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Human-Centered Design

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Information architects (IAs) and UX designers help to create a *human-centered* future, where the user's goals and needs serve as the guidelines for design and development. Human-centered design (HCD) is a framework that places people as the center of focus during the whole design process. In this approach, designers and other stakeholders identify people's needs and balance them with business and technical concerns, to improve usability and maximize the outcomes of an information space (Fig. 3.1).

Human-centered design expands on the previously popular term *user-centered* design. In chapters three through eight we cover concepts relating to HCD. For those new to IA and UX design (like the students we taught for many years) descriptions of our field may sometimes sound like a word salad, consisting of "human," "user," "people," "design," "experience," "centered," and finally "thinking." The key takeaway is to always keep HCD top of mind, focus on the impact your design has on the person using it and others, and use the appropriate methods throughout the design process.

3.1 Human-Centered Design Background

Human-centered design aims to make systems usable and useful by focusing on people and their needs by applying human factors/ergonomics, and usability knowledge and techniques. Digital systems have expanded well beyond websites and apps (the main focus of our book), making HCD an important concept for many industries where user experience impacts user and business outcomes (Norman, 2002). HCD enhances usability, improves human well-being, accessibility and sustainability; and counteracts possible

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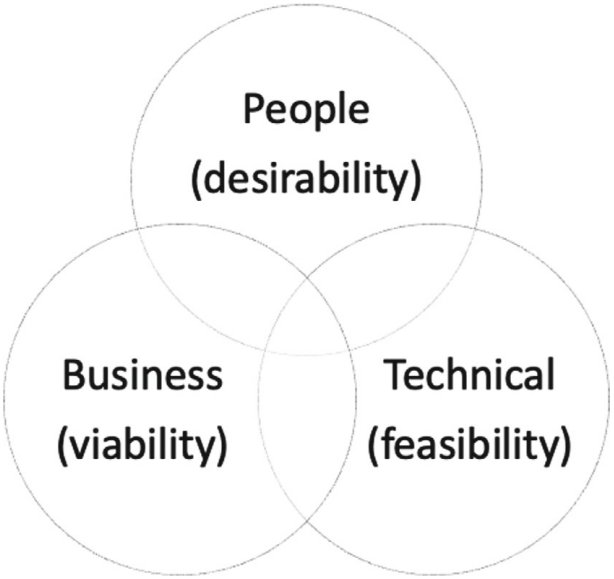

Fig. 3.1 Human-centered design components: IAs should look to balance what people want or need, with the business' ability to provide it and the technical ability to create it

adverse effects of use on human health, safety and performance. The International Organization for Standardization (ISO) (2019) defines HCD as an "approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques" (p. 2).

ISO also shares how human-centered design and user-centered design are often used synonymously—and we take the same approach in our work. The terminology is less important than the intent. The thing that matters is to include people in the design while putting their needs and goals at the center of the work.

While ISO talks of applying methods, the design firm IDEO zooms out to a more general view, defining human-centered design as "a process that starts with the people you're designing for and ends with new solutions that are tailor-made to suit their needs" (IDEO, n.d.).

With all this focus on users and people, do we really understand who they are? They can be customers or employees, current users or potential users, public users or internal users, experts or novices, early adopters or technophobes; we think you get the point. People are multifaceted and change over time. A novice can become an expert, or a person is happy one moment and angry the next. Part of the design process is identifying and prioritizing "personas" (Cooper, 2004; Pruitt & Grudin, 2003), to humanize this concept of system users, and coming up with creative solutions that serve their needs. For the purposes of this work, we offer the following definition of a user.

User defined: A person interacting with information space(s) to achieve a goal, in the context of work, information seeking or creating, entertainment, or play. They may be experts or novices, experienced or inexperienced, motivated or disinterested. Like all humans, they will have a range of cognitive, psychological, and physical abilities and limitations, and will have moods and preferences that vary over time.

3.2 Include Users in Research and Design

While in the past the user was too-often ignored, today gathering user input early and often is considered best practice. HCD emphasizes research, design, and evaluation as three iterative activities that should be embedded in every stage of design and development (Fig. 3.2). Design and development frameworks, like design sprints (Google Ventures, 2019), or design thinking (Meinel & Leifer, 2023), which we discuss in Chap. 8, are grounded in HCD concepts.

The human user is easily overlooked when designing information systems. Many stakeholders (such as business sponsors or engineers) think, "we know our users, we know what they want" or they listen to the loudest, but not most representative users ("the squeaky

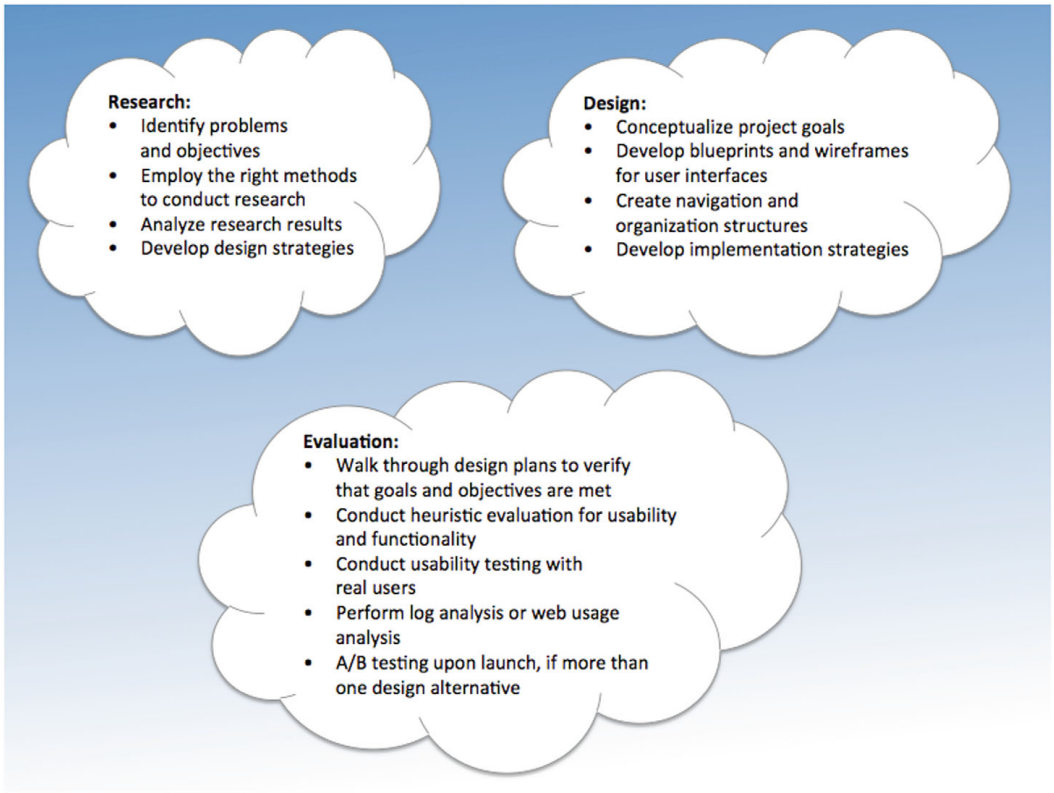

Fig. 3.2 Three clouds of the HCD research

wheel gets the grease" syndrome). This leads to unnecessary rework fixing problems that should have been identified in the early design phase of a project, substandard systems released for use, the need for expensive follow-up customer support, and unhappy users. HCD goes a long way towards avoiding these issues and has been adopted by organizations that see it as the way to build systems with increased adoption by consumers and return on investment (Ross, 2014; Whitten & Bentley, 2007).

HCD puts the user in the center. However, it does not minimize the influence of other stakeholders. Designers and user researchers, due to their unique position creating the system, often serve as the "voice of the user" in an organization while leading HCD processes. We will discuss ISO 9241 and usability from a user standpoint along with a general HCD process in this chapter. In later chapters we will dive into research, design and evaluation. Before we do that, we need some discussions to clarify misconceptions about HCD, and concepts to increase its reach.

3.3 Increasing the Reach of HCD

HCD has many benefits for both users/customer and the business. We share some below, and dispel misconceptions that may hinder organizations from adopting an HCD approach.

3.3.1 Combines User Needs and Business Goals

HCD does not mean focusing only on user needs and ignoring business goals and market opportunities. Rather, HCD means that the user is given a voice in the design process, providing information needed to make well-informed decisions and align business goals with user needs. How do you resolve a conflict between the user needs, business goals, and technology? Reconcile them through prioritization, where the tradeoffs between user needs, business goals, and technology limitations are known and agreed upon in advance.

For example, suppose that one of the business goals is to reduce the cost of customer service (such as phone calls to a call center), whereas the users' priority is to have live help available at any time. What are the implications for the design of a company website? The direct implication is to provide easy-to-use, easy-to-understand, contextual help, an AI powered chatbot, and knowledge base so that the need for calling the company is minimized. This is the ideal situation, but some scenarios may still arise in which the user needs even more help. Here is where the prioritization comes into play.

Option 1 is based on the conclusion that the business goal of reducing costs has the highest priority. Therefore, we may decide not to make any customer service phone number or live chat features easily accessible. For example many e-Commerce sites provide step-by-step instructions for common help needs, reducing the need for customer service calls or chat (Fig. 3.3).

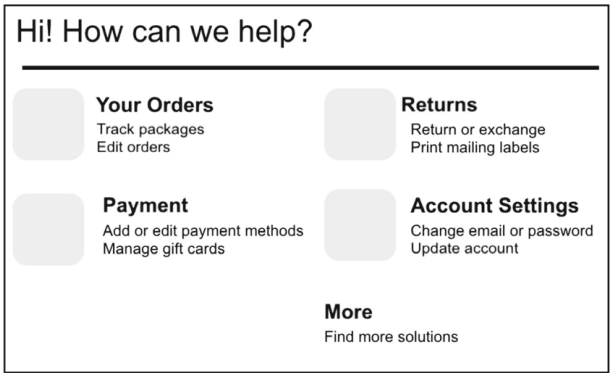

Fig. 3.3 Help section on an e-Commerce site with help categories and no easy "contact us" option—but links to answer common questions

Option 2 is based on the opposite conclusion, that the user's desire for live help is the priority, and always having contact information easily accessible is the right design. However, this will increase the need for more customer care representatives to handle the extra calls and chats, increasing the business costs.

Which one is the right choice? It really depends on the situation. Depending on the business model and culture, some companies (e.g., financial companies) are more likely to think direct contact increases opportunities to earn more business from users; so here making it easy to call the company wins. Other companies may deem cutting costs for customer support as the first business priority, so keeping phone numbers and chat off the site wins. There is not a right or wrong answer that will satisfy everyone in every situation. Part of the designer's role is to balance competing factors and help the team prioritize.

3.3.2 HCD Helps New Technology Adoption

HCD does not mean that the design is against introducing new technologies or changes. New technologies must be incorporated intelligently, while serving a purpose, not just for their own sake. At the same time, it is critical for design professionals to learn the capabilities of newly available technologies and leverage them to improve the user experience and design.

Advances in artificial intelligence (AI) drastically change system capabilities and how people interact with a system. Managing changes like this is always a challenge. For example, how does an IA design a system where the AI synthesizes thousands of sources to give a single answer versus the typical search engine results page with ten blue links? How does a designer provide for "human-in-the-loop" so that humans guide AI responses,

making them better over time? How do we design explainable AI (XAI) so people can trust the results? The key is to find the best match between problems at hand and the right technology, balancing features and learnability, with the need to drive technology forward.

3.3.3 Guides Design Ideas

HCD does not mean that users themselves can best design for their own use. Users are usually very good at telling what problems they have, but they do not necessarily always have good solutions. A famous quote has been attributed to Henry Ford: "If I would have asked my customers what they wanted, they would have asked for a faster horse." This means that while users may be able to identify problems they face, they do not always have the expertise, experience, or creativity to come up with innovative solutions that may solve those problems. The designer's responsibility is to understand user problems and needs and transform them into robust design solutions.

3.3.4 Human-Centered AI

The growth of AI applications in a variety of domains has been typically driven by a technology-centered approach, where humans are the second thought. However, the increasing intersection of AI and society gives IAs and designers the opportunity and obligation to guide the development of human-centered AI (HCAI) tools and products. HCAI takes into account the implications, both positive and negative, of AI on society and individual humans (Capel & Brereton, 2021). Today universities like Stanford (https://hai.stanford.edu/) and UC Berkeley (https://humancompatible.ai/) have established HCAI research programs to investigate this new human-centered domain. Governments around the world are likewise keeping an eye on the growing impact of AI.

Human-centered AI systems are designed to work with, and for, people (Barmer et al., 2021). HCAI for designers means applying the human-centered process to AI applications. Shneiderman (2020a), an influential HCI researcher who's written extensively on the topic, claims "HCAI systems emerge when designers, software engineers, and managers adopt user-centered participatory design methods by engaging with diverse stakeholders." (p. 2). Further, Shneiderman (2020b) offers additional ideas for reframing AI into a more human-centered focus:

- "High levels of human control AND high levels of automation are possible" (p. 115): Meaning to determine on a continuum where control should be weighted towards the human (such as a camera where the user points the camera and the software helps

eliminate shaking), and where automation should be in control (such as deploying an airbag in a crash).
- "Shift from emulating humans to empowering people" (p. 116): Moving us away from making AI look or sound like humans as a goal (e.g., humanoid robots) that may not be the most effective design and focusing on outcomes of the AI with a goal-centered design.
- "Governance structures for HCAI" (p. 118): In order to join ethical concerns and practice, follow these three practices; use reliable software development methods, develop a culture of safety in the organization, and establish independent oversight.

Similar concepts are found in Xu's (2019) framework for HCAI that has the goal of guiding "safe, efficient, healthy, and satisfying HAI solutions" (p. 44), with additional emphasis on the role of design.

- "Ethically aligned design" (p. 44), for solutions that are fair, just, and do not replace humans.
- "Technology enhancement" (p. 44), to reflect more human-like intelligence.
- "Human factors design" (p. 44), ensuring that AI outcomes are usable and understandable.

We are at the dawn of a new era where AI applications will have an ever increasing influence on design, society, and business. As we will see throughout the remaining chapters, IAs and UX designers are well suited to provide the crucial HCD perspective needed to make AI work for humans.

3.4 ISO 9241

How does an IA put HCD principles into practice? Fortunately, the concepts behind HCD are codified in the ISO-9241-210:2019 standard: *Ergonomics of human-system interaction Part 210: Human-centred design for interactive systems.* ISO describes the concepts, hardware design, software design, and the design processes related to HCD, while also defining several important terms for IA, including a useful and concise definition of usability.

Usability is the core concept when designing for users. ISO 9241 defines usability as the "extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (p. 3). In order to make usability actionable, let's examine the three components and ISO's definitions of each (Table 3.1).

Table 3.1 ISO definitions and examples

ISO definition	Example user metrics
Effectiveness: "Accuracy and completeness with which users achieve specified goals" (p. 2)	Task completion rates, e.g., "7 of 10 (70%) users successfully logged into the system, 3 of 10 (30%) failed"
Efficiency: "Resources used in relation to the results achieved" (p. 2)	Time on task/number of clicks needed to complete task, e.g., "users took on average 7 s to complete login"
Satisfaction: "Extent to which the user's physical, cognitive and emotional responses that result from the use of a system, product or service meet the user's needs and expectations" (p. 3)	User-reported ratings of a system, e.g., "the system scores a 77 out of 100 on our usability scale"

By measuring effectiveness, efficiency, and satisfaction IAs can track performance and improvements (or the opposite!) in ways that are understandable to others in the design field and business stakeholders. It's not just about "make it easy to use" or "make it usable,"—we can quantify usability metrics and objectively show how our systems perform.

Here's an example from industry, to show how usability can have a real-world impact. Imagine a large software enterprise with tens of thousands of employees who often must find information on a company intranet. Employees complain that finding information is difficult and takes a lot of time, and managers notice that even the top performing teams are sometimes not prepared. An exploratory investigation shows that employees often take several hours to find information critical to their jobs. Clearly, the information is not easily accessible. However, the company faces stiff competition and needs to improve the products that it sells. Making the intranet more usable seems to be a poor allocation of the company's IA efforts, which could be used to create better selling software products. The employees just need to get better at finding things, right?

In fact, when we consider ISO's definitions, balancing the usability of the intranet against other priorities becomes easier. Estimating that an improved intranet can save one hour per week per employee by helping them find what they need faster (increasing efficiency), we can judge the benefits the company will see versus the cost to redesign. Measuring the average time it takes to find documents before a redesign, and comparing it to the time it takes afterwards shows the impact of the UX work—when employees are more efficient the company saves money. To go further, we could look at the effectiveness of the intranet. What happens if a salesperson cannot find important documents that will help them close the sale, or a software developer cannot find documentation that explains how a system works and writes code that has a lot of bugs? What would the loss to the company be then? And all of this has not even touched on satisfaction yet. Happy employees are generally productive employees.

Taken together, a redesign of the intranet may be a great business decision due to improved productivity. By applying the concepts of effectiveness, efficiency, and satisfaction the benefits become clear. In fact, some organizations even go so far as to mandate internal systems must be redesigned if they score below a certain threshold on a widely accepted usability scale, to help maintain a high level of employee happiness and productivity.

3.5 HCD Design Process

HCD includes design of things the user sees (front end, user interface) and design of things the user will never see (back end, behind the scenes). Think about it like a car, the engine is almost never seen but has a huge impact on performance, while the steering wheel is always seen and has the biggest impact on user control of the direction. Figure 3.4 illustrates a HCD design process for information architecture. There are two parallel processes in design:

- The front-end user interface (UI) design
- The behind-the-scenes metadata and controlled vocabulary design.

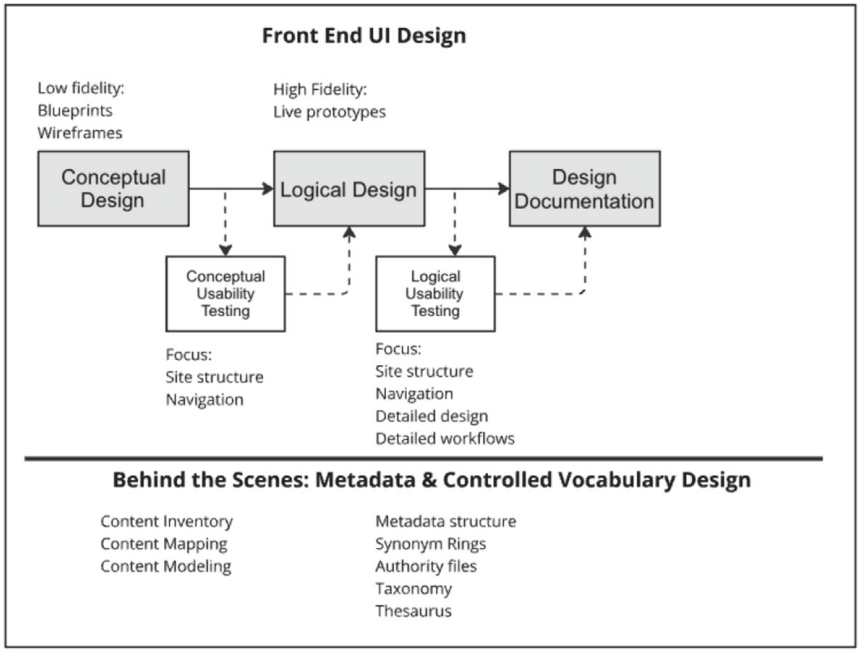

Fig. 3.4 Detailed view of the design process with two parallel processes, front end and behind the scenes

In most cases, the two should go hand in hand. For example, when designing a search capability, the UI piece looks fairly simple (search box, results display), but the majority of the work is behind the scenes in metadata and content. Without appropriate metadata schema, search engine indexing, keywords, relevance ranking mechanism, or controlled vocabulary, search would fail. This parallel work is very visible in a faceted search interface (Hearst, 2009; Tunkelang, 2009), where metadata is placed directly in the UI as filters which the user can apply to limit their search results to specific terms.

3.5.1 Front End UI Design

The upfront UI design involves IAs and UX designers along with visual designers, user researchers, and others. While the UI design evolves and iterates, it is meaningful to differentiate the high-level conceptual design from the more detailed logical design. The beginning conceptual design is more focused on the site structure and navigation—whether the user can easily tell where they are or what they can do, whether the labels make sense, and where else they can go from here. Visual details and specific interactions are handled during logical design—which is closer to the final look of the interface users will see.

Usability tests are recommended at the end of each sub-phase to examine the design with a sample of targeted users. The feedback is then incorporated into the iteration. Testing an interface early means that problems can be identified and fixed more easily and less expensively than finding them later—it's faster, cheaper, and easier to change a wireframe than a fully coded live prototype. Finding the correct users to test with is very important; they must match the characteristics of the projected users for the final product.

3.5.2 Behind the Scenes: Metadata and Controlled Vocabulary Design

Information architects and content people do most of the work behind the scenes developing content and its related metadata and taxonomy. This work is often performed in parallel with UI design. Here, we see the dual-roles IAs and UX designers can play—designing the front end and working behind the scenes as well. On small or medium projects one person may do both, while on larger projects it will take a team.

Metadata and taxonomy development (see Chap. 5) directly informs the design of the navigation and has a big impact on the user experience. Methods like content inventories, card sorting, and tree testing (see Chap. 4) can all be used to create and evaluate the behind the scenes IA work, with the goal of matching user's mental models of an information space with the structure created by IAs. This can be quite challenging and has long been studied in the library sciences.

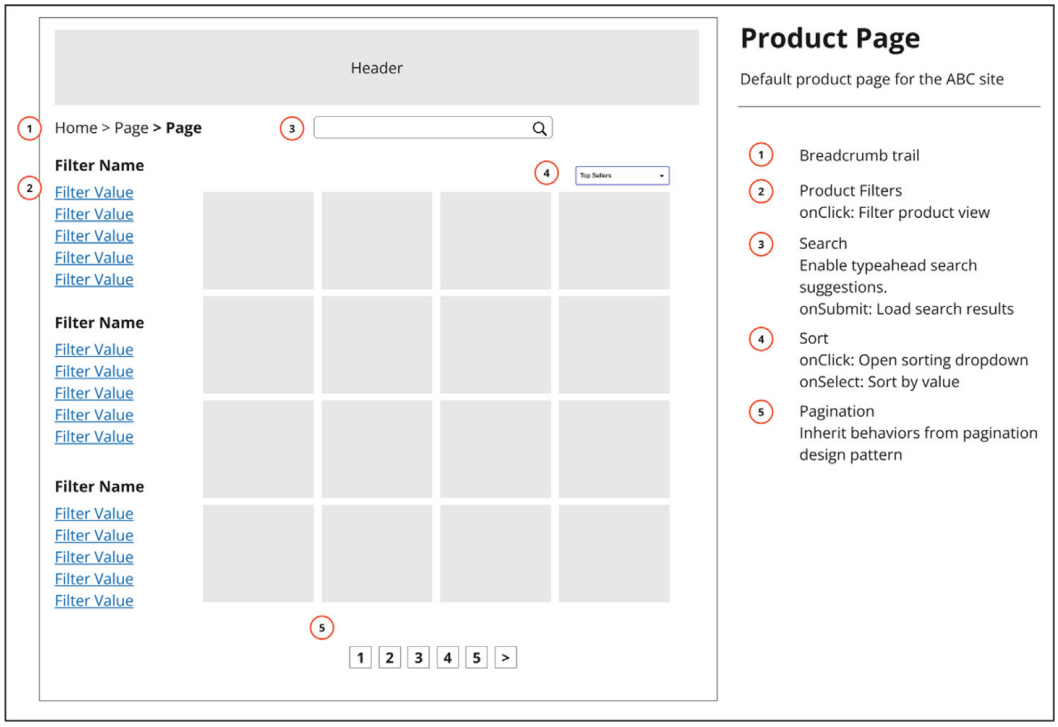

Fig. 3.5 Example low-fidelity wireframe showing a simple product page. On the right are annotations that describe the functionality called out in the screen (#1, 2, 3, etc.)

3.5.3 Design Deliverables

IAs and UX designers, along with other experts, create many deliverables during the design phase, used by the team to develop and communicate designs:

- **For conceptual design**: Wireframe (low-fidelity screens, Fig. 3.5), user-flow diagrams (Fig. 3.6), blueprints (or high-level IA diagram, Fig. 3.7), storyboards.
- **For logical design**: Detailed and interactive prototypes. Used for various design reviews and user tests.
- **Final documentation**: UI specification document, detailed navigation diagram, and detailed IA diagram. They are meant for the developers to fully implement the design.

3.6 Iterative Design

"I have not failed. I've just found 10,000 ways that won't work."—Thomas Edison

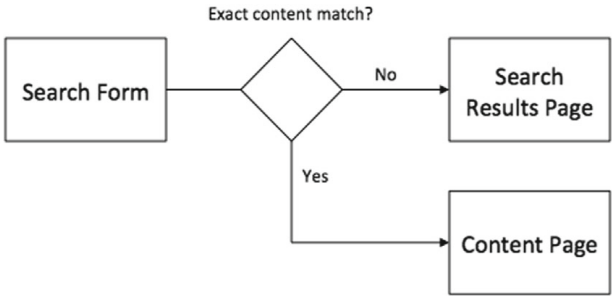

Fig. 3.6 Example user flow showing the path from a search form. The user enters a search term, and the system logic takes them to a search results page, unless the keyword is an exact content match, in which case the system takes them to the content page

Iterative design is based on the notion that the first implementation of a user interface will likely not work as well as it should, and you should continue iterating until it is right (Buxton & Sniderman, 1980). The iterative design process is a core principle of HCD. While we typically show the design process in a linear fashion, in reality the IA may revisit conceptual design and logical design several times, while working towards the optimum design. Buxton and Sniderman (1980) and Nielsen (1993) described iterative computer interface design as a process of prototyping, testing, evaluating results, and refining. Incremental improvements of a single, improving, interface towards a state of completion is the goal. Iterative design has been widely embraced by the UX and startup communities. The fundamentals remain since first described: *You are unlikely to get it right the first time, test with users to see what's not working, fix what doesn't work, and test again until it is right.*

3.7 HCD Teams

Creating complex information spaces requires an interdisciplinary team involving business sponsors, user researchers, visual designers, software developers, project managers, content writers and others. With so many "stakeholders," in order for everyone to collaborate effectively, roles and responsibilities should be made clear. The process may vary from project to project, but the goal should be the same: *Increase the business value of the design and meet the user needs.*

In many organizations, HCD is embedded into the overall product development process. While IAs and designers create UX deliverables, product owners and others gather business and technical requirements. Conceptual designs are often used to guide the requirement gathering activities, and the requirements in turn help refine the design. In our experience as IAs in technology organizations, the IA and product team work closely together cross-referencing requirements and conceptual designs—even going so far as using a checklist to make sure all requirements are met in design.

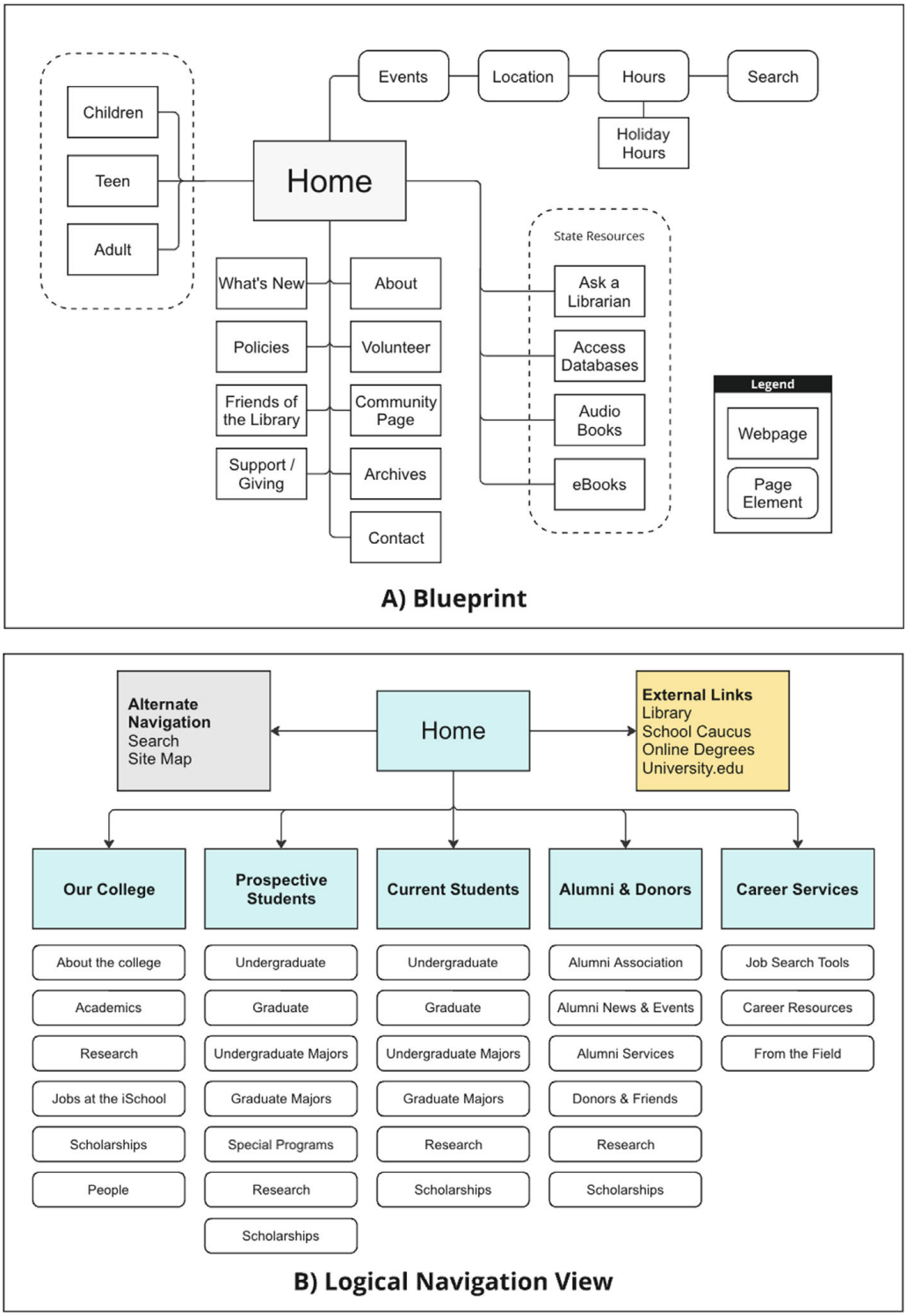

Fig. 3.7 Examples of IA deliverables, **a** Blueprint and **b** Logical navigation

Only after business requirements are officially gathered, reviewed and finalized, can the IT team make realistic commitments to the level of effort needed. Requirements and acceptance criteria will greatly benefit the design work. The following defines the benefits:

- Ensure that the system's expected behavior is captured, documented, and understood by both the business client and the IT project team.
- Define boundaries of the system, what is in scope and what is out of scope.
- Provide a basis for more precise estimation of costs and schedule.
- Establish and maintain agreement with business stakeholders on what the systems should do.

Note that many software development methodologies, like Lean and Agile (see Chap. 9), used in industry place a premium on working features, over written documentation describing the feature. Thus, the relationship between IA and software development is evolving, and each organization has its own flavor of collaboration. Some teams are reducing the amount of written or static documentation and instead substituting working prototypes created by the IA, using software to produce interactive interfaces. *There is no single best solution*, so it is important to choose methods that most effectively communicate with others on the team and help improve efficiency while ensuring the entire user experience is documented, including error states, edge cases, and other conditions.

3.8 Summary

Human centered design includes users, with their needs guiding design and development, while balancing business and technical requirements. IAs and UX designers often lead HCD efforts while serving as the "voice of the user." Iterative design, combining research, design, and evaluation is the best way to produce human-centered products, as it is almost impossible to get the design right the first time. ISO 9241 provides a foundation for HCD, including definitions for the terms usability, effectiveness, efficiency, and satisfaction.

In the following chapters, we will explore the standard's four human-centered design activities:

- Understand and specify the context of use.
- Specify user requirements.
- Produce design solutions to meet these requirements.
- Evaluate the designs against requirements.

The four activities seem so easy, and common sense. Yet, again and again, steps are skipped or user requirements are ignored leading to systems with poor usability, or even systems that are totally abandoned. In an iterative design environment, learning and understanding are built into the process and we design systems with the user in mind, helping to ensure products meet target user needs.

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