

A Design Study on the Developing In-page Data-based Persona for Web Service

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Webサービス向けページ内のデータベースPersonaの
開発に関するデザイン研究

A Design Study on the Developing
In-page Data-based Persona for Web Service

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2019年3月

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1. INTRODUCTION

The concept of a persona was introduced by Alan Cooper, the inventor of Visual Basic, as a user-centered design tool in his book “The Inmates Are Running the Asylum” [1] A persona is a precise description of a hypothetical user and what s/he wishes to accomplish. [2] Persona has been accepted as a general tool and a method for user experience design and much has been written about persona’s strengths. [1,3,4,5,6,7,8]

However, there have been various objections to the applicability of persona modeling. Typical disadvantages of traditional personas include followings: personas designed by a UX designer or group members are not based on data, personas are not communicated well, how to use the personas is hard to learn, and persona development process lacks the support of executives. [6] Pruitt and Grudin criticized a lack of connection between research data and personas. [7] Recently, companies have attempted to introduce a simple persona such as a proto-persona. It can be created quickly by filling in a specific template such as sketches, name, behaviors, needs and goals and pain-points in simple format. [8, 9] On the other hand, quantitative data such as survey, factor analysis, and clickstream data have been used for developing a data-based persona. Among them, this study focused on clickstream data and in-page web analytics which can analyze mouse usage patterns in specific web pages.

This study has two goals, as described below. The first goal of this study is to identify opportunities for data-based personas based on studies of advantages and disadvantages of formal persona and proto-persona, and research on web analytics and in-page web analytics. The second goal is to analyze the functions of in-page web analytics and to develop the persona clustering function, then study the system that can implement a specific persona model for workshops and meetings to gain quick user understandings and empathy without large amounts of user research, and verify through expert evaluation.

This research proposed a method of data-based persona modeling

based on in-page visual analytics which gather mouse pattern data in specific web pages. This study defined the data types related to the persona that can be explored and extracted for the recently developed in-page analytics software, Beusable. This study modeled data-based persona and evaluate persona model with experts in user experience design field.

In Chapter 2, this study described the web service and user experience design that are the background knowledge for data-based persona. In the following chapters this study discussed the features and advantages and disadvantages of the formal and proto persona (chapter 3).

In chapter 4, persona components were derived through analysis and development of in-page analytics, which are tools for deriving quantitative data. The modeling of data-based persona was performed based on them and the process, guide and elements for persona modeling was defined. (chapter 5). Chapter 6 explores the usefulness and the potential for using data-based persona through expert evaluations. The final chapter (chapter 7) concluded the research results, discussions from chapter 3 to 6, and future research opportunities. The correlations and flows between the chapters are described in Figure 1.

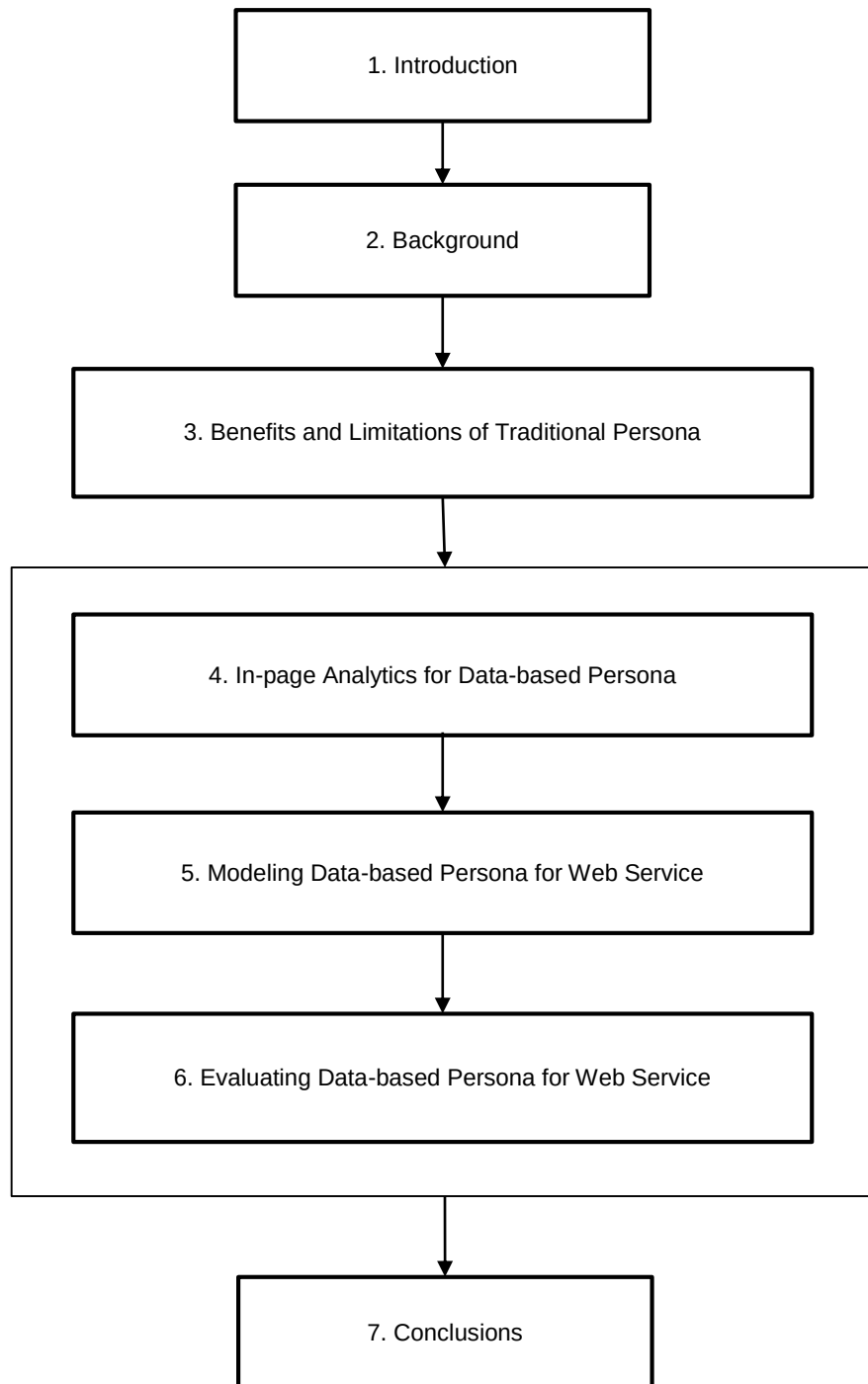


Figure 1: The correlations and flows between chapters in this paper

2. BACKGROUND

This chapter describes a brief introduction of prior studies and milestones

related to world wide web, web service and user experience design for web service. As there are various fields in the above-mentioned topics, this study will only discuss the most relevant and important works for this study. The overview of each area is explained at the beginning and the details are explained in following chapters as appropriate.

The review of internet services and world wide web is discussed to find out key characteristics of service. The user experience design review for web service includes elements, research methods and quantitative data analysis.

2.1 World Wide Web Service

2.1.1 Internet and World Wide Web

The Internet refers to computer networks that connect computers and exchange information using a communication protocol called TCP / IP (Transmission Control Protocol / Internet Protocol). The Internet connects computers with servers and clients. The origins of the Internet date back to research commissioned by the federal government of the United States in the 1960s to build robust, fault-tolerant communication with computer networks. [10] The primary precursor network, the ARPANET (Advanced Research Projects Agency Network) initially served as a backbone for interconnection of regional academic and military networks in the 1980s.

World Wide Web or the Web is only one of a large number of Internet services. The Web is a collection of interconnected documents and other web resources, linked by hyperlinks and URLs. [11] Tim Berners-Lee first proposed vision of a global hyperlinked information system. [12] In March 1989 Berners-Lee issued a proposal to the management at CERN (European Organization for Nuclear Research) for a system called "Mesh" that referenced ENQUIRE, a database and software project he had built in 1980, which used the term "web" and described a more elaborate information management system based on links embedded in readable text. Web services are basically developed as stand-alone server-independent documents, but the text, image, video, and source components in the service are linked to other web sites in hyper link form. This is because the Web, which forms the basis of Web services, is an information space with independent URL addresses that are accessible via the Internet and interconnected by hyperlinks. [13] Therefore, users interact with numerous web services through interconnected web services, and the connected web services have mutually symbiotic relationship. These complexly connected Web services have caused many usability problems, such as making users lose their way in the

internet space and making it difficult to find the information they need. A web browser is a software application for accessing information on the Web. Each individual web page, image, and video is identified by a distinct URL, enabling browsers to retrieve and display them on the user's device. The first web browser, called WorldWideWeb, was invented in 1990 by Tim Berners-Lee [14].

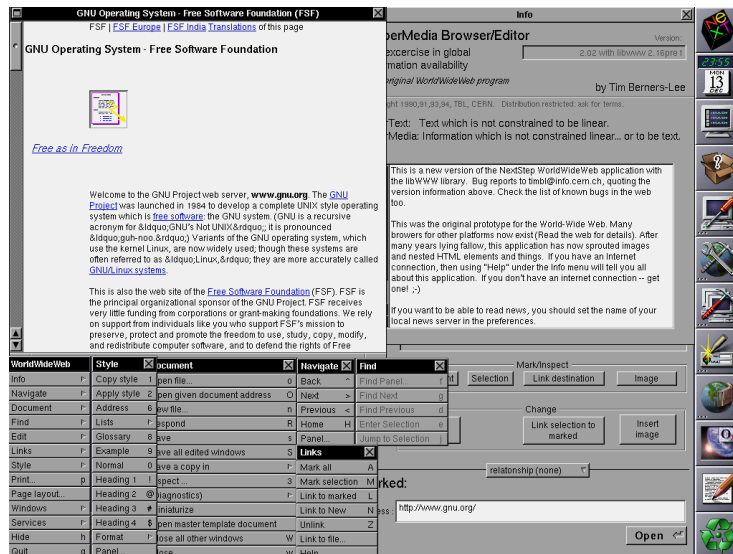


Figure 2: The First Web Browser, WorldWideWeb by Tim Berners-Lee

2.1.2 Evolution of Web Services

A Web service is a software service based on a web browser that utilizes an Internet network. Mosaic is the web browser that popularized the web service. Mosaic browser was released by NCSA (National Center for Supercomputing Applications) at 1993. Its innovative graphical interface made the Web service easy to use and thus more accessible to the average person. This, in turn, sparked the Internet boom of the 1990s when the Web grew at a very rapid rate. [15] Since then, Internet browsers such as Netscape, Internet Explorer, and Google Chrome have grown and Web services have grown together.

In terms of technology, browsers have greatly expanded their HTML (Hyper Text Markup Language), CSS (Cascading Style Sheets),

JavaScript, and multimedia capabilities since the 1990s. One reason has been to enable more sophisticated websites, such as web applications. Another factor is the significant increase in broadband connectivity, which enables people to access data-intensive web content, such as YouTube streaming. In this context, various kinds of web 2.0 services are emerging. Web 2.0 emphasize user-generated content, usability, participatory culture and interoperability for end users.

The term was invented by Darcy DiNucci in 1999 and popularized several years later by Tim O'Reilly and Dale Dougherty at the O'Reilly Media Web 2.0 Conference in late 2004. [16] Web 2.0 is a term used to reflect the perception of the evolution of the Web as a whole platform that provides advanced and powerful web service to end users in a collection of Web sites.

The emergence of smartphones made it easier to move web services that were primarily used for desktop and notebook computers. In January 2007, Apple Computer unveiled the iPhone, the company's first smartphone. The iPhone was designed around a large capacitive touchscreen, which supported the use of multi-touch gestures for interactions and offered features such as a web browser designed to render full web pages, multimedia functionality. After iPhone, Google released Android OS (Operating System) as open source operating system for smartphone. Android is based on a modified version of the Linux kernel and other open source software and designed primarily for touchscreen mobile devices such as smartphones and tablets. As the spread of smartphones spread, many web services began to be developed in the form suitable for smartphones.

The spread of smartphones has widened the view of responsive web design and mobile first for web service developers. Responsive web design is an approach to web design that makes web page render well on a variety of devices and window or screen sizes. Recent work also considers the viewer proximity as part of the viewing context as an extension for responsive web design. [17] Mobile first concept predated responsive web design which is unobtrusive JavaScript, and progressive

enhancement. Browsers of basic mobile phones do not understand JavaScript or media queries, so a recommended practice is to create a basic web site and enhance it for smartphones and PCs, rather than rely on graceful degradation to make a complex, image-heavy site work on mobile phones. [18] [19] The smartphone is equipped with various sensors and it provides a technical basis for presenting customized service using various context information of the user. As figure 3, accelerometer, rotation, orientation, gyroscope, GPS (global positioning system, light, microphone, proximity, camera sensors are typical sensors installed in popular smartphones. Different smartphone models have different sensors installed, and newer smartphones are equipped with more and more sensors, offering new functional possibilities.



Figure 3: Smart Phone Sensors: Galaxy S4 and embedded sensors. [20]

Figure 4 shows the context information used for mobile services. Using various context information, a web service can provide suitable service for specific context. [21] According to Savio and Braiterman, the model also highlights many opportunities for new forms of communication and computing that integrate into customers' lives rather than interrupting activities. Mobile applications have only just begun to gain new

customers by providing entertainment, connecting people, managing schedules, arriving at meetings and leisure activities, and making their lives easier.



Figure 4: Context for Mobile Interaction.

2.2 User Experience Design for Web Service

2.2.1 Definitions and Elements of User Experience

The term "user experience" was first used by Donald Norman, Apple's vice president, to describe his work. He defines the user experience as it covers all aspects of user interaction that recognize, learn, and use users,

products, and services. [22] As the design field expanded from hardware experience to digital experience and service experience, Donald Norman emphasized the importance of consistent experience design over an organization. On the other hand, the user experience is defined by the International Organization for Standardization (ISO) as the perception and reaction that individuals have through their actual use in anticipation of the use of products, systems, and services. [23] The definition of ISO is similar to Donald Norman's definition, but it is characterized by particular focus on recognition and response among aspects of interaction. The field of user experience design has been popularized as advance of IT technologies such as semiconductors, networks, Internet and smart devices. Due to Web 2.0 technologies, advanced rich interaction design for World Wide Web was diffused and lots of install-based software were converted to web services.

On the other hand, due to this broad definition, there has been much confusion in defining and organizing user experience design tasks. Because of this, Donoghue and Schrage defined the user experience design by separating the broad view from the consultation view. Donoghue and Schrage said, "The term user experience is complex. From a consultative point of view, the user experience refers to the relationship between an electrically made customer, product, and service, and encompasses both the physical user interface, the immersive, the interaction process, and the feedback system. In the broad sense, the user experience refers to experiences that involve user behavior and attitudes and encompasses the motivation to use the system. All of these are factors that cause changes in the business environment between companies and businesses. " [24]

J.J. Garrett described the complex elements of the user experience in five elements. The five elements are as follows: The first element is a strategy element that presents site objectives based on user needs. The second element is a scope element that presents content requirements and

functional specifications. The third element is a structure element that presents information architecture and interaction design, the fourth element is the skeleton element that performs navigation and information design to organize the interface, and the fifth element is the surface design element that performs the visual design. [Figure 5] [25]

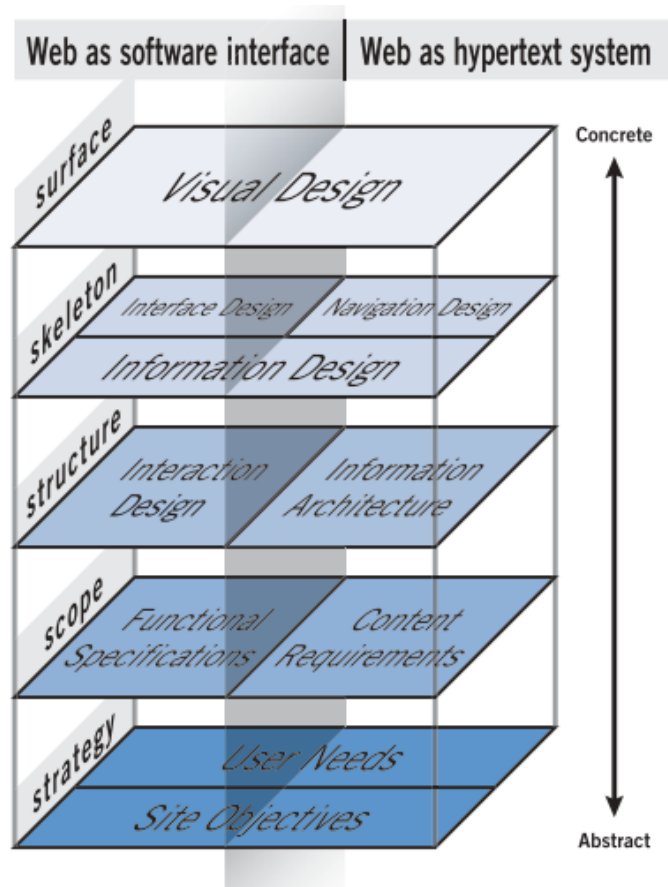


Figure 5: The Elements of User Experience

2.2.2 User Experience Research for Web Service

It is very widespread for a single expert to perform these elements of the user experience. Therefore, it is common for companies to perform tasks by subdividing tasks to perform user experience design. It is common for the user experience designer to be divided into three specialized areas or job categories, which are Information Architect, Interaction Designer, and User

Researcher. In the case of a small company or project, all three roles are performed by a single user experience designer. On the other hand, each role is subdivided in large-scale projects or large corporations that require expertise, and there are experts in charge of each role. As to the nature and main role of each role, Russ Unger and Caroline Chandler describe in their book *User Experience Design Project Guide* as [Table 1]. [26]

Table 1: The Position and Role of User Experience Design

Position	Role
Information Architect	User-friendly design of information structures, navigation, content categories, etc.
Interaction Designer	Defines the behavior of the website or application in harmony with the user's behavior.
User Researcher	Provide insights and directions into the project based on findings from users or validated

Among the three roles, user research is the task of discovering the insights that underlie the user experience design and evaluating and improving the design using various user research methodologies. According to interaction design foundation, user experience research is the systematic investigation of users and their requirements, in order to add context and insight into the process of designing the user experience. UX research employs a variety of techniques, tools, and methodologies to reach conclusions, determine facts, and uncover problems, thereby revealing valuable information which can be fed into the design process. [27]

The field of user experience has a wide range of research methods available, ranging from tried-and-true methods such as lab-based usability studies to unmoderated online UX assessments that have been more recently developed. Table 2 contains a description of the 20 most commonly used

methods in user experience research.

Table 2: 20 User Experience Research Methods [28]

UX Research Methods	Description
Usability-Lab Studies	participants are brought into a lab, one-on-one with a researcher, and given a set of scenarios that lead to tasks and usage of specific interest within a product or service.
Ethnographic Field Studies:	researchers meet with and study participants in their natural environment, where they would most likely encounter the product or service in question.
Participatory Design:	participants are given design elements or creative materials in order to construct their ideal experience in a concrete way that expresses what matters to them most and why.
Focus Groups:	groups of 3–12 participants are lead through a discussion about a set of topics, giving verbal and written feedback through discussion and exercises.
Interviews:	a researcher meets with participants one-on-one to discuss in depth what the participant thinks about the topic in question.
Eyetracking:	an eyetracking device is configured to precisely measure where participants look as they perform tasks or interact naturally
Usability Benchmarking:	tightly scripted usability studies are performed with several participants, using precise and predetermined measures of performance.
Moderated Remote Usability Studies:	usability studies conducted remotely with the use of tools such as screen-sharing software and remote control capabilities.
Unmoderated Remote Panel Studies:	a panel of trained participants who have video recording and data collection software installed on their own personal devices uses a website or product
Concept Testing:	a researcher shares an approximation of a product or service that captures the key essence (the value proposition) of a new concept or product
Diary/Camera Studies:	participants are given a mechanism (diary or camera) to record and describe aspects of their lives that are relevant to a product or service
Customer Feedback	open-ended and/or close-ended information provided by a self-selected sample of users
Desirability Studies	participants are offered different visual-design alternatives and are expected to associate each alternative with a set of attributes selected from a closed list
Card Sorting:	a quantitative or qualitative method that asks users to organize items into groups and assign categories to each group

Clickstream Analysis	analyzing the record of screens or pages that users clicks on and sees, as they use a site or software product
A/B Testing	a method of scientifically testing different designs on a site by randomly assigning groups of users to interact with each of the different designs
Unmoderated UX Studies	a quantitative or qualitative and automated method that uses a specialized research tool to captures participant behaviors and attitudes
True-Intent Studies	a method that asks random site visitors what their goal or intention is upon entering the site, measures their subsequent behavior, and asks whether they were successful in achieving their goal upon exiting the site
Intercept Surveys	a survey that is triggered during the use of a site or application
Email Surveys	a survey in which participants are recruited from an email message

As such, the user experience researchers are so diverse that the user experience researcher must understand and choose the method well, sometimes in parallel, to achieve the best performance. Christian Rohrer emphasized insights through a combination of user experience research methodologies. According to him, while it's not realistic to use the full set of methods on a given project, nearly all projects would benefit from multiple research methods and from combining insights. [28]

2.2.3 Data Analytics and User Experience Design

Traditionally, user research based on qualitative data has played a central role in the user experience design field, but the use of quantitative data is increasing due to the development of analysis software. The clickstream analysis and the A / B test introduced in the methodology of the user experience research in the previous chapter are the way to help design decision making based on quantitative data. Jon MacDonald emphasized clickstream analysis (analytics data) and design decision making based on data. He said that starts by analyzing your existing customers. Look at your site's in-page analytics, behavior flow, and site content to get a bird's eye view of what people are doing. After that, dive into your audience analytics and demographic data to get a sense of their personas. [29]

Analytics data describe what people are doing with your live product — where they go, what they click on, what features they use, where they come from, and on which pages they decide to leave the site or app. This information can support a wide variety of UX activities. In particular, it can help you monitor the performance of various content, UIs, or features in your product, and identify what doesn't work. [30]

Google is a company that traditionally places importance on analytics data when making design decisions, and uses the user experience data that they value, organized in HEART framework in the following table 3.

Table 3: HEART framework of Google [31]

HEART Framework	Description
H – Happiness	qualitative user experience measurements, such as satisfaction and ease-of-use
E - Engagement	frequency, intensity, or depth of interaction over a given timeframe (quantitative)
A - Adoption	how many new users a product, or an updated feature, gets in a defined time period (quantitative)
R – Retention	how many users stick around and how many start to churn (quantitative)
T – Task Success	what Google defines as “traditional behavioral metrics of user experience”, like time to task-completion, error rate etc. (quantitative)

In addition, Google focuses on a collaborative culture where data is important, and also reviews and discusses them carefully to meet the project's goals. Thus, Google utilizes data in line with project goals through a goal-based data tracking system called 'goals-signals-metrics.' Google's goals-signals-metrics are shown in Table 4. In addition to Google, most web services companies are using clickstream analysis as an important tool for decision making and as a means of evaluating user experience research.

Table 4: Google's goals-signals-metrics [31]

Goals-signals-metrics	Description
Goals	identifying the UX goals of a product or feature can be complicated. Brainstorming around HEART can unite the team towards one common goal, and weed out the project goals from the product goals.
Signals	kind of like UX KPIs, 'signals' are the user behavior signposts. It might help a team to track progress towards goals. Actions that indicate a goal has been met, or feelings that correlate to success or failure, should be mapped out here.
Metrics	how will signals manifest as metrics? This is where baggy data gets turned into statistics, which can then be compared against industry or product standards.

3. BENEFITS AND LIMITATIONS OF FORMAL PERSONA

3.1 Formal Persona

3.1.1 Definitions and Benefits of Formal Persona

The concept of a persona was introduced by Alan Cooper, the inventor of Visual Basic, as a user-centered design tool in his book "The Inmates Are Running the Asylum." [1] Cooper pointed out problems such as poor usability and development practices that focused on convenience when development is conducted from the perspective of a developer, not a user. He also had a philosophy that development should be carried out with the user's features, goals, and actions in mind. Cooper presented the concept of a persona, but with the efforts of UX experts working in his company, Cooper, and the User Experience Professional Association(UXPA), a persona became one of the representative methods of UX design.

According to "About Face 4," a persona is defined as "the most central fictional user character for a narrative scenario-based design process." [32] On the other hand, according to the Nielsen Norman Group, persona is defined as "a user model expressed as a fictional character that shares a specific goal." [33] Also, according to Ridwell et al., "Persona is a fictional

character that uses certain sites, products, and brands with similar patterns." [34]

According to Pruitt and Adlin, a persona puts a face on the user – a memorable, engaging, and actionable image that serves as a design target. It conveys information about users to your product team in ways that other artifacts cannot. According to Meg Hourihan discovery of and experience with personas, persona will help you, your team, and your organization becomes more user-focused. [35] Alan Cooper explained the advantages of persona in three ways. The first is to avoid designing for what Cooper calls "The Elastic User" — by which he means that while making product decisions different stakeholders may define the 'user' according to their convenience. Defining personas helps the team have a shared understanding of the real users in terms of their goals, capabilities, and contexts. Second, personas also help prevent "self-referential design" when the designer or developer may unconsciously project their own mental models on the product design which may be very different from that of the target user population. Third, personas provide a reality check by helping designers keep the focus of the design on cases that are most likely to be encountered for the target users and not on edge cases which usually won't happen for the target population. According to Cooper, edge cases which should naturally be handled properly should not become the design focus. [1]

3.1.2 Elements of Formal Persona

Formal persona is based on the qualitative research of the individual user and based on the detailed description of the user needs and behavior. According to Kim Goodwin, a persona captured in 1-2 page descriptions includes behavior patterns, goals, skills, attitudes, and environment with a few fictional personal details to bring the persona to life. [4] The formal persona has a wide variety of framework to suit the nature of the project, and the characteristics of the persona vary widely. Pruitt and Adlin suggested how various persona components were used based on the existing 31 persona examples used in user experience design. [36] According to them, there are four basic elements,

14 personal background descriptions, 18 occupational/task information elements, 6 technical and accessibility uses, and 7 other elements. The name, age, user's relationship and attitude toward the use of products/services was the most frequently used components in each field. Meanwhile, George Olsen's Persona Creation and Usage Toolkit was presented as Table 5. [37] George Olson presented the most important and frequently used elements among the various persona components. Figure 6 is sample persona for a Fictional Client for ACMEblue. [38]

Table 5: Elements of Formal Persona

Elements	Descriptions
Photo, Name	Use representative names and photos that can be immersed in the target persona
Personal Description	A short declaration that implies the characteristics of persona
Demographics	Basic attributes of persona including age, gender, occupation, family relation
Work or Activity Flow	A description of what tasks and how they perform to achieve the goal
Motivation	Personal and social motivators that persona has for a particular goal
Goal	A description of what motivates persona to have a task performance goal
Needs	Essential requirements of persona based on motivation
Frustration	Description of the elements that interfere with current goals



Figure 6: The Example of Formal Persona

Unger, Russ, and Carolyn Chandler divide elements of formal persona to minimum content requirements and optional content. [38] According to them, only the minimum content requirements of the persona elements are essential and the optional content is very different depending on the nature of the project. Minimum content requirements are photo, name, age, location, occupation and biography. Optional contents is education level, salary or salary range, personal quote, online activities, offline activities, key entry or trigger point to client, brand, or project, technical comfort level, social comfort level, mobile comfort level, motivation to use client, brand, or project and user goals.

3.1.3 Process of Building Formal Persona

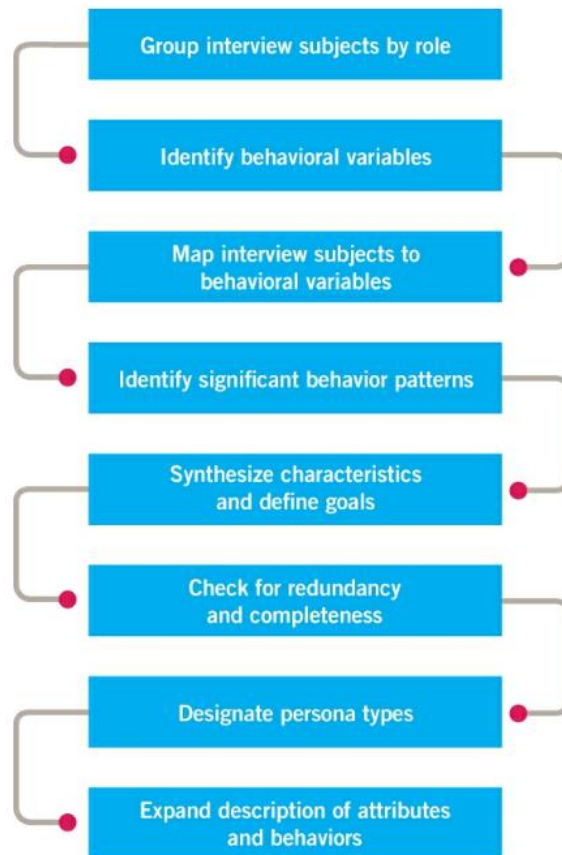


Figure 7: Overview of Persona Creation Process

Alan Cooper and his colleagues have continued to develop the process of making personas. He and his colleagues presented the process of making persona in eight steps in the book 'about face 4' as Figure 7. [39] A total of 8 steps is a method to map interview data to behavioral variables.

Persona needs vast amounts of user research because it has to vividly describe the user's background, purpose, and motivation. According to Unger and Chandler, don't look for one method to be the answer, however; it's best to find as much data as you can and mix it with a blend of observational and interview data—this can also include utilizing online surveys and analyzing behaviors in social networks. [40] Qualitative user experience research is indispensable to derive the elements of formal persona. Qualitative research helps us understand the followings: [41]

- Behaviors, attitudes, and aptitudes of potential and existing product users
- Technical, business, and environmental contexts—the domain—of the product to be designed
- Vocabulary and other social aspects of the domain in question
- How existing products are used

In order to create persona, observation and contextual interview play an important role in qualitative research. According to Cooper and co-authors, personas should be based on real-world observation. As discussed in the preceding chapter, the primary source of data used to synthesize personas should be in-context interviews borrowing from ethnographic techniques, contextual inquiry, or other similar dialogues with and observation research of actual and potential users. [42] The process of making formal persona is not a task that can be accomplished in a short period of time because a vast amount of qualitative data analysis is essential after intensive user experience research such as user observation and contextual research.

3.2 Proto-Persona

Proto-persona is a type of persona which is also called ad-hoc persona or quick and dirty persona. It is common to develop only the core components such as goals and needs, and the core behavior patterns, it is used when it is difficult to carry out qualitative research or when it is necessary to form a consensus for quick user-based decision making among UX projects.

The proto-persona is represented by a simple layout such as Figure 8, in which sketches and lists of persona name, behavioral demographic information, pain points and needs, and potential solutions are presented in quadrants. According to proto-persona template by Gothelf, the top-left quadrant holds a rough sketch of the persona and his or her name and role. The top-right box holds basic demographic information. The bottom half of the proto-persona is where space is a place to organize important information. The bottom-left quadrant contains the user's needs and frustrations with the current

product or situation, the specific pain points your product is trying to solve, and opportunities. [43]



Figure 8: Proto-persona template

Unlike formal persona, the creation process of proto-persona started with brainstorming. According to Gothelf, team members offer up their opinions on who the project should be targeting and how that would affect each potential user's use of the product. Once the brainstorming is complete, the team should narrow down the ideas to an initial set of three or four personas they believe are most likely to be the target audience. It is a way to differentiate persona based on major needs. [43]

The results of the proto-persona can be edited through computer software and used in the design process. The figure 9 [44] is an example of the proto-persona cards used in management meetings. According to Gothelf, the proto-persona exercise serves several goals. Initially, it will introduce the executive team to the concept of personas and

thinking from a customer-centric point of view. In addition, it will align the executive team around a target audience and get them to debate and agree upon value propositions that serve the needs and goals of that audience.



Figure 9: Proto-persona template

3.3 Limitations of Formal and Proto-Persona

A formal persona is a useful tool for user experience design, but user experience experts have pointed out the limitations and problems. Chapman and Milham pointed out the problems of formal persona in terms of methodological weakness and practical limitation. [45] They said that the most serious limitation of the Personas method is that it is difficult or impossible to verify that personas are accurate. This involves several aspects: a problematic relationship between personas and user populations; burdens on inference related to personas' high specificity; and the possibility that personas are non-falsifiable. They also pointed out that the personas method suffers from practical limitations. Two significant issues involve how personas are reconciled with other information, and who is responsible for interpreting them.

Matthews etc. explained four difficulties of persona for designers. [46] Firstly,

designers, developers and others in design teams who had difficulty “believing” in personas —how “all 40-something women shoppers in Mid-West” could be turned into one persona, “Katie”; they found personas to be abstract generalizations. Secondly, personas were impersonal—the personifying elements were unable to evoke the same sense of empathy in designers that first-hand observations of real users could. Thirdly, there was insufficient information provided by personas that allowed designers full understanding of the users. Lastly, the irrelevant personifying elements were distracting, sidetracking designers from constraints that mattered

Furthermore, formal persona requires a lot of time and effort to build. To understand more about the “typical” persona project, NNgroup surveyed 216 user-experience professionals who shared their approaches to creating personas and the time it took their teams to conduct or review research, analyze data, and craft the personas. Small companies spent less time creating personas. The time expended ranged from 22.5 to 72.5 staff hours, depending on the amount of empirical-research data informing the effort. For large companies, timing ranged from 55 to 102.5 staff hours. [47] Based on these results, smaller companies could realistically expect to create a persona in 3 to 9 working days if only one employee participates in the process, or just about 1.5 to 5 working days with 2 employees. For larger companies, a team of four could effectively research and create personas in 2 to 4 days. These numbers are medians, so there are of course instances where the effort could be much higher or lower.

Proto-persona provides limited information and evidence data, so its scope of use is limited. Peterson pointed out that proto-persona is based on a designer’s own intuition and assumptions and it should be used with other methods to understand users. [48] The main purpose is to help expose misconceptions and varying ideas about the target users within the design team and stakeholders.

4. IN-PAGE ANALYTICS AND DATA-BASED PERSONA

4.1 Traditional Web Analytics for Web Service and Persona

4.1.1 Traditional Web Analytics for Web Service

In the field of Web services, software called web analytics is used to analyze quantitative data about the user experience remaining on the Internet server. Web analytics provides a comprehensive set of capabilities for analyzing historical data within a server that has traditionally been called log analysis. The touch data collected when a finger touches a smartphone can also be referred to the same type of data. The clickstream is a set of click data that can be extracted from one connection and login session. As shown in Figure 10, the access data and the clicked action data are recorded in chronological order. [49]

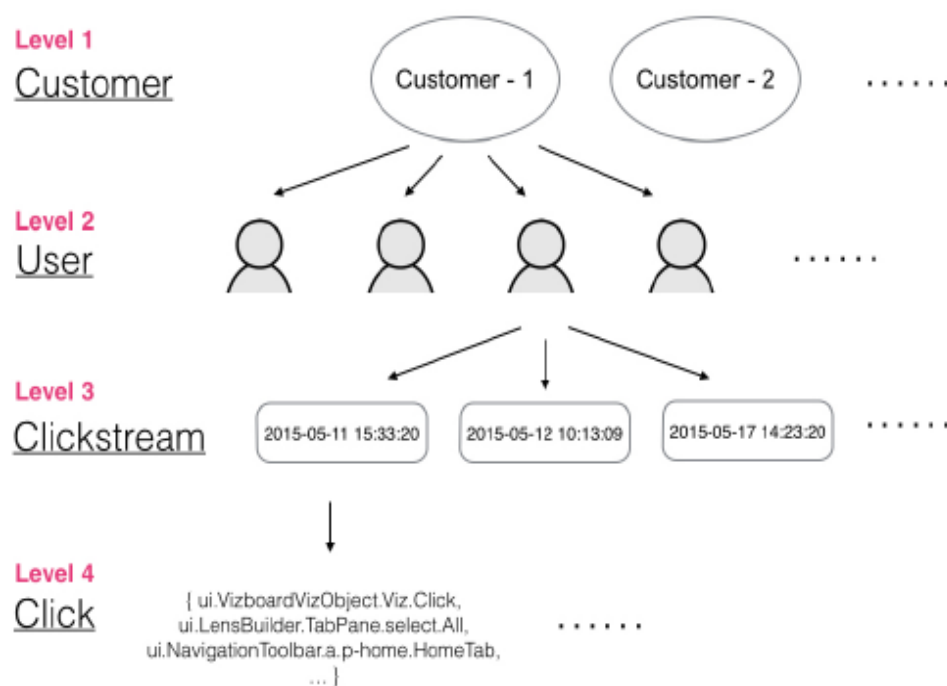


Figure 10: Concept of Web Analytics Tool

To analyze clickstream data in web services, companies use their own developed solutions or select commercially available solutions. Among these, the ranking of commercially available solutions shows that Google Analytics has a dominant position of web analytics market. Google Analytics has a 63.20% market share, followed by Facebook Analytics (11.11%), Google Global Site Tag (6.68%). [50] According to Google Analytics, the solution provides not only measures sales and conversions, but also an up-to-date analysis of how visitors interact with your site's activity, your site's traffic, and your customers' return. [51] Google Analytics includes content analytics to analyze high-performing content pages, social analytics to analyze content social sharing activity, conversion web analytics to analyze customer conversion rates, and ad analytics to evaluate ad effectiveness. [Figure 11]

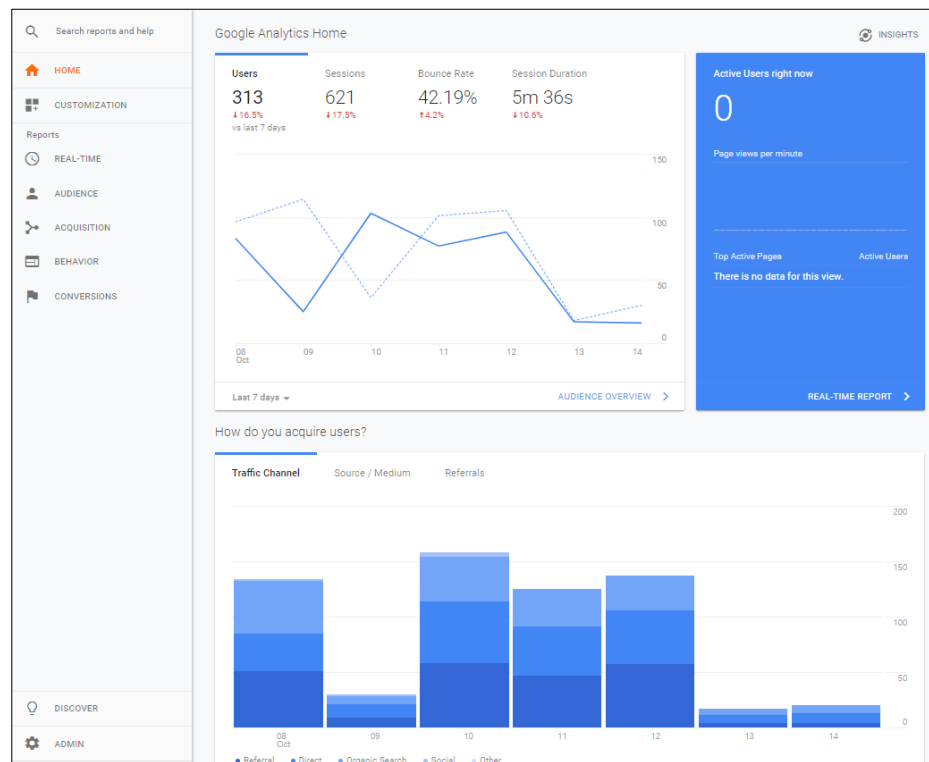


Figure 11: Main Screen of Google Analytics

4.1.2 Data Types of Google Analytics

Google Analytics gives the number of users, sessions, page views, pages/session,

average session duration, bounce rate, % new session within the setup period as figure 12. The data flow can be analyzed by setting various user groups as well as data flow within a specific period. The types of segments currently offered are: number of transactions, number of search traffic, number of buyers, session users, all users, mobile and tablet traffic, mobile traffic, non-exit sessions, non-converting visitors, site searchers, new user paid traffic, abandoned sessions, natural traffic, re-users, numbers, direct traffic, referral traffic, tablet and desktop traffic, and tablet traffic.

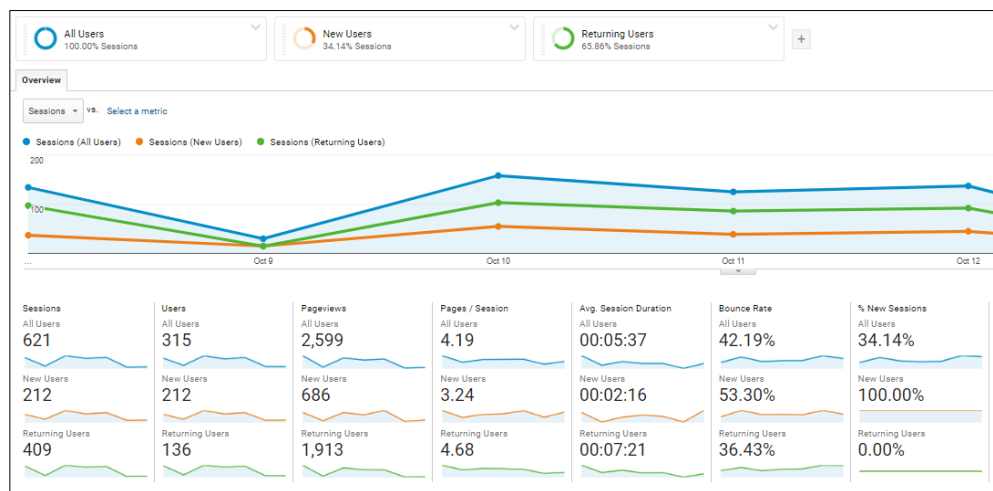


Figure 12: Audience Overview Data of Google Analytics

In addition, google analytics offers the ability to analyze the characteristics of demographic information, interests, geography, behavior, technology, and mobile behavior patterns by age and gender, which can be used as basic persona data as table 6. It can be used to compare the customer conversion rate and the web service goal contribution, such as acquisitions and conversions, and these are essential data for modeling personas.

However, since google analytics is a data analysis for marketing activities, its main purpose is limited data analysis for UX Design. In other words, through google analytics, demographics and access statistical data, which are basic data of the data-based persona, are mainly obtained. The recently developed users' flow provides useful data for tracking the user's usage flow within a Web site as figure 13.

Table 6: Data about Audience of Google Analytics

Audience Data	Description
Active Users	Number of returning users within a specific date range
Lifetime Value	Revenue per user in specific period after acquisition
Cohort Analysis	Acquisition data cohorts by user retention
Audiences	Summary page of acquisition, behavior (bounce rate, pages/session, avg. session duration), conversion
User Explorer	Analyze average session duration, bounce rate, revenue, transaction, and goal conversion rate based on a user's visit history
Demographics	Age groups, gender groups
Interests	Reached affinity category of total sessions
Geo	Language and location
Behavior	New & returning, Frequency & Recency, Engagement
Mobile	Desktop users, mobile users, tablet users
Cross Device	User data analysis through cross device
Custom	Customized data classification
Benchmarking	Benchmark channels, locations, devices
User Flow	Data about flow between web pages
Technology	Browser & OS, network

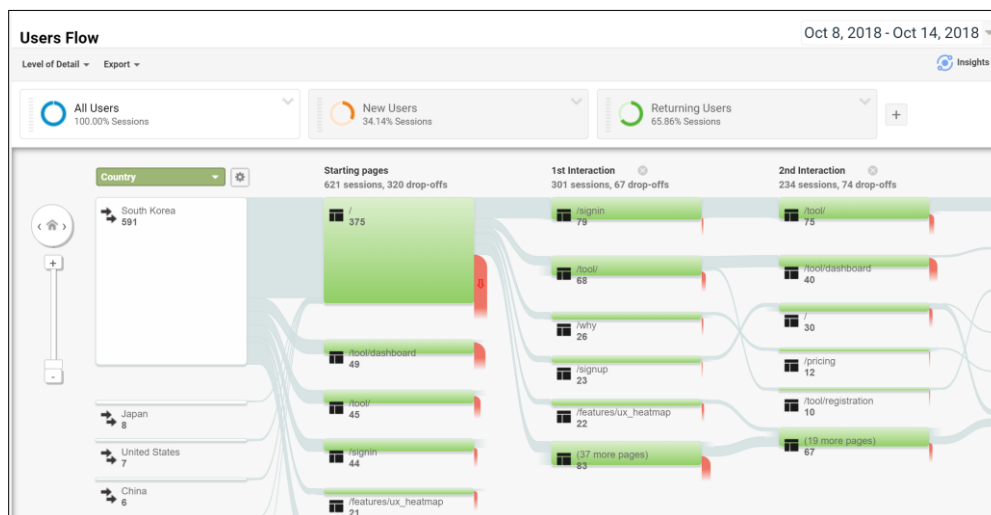


Figure 13: User Flow Data of Google Analytics

4.2 In-Page Analytics for Web Service

4.2.1 Concept of In-Page Analytics for Web Service

Traditional web analytics provides a vast amount of functionality for web service customer analysis, which is useful in persona modeling but does not provide analytic data for individual web pages or individual web UI elements. In addition, because it is an analysis tool based on page view data, it is insufficient in persona modeling as it cannot analyze user interaction or customers by interaction type. Due to these limitations, in-page data visualization analytics tools (visual in-page analytics) that help measure and visualize user interactions in the page to facilitate analysis are emerging. In sum, the difference between traditional clickstream analysis tools focused on page-to-page navigation and in-page data visualization analysis tools can be summarized as shown in Figure 14. [52]

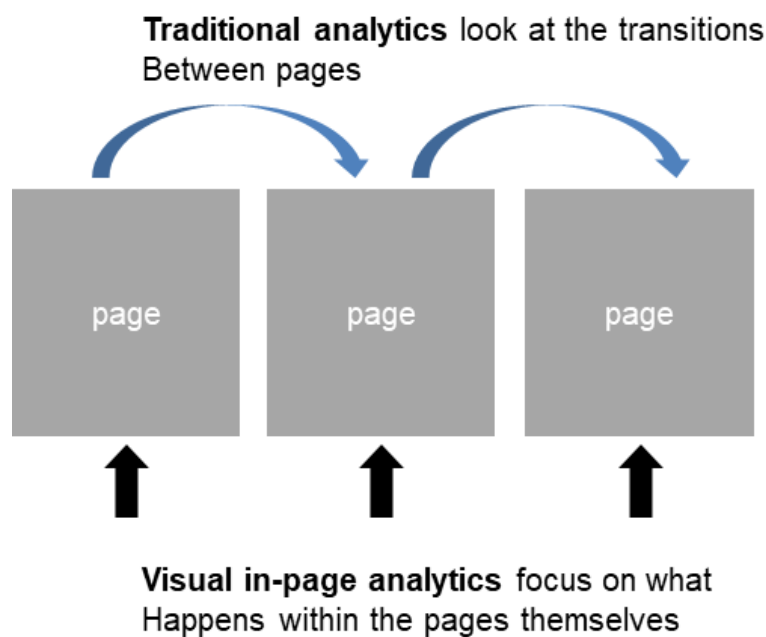


Figure 14: Concept of in-page data analysis tools

Mozyrko explained three key functions of in-page analytics. [53] First one is click-tracking heatmaps. Click-tracking heatmaps are useful tools for collecting data about your site visitors. Their biggest advantages are that they are easy to implement and do not require much of an investment in either time or money.

The tool visualizes your site visitors' clicks in the form of a heatmap, where the areas that receive most attention are hotter [Figure 15]. With that information, you can judge which areas are most “attractive” for your visitors.



Figure 15: Heatmaps showing an A/B test [54]

Mozyrko pointed out session replay is second key function. Session replay allows you to watch your website visitors and their actions. Using this tool, you can see all their mouse movements, scrolls, keystrokes, and clicks on a website or application. Session replay [see Figure 16] is a great way to study the step-by-step movements of your users to be able to find the pain points they are facing.

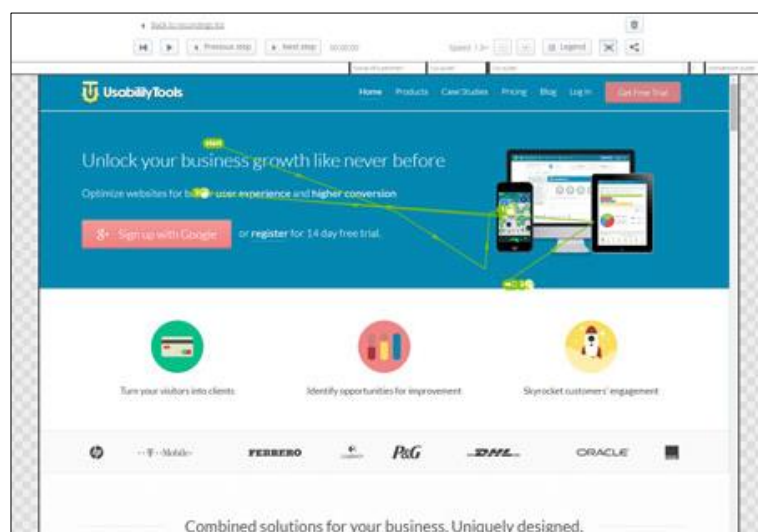


Figure 16: Session replay shows users' mouse movements

The third key function of in-page analytics is form analysis according to Mozyrko. Marketers, researchers, and business owners should recognize that forms are a vital part of their website. As shown in Figure 17, with web form testing and analysis it is possible to judge which customer pain points are responsible for a high bounce rate. Web forms can feature fields that make customers abandon a form, such as fields that take too much time to fill out or fields that are unclear in their goal. You can diagnose and fix these form usability issues with form testing and analysis.

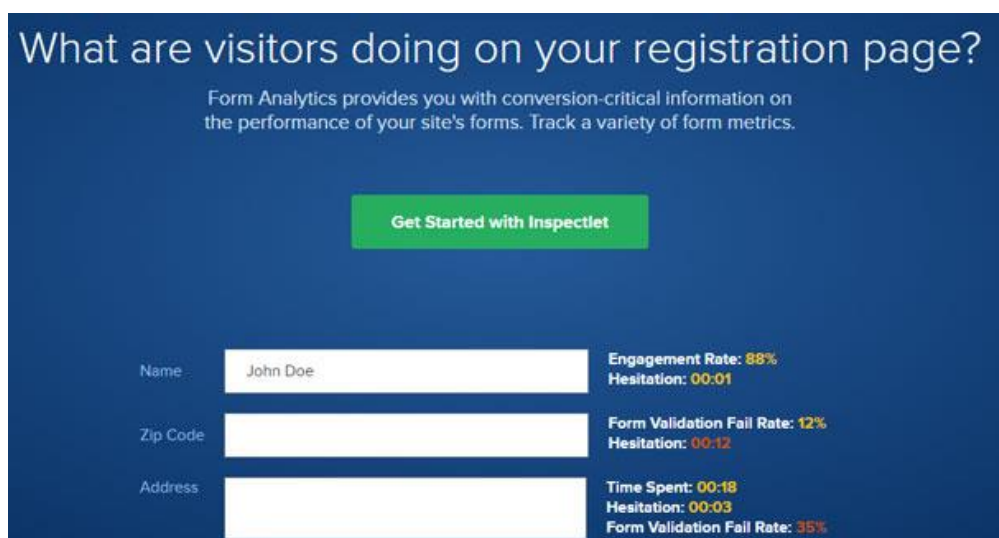


Figure 17: This form analysis shows data such as time spent, hesitation, and fail rate for each form field [55]

4.2.2 Visual in-page analytics, Beusable Solution

Beusable is a recently developed solution. It includes basic functions and in-page data visualization analysis tools such as UX heatmaps, reporting heatmaps (automated reporting on heatmap result and issues), activity stream, attention graph, comparing referrers, user analytics, user session report, segmenting CTA (call-to action), A / B testing, and funnels. These functions are based on eight user behavior data items, as shown in Figure 18. [56]

I have worked as a chief UX advisor for 4Grit which developed Beusable solution(<http://www.Beusable.net>) and I am in charge of research to develop functions for UX designers to use Beusable software more effectively. Beusable is a software that visualizes and displays user behavior data that occurs within

a specific page of a web site. Beusable provides the site visitor's behavior as a visualized data, enabling a deeper understanding of a cause and process along with a result.

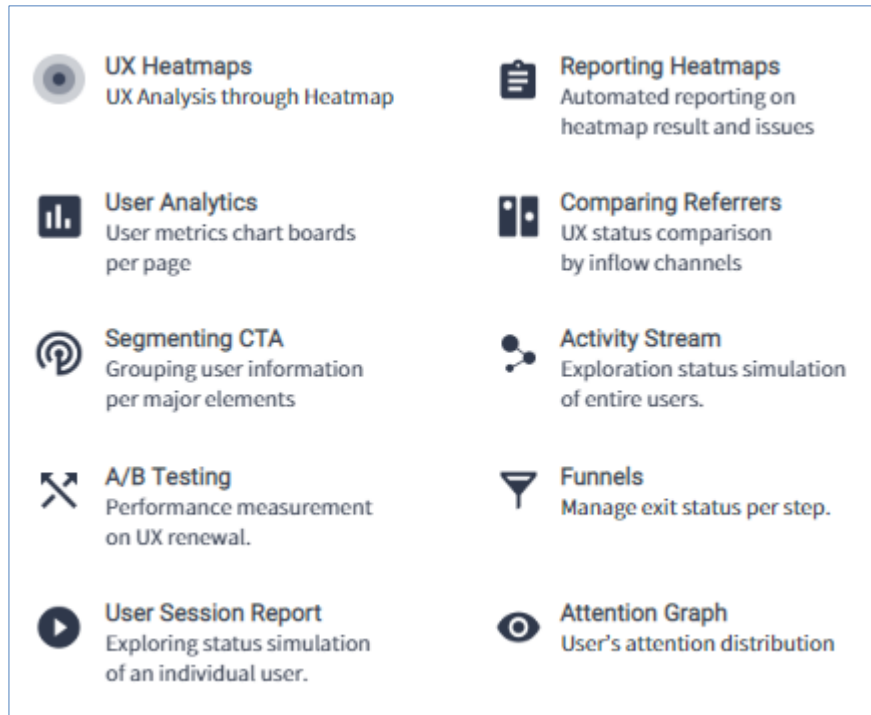


Figure 18: Key Functions of Beusable Solution

The overall user interface of the main screen is shown in figure 19. Major functions such as reporting heatmaps, analytics, comparison referrers, segmenting CTA, A / B testing, and funnels are placed in the menu on the left. The main screen is the reporting heatmaps screen. At the center, there is a screen showing the click rate of each UI element in the page by device type. Detailed click statistics such as clicks, click rate, clicks per PV, click PV rate (ratio of the PV that clicked the element to total PV), hover -> click rate, and hover -> click time when you mouse hover on a specific UI element can be checked.

In terms of user behavior, this study can get 8 types of data through Beusable solution as shown in Table 7. Among these, page visit data and user environment data are the one that can be obtained from google analytics. However, the rest of the data are only available in in-page analytics that traditional web analytics cannot obtain. The useful data for UI designers is the click data from specific UI elements. The click is an indicator of the results of a user's specific actions and is a key indicator of evaluating the achievement of

a Web service's goals. On the other hand, through mobile screen UX heatmaps analysis, only data such as click rate, scroll to click, and click PV rate can be obtained.

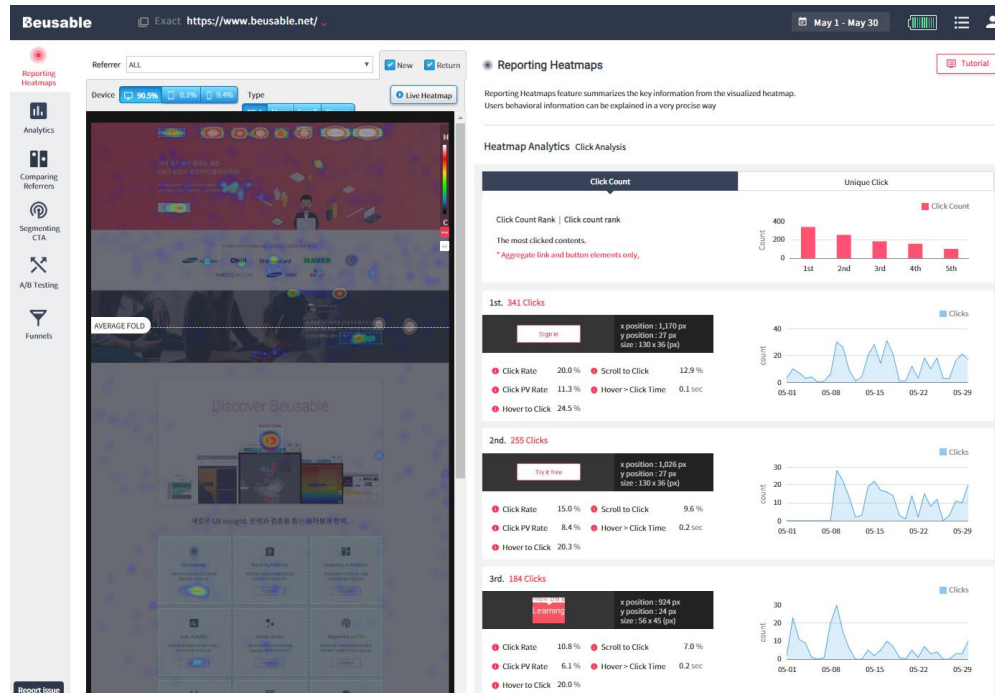


Figure 19: Main Screen (Reporting Heatmaps) of Beusable Solution

Table 7: User Behavior Data Types of Beusable Solution

Data Types	Description
Mouse Click Data	click count: ranking of the most clicked contents unique click: rank between contents by unique click counts
Mouse Movement Data	hover count: displays the contents rank based on the number of users' hover
Attention Graph	scrolled heights graph visualizes users' contents reach rate
Activity Stream Data	user movement flow: representative flow of all users with gaze plot
Page Visit Data	page view (PV), unique visitors (UV), average PV per UV, average PV per UV, average session length, exit rate, inflow channel
User Environment Data	monitor resolution distribution, monitor resolution detail, device statistics, country statistics, OS statistics, browser statistics

Segmenting CTA	Reports the statistics of users who clicked important elements by backtracking
Funnels	Aggregate step-by-step data from initial user inflow to users' final conversion and focus on the renewal of the pages with relatively high churn rate

Mouse click data is like the figure 20 and is useful for cursor click and movement information analysis. Mouse click data is divided into click counts (understand the ranking of the most clicked contents) and unique click counts (displays rank between contents by unique click counts).

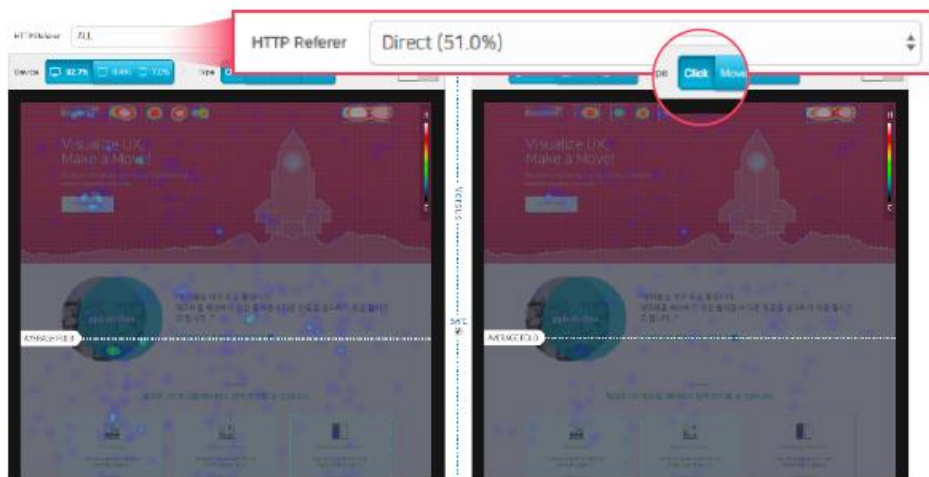


Figure 20: Cursor Click Information Window of Beusable

Mouse move data shows the movement of mouse cursors regardless of clicks. Hover counts display the number of users' hover counts and you can compare hover to click to see the conversion ratio from hover to click. [Figure 21]

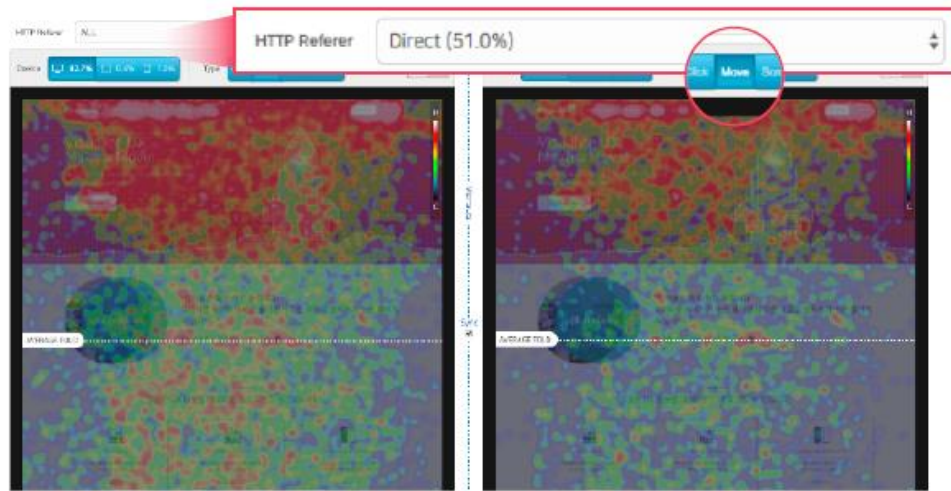


Figure 21: Cursor Movement Information Window of Beusable

Attention graph shows the intensity and duration of users' attention paid to each page area. Because of the nature of the web pages that need to be scrolled by the mouse, it is important to measure how far the user has scrolled the mouse to a certain position. The average fold line, which is the average scroll line, and the scroll line that is reached by 25% users, can be seen together with the visual information data. X-axis marks the attention value (interest level) of the users where the user's duration time is reflected. Where the farthest point of x-axis represents the most user-attentive area. Other points' user attention level can be known by relatively referring to that point. [Figure 22]

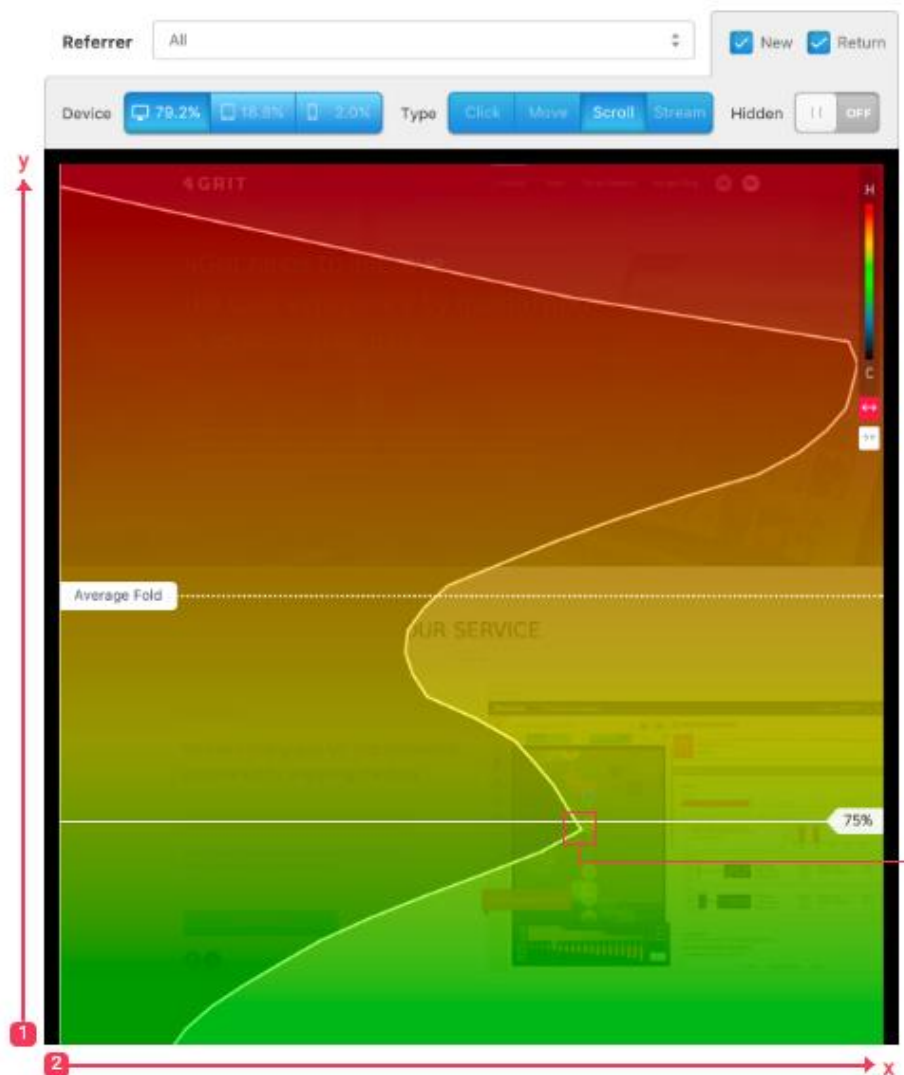


Figure 22: Attention Graph Window of Beusable

Activity Stream shows user's navigation order, interested area, and exit status through gaze plot. UX designers can see where users miss out most websites' important components or key contents more often than they would think. If exploring flow is too concentrated, it is highly likely that users are experiencing difficulties in reading or recognizing contents. In addition, if the session length of major components is too short, you should emphasize the contents through changing colors or repositioning the contents. [Figure 23]

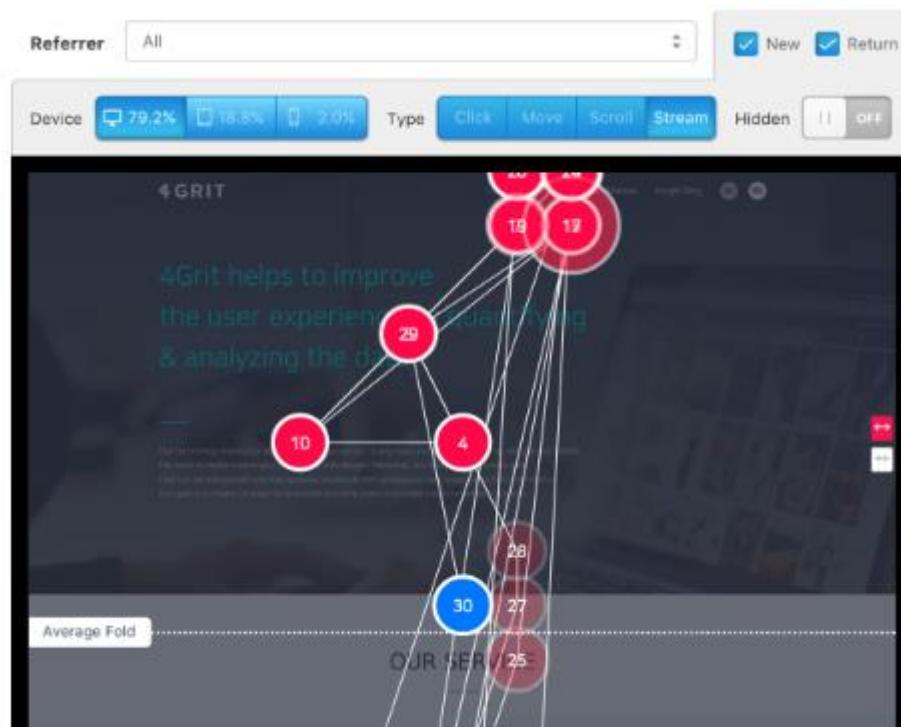


Figure 23: Activity Stream Graph Window of Beusable

Beusable provide basic analytics regarding page visits. It includes PV (Page View), UV (Unique Visitor), average PV per UV, average session duration of UV, exit rate, and inflow channel. Also, Beusable solution offers user environment data such as monitor resolution distribution, monitor resolution detail, device statistics, country statistics, OS statistics, and browser statistics. User environment data is provided in infographic form for six items and is designed to intuitively know the distribution of data. [Figure 24]

User behavior flow

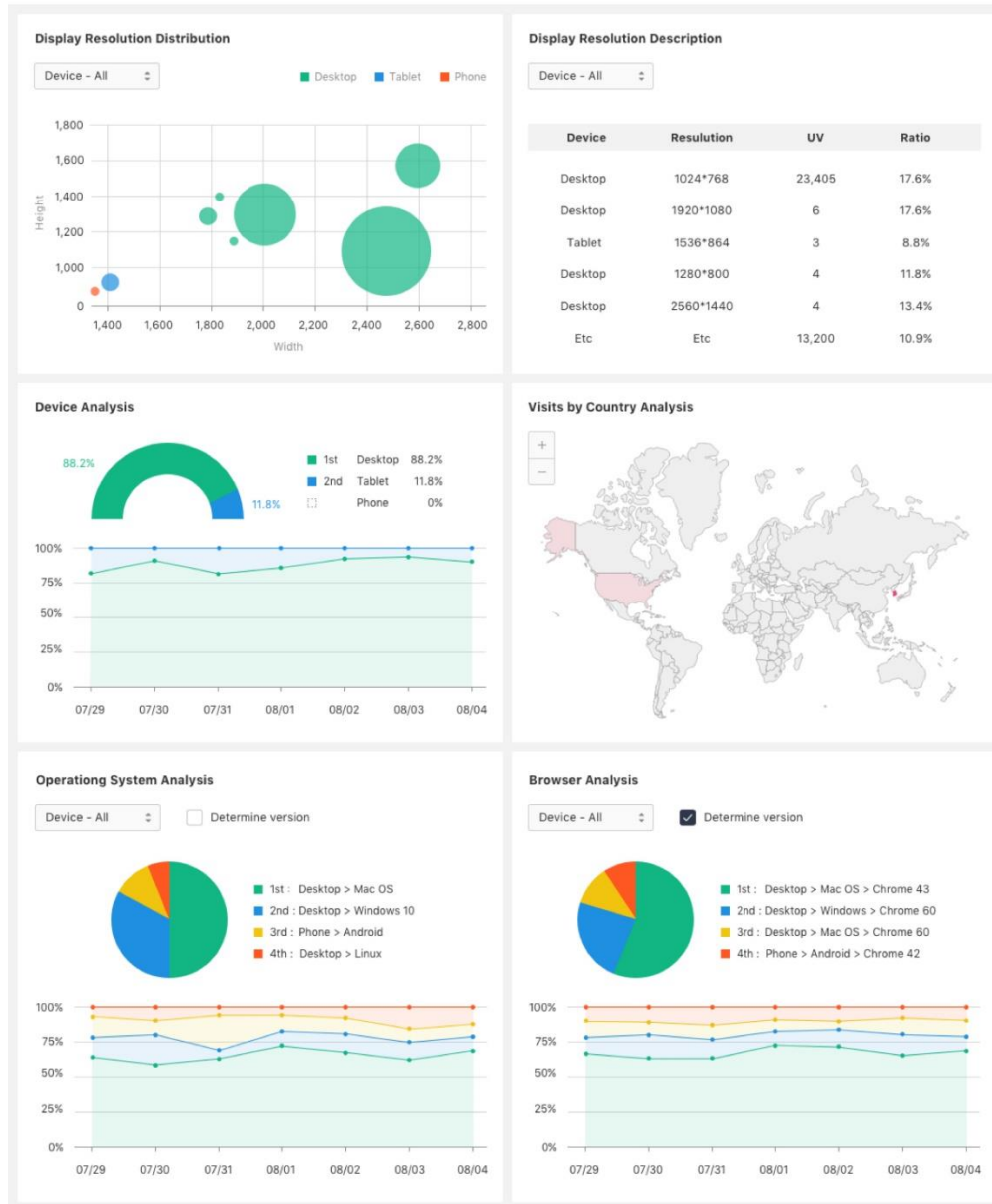


Figure 24: User Environment Window of Beusable

Segmenting CTA analyze user's CTA attributes to increase the conversion rate of the website by backtracking the information of user's flow path, a ratio between the new and returned visitors' number, and their average duration. It backtracked component's screen capture image and user inflow channel's information of the users who clicked according to components. Figure 25 shows a specific button as a CTA element and shows PV, UV, new-returning visitor rate, average duration, devices (desktop, tablet, mobile), and inflow path.

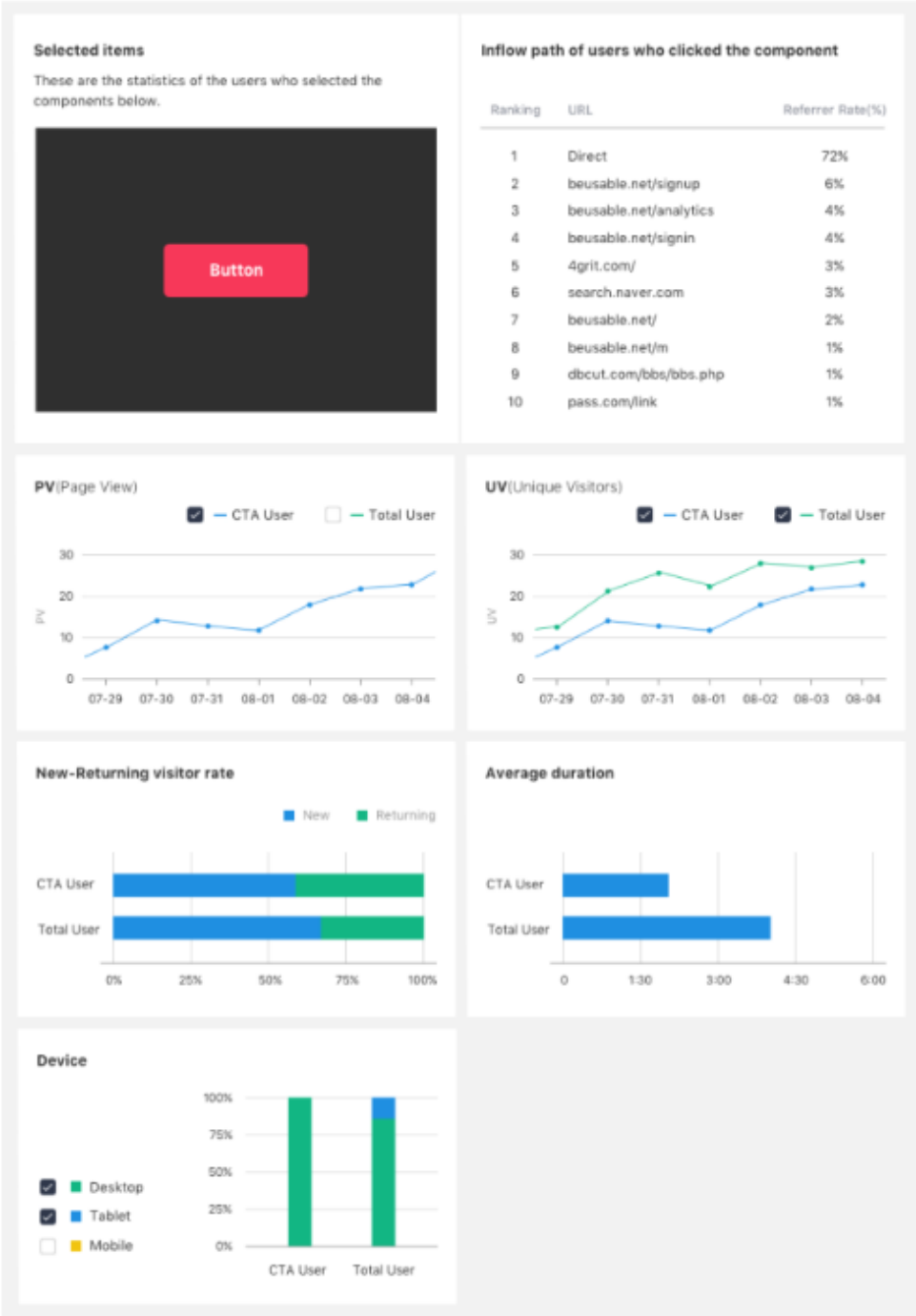


Figure 25: Segmenting CTA Window of Beusable

With Funnels, you can aggregate step-by-step data from initial user inflow to users' final conversion and focus on the renewal of the pages with relatively high exit rate. Users' behavior flow can be analyzed through the information

about before and after landing page visit and find the most optimized users' behavior flow by adjusting funnel steps. The remaining rate and exit rate in each step can be recognized at a glance. Wider the slope width means higher exit rate and vice versa. And UX designers can improve the remaining rate of users by renewing the pages that show a relatively high exit rate. In addition, individual user's page navigation order and their session lengths on each content can be monitored. [Figure 26]

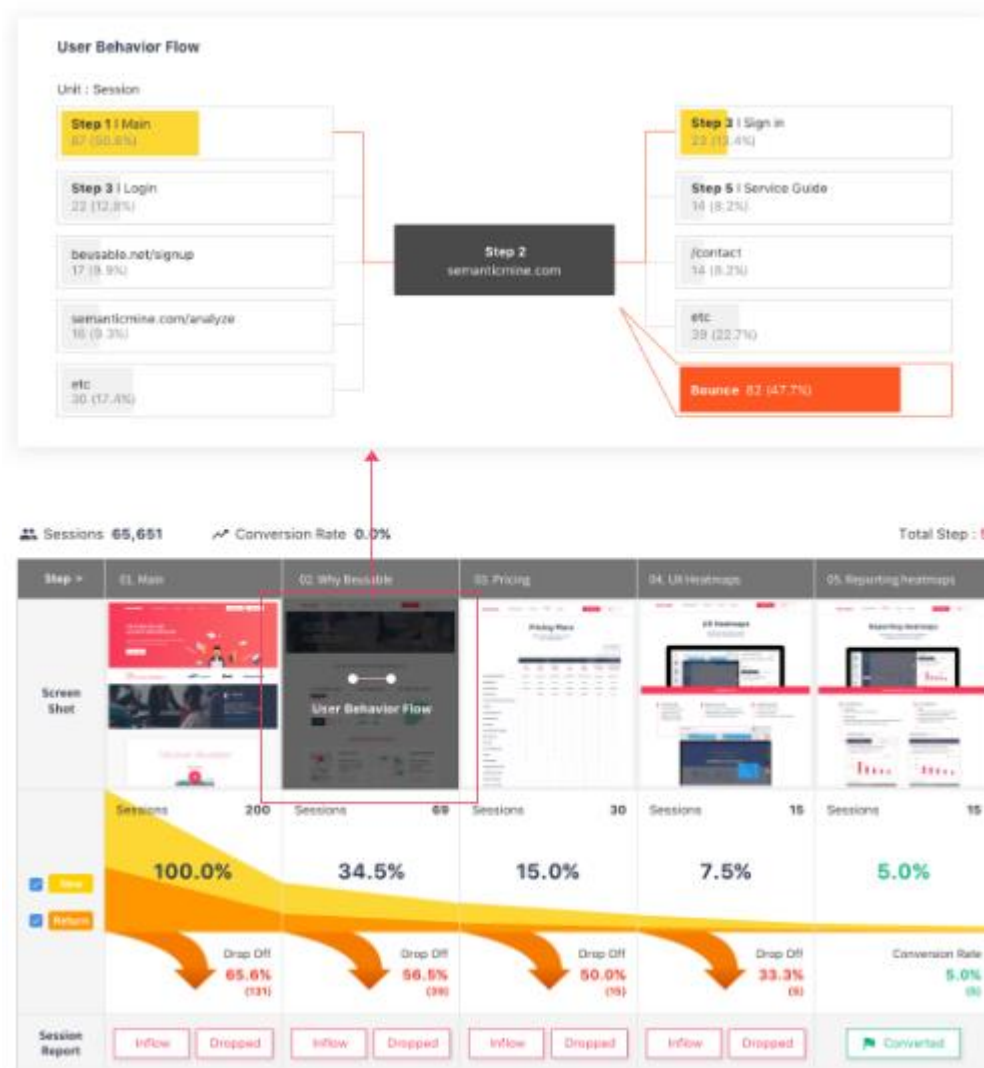


Figure 26: Funnels Window of Beusable

4.3 In-Page Analytics for Web Service and Persona

4.3.1 Use of Web Analytics for User Experience Design

Web analytics has traditionally been used for marketing activities, but in recent years, the use of quantitative data from web analytics has grown in the area of user experience design. Nielsen Norman group reviewed a variety of UX teams regarding their use of analytics and other web data, and they suggested some interesting high-value UX uses for analytics. NNgroup discovered 3 main categories of uses of web analytics. [Table 8] [57]

In terms of issue identification, UX designers work with data analysis teams within the company to set measurement plans and assess performance for service development and improvement based on web analytics data. The measurement plan used by the web service company consists of goals/macro conversions, desirable actions/micro conversions, and web metrics. For example, the web analytics rating index can be set to unique page views. Unique page views are a measure of how many visitors have visited a particular website page. Here, "unique" means that even if the same visitor visits multiple times, it is recorded as one visit.

Table 8: High-value of UX Using for Analytics

Category of Use	Description
Issue Indication	Notifying the team of potential problems reaching goals
Investigation	Identifying potential causes of issues
Triangulation	Adding data to supplement qualitative research

In terms of Investigation, UX teams collaborate with data analysts to set goals for service conversion and to assess how well they achieve their goals. There are five problem areas in the field of investigation using Web analytics: traffic, technical, content, navigation, and visual design. [57]

Table 9: Category of Investigation Uses of Web Analytics

Category of Investigation	Example Investigation
Traffic Issues	Determine if there is one traffic source that is responsible for a decrease in page visitors

Technical Issues	Determine if a page element is not loading properly
Content Issues	Determine if wording may not effectively communicate the benefits of or the process for taking a specific action
Visual Design Issues	Determine if imagery, typography, colors, and/or layout are distracting from calls to actions (CTAs)
Navigation Issues	Determine if specific links/buttons are not being clicked

Many UX researchers have mentioned that it is useful for analyzing the characteristics of user behavior and deriving insights by utilizing the traffic data of web analytics. [58, 59,60,61] Web analytics data only tells UX designers what users did but there is a wide range of interpretation because it does not tell us why the user did it. Particularly, influential factors of web analytics include temporal span and volume of data available for analysis such as cookie-based measurement techniques, and server log fields. [62,63,64,65]

In terms of triangulation, UX designers can supplement qualitative user research results such as usability testing with web analytics data. Qualitative user research has the risk of data errors, such as the bias of recruiting. The problem of data bias can be compensated by web analytics, which can provide large-scale of user samples and data.

4.3.2 Needs and Research for In-page Data-based Persona

With the introduction of analytics and in-page analytics in the field of web service design, more and more attempts are being made to effectively use quantitative data in the design field. Experienced UX designers can use analytics software such as web analytics and Beusable solution to do their design work. However, there are a lot of data and information to understand, and it is hard for new employees, developers, and visual designers who are not familiar with those data to select and interpret them. There are many training programs available to make good use of Google analytics. There are some formal education programs offered by Google and many other educational programs offered by other educational companies. Figure 12 shows the website of the online education program called analytics academy, which is provided by Google analytics. In addition, Jen Cardello at NNgroup points out that junior designers usually experience three types of problems when using web analytics. [table 10]

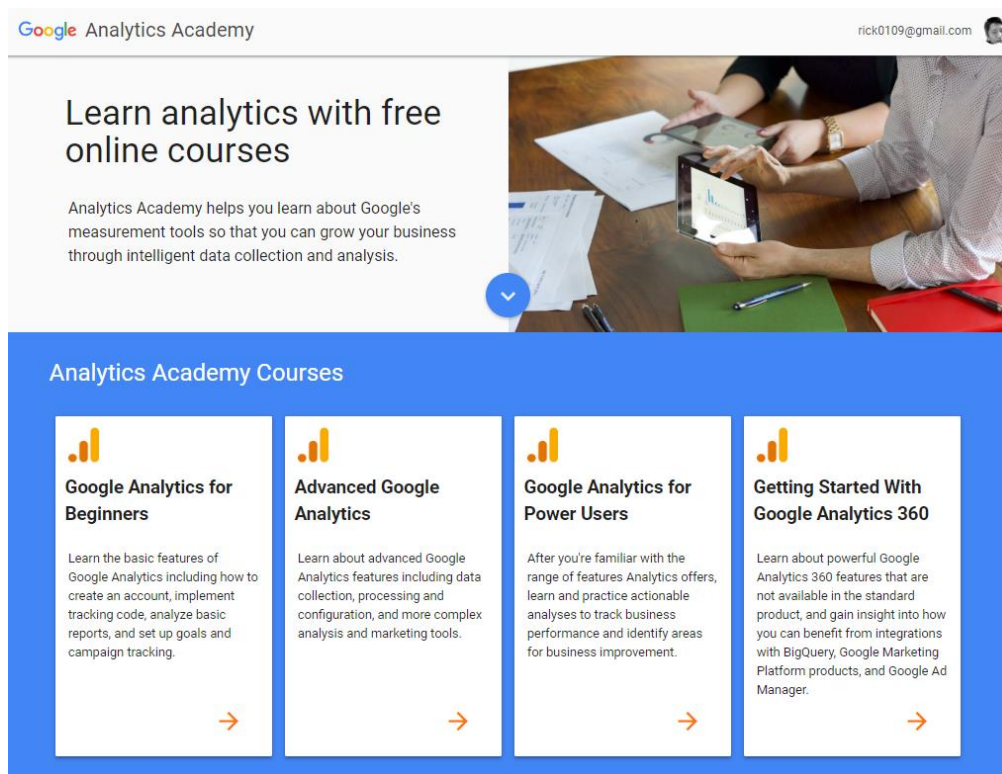


Figure 27: Google Analytics Academy Homepage

Table 10: Three Types of Hurdles of Analytics

Hurdles	Description
Scope of metrics	So many things that can be measured, but which are meaningful?
Difference between metrics	Which metrics best answer specific questions?
Interface complexity	How do you get the analytics system to tell you what you want to find out?

Also, it is difficult to use web analytics quickly and easily when conducting intensive discussion and identification in a short time, such as workshops, brainstorming sessions, or university classes. So there is a need for ways for designers to make data easier to use. It is essential to persuade developers, visual designers, service managers, and CEOs involved in the project to efficiently conduct UX design in web service companies. In the process of persuading them, there is a need for tools that can effectively compress web analytics data, in-page analytics data and UX

designers' insights.

Data-driven persona is a necessary tool for such persuasion process and meeting context. Particularly, it is more useful when participants have a wide range of understanding of data and a lot of disagreements. This is similar to the proto-persona being a tool for brainstorming. In other words, the data-driven persona has the purpose of allowing many participants to understand persona easily and quickly in a short time.

On the other hand, in terms of clustering methods for persona modeling, it is necessary to supplement quantitative data. Since Cooper created the concept of persona, persona clustering is based on qualitative research gathered through long-period projects and time-consuming participation of UX designers. A number of studies have reported research on clustering based on quantitative data in persona modeling. These approaches include exploratory factor analysis [66], principal component analysis [67] and multivariate cluster analysis. [68] By accepting the clustering method based on quantitative data, it is possible to compensate the lack of objectivity and bias of the persona clustering method based on qualitative data. Scholars argue that quantitative data-based clustering methods can complement the problems of subjective assignment decisions, alacrity of rigor, the need for experience in qualitative research training, cognitive limitations of humans and considerable resource commitments. [66,67,68,69,5]

Data-driven persona can be an effective alternative, especially if UX designers lack the time and money to do qualitative user experience research. The data-driven persona also has value as an alternative tool to complement the limitations of formal persona. Many design researchers have been studying ways to make personas. [70,71,72,73,74,75] Pruitt and Grudin explained a common problem with creating personas is that they are not based on first-hand customer data [76] and Jennifer and Nalini pointed out that the data set is not of a sample size that can be considered statistically significant. [77]

Jennifer and Nalini proposed data-driven persona model based on survey of large sample and factor analysis. [77] They received over 1300 survey responses from more than 90 countries and used exploratory factor analysis to group the responses into personas. Factor analysis, a data reduction technique, represents a large set of variables in terms of a smaller number of new variables. [77]

Beyond that, Brickey compared the use of online knowledge management systems for persona clustering. [78] In the field of games, Tobias analyzed the Tomb Raider: Underworld game telemetry to predict user behavior. [79]

Canossas uses game telemetry to create play-persona and improve the game experience. [80] Drachen has done player modeling for the Tomb Raider: Underworld Game. [81] They selected six of the major game features and clustered the play types of the gamers.

Zhang, Brown, and Shankar proposed an automated clustering method based on clickstream analysis. [Figure 28] They clustered groups of similar patterns by selecting key features and analyzing whether users frequently click on these features. In their study, similarities in the frequency of use of certain functions were the largest grouping criteria. [82] Zhang, Brown and Shankar's research clustering based on the frequency of users' clicks is significant in the field of persona modeling. However, it is a limitation that the persona cannot include in the persona data about what each persona has in detail, what kind of behavior pattern it has, and which UI element is used more.

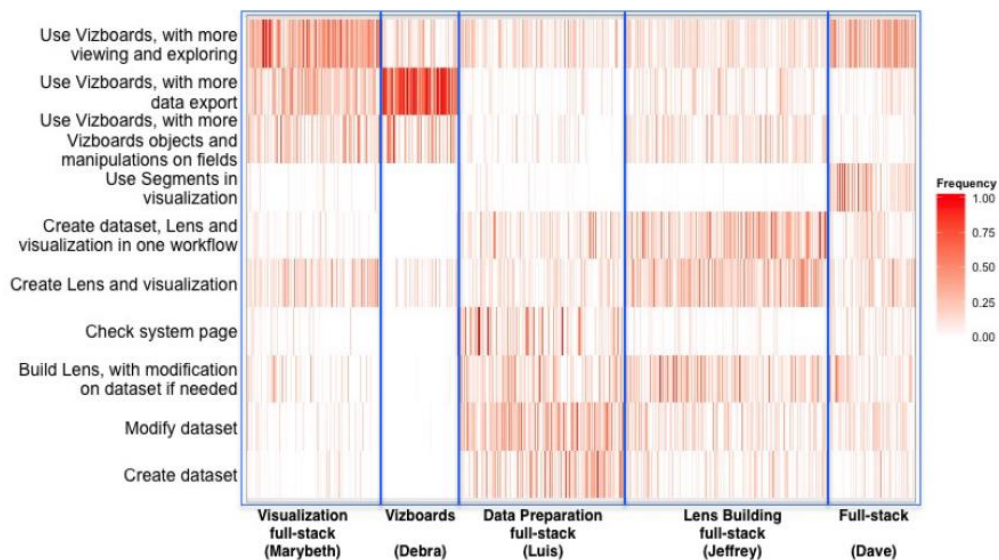


Figure 28: Automated clustering method based on clickstream analysis

Also, in the representation of a persona's behavioral attributes, there are also models that express quantitative numbers and ranges. The following figure is a sample of a quantitative persona element. Persona's behavioral attributes presented in UPA (Usability Professional Association), a prominent UX designer conference in the United States, express the range based on quantitative data. [83] [Figure 29]

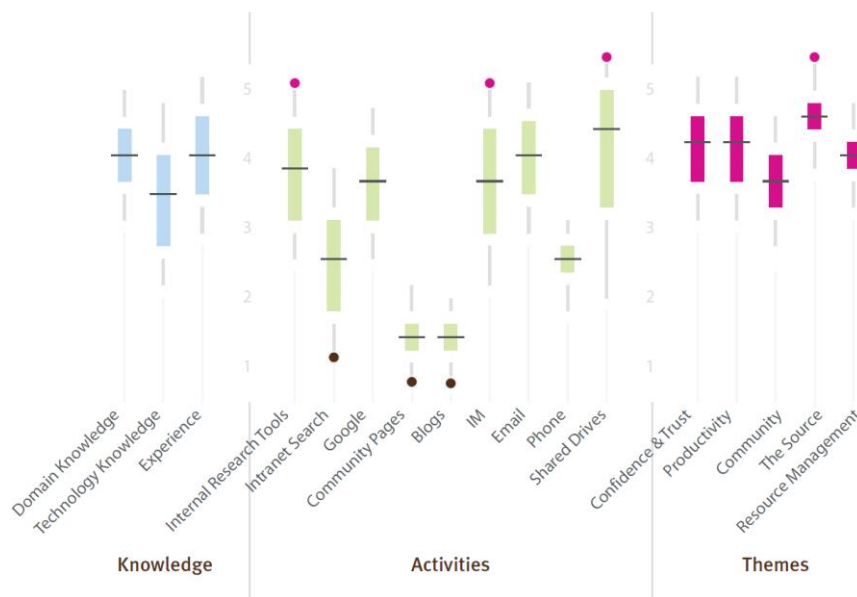


Figure 29: Visualization of Data-driven Persona Behavior Variables

Alec Cole suggested data-driven persona based on google analytics. [84] [Figure 30] As in this case, designers can create persona based solely on Google analytics data. The data shown in the persona model consists only of the average of the quantitative data of google analytics but there are no specific details on usage patterns, needs, frustrations, etc.

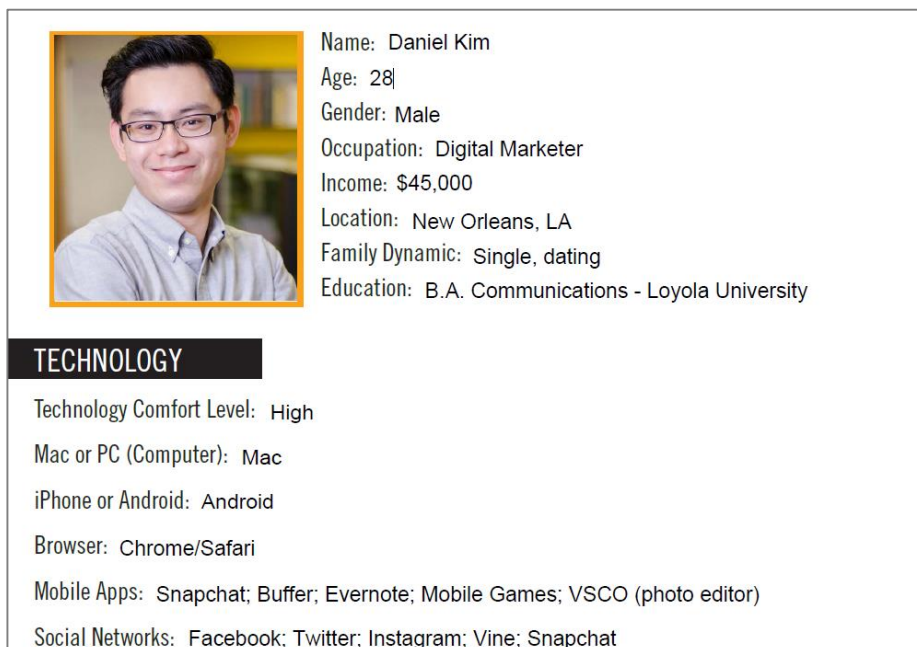


Figure 30: Data-driven Persona based on web analytics

The persona model using in-page analytics has not been developed yet, but it is expected that it will be useful if user clustering function development and persona modeling process are well studied and developed. In-page data-based persona will be well utilized in meetings, workshops, and brainstorming sessions because it contains concrete data on usage behavior. It is effective for many stakeholders to summarize and describe the data in a short amount of time for a particular user type.

Also, a proto-persona is built on the designer's assumptions, so there is a limit that does not have the authority of the data. Therefore, there is a doubt about the objectivity of proto-persona from other departments and in-page data-based persona can be an effective complement to proto-persona.

4.3.3 Developing features for in-page data-based persona

Among many in-page data-based analytics, this study used Beusable solutions to extract data on persona. The reason for this is that in the Beusable, the only heatmap, scroll data, etc. can be extracted by user groups, and the author has led the development of this functions. In other solutions, heatmap data is shown as the sum of all users. Implementation is very difficult because heatmap data needs to be separated and processed in real time in order to show data by user types. There is no software that provides clustering of in-page navigation data such as heatmap among commercially available software. I led the research and development of clustering functions and UI for persona modeling which is a representative user modeling tool in UX design field.

In order to make a persona, cooper originally proposed a clustering method using a manual technique based on qualitative research. Using qualitative data, researchers usually cluster participants using manual techniques such as affinity diagrams, card sorting exercises, and expert panels. From a process perspective, the persona type clustering phase is performed as steps 2, 3 and 4 of the persona creation process in figure 6. It includes the steps of identifying behavioral variables, mapping interviews subject to behavioral variables and identifying significant behavior patterns by UX experts. In the formal persona, the behavioral characteristics of the user are extracted from the qualitative user research data such as affinity diagrams, card sorting and expert panel. [85, 86] As shown in figure 31, and the key behavioral variables are derived by mapping them to the coordinates such as service-oriented to price-oriented. [75]

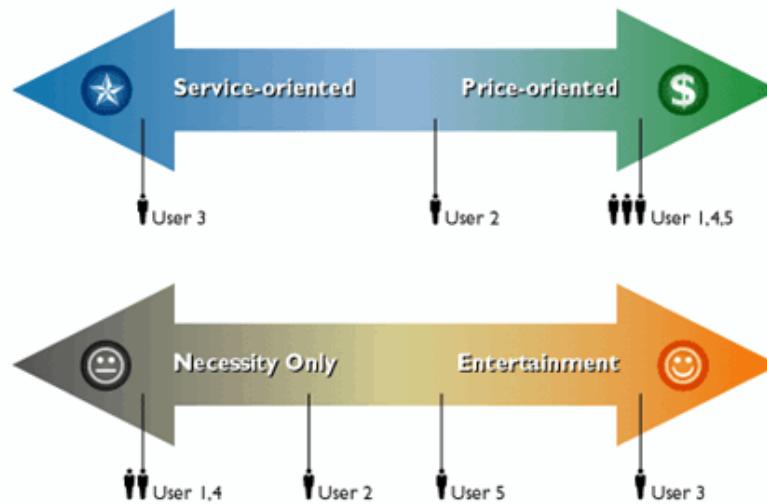


Figure 31: Users Mapped Against Behavioral Variables for Online Shopping

The grouping of similar participants for the formal persona is done by collaborative workshops by UX designers. Collaborating with other UX designers and user researchers has the benefit of having multiple perspectives and opportunities to discuss points of ambiguity or confusion. Figure 32 shows a scene that jointly maps persona behavioral variables and derives persona types. [88]



Figure 32: Scene of Persona Mapping Workshop

Mulder and Yaar suggested a 2 by 2 matrix to present various kinds of research data to build persona including quantitative and qualitative research data.

[Figure 33] [5] The X-axis consists of the goals, needs & frustrations - behaviors axes, and the Y-axis consists of the quantitative-qualitative axes. The in-page analytics data to be used in this study is located at the bottom right, system usage section.



Figure 33: Data Types Matrix for Persona Modeling

Traditional web analytics software can be used as the basis for persona clustering. However, traditional web analytics does not provide behaviors and navigation pattern data. Yet, clustering methods for modeling persona based on in-page analytics have not been studied. This study has developed three features for clustering quantitative data of Beusable solution to make in-page data-driven persona.

First, this study developed a function that can distinguish user types by referrer. Referrer logging is used to allow websites and web servers to identify where people are visiting them from, for promotional or statistical purposes. [88] Typical examples of referrer are search engines, recommendation through social networks, and social bookmark services. A user accesses a specific Web service through such a connection path, and is referred to as a referral when describing how a certain Web service is accessed through a connection path. Figure 34 shows the comparison of heatmaps for each group of users entering through two

different referrers.

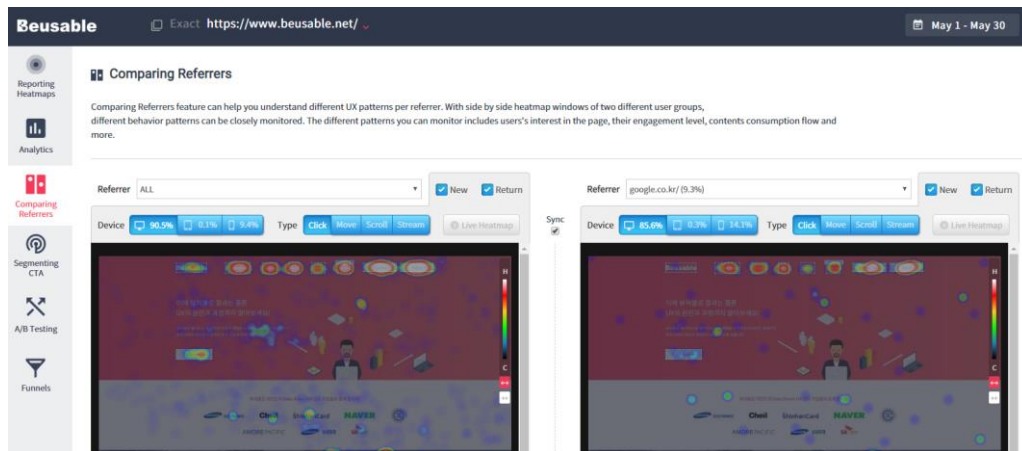


Figure 34: Comparing Referrers Screen of Beusable

This study also developed a feature that allows users to browse the heatmaps by grouping the first-time visitors and returning users into groups. As shown in the upper right corner of Figure 35, it provides a UI for selecting heatmaps as checkboxes for new users and returning users respectively. You can also query the heatmaps for new users and returning users for each referrer.

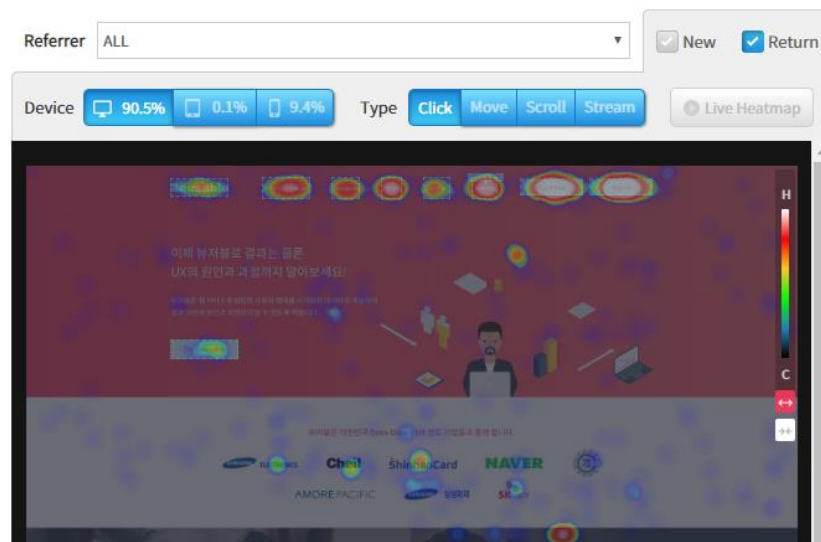


Figure 35: heatmaps window for new and returning users in Beusable

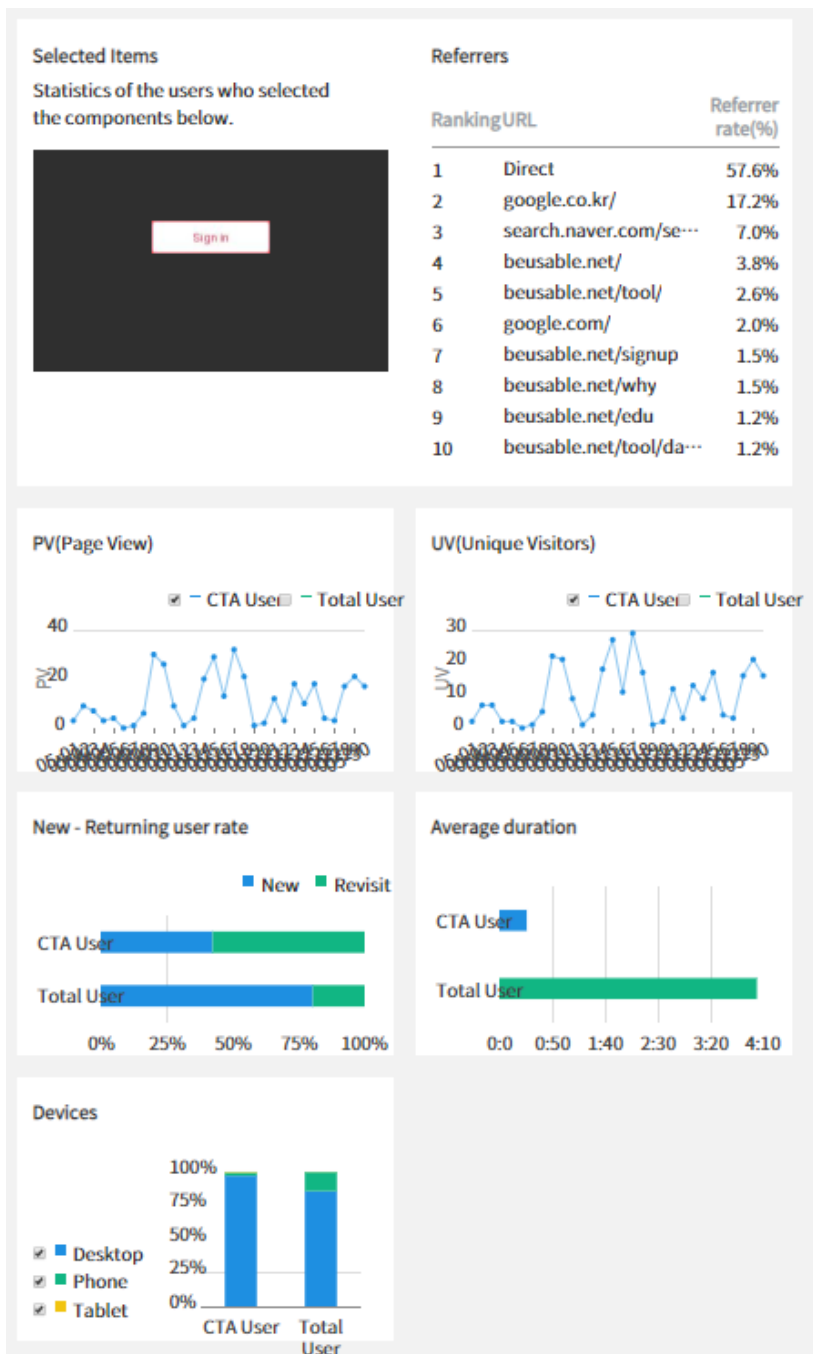


Figure 36: CTA analysis data for sign-in button

This study also developed CTA user analysis feature. Site conversion rate can be improved by back-tracking information such as inflow(refer) channel, new or returned users' ratio, and session time. Figure 36 shows the referrers, PV, UV, new-returning user rate, average duration, and device data for the sign-in button.

5. IN-PAGE DATA-BASED PERSONA FOR WEB SERVICE

5.1 Defining Concepts and Objectives of In-Page Data-based Persona

The purpose of proposing in-page data-based persona is to develop in-page data-driven persona model that can compare personas quickly and objectively at the time of a meeting and to easily understand various personnel who do not see data normally

The design of the persona model should not be so large that it should be easy for people to see at a meeting, so the persona is designed for A3 size. It consists of four parts: 1) Basic Elements of Formal Persona, 2) Basic Usage, User and Computing Environment Data, 3) Selected Beusable In-page Usage Data by Stakeholder Interview, 4) UX Designer's Analysis about Persona Interests, Motivations, Behavior Patterns, Frustrations.

In order to use it effectively in meetings, this study added basic information of the persona and key data about the key UI elements and behavior patterns within 2 pages, and summarized the features and pain points of the behavior patterns found by the UX designer. Statistical data and UX designer's insights are placed next to each other to make it easier to understand. In addition, it does not represent simple data, but compares data with other personas so the difference is easily noticeable. Furthermore, text information and graph data are designed to be harmonious.

The formal persona plays a key role in the user experience design process and has many advantages as outlined in chapter 3. This study sets specific goals to define a data-based persona model so that one researcher can make it quick and dirty in a short period of time. While the formal persona has been created through massive qualitative user research over the course of several weeks, the aim of this study was to create it with minimum time and manpower. As shown in table 11, in-page data-based persona modeling in this study is based on in-page analytics, Beusable solution data.

Table 11: Key attributes of In-Page Data-based Persona

Key attributes of In-Page Data-based Persona	Description
Focus	It focuses on specific page such as homepage rather than whole web service.
The Time Required	Completed within one day (minimum)
Human Resource Required	One person (minimum)
Data	Data of in-page analytics(Beusable) and UX designers' interpretations and insights
Segmentation	Referrer, CTA(Call-to action), New / Returning Users

5.2 Process and Target Homepage of In-Page Data-based Persona

The process for creating a Data-based Persona is shown in Figure 37. The first process is the stakeholder interview, mainly focusing on asking questions about behavior clustering types, target devices and homepage UI components selection and grouping. UX designers then can determine clustering types and perform homepage UI components grouping analysis based on the stakeholder interview. Then one models the data-based persona based on the persona template and the elements set review. Finally, the personas are utilized appropriately for each company's purpose. In the diagram in Figure 36, the shaded box shows the elements that can be modeled quickly and easily based on the definition in this study.

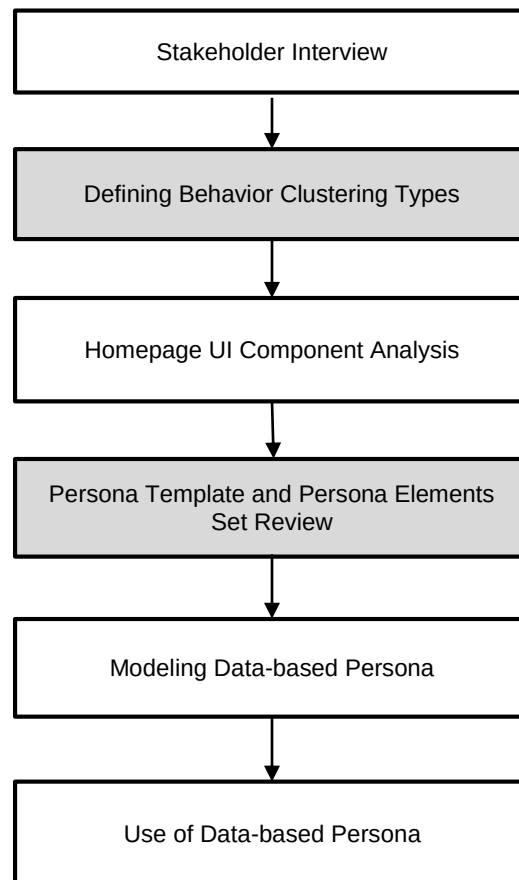


Figure 37: Process of Building Data-based Persona

For the demonstration of the process, the homepage of the Beusable service was set as the target homepage. Beusable service is an online software that allows companies and individuals who operate web service to make a certain amount of money revenue and to view the in-page analysis of user behavior data. Figure 38 and Figure 39 show the home page of the Beusable service from top to bottom. The Beusable Homepage was developed as a responsive web and shows the same contents regardless of device. The Beusable homepage consists of menu, introduction, related company, interview, video, key function introduction, columns, and footer from top to bottom.

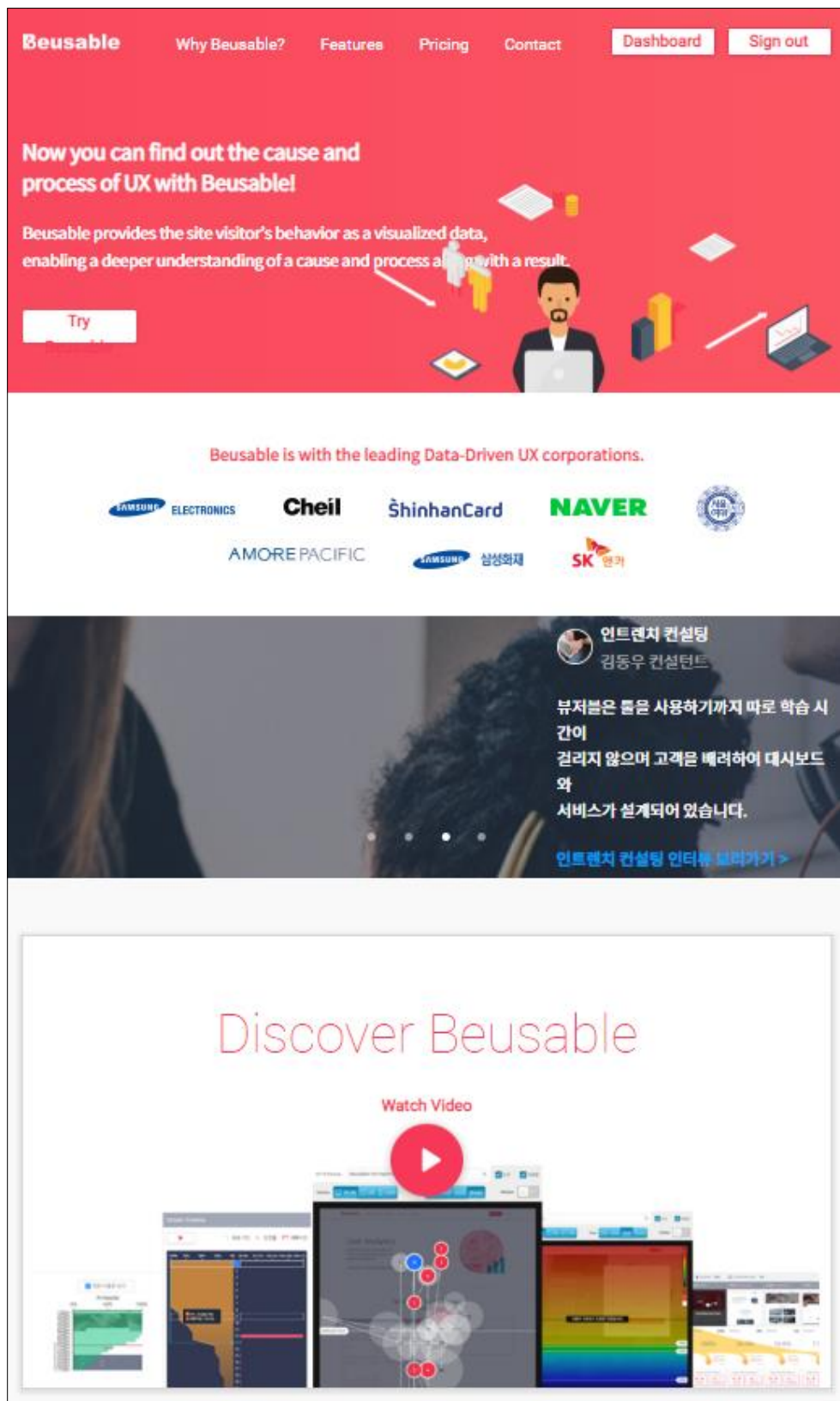


Figure 38: Beusable Homepage (Top half of all)

Gain new UX insight. Analyze and verify with Beusable.



UX Heatmap

You can see the user's UX result in the form of heatmap.

[Learn more](#)



Reporting Heatmap

Automatically summarize and outline the analytics results and issues of heatmap.

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Comparing as Referrers

Directly compare the variation in UX depending on user's inflow channel.

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User Analytics

After installing Beusable, you can view user metrics of all experience levels in real time.

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Activity Stream

'Gaze plot' shows user's navigation order, interested area, and exit status.

[Learn more](#)



Segmenting as CTA

You can discover which type of users clicked a particular button or a clickable components.

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A/B Testing

A/B Testing measures the UX performance after a renewal with just few clicks.

[Learn more](#)



Funnels

Funnel calculates the exit rate from the initial inflow to the final conversion.

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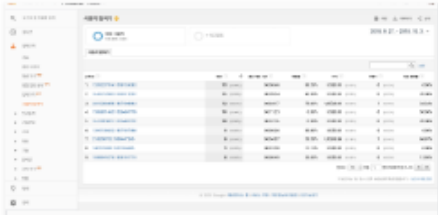


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Session Report simulates users contents consumption flow over selected time-period.

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올바른 설문 조사지 작성법과 조사 결과를 왜곡하는 편향



뷰저블리로 사이트 내 소구 콘텐츠의 우선순위 파악하기

You can start for free!!

Figure 39: Beusable Homepage (Bottom half of all)

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5.3 Defining Key Factors of In-Page Data-based Persona

This study has systematized the data types that can be obtained through Beusable solution for persona modeling. The motivation, goal, needs, backgrounds of in-page data-driven persona are limited in comparison with traditional persona. However, data such as behavior data, interests, goal, computing settings, and pain points are the key elements of in-page data-based persona. [Table 12]

Table 12: Data Types of In-page Data-based Persona

Persona Elements	Proto-Persona	Formal Persona	In-Page Data-based Persona
Name, Face Photo (Sketch), Demographics	•	•	•
Needs	•	•	•
Pain Points	•	•	•
Goal	•	•	•
Motivation		•	
Behavior (General)		•	
Background		•	
Interests (UI Elements)			•
Behavior Data (Navigation Patterns)			•
Computing Specifications, Settings			•

For the case study, the core menu and functions were selected within the Beusable homepage considering the service nature of the Beusable solution. The results of the key functions and menu selections are shown in the Table 10. The major goal of the Beusable homepage is to introduce a Beusable solution for customers. The homepage provides two trial buttons, 'Try Beusable' and 'Try it free', which are the same function. In table 10, the introduction of 9 core features are 9 information boxes which are UX Heatmaps, Reporting Heatmaps, Comparing as Referrers, User Analytics, Activity Stream, Segmenting as CTA, A/B Testing, Funnels, and Session Report. It also provides 'why Beusable' menu for basic introduction. The contents of the Beusable case studies, and guidelines are provided through the UX Insights column at the bottom. [Figure 40]

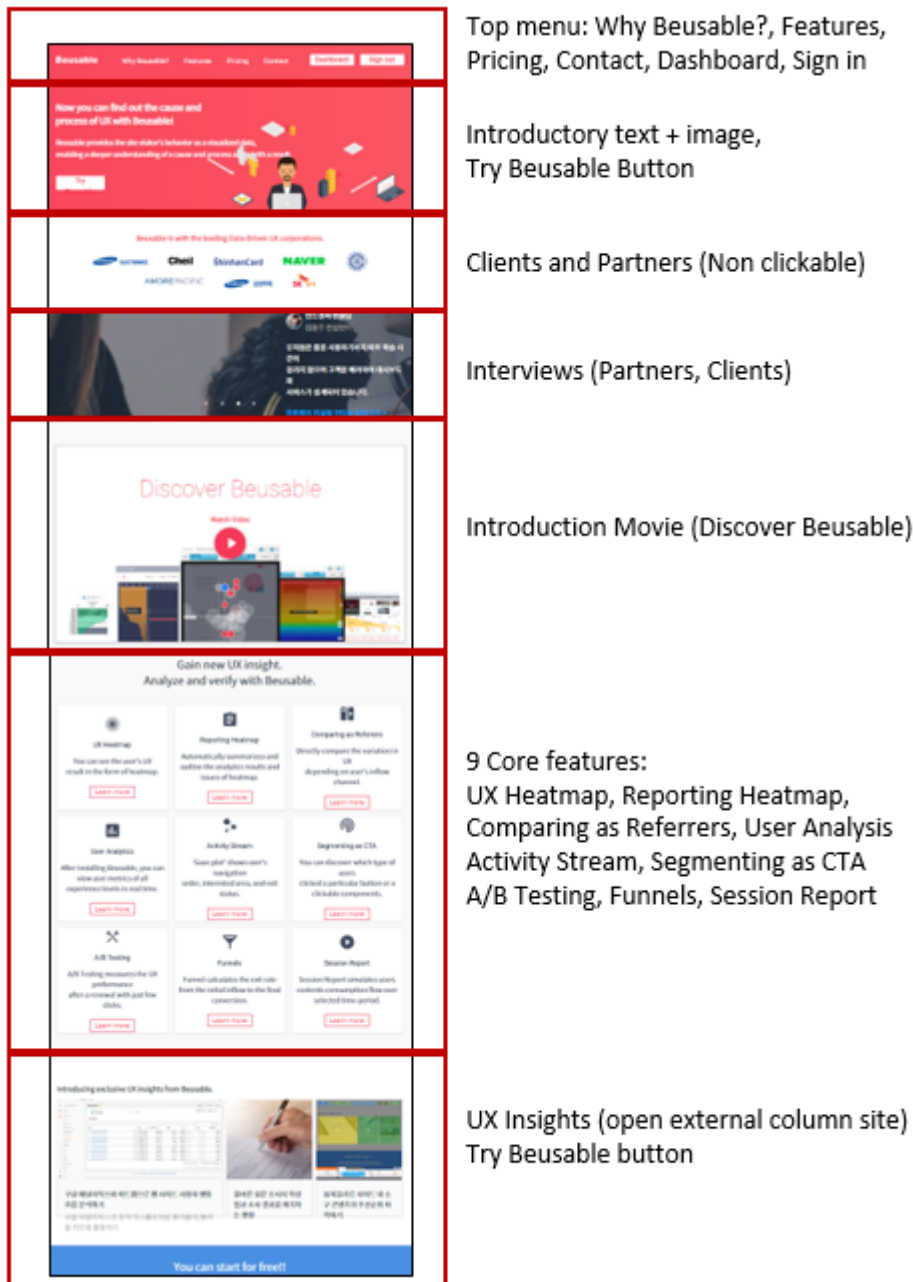


Figure 40: Beusable Homepage UI Component Analysis for Persona

5.4 Modeling In-Page Data-based Persona

This study performed persona modeling based on Beusable Analytics data and Beusable user clustering research and features. As described in Section 4.2.3, in-page data-based persona can be clustered and modeled in three ways. [Table

13]

Table 13: Behavior Clustering Types of Beusable Solution

Clustering Types of In-page Data-based Persona	Description
New – Returning	By comparing new users with the returning users, this study can show UI differentiation methods and marketing methods. In the Beusable service management side, it is important to stimulate interest from new users, encourage returning, and for them to try the free version. It is important for returning users to provide sufficient information for decision making and induce service subscription.
CTA (Call-to Action)	It is possible to analyze behaviors and characteristics of users by clicking or non-clicking of core UI elements. For Beusable Management, 'Try Beusable' and 'Pricing' are key functions for attracting customers.
Referrer	The Referrer of a website is a very important basis for marketing and promotional activities because it allows users to know which way they are coming. Beusable has been steadily doing search engine marketing and has been doing social marketing using Facebook.

The short stakeholder interview with Beusable CEO was conducted. As a result of the stakeholder interview, clustering factor of new-returning persona was most important and selected for persona clustering criteria. Since more than 80% of all users accessed homepage through desktop, the analysis was conducted only for users who visited the desktop version homepage.

In the Beusable solution, data is diverse because it continuously develops various data about user behavior. This study selected appropriate data for persona modeling and the type of data suitable for the persona modeling and the infographics study were used to derive 19 types of persona components as shown in Table 14. The form of the data that constitutes the persona varies. A persona composed of text, statistics, image, and infographics was constructed to show quantitative data effectively. In particular, average folds and scrolled heights, and conversion are easy to understand at a glance because they consist of infographics. When it was effective to show statistical data directly, it shows statistical data, but it is composed mainly of core data, and it shows data easily compared with other persona. Examples are Data Collection Periods, unique

visitors, page views, technology access, usage of key UI elements, and UI elements of top 5 clicks.

Table 14: Elements for In-page Data-based Persona

Persona Elements	Type	Description
Persona Title	Text	Title representing the user type
Quote	Text	A sentence that represents persona's thoughts
Data Collection Period	Statistics	Data collection period (depends on purpose)
UV, PV	Statistics	Number of Unique Visitors, Page Views
Photo	Image	A face photo representing the persona's image
Demographics	Text	Name, Age, Job Title, Residence, Nationality
Technology Access	Statistics	Representative value of Computer, OS, Browser, Monitor Resolution, Number of Session, Average Session Time, Drop Off Rate
Usage of Key UI Elements	Statistics	Number of Clicks and Click rates of Important UI Elements
Comparison with Another Type of Persona	Text + Statistics	Comparison of clicking behaviors with another persona for key UI elements
Key Interests (Top 5 Clicks)	Statistics	5 UI elements with the highest click number
Interests	Text	Insights on the UI elements that users often use
Male to Female Ratio	Statistics	Percentage of male and female users
Referrers Ratio	Statistics	Search, Direct, Social sites, etc. Referrers ratio
Motivation	Text	Insights on user motivation by funnel
Average Fold and Scrolled Heights	Infographics	Mouse scroll usage and average fold line
Analysis of Mouse Scroll Behavior	Text	Review and Analysis of Mouse Scroll Behavior
Navigation Patterns and Insights	Text	Review and analysis of mouse click behavior and scroll behavior
Conversion	Infographics	Percent of users reaching site goal link
Analysis of Conversion	Text	Analyze the percentage of users who reach your site goal link

To effectively demonstrate these persona elements, a persona was designed with the layout shown in Figure 41. In order to effectively demonstrate the data and

related content, this study have organized the persona into a layout using two A4 paper standards. However, in order to link between two pages, basic information such as persona title, quote, data collection period, UV, and PV are displayed at the top.

Page 1		Page 2	
Persona Title Quote	Data Collection Period UV, PV	Persona Title Quote	Data Collection Period UV, PV
Photo Demographics	Technology Access	Analysis of Mouse Scroll Behavior	Average Fold and Scrolled Heights
Usage of Key UI Elements	Comparison with Another Type of Persona	Navigation Patterns and Insights	
Key Interests (Top 5 Clicks)	Demographics (Male to female ratio Pie Chart)	Analysis of Conversion	
Referrers (Ratio and Pie Chart)		Conversion Infographics	

Figure 41: In-page Data-based Persona Template

Since the persona model is based on the quantitative data of in-page data analytics, this study selected core data that can be explained to a large number of participants in a short time at a meeting place. At the meeting place, the UX designer could explain the key attributes and interests, behavior patterns, and insights and frustrations efficiently in a short time

When selecting the elements and key behavioral variables of the formal persona, the UX designer selects the variables that are thoroughly suited to the nature of the business. Because each business has different key behavioral variables, persona modeling is difficult to automate by algorithm.

So, this study created a process to perform a stakeholder interview to select the important UI elements of an in-page data-based persona. In order to show the top 5 clicks data that can summarize the users' interests, I have planned out the related functions and guide development in Beusable development team.

In page 1, the criteria included in the persona are basically included as the most commonly used elements in the formal persona. (Photo, Name, Age, Job, Computing specifications, Key comments, goals)

This study added UV (Unique Visitors), PV (Page Views), session, average session time, and drop off rate, which are the basics of the web service data. Among these, user age, occupation, residence, etc. are the parts that UX designers set by mixing data of stakeholder interview and Beusable solution. Analysis of the Beusable users showed that the PV / UV ratios are very different for each persona. Returning user persona had less UV, but PV was overwhelmingly higher. This is done by comparing the data at the top of the Persona. The difference in visit behavior between persona is intuitively known through the large difference in average session time. The average session time was also 2.8 times higher for returning user persona. This intuitive comparison of quantitative data is one of the advantages of a data-driven persona.

The Key Interests (Top Clicks) section represents UI elements that users are most interested in. New user persona and returning user persona had different interests. In the Referrer aspect, they appeared at different rates. The new user persona mainly clicked on the "Why Beusable" menu, while the returning user persona mainly clicked the "sign in" and "try it free" buttons.

In page 2, the analysis of scrolling behavior part is a part of the UX designer's analysis of the scrolling graph. This study added a scroll pattern graph because it is effective to directly check the UI elements and the scroll graph in the same place as meetings and workshops. The navigation pattern and insights section analyzes the overall data and organizes user behavioral characteristics, unmet needs, issues and frustrations. It is necessary to understand and interpret data and to understand web UI contents for effective writing. This part can be written by an experienced UX designer. Especially, the UX designer who operates the service directly can analyze the behavior in depth and discover and present the frustration issue.

Only click rates and click numbers on important UI elements selected through stakeholder interview, for this case study, try Beusable, try it free, why Beusable, 9 core features, and Beusable notice link were selected as important UI elements. This study modeled the persona as a case study based on the layout of figure 36 and the persona elements of table 11. Among the three clustering criteria introduced in Table 10, this study conducted modeling of the New-Returning user persona, which was most importantly requested in an interview with Beusable CEO. According to Beusable CEO, Beusable homepage is a

marketing platform that introduces Beusable solution and allows users to buy Beusable solution after all. Beusable's new visitors are very diverse, including students, company representatives, and related occupations, and they can be prospects for the spread of Beusable solutions and can be influential stakeholders. On the other hand, returning visitors are very important because they are potential customers who can be direct buyers of the Beusable solution. In the case of Beusable management, it is very important to analyze how the behavior of return visitors differs from that of new visitors. [Figure 42,43,44,45]

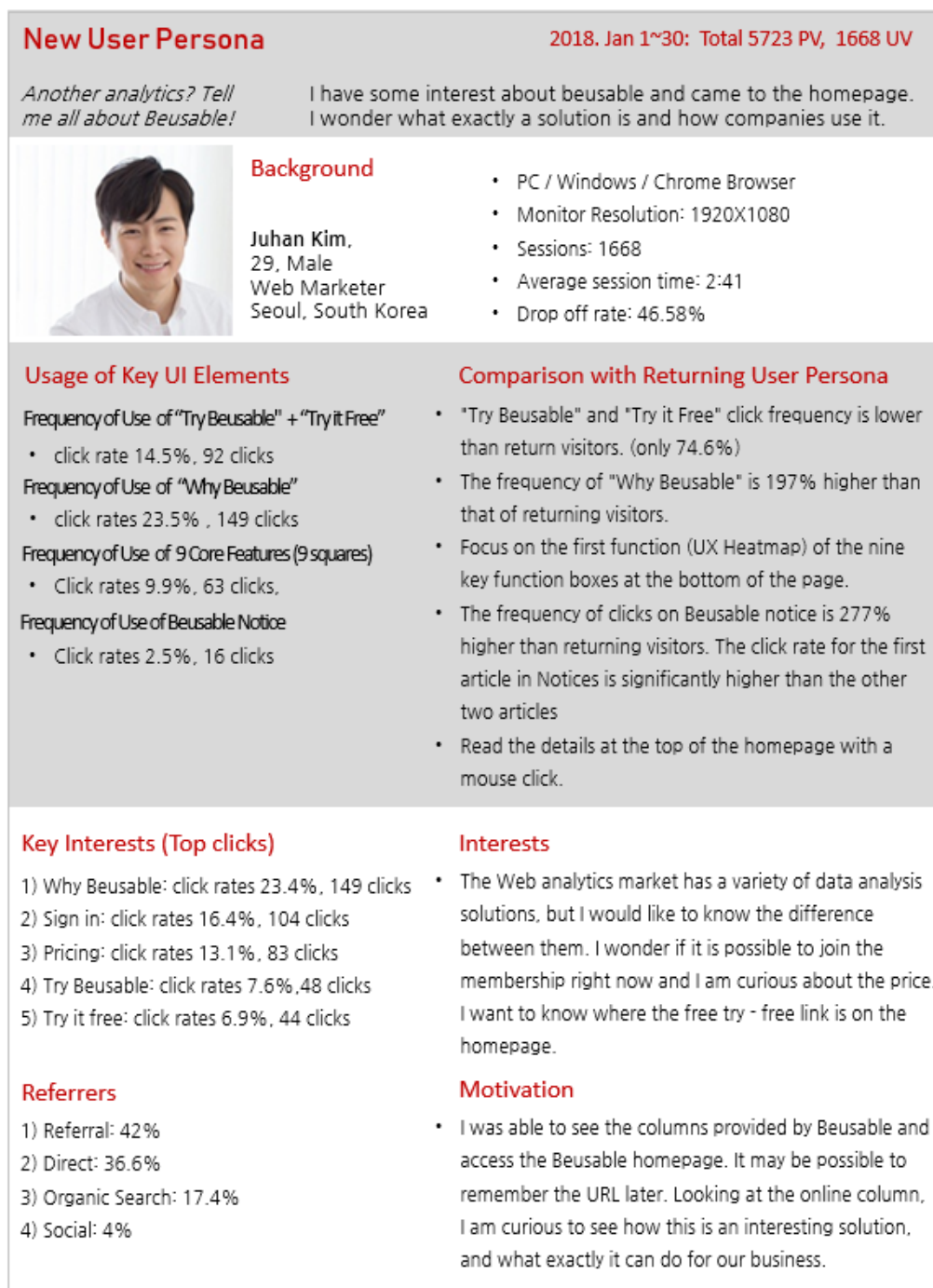


Figure 42: New User Persona for Beusable (Page 1/2, In-page Data-based Persona)

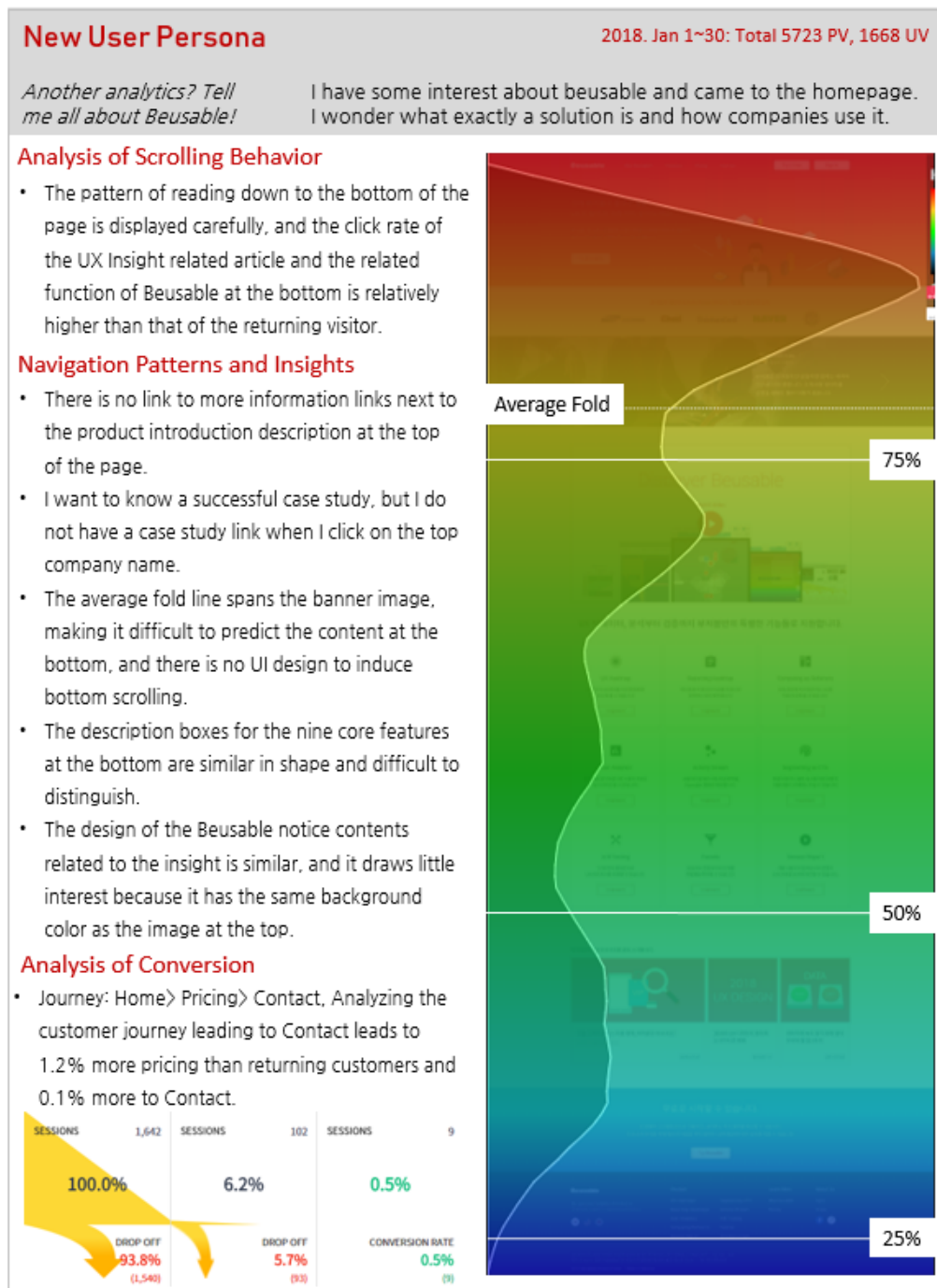


Figure 43: New User Persona for Beusable (Page 2/2, In-page Data-based Persona)

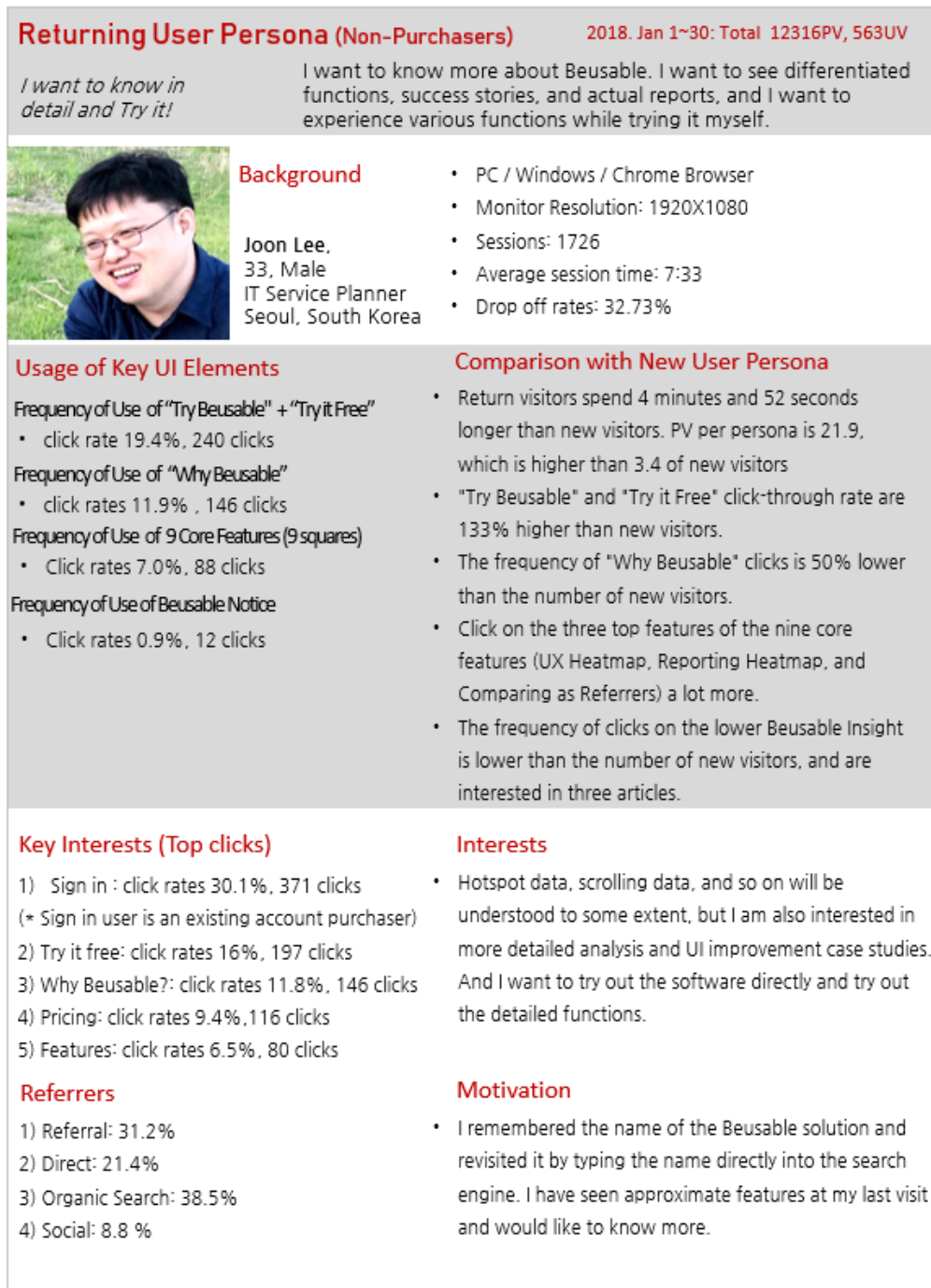


Figure 44: Returning User Persona for Beusable (Page 1/2, In-page Data-based Persona)

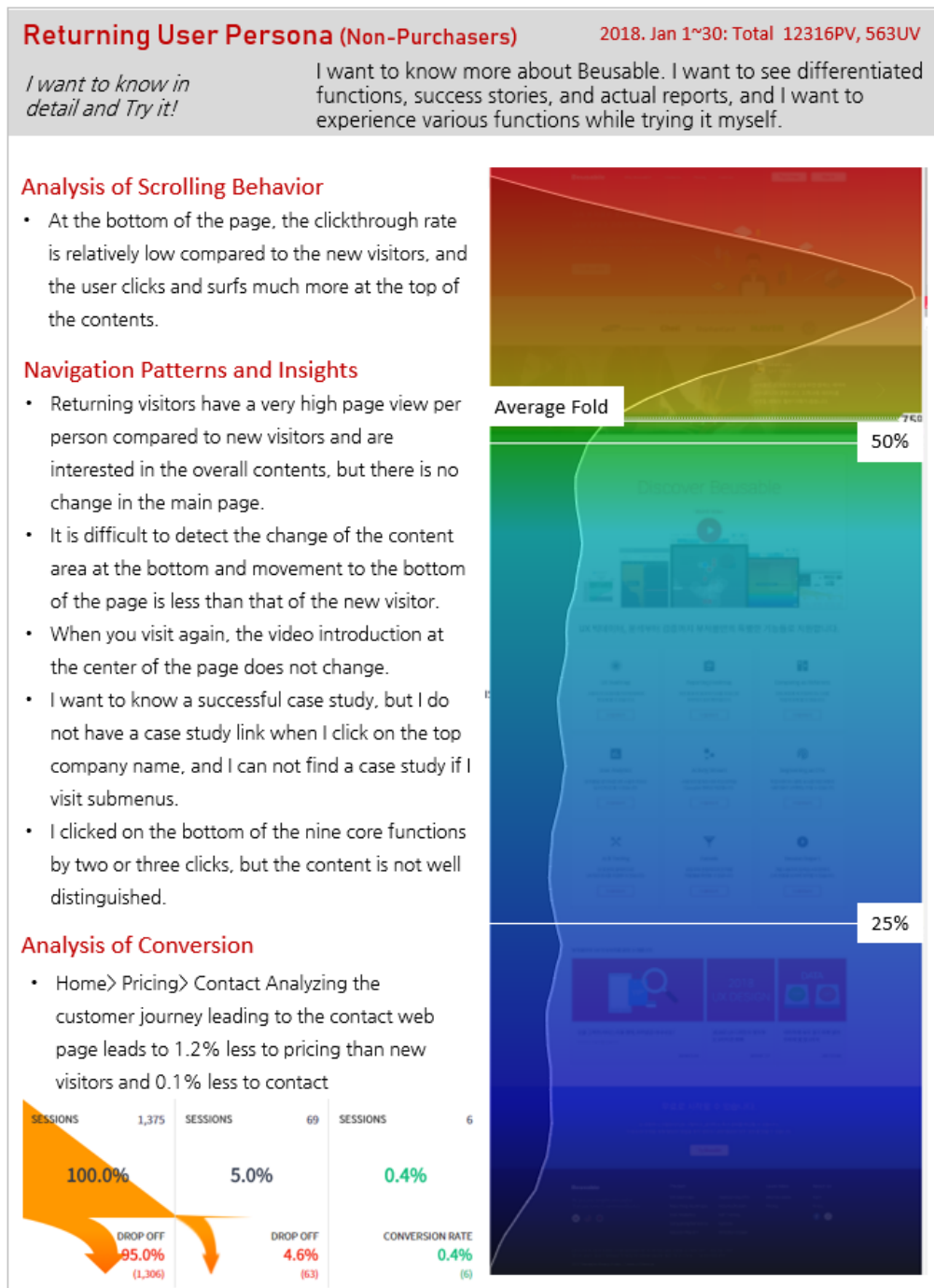


Figure 45: Returning User Persona for Beusable (Page 2/2, In-page Data-based Persona)

This study considers that the data and contents can be shown well based on the persona template when modeling the persona. Unlike traditional persona, the top of Figure 42 and 44 show the specific usage period, PV, UV, monitor resolution data, OS data, session, average session time and drop off rate. When

persona is used, the numerical data of figure 42 and figure 44 can be directly compared. For example, you can immediately see that the new user is 1668 UV, about three times as many as returning visitors. However, as the PV of the returning visitor is 12316, you can see more than twice as much as the new user. You can also see the PC / Windows / Chrome browser data that most users are using, and you can also see that the monitor's average resolution is 1920 X 1080. Quantitative data on these users and the environment of use is a definite strength that can only be verified by a data-based persona.

The data below the user picture in Figure 42, 44 shows the usage of key UI elements and compares them to the other persona. The comparison can be made with other personas, and it can be compared with the average behavior pattern of the whole user as needed. The summation data of the 'Try Beusable' and 'Try it Free' button click data, which are the core CTA elements of the homepage, are arranged at the top. The percentage of returning visitors clicked on these buttons was 19.4%, while only 14.5% of new users clicked on it. On the other hand, 23.5% of new users clicked "Why Beusable", while returnees only clicked by 11.9%. 9.9% of new users clicked on the nine core features of the homepage, while 7% of the return visitors clicked. 2.5% of new users clicked on the 'Beusable Notice' at the bottom of the homepage, while 0.9% clicked on returning visitors. On the right side of these quantitative data is the section 'Comparison with another user persona'. This section summarizes the analysis of 'Usage of Key UI Elements' on the left.

At the bottom left of the Persona (Figure 42, 44) is the 'Key Interests (Top Clicks)' which summarizes the five most-clicked UI elements. On the right side, based on the user click data, insights about the user's interests are described. Percentage of male and female users showed and insights on the motivation factors of the funnel ratios and the funnel are described.

On the second page of the persona, a graph of the scrolling behavior and analysis of behavior are shown. The scrolled graph shows average fold (the average height of web browser) and scrolled area (the average of the scrolled area under an actual scrolled distance). Navigation patterns and insights based on scrolled behavior data are described. At the bottom of the persona, an analysis of conversion section with a conversion graph was placed.

5.5 Guide for In-Page Data-based Persona modeling

The in-page data-based persona modeling presented in the previous chapter can be designed based on other business areas or other clustering factors. The detailed guide and the design process are summarized as below.

In the first page of persona, top persona statement, goal part is the element that the UX designer creates based on the data. In particular, occupation, age, and city information cannot be created without existing marketing materials and stakeholder interviews. Other quantitative demographic, web analytics and user computing environment data used in persona can be obtained from Beusable solutions.

Usage of Key UI Elements needs to be sorted out after defining UI elements based on stakeholder interview which is conducted by UX designers. The comparison with other persona part can be completed by analyzing the core UX element based on the homepage UI analysis and stakeholder interview. It is necessary to compare the difference between the frequency and the user behavior in order to organize the contents.

The Key Interests (Top Clicks) section represents UI elements that users are most interested in. The Interests section is an analysis of UX Designer based on Key Interests data. Referrer is the statistical data that show the main funnel channel in order. Motivation is the analysis of the user's intention by the UX designer based on the funnel data.

On the second page, the scroll graph is arranged relatively large, so that the entire homepage layout can be seen through the graph, which assists the layout of the homepage and the understanding of the usage behavior. Less important data is excluded so as not to be more than 2 pages because the persona needs to be used at the meeting. Move and stream data were excluded when modeling persona. Move is less important than mouse click data and it is possible to be interpreted into various meanings. Since stream data is simple average order data, it is different from actual user behavior patterns. There are a wide variety of links and UI elements on the homepage. Only click rate and click number were selected as important UI elements from the stakeholder interview, and were added to the persona. When UX designers want to apply this persona model to other businesses, they should conduct a stakeholder interview and then select the important UI elements.

Overall, Figure 46 shows the areas highlighted in blue boxes that should be interpreted by UX designers based on the data. UX designers can use this data

interpretation to lead persona-based conferences and workshops to empathize and explain the characteristics of the user experience that data shows to all conference participants.

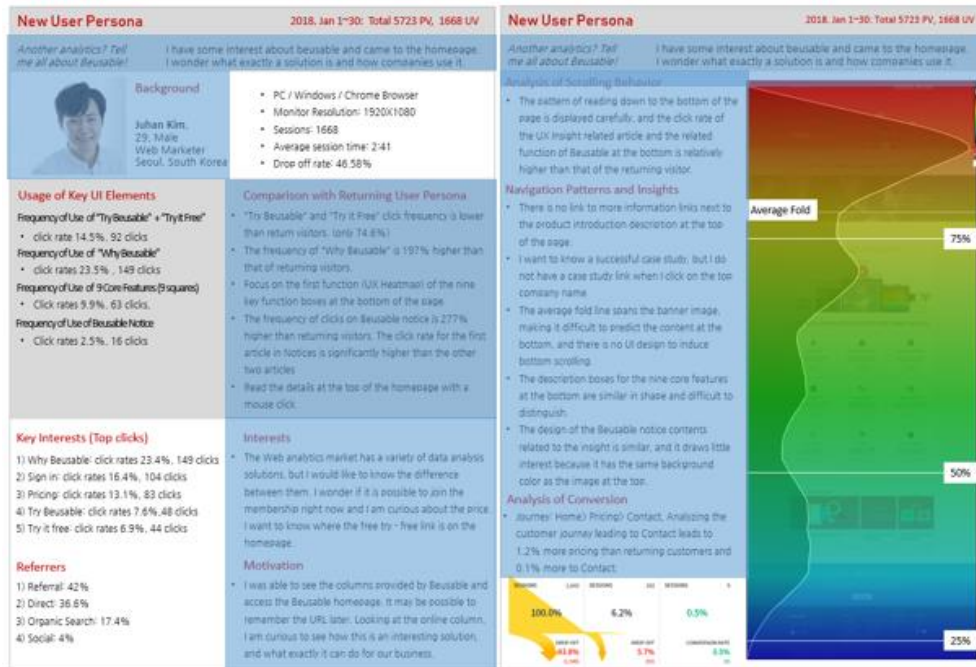


Figure 46: Parts where the UX designer needs interpretation (Blue boxes)

This study also summarized how to get the necessary data from Beusable solution. The step-by-step guide, allows UX designers to obtain the data needed for persona modeling. The step-by-step guide consists of 7 steps in total. [Figure 47,48] By using this guide, the UX designer can easily obtain the data needed.

A Design Study on the Developing In-page Data-based Persona for Web Service

Step 1

- After logging in, get basic persona information through the analytics menu on the left: UV, PV, Average Duration, Exit rate, Inflow Channel, Display Resolution, Device Analysis, Visits per Country Analysis, Operating System Analysis, Browser Analysis



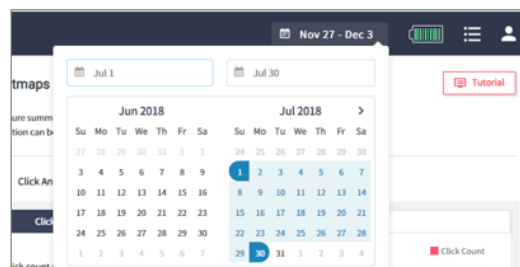
Step 2

- Select the desired service domain, group, and page from the links at the top.



Step 3

- Set the desired data collection period. Currently, the period is limited to within one month.



Step 4

- Set the desired clustering factor in the Beusable solution. Depending on the purpose, groups can be set for new - returning, segmenting CTA, Referrer.

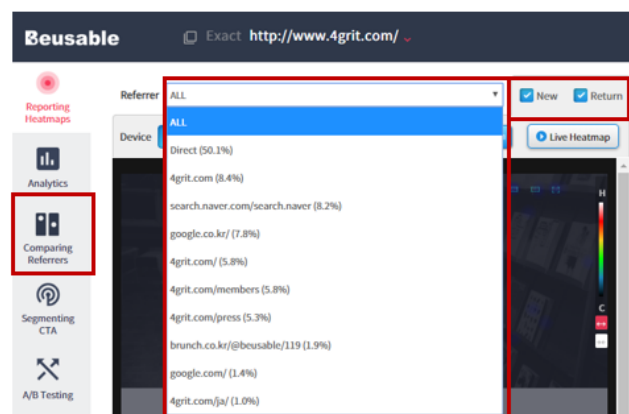
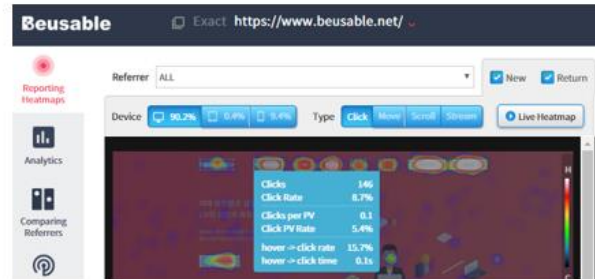


Figure 47: Step-by-step guide to get the data needed for persona modeling in Beusable solution (1/2)

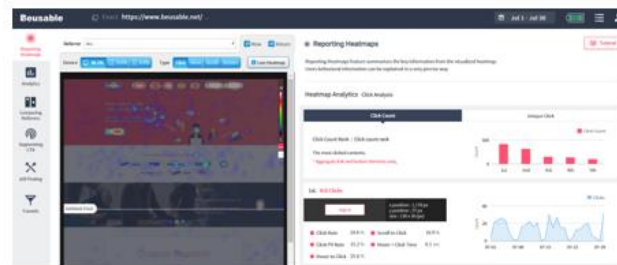
Step 5

- Click on each UI element on Heatmap to get the data value. Through the Stakeholder Interview, the data of the part defined as the important UI element is concentrated.



Step 6

- On the screen on the right side of Heatmap, get the top 5 top clicks data.



Step 7

- Select the scroll tab to get the scroll data for the persona type.

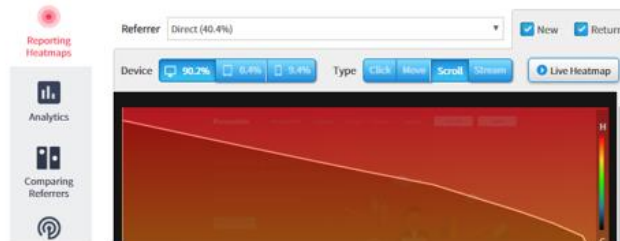


Figure 48: Step-by-step guide to get the data needed for persona modeling in Beusable solution (2/2)

Based on this step-by-step guide, another case study of persona modeling was conducted. Based on the in-page data-based persona elements, layouts, and guides, this study has done referrer persona modeling work. In the Referrer, the persona modeling was carried out by dividing the user group by the direct users' group entering through Beusable 's direct address or entering through the favorite and the design community site Dbcut. Looking at the referrer ratio data, there are users who come in from direct, Google, Naver, Dbcut, 4grit, and so on. [Figure 49] Therefore, a total of five types of referrer persona can be created. In this additional case study, two personas were modeled to examine the

characteristics of the Dbcut referrer, a design community service, and the characteristics of a direct referrer. The other personas also have the same format in all additional modeling.

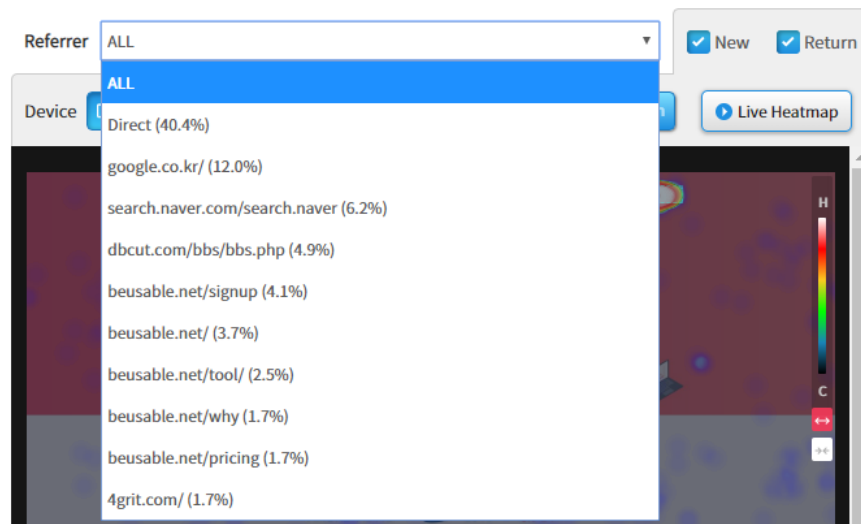


Figure 49: UI design of Beusable service showing ratio of Referrer

The persona modeling results show that the difference between the two persona is significant, and each persona feature can be confirmed in figure 50 and 51 below. This persona model showed that successful application of the in-page data-based persona elements, layout, and guide in the previous chapter through additional case study. Beusable is currently providing more data about the new and returning users.

Compared to the New and returning persona, the following data are lacking in referrer persona and CTA persona: Analysis of conversion, Sessions, Average session time, Drop off rates. These elements are not a core component of persona, but due to the lack of information listed above, there is no funnel graph at the bottom right of page 2, so the appearance of the persona can be expressed somewhat differently. The Segmenting CTA persona modeling element is the same as the Referrer persona modeling element. This small information gap should be complemented by functional development.

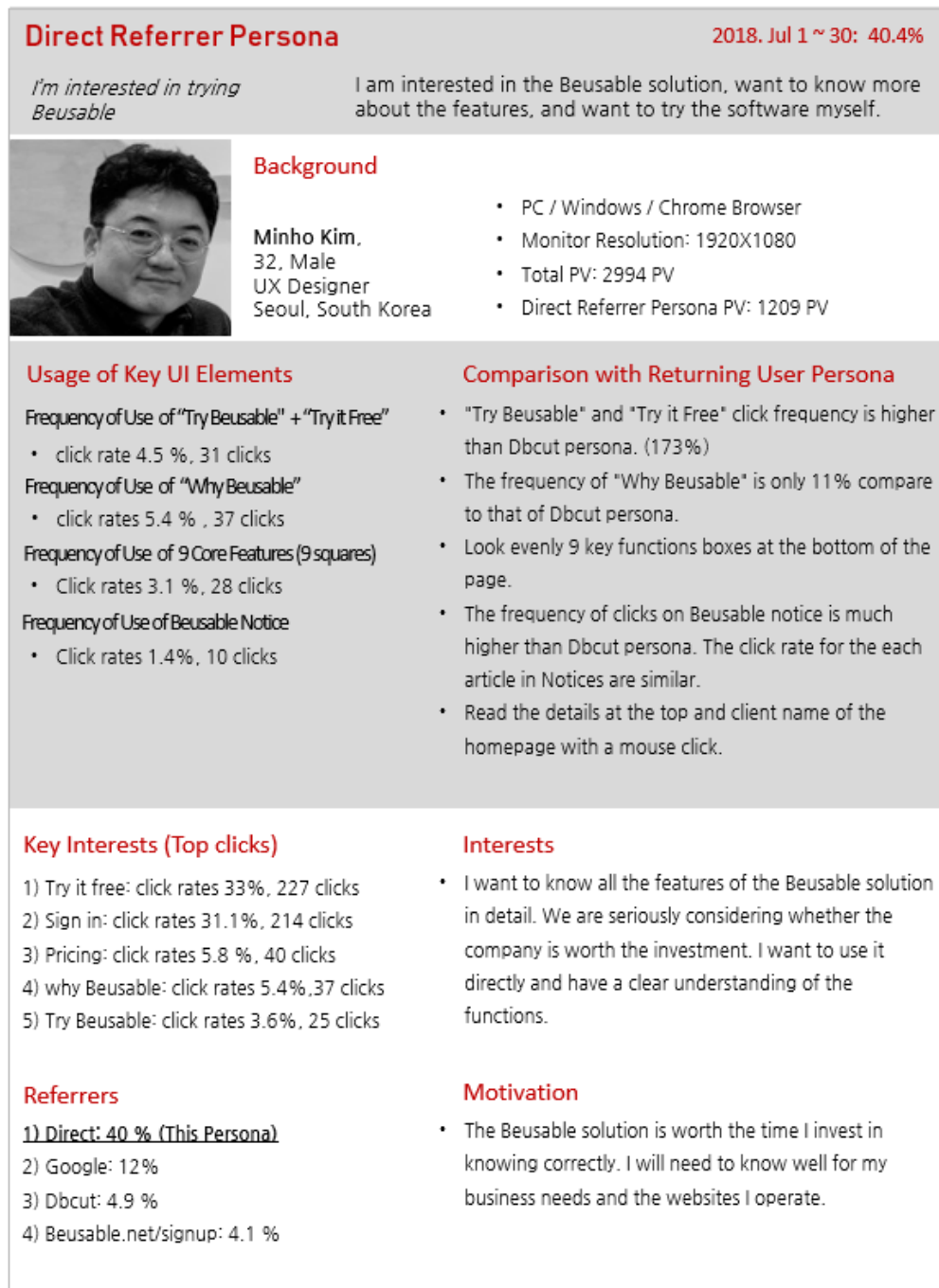


Figure 50: Direct Referrer Persona for Beusable (Page 1/2, In-page Data-based Persona)

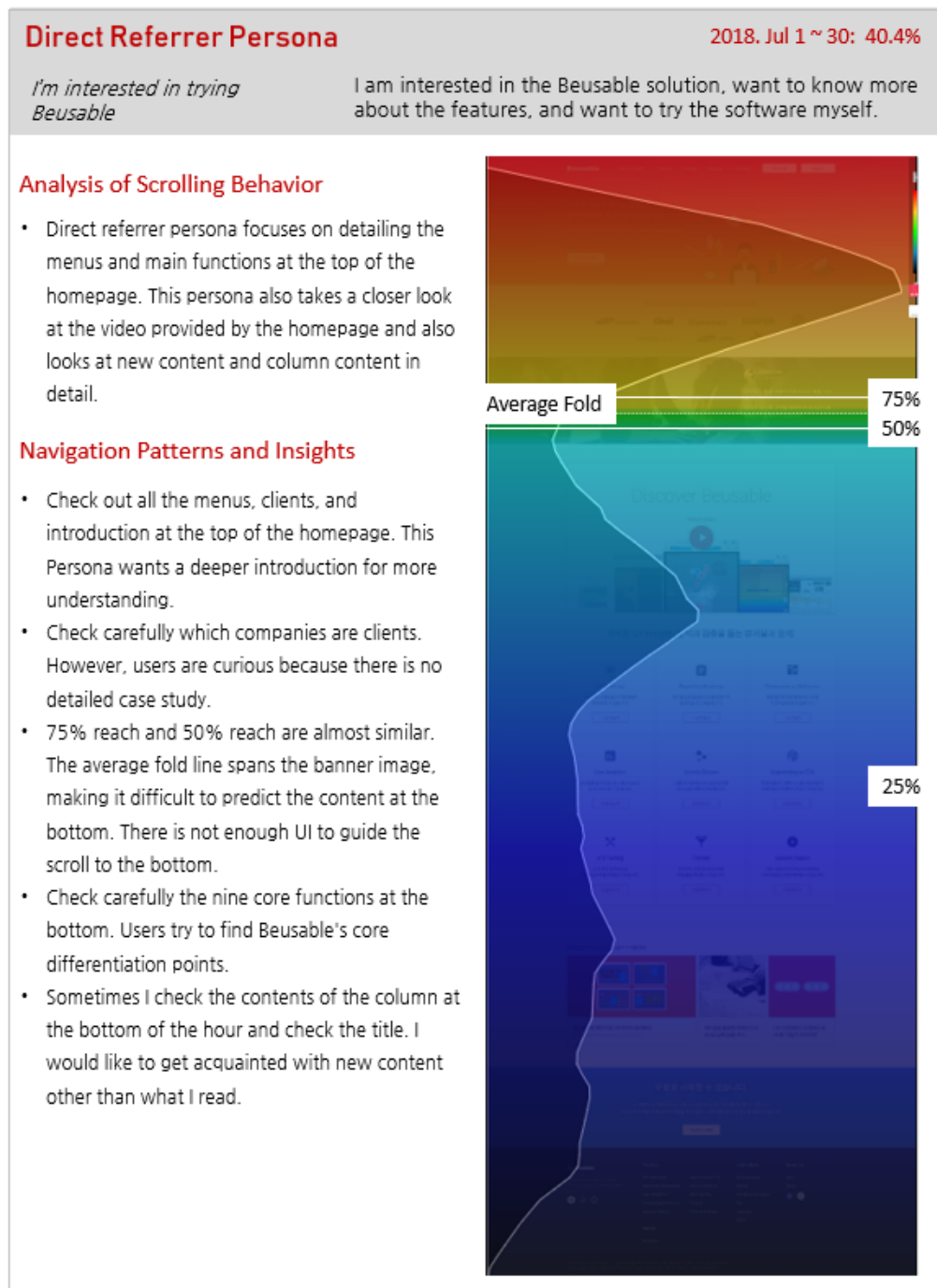


Figure 51: Direct Referrer Persona for Beusable (Page 2/2, In-page Data-based Persona)

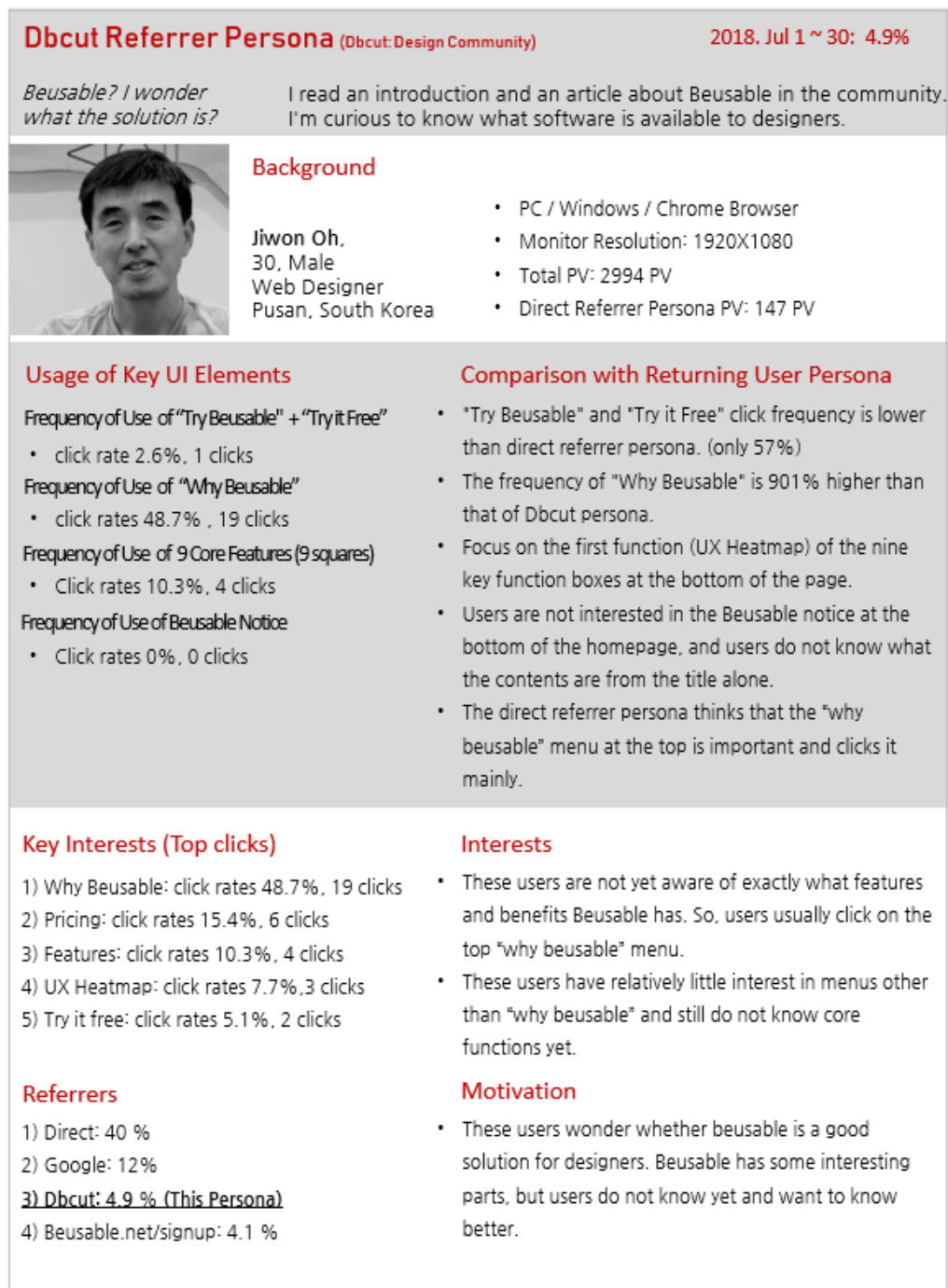


Figure 52: Dbcut Referrer Persona for Beusable (Page 1/2, In-page Data-based Persona)

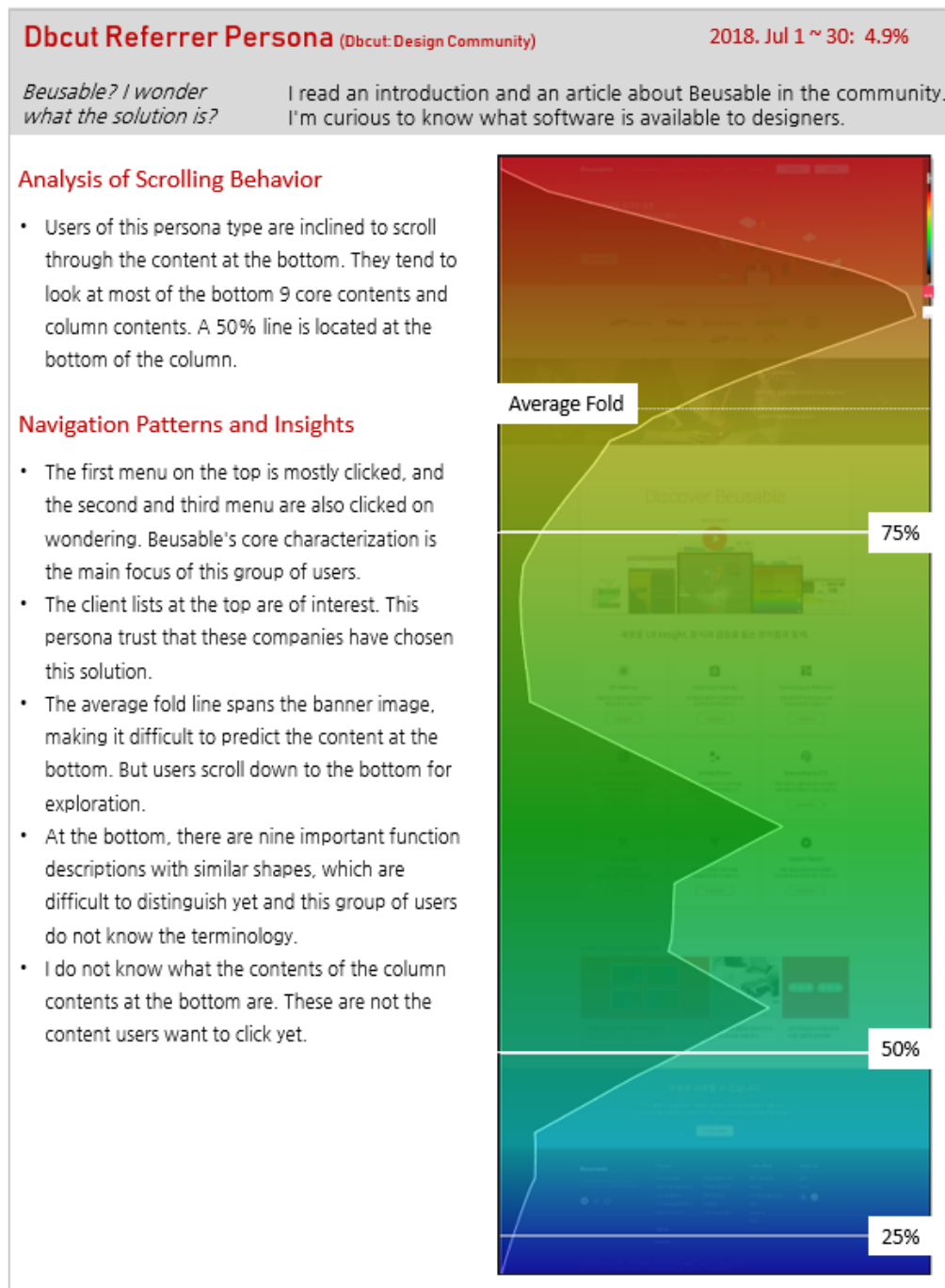


Figure 53: Dbcut Referrer Persona for Beusable (Page 2/2, In-page Data-based Persona)

6. EVALUATING IN-PAGE DATA-BASED PERSONA

6.1 Evaluation Method for the Persona Model

This study interviewed the experts to evaluate the usability of the in-page data-based persona model. This persona model is difficult for the general public to understand because it contains specialized data and insights on Internet services. Expert interviews were conducted through expert users who can understand and utilize the persona model of this study. It was conducted in the form of 1:1 structured interview on the evaluation and applicability of new persona models. Also, it was conducted for a new - returning persona, which required comparison through a stakeholder interview with Beusable CEO. [Table 15]

In order to obtain opinions of the experts at the interview, the answers on two questions were first written on the post-it card, and then the interview was conducted in a format to be explained later. [Figure 54] Table 16 shows the average age, male-female ratio, and career experience of the subjects interviewed.



Figure 54: Scenery of expert comment on notes after reviewing of persona

Table 15: Detailed Condition of Expert Evaluation

Detailed condition	Description
Research Method	1:1 Expert Interview (20 experts)
Analysis Method	Thematic Analysis
Recruiting Guideline	- Experts who can participate 1: 1 interviews for more than an hour - Experienced in web site user research or UX design or development - Those who have more than two years of experience in the above field
Interview Questions	- Describe the usefulness of the in-page data-based persona - Describe the in-page data-based persona's weak points and improvements

Table 16: Detailed Condition of Expert Evaluation

Condition	Characteristics of Research Participants
Age	Average 30.5
Male : Female	4:6
Average career	3.5 years

6.2 Thematic Analysis for Expert Interview

The results of the expert interviews were analyzed through thematic analysis. According to Braun, Clarke, and Terry, thematic analysis is a method for systematically identifying, organizing, and offering insight into patterns of meaning themes across a data set. [89] According to Braun and Clarke, thematic analysis is a method for identifying, analyzing, and reporting patterns of themes within qualitative research data. It minimally organizes and describes research data set in rich detail. [90]

According to Braun and Clarke, thematic analysis has a less coherent developmental history and it appeared as a “method” in the 1970s. [91] Boyatzis suggested specification and guidelines in a key text focused around “coding and theme development” that moved away from the embrace of grounded theory. [92] By Braun and Clarke, “thematic analysis” as a named, claimed, and widely used within the social sciences following the several publication of papers Using

thematic analysis [90, 93, 94, 95, 96, 97, 98]

Braun and Clarke presented several advantages of thematic analysis as in table 17. [90] As a result of this study, the advantages of thematic analysis are useful, because of the vast amount of expert opinions that can be summarized as "Can usefully summarize key features of a large body of data, and/or offer a thick description of the dataset" and "Can highlight similarities and differences across the data set".

Table 17: Advantages of Thematic Analysis

Advantages
Flexibility.
Relatively easy and quick method to learn, and do.
Accessible to researchers with little or no experience of qualitative research.
Results are generally accessible to the educated general public
Useful method for working within participatory research paradigm, with participants as collaborators
Can usefully summarize key features of a large body of data, and/or offer a thick description of the data set
Can highlight similarities and differences across the dataset
Can generate unanticipated insights
Allows for social as well as psychological interpretations of data
Can be useful for producing qualitative analyses suited to informing policy development

Braun and Clarke proposed a six-step process of thematic analysis like table 18. [90] The six-step process illustrates the process of extracting core content based on expert interviews. Thematic analysis is based on qualitative interviews and is a step to determine the theme. It helps to summarize the vast amount of interviews effectively. Ritchie and Lewis, Joanna, and Jill also presented the process of thematic analysis through their research, and the process flow is generally similar and step-by-step segmentation is different. [99,100]

Table 18: Phases of Thematic Analysis

Phase	Description of the process
1. Familiarizing yourself with your data	Transcribing data (if necessary), reading and rereading the data, noting down initial ideas.
2. Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes	Checking in the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic „map“ of the analysis.
5. Defining and naming themes	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells; generating clear definitions and names for each theme.
6. Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

6.3 Usefulness and Improvements in In-page Data-based Persona

Through the Thematic Analysis, this study has developed an application guide and improvement issues of in-page data-based persona in UX design field. The results of the thematic analysis are summarized in the order of transcription, in-vivo codes, what is this about (concept) and category, as shown in Table 19. Transcription is what the interviewees talked about directly. In-vivo codes summarize the most important key words in transcription data. 'What is this about (concept)' summarizes the key concepts of in-vivo codes. Category is a group that summarizes common concepts belonging to concepts.

Table 19: Thematic Analysis Example

Transcription	In-vivo codes	What is this about (concept)	Category
At the top of the homepage, you could see that the visitors were concentrated in the beusable description. Explanatory phrases identified the need to refine content to drive more customer conversions.	Visitor focused on service explanations at the top...Explanatory text needs to be refined to drive more customer conversions	Improved visitor conversion rates by improving the Beusable description at the top of the homepage	Improve service experience by improving specific UI elements
As the users click on the corporate logo a lot, the need for the case study is very large. It helped to prioritize work on case study content.	The need for case studies is very large as a lot of corporate logos are clicked...Prioritize tasks related to case study content	Need to introduce case study by clicking on company logo	
At the bottom of the page, I learned the need for UI changes and improvements in the nine core feature boxes. Depending on the level of interest, you may need to rearrange the order, facilitate the distinction, or improve the way to learn more.	Feel the need for UI changes and improvements in the nine core feature boxes at the bottom of the page.. We need to improve the UI to make users feel like they want to know more	Bottom of page 9 key features needed UI improvements to improve CTR	
Return visitors have higher engagement than new visitors, and it is found that return visitors are actively searching for using and using Beusable, and UI needs to be improved so that return visitors can easily find Beusable features.	Return visitors aggressively explore contents to use.. UI needs to be improved so return visitors can easily find Beusable	Need to make it easy for returning visitors to know how to use Beusable	
The second-highest click-through rate for new visitors is "sign in" , and the click rate for "Try beusable" is 4th. Users confused login and subscription links, so we identified the need for improvements, such as changing labels or designs.	Users are confusing login and subscription links, so we need to make improvements such as changing labels or changing the design.	Being able to try more Beusable service through membership	

The categories derived from Thematic analysis are summarized as Table 20. Opinions about the use of in-page data-based persona similar to traditional persona are grouped into one category. 'Comparison with Formal Persona' compares characteristics of Persona with formal persona. The remaining categories are different from the formal persona in the use of in-page data-based persona.

According to thematic analysis, the important feature was the data of the user interface elements and the contents related to the improvement plan. 'Enhance service experience by improving specific UI elements', 'Insights about UI elements', 'Insights about adaptive UI' are categories related to UI elements. Unlike the formal persona, it had unique benefits of the in-page data-based persona that many UI improvements and UI insights were obtained. The 'Insights about adaptive UI' category is one of the benefits of in-page data-based persona that is not directly derived from formal persona. As Web development becomes more sophisticated and personalized in the future, this study expects it to be a very useful benefit to in-page data-based persona.

In addition, the data-based persona provided opportunities for marketing ideas and new user research. In addition, a category of the benefits and visible differences of formal persona was derived, along with the opinion that it had similar effects to formal persona.

Table 20: Categories derived from the thematic analysis (Benefits of In-page Data-based Persona)

Category
Enhance service experience by improving specific UI elements
Insights about UI elements
Overall Data Trend and Check Points
Insights about Adaptive UI
Comparison with Formal Persona
Traditional Benefits of Persona
Insights related to marketing
Needs for new user research projects
Specific advantages learned from persona elements

A total of 9 sub-concepts related to the enhancement service experience by improving specific UI elements category were derived from the analysis of the experts through Thematic analysis. As shown in Table 21, the experts correctly identified problems with specific UI elements through an in-page data-driven persona and proposed specific improvement directions.

Table 21: Results of Thematic Analysis: Enhance service experience by improving specific UI elements

Category	What is this about (concept)
Enhance service experience by improving specific UI elements	Improved visitor conversion rates by improving the Beusable description at the top of the homepage
	Need to introduce a case study by clicking on the company logo
	Bottom of page 9 key features needed UI improvements to improve CTR
	Change label or UI about confusing login and subscription links
	Change the information at the top menu because returning visitors use a lot
	Provide company name and contents more besides footer
	Add more information to 'Why Beusable' menu
	Update the content in the top area periodically

	Identify and improve UI design elements
--	---

Then, from the expert interview, Insights about UI elements category were derived, and there were 12 sub concepts in total. As shown in Table 22, experts were able to conveniently get insights about specific UI issues and problems. Here, Insights encompasses ideas with various possibilities except for direct UI design improvements.

Table 22: Results of Thematic Analysis: Insights about UI elements

Category	What is this about (concept)
Insights about UI elements	Returning user persona click 'Try Beusable' and 'Try it Free' more
	New visitors are interested in "UX Heatmap", Beusable should get more attention for other features
	Wonder why new users click "sign in" more than "try it free"
	Frequency of using "Why Beusable" is reduced when visited again
	New User Persona click "Beusable UX Insights" more
	Provide a way to scroll to the bottom or aggressive information at the top.
	Users are generally looking at the functionality of Beusable
	Returning user persona look at main function pages with purpose
	Problems with the description or the layout about pricing information
	Lack of Feedback about buttons and images
	Click analysis can be used to improve the menu
	UI needs to be improved for returning visitors to know more in depth

Table 23: Results of Thematic Analysis: Overall Data Trend and Check Points

Category	What is this about (concept)
Overall Data Trends and Check Points	Able to detect unusual behaviors
	See if your content is being delivered
	The user's major departure points tell hidden needs and pain points.

	The rate of moving to price was very low.
	Interesting content and features of persona clearly identified and compared.
	Find solutions for different needs of new and returning persona
	The basis for improvement work by analyzing poor performance
	Analyzing the behaviors of returning visitors can lead to actual service purchases
	Users' navigation path help to understand the usage
	New users stay around 4-5 minute, so provide more readable contents

Then, Overall Data Trends and Check Points category were derived, and there were 10 sub concepts in total. As shown in Table 23, the in-page data-based persona showed that experts understood the flow of usage patterns of users in general and that they could also grasp important checkpoints.

Table 24: Results of Thematic Analysis: Insights about Adaptive UI

Category	What is this about (concept)
Insights about Adaptive UI	Revise the content based on the user's visit history at next visit
	For returning visitors, more detailed contents are accessible
	Plan your UI strategy to attract new visitors to stay longer
	Review UI optimizations and changes that encourage repeat visitors
	Variable content delivered to returning users placed at the top
	Suggest different types of UI based on the difference in usage
	Identify the different needs and define improvement goals

Also, there are 7 types of opinions about the Insights about Adaptive UI category, a new direction in the field of Web services. As you can see in Table 24, the experts understood the necessity of adaptive UI through an in-page data-based persona.

Table 25: Results of Thematic Analysis: Comparison with Formal Persona

Category	What is this about (concept)
Comparison with Formal Persona	Understand specific usage situation and patterns
	Understand more specific needs and behaviors
	Data-driven persona is a solid basis in communication
	Data-driven persona is more objective
	Data-driven persona has specific behaviors and characteristics
	Production period is very short and can be updated periodically
	Numerical data in persona help better communication

There is also a category about Comparison with Formal Persona. This is a category that discusses the advantages and usability of an in-page data-driven persona that differs from a formal persona. There were seven types of expert opinions, as shown in Table 25.

Table 26: Results of Thematic Analysis: Traditional Benefits of Persona

Category	What is this about (concept)
Traditional Benefits of Persona	Basis for communication
	Usage pattern will be able to anticipate the success of new service and content
	Use it as an objective indicator for persuasion
	Users' needs can be understood in detail
	Determine how often to update new columns
	Persona is an important rationale for UX design decisions.
	Persona can be used for prioritization in the improvement and coordinating schedule

Also, opinions about traditional benefits similar to formal persona have been derived. A total of 7 types of expert opinions were derived as shown in the table 26. This shows that in-page data-driven persona has many similar advantages to formal persona.

Table 27: Results of Thematic Analysis: Insights related to marketing

Category	What is this about (concept)
Insights related to marketing	Findings to increase the inflow rate of return visitors
	Pinpoint the user's funnel
	Referrer information is good for marketing and Search Engine Optimization
	Users concentrated on the top part, so various marketing activity can be done for this
	Current visitors have a large influx through social services
	Routes for new and returning visitors are different

In addition, an interesting expert opinion on the in-page data-based persona is that opinions on Insights related to marketing are derived. This category is not found in the advantages of formal persona. As can be seen in Table 27, a total of 6 types of expert opinions were derived.

Table 28: Results of Thematic Analysis: Needs for new user research projects

Category	What is this about (concept)
Needs for new user research projects	Try A / B test to check click patterns
	A/B test based on persona
	Additional UX research of returning visitors to identify the information they want
	Auxiliary data for a usability test

Expert interviews on in-page data-based persona showed the need and potential for new user research projects. This shows that the in-page data-driven persona is representative of the characteristics or problems of the user experience. There are four types of expert opinion in this field, as shown in table 28.

Table 29: Results of Thematic Analysis: Specific advantages learned from persona elements

Category	What is this about (concept)
Specific advantages learned from persona elements	Frustrations and insights have been explained in detail
	Useful for improvements because of the clear distinction between return and new visitor data
	User needs and behaviors sections are convincing and interesting
	Different PV and UV ratios is a great help in understanding persona
	The characteristics and differences of persona can be analyzed quickly
	Big data gives confidence to the UX designer.
	Persona background is useful for reviewing the development specification

In addition, UX experts commented on the benefits of the specific elements of the in-page data-driven persona. As shown in Table 29, a total of 7 types of opinions were derived. The contents of this category are about the elements that make up persona and the advantages due to characteristics of data.

As a result of the interviews with the experts, opinions on improvements were also summarized through the thematic analysis. Three categories are 'Rich Data/More Segmentation Features', 'Data Analysis/Visualization' and 'Usability/Readability'. Among the three categories, Rich Data/More Segmentation Features categories were derived and 5 types of opinions were obtained as in table 30. Rich Data/More Segmentation Features category is difficult to apply now because of the need for new technology and functions of software development. However, it provides some important insights for future persona modeling and software development.

Table 30: Results of Thematic Analysis: Rich Data/More Segmentation Features (Improvements)

Category	What is this about (concept)
Rich Data/More segmentation	Persona description to be longer with situation and background

features	Data on navigating from the homepage to other pages
	Set the various segments to personalize
	Create a persona into meaningful data related to the company's purpose
	Collected behavior pattern data in more detail

Table 31: Results of Thematic Analysis: Data Analysis / Visualization (Improvements)

Category	What is this about (concept)
Data Analysis / Visualization	Analyze referrer data by time
	Average fold value in pixel data
	Distinguish the user's actual behavior
	Analyze the data of users focused on CTA
	Cross analysis of click, movement, scroll, attention
	Write how much invalid clicks occurred

The second category of expert interviews on improvements is comments on Data Analysis/Visualization. A total of six types of opinions were derived, as shown in Table 31. The data analysis/visualization category provides ideas on how to analyze and present data in a variety of ways. It is an important guideline for later modeling of various versions of Persona.

Table 32: Results of Thematic Analysis: Usability/Readability (Improvements)

Category	What is this about (concept)
Usability/Readability	Persona comparison to be easier to improve
	Compare all data at a glance
	Provide criteria and information to understand what is high or low
	Separate the data that show the positive and negative experiences
	Visually express the difference between persona
	Explain the definition of the average session time

The third category of expert interviews on improvements was comments on Usability/Readability. As shown in Table 32, six types of expert opinions were derived. Opinions in this category are suggestions for future design and organization of persona in usable and readable way. Just as the layout and design have been developed by the formal persona through various researchers and case studies, the composition and form of the in-page data-driven persona should be improved and developed in the future. Some of the results of Usability/Readability category are opinions about possible persona elements for beginners who are not experts. This is an important guideline when creating a new persona version for students or beginners.

The results of the Thematic analysis can be summarized as the proposed a persona model for workshops and meetings of gain quick understandings and empathy without large amounts of user research proposed in this study. Experts have shown that this persona model can better inspect user responses to user behavior and UI design. In addition, this persona model can be quickly modeled based on the persona elements and layout system of this study according to the persona modeling process proposed in this study.

7. CONCLUSION AND FUTURE WORKS

7.1 Conclusion

This research explored persona and in-page web analytics tools for web user experience design and proposed in-page data-based persona model and applications. Specifically, this study started with a literature study on user experience design, formal and proto-persona, and needs for data-based persona. Then, this study developed clustering functions for in-page data-based persona modeling, define persona elements, and layout and guide UX designers to utilize them. Then, in-page data-based persona modeling was conducted through a case study, and the usefulness and improvement were identified through expert evaluation. Specifically, the following two conclusions were drawn.

The literature study began by exploring the emergence, definition and

evolution of the Internet and Web services. For the design of web service, this study has explored the definition of user experience design and process of user experience research field. Then, this study investigated how to use quantitative web analytics data in the field of user experience design of web services. Also, this study conducted a literature review on the definition, pros and cons, and processes of formal persona and proto-persona. (see Chapter 2,3)

Then, this study investigated the main functions of traditional web analytics used in the field of web service and the value of utilization in user experience design field. In addition, this study explored the key functions and usefulness of in-page analytics for user experience design field. This study investigated the use of quantitative data for persona modeling of existing researchers and conducted a comprehensive study on how to use in-page analytics data for persona modeling. In-page analytics, the researcher studied the Beusable solution, which is directly involved in development, and designed and developed the clustering functions for persona modeling. (see Chapter 4)

Furthermore, this study studied a step-by-step guide for data collection for in-page data-based persona's concepts, objectives, processes, key elements, and layouts and persona. The case study of actual in-page data-based persona was conducted on Beusable home page. A case study was conducted based on the process and elements research presented in this study. To further demonstrate the validity of the persona modeling framework of this study, additional persona modeling with different variables was performed. (see Chapter 5)

In order to verify the usefulness of the persona model presented, this study conducted an expert evaluation. 1: 1 interviews were conducted with experts in the web service field who could understand and utilize the persona model. The results of the interviews were analyzed using thematic analysis. Thematic analysis shows that UX designers can get directions and guidelines on UI elements such as UI element improvements, insights, and insights of adaptive UI. Similar advantages to the traditional persona was suggested but also the usefulness of the differences were found. Also,

through in-page data-based persona, UX designers can quickly identify the overall data trend and critical checkpoints. Interestingly, UX designers were able to get insights into new user research projects and marketing activities. UX designers also pointed out the merit of each persona elements and possibility of utilization. Overall, an in-page data-based persona has similar advantages to a formal persona, but has the advantage of getting more specific UI elements improvements, adaptive UI, and insights quickly. It also had the advantage of being able to quickly see the overall flow of data and gain insights for new user research and marketing activities. On the other hand, through the thematic analysis, this study will be able to grasp the improvements in all three fields. The three categories are 'Rich Data/More Segmentation Features', 'Data Analysis/Visualization' and 'Usability/Readability', which can be used to develop advanced persona model, create various persona models and case studies, and develop advanced in-page analytics functions. (see Chapter 6)

7.2 Future Works

In chapter 2, the user experience design field is continuously evolving, and the field of data-driven design using analytics data is being studied. In the field of data-driven design, the number of service companies and the number of researchers are expected to increase as web services become more sophisticated and utilize big data. Therefore, it is necessary to continuously grasp and study the progress of this field.

In chapter 3, formal persona has also developed a UX design community and various UX designers through research and case application since Cooper presented the concept for the first time. It is necessary to continue to study the evolutionary directions and cases of formal persona. Especially, it is necessary to focus on research to combine qualitative and quantitative data effectively in formal persona field.

In chapter 4, web analytics and in-page web analytics continue to be developed and evolving, so future studies need to keep track of new and

available quantitative data and research how to use them. In particular, since in-page analytics data is not yet diverse, it is necessary to research and develop a data system that can better demonstrate usage behavior. This study has developed new-returning, referrer, and segmenting CTA clustering functions for clustering of in-page data-based persona, but future studies need to develop more clustering functions. In addition, in-page analytics features need to be developed to provide richer, more detailed information for each persona.

In chapter 5, research on in-page data-based persona is now in its infancy, so more case studies of persona modeling are needed for diverse industries and services. In addition, it is necessary to study the diversity of persona modeling elements, form, and expression based on the findings from chapter 6. Just as formal persona has been developed by various UX researchers, in-page data-based persona will have to mature, develop and diversify through various studies.

In chapter 6, a variety of in-page data-based persona models will also be studied and evaluated to assess these models at the stage of actual application. It will be necessary to continue to design and evaluate various persona models according to the industrial sectors, service business models, and persona data types.

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Appendix.

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
At the top of the homepage, you could see that the visitors were concentrated in the beusable description. Explanatory phrases identified the need to refine content to drive more customer conversions.	Visitor focused on service explanations at the top... Explanatory text needs to be refined to drive more customer conversions	Improved visitor conversion rates by improving the Beusable description at the top of the homepage	Improve service experience by improving specific UI elements
As the users click on the corporate logo a lot, the need for the case study is very large. It helped to prioritize work on case study content.	The need for case studies is very large as a lot of corporate logos are clicked... Prioritize tasks related to case study content	Need to introduce case study by clicking on company logo	
At the bottom of the page, I learned the need for UI changes and improvements in the nine core feature boxes. Depending on the level of interest, you may need to rearrange the order, facilitate the distinction, or improve the way to learn more.	Feel the need for UI changes and improvements in the nine core feature boxes at the bottom of the page.. We need to improve the UI to make users feel like they want to know more	Bottom of page 9 key features needed UI improvements to improve CTR	
The second-highest click-through rate for new visitors is "sign in", and the click rate for "Try beusable" is 4th. Users confused login and subscription links, so we identified the need for improvements, such as changing labels or designs.	Users are confusing login and subscription links, so we need to make improvements such as changing labels or changing the design.	Change label or UI about confusing login and subscription links	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
The necessity of changing the contents through the use behavior of the returning visitor who searched through the upper menu bar was found. You may want to consider changing the information at the top and introducing it regularly.	Change the contents through behavior of returning visitor's usage of upper menu bar. Change the information at the top regularly	Change the information at the top menu because returning visitors use a lot	Improve service experience by improving specific UI elements
The click rate of the bottom footer is very low. I was worried that it would be better to provide only the footer with a link to describe the company name or content.	Click rate of footer is low...worried footer with a link to describe the company name or content	Provide company name and contents more besides footer	
As the number of clicks of "Why Beusable" is relatively high, new visitors can find out the need to know the characteristics of Beusable. Beusable should add the information they want and need to 'Why Beusable'	clicks of 'Why Beusable' is relatively high,, add the information to 'Why Beusable'	Add more information to 'Why Beusable' menu	
New user persona was able to read the top of the homepage carefully and check. You should update the content in the top area periodically to improve it to lead back to your next visit.	New user persona read the top of the homepage carefully...update the content in the top area periodically	Update the content in the top area periodically	
You can identify and improve UI design elements that need to focus on improvements and update them.	Identify and improve UI design elements...focus on improvements	Identify and improve UI design elements	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
Returning user persona has a relatively high click rate for 'Try Beusable' and 'Try it Free'. Visitors found that they decided to buy and use a Beusable solution after they had searched more than once without having decided on one visit.	Returning user persona click 'Try Beusable' and 'Try it Free' more...'. Visitors decided to buy and use a Beusable solution after visiting more than once	Returning user persona click 'Try Beusable' and 'Try it Free' more	Insights about UI elements
I noticed that new visitors were intensely interested in introducing the "UX Heatmap" feature. You need to know exactly why "UX Heatmap" can be supplemented, and you will have to worry about getting additional attention to other features as well.	new visitors intensely interested in "UX Heatmap" feature.... Worry about getting additional attention to other features as well	New visitors are interested in "UX Heatmap", Beusable should get attention to other features	
If you look at the click rate of New User Persona, "sign in" is higher than "try it free" button. You need to understand this reason. "Try it free" would be more attractive on the label, but I wonder why users did not click on it.	New user persona's click rate of "sign in" is higher than "try it free" button.... "Try it free" would be more attractive... but I wonder why users did not click	Wonder why new users click "sign in" more than "try it free"	
New User Personas are frequently clicked on "Why Beusable". However, the frequency of use is reduced when visiting again. We need to find ways to improve these problems.	the frequency of using "Why Beusable" is reduced when visiting again. We need to find ways to improve	Frequency of using "Why Beusable" is reduced when visiting again	
New User Persona identified 'Beusable UX Insights' as a lot of clicks, and it was understood that the important thing among the purpose of the visit was to collect UX related information. We also found a new need for the Beusable product site.	New User Persona identified 'Beusable UX Insights' as a lot of clicks...found a new need for the Beusable product site.	New User Persona click "Beusable UX Insights" more	
Return visitors have higher engagement than new visitors, and it is found that return visitors are actively searching for using and using Beusable, and UI needs to be improved so that return visitors can easily find Beusable features.	Return visitors aggressively explore contents to use. UI needs to be improved so return visitors can easily find Beusable	UI need to be improved for returning visitors to know in depth	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
In the case of the returning user persona, the scroll reaching rate rapidly decreases based on the average fold line. You need to provide a way to scroll to the bottom of the web page. Or more aggressive information at the top.	the scroll reaching rate of returning users rapidly decreases based on the average fold line...provide a way to scroll to the bottom or aggressive information at the top.	Provide a way to scroll to the bottom or aggressive information at the top.	Insights about UI elements
By looking at the click status of the New User Persona, we can see that users are generally looking at the functionality of Beusable. However, I realized that the need to introduce content in a direction to promote the desire to purchase	we can see that users are generally looking at the functionality of Beusable... promote the desire to purchase	Users are generally looking at the functionality of Beusable	
Returning user persona also showed a tendency to look at main function pages with purposefulness. In the future, we were able to improve understanding of the Beusable function introduction page.	Returning user persona showed a tendency to look at main function pages with purpose...to improve understanding of the Beusable function introduction page.	Returning user persona look at main function pages with purpose	
Returning User Persona is expected to require pricing information, but it is not. There may be no user needs, but there may be a problem with the description or the layout. Various follow-up judgments and discussions are possible.	Unexpectedly, returning user persona does not require pricing information... a problem with the description or the layout.	Problems with the description or the layout about pricing information	
I was able to identify buttons and images that users often click but do not have feedback. Feedback can be added to prevent the user from recognizing an error.	Buttons and images that users often click but do not have feedback... Feedback can be add	Lack of Feedback of buttons and images	
The contents and navigation in the menu can be improved by analyzing the menu click rates of the users.	The contents and navigation in the menu can be improved by analyzing the menu clicks	Click analysis can be used to improve the menu	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
Through analysis of users' behavior patterns, we were able to detect unusual behaviors. This allows you to find pain points that you did not know.	We were able to detect unusual behaviors. This allows you to find pain points	Able to detect unusual behaviors	Overall Data Trends and Check Points
You can see if your content is being delivered to your users effectively.	You can see if your content is being delivered	See if your content is being delivered	
By knowing the user's major departure points, you can learn more about your hidden needs and pain points.	the user's major departure points... learn more about your hidden needs and pain points.	The user's major departure points tell hidden needs and pain points.	
The rate of moving to pricing, the goal of planning, was very low. You can focus on this and figure out why.	Rate of moving to pricing... was very low. You can focus on this and figure out why.	Rate of moving to pricing was very low. You can focus this.	
The most interesting content and features for each type of persona can be clearly identified and easily compared.	Interesting content and features for each type of persona... clearly identified... easily compared.	Interesting content and features of persona clearly identified and compared.	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
You can analyze the differences in usage between new and returning visitors, and you can find solutions for different needs.	Analyze the differences in usage between new and returning visitors...find solutions for different needs.	Find solutions for different needs of new and returning persona	Overall Data Trends and Check Points
It can be used as a basis for improvement work by analyzing contents with poor performance and low performance.	Used as a basis for improvement work by analyzing contents with poor performance	Basis for content improvement by analyzing poor performance	
Returning visitors are returning without purchasing services. By closely analyzing the behaviors of return visitors, we reinforce the content and benefits that can lead to actual service purchases.	Analyzing the behaviors of return visitors, we reinforce the content and benefits that can lead to actual service purchases	Analyzing the behaviors of return visitors can lead to actual service purchases	
By knowing the users' specific site navigation path, it can be used as the base data for the UX designer to understand the use as intended.	Users' specific site navigation path...base data for the UX designer to understand the use as intended.	Users' navigation path help to understand usage	
The difference in residence time between persona could be grasped accurately. New users will have to stay for 4-5 minutes so Beusable will have to provide new users with content that can be consumed faster.	Grasped the difference in residence time between persona ...New users stay 4-5 minutes...provide content that can be consumed faster	New users stay 4-5 minute, so provide more readable content	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
It would be nice if you revise the content based on the user's visit history at the time of the next visit.	Nice if you revise the content based on the user's visit history at the time of the next visit	Revise the content based on the user's visit history at next visit	Insights about Adaptive UI
For returning visitors, a more detailed introduction and downloading of related materials are accessible. This enables more detailed content identification and inducement of service purchase.	For returning visitors...more detailed introduction and downloading of related materials are accessible...enables more detailed content identification	For returning visitors, more detailed contents are accessible	
The average residence time of new visitors is relatively short compared to returning visitors. You can plan your UI strategy to attract new visitors and increase your stay time.	Residence time of new visitors is relatively short... plan your UI strategy to attract new visitors	Plan your UI strategy to attract new visitors stay longer	
You can review UI optimizations and changes that encourage repeat visitors to continue to consume new information.	Review UI optimizations and changes that encourage repeat visitors to continue to consume new information	Review UI optimizations and changes that encourage repeat visitors	
The hypothesis that variable content delivered to returning users should be placed at the top was based on the persona.	Hypothesis that variable content delivered to returning users should be placed at the top	Variable content delivered to returning users placed at the top	
You can scrutinize the difference between returning visitors and new visitors, and you can suggest different types of UI	Scrutinize the difference between returning visitors and new visitors...suggest different UI	Suggest different types of UI based on difference of usage	
You can identify the different needs of returning visitors and new visitors, and define each of the key enhancements. It is also possible to define short-term and long-term improvement goals.	Identify the different needs of returning visitors and new visitors... possible to define short-term and long-term improvement goals	Identify the different needs and define improvement goals	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
Compared to Traditional Persona, it helps to understand specific usage situation. (Pattern, Needs, Key Insights, Frustrations, Insights, etc.)	It helps to understand specific usage situation. (Pattern, Needs, Key Insights, Frustrations, Insights, etc.)	Understand specific usage situation and patterns.	Comparison with Formal Persona
Traditional Persona is helpful to grasp the overall needs. Data-driven persona are a great help in understanding more specific needs and behaviors.	Data-driven persona are a great help in understanding more specific needs and behaviors.	Understanding more specific needs and behaviors	
Traditional persona can be difficult to coordinate with researchers' subject matter. However, data-driven persona is more reliable because it has a solid basis in communication with other departments.	Traditional persona can be difficult to coordinate...data-driven persona is more reliable because it has a solid basis in communication	Data-driven persona is a solid basis in communication	
Data-driven persona is more objective, as it is based on actual behavior data compared to traditional persona.	Data-driven persona is more objective...based on actual behavior data	Data-driven persona is more objective	
There are specific behaviors and characteristics that can only be found in data-driven persona.	Specific behaviors and characteristics that can only be found in data-driven persona	Data-driven persona has specific behaviors and characteristics	
The production period is very short compared to the traditional persona. It can be updated periodically.	Production period is very short... It can be updated periodically.	Production period is very short and can be updated periodically	
It is easier to explain and communicate persona than to a traditional persona because there are numerical data.	Easier to explain and communicate persona because there are numerical data	Numerical data in persona help better communication	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
If you are conducting a meeting between different departments, you can reduce conflicts and use it as a basis for communication.	Conducting a meeting between different departments...reduce conflicts and use it...communication.	Basis for communication	Traditional Benefits of Persona
The persona that can grasp the usage pattern will be able to anticipate the success of the newly introduced service or content and prepare for the result.	Grasp...usage pattern will be able to anticipate the success of the newly introduced service or content	Usage pattern will be able to anticipate the success of new service and content	
If you have to persuade other departments, you can use it as an objective indicator for persuasion.	Have to persuade other departments...use it as an objective indicator for persuasion	Use it as an objective indicator for persuasion	
Since users' needs can be understood in detail, it will be possible to prevent unnecessary development of functions and UI development efforts in advance.	Users' needs can be understood in detail...to prevent unnecessary development of functions and UI development efforts	Users' needs can be understood in detail	
You will be able to determine how often to update your topic when writing new columns using data-driven persona.	Determine how often to update your topic when writing new columns using data-driven persona	Determine how often to update new columns	
Persona can be a clear source of significant influence in UX design decisions.	Persona...source of significant influence in UX design decisions.	Persona is an important rationale for UX design decisions.	
Based on the behavior pattern of persona, it can be used as a basis for prioritization in the improvement work. Because it has priority, it will also be useful in coordinating project schedule.	Persona...can be used as a basis for prioritization in the improvement...useful in coordinating project schedule.	Persona can be used for prioritization in the improvement and coordinating schedule	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
An additional method is needed to increase the inflow rate of return visitors. (URL favorites, social marketing, etc..)	additional method...increase the inflow rate of return visitors.	Finding to increase the inflow rate of return visitors	Insights related to marketing
Planners can pinpoint the user's funnel. For example, I was able to understand the performance of facebook marketing.	pinpoint the user's funnel...understand the performance of facebook marketing	Pinpoint the user's funnel	
Referrer information is a good way to get a glimpse of your organization's marketing and Search Engine Optimization performance. It would be good for UX designers to understand their work performance or influence.	Referrer information is a good way to...marketing and Search Engine Optimization performance. It would be good for UX designers	Referrer information is a good for marketing and Search Engine Optimization	
Most of the users concentrated on the top part of the website. Using this data, various marketing planning and execution can be done.	Most of the users concentrated on the top part ... various marketing planning and execution	Users concentrated on the top part, so various marketing activity can be done	
You can see that the current visitors have a large influx through social services. If the acquisition of new customers is a KPI (Key Performance Index), you can try to invest and concentrate on social marketing.	Current visitors have a large influx through social services...you can try to invest and concentrate on social marketing.	Current visitors have a large influx through social services	
Since the routes for new and returning visitors are different, they can be used for marketing purposes.	Routes for new and returning visitors are different, they can be used for marketing	Routes for new and returning visitors are different	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
At the bottom of the page, users click on only the top three of the nine core feature description content. In fact, I would like to try A / B test to see if users are interested in only the top three or if they have seen the effect from location.	Users click on only the top three of the nine core feature description content...try A / B test to see	Try A / B test to check click patterns	Needs for new user research projects
You can make good use of the A / B test when you make improvements based on persona. Persona can also be improved continuously after the A / B test.	good use of the A / B test when you make improvements based on persona...can also be improved continuously after the A / B test	A/B test based on persona	
While returning visitors have a long session time, content consumption is scarce to the bottom of the page. Additional research on the diverse use behavior of returning visitors can help to identify the information they want.	Returning visitors have a long session time, content consumption is scarce to the bottom...Additional research on the behavior of returning visitors...to identify the information	Additional UX research of returning visitors to identify the information they want	
Because it shows actual web site usability data, It can be used as auxiliary data such as usability test.	it shows actual web site usability data, ...used as auxiliary data for usability test	Auxiliary data for usability test	

Transcription	In-vivo codes	What is this about (concept)	Category (Usefulness)
Even without a basic knowledge of the website, frustrations and insights have been explained in detail so that the basic content has been well understood.	Frustrations and insights have been explained in detail...the basic content well understood.	Frustrations and insights have been explained in detail	Specific advantages learned from persona elements
This is useful for identifying improvements because there is a clear distinction between return and new visitor data.	Useful for identifying improvements because ...clear distinction between return and new visitor data.	Useful for improvements because clear distinction between return and new visitor data	
It's fun to read data about user needs and Behaviors. Data-driven persona is convincing and interesting.	Fun to read data about user needs and Behaviors....convincing and interesting	User needs and Behaviors sections are convincing and interesting	
The fact that new visitors and returning visitors have different PV and UV ratios is a great help in understanding persona. It is worth using as basis data.	Have different PV and UV ratios...help in understanding persona...basis data.	Different PV and UV ratios is a great help in understanding persona	
The use patterns of new users and returning users can be visually compared at a glance, and the characteristics and differences of user types can be analyzed quickly.	Use patterns...visually compared...and the characteristics and differences of user types can be analyzed	The characteristics and differences of persona can be analyzed quickly	
Because it is based on big data (Total: 5723 PV, 1668 UV) There is confidence in persona because of the certainty.	Based on big data (Total: 5723 PV, 1668 UV), there is confidence in persona.	Big data gives confidence to the UX designer.	
The user's monitor resolution, browser, OS, etc. written in the persona background can be used as information for reviewing the development specification.	user's monitor resolution, browser, OS, etc. ...can be used as information for reviewing the development specification	Persona background is useful for reviewing the development specification	

Transcription	In-vivo codes	What is this about (concept)	Category (Improvements)
I would like to be able to analyze referrer data by time. This allows you to think about timing marketing.	analyze referrer data by time...to think about timing marketing	Analyze referrer data by time	Data Analysis / Visualization
You might also want to look at the user's content navigation order information and figure out what features the user sees before failing. If the persona can easily distinguish the user's actual behavior, the stakeholder of the enterprise will be able to show deeper interest.	look at the user's content navigation order information and figure out what features the user sees before failing...distinguish the user's actual behavior	Distinguish the user's actual behavior	
I would like you to write the average fold value in pixel data.	write the average fold value in pixel data	Average fold value in pixel data	
If we can analyze the data of users who have consumed specific contents with a focus on CTA, we will be able to broaden the scope of analysis of current persona.	analyze the data of users who have consumed specific contents with a focus on CTA...broaden the scope of analysis	Analyze the data of users focused on CTA	
Movement data analysis is also good. I would like a cross analysis of Click, movement, scroll, attention. The click PV rate is better than the click rate for the comparison of new and returning users.	Movement data analysis is also good...cross analysis of Click, movement, scroll, attention.	Cross analysis of Click, movement, scroll, attention	
If you click on the company logo at the top, there is no case study link. In this case, I'd like you to write how much invalid clicks occurred	click on the company logo at the top, there is no case study link...write how much invalid clicks occurred	Write how much invalid clicks occurred	

Transcription	In-vivo codes	What is this about (concept)	Category (Improvements)
I would like to explain the definition of the average session time. You need to explain what average method you used. It is necessary to explain whether extreme values are excluded, whether median or arithmetic mean is used.	explain the definition of the average session time.... explain whether extreme values are excluded, whether median or arithmetic mean is used	Explain the definition of the average session time	Usability / Readability
I would like to separate the data that show the positive experience of persona and the data that shows negative experience separately. I would like to organize positive and negative experiences in the form of a journey map.	separate the data that show the positive experience of persona and the data that shows negative experience separately...in the form of a journey map	Separate the data that show the positive and negative experience of persona	
I would like persona comparison to be a little easier. If you know the trends related to visit time, you might be able to get a better understanding of the direction of improvement and marketing	persona comparison to be a little easier...trends related to visit time...able to get a better understanding of the direction	Persona comparison to be easier to improve	
I would like to be able to compare all data at a glance, rather than showing the data for each persona.	able to compare all data at a glance, rather than showing...each persona	Compare all data at a glance	
If you do not have a basic knowledge of the data, it may be difficult to draw insight by looking at persona. If you are not doing data analysis, you might want to provide criteria and information so that you can understand what is high or low.	do not have a basic knowledge of the data...difficult to draw insight by looking at persona...provide criteria and information	Provide criteria and information to understand what is high or low	
I would like to be able to visually express the difference between persona expressed in % or time, and to grasp it at a glance. I would like to emphasize the similarities and differences between persona and text or image.	visually express the difference between persona expressed in % or time...emphasize the similarities and differences between persona and text or image	visually express the difference between persona	