Intuitive Navigation: The Impact of Information Architecture (IA) on User Experience and Its Cognitive Psychology Relevance

Case study: Jobs page of Glassdoor & LinkedIn

Abstract

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Title of the thesis

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Abstract

This thesis work studied the role of information architecture in bringing a good user experience on digital products such as websites or mobile applications.

To answer the research question, the thesis report focused on 4 main components of information architecture which are the organization system, labeling system, navigation system, search system, and its natural dependence between user, content, and context. All of them were indicated by Rosenfeld and Morville (1998) who also clarified that those components as hidden parts would provide significant support on which and how the information would be organized on the interface to help users have good navigation on the interface and affect the satisfaction of users. Furthermore, the thesis indicated a notable relationship between cognitive psychology and information architecture in user experience, by analyzing three popular aspects of cognitive psychology that are mental models, Gestalt principles, and cognitive load. Besides, highlighted techniques and objects contributing to an effective information architecture were shared.

Also, various research methodologies, which were content analysis, interview, usability testing, and System Usability Scale (SUS) questionnaire, were applied to the case study of Jobs page on Glassdoor and LinkedIn. Those techniques aimed to analyze the interface based on 4 main components of information architecture, evaluate users' satisfaction with navigation on the interface, and from those, reveal the quality and logic of information architecture as hidden works.

To conclude, the report shows that establishing a good foundation in IA works leads to a stable system of beneficial content and logical information organization for users on websites or mobile applications. Also, it results in efficiency during maintenance and modifications for the product in further development and improvement to consistently bring a good user experience.

Keywords

Information Architecture, Information Organization, Navigation, Digital Product, User Experience, Interface, Cognitive Psychology, Sitemap, Content Inventory, Labelling, Taxonomy, Usability Testing, Content Analysis.

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Appendix 1. Coding Scheme Table for Content Analysis

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1 Introduction

1.1 Research background & problem statement

When using a digital product like a website or a mobile application, users mostly interact on the interface and are aware directly of the obvious things like colors, shapes, animations, and functions they click and use on the product. However, what does not show up on a digital product but silently plays an important role in framing beneath is its information architecture (IA), which is usually supposed to be worked on before and continuously updated and maintained even after the product is launched.

In most cases, even the nice appearance of a website or mobile application could bring users first good impression, but the experience of users while using the product to reach their goals as serving their usage purposes is extremely important to keep them coming back to use again. The dropping rate of users who do not complete the main tasks in a product or their confusion while using has a great effect on the success or failure of that product. Due to that, IA plays an important role in helping to plan and build logical flows as navigation on a product, which is the organization of pages on websites or mobile applications. In general, an effective IA can contribute to smooth navigation for users and support the product in satisfying users by helping them use the product to serve their goals within a reasonable timeframe with effectiveness as the outcome. Without an effective IA, the flows might be incoherent and difficult to navigate, and how easily and effectively users can use the product to assist their daily lives is also the ultimate goal for the user experience (UX) on a digital product. Therefore, IA needs to be taken into account as one of the most important aspects of bringing a good UX, not just the final appearance of the product. Figure 1 shares how dissatisfaction with navigation while using a website or mobile application could lead to failure.

Figure 1. Why does it matter to build good navigation for websites or mobile applications?

Arango, an information architect with more than 20 years of experience, expressed his concerns related to the lack of understanding and application of IA in the UX field in an interview regarding the topic of the IA's role in UX design on O'Reilly Radar. The interview happened in the period he was finishing his book, the 4th Edition of Information Architecture as a co-writer with Rosenfeld and Morville. In that interview, Arango referred to IA creation in UX design as the base frame of buildings in construction via his experience of previous learning and working in architecture, and he suggested that the way we make that base frame would affect what we could continue to do or could not do with that construction in the future as for maintenance or innovation. (Arango 2015.)

1.2 Research question

The main research question of this thesis is:

Why is information architecture (IA) important to bring a good user experience (UX) on digital products such as websites or mobile applications?

Subordinate questions were defined to bring more important details to support answering the main question:

- What does it make IA has a significant impact on UX?

- Is Cognitive Psychology (CP) related to IA and UX? And how is the relation?

- What are the techniques & related objects contributing to an effective IA?

- How can a digital product be evaluated if it has an effective IA or not by only using or taking actions on its interface?

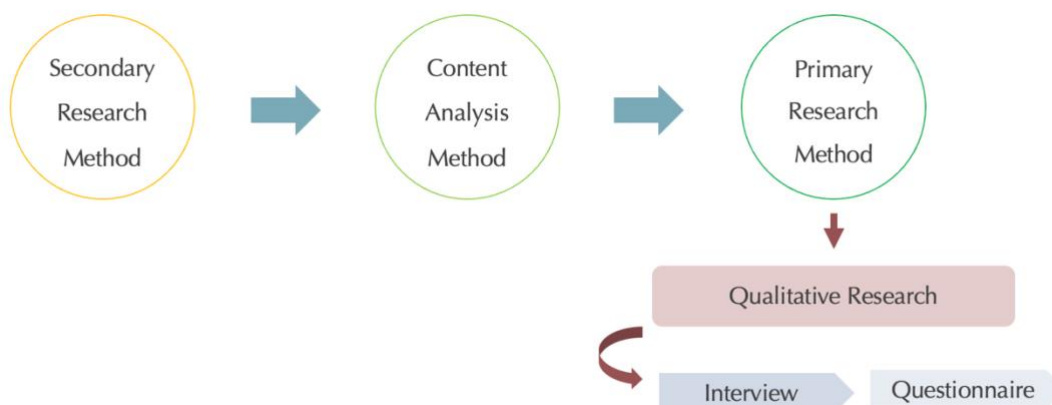## 1.3 Research methodology, data collection and limitation

Figure 2. Research methodologies and conducting order in this thesis

Secondary research

This thesis aims to provide deeper knowledge of the impact of IA in the UX field for digital products that are limited to mobile applications and websites. In other words, when a digital product term, a product term, or an application term is mentioned in this thesis, it means websites and mobile applications. One of the methods of research to be used in this thesis is secondary research which is the method of analyzing collected data finished and published by other people from previous research (Bouchrika 2023). Secondary research is used to provide persuasion in literature review & theoretical frameworks by bringing up previous analyses of experienced people with their primary research results. The reason is the work of IA on a current effective digital product that is in use at present usually could not be easily found. In practice, the works on information architecture are usually hidden works, which were built after going through a lot of planning stages and research with target users based on the specific product requirements regarding related functions and the business field. As explained by Cardello (2014), IA is not a thing that can be seen directly on the interface, instead, it plays the role of informing the user interface by being documented in diagrams and spreadsheets, and above all, it is described as the thing having significant impacts on the experience and satisfaction of target users by connecting their expected content to them.

It is worth mentioning that even if a renovated website of a company could be found, which was more effective than its previous version, it is still hard or almost impossible to find its old website to conduct testing for comparison of how and why it is better in the before and after versions regarding information architecture because the old version is mostly immediately removed when the business replaces it with a new one. Also, it needs to be emphasized that those new or old launched designs are only what is shown on the surface via the site's interface design, which could not express all about the hidden works of its information architecture. For that reason, in the empirical part of this thesis where primary research was conducted, firstly, a research method called content analysis was used.

Primary research: content analysis

As stated by Gratton & Jones (2010), primary research is defined as a method to collect original data for a specific research project. Besides, according to Columbia University, content analysis is a research method to analyze the themes, concepts, or words to determine their meaning, the relationships, and the elements that are related. Berelson (1952) also describes content analysis as a popular method to use in research for systematic, objective, and quantitative evaluation of the content of communication. Additionally, it is indicated that content analysis has been not only used in examining

traditional communication according to Al-Olayan & Karande (2000), but also widely used in analyzing web-based applications content in the field of human-computer interaction as stated by Okazaki & Rivas (2002). Neuendorf (2002) publishes his 9 steps to conduct the content analysis in his book. Treadwell (2013) describes the content analysis study process as generally having 7 parts. Columbia University lists down 8 general steps in the conceptual content analysis process and 6 in the relational content analysis process, which depends on how we choose to approach the content analysis and our research goals. However, those processes listed above have common points in general main tasks to do and objectives, which are, as following order:

1. Developing a hypothesis or research question

2. Selecting the material which is the content to analyze.

3. Identifying categories or units to focus on analyzing.

4. Developing a coding stream that could be understood as a system to evaluate them.

5. Applying the coding stream to evaluate

6. Analyzing the coded data found from the coding stream to draw insights and patterns, and coming up with implications and conclusions related directly to research objectives.

To apply the content analysis method, the content on the Jobs page from the main menu on Glassdoor and LinkedIn websites was analyzed based on the knowledge from theoretical parts of the research, focusing on navigation and how easily the users could find their needed information and complete their main task flows from those pages. Firstly, The coding stream was created and applied to evaluate points by the author as the initial evaluation before conducting usability testing to affirm again the results. Figure 3 below presents samples of coding sheets by Treadwell (2013), which were created flexibly and differently based on specific intentions and research goals toward expected data and content to evaluate. Also, the coding sheet of this research was created and evaluated by the author, and a part is visualized in Figure 29 while the full sheet can be found in Appendix 1.

Exhibit 12.3 Sample Coding Sheet for Content Analysis of Comic Strips

Substance	Frequencies of Appearance				
	User			Setting	
	Overall	Male	Female	Work	Home
Tobacco					
Visuals					
Words					
Alcohol					
Visuals					
Words					
Prescription Drugs					
Visuals					
Words					
Over-the-Counter Drugs					
Visuals					
Words					
Illegal Drugs					
Visuals					
Words					
Generic Reference to Drugs					
Visuals					
Words					

Exhibit 12.4 Sample Coding Sheet for Group Behaviors Over Time

Behavior	Frequencies of Appearance		
	Time 1	Time 2	Time 3
Task-Oriented			
Reminds group members of deadlines			
Proposes solutions to problems			
Group-Oriented			
Makes statements supporting a group idea			
Makes statements approving of group's progress			
Self-Centered			
Refuses assignments			
Makes antagonistic statements			

Figure 3. Sample coding stream organized on sheets (Treadwell 2013)

To be clear, the Jobs page mentioned here is the page appearing after clicking the Jobs title navigation on the main menus of Glassdoor and LinkedIn. User flows of main tasks and the ease of final goal-reaching was discussed because an effective IA was built to encourage users to accomplish their goals, which brings benefits for both users and the business. Garret (2000) defines IA as a structure of information space and the forming of flows to provide users smooth and convenient access to a product's content and accomplish tasks, so navigation is one of the core things that is built based on the IA creation, also its effectiveness or ineffectiveness. As mentioned, the IA works of a website usually are hidden works belonging to the organization that owns the product so analyzing related things such as how information is organized as seen on the site, navigation, and the ease in completing tasks, etc., on those job search websites would be helpful to reveal if their IA is effective or not.

Primary research: content analysis results were supported by other research methods which are usability testing, a System Usability Scale (SUS) questionnaire, and interviews.

After applying the content analysis research, a better website between Glassdoor and LinkedIn was suggested based on that analysis, however, another primary qualitative research was conducted to continue collecting more evidence to support the results from content analysis which was analyzed by the author based on theoretical parts. As Kuljis (2010) states only results from content analysis cannot provide the final convincing answers for the research, this is also one of the disadvantages of the content analysis method,

however, combining it with other research methods such as surveys, interviews, experiments, etc., could help to lessen this limitation to bring a more convincing result. Therefore, a usability test together with a follow-up questionnaire and interview was conducted with 7 participants to collect more qualitative data. Especially, System Usability Scale (SUS) questions, which were applied to evaluate how easy or difficult tasks, were done based on a rating scale from 1 to 5 which was equal to strongly disagree to strongly agree. Additionally, The interview method is one of the common types of primary qualitative research. (Bouchrika 2023.) Apparently, the qualitative data from usability tests, questionnaires, and interviews were used to strengthen the results from the prior content analysis work and to provide a clear persuasion about the important role of IA in user experience on websites and mobile applications. More details of the primary research were described in Chapter 5 as the empirical research part.

1.4 Thesis structure

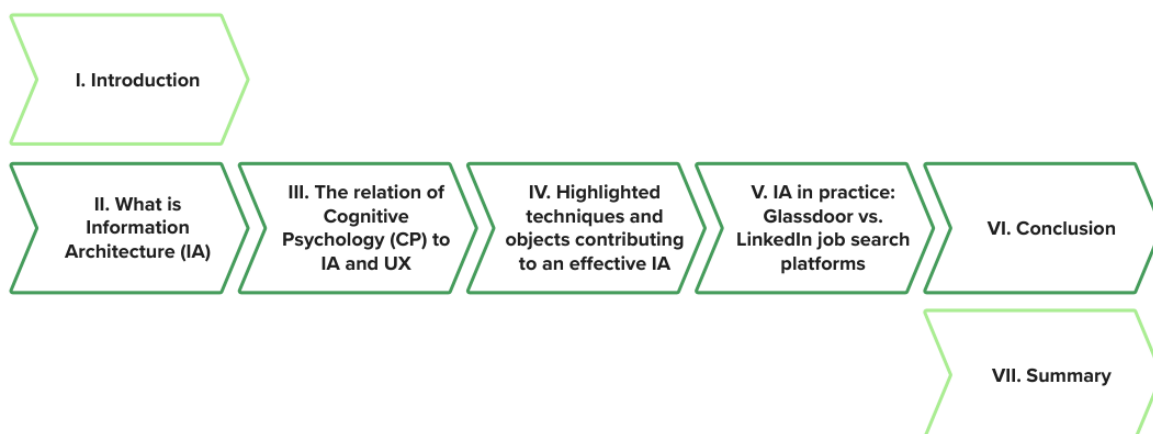This thesis contains 7 chapters visualized in Figure 4:

Figure 4. Thesis structure

Chapter 1 introduces the research background which leads to the matter of forming the problem statement for the topic of this thesis to be worked on. Along with those, the research question and sub-questions are introduced for readers. Also, the methods of research, how the data is collected, and the limitations of this thesis are mentioned. After that, the thesis structure is visualized and explained for readers to have an overview of the process.

Chapter 2 to Chapter 4 is mainly about the literature review as well as the theoretical framework, and Chapter 5 is about the process of collecting empirical data for this thesis.

Chapter 2 starts with the definition of information architecture (IA) and the history of the term to provide readers with an overview picture of the main object of this thesis. In addition,

4 main components of IA were mentioned to see how they are involved in a digital product. Then, the role of IA in bringing a good UX is revealed as its benefit in organizing a huge amount of information in the digital world.

Chapter 3 focuses on the relevance of IA and UX design with Cognitive Psychology which has a great impact on building a good user experience.

Chapter 4 presents some highlighted techniques and objects in IA creation, which aims to provide readers with an overview of how those objects and techniques are involved in IA works and can contribute to the quality of an IA.

Chapter 5 brings readers to the case study on Jobs page of Glassdoor and LinkedIn, which is also the empirical part of the thesis. This chapter presents how the research methods mentioned are conducted and how data is collected to bring a persuasive outcome for this thesis. Accordingly, the results are analyzed in detail based on theories explained in the previous chapters.

Chapter 6 is the conclusion part of the thesis, which concludes the persuasive answers to the research question with a strong affirmation of the reliability of the thesis. Additionally, suggestions for future research are mentioned.

Chapter 7 is the summary part of the thesis, which recaps shortly all chapters of the thesis.

2   What is Information Architecture (IA)

2.1   Definition and history of IA

Definition of IA

Cambridge Dictionary defines information architecture (IA) as the process in which websites are designed and organized for users to easily look for what they need (Cambridge University Press). Dillon (2002, 821) defines IA as the activities involved in creating, implementing, and assessing information environments to ensure they align with the preferences and societal norms of their targeted stakeholders. Additionally, IA plays an important role when it assists users not only in knowing where they are on the website but also what they can expect to see if they continue to use and navigate (Morville 2012). Strickland (2016) also agreed that IA is related to structuring the content and functionality of a digital product to help users understand what the product they are using has and create intuitive navigation to support them. Also, he indicates based on that users can use the application more effectively by smoothly looking for information. To be more specific, it is how we organize or structure the sites of a website while logically linking them together, and it is also about the display of information on each page of the product such as where we decide to put the product catalog and how users can navigate to it (Fitzgerald 2022). Figure 5 shows a library website's IA diagram visualizing information flows with content structure grouped as levels for purposes of usage (Greig 2008).
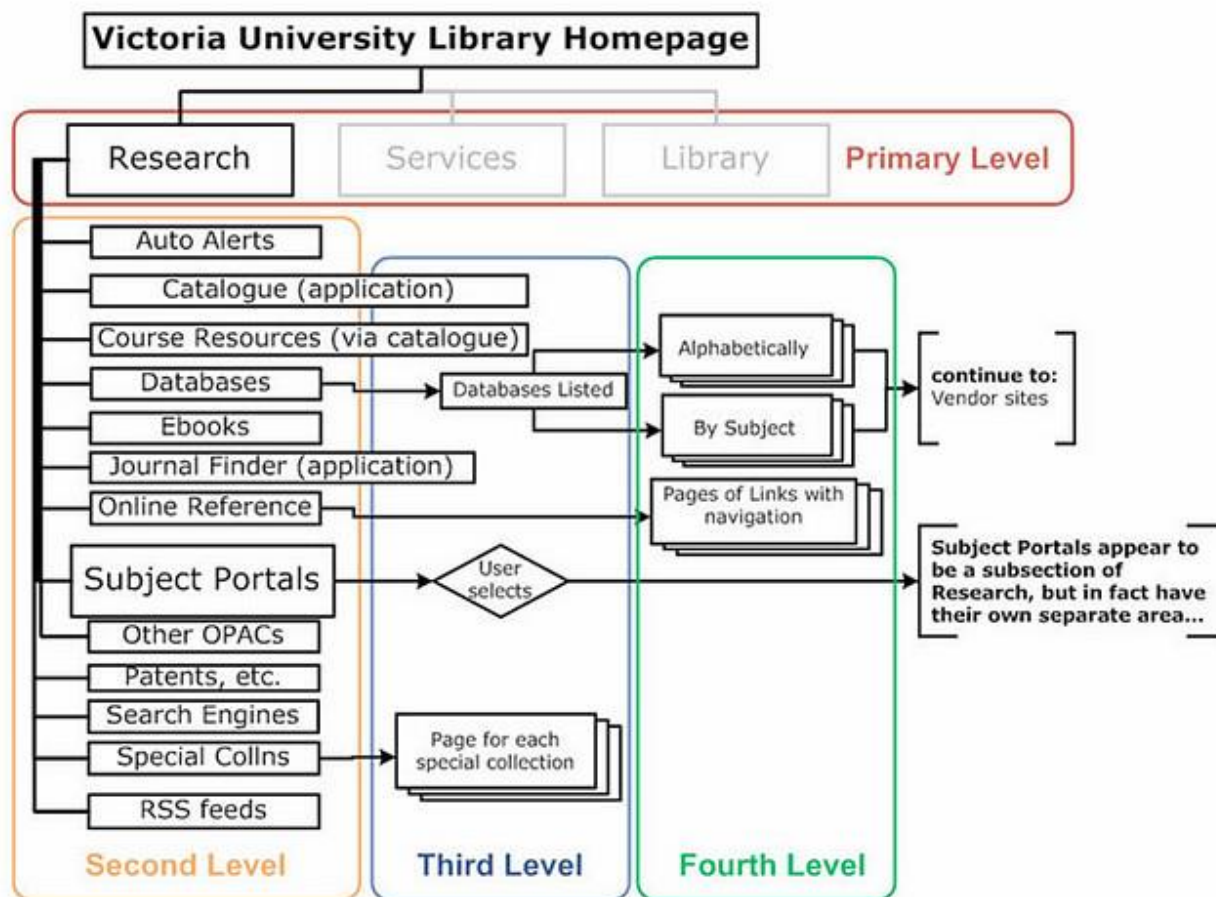
Information Architecture: Research Section, showing content levels.

Figure 5. A library website's IA diagram shows information flows with content levels are grouped for noticing (Greig 2008)

History of IA

Rascão claims that the architecture concept, which is used popularly in information and communication (ICT) context, is also related to other various terms such as information architecture, network architecture, strategic architecture, architecture business, architecture governance, etc., His research also indicates and analyses the process of the term information architecture started to be accepted and used in the ICT context. (Rascão 2015, 62.) Furthermore, the practice of IA includes the theory, methods, and knowledge of various fields but is not limited to Human-Computer Interaction and Design, Computer Science, Information Sciences, and Knowledge Management (Resmini & Rosati 2011, 28). Regarding the usage of the architecture term in the digital world, Dillon (2012, 821) mentions that Wurman started to use the term architecture of information in 1976. Also, it is necessary to mention that, according to Wurman (1997), the art and science of organized space instructions originally came from design and architecture.

In 1970, there was a group of information science specialists at Xerox Palo Alto Research Center (PARC) started to work on technology that was for the development of the architecture of information (Pake 1985). Following their results, Resmini & Rosati (2011) emphasize that this group of specialists has made many important contributions, some of that is in the field of Human-Computer Interaction encompassing user-friendly interface in the initial personal computer. In the following period, most of the articles, which were written in the middle of the 1980s, mentioned information architecture (IA) as a design tool, also a tool for the creation of layers of data and infrastructures of computers, and a big proportion of those writing was emphasized as an association to aspects of businesses and organizations (Morrogh 2023). Furthermore, it is stated by Brancheau & Wetherbe (1986) that the period of the 1980s witnessed many outcomes referring to the IA, that we have today, such as basic guidelines of business processes, blueprints, information categories, and needs of global corporations. Following that, Resmini & Rosati (2011) also mention that the late 1990s observed the wave led by Rosenfeld and Morville, of incorporation of those outcomes into a toolkit for IA, especially when their book, Information Architecture for the World Wide Web, was published firstly in 1998 as the first edition. To visualize the milestones of IA development, Figure 6 shows the information architecture chronology from the 1970s to the early 1990s in Spanish by Ronda León (2008), and Figure 7 is the adapted version in English by Resmini & Rosati (2011).
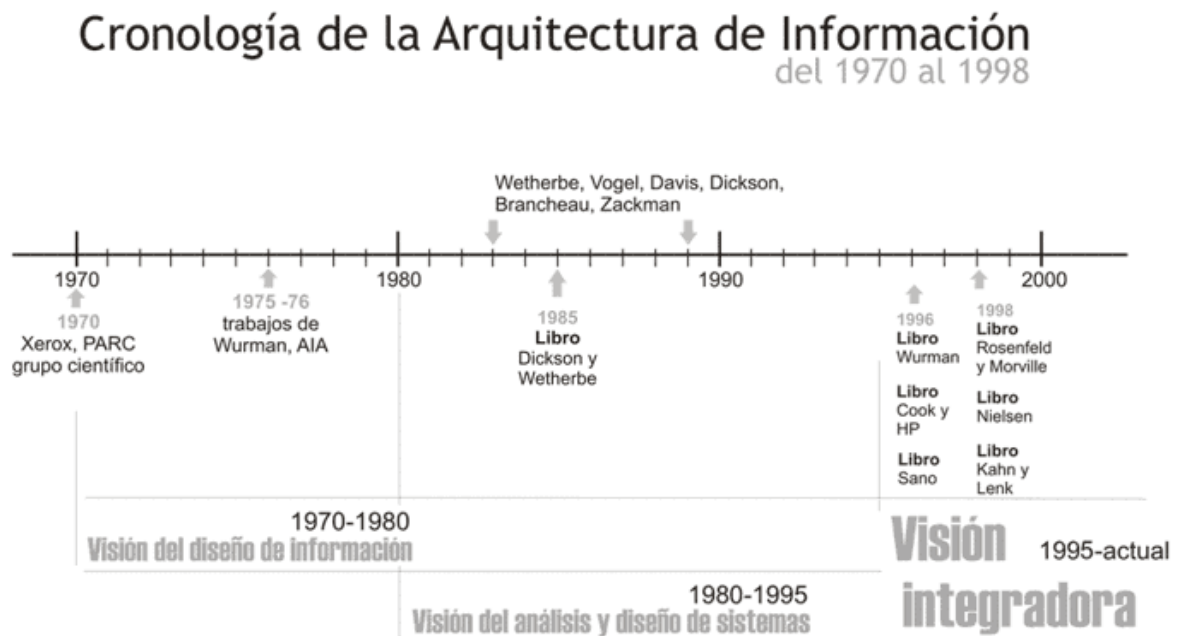

Figure 6. Information architecture chronology from the 1970s to early 1990s in Spanish (Ronda León 2008)
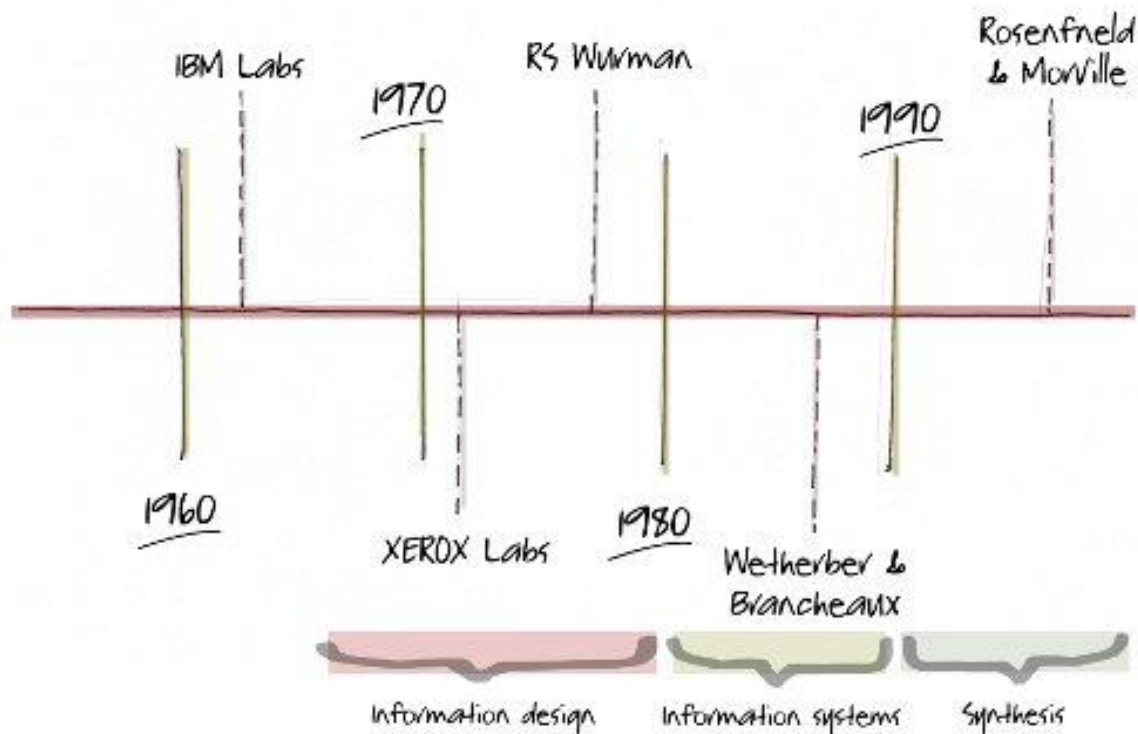
Figure 7. A simplified version in English of information architecture chronology from the 1970s to early 1990s (Resmini & Rosati 2011, according to Ronda León 2008)

In 2010, a report about IA, which was published on Forrester Research, indicates the primary role of IA in the IT sector is to create correct and consistent access to data. The research mentions the separation focus into two different roles of IA that can be beneficial to businesses, one is about information assets structuring for enterprise called enterprise IA while the other is related to information, which is designed for websites, portals, or applications into user interface, referred to web IA or user experience IA. (Leganza 2010.) Also, it was discussed that the mentioned enterprise-layered view approach to IA, at the same time, helps to shift design thinking to focus on user-centered problems including data connections, costs, limits in storage, operation, and maintenance issues such as bandwidth and server topology. For the record, Rosenfeld and Morville were commented on as having a huge contribution to both practical and empirical knowledge while bringing usability engineering and user research to the heart of mainstream tools of IA. (Resmini & Rosati 2011.)

2.2 Main components of IA

Rosenfeld and Morville (1998) clarified in their book, Information Architecture: For the Web and Beyond, that an information architecture (IA) consists of 4 main components which are

an organization system including schemes and structures, labeling system, navigation system, and search system. Furthermore, they also share the nature of interdependence of 3 main factors including user, content, and context, which are supposed to have core relationships in building an IA. That nature of interdependence, by Wang (2017) according to Rosenfeld & Morville (1998) is shown in Figure 8, and Image 1 shows 4 main components of IA, visualized by Khandekar (2020).

Components of information architecture

Organisation system   Labelling system   Navigation system   Searching system
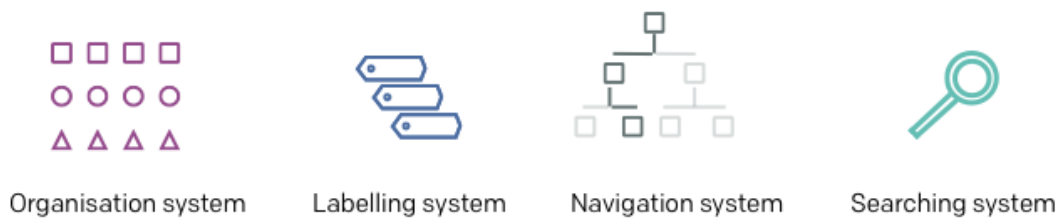
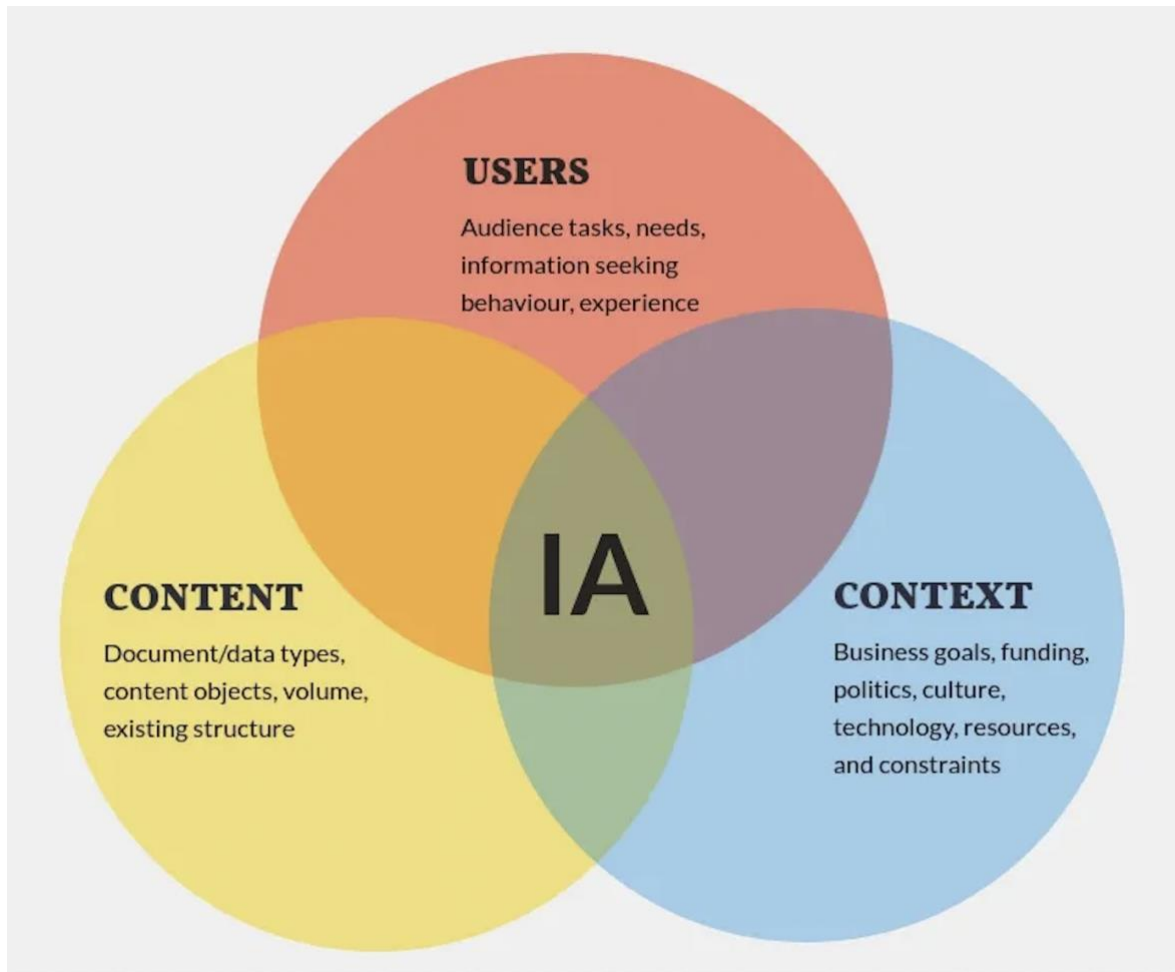Image 1. Main components of IA (Khandekar 2020)

Figure 8. The nature of interdependence between three factors: users, content, and context (Wang 2017, according to Rosenfeld & Morville 1998)

Organization system: schemes and structures

Organization schemes

Organization schemes are ways to organize information into categories according to, for example, alphabetical streams, chronological schemes, or geographical schemes. Another way is organizing into subjective organization schemes such as division into different topics, tasks, or types of audience, etc., as examples, this way is considered more effective by applying mental models of users and assigning content into meaningful groups. (U.S. General Services Administration.) Image 2 is an example of organizing information as different topics as an organizational scheme for the main menu on the homepage.

Image 2. Homepage with the main menu for navigation categorized into topics (The New York Times 2023)

Organization structures

Organization structure is how we organize information based on their relationships in content. As a result, if this structure performs well, it will help users predict the location of their needed information on the site. Three popular main structures are hierarchical, sequential, and matrix structures (U.S. General Services Administration, according to Rosenfeld & Morville). Figure 9 below illustrates examples of these three different structures with matrix structure mentioned as a web-linked structure.
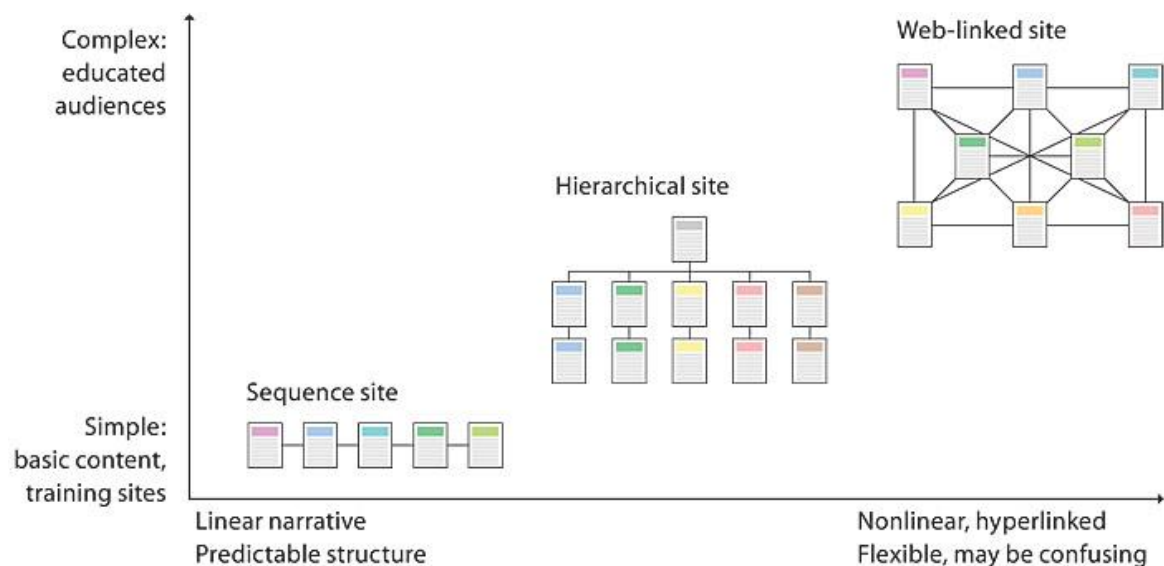

Figure 9. Three main popular organization structures on the scale of complexity and narrative regarding content information (Lynch & Horton)

Labeling system

As demonstrated by Rosenfeld and Morville (1998), there are two formats of labels for a navigation system, which are textual and iconic formats, and they are usually discovered as links that lead to pages, or headings of pages that help for the identity of information on the page. Additionally, Rosenfeld and Morville share that one label can do both duties which are appearing as both a leading link and heading of that page. More examples of labeling are shown in Chapter 4 where there is a more detailed discussion regarding the hierarchy of IA.

Navigation system and search system

In addition, two other main components are navigation system and search system. Navigaion system refers to browsing and moving through information on the site, and search system is about looking for needed information (U.S. General Services Administration). An example is when users surf on Amazon.com to browse their favorite books, they can simply click into available categories they Amazon labeled direct names such as Best Books of the Month or Children's Book or use filters to narrow down to their focuses like Author's name or Book Series as Harry Potter, which will help them to choose suitable books easier and quicker. Image 3 shows the search feature of Amazon books, and Image 4 shows search results that are filtered.

Image 3. Search page of Amazon books (Amazon 2023)

Image 4. Search results of Amazon books with filter choice as Harry Potter book series (Amazon 2023)

2.3 Role of IA in creating a good user experience (UX)

2.3.1 Effective IA for a good information structure

Findability

IA is one of the core elements in UX design to arrange information and structure all the pages of a website or mobile application. Specifically, it is the initial thing to be used as a base for forming a website or application's user experience by arranging complex information sets and structuring useful content to serve target users. Reasonably, a good organization of IA will help users to go through pages with facilitated interactions and effortless needed information navigation. That effortless usage is expressed through how users can save time while using the product and how they can easily complete their goals. A digital product has a good IA when it meets some key aspects such as the needed information of customers or users, the logical and suitable content, and the goals & budget of the business. Additionally, it is emphasized that design for user experience is just a non-value decoration if there is a lack of content structure with IA. (Stefanuk 2020.)
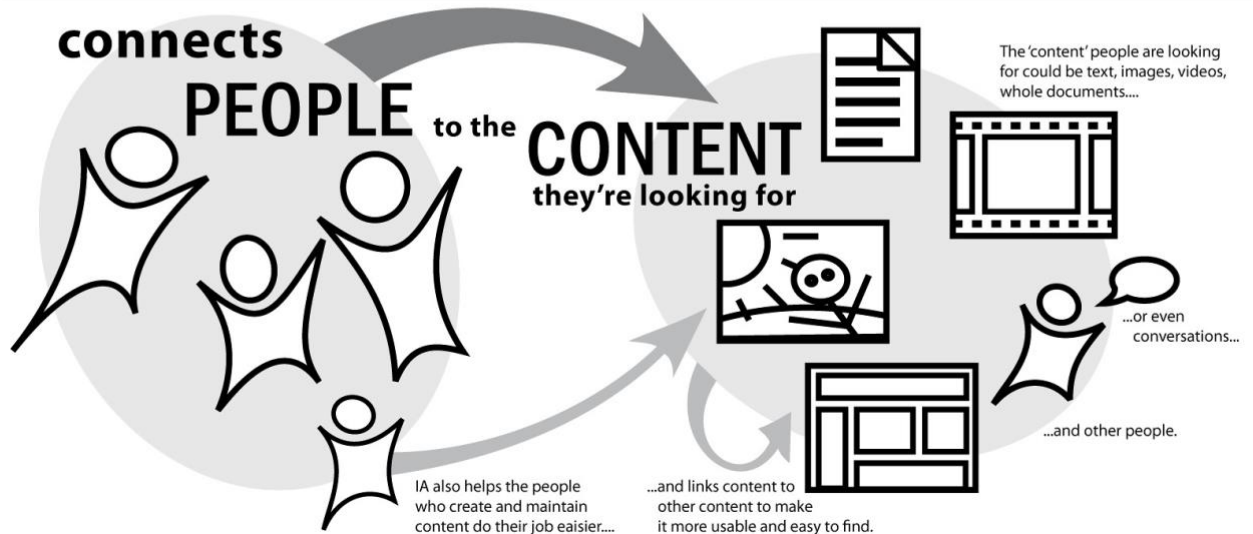
Image 5. The illustration explains how IA helps to connect users to content (Thompson 2010)

As explained by Thompson (2010) via the illustration shown in Image 5, IA plays a key role in connecting users with the content, helping users easily find their needed information which could be images, text, videos, documents, or even conversations and other people in the digital world. Also, Thompson clarified the benefit of IA in assisting in creating, maintaining content, and linking related content together, which results in more convenient usage and finding for users.

The Elements of User Experience

Jesse James Garrett
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30 March 2000

A basic duality: The Web was originally conceived as a hypertextual information space; but the development of increasingly sophisticated front- and back-end technologies has fostered its use as a remote software interface. This dual nature has led to much confusion, as user experience practitioners have attempted to adapt their terminology to cases beyond the scope of its original application. The goal of this document is to define some of these terms within their appropriate contexts, and to clarify the underlying relationships among these various elements.
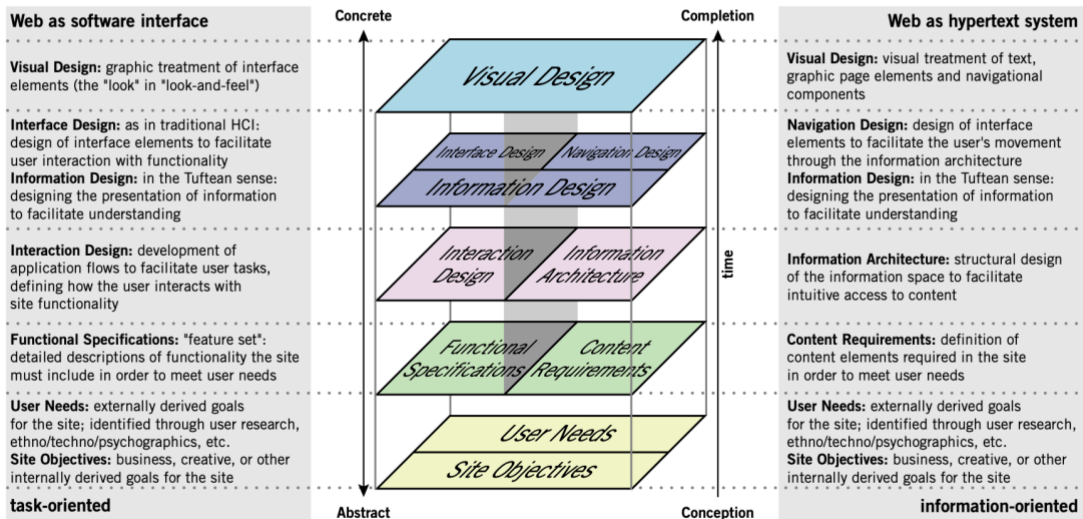
This picture is incomplete: The model outlined here does not account for secondary considerations (such as those arising during technical or content development) that may influence decisions during user experience development. Also, this model does not describe a development process, nor does it define roles within a user experience development team. Rather, it seeks to define the key considerations that go into the development of user experience on the Web today.

© 2000 Jesse James Garrett

http://www.jjg.net/ia/

Image 6. Visualized layers show the relation of IA in UX (Garrett 2000)

Garrett (2000) visualizes the layers of web development in which he suggests IA as one of the key layers in Image 6, which lies in the middle between elements, after figuring out user needs, objectives of the website, needed functions, and required content, and before reaching to visual design. Also, IA is shown as a layer to prepare for the design of the navigation and interface of the website. Due to that, the analyzed layers from Garrett contribute to necessary considerations including IA during the development of digital products like websites and mobile applications by dividing two main sections within the web development process which are the website as a software interface focusing on task-oriented, and the website as a hypertext system focusing on information-oriented.

Support in data aspects

With a bigger picture, Sam (2021) specifies that IA is a part of the architecture in the software industry, which is necessary to turn up the right data architecture later so he emphasized that IA needs to be fully completed first for the whole team to run following development process to result in a more quality work. Accordingly, by emphasizing the involvement of IA in creating the visual presentation by preparing in advance the expected achievement for the product such as related information, stakeholders, target users, the

expected location of information within the product, and how the information needs to be facilitated and manipulated, Sam clarify the important role of IA for abstracting the right data we need from the product to help the further product development process or to help the future innovation and growth of the whole business by analyzing the receivable data. Correspondingly, Rina (2023) points out that IA is a significant practice for building an effective data presentation in a UX design, encouraging more effective findability through concise navigation patterns that are well connected by logical data organization and decomposed complicated information into controllable units. Accordingly, it is shared by Myre (2022) that the knowledge or ability to manipulate data such as creating, accessing, storing, and presenting is one of the helpful skills to contribute to designing an IA.

Business values

Regarding more details into business values that would result from IA regarding UX, according to Coursera (2023), IA both benefits users and businesses because it is the blueprint to help the product be accessible to users, supports users in perceiving and understanding, and from that the business can build trust and name as well as increase the loyalty in users. In UX design, to enhance user satisfaction, users need to be aware of where they are, what the product can assist them with, how they can surf around for needed information, and how they can reach the goals of their usage purposes. Furthermore, a good structure of IA allows users like end customers, staff, and future investors to relate the quality of the business and potentiality of that organization. In other words, IA could help to reflect how good the business is and build brand strength via the website or mobile application to the market. (ITMAGINATION.) For a more specific reason, Hannah (2023) indicates that the goal of user experience (UX) is to improve the convenience in users' lives, for example, by helping them less suffer from the overload of information and the decreasing in attention spans nowadays, so focusing on building a good IA will help the company to have the increase in conversion for profits by the effectiveness in guiding users complete their tasks such as purchasing products or subscribing newsletter, quickly and seamlessly, via the effective UX outcome.

2.3.2 Challenges of digital information-rich and how IA supports solving

Optimal management for a huge amount of information

As claimed by Barker, the high speed of development in technology accompanied by many innovations in functionality is the reason why IA becomes even more important because he believes that users do not naturally know what they should do when interacting with a website or a mobile app without any impact, and the effortless navigation for users also

does not automatically happen. Baker also mentioned that a large number of online consumers quit the buying process not because they did not like the product but because the navigation of the site frustrated them and they could not see their needed products, and this problem came from the information architecture organization. Due to that, similar problems related to information architecture might potentially make the information system of a site get worse when there is more and more information added throughout the sites such as new products or new research articles, which then will not only disappoint users and drive them away from using that product or service but also create huge consequences for organizations in their operation costs or profits for the business. (Barker 2015.) Regarding the consequences, the possible expanded discussion will depend on the purpose of a specific digital product or business.

It is also stated that due to the significant growth of the internet, UX designers face a lot of problems along with opportunities. Accordingly, the high-speed development of the network environment leads to the continuous pushes of huge amounts of information, causing overwhelming. Moreover, given the ability to browse, search, and read the information on different types and sizes of devices for different purposes, the information presentation, therefore, brings many new complex challenges to design. To be more specific, it is indicated that the information on digital interfaces needs to have a logical connection between their content, the medium of their display, and an understanding of the intentions and purposes of readers. Therefore, many necessary techniques and implements need to be applied to encourage the effectiveness of digital information presentation, and the digital interface is suggested as growing to be the main way people will collect information, which makes designing for the digital world one of the key aspects to creating easy ways to access and understand information for users. (Weitzman 1994.)

Support both design and development process

Regarding the necessary considerations in web development that Garrett (2000) visualized via the layers in Image 6 in Chapter 2, he also refers to web development as two main aspects which are task-focused and information-focuses, that he indicates the necessity of organizing information before moving to visual design to enhance user experience. Additionally, Fitzgerald (2022) mentioned IA as one of the key factors in creating a satisfied user experience by solving problems in arranging information. Consequently, if the design of a website or mobile application lacks that factor, no matter how great it looks, the poor underlying organization of information will turn the experience of users into negativity and affect the completion rate of their tasks on the product. However, she also prompts that it is important to emphasize that UX is an including of many factors and action steps besides IA

design, that also play necessary roles in affecting product effectiveness. Nevertheless, the base but significantly core role of IA should never be denied in the process. Image 7 is a visualization of UX disciplines, which shows IA as one of the key factors in UX and its interrelation with other factors (Hess 2009)
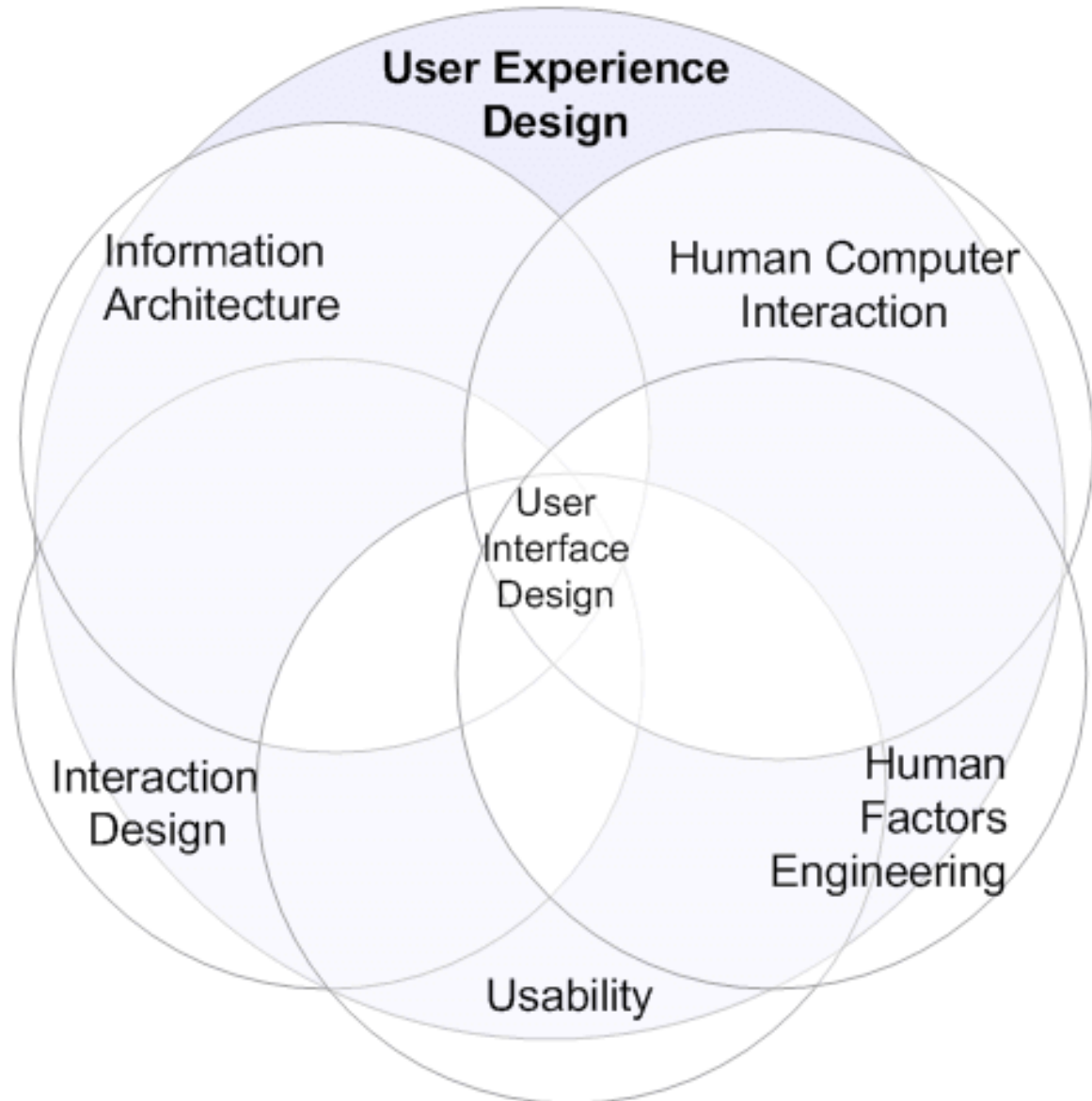
Image 7. A visualization of UX disciplines (Hess 2009)

As for technical values, Palmer (2019) suggests that, in a UX design process, beginning with a great effort in building a detailed IA will later help to avoid many problems in design and also help to minimize the number of circles of iterations that the team could need to spend time for. Additionally, Chowdhury (2023) shares that the significant assistance of IA will be recognized obviously during the implementation of developers when building along the clear visualized flows of the digital product by having IA's support, and it also benefits

UX designers when they put their hands into creating prototypes by following IA to create necessary pages and transitions for interaction.

3 The relation of Cognitive Psychology (CP) to IA and UX

3.1 Cognitive Psychology (CP)

Zivony (2019) mentions that the goal of CP research is to contribute to theories to better understand the mind. Also, he indicates that CP brings up not only knowledge of theories but also methods, which becomes the basis for developing further cognitive research for applicative activities. To extend, he shares some examples that regarding CP, attention theories can contribute to research about the effectiveness of road signage and the interfaces of human-machine as well. According to the American Psychological Association (APA) (2022), the study of CP involves learning the way the human brain works such as our ways of thinking, remembering, and learning, and together with psychological science, CP is applied to understand the way of perceiving events and making decisions. To be specific, by learning how people interact with information including perceiving, acquiring, processing, and storing, CP encourages understanding particular stimulus, to which a brain reacts (APA 2022). In addition, Cherry (2022) argues that all the things running inside the human brain such as memory, language, learning, problem-solving, and attention are all related to CP as the internal processing of mentality. Mcleod (2023) states that the approach of CP supposes that we can study the behavior of internal mentality by applying controlled experiments in the laboratory, and by that, cognitive psychologists can measure behaviors to accomplish information regarding cognitive processes.

Schemas, which is a framework of mentality about expectations and beliefs grown from our experience, are mentioned about their role in cognitive processing. Schema is compared to an information packet to assist us in organizing and interpreting information effectively and quickly, it also helps us avoid the overwhelming because of the huge amount of information we might perceive around us. Nevertheless, Schema also might oppositely affect us by irrelevant processing which could lead to misstating the processed information. For example, in some situations such as the unintended inaccuracies of the testimony of eyewitnesses or incorrect perceiving when we are in optical illusions. (Mcleod 2023.)

According to Zivony (2019), CP started to be considered as a discipline of science in the middle of the 20th century and as having a relation to behaviorist psychology. The term cognitive psychology and its definition were introduced and defined by psychologist Ulric Neisser in 1967 as the study of how the human brain perceives, transforms, stores, and recovers information (Cherry 2022). Back to that, as reflected by Mcleod (2023), the approach to CP began to develop in the psychology area during the late 1950s and early 1960s, then became a perspective around the late 1970s, and after that, the expansion in

CP study was expressed more via the work of Tolman from 1932 and Piaget during 1936 until 1981. Eventually, the appearance of computers encouraged the necessary to learn more about the minds of humans by giving the CP field the needed terminology and metaphor. For a better explanation, using computers gave chances for psychologists to learn the complex human cognition when comparing it with the system created by humans, the computer, which is easier to understand by its simplicity compared to the mystery of the human mind. For example, by using a computer and observing the way it handles information such as changing, storing, using, and outputting, psychologists can research those and compare them with how humans process information. In this way, cognitive psychologists embrace the way human thoughts perform similar to the model of information processing in computers. (Mcleod 2023.)

3.2   Popular aspects in CP related to IA and UX

The University of Michigan states on their site of The Information and Technology Services that IA is based on cognitive psychology, library science, and Human-Computer Interaction to create effectiveness for information organization and systems of wayfindings by helping people to seek information, think about content groups while searching for their aimed information types, and move or navigate between and within the information. Indeed, Drew also agrees that psychology and IA have an interconnection, and she clarifies that when we build a website or application in which we want users to buy, share, learn, or adopt something, that is when we are building something to try to encourage or even control users to visit and keep revisit after that to repeat the expected actions from time to time.

Additionally, it is declared that CP and IA share a common ground in their focus on mental processes and how to support them because both fields explore research and theories to improve understanding of the way humans process information. Furthermore, there are some important aspects to know so we can understand how CP informs IA, such as mental categories, which are related to how we organize content on a website or mobile app, visual perception which plays a role in how users associate items on an interface, with the examples as the laws of Gestalt Principles, short-term and long-term memory are also the key points to pay attention in designing IA regarding CP, and the Learning during the transference stage when users' interaction with new interfaces is affected by their knowledge and familiarity with the previous interface. Due to those relationships, it is recommended that understanding these aspects of CP can help us create an effective IA leading to a good user experience. (Withrow 2003.)

Correspondingly, according to Fitzgerald (2022), cognitive science analyses in human these habits which are memory, attention, decision-making, learning, perception, creative

thinking, and problem-solving. She also mentions some most popular cognitive principles that we should apply to UX design as well as IA, such as mental models, Gestalt principles, and cognitive load.

3.2.1 Mental models

Carey (1986) defines mental models as the model in which people's brains process how something will work based on their understanding getting from past or current experiences by surroundings. Also, Nielsen Norman Group (2010) considers mental models as an important aspect in designing for human-computer interaction (HCI), and besides that, they emphasize that mental models are not based on facts, but actually on belief, and define as what users think they know or actually know for designers and architects to base on that to predict and create a suitable system and interface with reasonable effectiveness and accuracy for a successful digital product. In addition, Nielsen Norman Group indicated that mental models are always changing instead of being fixed because the new intended designed experience going along with a system, or external experience and stimuli by users themselves definitely can change their mental models. For example, Weinschenk (2011) shares that a person who never read books on an iPad, when they heard about that possibility, on their head could immediately imagine the way they read a book on an iPad being similar to when they read an actual paper book, which is an assumption of what they could be able to do on a new product, created by their mental model based on their experience, and that was visualized in Image 8. Another example is the categories of products on Procter & Gamble's website suggested as being built to match with mental models of their target users, which was borrowed and visualized by Young (2008) in Figure 10. In practice, Bowers suggests using the card-sorting technique in the process of creating IA for a website or mobile application, which will help to align users' mental models for a better IA for the digital product. Besides, Niesel Norman Group (2018) also recommends that the card-sorting research technique applied in the IA building process will help us uncover the mental models of users. This technique will be discussed more in the next chapter.
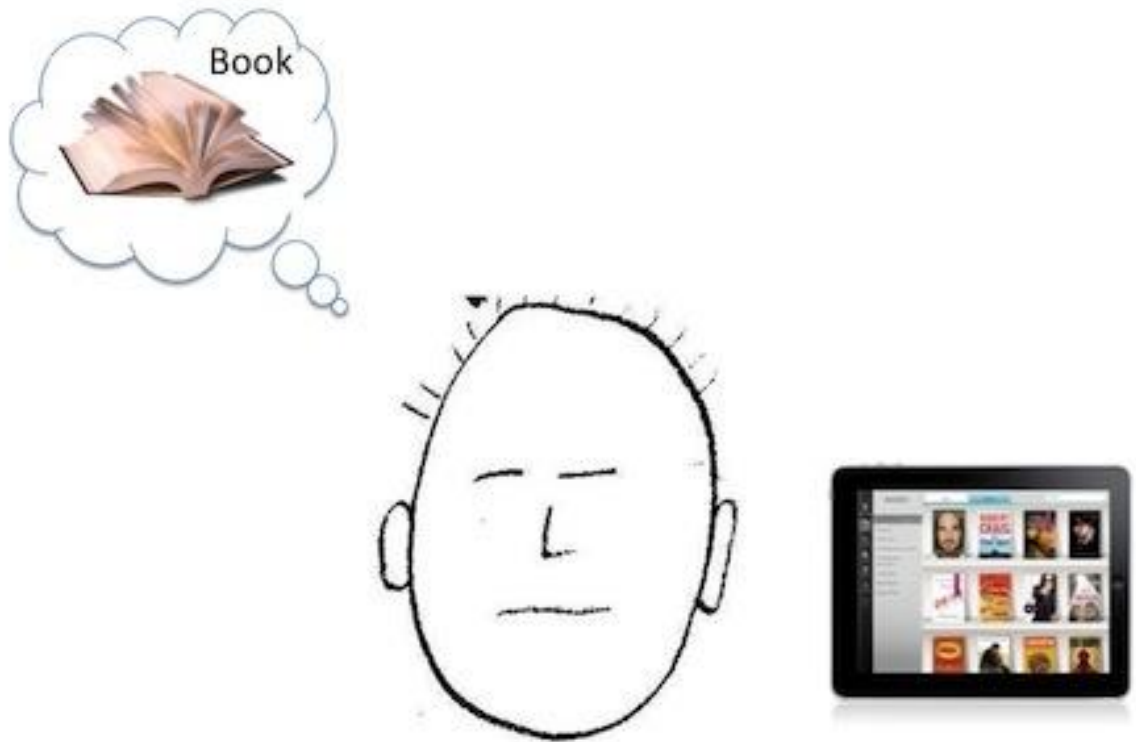
Image 8. Imagination of a person between the current experience of reading a paper book versus digital reading on an iPad that they have never done (Weinschenk 2011)
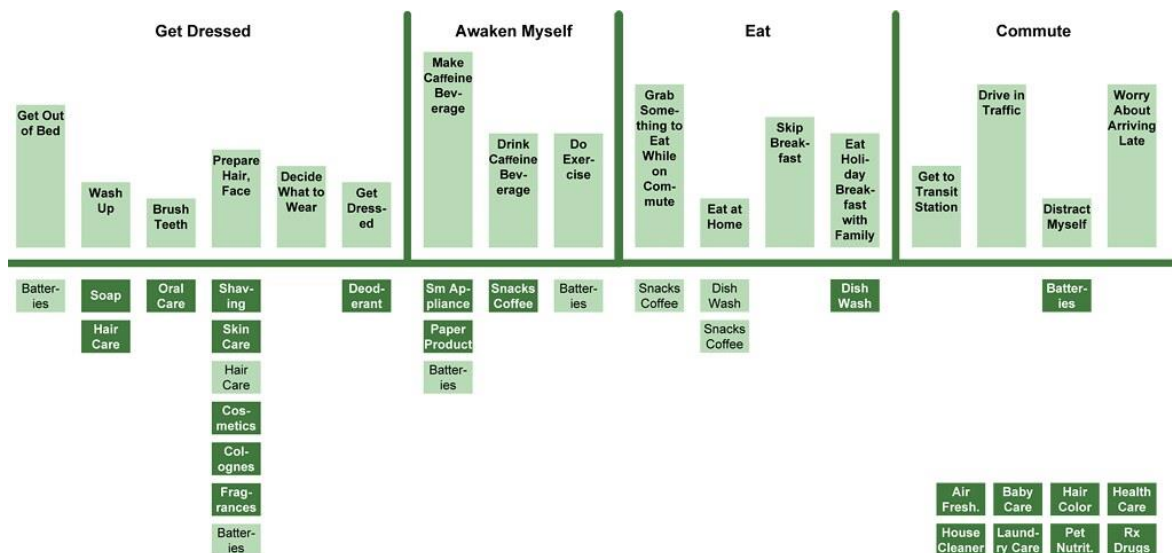

Figure 10. A visualization of mental models and their aligned categories of products on Procter & Gamble's website (Young 2008)

3.2.2 Gestalt principles

The second aspect in the relation of CP with IA and UX design is the application of Gestalt principles. In 1923, Wertheimer formalized Gestalt principles, which also are called the Laws of Perception, in a treaty publication. Those principles include the law of simplicity, similarity, proximity, common region, continuity, and closure. It is defined as psychology to understand the way humans perceive experience would be different based on different structures, and it also explains how the human brain operates while seeking patterns and is based on the tendency of humans when naturally looking for order in disorder via their eyes. To be specific, those principles that the brain recognizes uniform forms instead of separated items. However, it is also described as shortcuts in mentality to analyze information for understanding so sometimes it can create inaccuracy in perceptions. (Bustamante 2023.) According to Zeka Graphic, the factors we just mentioned regarding Gestalt principles can affect the way designers organize data on the screen. Karahan (2021) also suggests being based on those principles while arranging elements and parts in the system of information architecture, especially, paying attention to grouping objects including many elements to express their whole meaning for better understanding to users instead of only focusing on a collection of simple objects but separated and distracted for perceiving. Image 9 shows different Gestalt principles via visualization, and Figure 11 presents an example of grouping related data which could encourage users to perceive information to navigate regarding Gestalt principles.
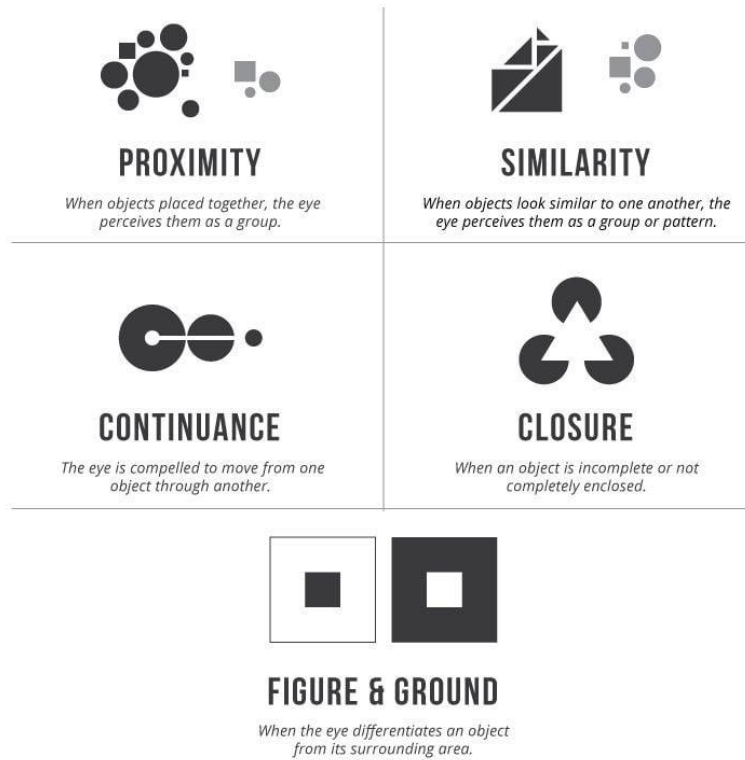
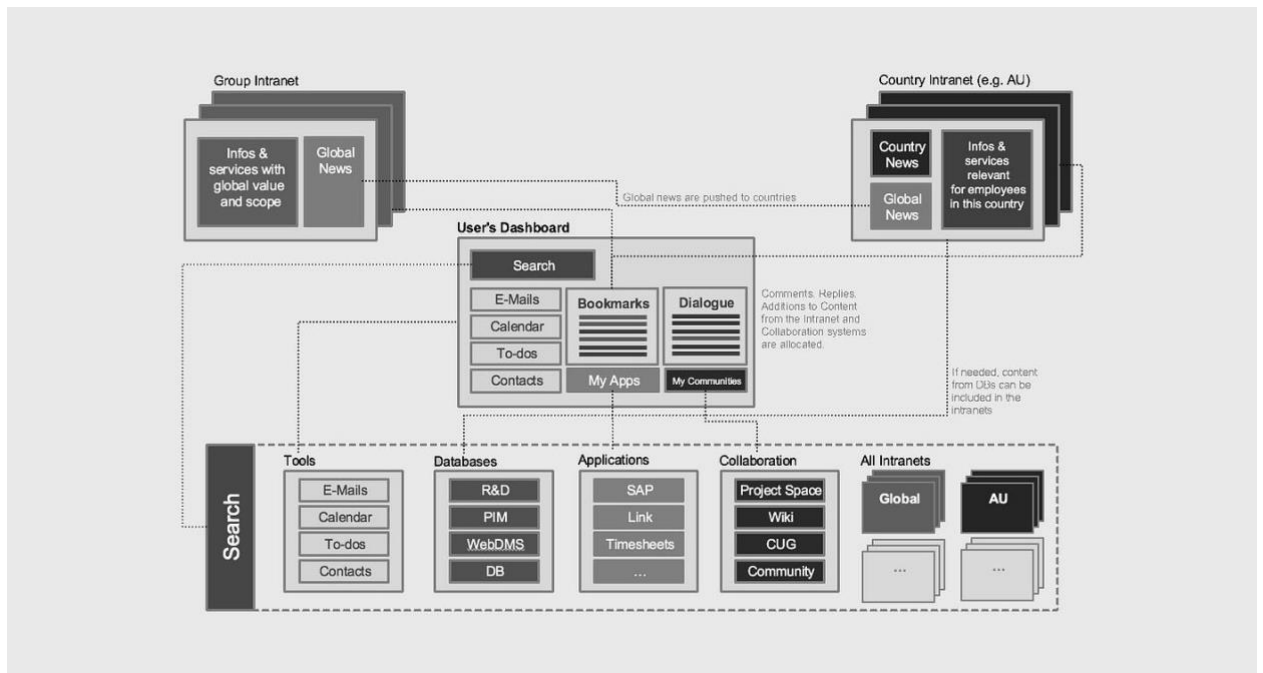Image 9. Laws in Gestalt principles via illustration (Bustamante 2023)

Figure 11. Example of grouping related data in IA to encourage perceptions of users while navigating through information (Amherd 2016)

3.2.3 Cognitive load

Paas et al. (2003) clarify that the theory of cognitive load is related to learning complicated cognitive tasks which usually make learners feel overwhelmed according to the amount of information elements and their necessary interactions to be processed at the same time before meaningful information can be perceived or understood. They also mention that, since the 1990s, the relation of the interaction between information organization and the structure of the human mind has started to rise as a necessary learning field for designers and researchers. As explained by Navacchia (2023), cognitive load in IA emphasizes the volume of information that users can take on, which indicates that not overwhelming users with too many options and information at the same time is a key thing that we should keep in mind. With clarity, Orozco (2022) simplifies the role of cognitive load in IA by saying that when we are creating the information architecture for a website or a mobile app, we are drawing a line to balance between the options of discovery for users and their cognitive load. An example of an overwhelming interface from the 90s and early 2000s is shown in Image 10, which is a result of an abundance of options organized in information structure, leading to the high demand for the mental effort of users. Also, the contrast in development tendency between cognitive load, discoverability versus complexity in information is represented via Figure 12.
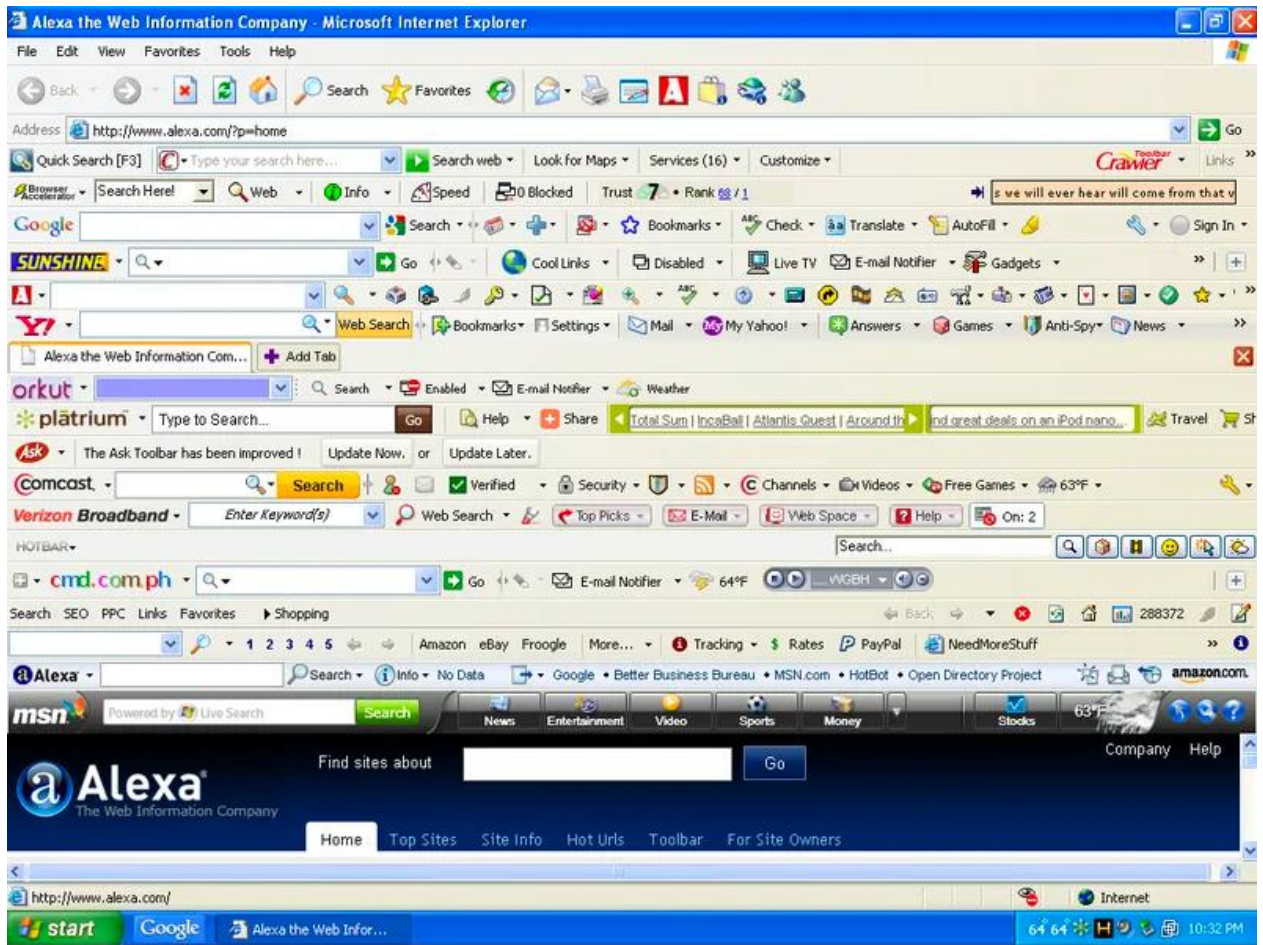
Image 10. An example of an overwhelming interface from the 90s and early 2000s, which leads to the high demand for the mental effort of users (Orozco 2022)
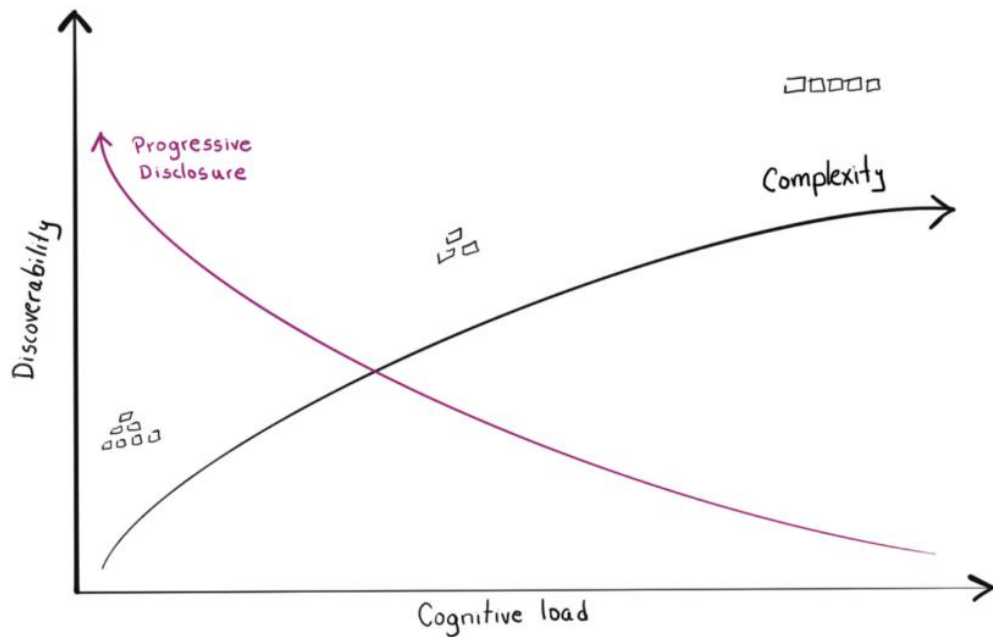
Figure 12. The contrast in development tendency between cognitive load, discoverability versus complexity in information (Orozco 2022)

Some factors related to CP such as mental models, Gestalt principles, and cognitive load and their implications on IA and UX design are analyzed. While the factors of CP hold significant relevance to our study, some other important factors such as short-term and long-term memory, visual hierarchy, or recognition patterns, etc., are not discussed in detail in this chapter yet. The reason is the constraints of this research necessitate a shift in focus in the subsequent chapter. The forthcoming section will navigate toward the IA design in detail within the whole UX design process, which is integral to developing a comprehensive understanding of the importance of IA in UX design. Although the exploration of factors of CP remains incomplete, it is important to recognize that the decision to pivot is driven by the need to describe the process including popular techniques of building an IA, and uphold the coherence and depth of our investigation. Future research may provide opportunities to revisit these factors in greater detail. However, it is essential to acknowledge that the scope of this investigation is constrained by the necessity to maintain focus and depth within the allotted chapter.

4   Highlighted techniques and objects contributing to an effective IA

Tankala (2023) emphasizes that IA creation is not just single work that could be done to deliver once and then check off the task list, but it is a continuous process of website management involving content updating and arranging along with the running and innovation of the digital product's system that was created. At the same time, Tankala shares that it is necessary to know that when doing work related to IA, there are a number of deliverables that should be done according to achievement goals, for instance, content inventory, content audit, taxonomy creation, research techniques such as card sorting and tree testing, and so on. In addition, the UX Booth Editorial Team (2015) describes IA as a task that can be shared by designers, developers, and content strategists, and mentions activities related to creating IA including doing user research and analyzing results, creating navigation and hierarchy, making wireframing, labeling, taxonomies, metadata, and data or content modeling. In the study guide for IA, Nielsen Norman Group (2023) shares resources to take actions on IA creation regarding main topics and skills with keywords belonging to popular groups such as navigation, menu, hierarchies, and some techniques to test the built IA such as card sorting and tree testing.

Previously, as mentioned in Chapter 2, Morville and Rosenfeld (2006, 231) also analyzed IA's components as navigation, labeling, search function, organization's system, and the possibility of using manageable vocabulary and metadata to provide structure. In connection with the statements above, AltexSoft (2023) indicates the profession of an information architect as being responsible for content structuring and labeling, which is to support for navigation of websites or mobile applications, and that could be the role under the responsibility of UX designers or as a person who concentrates on IA solely but works along with a UX designer to have the final result. Additionally, AltexSoft specifically visualizes a diagram of key steps in IA creation as shown in Figure 13 below. Also, the objects regarding three factors in IA: user, context, content, and their relation during the process of building IA are visualized via Figure 14 by the author.
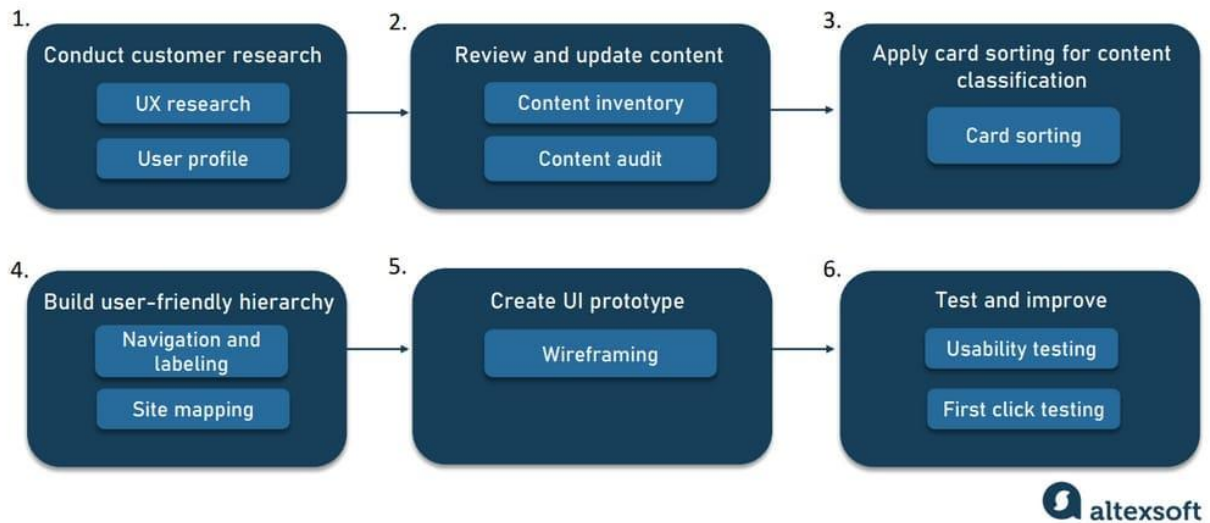
MAIN STEPS OF INFORMATION ARCHITECTURE DESIGN

1. Conduct customer research
- UX research
- User profile

2. Review and update content
- Content inventory
- Content audit

3. Apply card sorting for content classification
- Card sorting

4. Build user-friendly hierarchy
- Navigation and labeling
- Site mapping

5. Create UI prototype
- Wireframing

6. Test and improve
- Usability testing
- First click testing

altexsoft

Figure 13. Key steps in designing IA (AltexSoft 2023)

Users → User research → Plan for Content

Context → Business goals, competitors / Resources, constraints, etc.,

Organizing content
(Popular: Cart Sorting research method - users mental models)

Content

Testing to iterate
(Tree Testing research method and other methods)

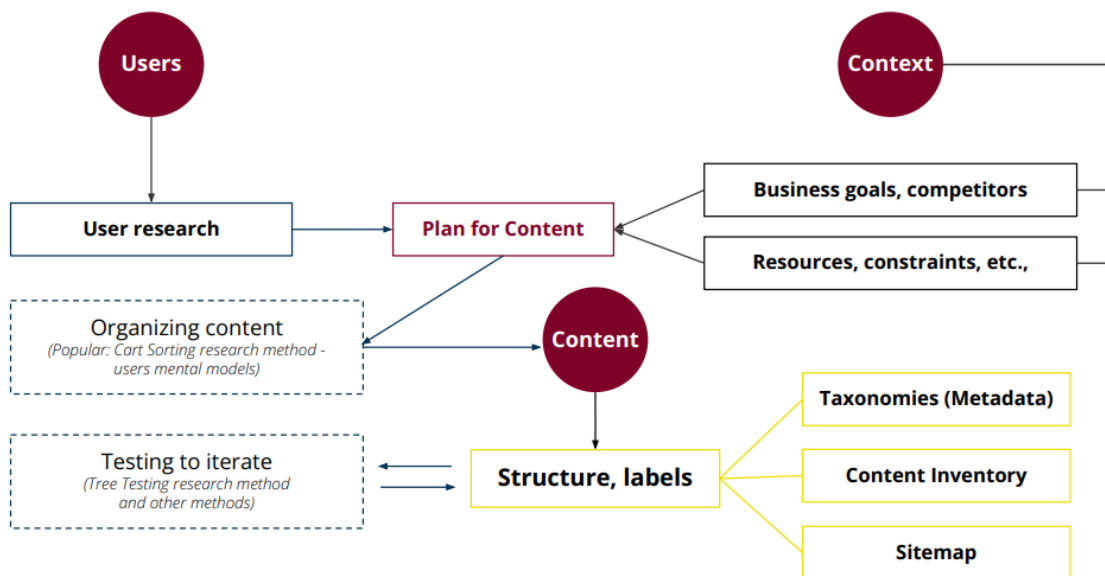Structure, labels → Taxonomies (Metadata) / Content Inventory / Sitemap

Figure 14. Objects regarding three factors in IA: user, context, content, and their relation during the process of building IA

4.1 Research: user goals, business objectives, and competitors

Discover user goals

Before approaching the specific objects to work on such as content inventory and audit, card sorting for classifying prepared content, and building a user-friendly hierarchy by creating logical navigation with supporting labeling, AltexSoft (2023) indicates that the

process has to be started with user research to have initial understanding of the needs and behaviors of target users. As a result, the data abstracted from the research is also supposed to be used to connect with business requirements for creating user profiles and user flow later, which are for illustrating how target user would process their thoughts and interact with the product. Similarly, Ross (2011) confirms that the initial user research is the significant core step at the beginning of any design process to have the very first understanding of the necessary content for the site and the vocabulary of users, which will help in choosing related items and labeling in further steps, supporting the card sorting research which is a more generative method later. To be specific, Babich (2022) suggests the need to clarify by answering some questions such as who the target user is to use the product, what they will do on the product when using it, and finally, what they would like to achieve, which also means which tasks and goals they would like to complete by using the product.

Understand business objectives and competitors

Understanding user goals is important, but when creating a digital product for a business, it is also necessary to align user goals with business objectives by communicating frequently and taking into account stakeholders' requirements to create a product that would help the company accomplish its business goals. Spelling out the primary and secondary goals of the business would show a clearer path to go along when brainstorming related solutions. After that, competitive analysis research is a powerful tool to understand the current market and available competitors. This type of research aims to analyze similar products, and based on that, it could give some discoveries about what users might be familiar with at the moment and what they might expect. In addition, a SWOT analysis focused on content should be brought up to have a clear picture of the advantages and disadvantages of both the business and its competitors. (Babich 2022.)

4.2   Content quality: management and continuous audit

Create a content inventory to manage information throughout the site

Content inventory is a list of available content that is organized at the levels of asset or page and consists of specific related attributes of each piece of content. Besides that, a content audit is an activity of assessing, examining, and evaluating the available content quality, in which the content could be replaced, filled, or even removed. Furthermore, it is recommended to do both content inventory and content audit continuously due to the initial nature of depth and breadth but generality of content inventory, which usually needs to be audited to re-evaluate and improve the quality to minimize users' confusion, redundancy,

and overload as to information while using the digital product. However, the details in organizing of content inventory are very important for the process of auditing later, to make decisions and take immediate actions. Also, the activities related to creating and managing content inventory and audit can both happen in the beginning or even throughout the process of product development, and at any needed phase. Besides, Image 11 shares the overlapping and supporting each other in the continuous improvement process between content inventory and content audit. (Kaley 2020.)
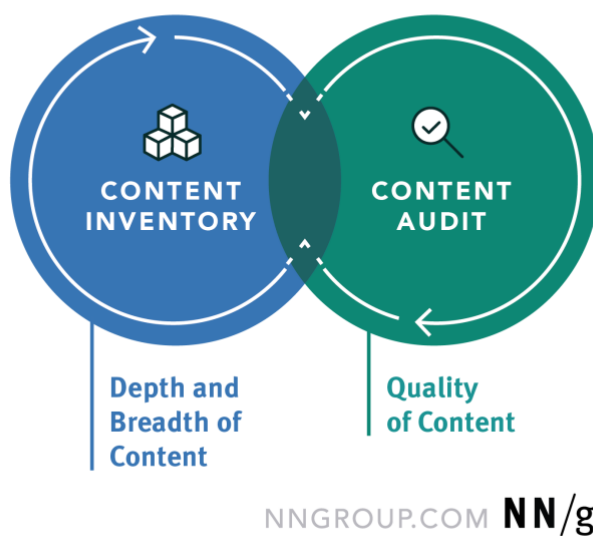

Image 11. The overlapping and supporting each other between content inventory and content audit (Kaley 2020)

The U.S. General Services Administration gives a list of some typical content pieces of a website or mobile application in the inventory such as text, documents, images, and applications. Specifically, they could vary from raw to completed data including IDs of content or page, URL, files with different formats like HTML, DOC, PDF, TXT, etc., titles, author names, created or revised dates, meta descriptions and keywords, categories or tags, and physical locations such as in content management system, server, etc., Those content pieces are recommended to be put into a spreadsheet for convenient sorting and editing later with a column showing done activities on the piece of content such as checked, edited, approved, or sent for development, and it is emphasized that recognizing any redirect links is also an important thing to keep in mind while creating the content inventory. Besides that, Allabarton (2023) advises creating categories on the spreadsheet for data including similar ones listed above and the navigation category consisting of menu titles on

the site like Home, About, News, etc., also considering additional categories, for instance, basic description of the content, owners who are responsible for the piece of content, the last updated date, related or linked pages, attached files, availability of access which means the content could be accessed by which devices. Figure 15 shows a content inventory template by the Government of British Columbia (2023).

Figure 15. An example of a content inventory template (Government of British Columbia 2023)

As recommended by the Government of British Columbia (2023), it is also necessary to follow the Web Content Accessibility Guide (WCAG) and use some suitable tools to keep tracking the analytics of the product to follow the performance of created content, and the reports should include some results such as real-time visiting which could be approximately 15 minutes difference in time, live filtering, capabilities of data export, history of data within 2 years with at least completed report of the nearest 24 months, and the organization also suggests combining those data with other related data sources to have the best final results for improvements.

Regarding the content audit, Gould considers it as a qualitative analysis using supporting tools such as Google Analytics and Siteimprove and suggests some ways to do content analysis including search engine optimization (SEO), Heat map, Accessibility, and ROT (redundant, outdated, trivial) techniques. However, Gould emphasizes it is necessary to discuss with the team to choose the most relevant reports and analysis techniques that are suitable with the team, product, and goals, and it is also possible to combine and create customized techniques for the own work. Figure 16 and Figure 17 are parts of content inventory and content audit of the University of Arizona's Main Library by Gould.

Main Library ⊞ Show All ∨

Page ID	Title	Content Manager	URL
0	Homepage	@Bob Liu	library.arizona.edu
1.1	Find books & ebooks		http://new.library.arizona.edu/find/books
1.1.2 (redirect)	Finding & using ebooks		Redirects to 1.1 https://new.library.arizona.edu/find/books
1.2	Find articles & journals		http://new.library.arizona.edu/find/articles
1.3 (redirect)	Research databases		https://libguides.library.arizona.edu/az.php
1.4	Digital collections & exhibits		https://new.library.arizona.edu/digital-collections
1.4.1	Digital exhibits		https://new.library.arizona.edu/digital-collections/exhibits
1.5	Other types of materials		http://new.library.arizona.edu/find/other
1.5.1 (redirect)	Find articles		/find/journals
1.5.2	Find biographies		http://new.library.arizona.edu/find/biographies
1.5.3	Find book reviews		http://new.library.arizona.edu/find/book-reviews
1.5.4 (redirect)	Find books and ebooks		Redirects to 1.1 https://new.library.arizona.edu/find/books

Figure 16. An available content inventory of the University of Arizona's Main Library (Gould)

	A	B	C	D
1	Date	Headline	Audience	URL
2	14-Jul	Fall events announced	community	http://www.library.arizona.edu/news/entries/view/3069
3	2-Dec	Call for Friday Tech Talks presenters at iSpace	faculty/grads	http://www.library.arizona.edu/news/entries/view/3125
4	16-Dec	Science-Engineering Library will close January 13-15	all	http://www.library.arizona.edu/news/entries/view/3120
5	11-Jan	Free, online course teaches research strategies for graduate students	grad students	http://www.library.arizona.edu/news/entries/view/3036
6	7-Jul	University of Arizona and OpenStax promote free textbooks	faculty/instructors	http://www.library.arizona.edu/news/entries/view/3068
7	9-Aug	Apply for a scholarship to attend OpenCon	faculty/grads	http://www.library.arizona.edu/news/entries/view/3073
8	1-Jun	Phishing email regarding interlibrary loan	all	http://www.library.arizona.edu/news/entries/view/3067
9	13-May	University of Arizona Press picks for your summer reading list	all	http://www.library.arizona.edu/news/entries/view/3065
10	12-May	Watch a film from one of our databases	all	http://www.library.arizona.edu/news/entries/view/3064
11	11-May	Summer hours begin	all	http://www.library.arizona.edu/news/entries/view/3063
12	4-Apr	Faculty Senate passes open access policy	faculty	http://www.library.arizona.edu/news/entries/view/3061
13	13-Jan	What's your favorite place to study? (contest)	students	http://www.library.arizona.edu/news/entries/view/3045

Figure 17. A part of the content audit table with the updated date column of the University of Arizona's Main Library (Gould)

4.3   Understand user mental models: cart sorting

Building an IA that relies on real user data will benefit in ensuring long-run effectiveness, therefore, card sorting is one of the popular research techniques that is conducted after having the planned content based on previous initial research and content inventory creation. Specifically, this is a technique in which the research participants will arrange given items of content, as index cards, into related topics or keywords that make sense to

their thoughts. Also, the card sorting activity can help to answer some questions related to users' thinking process, for instance, what the mental models of target users are, how to structure the site's content to support their thoughts based on those mental models, and which labels should be used to be intuitive for users' navigation. (Chen 2020.) Regarding mental models mentioned in Chapter 3 about cognitive psychology (CP), Nielsen (2010) also states that the card sorting technique helps to reveal mental models of users in a specific information space, which encourages building good navigation for IA. Figure 18 shows a cluster diagram visualizes card sorting as one of the popular research types applied in the user experience field by Konrad Group.
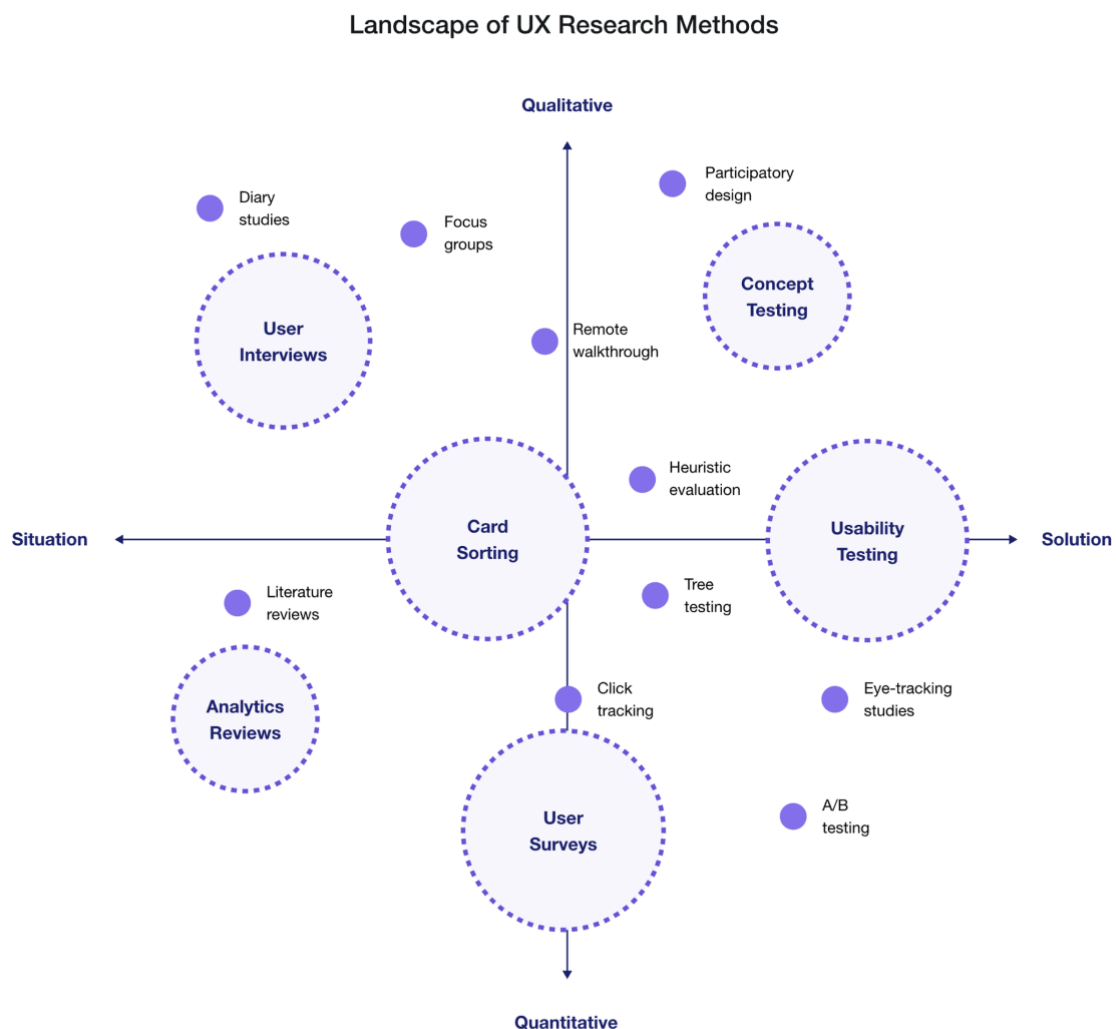
Figure 18. The cluster diagram of popular research types in the user experience field (Konrad Group)

Recommended numbers of participants to be optimal in both cost and results

Furthermore, as demonstrated by Tullis & Wood (2004), it is emphasized that the card sorting technique has become one of the most-used techniques to assist the content element arrangement of an information system to be suitable with the users of the system, and it also has been familiar with professionals in usability and IA fields as a key tool in their box to design for a better UX. Regarding cost-effectiveness analysis for a recommended number of participants in one card sorting research, by conducting a card sorting study for redesigning the website of intranet at Fidelity Investments' usability department, Tullis & Wood also use related statistics in the research to provide the answer for the question about how many participants are enough to generate the result from card sorting research, and they suggest that the best sample size of participants should not be over 20 to 30 people. As associated with the number of people, Calderon (2022) shares that at least 15 people should be invited as participants because this will effectively help to find the patterns to generate an acceptable and reasonable result for improvements, which is quite similar compared to the result and recommendation number from Tullis and Wood. In Figure 19, the graph by Tullis & Wood (2004) shows correlation coefficient results, which support the statement that a good sample size should be from 20 to 30 people, from the Card Sorting activities conducted at Fidelity Investments online.
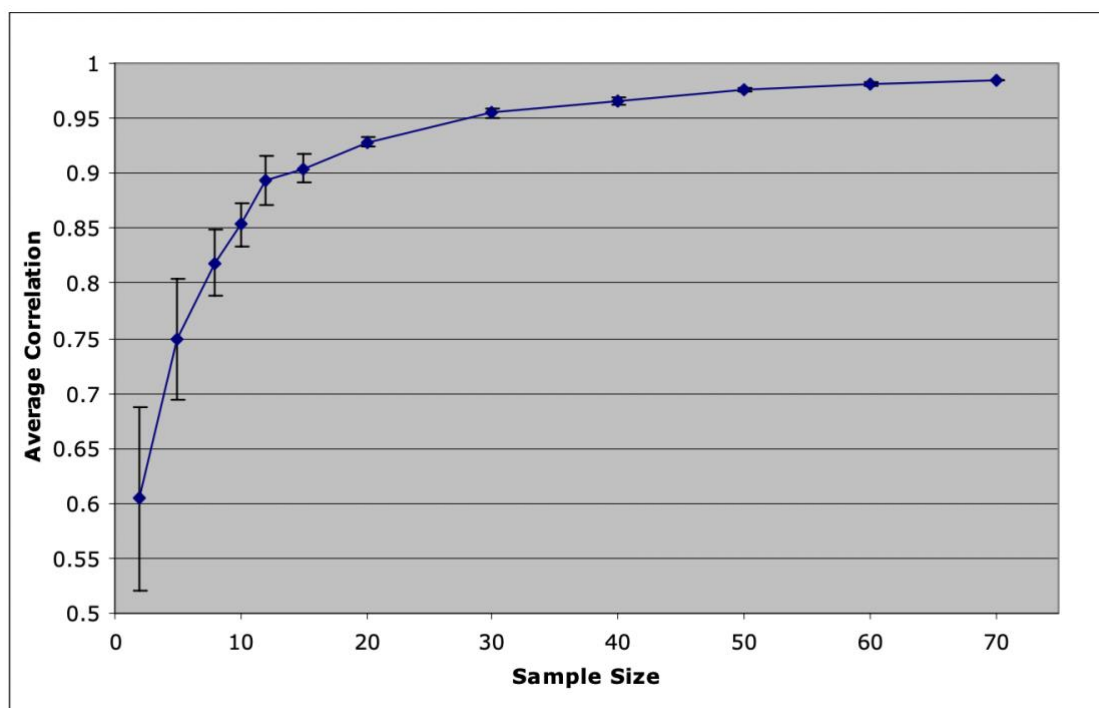

Figure 19. The graph of correlation coefficient results from the Card Sorting activities conducted at Fidelity Investments online (Tullis & Wood 2004)

Two types of research results could be given after conducting card sorting, that are qualitative and quantitative, Particularly, the qualitative information could be found via users' comments which share aloud thinking of what users had in mind and why they classified cards of content in implemented ways, and the quantitative information is the data as statistics extracted from the results to answer, for example, how often the given cards are grouped as the same category or how many users create the same label as a name for the same category. Also, it is mentioned that the activity could be conducted via both the moderated which is led by a workshop facilitator, or the unmoderated which users will conduct by themselves with necessary guidance documents. Furthermore, paper form which means the topics are written on physical index cards or digital form as cards are created via online tools could be applied for suitable situations and environments. (Bower.)

Recommended methods to collect high-quality data

Konrad Group indicates that open and closed card sorting are two main methods of the card sorting research activities, and it is summarized that, in an open sorting session, the participants are required to freely class cards into groups that they create on their own, but in a closed sorting session, main categories are created before, and the participants only need to put cards into the category that they think it is suitable as the listed topic. Additionally, as claimed by Banus (2022), another third technique that combines both open and closed card sorting is called hybrid card sorting in which firstly users are asked to separate cards into given groups, however, if they could not find any suitable groups of certain cards, they are allowed to freely create new related groups and put those card into accordingly. Image 12 visualizes the different steps between open and closed card sorting sessions.
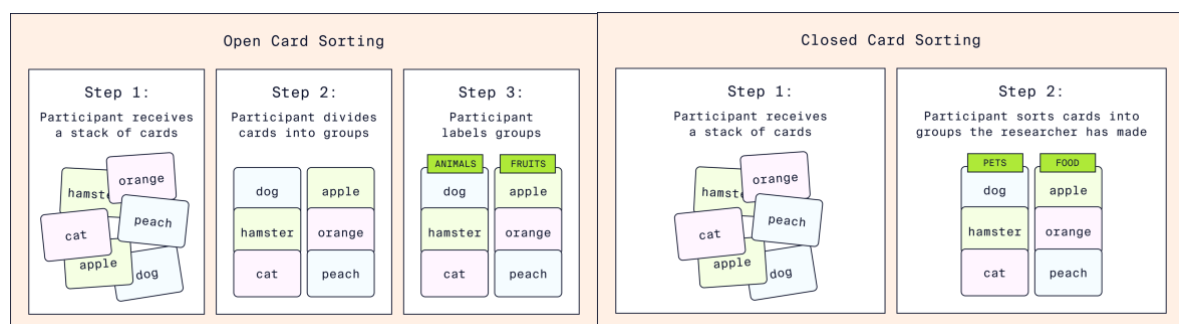

Image 12. Steps in open and closed card sorting sessions (Codecademy 2023)

According to GitLab (2023), card sorting assists in revealing the mental models of participants by discovering the way users group given items, which helps to understand the relevant terms according to users' mindsets. Also, in the opinion of Kancar (2023), card sorting techniques, in general, are usually used to find reasonable ways of grouping the content, which is then used for creating effective navigation and sitemap. However, Kancar

explains further according to Nielsen Norman Group (2019) that the closed card sorting technique also can be used after the IA is created for usability testing to figure out if the created names of items and categories are comprehensible and convey correctly their meaning or not, which then helps to evaluate for requisite improvements. Over and above that, Nielsen Norman Group recommends doing card sorting in this stage in person or, at least, remotely moderated form to be able to have direct and better observations for the best results.

To add more to the statements from Bower and Nielsen Norman Group above, Codecademy (2023) also suggests that the moderated session is necessary to gather qualitative data because this creates the opportunity to ask follow-up questions that would lead to a deeper understanding of the thoughts of participants about their own beliefs and explanation about certain keywords and terms appearing the session. Besides that, the unmoderated form is more suitable if the research is conducted for gathering data from a large scale of participants as collecting quantitative data but it might lack understanding of the reasons behind the ways users picked and placed cards with those available given or own created categories. Image 13 shares examples of cart sorting activities in real life for for IA of Paragon Sports' Website by Min (2019).
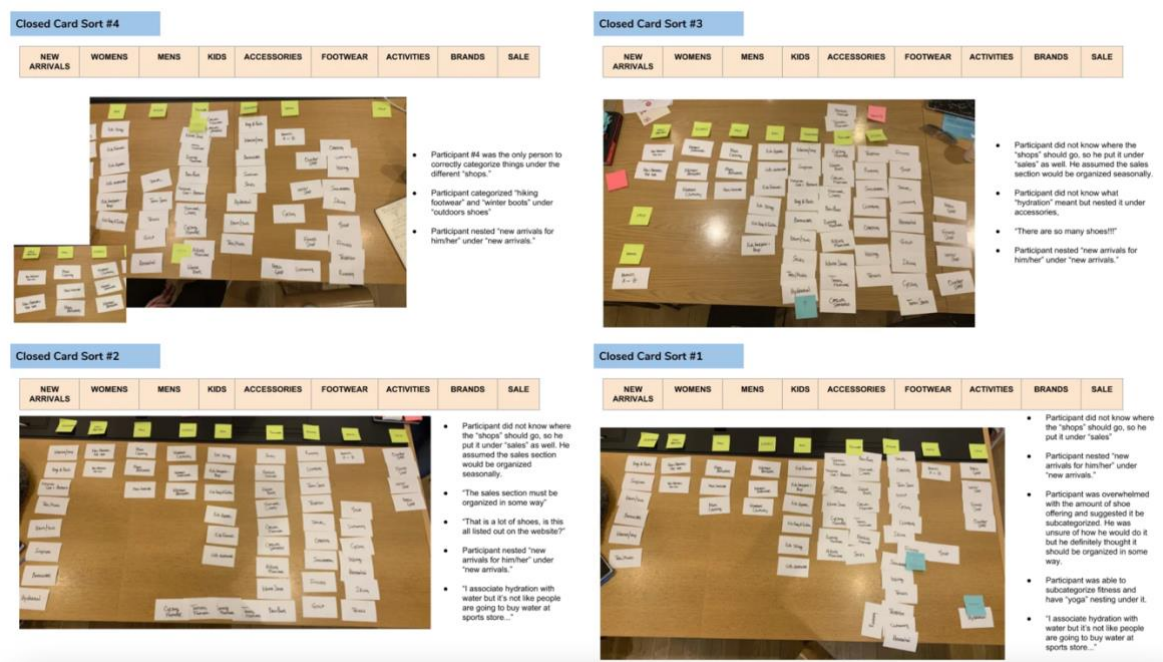

Image 13. Physical closed card sorting for IA of Paragon Sports' Website (Min 2019)

4.4 Hierarchy: navigation, taxonomy, labeling, and sitemap

Navigation

According to AltexSoft (2023), navigation is sometimes referred to as an interchange term of IA but it is only a part of IA, and building a hierarchy for a user-friendly website or mobile app, which means a digital product that is intuitive, clear, and easy to understand for using, needs to be inquired some steps such as navigation designing, labeling, sitemap creation. Moreover, Stanford University stated in their User Experience Guide site that navigation is one of the functions having the most significant impact on a website, and it is encouraged to have effort from both sides to build good navigation, which is from content creation and organizing side, and technical functions building side such as interaction design, UI display, responsiveness in mobile and website versions. In addition to that, based on the IA iceberg by Rosenfeld and Morville (1998) as in Figure 21, Davis (2011) visualizes navigation as the surface of an iceberg as displayed in Figure 20, which means it represents IA shown on the interface, and he suggests that this visualization of the iceberg helps to show the scope of IA which could be focused on an enterprise or a specific project. Moreover, Davis suggests using this iceberg for questions framing to consider effective methods and solutions for building an IA. Figure 22 shows a part of Davis's table about the recommendation of questions and example methods.
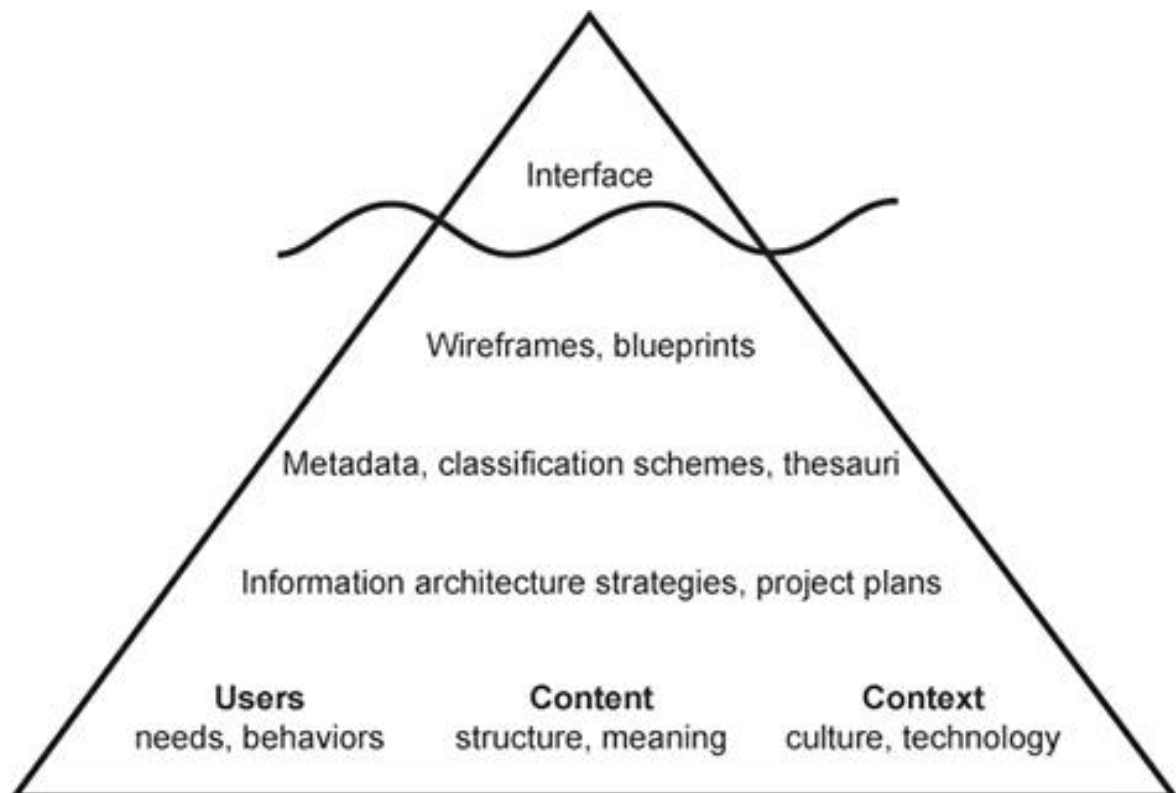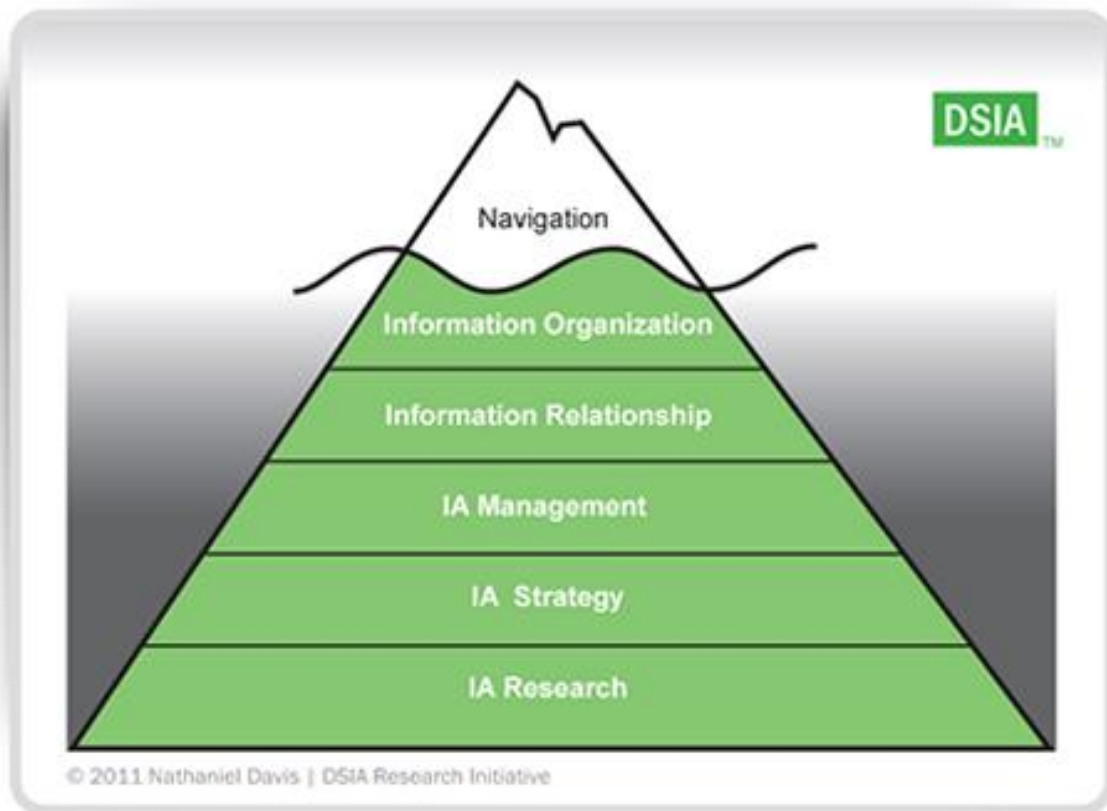

Figure 20. The iceberg of IA (Davis 2011)

Figure 21. The iceberg of IA (Rosenfeld and Morville 2006)

Questions	Example Methods
Navigation	
What information retrieval methods will people need to find targeted information?	● Search ● Hierarchal Menu ● User Recommendation
Information Organization	
How should we formally group the information?	● Taxonomy ● Content Matrix ● Thesaurus
Information Relationships	
How can we define the targeted information to offer flexibility and extensibility?	● Content Model ● Metadata ● Domain Model

Figure 22. Recommendation of questions and example methods for IA building process (Davis 2011)

It is mentioned in the Yale ITS Services site of Yale University that some kinds of navigation, such as primary, local, and utility ones, as menus on websites or mobile applications, and those menus are identified as the way that users interact with the built hierarchy, which can be placed in different areas of a site, for example, at the top of a website is usually the primary menu, a local menu can be placed at the left or right sidebar, and footer and header could be placed with the additional menu contained necessary links for convenience. Importantly, it is emphasized that good menus, which are built and placed correctly to assist users in navigating through the digital product, are one of the most significant impact aspects of good usability. (Yale University.)

Correspondingly, Cardello (2014) defines the navigation of a website as a component collection of user interface which includes types of navigation such as global, local, utility menus, and menu at the footer as Yale ITS Services mentioned above, and also includes filters, breadcrumbs, related links, etc., Furthermore, Cardello indicates that decisions that need to be made on navigation components are based on the priority of their usage, which might lead to the questions like where to put them and which pattern is suitable to design them, for example, megamenus, tabs, carousels, or accordions, etc., that all need to be taken into account. Image 14 shows examples of different kinds of navigation components

placed on the website of the U.S. Small Business Administration, and those are explained in order as numbers by Cardello (2014).

Image 14. Kinds of navigation components were explained in order as 1. utility navigation; 2. global navigation; 3. breadcrumb trail; 4. local navigation; 5. related links; 6. fat footer (Cardello 2014)

Taxonomy: metadata of content

According to Laubheimer (2022), taxonomies, are the way to call controlled vocabularies in information science, and they are created in a system way to make metadata related to content richer, which helps to retrieve the related information more effectively and conveniently. To be clearer, Laubheimer shares a definition of taxonomy, which is an accepted list of terms that has hierarchical organization and are applied to separating and giving details of content, and the content creators, whenever creating a new piece of content on the site, need to add one or more related taxonomies for the content based on ground rules to keep the information on a system organized. More simply, Laubheimer refines that taxonomies can be described as controlled tags of a system, that are built for managing content of the site from the backstage.

Regarding metadata, it is described as the information about the information, for example, if the content object is a book, its metadata includes title, author, published date, and even the catalog number of the book. Moreover, consistency in using metadata is advised for better content searching, and another way of mention is discoverability. On top of that, the right establishment of metadata might stimulate better navigation by creating elements of navigation based on created terms of metadata and increasing the flexibility in managing and organizing content, for example, in a situation when a merging in content is necessary, changing different taxonomies of them into one taxonomy will help to merge many pieces of content into one desired category quickly. (Microsoft 2023.) Image 15 shares the search feature on SharePoint of Microsoft, and displays a panel on the left side, which allows users to have narrowed-down search results by filtering using metadata choices Microsoft (2023).
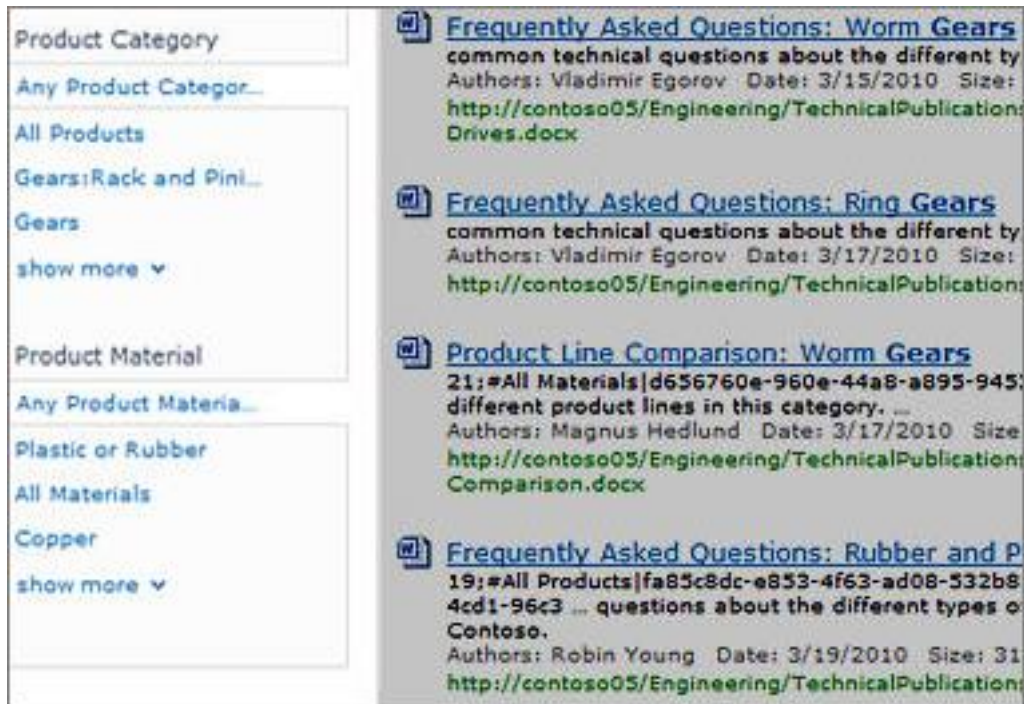
Image 15. Search feature on SharePoint of Microsoft (Microsoft 2023)

Similarly, it is clarified that taxonomy is both the practice and science of classification and they emphasize that controlled vocabularies need to be created for main categories of content so that related things on the site are consistently labeled, which is explained as the way that the site content is arranged into both hierarchies and taxonomies. Hence, it is suggested that this system of classifications should proceed from a widespread range to a particular item, and as a result, the mentioned systematic and hierarchical arrangement will become the base for search systems and navigation on that digital product. (Lynch and Horton 2016.) Figure 23, by Martchek (2022), visualizes an example of a hierarchical taxonomy system that is created and organized according to its relevance. Image 16, by Putkey, shows taxonomies as genres are used by Goodreads for users to easily find books they are in need and Image 17, also by Putkey, shares search results with books in the New Releases category are narrowed down into the books that have taxonomy as "Historical Fiction" tag.
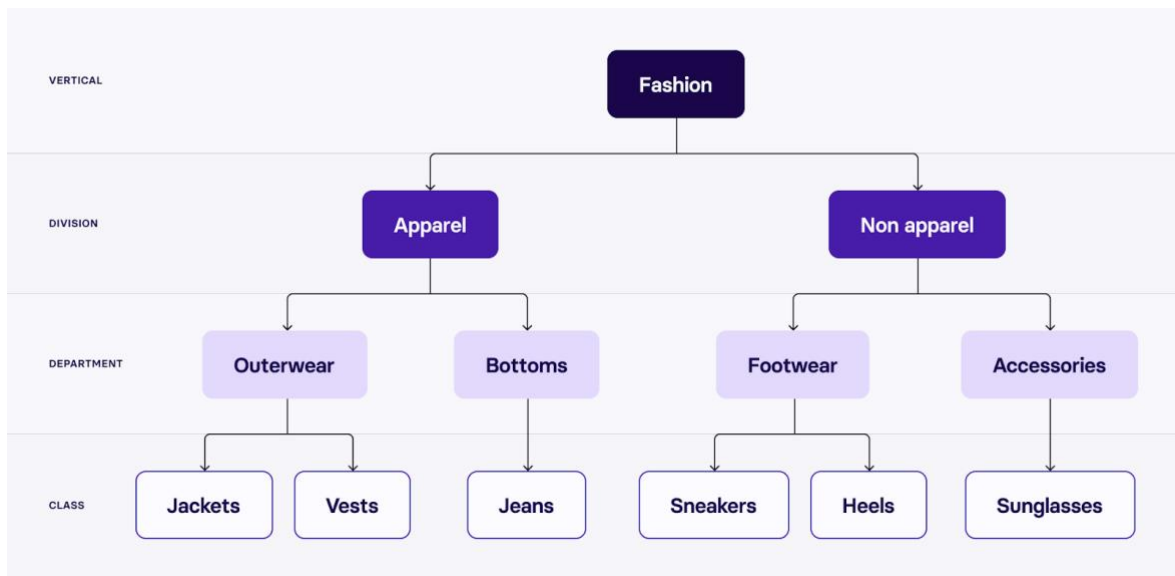
Figure 23. A hierarchical taxonomy system is created and organized according to its relevance (Martchek 2022)

Image 16. Taxonomies as genres are used by Goodreads (Putkey)

Genres > Historical

Historical Fiction

Historical fiction presents a story set in the past, often during a significant time period. In historical fiction, the time period is an important part of the setting and often of the story itself.

Historical fiction may include fictional characters, well-known historical figures or a mixture of the two. Authors of historical fiction usually pay close attention to the details of their stories (settings, clothing, dialogue, etc.) to ensure that they fit the time periods in which the narratives take place.

In some historical fiction, famous events appear from points of view not recorded in histor ...more

NEW RELEASES TAGGED "HISTORICAL FICTION"

Image 17. Books in the New Releases category are narrowed down into the books that have taxonomy as "Historical Fiction" tag (Putkey)

Labeling

Related to the labeling system as one of the main components of IA indicated by Rosenfeld and Morville (1998), there are two types which are textual and iconic labels. For instance, a Contact Us section shown on a menu can carry a link to navigate to the Contact Us page, and on the Contact Us page, the Contact Us words could show there as the heading as well.

However, as indicated by Harley (2014), an icon should always go along with a relevant text label to avoid causing confusion and misunderstanding among users. Correspondingly,

Rosenfeld and Morville (1998) clarify that labeling as icons can be used but only for representing some familiar key information such as representing a homepage with a house icon or a search page with a magnifying glass, and they emphasize there are not many of those popular icons so usually iconic labels are also accompanied with textual labels for clarification. However, Rosenfeld and Morville share that iconic labels can be recognized quickly so it can help users easily find things on a page if using icons that are universally familiar or have consistency on all pages of the site, also, they play an important part in creating a strong identification and attracting users in graphic impression for a digital product.

Image 18 by Harvard University (2018) shows examples of labels as text on the main menu of news websites, and Image 19 by Moran (2019) shows labels as links on the Microsoft website, which are evaluated as effectively communicating the content behind the links that users should know to navigate to. Besides, Image 20 displays the hamburger icon as the menu for main navigation on the Buy My a Pie app as an example by Harley (2014), which is also one of the rare well-known universal icons without necessary come-along text labels to make its meaning clearer. The main menu will open up a sub-menu that shows labels as links in textual format. Furthermore, Image 21 is an example on Material Design 3 source by Google, which is a main menu for navigation using both icon and text labels to assist users in catching the right meaning of the icons.
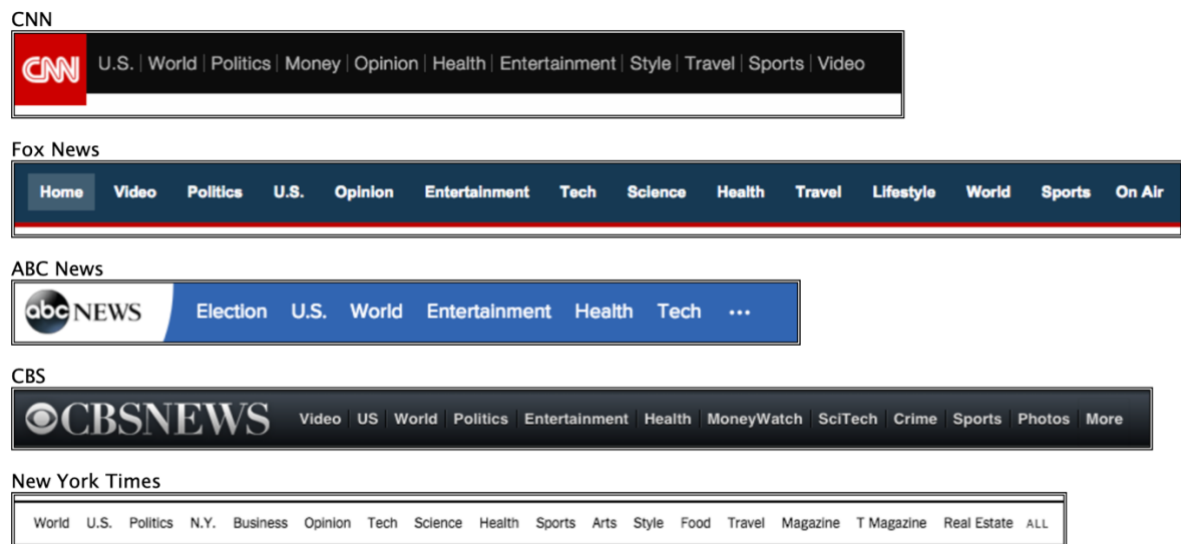

Image 18. Labels as text on the main menu of news websites (Harvard University 2018)

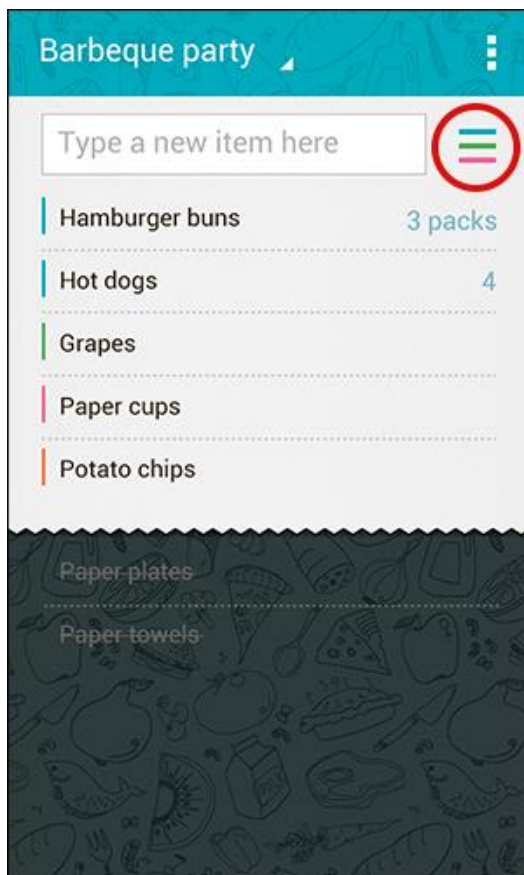Image 19. Labels as links on the Microsoft website (Moran 2019)

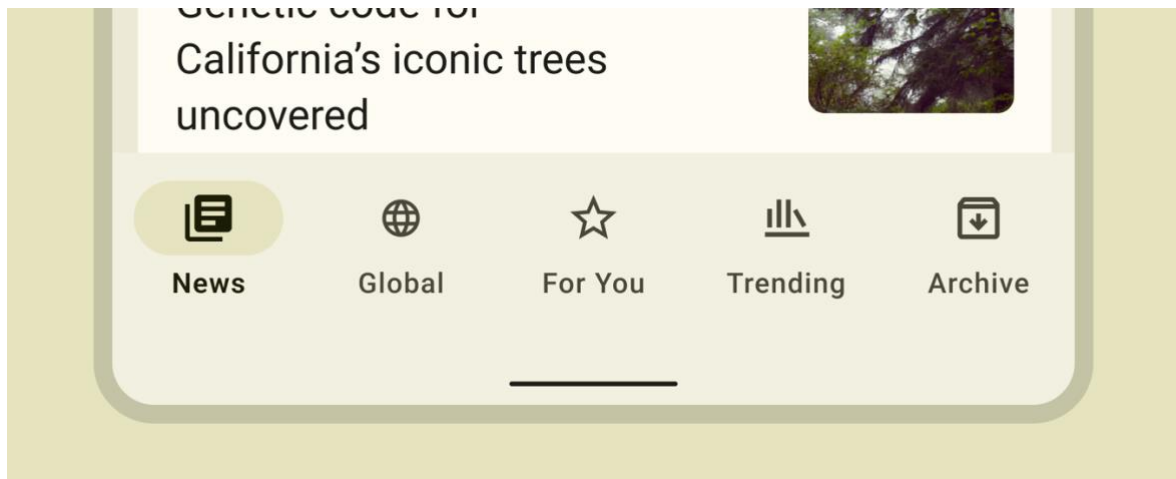Image 20. Hamburger icon represents the main menu on Buy My a Pie app (Harley 2014)

Image 21. A main menu design on Material Design 3 source (Google)

Sitemap

A sitemap is defined as a diagram that visualizes the structure of a site at a high level and an information design artifact, including all pages and subsections throughout the site, represented by labels as text. It is described that a sitemap is used mainly for reflecting the structure of information and limited navigation of a site, and usually, it is used internally for the team to have consensus on the scope and goals of a project and for organizing their work. On top of that, the entire life of the project is indicated as being involved with sitemap by constant updates and revises from time to time, so because of that, the details of a sitemap could be increased more and more as progresses during the product's lifetime. Especially, a sitemap is also beneficial in assisting project management, content administration, and the creation of specifications. In the example of a sitemap in Figure 24 below, it is explained that each block visualizes a page with a short text label as the short content description of that page, and lines and arrows visualize primary paths of navigation but do not necessarily reflect every detail of navigation such as back navigation to the homepage from each page in the sitemap. (Newman and Landay 2000.)
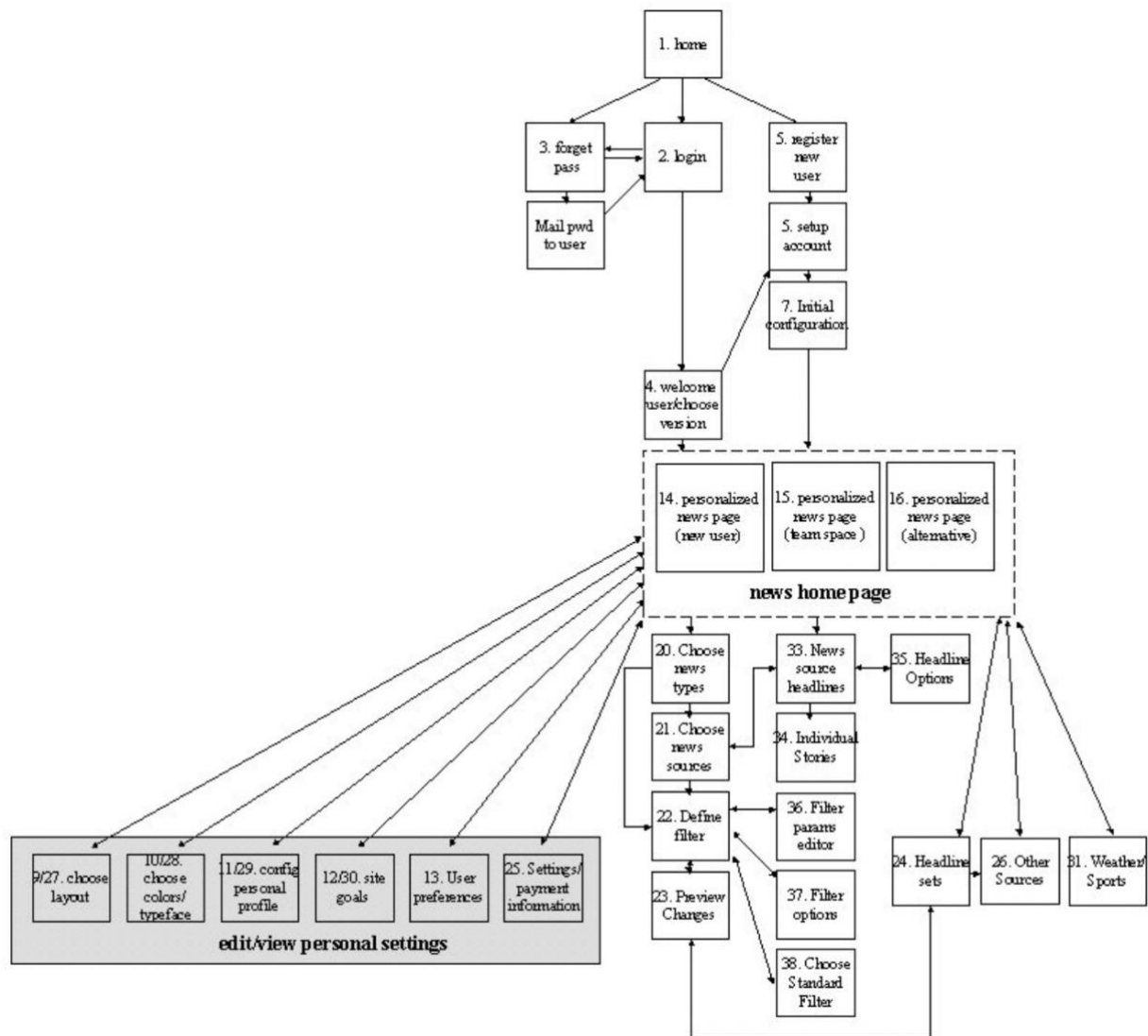
Figure 24. A hypothetical sitemap for a news website (Newman and Landay 2000)

Back to chapter 2 where the main components of IA are mentioned, the organization scheme and structure is one of them. Relevantly, Yale University also notices that the design of a sitemap is determined by the organizational scheme and labeling of that site. Additionally, they suggest that a sitemap should visualize the hierarchy of the site, and sites that have similar target users and purposes can apply similarities in their solutions to structure pages. Besides referring to a sitemap as a hierarchical organization of pages, Yale University also mentions another type of sitemap which is an actual page on a website showing the list of related pages so users can have an overview of general information and carry on their navigated direct clicks, instead of paying more effort to click through pages looking for what they need. To distinguish the second type of sitemap as described by Yale University, Pavlik (2023) calls it an HTML sitemap, and Pavlik emphasized that even there

are many referring to HTML sitemap as a less common type these days, it is still suggested as having an important role in optimizing the search engine for the site.

Image 22 and Image 23 are HTML sitemaps on H&M Group and Apple's websites, that show an overview of the hierarchical structure of content, and clickable links to navigate directly from it. However, according to the limitation of this research which is more about mentioning sitemap as representing IA work for internal teamwork, the HTML sitemap will not be focused on for further explanation. Additionally, Figure 25 by Pilgrim (2007) shows the evolutions of Sitemap designs in HTML format from 1999 to 2006 on website interface,
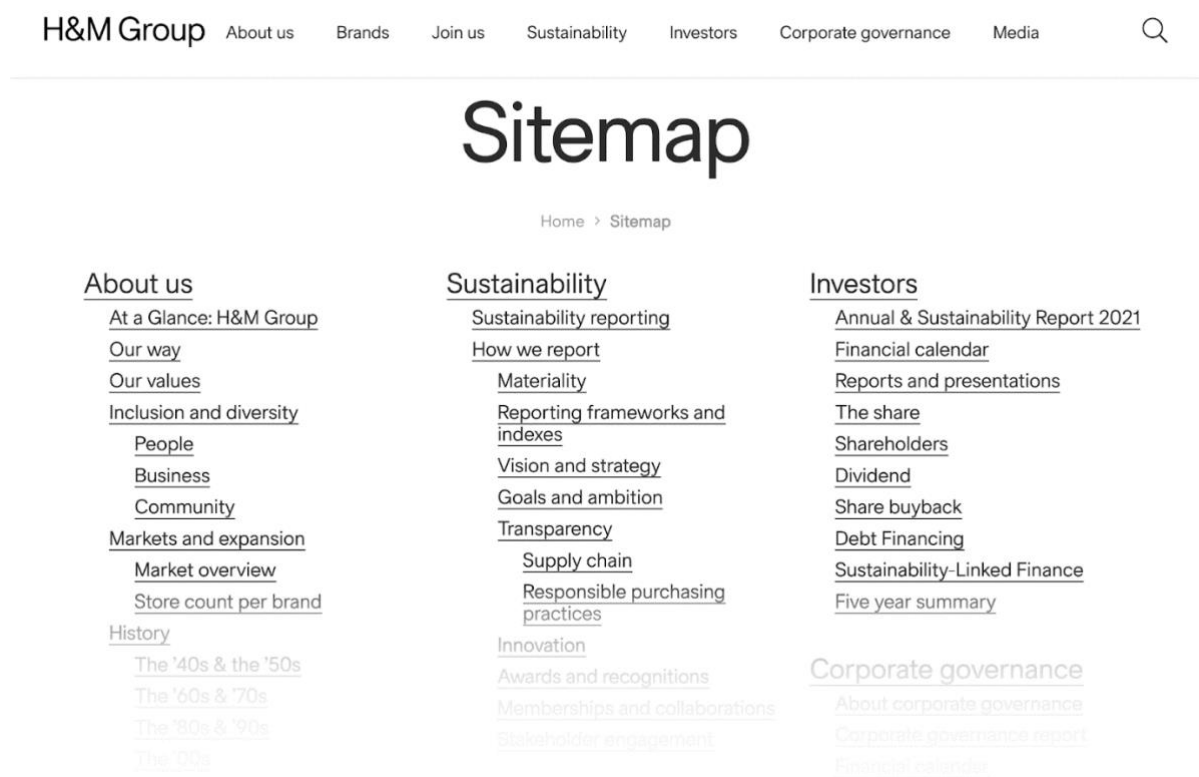

Image 22. HTML sitemap on a website displays to users the hierarchical structure of content and clickable links (H&M Group)
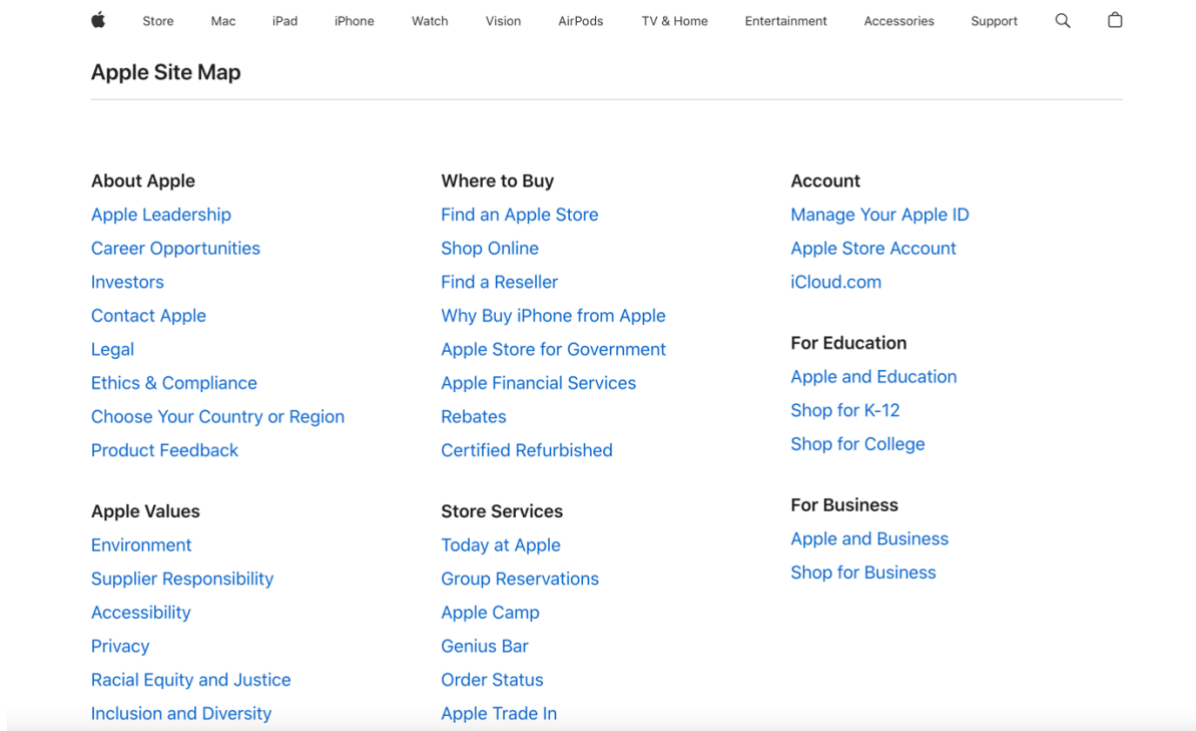
Image 23. Apple's HTML sitemap on the website version of 2024 (Apple)
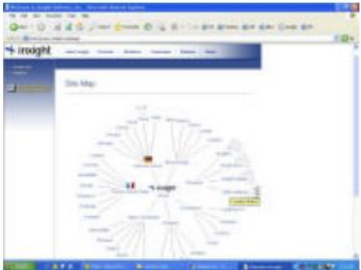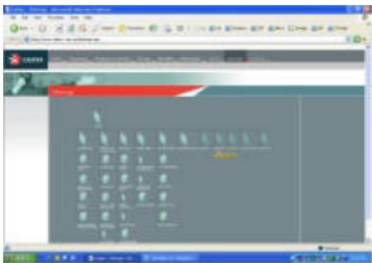
Sitemap Designs : 1999 and 2006		
	1999	**2006**
Apple		
Lycos		
Inxight		
Caltex		
Optus		

Figure 25. Sitemap designs in HTML format shown on website interface, evolutions from 1999 to 2006 (Pilgrim 2007)

Regarding the structure of a website or mobile application, Harvard University (2018) presents in their lecture notes the structure models of a site including three models which are hierarchical, sequential, and organic structures as in Image 24. The organic model is

also called a web-linked-site structure according to Lynch & Horton (2016) or the matrix model according to Justinmind (2019) and Mani (2023). Also, Harvard University shares the visualization of deep or shallow structures, which are also mentioned as deep or flat hierarchies by Whitenton (2013) as in Image 25, that are suggested by Whitenton to be used with careful consideration for being suitable with the information amount and content strategy for a good user experience. Relevantly, it could be referred to as having a relationship with cognitive load, explained by Orozco (2022) and Navacchia (2023) in Chapter 3, to avoid overwhelming users with the information shown.
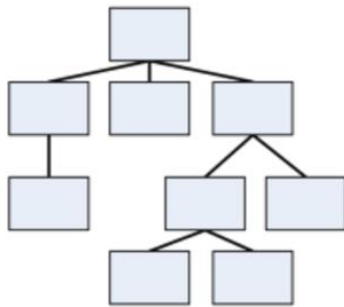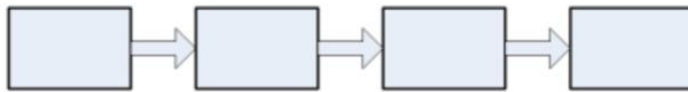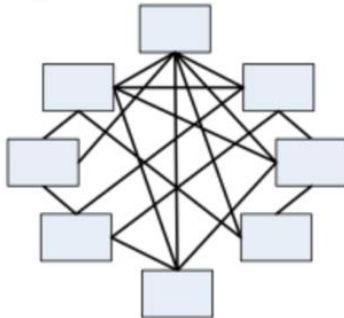
Image 24. Structure models presented in Harvard's lecture notes (Harvard University 2018)
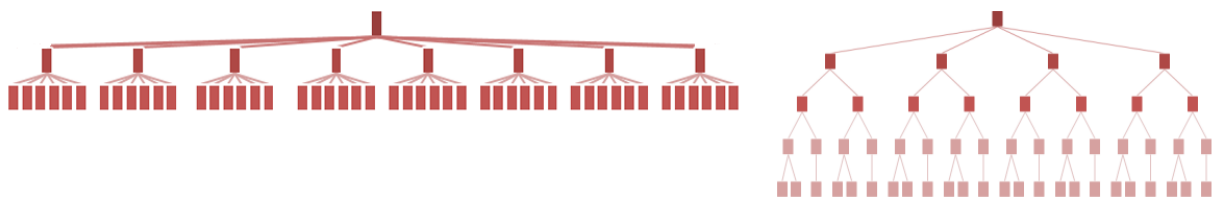
Image 25. Flat (left) vs deep (right) hierarchies (Whitenton 2013)

According to Tankala (2023), while structuring, arranging, and labeling content belongs to the practice of building an IA, IA is the foundation that is built before sitemaps, and sitemaps are created later to represent IA as the actual visualization of IA work. It is indicated by Tankala that an IA is an abstracted work while a sitemap is an artifact that actually can be seen and viewed. However, similar to the statement by Newman and Landay (2000) above, Tankala also suggests a sitemap does not usually or necessarily visualize all the detailed work that is related to IA, that is to avoid overwhelming and confusing stakeholders who are supposed to view a sitemap as an assistance of overview for following goals, necessary conversations, and decision makings on the workflows and scopes of the team. Figure 26 is the Sitemap of Nielsen Norman Group, shared by Cardello (2014), with levels of navigation differentiated by using colors. Image 26 is the actual homepage and global navigation on Nielsen Norman Group's website (2024), which shows the main menu having similar global navigation as shown in their sitemap that Cardello shared from 2014. However, there are some innovations regarding new items added and names changed on some labels.
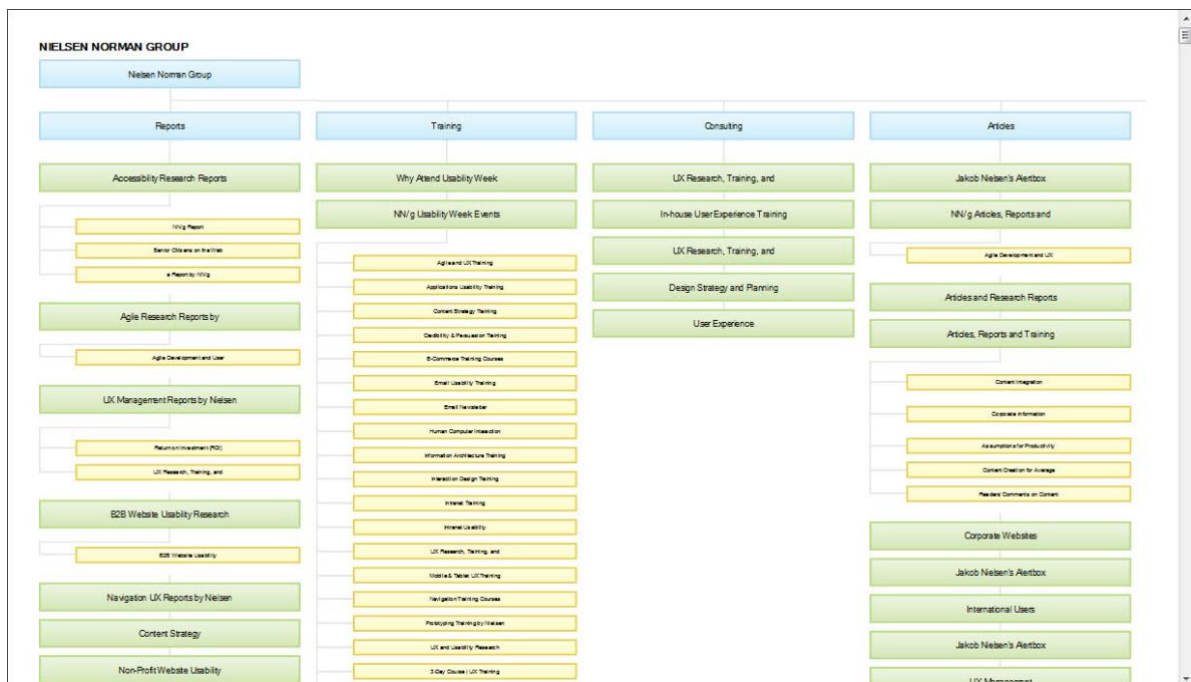
Figure 26. Sitemap of Nielsen Norman Group and its levels of navigation differentiated by using colors (Cardello 2014)

Image 26. The actual homepage and global navigation on Nielsen Norman Group's website (Nielsen Norman Group 2024)

5 IA in practice: Glassdoor vs. LinkedIn job search platforms

Research question for practical part and scope limitation

To narrow down the scope of this practical part to avoid significant time spent and analysis due to the huge amount of content and information on the whole Glassdoor and LinkedIn website, the research question was defined as:

How effective the information is provided and organized on the Jobs page of LinkedIn and Glassdoor to encourage international freshers to perform their job search in English within the European Union (EU)?

LinkedIn and Glassdoor were chosen to analyze and compare to each other because they both offer the ability for users to perform job searches as employees, and they both have English language choice for user interface globally no matter where users are located and where they are aiming to look for jobs. For instance, a user might be a non-Finnish speaker and could be located in any country, but they can look for jobs in Finland using the English interface. Some other platforms automatically show the local languages of the countries in which users were looking for jobs, and this would bring obstacles in choosing participants and their languages for usability study and obstacles in evaluating text labeling equally in the same language between participants, and text labeling is one of the core components of IA related to language on the interface. Therefore, Glassdoor and LinkedIn were chosen to compare in this practical part of the research.

The content analysis work was focused only on the Jobs page used on the website's desktop browser. To be clear, the Jobs page means the page appears after clicking the Jobs navigation text label on the main navigation menu. The clicked Jobs navigation text labels on the 2 platforms' main menus are shown in Image 27 and Image 28 below.

Image 27. LinkedIn main menu with clicked status in its Jobs section

Image 28. Glassdoor main menu with clicked status in its Jobs section

To be clear, besides job search purposes, LinkedIn is also the largest professional networking platform, and Glassdoor has rich features for employer branding solutions which make it the primary platform that job seekers visit for company reviews and research. However, to focus on the research question stated above, those 2 different highlighted

advantages of the platforms were left out of the scope of criteria to compare and evaluate in this research.

Besides, to have an overview of information flows on the Jobs page of Glassdoor and LinkedIn, Sitemaps, which are shown in Figure 27 and Figure 28, were documented based on the information and navigation titles displayed on their websites. The visualized flows were displayed according to the 3 first levels of navigation and focused on key things related to units that were going to be analyzed in content analysis research. Some initial things that were identified via the sitemaps are that Glassdoor seemed to have cleaner information displayed on the Jobs page because it just has 4 main navigation areas while LinkedIn had around 9 navigation titles including its footer. The footer of Glassdoor was not directly shown on the page but hidden below job listings, and managing job alerts on Glassdoor seems staying in a more obvious place compared to LinkedIn. Also, direct filter options on LinkedIn, without the hidden options, were shown as more diverse options. Furthermore, LinkedIn seems to have many direct advertisements to navigate regarding their premium membership or related services on display.
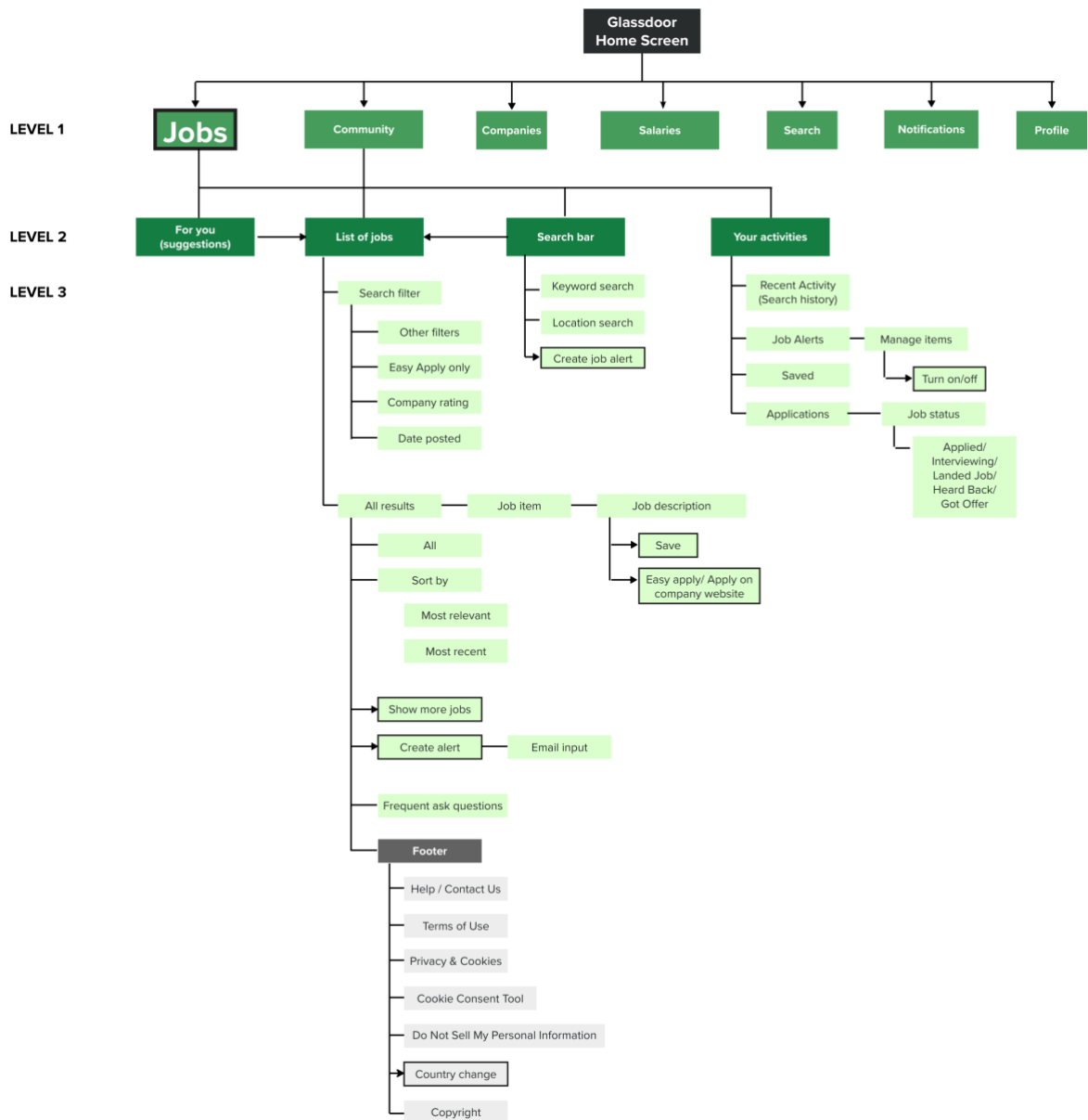
Figure 27. Sitemap of Glassdoor with 3 levels of navigation, focused on key things to navigate from the Jobs page
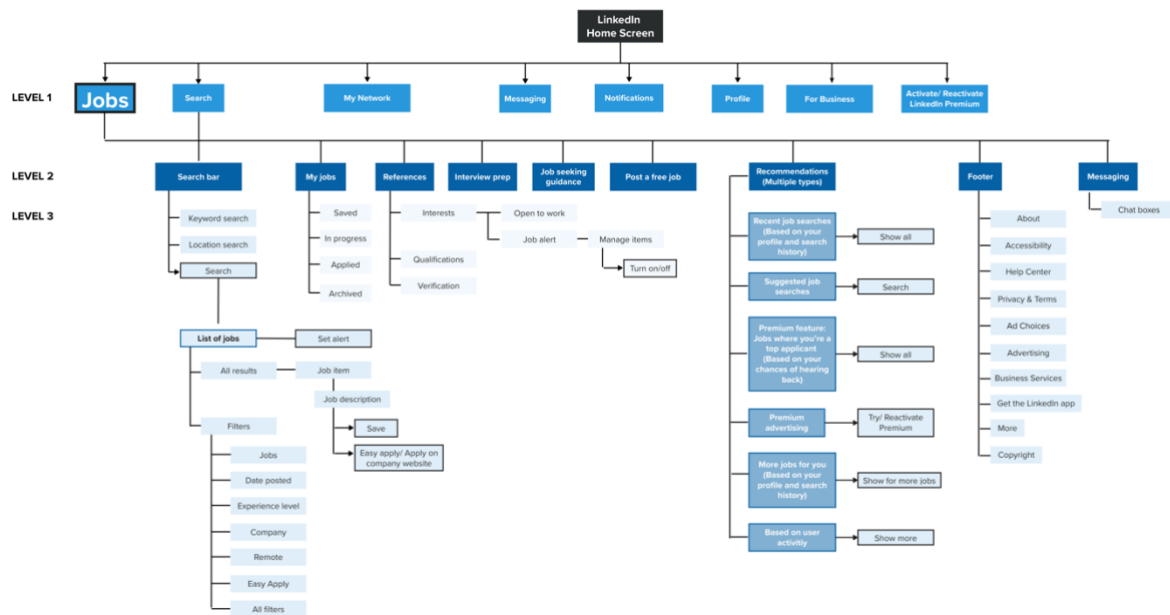
Figure 28. Sitemap of LinkedIn with 3 levels of navigation, focused on key things to navigate from the Jobs page

5.1 Content analysis on Jobs pages of Glassdoor and LinkedIn

Regarding the outcome of content analysis, as clarified in Chapter 1 regarding research methodologies, data collection, and limitations, other supportive research methods were conducted in this empirical research part. Therefore, after doing content analysis on Glassdoor and LinkedIn, usability tests for chosen main tasks on both platforms along with a questionnaire and interviews were applied to support the initial conclusion from the content analysis method.

5.1.1 Units to analyze based on 4 components of IA

Units to focus

Besides narrowing down to analyze the Jobs page of those 2 platforms, the information to be chosen to analyze was also focused on 4 core task areas that were significantly related to the purpose of finding a job, that were job search, job application, job save, job alert managing including create, edit, and turn off. Especially, it is necessary to mention that the areas to analyze were chosen because they were related to the 4 main components of IA, which are the organization system focused on organizational schemes, labeling system, navigation system, and search system, according to Rosenfeld and Morville (1998) mentioned in Chapter 2. Furthermore, two additional general sections were analyzed on 2 Jobs pages and core chosen task flows, one is to evaluate the effectiveness of supportive

information/ features to job seekers, and one is to evaluate the presentation of information on the interface because those were beneficial in studying how effective those platform provide information to users and assist users in consuming information, which are all related to IA as the relevant content is one of the key parts to build up a good IA. Also, during stages of analysis, things related to Cognitive Psychology (CP) were identified and discussed based on theoretical knowledge clarified in Chapter 3. The logic in navigation and labeling, which are visualized parts related to hierarchy, were also evaluated regarding knowledge in Chapter 4.

Coding stream table for evaluation

The coding stream was created based on features and functions related to 4 main components of IA focused on the core chosen task flows that participants would the usability testing to confirm the results extracted from content analysis. Figure 29 is a part of the coding stream evaluated in table form for content analysis research. The full evaluation table based on the created coding stream is presented in Appendix 1.

Items	Coding Scheme	Encoding Rules	Grades for Encoding	Objects to grade	
				Glassdoor	LinkedIn
Organizational Schemes					
Categorization of Filtering Options	Code 1	Clear and logical categorization of search filtering options, organized by industry, location, or other relevant criteria.	3		3
	Code 2	Search filtering options are categorized but could benefit from improved classification for better organization.	2	2	
	Code 3	Poor organization of search filtering options, leading to confusion or lack of relevance.	1		
Logic Order of Saved Job	Code 1	Clear organization of saved jobs, allowing users to easily retrieve and manage selections by category or preference.	3		
	Code 2	Jobs are saved but the organizational structure could be enhanced for better user understanding.	2		2
	Code 3	Poor organization of saved jobs, leading to difficulty in retrieval or management.	1	1	
Job Listing Presentation	Code 1	Clear and concise job listings with essential information (job title, company, location).	3		3
	Code 2	Job listings are present but lack clarity or essential details.	2	2	
	Code 3	Job listings are confusing or poorly presented.	1		
Job Details and Requirements	Code 1	Well-organized presentation of job details and requirements, allowing easy comprehension for applicants.	3		3
	Code 2	Job details are available but may require better organization for improved readability.	2	2	
	Code 3	Poorly organized job details and requirements, making it challenging for job seekers to grasp crucial information.	1		

Figure 29. A part of the evaluation table which is based on the created coding stream.

5.1.2 Summarize findings from coded data

The results from coded data, which were finalized by summing points from the evaluated coding stream, is that LinkedIn has more effective information providing & organizing on the Jobs page to encourage international freshers to perform their job search in English within

the European Union. Some significant points were identified as contributing to the final result.

LinkedIn had a clearer presentation of job listings and job details

One of those was LinkedIn had a clearer presentation of job listings and job details, which supports users better in quick scanning and spending less effort and time on reading information. This might be a factor related to cognitive load which is one of the things analyzed in Chapter 3, and by having that good experience, users would love to stay longer to continue their job search. To be more specific, on Glassdoor, the tight distance between words and text lines might make users feel tired when reading through many job posts at the same time because there might be already much information to consume plus the effort they need to make to read through for making decisions.

LinkedIn provides various personalized job recommendation sections

Secondly, LinkedIn displayed clearly different Job recommendation sections, as shown in Image 30, along with supportive information to state why those should be matched with users' interests such as those based on users' profiles, search history, or even chances of hearing back so users could know why those were relevant and could create the feeling of highly customized to them. From grouping into different relevant sections with supportive descriptions, we can see this is related to Gestalt principles and it supports users better in looking for information. Furthermore, explaining why they recommend those jobs in relevant sections matched users' backgrounds, skills, or hobbies, which is related to the effective study on users' mental models to create those. Also, the list of job recommendations on LinkedIn looks limited before clicking to see more so it seems easier to encourage users to decide to spend time to check and reduce their cognitive load as well. On the opposite side, Glassdoor shows unlimited options if users keep rolling down as in Image 29 which shows that Glassdoor displays all recommendations on one tab "For you" which seems to include all kinds of suggested items in one.
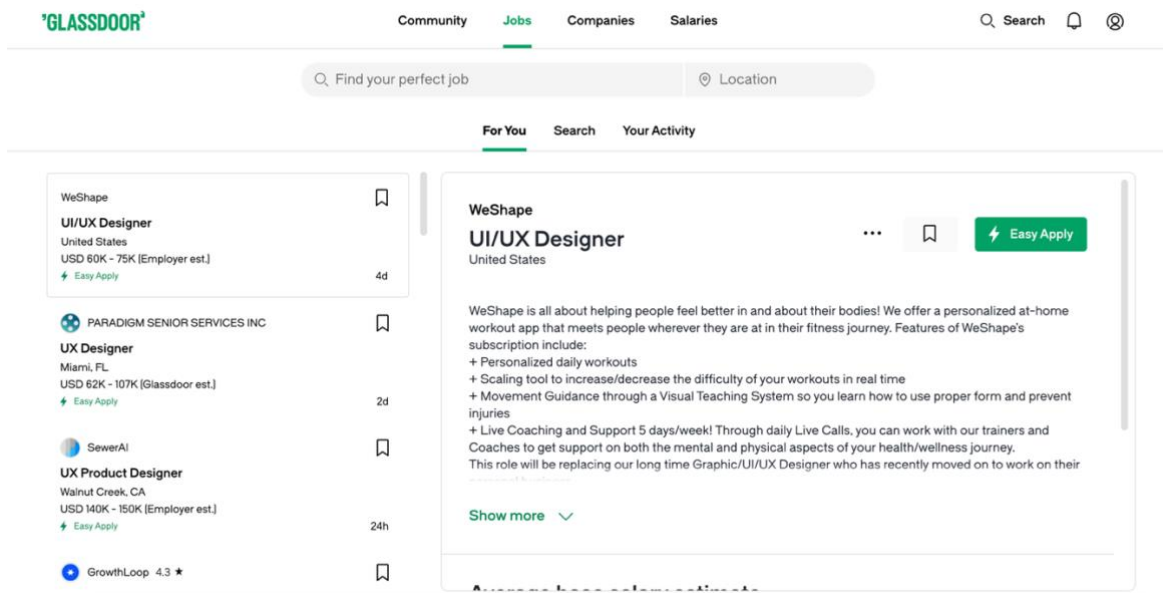
Image 29. Glassdoor displays all recommendations generally on one tab named "For you"
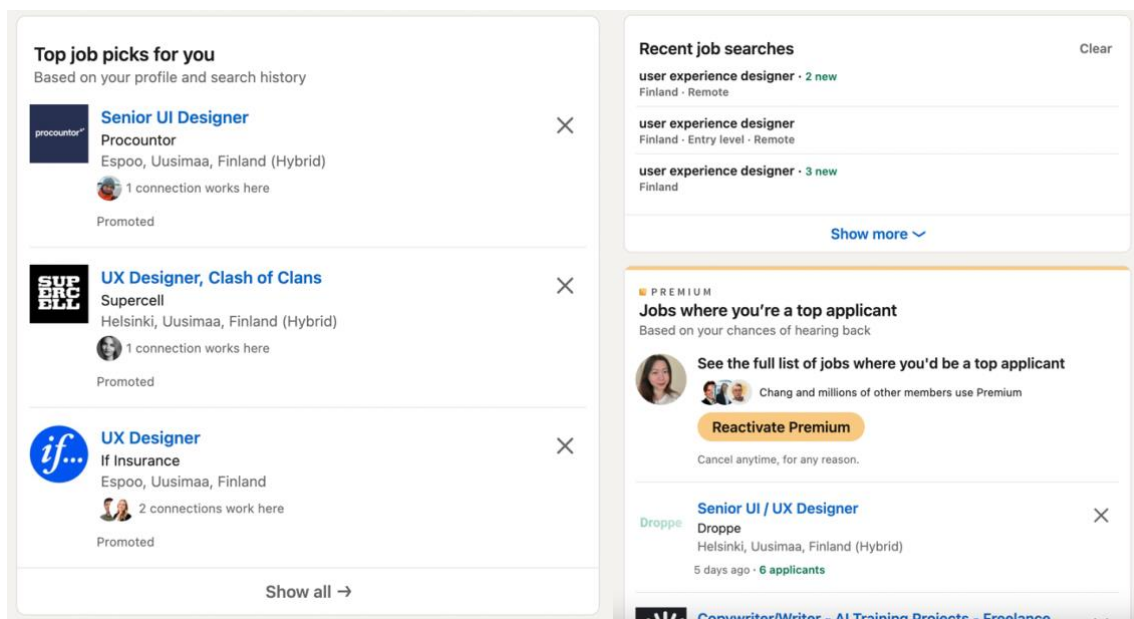
Image 30. LinkedIn has different sections of recommendations with supportive descriptions that help users understand easily

Glassdoor is better at helping users manage their job alerts regarding job notifications

The third highlighted point during the content analysis is Glassdoor assists users much better in managing their created job alerts. Those created job alerts usually send many emails and notifications to users to announce new relevant jobs, so by letting users easily customize those, Glassdoor helps users have a better experience.

At this point, LinkedIn's problem was raised from their navigation flow for managing job alerts, which could be related to mental models. When users look for places to edit or manage the actions that they took or information that they inputted, they tend to look for them in similar places like in other websites or mobile apps that they have been using. If the product fails in this or uses an unfamiliar path, this could confuse users. This could be because LinkedIn has the Settings section on the main menu but users need to go to another place to access the Preferences section to manage or delete the job alerts that they created, and settings and preferences terms are quite similar. The same situation happens when LinkedIn requires to look for another place to manage the CV versions uploaded. While on Glassdoor, everything is in the Settings section which is easily found from their main menu.

Other highlights found

Some other differences in their provided information, that also play a significant effect in assisting users with their job searches, are LinkedIn provides the possibility to upload and manage multiple CV versions while Glassdoor only allows to upload one at a time. It is only possible to replace the new one, not upload more than one on Glassdoor. Another thing is that on LinkedIn, users can quickly see the posting date and applicant count of jobs while scanning. Understanding that this information helps applicants to quickly see if those jobs are possible to apply for with higher chances to be contacted or so many competitors already. These are things that could be figured out by studying users' mental models.

5.2   Usability testing on Jobs pages of Glassdoor and LinkedIn

5.2.1   Data collection

As explained, the results of usability testing will support the results found from content analysis. Before the testing, a participant profile was created to recruit suitable participants which plays an important role in generating good results with smaller wrong degrees. This is qualitative research, in which the data was collected via questionnaire and interview after conducting required tasks, so there will be only 7 participants joining the testing.

Participant profile

The participant profile was set to require participants to be English-speaking fresh graduates or students who were currently in or going to be in their job-seeking, and participants needed to be living in the European Union or aim to look for jobs in the European Union. Participants were not people in the UX field and did not know about IA,

this profile filtering is to avoid bias in answers when people already had significant knowledge on the field.

Furthermore, participants were required to have been using LinkedIn and Glassdoor for job-seeking actions for at least 1 month to not more than 3 months, this requirement is to avoid participants who are too familiar with both or one of the platforms, which could lead to bias in choosing the easier one to use due to their regular use on that, or could not identify pain points in new users' perspectives to bring objective results on available problems.

The participants are not necessarily completely new users because there were tasks that only participants who had been using, uploading, or creating data such as CV versions, saved jobs, submitted applications, and trying to manage them can help to answer the related questions. Also, the people who wanted to participate were asked to do a self-evaluation on a 1 to 5 scale which was equally from not familiar at all to very familiar, and only people from 1 to 3 were chosen to join the test.

Data collection: tasks to conduct, SUS questions, and interviews

The testing was unmoderated and conducted remotely from 18 February 2024 to 23 February 2024, follow-up interviews were also during this period after a participant announced they had done the required tasks and answered the rating questionnaire. Participants are required to complete 4 main task areas below on each platform, which include some sub-tasks related to the flow, before answering the questionnaire:

1. Job search (search for jobs that suit participants' needs, create a profile for job search if required)

2. Job application (apply for at least 1 job that was able to apply directly on the platform, not the one that was redirected to apply on its company website. After that, find the place to check the application history)

3. Job save (save at least 15 interested jobs, then close the website. After that, open the website again and find the place to check those saved jobs)

4. Job alert managing (create at least 1 new job alert, then close the website. After that, open the website again, find the created alert to edit, and then turn off the alert)

After finishing the required tasks on each platform, participants answered a series of System Usability Scale (SUS) questions. Participants then submitted the answers and announced with the author their completion, and the author followed up with them by interviews. To be clear, the purposes of the interviews were to gain more qualitative data as well as to confirm their answers on SUS questions matched with what they shared while being interviewed.

System Usability Scale (SUS) questions: 3 parts and their goals

As clarified in previous Chapters, a good AI involves relevant content to its target users and has good information organization that helps users navigate and consume information easily, and the final goal of a good IA is for users could complete tasks on the product with ease to be satisfied and keep coming back to use the product. Therefore, the SUS questions were created to have evaluations from participants on main aspects, regarding IA's components, that could help to see the effectiveness of how Glassdoor and LinkedIn provide and organize content as well as features on their websites to support job seekers.

There are 3 main parts consisting of 21 questions on the same rating scale from 1 to 5. The participants needed to answer these 21 questions for each platform:

- The 10 first questions were for evaluating the easiness of conducting required tasks.

- The next 3 questions were for evaluating the easiness, effectiveness, and accuracy when using search filtering.

- The 8 following questions were for rating intuitiveness and relevance in the information display.

After that, in interview, they were asked to compare 2 platforms by answering:

- 6 multiple-choice questions to choose one of the platforms.

- 7 open-ended questions with some follow-up questions when necessary to encourage them to share their perspectives and thoughts more. These open-ended questions also supported confirming results from their ratings again.

The full questionnaire is attached in Appendix 2 and Appendix 3.

5.2.2   Data analysis & summary

LinkedIn was preferred over Glassdoor

As proportions shown in Figure 30, all participants joining the usability test chose LinkedIn as their preferred job search platform compared to Glassdoor. The reasons mainly were from their better experience on LinkedIn when using a search system with better filtering options and more matched results provided, better-personalized information such as job filtering options regarding user expectation by being affected by job market trends and job recommendations based on their profile as from skill set and search history. Relevantly, content is one of 3 key factors contributing to IA as clarified by Rosenfeld & Morville (1998) in Chapter 1, and the carefulness in research, preparation, and adaption of content

quality and relevance to users play a key role in attracting users to visit and stay on the site as emphasized in Chapter 4, also the continuous research, audit, and necessary updates on the content were mentioned as involved to the continuous success of the digital product. Due to that, LinkedIn was suggested as bringing better outcomes from their process by having most of the participants satisfied and preferring to use it over Glassdoor for their job-seeking in the EU.

In addition, participants also felt more comfortable with fonts and the layout of job lists and job details displayed on Linkedin, which helped them more easily scan job posts and read information while being less tired compared to Glassdoor.

1. After doing the required tasks, which platform do you prefer to use for job search? (only specifically mentioning their Jobs page, not the whole platform)
7 responses

Glassdoor's Jobs page
LinkedIn's Jobs page

100%
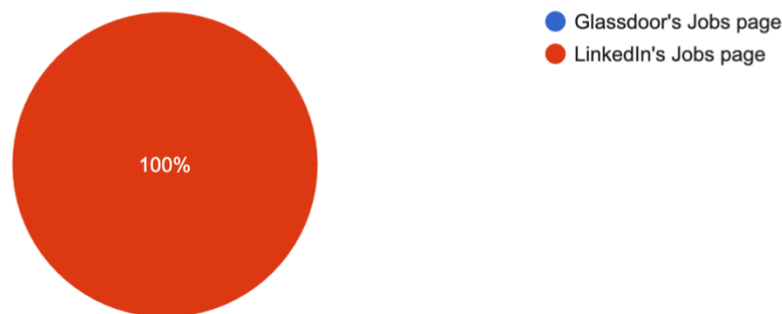
Figure 30. All participants chose LinkedIn as their preferred job search platform compared to Glassdoor.

However, 100% of participants preferred using LinkedIn did not mean that LinkedIn was perfect compared to Glassdoor. The fact that Glassdoor had some aspects that were better than LinkedIn. The detailed results came from patterns that were identified by inputting all answers from interviews as the field notes, also called qualitative notes, and then classified using the affinity mapping method, shown in Figure 31 and Figure 32, which is a popular technique to categorize gathered qualitative information to generate patterns for valuable insights. The author identified insights & patterns based on the main components of IA and relevant content to target users. These insights were used to support insights from content analysis, which is going to be clarified in the following part this, also provides opportunities for improvements on Glassdoor and LinkedIn. The insights were discussed together with data from rating scale questions below to support each other.

Data set
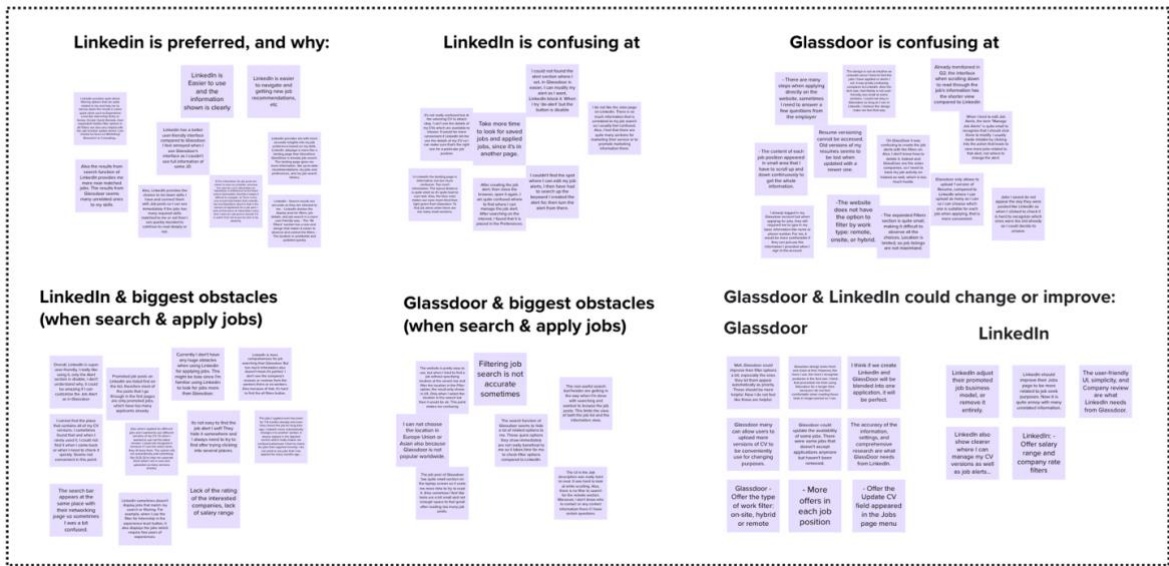
Figure 31. Initial data from interviews regarding questions was inputted as field notes, also called qualitative notes, to prepare for using an affinity map to classify.

By classifying similar answers stating similar problems or comments, 9 patterns were identified that also related to the main components of IA. Some significant patterns are discussed below.
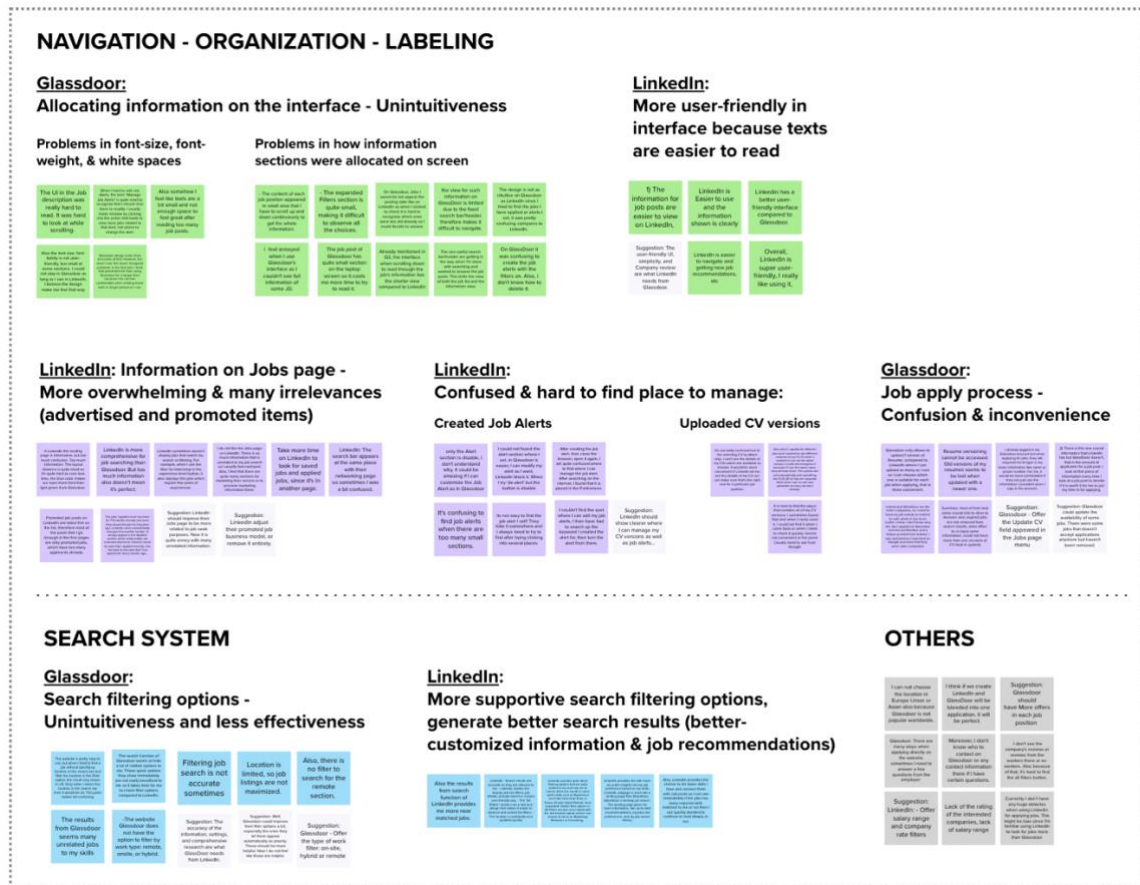
Figure 32. Results from interviews and usability tests were classified using affinity mapping.

Navigation system - Organization system - Labeling system

Glassdoor: unclearness in allocated information and fonts on the screen

On Glassdoor, a pattern was shown regarding this IA component, which was the unclearness in how they allocate information on the interface. The problems mainly from their Jobs page has unsuitable organizing sections which made the area to check job lists and job details too small on the screen while the search bar area always took much space on the screen even though they did not use it when reading job posts, and users found that discouraging to stay long on the website by having to make more effort when checking job posts.

Another problem was the unsuitable font sizes and font weights, which caused participants inconvenience and uncomforting when reading texts, adding more obstacles for users while they usually had to read through many job details when in job seeking period. The problems regarding font sizes and font weights also are related to text labeling and the hierarchy of information display that is involved in the organization system, and those might also affect the cognitive load of users when making them tired and not want to stay longer on the site.

At this point, the result also supported for grades of Glassdoor's visual hierarchy for key information on content analysis, which was only 2 compared to LinkedIn at 3. Furthermore, this is related to Gestalt principles in CP due to obstacles of quick and easy grouping of information by lacking clear hierarchy in information display. Figure 33 shares the number of choices from participants, indicating that the information on Job posts on Glassdoor was evaluated as harder to view compared to LinkedIn.
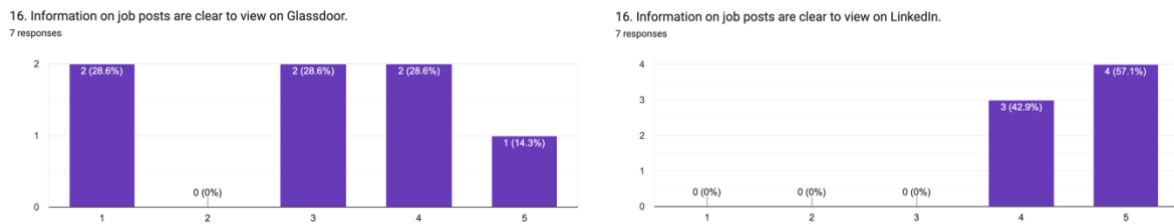
Figure 33. Information on Job posts on Glassdoor was evaluated as harder to view compared to LinkedIn

LinkedIn: overwhelming information on the Jobs page vs. simplicity of Glassdoor

On LinkedIn, it was commented as more user-friendly than Glassdoor in the interface because participants found information is easier to read compared to Glassdoor. However, participants suggested LinkedIn to improve for a more simplified interface as of Glassdoor. As numbers shown in Figure 34, Glassdoor was identified as having less overwhelming information displayed on the main Jobs page when just clicking on the Jobs navigation text label on the main menu. More users thought that the information on the Jobs page of LinkedIn was too overwhelming by many sections mixed with advertising and promotions. The Jobs page of Glassdoor was commented as being cleaner in the information display and having more direct information for job seeking. Regarding CP, the overwhelming of information usually requires users to put more effort into consuming content as explained.

According to Figure 35, most of the participants agreed that information on Glassdoor's Jobs page including keywords or terms that are clearer for users to understand where to navigate compared to overwhelming information on LinkedIn's Jobs page. This could explain the effectiveness of naming labeling and the amount of displayed information to avoid cognitive load on websites because Glassdoor has a more simplified Jobs page. Image 31 shares that screen of the Jobs page of Glassdoor, which was more simplified with more direct information for job seekers. Following that, Image 32 displays the Jobs page of LinkedIn with more overwhelming information from many different sections, advertisements, promotions, and many navigating options, which increases the cognitive load of users and

prevents them from taking quicker and easier actions unless they are very used to the page already.

8. Which Jobs page do you think the display of information is clearer (less overwhelmed feeling)?
7 responses
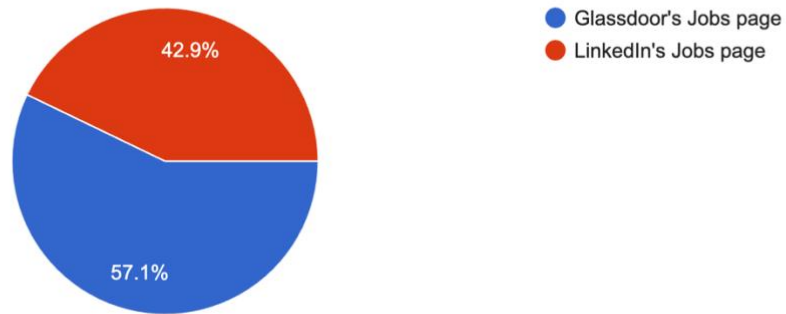
Glassdoor's Jobs page — 57.1%
LinkedIn's Jobs page — 42.9%

Figure 34. Glassdoor was identified as having less overwhelming information displayed on the main Jobs page

15. On the overall, keywords/ terms on the Jobs page (the page was shown after clicking the Jobs section on the main menu) is understandable to know where to navigate on Glassdoor.
7 responses
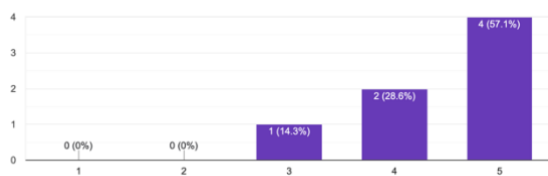
15. On the overall, keywords/ terms on the Jobs page (the page was shown after clicking the Jobs section on the main menu) is understandable to know where to navigate on LinkedIn.
7 responses
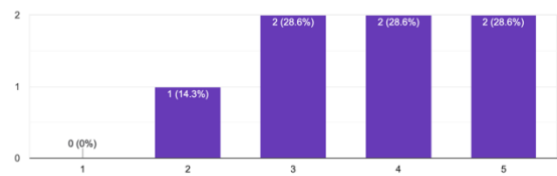
Figure 35. Information on Glassdoor's Jobs page including keywords or terms which were evaluated as clearer for users to understand.

Image 31. More simplified Jobs page of Glassdoor

Image 32. The Jobs page of LinkedIn with more overwhelming information display

The information organization on the Jobs page of LinkedIn was commented as more overwhelming compared to Glassdoor because there were many different sections shown, and also many irrelevant information displayed for advertising and promoting. Most of the participants also felt confused because they were not sure where to navigate to find places for managing their uploaded CV versions, and especially their created job alerts were commented as being hidden causing inconvenience for them to adjust or turn them off to avoid many notification emails coming. This problem also lay in how relevant information was grouped or organized near each other as mentioned in Gestalt principles, and the

overwhelming provided information also led to high cognitive load in users as explained in Chapter 3 about CP. From Figure 36, it is shown that most of the participants found it hard to find and manage job alerts on LinkedIn, and from Figure 37, Most of the participants agree and strongly agree that it is easy to manage their uploaded CVs on Glassdoor. The negative choices were made because they found they could not keep more than 1 CV on Glassdoor. While on LinkedIn, participants disagreed or were neutral.
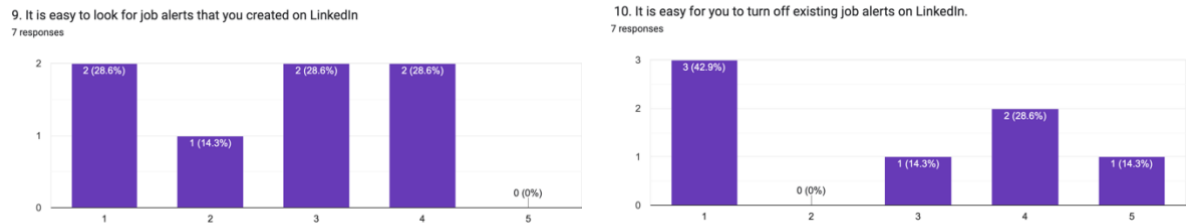
Figure 36. Most of the participants found it hard to find and manage job alerts on LinkedIn.

Figure 37. Most of the participants agree and strongly agree that it is easy to manage their uploaded CVs on Glassdoor.

This pattern is matched with the grades based on the coding stream for content analysis, where Linkedin had 2 and Glassdoor had 3 in intuitiveness in the user interface with support for smooth navigation. Additionally, the use of familiar icon labeling is a factor related to mental models in CP, such as the alert with bell icons, or job-saving related information and action button displayed with the paper mark icon to support users in identifying the meaning when quickly scanning without reading every text labels, that also helped in reducing cognitive load.

Glassdoor: less supportive information and features on applying process

Some points that made Glassdoor less preferred by participants in the final results was from lack of some crucial information that helps to drive users to decision-making in whether a job is suitable and worth for applying or not. For example, participants expected to see the

number of applicants and the posting date which were commented on as very helpful on LinkedIn to contribute to their consideration. Understanding that this information helps applicants to quickly see if those jobs are possible to apply for with high chances to be contacted or so many competitors were also related to mental models of users. Figure 38 shares that most of the participants were more satisfied with the information provided on LinkedIn, which is more likely to drive them to make decisions or take actions in the job-seeking process.

Also, they found an inconvenience when Glassdoor only allowed them to upload 1 version of their CV while LinkedIn allowed for more so they could easily choose when applying. Another problem that was raised was, that on Glassdoor, expired jobs were usually not removed from search results, and some extra effort had to be made to re-input the same information. Moreover, a participant raised a concern related to information when they applied for a job from Glassdoor but received follow-up emails from Indeed which is a sister company of Glassdoor, in which they then needed to create another account on Indeed to manage their application. Regarding mental models, understanding that some applicants do not only apply for one job kind or have many different customized versions of their CVs that they would love to use for different jobs when applying might be what made LinkedIn allow users to upload and store more than 1 CV version.

Those mentioned problems related to the providing and organization of information throughout the job-seeking process of users, and this was graded on the content analysis part as well, where Glassdoor was graded with 1 and LinkedIn with 3 at 2 parts in the section of supportive information and features to job seekers.
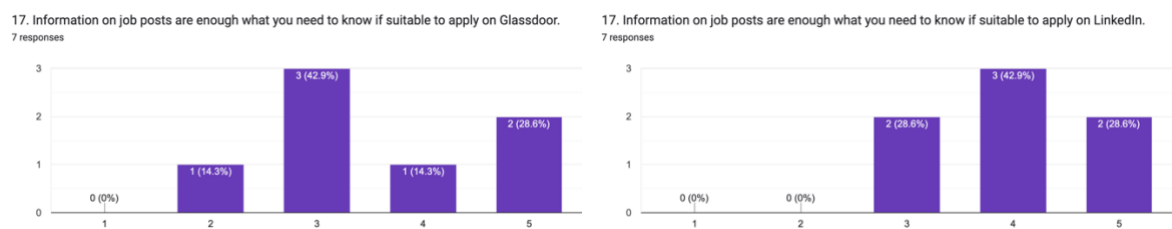
Figure 38. Most of the participants were more satisfied with the information provided on LinkedIn

Search system

LinkedIn: well-personalized and more matched search results & job recommendations

According to Figure 39, the search system on LinkedIn was more highly evaluated by most of the participants for having a more user-friendly filtering system with more useful options and helping users narrow down the results in some quick clicks such as experience level like internship, entry or senior, and working forms as onsite, hybrid or remote. Also, their additional expanded filter options in all filters are helpful with the Job function option where users can choose to focus on marketing, research, consulting, etc.,

The search system of 2 platforms has things related to CP in cognitive load and mental models. If there were many options for filtering might also lead to cognitive load, and relevant filter options as evaluated if those are helpful or not related to the mental models of users. For example, the shifting from on-site work to hybrid or remote work leads to the interest of job seekers that they expect or prefer that there was a filter option for them to classify jobs based on those forms, or the understanding of how users preferred jobs that are easy for them to apply leading to job search platforms having sections to filter jobs into Easy Apply call-to-action button or not.

Along with that, the search results and job recommendations from LinkedIn were complimented as better personalized based on the skill set of users & search history so it provided more matched results as potential jobs to users. Also, the way LinkedIn displayed groups of similar jobs or similar types of relevance helps users decide where they should stop to spend more time, which was mentioned regarding Gestalt principles in CP.
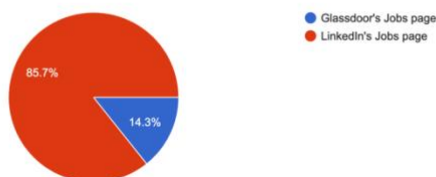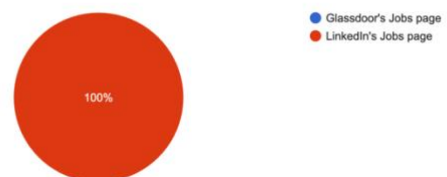
Figure 39. Many participants chose LinkedIn as having an easier search function to use and generate more useful search results

6   Conclusion

This chapter is the conclusion part of the research, which provides answers to the research questions, clarifies the reliability and validity, and provides suggestions for future research.

6.1   Answers to research questions

This chapter is the conclusion part of the research, which provides answers to the research questions, clarifies the reliability and validity, and provides suggestions for future research.

The objective of this study was to discover the role of information architecture (IA) in bringing a good user experience (UX) on digital products such as websites or mobile applications.

Before answering the main research question, answers of sub-questions are provided:

What does it make IA has a significant impact on UX?

Via 4 main components of IA which are the organization system, labeling system, navigation system, search system, and the nature dependence of IA by user, content, and context, all were indicated by Rosenfeld and Morville (1998), it is clear to see those are all related to users and parts of building a digital product such as a website or a mobile application. As clarified, to have good navigation on the interface, those related hidden parts of work needed to build a good IA as a base frame of a product would support significantly which and how information would be organized on the interface to help users navigate, and that affects to the satisfaction of users in their experience while using a product.

Is Cognitive Psychology (CP) related to IA and UX? And how is the relation?

3 aspects of CP listed in Chapter 4 which are mental models, Gestalt principles, and cognitive load, show a notable relationship between CP and IA as well as UX. IA involves how content or information was prepared and organized on the interface for users to interact with, and the cognitive load is directly related to the effect in the amount of information shown to users to consume. Besides, the mental model aspect clearly clarifies the nature of humans when having a tendency to find and understand information to navigate easier due to their current experience and their familiarity with things around which they have been used to interacting or perceiving that way. The importance of mental models also has led to research methods such as card sorting to discover the perception of users to support how information should be grouped or organized. In addition, Gestalt principles show the relationship in how information was organized or grouped on the interface can help users recognize or understand more easily due to the nature of the human brain in seeking patterns and looking for order in disorder.

What are the techniques & objects contributing to an effective IA?

Techniques and objects were highlighted in Chapter 4 including doing initial research to understand users and the context such as competitors, business goals, current resources, any constraints, etc. From those, content is planned, and then it is suggested to apply a popular research method which is card sorting to discover mental models of users, based on that to classify and organize content to support users in perceiving. Besides, labels as text or icons to support users in navigating could be prepared, and then card sorting is also suggested as one of the most popular research methods to test with users and modify labels and groups of content that are related to the navigation system if needed. Later, the structure and hierarchy of the information started to be built together with a taxonomy system to support the organizing in hierarchical relation to classifying and organizing metadata. Furthermore, a content inventory would be created to support managing and updating information throughout the product. Finally, a sitemap is built to visualize the structure of IA to support stakeholders to have an overview conveniently. Those techniques in research could be repeated for further understanding to provide better or updated information to users, and other related things such as labels, taxonomies, content inventory, or sitemaps would be updated accordingly to maintain a united system regarding IA.

How can a digital product be evaluated if it has an effective IA or not by only using or taking actions on its interface?

From the iceberg visualized by Rosenfeld and Morville (2006) and adapted by Davis (2011) in Figure 21 and Figure 20, it is suggested that the interface and navigation as what are finally shown to users after all the hidden works regarding IA such as content preparation, taxonomies, structure, hierarchy, etc., as shared. Therefore, it could be considered that the quality of navigation would play a key role in revealing the quality of IA beneath which is the product's base frame regarding information organization and it directly affects users' satisfaction while interacting with the product's interface. Therefore, in the practical part of this research in Chapter 5, the author analyzed the information organized on the interface on the Jobs page from the main menu of Glassdoor and LinkedIn, also analyzed the flows that support freshers to look for jobs starting with actions from that Jobs page. All units to focus on content analysis from the interface were decided and classified based on the 4 main components of IA, and then results from usability testing and interviews also supported the evaluation from content analysis. Via this work, it can be seen that the quality of users' satisfaction in navigation to complete their goals on the interface can reveal the quality and logic of IA related hidden works.

Now, to answer the main question:

Why is information architecture (IA) important to bring a good user experience (UX) on digital products such as websites or mobile applications?

From Chapter 2, 4 main components of IA and the nature dependence of IA play important roles in answering why IA has a significant impact on the user experience of a digital product. As clarified in the following Chapters, to have good navigation on the interface, the hidden parts needed to work on to build a good IA as a base frame of the product would support significantly which and how information would be organized on the interface, and those hidden works and related objects mentioned in Chapter 4, which can be seen as related to 4 main components and dependence factors suggested by Rosenfeld and Morville. To be specific, a digital product such as a website or a mobile application mainly serves the users through their interaction with the product's interface. How users can navigate smoothly throughout the product to look for what they need and complete their goals regarding the purpose why they use the product will decide their satisfaction as one of the main parts of having a good user experience on that product. As mentioned, those works include preparing for matching content to users' needs, effectively organizing them, intuitive navigation titles to be created to support users' cognitive psychology aspects to help users easily perceive and understand where to navigate and building a good taxonomy system to support users with beneficial search results, etc. All of those contribute to a good user experience that cannot randomly happen or be created on the interface without those good works regarding IA. Additionally, the results from the practical part in Chapter 5, by content analysis and usability testing with interviews on the Jobs page from the main menu of LinkedIn and Glassdoor, which were collected and analyzed focusing on 4 main components of IA, also brought supportive results to the research despite some limitations were mentioned.

6.2   Validity and reliability

Secondary and primary data sources were used in this thesis. Secondary data were referenced via online articles and blogs on verified websites, as well as via books, reports, and previous research of experts in the industry. Furthermore, primary data was collected by the author by using the content analysis method together with further support research methods including usability testing, an SUS questionnaire which is to evaluate participants' experience while doing tasks for the usability test, and finally interviews with open-ended questions to confirm again their answers in SUS questionnaire as well as to get more information from participants regarding the results from usability test and SUS questionnaire. Various methods were applied as a combination to collect primary data to support each other for stronger confirmation of the results. All those supportive data also

gave key findings as the answers to the research question and sub-questions which were set as objectives for this thesis. Due to that, the research can be concluded as reliable.

However, it is important to keep in mind that the usability testing, SUS questionnaire, and interviews were conducted with participants who were freshers using Glassdoor and LinkedIn to look for jobs in the European Union. It is worth mentioning that all 7 participants were international students in Finland. Therefore, the perspectives might not be the same for people who are living or looking for jobs in other areas, which could be done with different tendencies, habits, or expectations.

Moreover, job results from Glassdoor and LinkedIn could not show the same even using the same basic filter to search because the shown job posts were based on how Glassdoor and LinkedIn were chosen to be used by recruiters for their job posts and advertisements. However, this limitation was identified by the author while analyzing the data to avoid taking biased answers where participants might prefer a platform over another platform because of the number of jobs shown. Besides, different unique advantages of each platform, such as Glassdoor with a great reputation in reviews of companies, salary, and benefits, and LinkedIn as a big networking platform, were identified from the beginning and excluded during doing research and data analysis.

6.3   Suggestions for future research

More research about the impact of IA on UX should be conducted to emphasize the importance of works related to IA should be focused on to create a good user experience. Due to the limitation that is clarified in Chapter 1, IA-related works are usually hidden works that have ownership by that product's organization. Therefore, the author suggests that the research on IA impact on the UX of websites or mobile applications would be more supportive when having the right to conduct with provided resources of the organization regarding their current available IA works or for necessary related resources during the IA building process.

Regarding the practical research on the Jobs page from the main menu of Glassdoor and LinkedIn. The author suggests further research to be conducted to reveal more about mental models of target users which could bring supportive results or direction for further improvement on some problems found via the author's practical research, and because as explained, mental models of humans are not fixed but always changing. In addition, more usability testing should be conducted with various user groups and locations to bring stronger pieces of evidence as both Glassdoor and LinkedIn are international job search platforms, and they might have their own target segments which affect how they adapt to

their product. Specifically, the cultures and job market trends in different locations could also affect to users' goals and behaviors differently.

With the output from this thesis, IA works and related research are suggested to be taken more seriously in the user experience design process. For products that had been created a long time ago without any proper documentation regarding IA works, some basic works such as content inventory and sitemap are suggested to be documented on the current product, which could be beneficial for the team and stakeholders to initially have an overview of current flows that can bring the possibility to identify any holes that need to be improved, and then the further necessary works could be developed accordingly. For products that have been working on IA and have necessary documentation already, continuous research on trends and mental models of target users would help to reveal more necessary updates to keep the information on the product supporting well to users' needs. With products that start to be built from scratch, proper initial research is recommended for a good starting point as a strong base, and necessary works are recommended to follow.

In conclusion, establishing a good foundation in IA works leads to a stable system of beneficial content and logical information organization for users on websites or mobile applications. Also, it results in efficient time and resource management during maintenance, updates, and modifications for the product in further development and improvement to consistently bring a good user experience to the whole product over time.

7 Summary

The study purpose of this thesis is to have a stronger understanding of the role of information architecture in contributing to user experience on websites or mobile applications. Previously, IA has been suggested as related to assisting users to navigate smoothly, complete their usage goals, and bring satisfaction to users, which are the ultimate purposes of a product and have a significant effect on its success. In addition, some concerns regarding the lack of application of IA in UX also were raised. Therefore, a main research question was set and sub-questions were developed to support looking for the answer to the main question.

The research carries both theoretical and empirical parts. The theoretical part provides knowledge from previous research as secondary data. Chapter 2 is about the definition and history of IA, and 4 main components of IA were mentioned. Chapter 3 is about the relation between cognitive psychology and IA as well as UX. Next, Chapter 4 highlights techniques and objects that support building an effective IA. The following Chapter 5 is the empirical part using several methods to support results of each other including content analysis, usability testing, SUS questionnaire, and interviews. All data extracted and collected from the empirical part were analyzed based on knowledge provided by theoretical parts. Furthermore, Chapter 6 provides the answers to sub-questions as well as the main research question. Additionally, it brings up an evaluation of the validity and reliability of the research, and suggestions for future research. In the last chapter, a summary of the whole thesis work was written.

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Appendices

Appendix 1. Coding Scheme Table for Content Analysis

Focus areas/ units to analysis:

4 main components of Information Architecture: Organizational Schemes, Labeling System, Navigation System, Search System

Additional section 1: Supportive information & features to job seeker

Additional section 2: Information presentation on interface during job seeking & applying process (General evaluation)

Items for evaluation	Coding Scheme	Encoding Rules	Grades for Encoding	Objects to grade	
				Glassdoor	LinkedIn
Organizational Schemes					
Categorization of Filtering Options	Code 1	Clear and logical categorization of search filtering options, organized by industry, location, or other relevant criteria.	3		3
	Code 2	Search filtering options are categorized but could benefit from improved classification for better organization.	2	2	
	Code 3	Poor organization of search filtering options, leading to confusion or lack of relevance.	1		
Logic Order of Saved Job	Code 1	Clear organization of saved jobs, allowing users to easily retrieve and manage selections by category or preference.	3		
	Code 2	Jobs are saved but the organizational structure could be enhanced for better user understanding.	2		2
	Code 3	Poor organization of saved jobs, leading to difficulty in retrieval or management.	1	1	
Job Listing Presentation	Code 1	Clear and concise job listings with essential information (job title, company, location).	3		3
	Code 2	Job listings are present but lack clarity or essential details.	2	2	
	Code 3	Job listings are confusing or poorly presented.	1		
Job Details and Requirements	Code 1	Well-organized presentation of job details and requirements, allowing easy comprehension for applicants.	3		3
	Code 2	Job details are available but may require better organization for improved readability.	2	2	

	Code 3	Poorly organized job details and requirements, making it challenging for job seekers to grasp crucial information.	1		
Company Information	Code 1	Clear presentation of company information, including company name, industry, and a brief overview.	3		
	Code 2	Company information is present but may need improvements in terms of clarity or additional details.	2	2	2
	Code 3	Lack of clear company information, leaving job seekers without essential context about potential employers.	1		
Relevant Job Recommendations	Code 1	Presentation of relevant job recommendations alongside the current job listing, enhancing the job seekers' exploration.	3		3
	Code 2	Job recommendations are present but may need improvements in terms of relevance or visibility.	2	2	
	Code 3	Lack of relevant job recommendations, missing an opportunity to assist job seekers in discovering additional opportunities.	1		
Labeling System					
Job Application	Code 1	Well-labeled and structured application process with clear steps and guidance.	3	3	3
	Code 2	Application process is labeled but may have areas for improvement in clarity and precision.	2		
	Code 3	Lack of clear labeling or logical structure in the application process.	1		
Creating Job Alerts	Code 1	Intuitive labeling of steps for creating job alerts based on specific criteria.	3		
	Code 2	Alert creation is labeled but may have areas for improvement in clarity and precision.	2	2	2
	Code 3	Lack of clear labeling or logical structure in the process of creating job alerts.	1		
On Overall Jobs page and flows from Jobs page	Code 1	Intuitive labeling, easy to understand	3	3	
	Code 2	Most of lebels are understandable but still many areas for improvement in clarity and precision.	2		2
	Code 3	Many confusing places because of unclear labels	1		
Navigation System					

Managing Job Alerts	Code 1	Clearly navigable features for managing and editing existing job alerts with a logical flow.	3	3	
	Code 2	Management of job alerts is navigable but could benefit from improved flow and structure.	2		
	Code 3	Limited navigational options or confusion in the organization of features for managing job alerts.	1		1
Turning Off Job Alerts	Code 1	Intuitive navigation for turning off or modifying existing job alerts with a logical sequence.	3		
	Code 2	The process is navigable but may have areas for improvement in flow and structure.	2	2	
	Code 3	Lack of clear navigation or logical sequence in the process of turning off job alerts.	1		1
Manage Job Search Profile & CV versions	Code 1	Intuitive navigation through the interface for managing different versions of profiles and CVs, allowing users to easily switch between and update versions.	3		
	Code 2	Navigation is present but may have areas for improvement in terms of intuitiveness or efficiency.	2	2	
	Code 3	Complex or confusing navigation, hindering users from efficiently managing different versions of their profiles and CVs.	1		1
Search System					
Diverse & relevant filter options	Code 1	Filter options are diverse enough to support main purpose of job seekers	3		3
	Code 2	Filter options are diverse but not so straight to the point, need to spend much effort to choose which to use	2	2	
	Code 3	Filter options are not enough to serve main purpose or too confusing to use	1		
Relevant results from filtering	Code 1	Search results are relevant to background and skill set	3		
	Code 2	Search results are quite relevant but some irrelevant results also show	2		2
	Code 3	Search results show very less relevant ones going along with many irrelevant ones	1	1	
Supportive Information/ Features to job seekers					

Multiple CV Uploads	Code 1	User-friendly functionality allowing job seekers to upload and manage multiple CVs, catering to diverse job applications and roles.	3		3
	Code 2	CV upload is available but could be more streamlined or offer additional features for managing multiple versions.	2		
	Code 3	Limited or cumbersome CV upload functionality, hindering users who want to submit various CVs for different applications.	1	1	
Job Posting Date and Applicant Count	Code 1	Transparent display of job posting dates and the number of applicants, providing valuable context for job seekers.	3		3
	Code 2	Information about posting dates and applicants is present but may require more visibility or detail.	2		
	Code 3	Lack of information about job posting dates or applicant count, leaving job seekers without essential context.	1	1	
Application Status Tracking	Code 1	User-friendly features allowing job seekers to track the status of their applications, providing real-time updates on the progress.	3		
	Code 2	Application tracking is available but could offer more detailed information or additional functionalities.	2	2	
	Code 3	Limited or absent application status tracking, making it challenging for job seekers to monitor the progress of their submissions.	1		1
Skill Matching and Gap Analysis	Code 1	Platform offers features to match job seekers' skills with job requirements and provides gap analysis to help users understand areas for skill improvement.	3		3
	Code 2	Skill matching is available but could be more detailed or provide additional insights into skill gaps.	2		
	Code 3	Limited or absent features for skill matching and gap analysis, missing an opportunity to guide users in skill development.	1	1	
Remote Work Filters	Code 1	Inclusion of filters or features that allow job seekers to specifically search for remote work opportunities.	3		3
	Code 2	Remote work filters are available but may require improvement in terms of effectiveness or user understanding.	2		
	Code 3	Absence of filters for remote work, potentially limiting options for job seekers interested in remote positions.	1	1	
Information Presentation on Interface during Job Seeking & Applying Process (General Evaluation)					

Intuitive User Interface Design	Code 1	Intuitive and user-friendly interface design that facilitates easy navigation and understanding of features.		3	
	Code 2	User interface design is acceptable but could be more intuitive or streamlined for better user experience.			2
	Code 3	Complex or confusing interface design, making it challenging for users to navigate and comprehend information.			
Visual Hierarchy for Key Information	Code 1	Effective visual hierarchy, highlighting key information such as job titles, posting dates, and application status for quick comprehension.			3
	Code 2	Code 2: Visual hierarchy is present but may need adjustments for better emphasis on important details.		2	
	Code 3	Lack of clear visual hierarchy, causing difficulty in prioritizing and understanding crucial information.			
TOTAL				40	49

Appendix 2. System Usability Scale (SUS) questionnaire

These are rating scale questions from 1 to 5 which is equally from strongly disagree and strongly agree.

This question part is for both Glassdoor & LinkedIn after conducting tasks for usability tests on each platform, which means participants answer this questionnaire twice. One for each platform.

A. Easiness in conducting specific tasks

1) The application process is easy to complete. (the one directly on the platform, not the one redirected to apply on its company website)

2) Keywords/ terms displayed during the application process are clear and easy to understand.

3) It is easy for you to find job applications that you applied for and check the process.

4) It is easy for you to manage versions of CV/ Resume that you uploaded (add new, delete, recognize old or new versions).

5) It is easy to manage your created profile for job search (create new, modify, delete).

6) It is easy to save interested jobs.

7) It is easy to look for jobs that you saved.

8) It is easy for you to create new job alerts.

9) It is easy to look for job alerts that you created.

10) It is easy for you to turn off existing job alerts.

B. Easiness, effectiveness, and accuracy when using search filtering

11) Filtering for job search is easy to use?

12) Options on filtering are not overwhelming with too many options.

13) Search results are accurate as they are relevant to me.

C. Intuitiveness and relevance in information display

14) On the overall, content/ information on Jobs page (the page was shown after clicked Jobs section on main menu) is all relevant to job search purposes.

15) On the overall, keywords/ terms on the Jobs page (the page was shown after clicking the Jobs section on the main menu) is understandable to know where to navigate.

16) Information on job posts are clear to view.

17) Information on job posts are enough what you need to know if suitable to apply.

18) Job recommendations are all relevant to me.

Appendix 3. Interview Questions

Participants were interviewed and also required to choose between Glassdoor or LinkedIn in some questions.

1) Which Jobs page has the search function which is easier to use?

2) Which Jobs page has the search function which generates more good results?

3) Which Jobs page that you think the content is more personalized correctly based on your profile and activities?

4) Which Jobs page makes it easier to complete most of the required tasks?

5) After doing the required tasks, which platform do you prefer to use for job search? (only specifically mentioning their Jobs page, not the whole platform)

   Follow-up question: Can you share the reasons?

6) Which Jobs page do you think the display of information is clearer (less overwhelmed feeling)?

   Follow-up question: What did it make you feel the other page's content was more overwhelming?

7) On Glassdoor, is there any situation in which you feel confused (hard to understand or follow) when you conducting required tasks? Can you describe it?

8) On LinkedIn, is there any situation in which you feel confused (hard to understand or follow) when you conducting required tasks? Can you describe it?

9) What do you hope that Glassdoor & LinkedIn could change or improve to support you more?