changes and distorts in a given situation. People are not good at grasping general descriptions and are naturally focused on individuals rather than abstract crowds (Platt, 2016). So, the more targets you have (that means you want to engage a broader group of users with the product), the more likely you are to deflect them.

I define designers, researchers, and project managers as personas for Statiqx because these people are responsible for the user experience of the product. These people need to think from the user's point of view, not the engineer's point of view.

Adopting the persona approach in the Statiqx project helps to clearly define the problem, externalize the user personas, reveal the user goals, clarify the scope and nature of the problem, and stay focused on the target personas during the design process.

Colborne (2017) divides the user level into three types, namely expert users, casual users and mainstream users. Mainstream users will not use the product because of technology. They use the product to complete a certain task and master the use method of some important function, and will not typically have the goal of learning all functions (Colborne, 2017). In the Statiqx project, expert users and casual users will be ignored as this is a small segment user group, these three roles are mainstream users.

Persona 1—Designer

The first is the designer, who is responsible for the UI and UX design of the product and needs to know the deficiencies of the current product and the needs of the users. Simple quantitative analysis may be helpful for them.

	***"My goal is to give our users the best possible experience" – Qing***
Name	Qing
Age	27
Education	Bachelor
Hometown	South Korea
Family	Lives alone
Occupation	As UI designer for 2 years
Goals	• He wanted a tool that would help him evaluate which design was better from a data point of view. • He wanted to prove that some of his new designs could lead to a better user experience.
Background	Qing has a bachelor's degree in industrial design and two years of experience as an interaction designer.
Frustrations	• When promoting a new design, he was sometimes rejected by the development team because they did not have more sufficient reasons to persuade them. • Sometimes subjective or qualitative user feedback on a product after launch far outweighs usability testing findings.
Motivations	Qing is a UI designer who likes to try new things. He often visits design forums to talk to other designers. He has been working as an interaction designer for two years. He works for an internet company. Internet products update very quickly. He hopes that each iteration will lead to better design.

Figure 17: *Persona of Qing, designer.*

Persona 2—Researcher

Secondly, researchers. In some large companies, researchers are distinguished from designers. They will carry out more detailed and professional research on products and users, and they need more detailed and professional research methods and tools.

	***"Data helps me understand design from a different perspective" – Kim***
Name	Kim
Age	23
Education	Bachelor
Hometown	U.K.
Family	Lives with her roommates
Occupation	UX researcher as an intern
Goals	She hopes to implement product data analysis from a more professional perspective. Kim wants to study how to evaluate the overall situation using data from usability tests.
Background	Kim is a recent graduate majoring in psychology. She has some basic knowledge of mathematics.
Experience	She just graduated as an intern, so she doesn't have any experience.
Frustrations	Although she has a professional background, her skills are not solid due to her lack of experience.
Motivations	Kim wanted a tool that could simplify her workload or validate her work results.

Figure 18: *Persona of Kim, researcher,*

Persona 3—Product manager

Finally, product managers, who are responsible for product planning, short term and long-term goals, also need to fully understand the product, market and users.

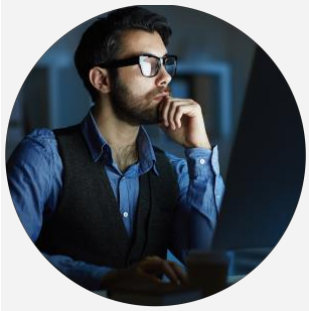
	***"I want to design products that people really want" – Devin***
Name	Devin
Age	35
Education	Master
Hometown	New Zealand
Family	Lives with wife
Occupation	Industrial designer
Goals	• Devin wanted to quantify the differences with his competitors' products. • Usability testing is expensive, and he wants to know how to recruit the fewest users to get the most revenue and evaluate whether his design is living up to expectations.
Background	• Usability testing is expensive, and he wants to know how to recruit the fewest users to get the most out of it. • He wanted to assess whether his design lived up to expectations.
Experience	5 years' experience as a designer and 2 years as a product manager.
Frustrations	When recruiting test users, sometimes the number of people he recruited was too large and he exceeded his budget, and he was afraid that he could not find all the problems if he recruited too few. Sometimes the reaction to a product's launch is inconsistent with expectations.
Motivations	• Devin has strict requirements for product quality, and he always spares no effort to improve the competitiveness of products in the market • As a product manager, Devin needs to control the quality of the product from an overall product perspective.

Figure 19: *Persona of Devin, project manager.*

3.2 Use Context

Context data can reflect the reality of the design in the original environment—a noisy, chaotic, challenging and disruptive world (King et al., 2017). In practice, we cannot control the environment in which the software is used, so we need to make the software design conform to the requirements of the environment and adapt to various interferences (Colborne, 2017).

Statiqx is mainly oriented towards the development process of interactive software products at this stage. Users often perform tasks in an office and use a desktop or laptop. The main platform of the tool is the web browser side. Before using the tool, users need to perform usability tests or questionnaires to obtain raw data. After using the tool, users usually report to colleagues for analysis and discussion through meetings or emails.

3.3 User Journey Map

The User Journey Map is a document that visually illustrates the process, needs and opinions of customers in the relationship between customers and the company (Temkin, 2010). Brice Temkin was an early advocate and greatly promoted its use in the United States (Kalbach, 2020).

User Journey Map is sometimes called Customer Journey Map (CJM), and the terms "User Journey Map" and "Customer Journey Map" are used interchangeably. Both involve visualization of a person using your product or service (Sarah 2018). Through User Journey, users' thoughts and feelings in the process of interaction with products can be analyzed from a user's perspective. In the process of analyzing each step, design opportunities can be identified.

In the Statiqx project, I divided the user journey into nine tasks: log on Statiqx, select a project, create a new study, select the function that applies to the target, raw data collection, define the properties of raw data, upload raw data, view basic conclusion & advice, view advanced statistical results within three stages: study planning, data preparation and processing.

Devin's user journey									
Background	Devin works for EastSoft, a medical device company, as product manager on a project called Hurricane, which is developing a CT scanner. The CT scanner is used to perform body scans of patients in emergency departments in hospitals. Whether from customer demand or regulation, the design of man-machine interface has put forward high requirements.								
Goal	The team wanted the design of the current interface to ensure that technicians could complete tasks in less than five minutes and that the results of the analysis were statistically significant								
Proficiency in operating Statiqx	Beginner								
Stage	Study planning				Data preparation and processing			Get result	
Task	Log on Statiqx	Select a project	Create a new study	Select the function that corresponds to the target	Raw data collection	Define the properties of raw data	Upload raw data	View basic conclusion & advices	View advanced statistical results
Thoughts and feelings	"It is not difficult"	"This is too easy."	"What's the difference between a project and a study?	"Which one should I choose?"	"I don't understand what these terms mean."	"These questions are too abstract for me to choose."	"How long do I manually enter this much data?"	"Is this conclusion credible? "	"Great, I don't need this feature."
Scenarios	Devin logged on to Statiqx	Devin created the Hurricane project	Devin created a study called "Benchmarking 5min.	Devin hesitated and chose the Benchmarking feature with help	Devin was new to these terms, but did his usability testing and got the data he needed with the help of Statiqx	Devin was confused by the abstraction problems he encountered while defining data attributes, but the system helped him with the task	Devin copies data from Excel directly to Statiqx	Devin was pleased to see the results. He doesn't know how Statiqx came to this conclusion, but Stitiqx provides analysis steps, algorithms, and quotes that Devin finds very credible	Devin does not understand or have an interest in advanced statistics, so he ignores this feature
Emotional Journey									
Oppotunities	N/A	N/A	A case can be provided to explain the relationship between project and study	Text or graphical explanations should be provided for different functions	Users should be given guidance on the types and methods of data available, such as how to obtain quantitative data through usability tests and questionnaires	Explanations should be made in graphic format and cases provided for different questions	Users can upload or copy and paste data in batches	Provide references to relevant analysis and links to further study	Tell regular users that they don't need to continue with this feature. It is provided for advanced users only and is simplified on the interface

Figure 20: *User journey map for Devin from the user group of project manager.*

3.4 Function Design

There are many methods of quantitative analysis. As mentioned before, some are based on questionnaires, scale, usability tests, and some are based on some high-tech means, such as hot map of websites, or even eye movement analysis requiring an eye movement tracker. In the project, measurements based on questionnaires and general usability tasks were mainly included in line with MVP principles. Statistical analysis is the main feature of the project.

`Based on the results of previous research and analysis of user needs, Statiqx will include four basic features :`

- A/B testing
- Benchmarking
- Overall Estimation
- Correlation

A/B testing

The A/B test is used to answer the question "Which of the two plans is better?", comparing the difference between two design schemes. Assuming that other conditions remain the same, only the influence of a certain attribute in the experience on the user is considered, which is the AB test (Croll & Yoskovitz, 2013). For example, it can evaluate the quantitative data of different design schemes of the same product

and can also compare similar products. Meaningless quantitative numbers can be made meaningful by comparison, that is, the gap between two design schemes in a certain aspect can be reflected by the comparison of the size of the numbers.

In similar schemes, users should be selected as far as possible from the test, so as to avoid affecting the test effect because of users' familiarity with the system. When testing between users, prepare as many users as possible to offset random differences between them. The problem with in-user testing is that a test user who has learned to use one system is not considered a novice to use another system (Nielsen, 1994).

Benchmarking

The benchmarking function is used to compare an aspect of the product to a target benchmark. For example, the industry average SUS (67) is used as a benchmark when developing new phones. It can find out whether an index has reached the standard of the benchmark in statistical significance and provide the basis for decision-making. When the lowest point of the confidence interval is higher than the benchmark, it can be concluded that it exceeds the benchmark in statistical significance; when the highest point is lower than the benchmark, it does not reach the benchmark in statistical significance. When the benchmark is in the middle of the confidence interval, the number of samples should be increased, and the confidence interval should be reduced.

Overall Estimation

Estimate the population by sample. For example, a successful usability test with 8 out of 10 testers has a 48% to 95% chance of actual user task success, but a successful usability test with 40 out of 50 testers has a 67% to 89% chance of actual task success. Small sample size will lead to too large confidence intervals and increasing sample size will narrow the confidence interval and make the estimation more accurate.

Correlation

Correlation answers whether there is a causal relationship between the two variables. Correlation is a statistical measure of the degree to which two variables are linearly related (that is, they change together at a fixed rate). It is a common tool for describing simple relationships without stating cause and effect. Sample correlation coefficient r quantifies the strength of the relationship. For example, when you understand statistical significance, you should also test correlations. Finding correlation can predict the future, and finding causality can change the future (Croll & Yoskovitz, 2013).

Information architecture means to give a lot of information a certain structure, that is, to organize the information in a certain way (Marsh, 2015). Information architecture can be used to organize the structure from an overall perspective. This provides a higher level of insight into the product and provides a basis for ideas to complement.

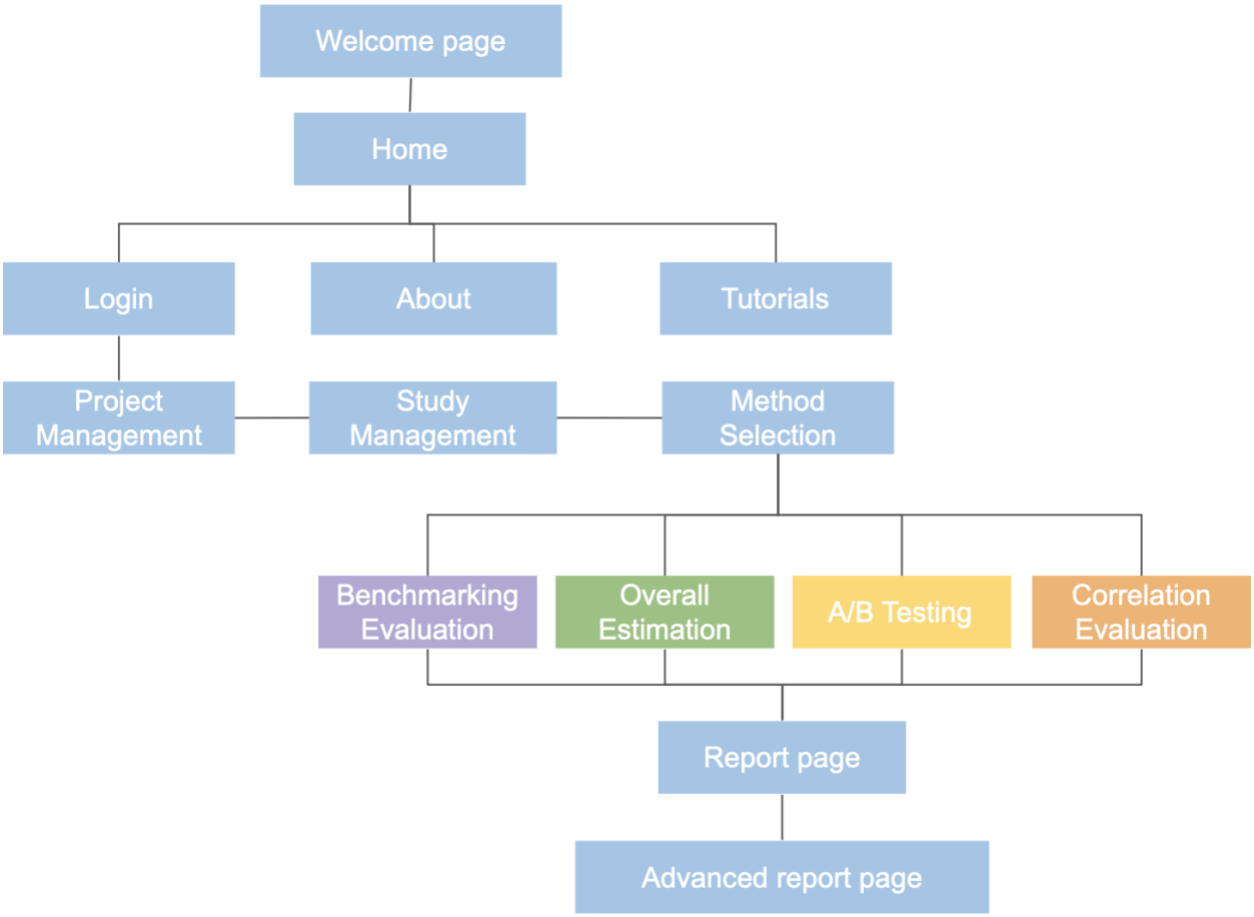


Figure 21: *Information architecture map.*

3.5 Low-Fidelity Wireframes

The term wireframe was originally used in CAD design to represent the basic structure of an object with wire-like lines but containing any details. In web design, wireframe is used to design the basic layout of a page, focusing only on function, not on the visual appearance of the page (DevToolGuy, 2015).
One of the great things about hand-drawn wireframes on paper is that it is free of the computer, it provides the opportunity to explore a large number of design ideas in a short period of time, and it is easier to stick on the wall and display flat to inspire more design ideas. Designers can do user tests on paper prototypes, which can help spot problems before moving to digital wireframes. But paper prototypes cannot be remotely user tested like digital wireframes.
In the Statiqx project, paper prototypes are used to explore design ideas and be a supporter for design discussion. And because Statiqx has a simple use path, a digital prototype can be made easily, so the user testing part will be carried out using a digital prototype.

Figure 22: *Hand-drawn paper wireframes, photograph by author (2021).*

Chapter 4. Usability Evaluation

In all likelihood, usability became a common practice for designers working within software development in the 1980s (Sauro, 2013). Without usability testing, the debate over products turned into a war of beliefs pitting designer against designer, and designer against engineer or developer, which has a lot in common with many political and religious discussions, and a lot of personal beliefs that cannot be verified. In the end, the debate doesn't change people's minds. Use testing shifted the discussion of right and wrong towards what works and what doesn't. Testing allows us to see differences in users' motivations, understanding, and reactions, so that we don't insist that users think the same way we do (Krug, 2005). A complete usability testing process includes usability testing planning, user recruitment, usability testing implementation, and usability testing analysis and reporting.

4.1 Usability Test Plan

The plan documents are the main steps of usability, including tester recruitment, test script design, test process, test platform, and post-test questionnaire information. The purpose of this plan is to ensure that usability issues are found and documented through testing and provide input for subsequent analysis.

Usability testing can be divided into moderated and unmoderated methods (Krug 2009). Moderated tests usually require a moderator to guide users through tasks and communicate with them to discover design usability issues. There is no moderator for the unmoderated test. The test is performed by users themselves. The moderated test usually needs to be conducted face to face, which requires the moderator and the tester to make an appointment. In-depth interviews can be conducted, but the cost is relatively high. Unmoderated eliminates the moderator and is more flexible but may miss some usability issues. In the test of Statiqx, I adopted a mixture of the two methods. The advantage of this method is that it can provide flexible and convenient conditions for testers, and it can also conduct in-depth communication with users as much as possible, so as to find more valuable usability problems.

4.1.1 Test Set Up

The test was carried out on the Loop11 platform, which was analyzed in Chapter 2. Loop11 provides a simple interface that allows users to perform their own usability tests with a few settings and record the test screen for subsequent analysis. Testing with Loop11 allows flexible test methods and pre-set test tasks in the system. Users can complete the entire test process by accessing a test link, making it very easy to use. The following figure shows the settings in Loop11.

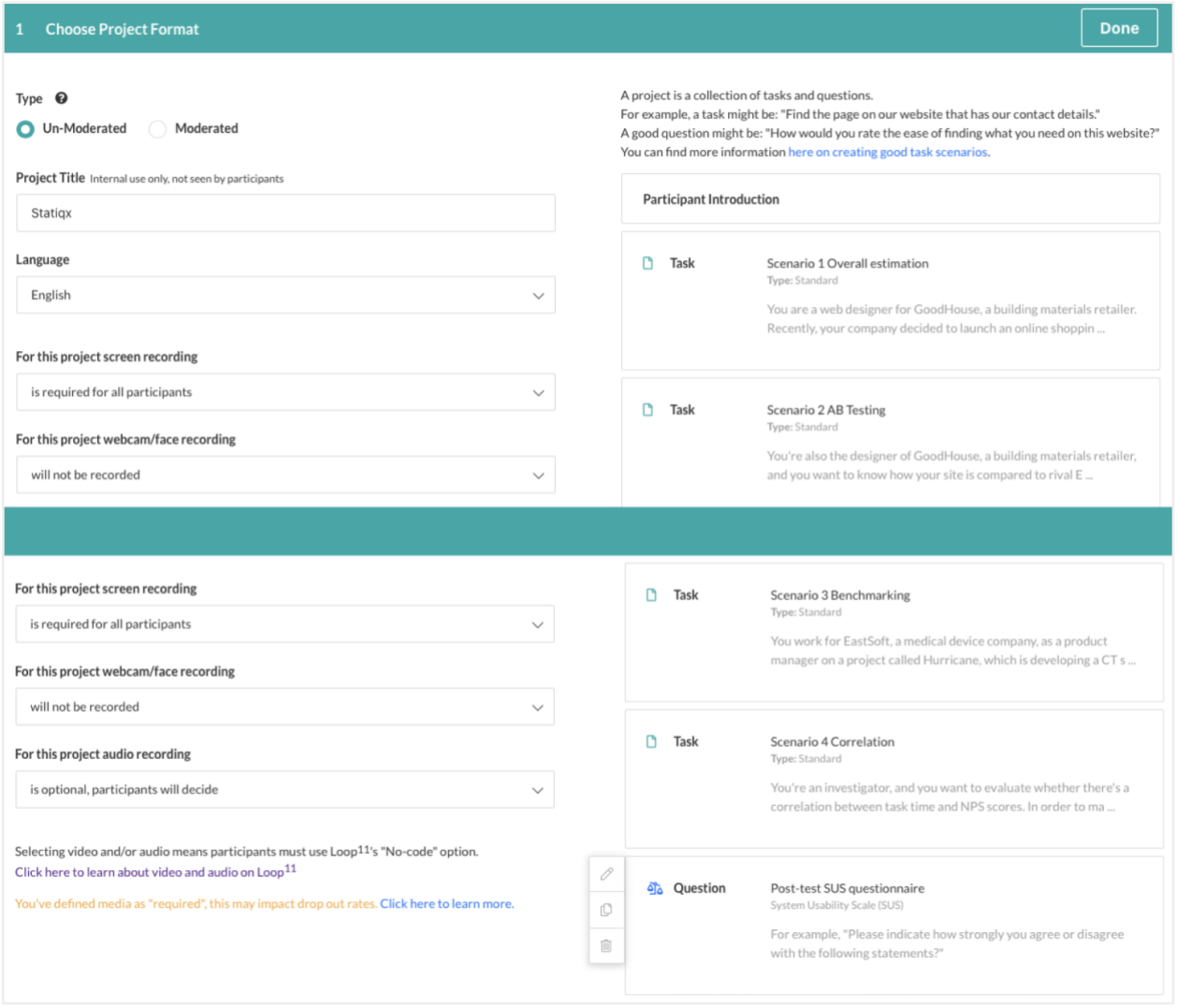


Figure 23: *Usability task settings on Loop11.*

4.1.2 Test Introduction

A clear introduction is very important for the success of the whole test. In the introduction, users should be clear about the test background, test purpose, task flow, and matters needing attention in the test.

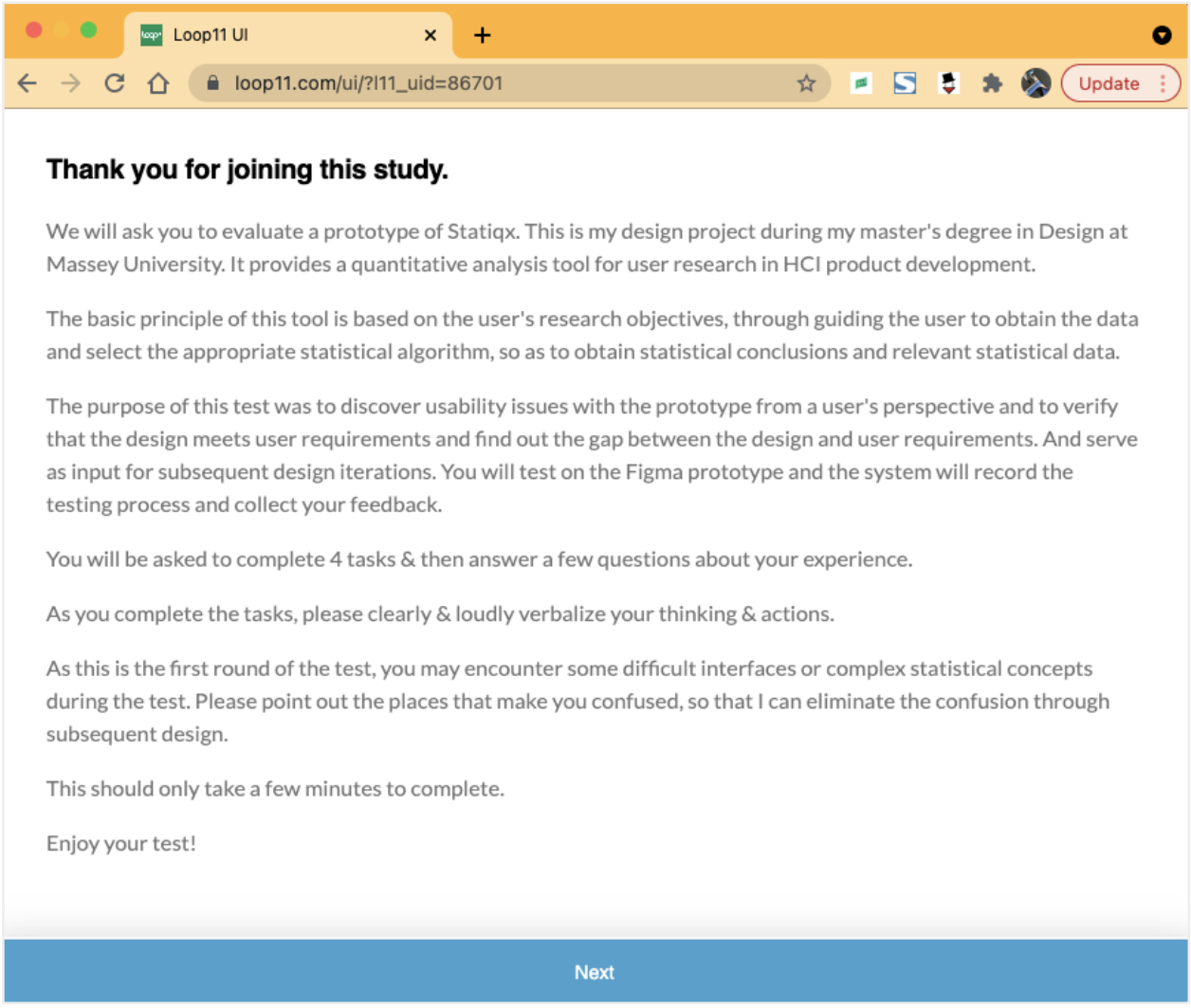


Figure 24: *Usability test introduction page showing for users on Loop11 test platform.*

4.1.3 Test Script

Usability tests help researchers identify problems that users encounter when interacting with the user interface by simulating real user usage scenarios, and test scripts are designed for this simulated scenario. Usability scripting design needs to simulate real-world scenarios as much as possible and ensuring major functions are covered by testing tasks is critical to accurately identifying whether an interface design meets user needs. For the Statiqx project, I designed four scripts, each representing the four main tasks for three personas.

Scenario 1 – Overall estimation

You are a web designer for GoodHouse, a building materials retailer. Recently, your company decided to launch an online shopping site. The boss requested that the website be designed to allow customers to complete the purchase process as much as possible, because it was related to the company's sales and to save the cost of arranging customer service resources over the phone.
You invited 12 users to conduct a usability test on your website. The task of the test was to search and order an electric screwdriver of "SLTG1730". The tasks of these 12 users are shown in the following table:

You now want to estimate the actual user success rate of the site after launch based on the test results.

User No.	Success/Fail	User No.	Success/Fail
User 1	Success	User 7	Success
User 2	Failed	User 8	Success
User 3	Success	User 9	Failed
User 4	Success	User 10	Success
User 5	Success	User 11	Failed
User 6	Success	User 12	Success

Table 8: *Raw data of scenario 1 for usability test.*

You now want to estimate the actual user success rate of the site after launch based on the test results.

Scenario 2 – AB Testing

You're also the designer of GoodHouse.co.nz, a building materials retailer, and you want to know how your site is compared to rival Easytool.com. After two usability tests, users fill out the SUS usability scale and rate both sites.

Table 6

Raw data of scenario 2 for usability test.

User number	SUS	User number	SUS
User 1	87	User 7	68
User 2	77	User 8	83
User 3	89	User 9	90
User 4	66	User 10	92
User 5	84	User 11	89
User 6	68	User 12	75

Table 9: *SUS data for GoodHouse.co.nz.*

User number	SUS	User number	SUS
User 13	76	User 19	84
User14	96	User 20	89
User15	65	User 21	90
User 16	77	User 22	84
User 17	88		
User 18	86		

Table 10: *SUS data for Easytool.com.*

How different is your site from Easytool.com in the general population?

Scenario 3 – Benchmarking

You work for EastSoft, a medical device company, as a product manager on a project called ‘Hurricane’, which is developing a CT scanner. The CT scanner is designed to perform body scans on urgent patients in the emergency department of a hospital, so the interface design requirements for human–computer interaction are high, because time is of the essence for patients.
The team wanted technicians to complete the scan in 5 minutes and invited 16 technicians to perform a summative usability test. The results are shown in the following table:

User No.	Task time(min)	User No.	Task time(min)
User 1	7.2	User 9	8
User 2	4.5	User 10	6.7

User 3	7.5	User 11	4.7
User 4	6	User 12	5.6
User 5	4.4	User 13	6.6
User 6	4.8	User 14	4.7
User 7	3.9	User 15	3.6
User 8	4	User 16	3.8

Table 11: *Raw data of scenario 3 for usability test.*

Now you want to do a statistical analysis to see if the design changes can achieve the goal.

Scenario 4 – Correlation

You're an investigator, and you want to evaluate whether there's a correlation between task time and NPS scores. In order to make a decision on whether to continue simplifying the interface, you run a usability test with the following results:

User No.	Task time (s)	NPS score (0-100)	User No.	Task time (s)	NPS score (0-100)
User 1	365	90	User 7	67	98
User 2	553	86	User 8	76	89
User 3	333	78	User 9	58	90
User 4	356	87	User 10	96	65
User 5	664	68	User 11	75	77
User 6	78	65	User 12	67	67

Table 12: *Raw data of scenario 4 for usability test.*

In order to facilitate the rapid recording of user performance and feedback in the test, I designed and printed the following table, each table corresponding to a scenario. Each Stage, task, success criteria and corresponding user behavior are recorded in detail in the table.

Date_____User No._____Senario._____			
Stage	Task	Success/Fail	Note
Study planning	Log on Statiqx	□Success □Success with assistance □Fail □N/A	
	Select a project	□Success □Success with assistance □Fail □N/A	
	Create a new study	□Success □Success with assistance □Fail □N/A	
	Select the function that corresponds to the target	□Success □Success with assistance □Fail □N/A	
Data preparation and processing	Raw data collection	□Success □Success with assistance □Fail □N/A	
	Define the properties of raw data	□Success □Success with assistance □Fail □N/A	
	Upload raw data	□Success □Success with assistance □Fail □N/A	
Result viewing	View basic conclusion & advice	□Success □Success with assistance □Fail □N/A	
	View advanced statistical results	□Success □Success with assistance □Fail □N/A	

Table 13: *Usability test script.*

4.1.4 Post-Usability Test Question

The Post-Usability Test Survey is used to collect subjective opinions about this test. Specifically include the following questions.

Thank you for completing the usability testing process and please complete this questionnaire.
What are your general impressions of Statiqx?
What do you think is the best feature of Statiqx?
What do you think is the worst feature of Statiqx?
List 3 things on the interface that confuse you the most
What features would you like Statiqx to add that would be more helpful in your work?
Do you have any comments or suggestions for this usability test?

Table 14: *Post-Usability test survey.*

4.1.5 User Recruitment

In the selection of test candidates, try to mix different age groups and experience backgrounds to ensure that the test conforms to the actual situation and avoid bias.

User No.	1	2	3	4	5	6	7
Date	7-Mar	8-Mar	8-Mar	17-Mar	22-Mar	23-Mar	23-Mar
Age group	30-40	20-30	20-30	40-50	30-40	30-40	20-30
Design background	No	Yes	Yes	Yes	Yes	Yes	No
Project management background	Yes	No	No	No	No	No	No

Statistical research background	No	No	Yes	No	No	No	Yes
Work experience	5	5	1	15	7	9	0

Table 15: *Demographic of users.*

4.2 Perform Usability Test

I adopted a mixture of the two methods, allowing users who do not go to the site to conduct tests independently on loop11 platform, and conducting unmoderated tests for users who are able to go to the site. This has the advantage of providing flexibility and convenience for testers, while allowing deeper communication with users to discover more valuable usability issues.

Users complete tasks given in a simulated office setting, meanwhile I act as a facilitator and note taker. After the completion of the test, the user's task completion and operation experience were investigated.

Figure 25: *Site photo of usability test – MDes studio, Block 10 building, Massey University, Wellington, New Zealand, photograph by author (2022).*

4.3 Analyze and Synthesize Usability Study Results

When usability testing is completed, it is necessary to summarize, organize, and analyze the data in the test. The results of the analysis serve as input to redesign action, completing a new design iteration.

Stage	Task	Note	User 1	User 2	User 3	User 4	User 5	User 6	User 7	Analysis	Redesign action
Study planning	Log on Statiqx	The user did not know he/she should log in firstly but tried to click somewhere else.	✓	✓	✗	✗	✓	✗	✗	User did not realize that log in was part of the task. It was due to no training before testing.	A welcome word should be added to inform the current page to users.
		The user is expected to do calculations directly on the welcome page.	✓	✗	✗	✗	✗	✓	✗	Users did not understand the task clearly. Redesign is not required.	N/A
	Select a project	The user did not understand what to do with Statiqx at the beginning.	✓	✗	✗	✗	✗	✗	✗	Users did not understand the task clearly. Redesign is not required.	N/A
	Create a new study	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	This task is clear, and users were all guided well by the interface.	N/A
	Select the method that corresponds to the target	The user did not know how to proceed as he/she did not understand each method, but also did not place the mouse on the '' symbol on interface.	✓	✓	✓	✗	✗	✓	✗	The '' Symbol recognition is so low that users ignore the fact that clicking on it is helpful.	A clear guide should be designed to indicate users to hover the mouse on '' when he/she does not understand.
		The user selected the wrong method by guessing without having read the guide.	✗	✗	✓	✗	✓	✗	✗	The user is not a native English speaker and was taking part of the content from the tip.	Tip messages should be optimized. A multilingual support is required if possible.
		The user thought the tip was too much information and expected a break.	✗	✓	✗	✗	✗	✗	✗	N/A	Tip messages should be optimized. Words need to be refined and segmented.
Data preparation and processing	Raw data collection	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Define the properties of raw data	The user did not know how to proceed as he/she did not understand each method, but also did not place the mouse over the '  '.	✓	✗	✗	✗	✗	✗	✓	The '' symbol recognition is so low that users ignore the fact that clicking on it is helpful.	A clear guide should be designed to indicate users to hover the mouse over '' when he/she does not understand.

		The user hovers the mouse on the '' and then knew what to do.	✗	✓	✗	✗	✗	✗	✗	N/A	N/A
	Upload raw data	The user wanted the data column to run down continuously, rather than two separated columns.	✗	✓	✓	✗	✗	✓	✗	The two-column data organization makes users confused and is difficult to read.	The table should be designed to be one continuous column.
Get result	View basic conclusions & advice	The user expected to return to the previous page in order to check the data.	✓	✗	✗	✗	✓	✗	✗	The tool provides an undo button so the user can go back to the last step at any time. Redesign is not required.	N/A
		The user expected a calculating process as he/she doubted whether the calculation was correct.	✓	✗	✗	✗	✗	✗	✗	The calculating process is not shown on the interface.	A window or page showing the calculating process should be added.
		The user did not understand the confidence level	✓	✗	✗	✗	✗	✗	✓	As confidence level is a statistical concept, conventional users cannot understand it easily.	An interpretive segment/window should be added to the interface.
		Users expect to see more specific suggestions for improvement	✗	✗	✓	✗	✓	✗	✗	The improvement suggestion is too simple and should be explored further.	More detailed and practical suggestions should be added to the interface.
	View advanced statistical results	The user expected a calculating process as he/she doubted whether the calculation was correct.	✓	✗	✗	✗	✗	✓	✗	The calculating process is not shown on the interface.	A window or page showing the calculating process should be added.
		The user thought the advanced report page was intuitive and detailed.	✓	✗	✓	✗	✗	✗	✗	N/A	N/A
		The user wanted to see the variables for putting into the formula.	✗	✓	✗	✗	✓	✗	✗	The calculating process is not showen on the interface.	A window or page showing the calculating process should be designed.

Table 16: *Post-usability test survey.*

4.4 Iteration

Software design is based on the design & testing iterative process, and in each iteration to complete its optimization. The results of usability tests serve as input for the next design iteration. For Statiqx, the redesigned interface will be reflected in chapter 5.

Chapter 5. Scenario & High-Fidelity Prototype

Creating scenarios is a great way to discover new ideas. The narrative of the scene shifts the designer's focus from technology to the goal of learning and solving problems, thus making him focus on the human aspect. Because the behavior itself has dimensions, the scene forms a depiction of what happens at a series of points in time (Kolko, 2010).

Figure 26: *Scenario design on post-it, photograph by author (2021).*

In this chapter, I shall introduce four user scenarios for Statiqx, each corresponding to main functions. Each step corresponds to a high-fidelity UI design. In order to simplify the length of the page, the corresponding screenshots of the repeated UI are omitted, only describing the tasks by words.

5.1 Scenario 1: Qing Used Statiqx for the First Time and Performed Overall Estimation

Background

Qing, a web designer at GoodHouse, a building materials retailer, is in charge of designing the company's recently launched online shopping site. The boss wanted to design the site to allow customers to complete the purchase process as much as possible, because it was related to the company's sales and saving the cost of arranging customer service resources over the phone.

Figure 27: *Background for scenario 1.*

Qing remembers that Statiqx, which he heard in the designer group, can provide some analysis functions for people with a statistical background, and he wants to see if Statiqx can help him in any way.

The steps for Qing to use Statiqx to conduct overall estimation are shown as follows:

- Qing logs in to the home page of Statiqx according to the website given by his friend. He sees some introduction about Statiqx and knows some basic functions of Statiqx.
- Qing quickly registers and clicks log in.

Figure 28: *Welcome page of Statiqx.*

- Qing logs into the home page of Statiqx and sees that the home page mainly displays recent projects. As he is using it for the first time, the list of all items is empty, and he needs to create a new project.

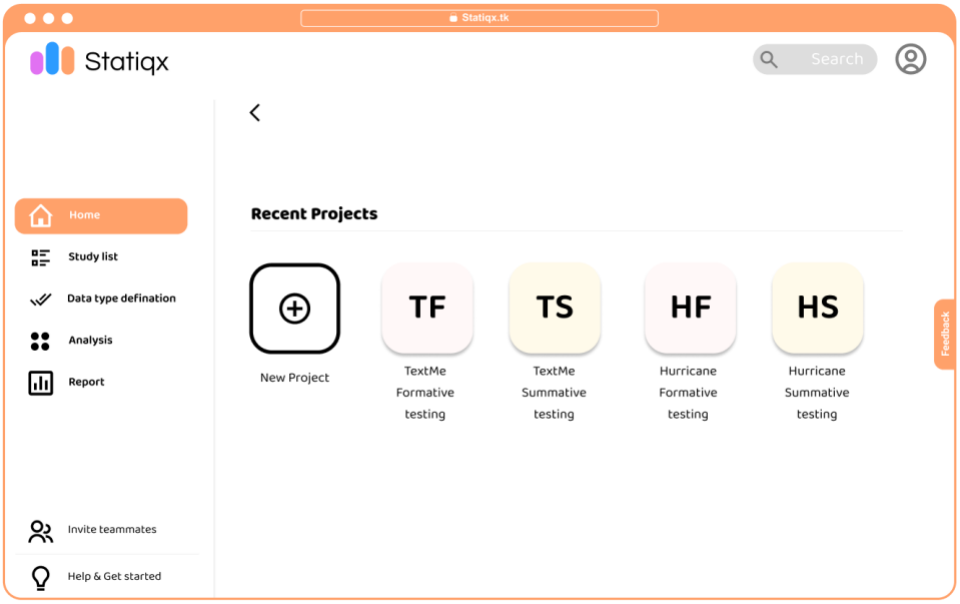


Figure 29: *Project selection page of Statiqx.*

- Qing clicks the new project button to create a new project and enters the study list. The study list is also empty. Then he creates a new study.

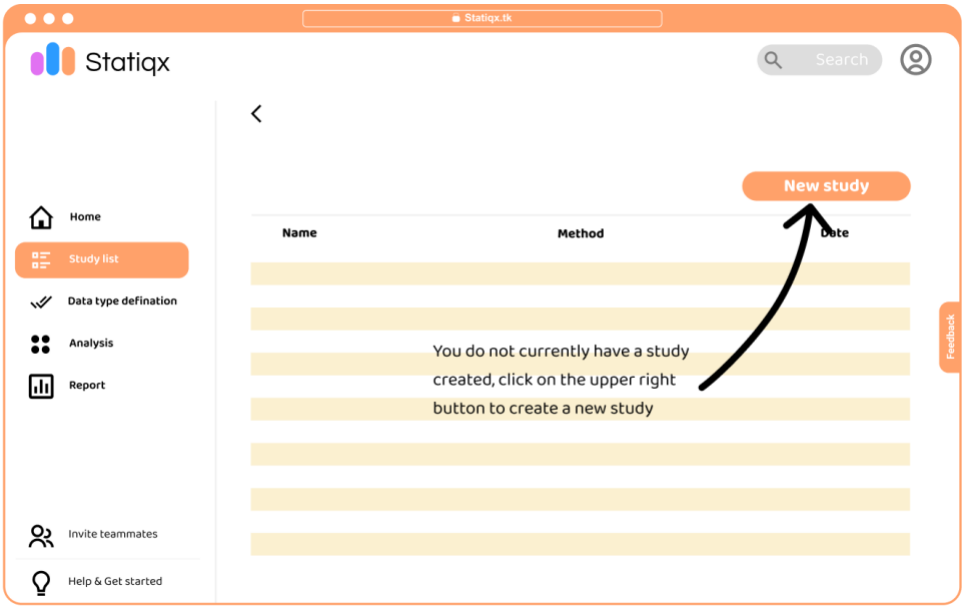


Figure 30: *Study management page of Statiqx.*

- Qing is not sure which feature he should select. He noticed a "question mark" in the bottom right corner of each tab, he hovered the mouse over it to read the brief description of each method. He quickly learned that he should click on the "overall estimation" tab.

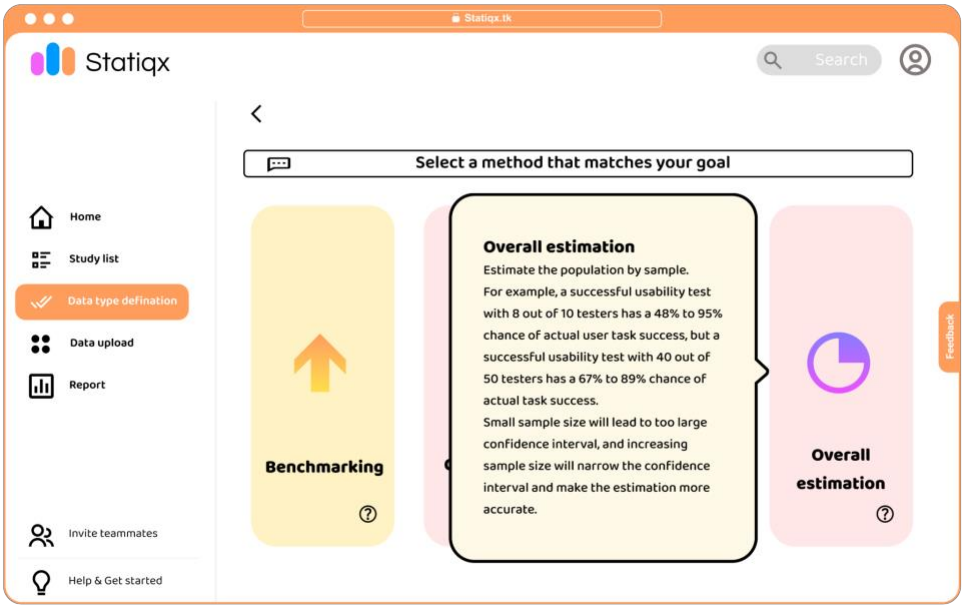


Figure 31: *Tip card in method locating page of Statiqx.*

- Qing is using Statiqx for the first time, so Statiqx pops up a prompt window indicating the type of raw data that Qing needs to prepare before performing data analysis.

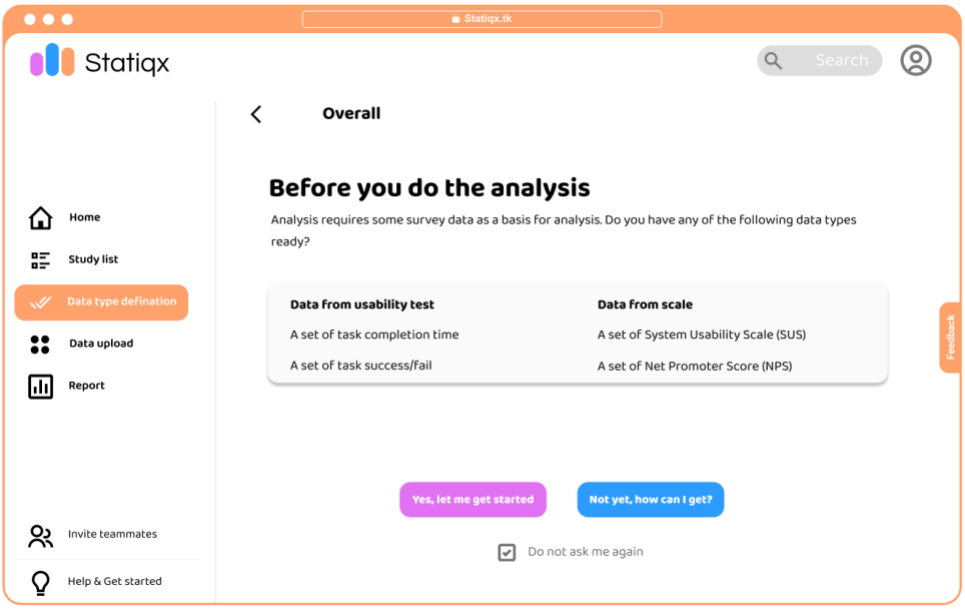


Figure 32: *Tip card in method locating page of Statiqx.*

- Qing doesn't know much about the raw data, so he selects to go to the teaching page.

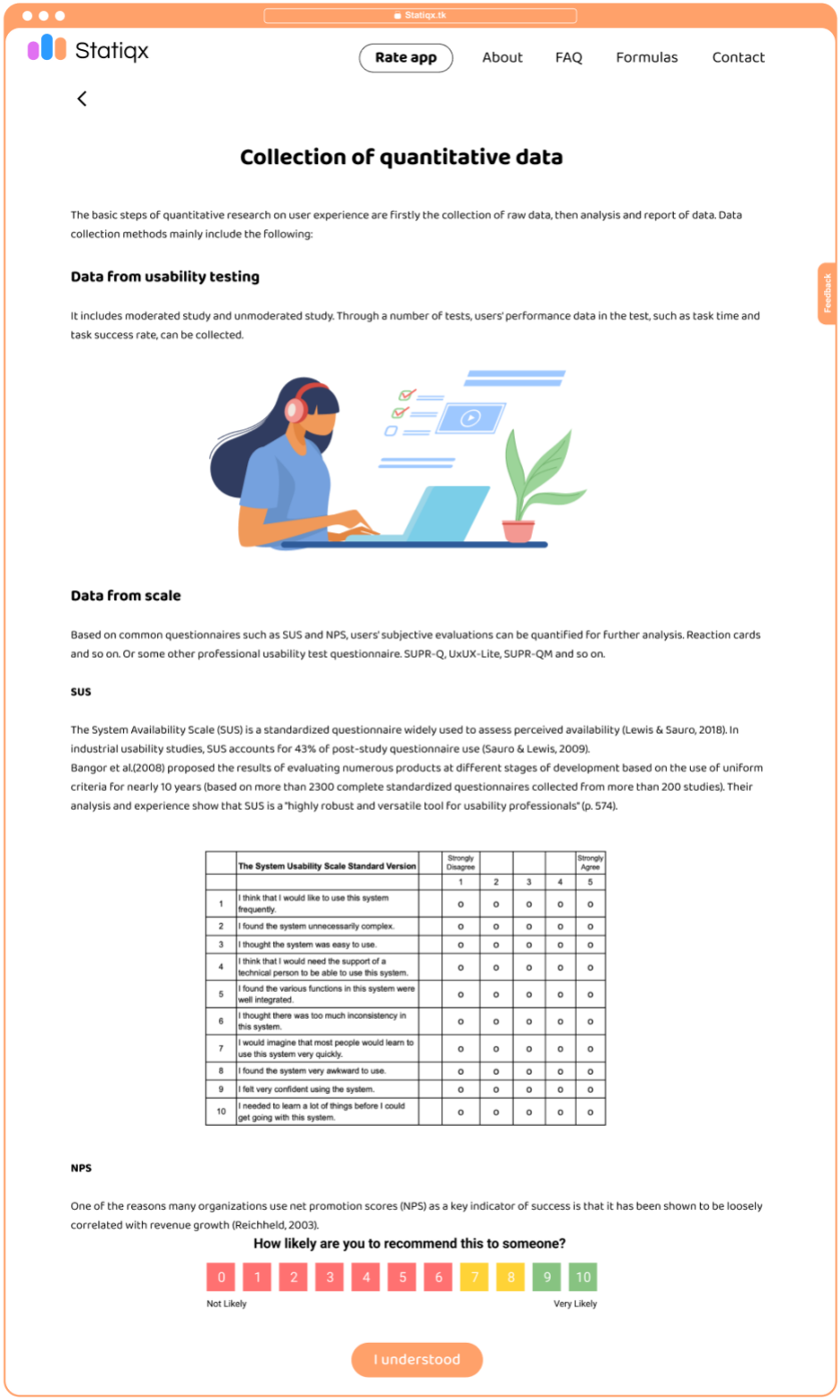


Figure 33: *Data type reminder page of Statiqx.*

- After reading the tutorial for gathering raw data. Qing invites 12 users to conduct a usability test on the website. The task of the test is to search for and order an electric screwdriver "SLTG1730". The tasks of these 12 users are shown in the following table:

User No.	Success/Fail	User No.	Success/Fail
User 1	Success	User 7	Success
User 2	Failed	User 8	Success
User 3	Success	User 9	Failed
User 4	Success	User 10	Success
User 5	Success	User 11	Failed
User 6	Success	User 12	Success

Table 17: *Raw data of scenario 1 for usability test.*

- Qing returns to the previous data checking page and clicks "yes, let me get started" to carry on.
- The page then comes to data definition, which is important for automatic statistical method selection. Qing did not really understand the data type definition, so he hovers the mouse over the "?", then a pop-up window explains the difference between continuous data and binary data.

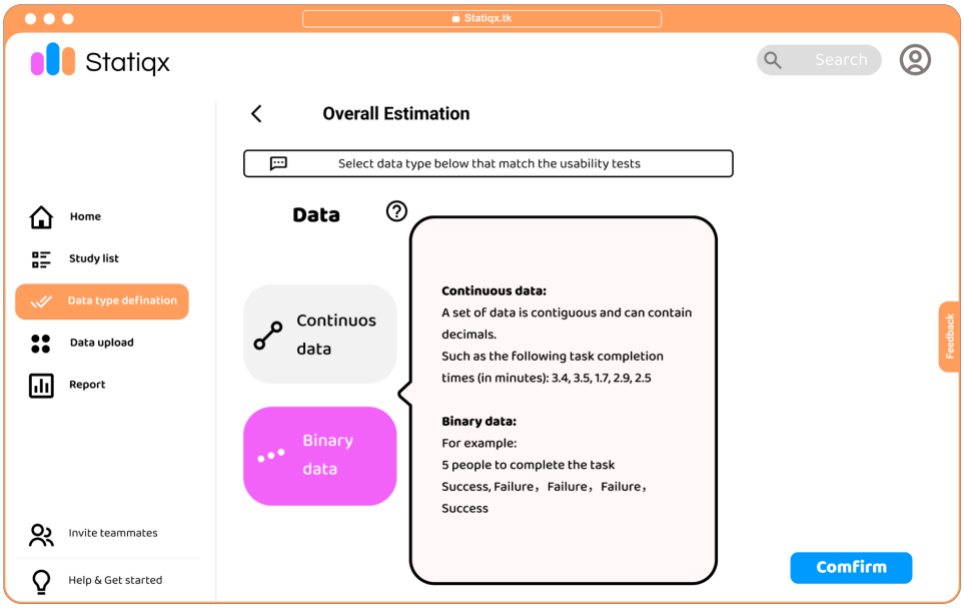


Figure 34: *Data type selection page of Statiqx.*

- The interface comes to the "upload raw data" interface, Qing inputs the data, fills the required form and then clicks "confirm".

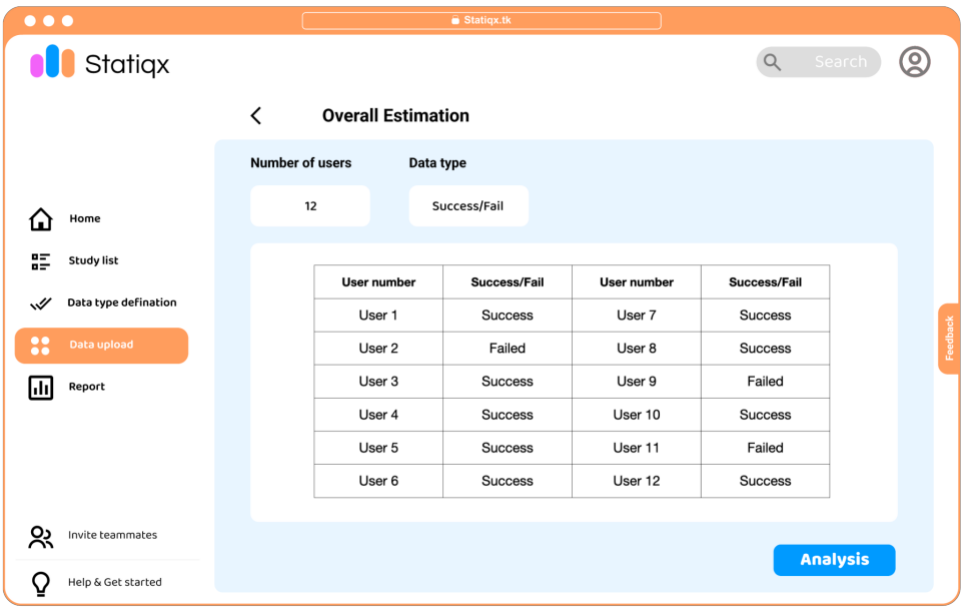


Figure 35: *Raw data input page of Statiqx.*

- Statiqx gives the conclusions and suggestions for improvement.

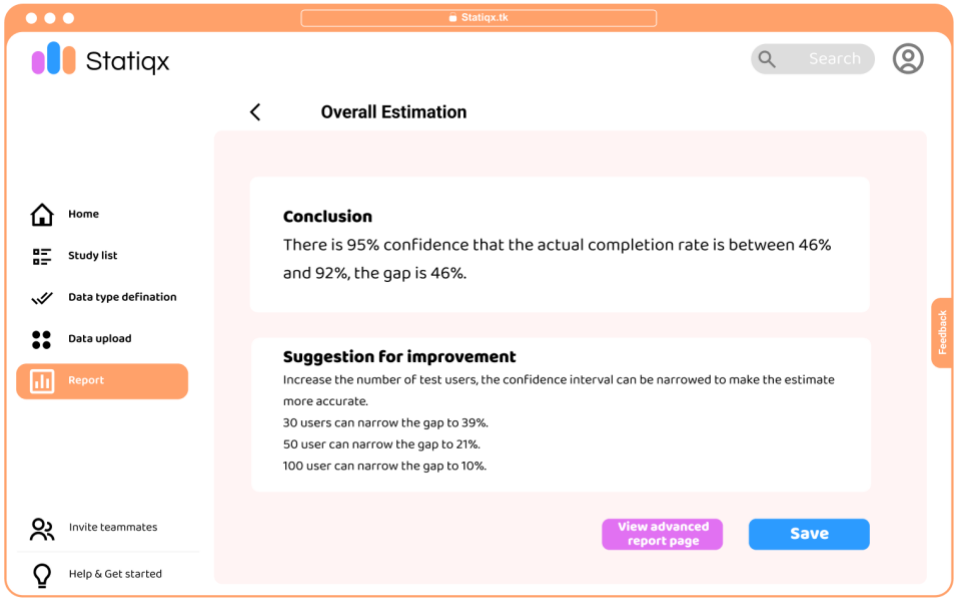


Figure 36: *Study report page of Statiqx.*

- Qing clicks “save”, the interface returns to the study list, this time the name of the study Qing just conducted appears in the list, Qing has completed his first attempt of Statiqx.

5.2 Scenario 2: Qing Conducts A/B Evaluation

Background

Qing also wants to know the gap between his site and rival Easytool.com. This time Qing knows how to collect raw data before analysis. After two sets of usability tests, users filled out the SUS usability scale to score both sites.

User number	SUS	User number	SUS
User 1	87	User 7	68
User 2	77	User 8	83
User 3	89	User 9	90
User 4	66	User 10	92
User 5	84	User 11	89
User 6	68	User 12	75

Table 18: *SUS data for GoodHouse.co.nz.*

User number	SUS	User number	SUS
User 13	76	User 19	84
User14	96	User 20	89
User15	65	User 21	90
User 16	77	User 22	84
User 17	88		
User 18	86		

Table 19: *SUS data for Easytool.com.*

The steps for Qing to use Statiqx to conduct A/B evaluation are shown as follows:

- Qing logs on to the Statiqx home page.
- Qing creates New Study.
- Qing selects A/B testing.

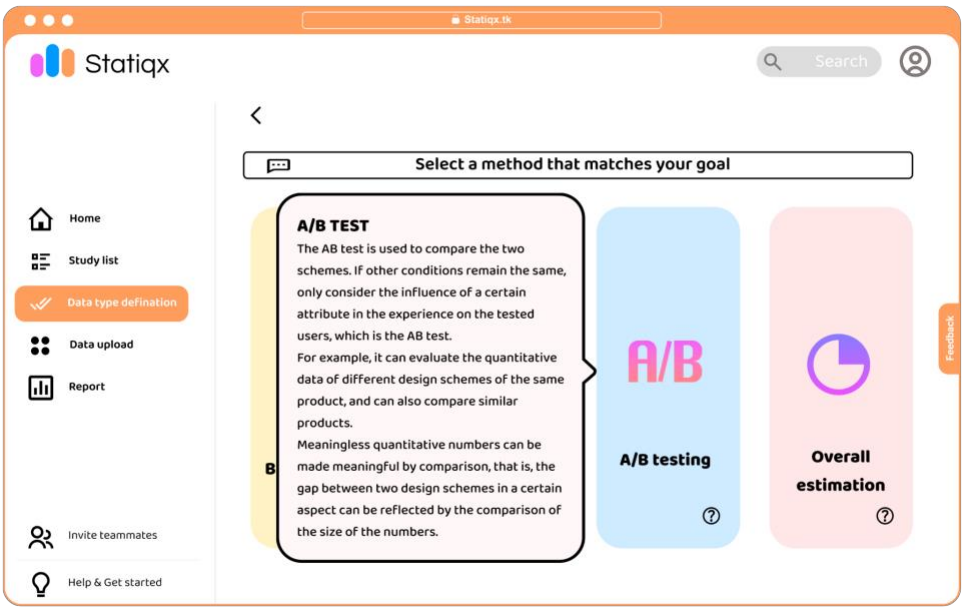


Figure 37: *Method selection page of Statiqx.*

- Since Qing wants to compare based on SUS scores and uses data from two tests by the same group of users, he chooses “compare between group”, “continuous data”, “less than 3 group”, and “no, different users in each group” for the data definition.

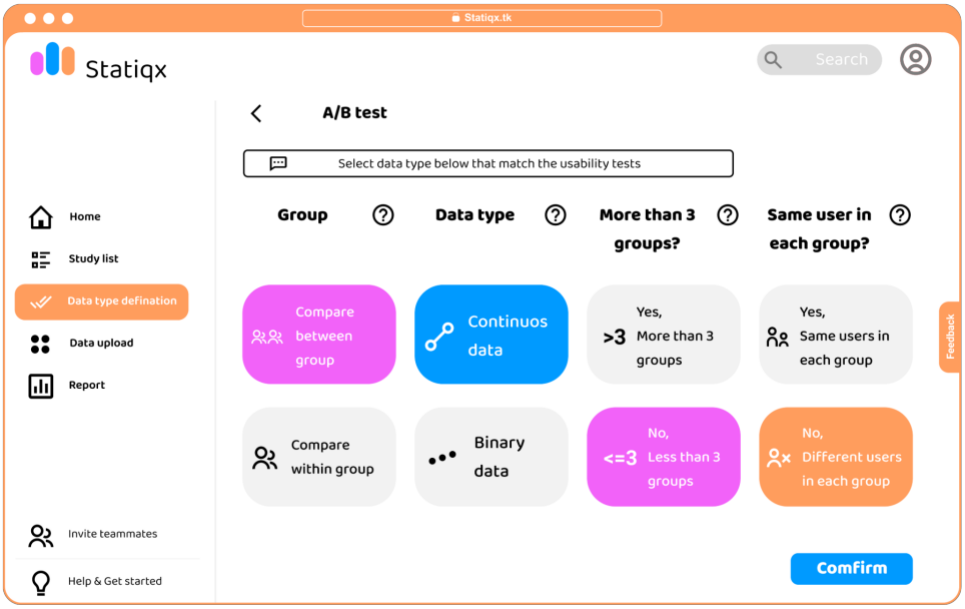


Figure 38: *Data type selection page for A/B testing.*

- Qing enters all SUS scores in the table and clicks on "analysis".

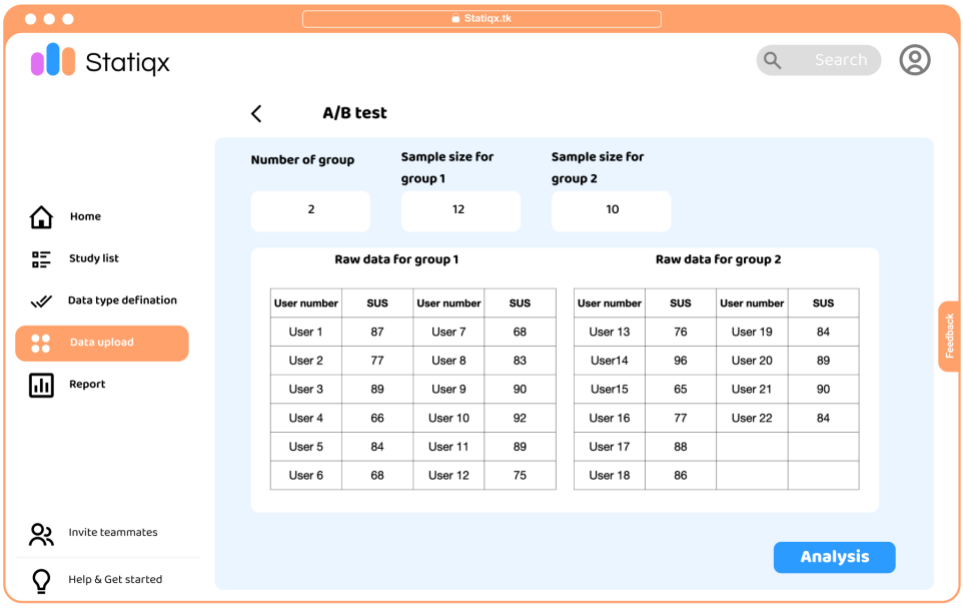


Figure 39: *Raw data upload page for A/B testing.*

- Statiqx gives the relevant statistical information of the test results and concludes that the probability of difference between product A and product B is 47.98%, which is not statistically significant, and also provides improvement suggestion.

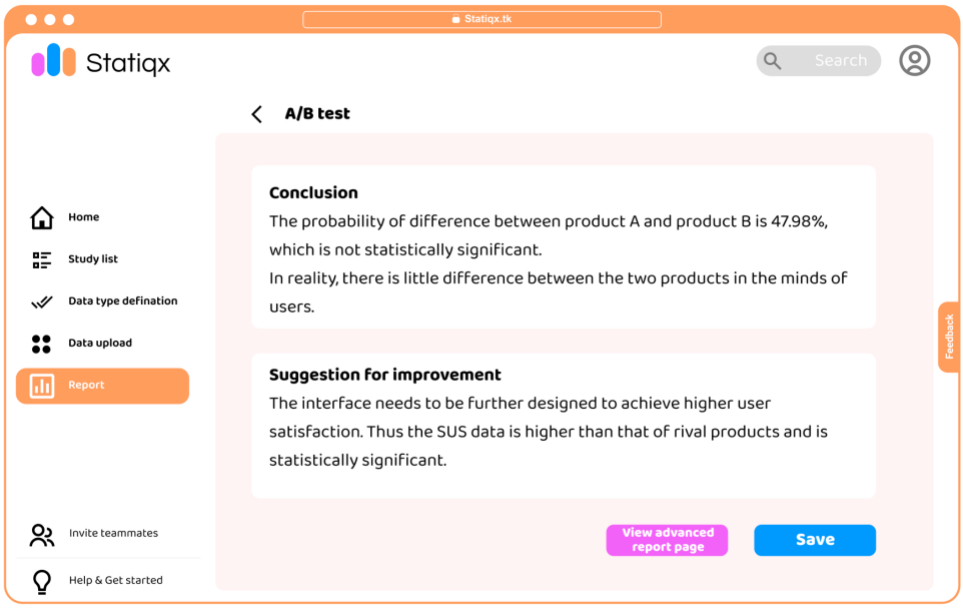


Figure 40: *Study report page of A/B testing.*

5.3 Scenario 3: Devin Conducts Benchmarking Evaluation

Background

Devin works for EastSoft, a medical device company, as product manager on a project called Hurricane, which is developing a CT scanner. The CT scanner is designed to perform body scans on urgent patients in the emergency department of a hospital, so the interface design requirements for human-computer interaction are high, because time is of the essence for patients.

The team wanted the technician to be able to complete the scan in 5 minutes, but there was a dispute between the design team and the development team as to whether the current interface achieved their goals, and the design team proposed an optimized interface design that was rejected by the development team.

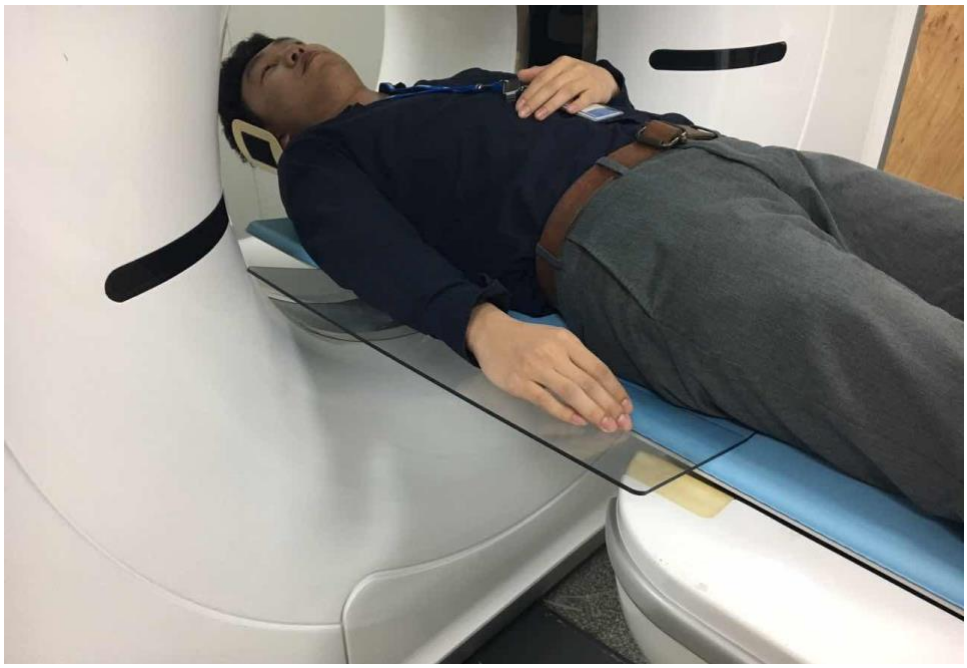


Figure 41: *Background for scenario 3, photograph by author (2018).*

Devin then invited 16 technicians to perform a summative usability test. The results are shown below:

User No.	Task time(min)	User No.	Task time(min)	User No.	Task time(min)	User No.	Task time(min)
User 1	7.2	User 5	4.4	User 9	8	User 13	6.6
User 2	4.5	User 6	4.8	User 10	6.7	User 14	4.7
User 3	7.5	User 7	3.9	User 11	4.7	User 15	3.6
User 4	6	User 8	4	User 12	5.6	User 16	3.8

Table 20: *Raw data of scenario 3 for usability test.*

Devin now wants to use statistical analysis to verify whether the design achieves its goals.
The steps for Devin to use Statiqx to conduct benchmarking evaluation are shown as follows:

- Devin logs directly into the home page of Statiqx via the URL as usual.
- Devin creates the new study.
- Devin chooses the benchmarking tab because he wanted to compare the task completion time against the benchmark.

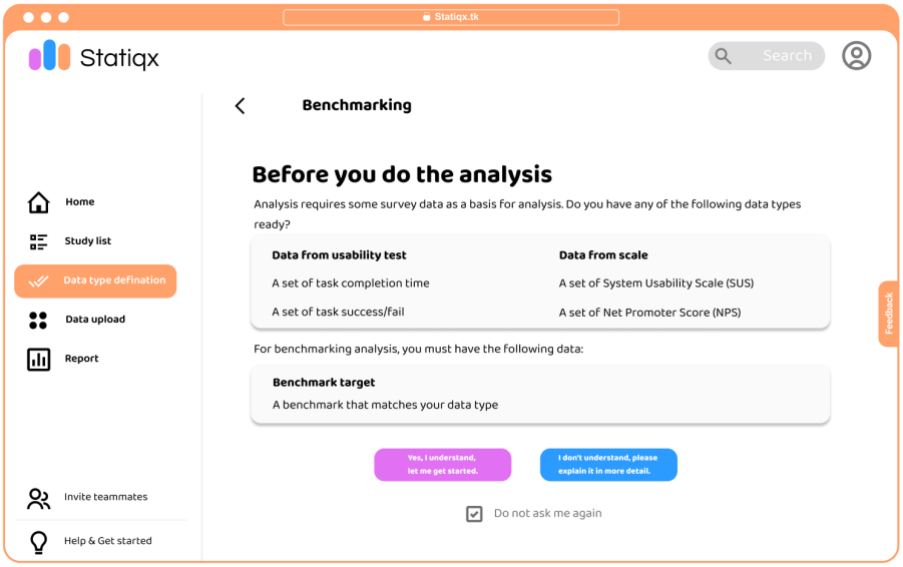


Figure 42: *Study selection page of benchmarking.*

- Devin should select “continuous data” and click “yes” on the time related question based on the actual situation. Then click “confirm”.

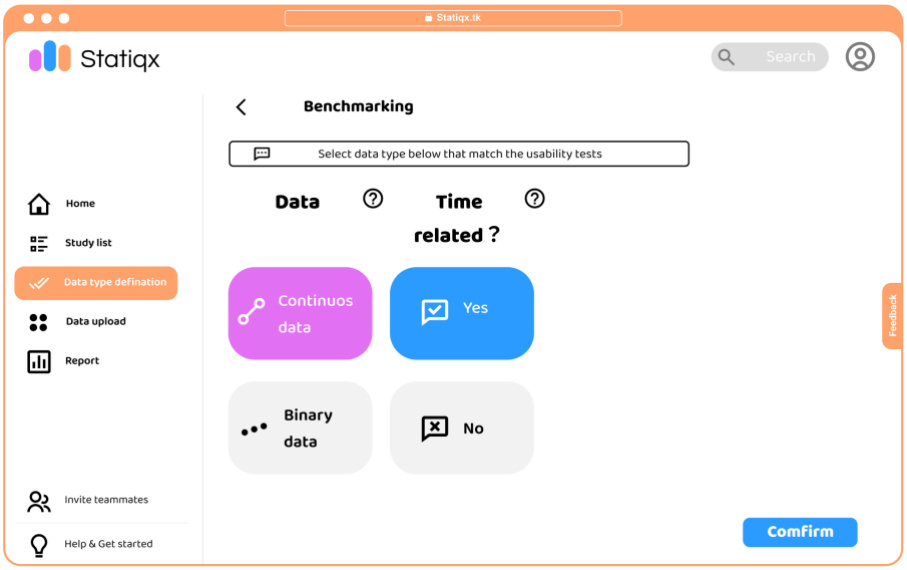
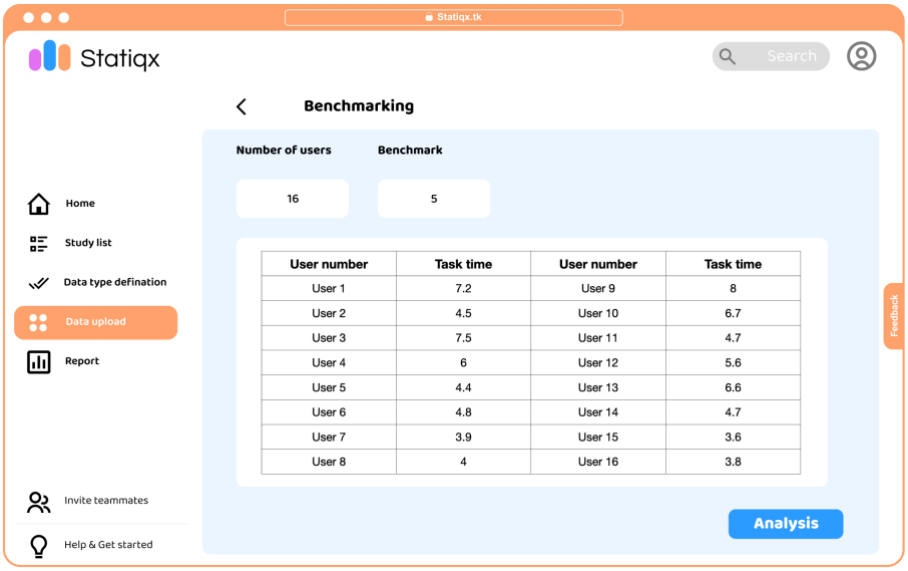


Figure 43: *Data type selection page of Statiqx.*

- Devin enters the task completion times for all users in the table. He also enters the benchmark task times, and clicks “confirm”.



User number	Task time	User number	Task time
User 1	7.2	User 9	8
User 2	4.5	User 10	6.7
User 3	7.5	User 11	4.7
User 4	6	User 12	5.6
User 5	4.4	User 13	6.6
User 6	4.8	User 14	4.7
User 7	3.9	User 15	3.6
User 8	4	User 16	3.8

Figure 44: *Raw data input page of Benchmarking.*

- The user interface gives the relevant statistical information of the test results and concludes that "5 minutes to complete the task" is not statistically significant because the benchmark is within the confidence interval, which is less than 5 minutes”.

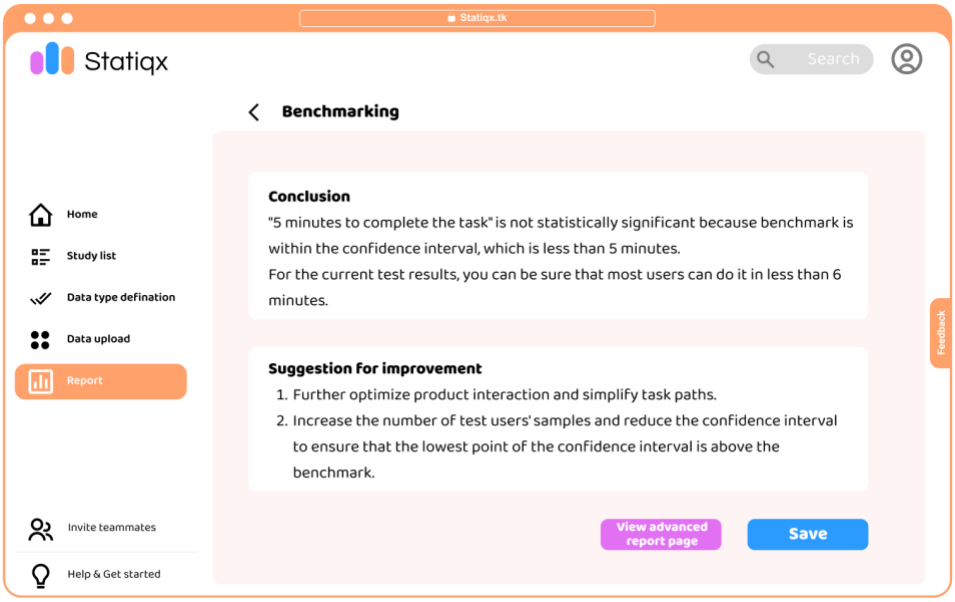


Figure 45: *Study report page of benchmarking.*

5.4 Scenario 4: Kim Conducts Correlation Evaluation

Background

Kim, the researcher, wanted to evaluate whether there was a correlation between task duration and NPS scores. In order to make a decision on whether to continue simplifying the interface, she ran a usability test with the following results:

User No.	Task time (s)	NPS score (0-100)	User No.	Task time (s)	NPS score (0-100)
User 1	365	90	User 7	67	98
User 2	553	86	User 8	76	89
User 3	333	78	User 9	58	90
User 4	356	87	User 10	96	65
User 5	664	68	User 11	75	77
User 6	78	65	User 12	67	67

Table 21: Raw *data for Kim.*

The steps for Kim to use Statiqx to conduct correlation evaluation are shown as follows:

- Kim goes directly to Statiqx's home page via the URL.
- Kim creates a new study.
- Kim selects “correlation”.

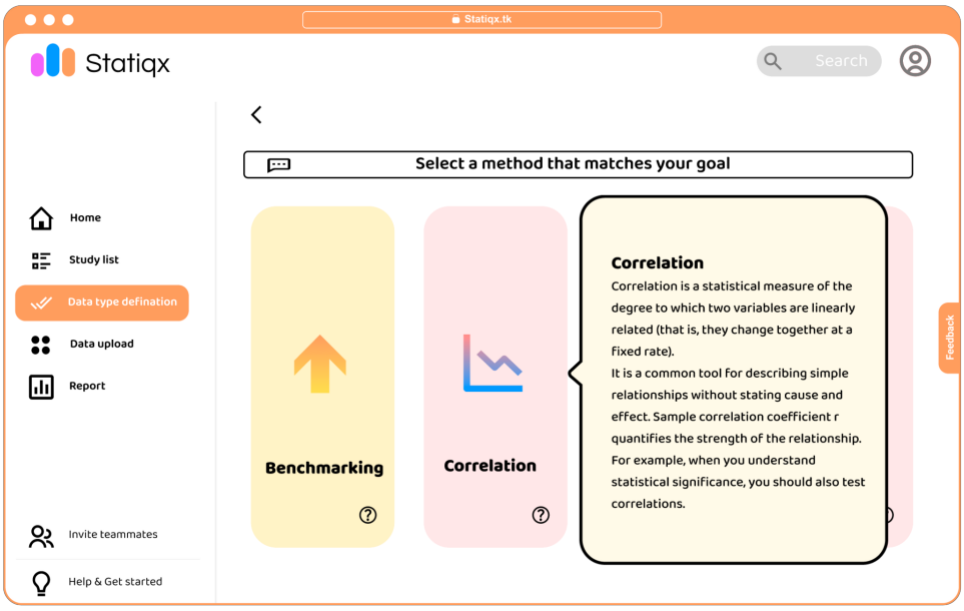
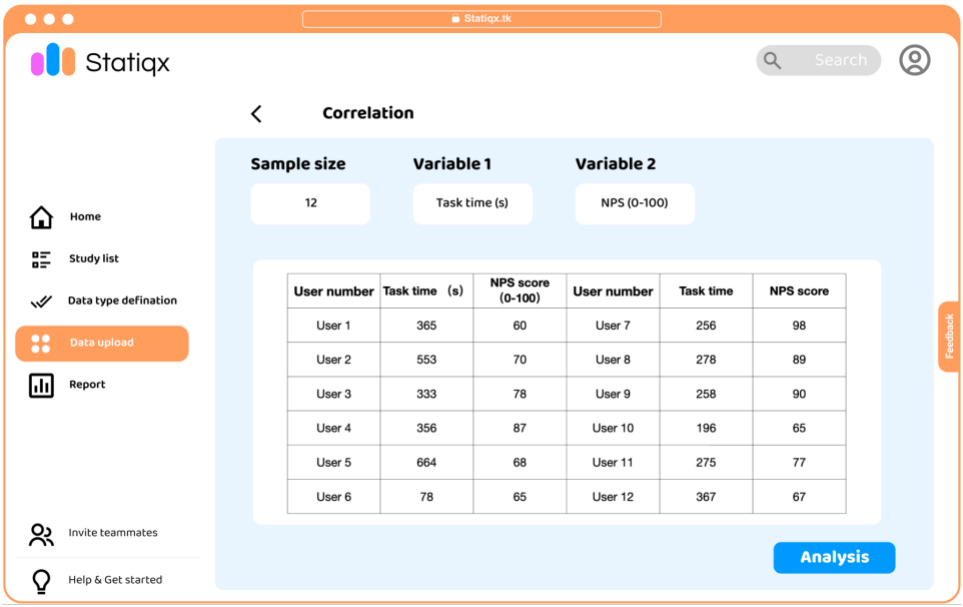


Figure 46: *Study selection page with pop up tip for Correlation Analysis.*

- Kim enters the relevant data in the form.



User number	Task time (s)	NPS score (0-100)	User number	Task time	NPS score
User 1	365	60	User 7	256	98
User 2	553	70	User 8	278	89
User 3	333	78	User 9	258	90
User 4	356	87	User 10	196	65
User 5	664	68	User 11	275	77
User 6	78	65	User 12	367	67

Figure 47: *Raw data input page of Statiqx.*

- The user interface gives the relevant statistical information of the test results and gives the conclusion that their correlation coefficient is 0.88. There is a strong correlation.

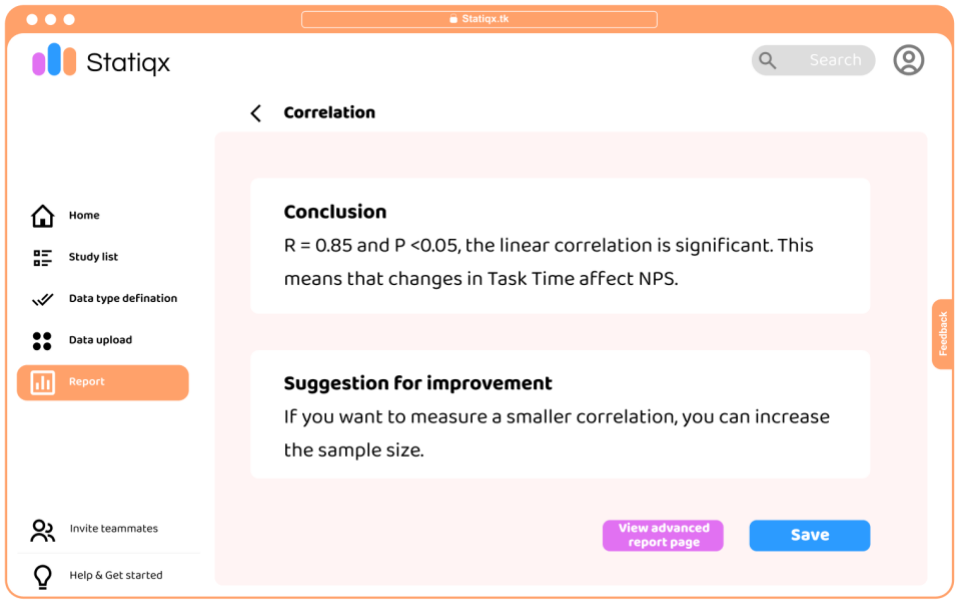


Figure 48: *Study report page of Statiqx.*

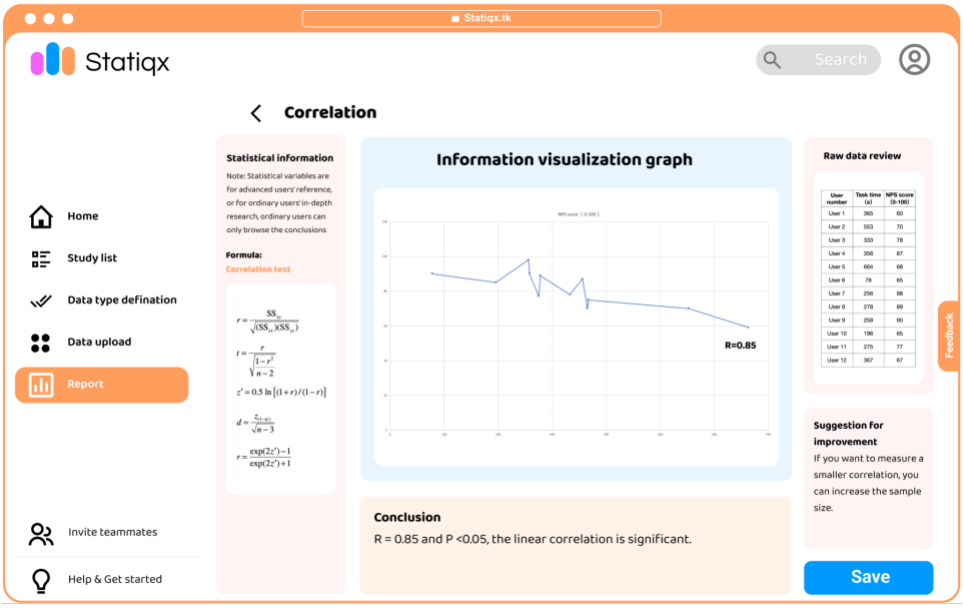


Figure 49: *Study report page of correlation*

- When the user clicks "save," the screen returns to study management and displays the completed study.

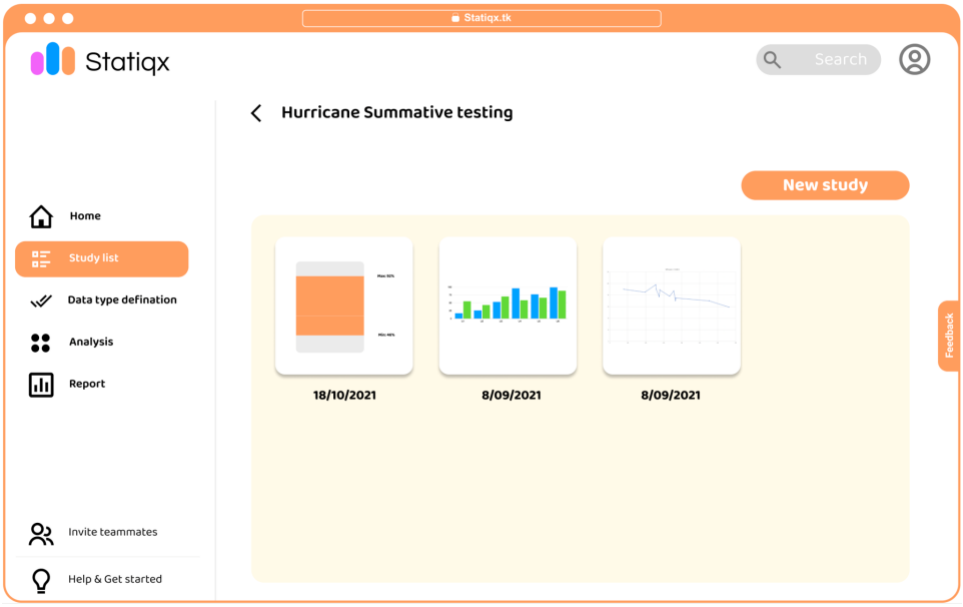


Figure 50: *Study management page of Statiqx.*

Chapter 6. Conclusion

6.1 Summary

Research is very important in the product development process, as especially in the early stages of the project, sufficient user research can avoid a lot of detours. Of course, conducting user research is highly energy-consuming work. For many practitioners, especially small companies, it is not easy to implement due to various constraining conditions, such as cost, time limit and human resources.

The use of quantitative data has many benefits for interactive product developers, such as increasing efficiency in cross-functional team communication, avoiding bias, conducting structured research, and helping to understand the extent of the problem. These benefits are the motivation for interactive product development practitioners to conduct quantitative research.

Through the survey, it was found that although quantitative research is highly accepted among user experience practitioners, there are still some further needs. Generally, interactive product practitioners only carry out some simple quantitative analyses. Such as calculating the average value of a set of data or making simple quantitative comparisons but lack in-depth and professional statistical analysis. At the same time, some practitioners think that quantitative research is difficult.

This exegesis introduces the quantitative analysis tool Statiqx by way of user experience design. In the current version, it provides four features: overall estimation, AB testing, correlation analysis, and benchmarking. The goal is to produce a minimum viable product (MVP) that will provide a foundation for deeper, extending, and more valuable functionality. Statiqx integrates current, commonly used statistical formulas into the system and automatically selects statistical methods based on the user's goals. Users simply upload raw data such as SUS, NPS questionnaires, or metrics from usability tests to get results immediately. The results not only include some conventional simple calculation results, but also include professional statistical calculation results, such as median, confidence interval, confidence, regression analysis, correlation, etc. These statistical analysis results will help the team to make better decisions or carry out further in-depth analysis.

Statiqx can help users conduct quantitative research based on statistics, and also has some educational functions, it helps to understand quantitative research. The whole process does not require users to know how to use the formula in Excel or more complex professional statistical software, nor does it require users to understand the principle and algorithm behind the formula, which greatly reduces the operation difficulty of quantitative analysis. It is suitable for novice and non-professional user experience practitioners who want to conduct quantitative analysis. Statiqx is not only suitable for products connected to the internet, but also for general human–computer interaction products. Even without the

analysis of network tools, it can carry out quantitative research. In a way, Statiqx helps simplify the design process and is an optimization from method level.

6.2 Limitations and Future Work

Quantitative user research is a profound and complex field, and the user needs Statiqx can satisfy are still very limited. With the improvement of science and technology, there are more and more ways to obtain quantitative data, such as the system back-end data, biometric assessment and so on. The number of users involved in this project is still very limited. More user interviews, questionnaires and usability tests, and more in-depth competitive product analysis are still necessary. These require continuous improvement in subsequent iterations, as software development is a never-ending process.

In the Master of Design stage, my main work was problem definition and prototype design, which did not involve the coding development of Statiqx too much. I tried to do some early code development work on my own (https://www.statiqx.tk), but there will be a need for members of different roles in the future, such as front-end and back-end developers, to really take the project forward.

Another topic that will come up when we finish developing Statiqx is that we can use Statiqx to evaluate itself, which will be a very interesting experiment. This can be my future direction as a designer.

Definitions and acronyms

Term	Definition
UX	User experience
UI	User interface
HCD	Human-centered design
SUS	System usability scale
NPS	Net promoter score
HCI	Human-computer interaction

Appendix

Questionnaire Survey on the Use of Quantitative Research Methods in Interactive Product Development

Introduction
Hello,
I am conducting research on design research methods. The main purpose of which is to investigate the designers' attitudes to quantitative analysis in the design process.
I would appreciate a few minutes of your time to ask you a few questions.
At this stage of the research, all information submitted will remain anonymous. You may choose to be identified if you wish to... Please indicate whether you would be willing to participate in future user test or other conversations in the short term.
Under no circumstances will we sell or use any contact information that you supply us other than in the context of this research project outlined above.
If you have any questions about this survey, please contact me. Thank you for your time.

Qinghua Zeng
Master of Design candidate at the College of Creative Arts, Massey University
Email: qinghua.zeng.1@uni.massey.ac.nz

1. What is the industry you work in? * Check all that apply.

- Mobile Software
- Desktop Software
- Industrial Design
- Academia
- Other:

2. What is your function at work? * Check all that apply.

- Designer
- Researcher
- Product Manager (PM) Developer
- Business owner
- Other:

3. How many years have you been working? * Mark only one oval.

- 0-2
- 2-5
- 5-10

- 10+
- I am still a student.

4. Have you done user research on your product? * Mark only one oval.

- Yes
- No

5. Do you know or use any user research tools? Check all that apply.

- TryMyUI
- Loop11
- Userlytics
- Hotjar
- Other:_____

6. Have you tried quantitative research methods? Mark only one oval.

- Yes
- No
- Other:_____

7. What quantitative research methods do you know?

8. (If you haven't done quantitative research) What's the reason you didn't do quantitative research? Check all that apply.

- I don't have the knowledge and skills of quantitative research.
- Too expensive.
- I don't think it's necessary.
- Other: _____

9. What is your attitude towards quantitative analysis? Mark only one oval.

- I don't think it works. I don't want to do it at all.
- I think it's useless and not worth my time.
- I think it's very useful and I'll consider using it in the future I find it very useful.
- Other: _____

10. In response to the last question, could you elaborate on the reasons for your attitude?

_____

11. If you have done quantitative research, what do you think are the problems and shortcomings?

_____

12. How do you do your quantitative research?

_____

13. What problems do you want to solve with regard to quantitative research? Check all that apply.

- Statistical analysis & use of data
- Comparing with UX benchmark
- Comparing between alternative design solutions
- Make decisions for the sample size for surveys
- Make an estimate of the overall situation from the sample
- Make decision for the number of participants recruited for usability testing
- Design a usability questionnaire
- Select the appropriate test method
- Reduce the cost of quantitative testing
- Evaluating the impact of subtle changes
- Biometric assessments of user experience (e.g., changes in heart rate between time 1 and time 2 percent of improvement on sales)
- Conversions after implementing a change for the product
- Experimental design
- Other:_____

14. I will soon be developing a web app for quantitative analysis. If you wish to participe in its usability testing, leave your contact information (email preferred) here :)

_____

15. I am happy to share the survey report of this questionnaire. Do you want to obtain the survey report? If yes, leave your contact information (email preferred) here :)

_____

16. Thank you very much and congratulations on reaching the last question! Any other suggestions about this questionnaire?

_____

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Image List

Table List

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