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Electronic Form Design

by

Mikako Matsunaga

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
MASTER OF FINE ARTS

Major: Graphic Design

Program of Study Committee:
Roger Baer, Major Professor
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Ames, Iowa

2012

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ABSTRACT

With technological innovation and emergence of the World Wide Web, digital forms of information surround us today more than ever. It is common for us to access information online with computational devices, rather than in paper and other analog media. Today information is fluid, always up-to-date without interruption. We can find most information with computational devices online. It is convenient for users from some perspectives; they can access information anytime, anywhere with an Internet connection.

In some instances, access to necessary information is accompanied by problems. Usability of the electronic site is one of the problems; some users are fluent in new technologies and how to use them, whereas others are not. The economist, Aleph Molinari, mentioned during the 2011 TED conference that the information gap between those who have access to information technologies and those who do not is called digital divide (Molinari, February, 2012). He stated that only 30% of the world was digitally included. Most of the region with digital inclusion was in North America and Europe. In the rest of the world, five billion people never had access to Internet (Molinari, 2011). People without access to information through technology include senior citizens, the poor, developing nations, etc. They tend not to have an access to information due to the lack of the devices and the lack of knowledge of the technology. According to Molinari, the reason they do not have access to the Internet is because they cannot afford it, they do not know how to use the technology, or they do not know the benefit of using technology to find information (2011). These groups of people often need special support; however, the digital divide could prevent people in need from receiving care and aids. Most applications for care and aid are now found online or through computational devices in the

United States today. Not only the availability of devices but also the presentation of digital forms causes accessibility problems to available resources. Resources are not limited to information as knowledge; they include beneficial resources such as monetary funds and human resources to improve quality of life.

Ideally, any forms should be available in both digital and analog forms, so users can choose the media they want to use. However, there is the dilemma of cost and time. In the United States today, digital forms are the predominant method for users to complete applications for information and services. This study is aimed at the analysis of the usability problem in digital forms and to find a solution from a designer's perspective.

CHAPTER 1. INTRODUCTION

This thesis consists of three chapters. In the first chapter, the literature review introduces the current condition of form design, studies completed about form design, as well as design principles of graphic design. In the second chapter, the author presents the analysis of electronic forms with examples. Guidelines for the analysis were developed based on the literature review, design principles and observations. In the last chapter, the author presents a suggestion for a new guideline of electronic form design that enhances usability.

1-1. The Reasons for Research

This topic was conceived after a visit to ChildServe in Ames. ChildServe is a non-profit organization that works with children with special health care needs and their families. ChildServe's services include pediatric nursing care, physical therapy, on and off-campus education, as well as family support. In a graduate level course, *Design for Behavioral Change*, the class visited ChildServe in order to observe children to understand our target audience for a class project to design an application/device to empower children with Autism Spectrum Disorders and their families. The class met a family that needed financial support and appeared to qualify to apply for financial aid. However, they had not applied because they did not know there was financial support for children with disabilities and their family. They did not know how to apply either, because the process was complicated. They were also too busy to deal with it. This author thought they needed help in some way. She felt this was one issue she would deal with because she used to have a family member with a disability and was in need of special

health care. This author wanted to help in some way because life is not as easy as others when one has a disability.

Disabilities are often accompanied with health concerns, and family members of the disabled need to provide special care. If one has a disability today, unfortunately, a life is different from others without disabilities. There is an emotional struggle, as well as financial, social, and other struggles due to the lack of support. Therefore, this author decided to design simpler and user-friendly forms that communicate to people with no special knowledge about governmental financial aid for children with disabilities.

When this author contacted a librarian in Family Studies to search for literature, she mentioned that it would not be helpful to redesign forms because social workers usually help families when they apply for aide. Does this mean that social workers can fill forms out so families do not need to understand what the forms mean? What happens if you move to different cities? This author still thinks it is good if the application form is easier for families to understand. Social workers can still help, but it would be better if families know what they can receive and how.

Design has the power to change people. Currently it is not very common to design for social change. Design should work for disabled people and the socially weak, because these people need to be noticed in a democracy.

Currently most design practice is for commercial purpose; however, there are some design movements for social change, such as Design for Democracy by Marcia Lausen. Lausen and her colleague redesigned ballots and other materials for elections in order to reflect people's opinions in elections more accurately. Her project proved that bureaucratic forms are barriers for people, but the barriers can be broken or at least reduced by better design.

In *The Whole New Mind*, Daniel Pink mentioned how design education changed the lives of minority students. Another example of design as a social change is *Motherhouse*, a bag manufacturer. Eriko Yamaguchi founded *Motherhouse* in Bangladesh. Her mission was to “Develop apparel products in developing countries and market them to developed countries” (*Motherhouse*, n.d.). The company manufactures jute and leather goods in Bangladesh and sells them in Japan.

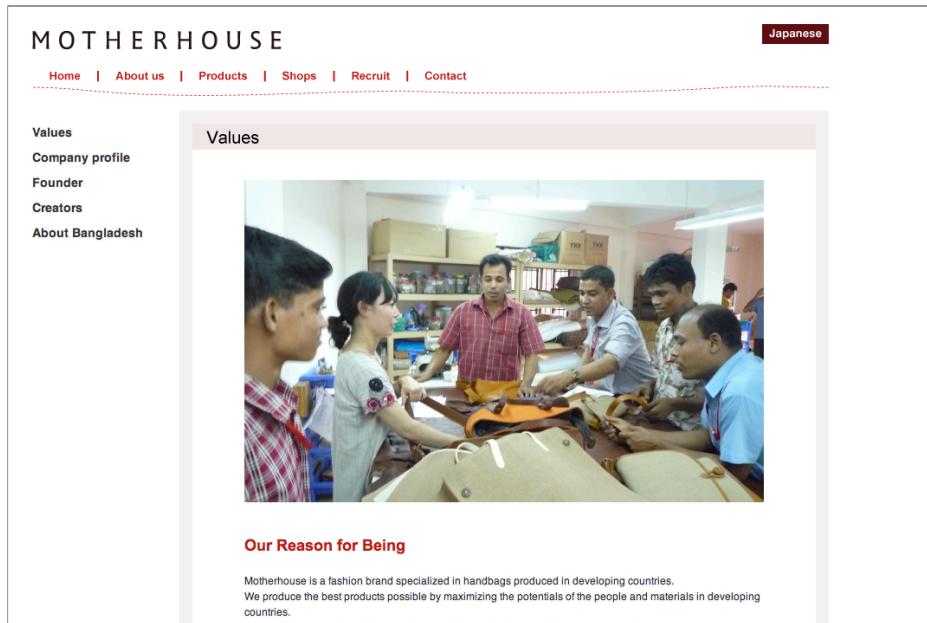


Figure 1. Screenshot from Motherhouse website.

This thesis is in pursuit of eliminating barriers that are created by bureaucracy, technology, and electronic forms.

1-2. The Purposes of Research

This thesis has two major purposes for its research. The first purpose is to create a suggestion for more user-friendly electronic forms. The other is to create a recommendation for occasions to use electronic forms.

1-3. Research Questions and Objectives

- What are current electronic forms like?
- What are the advantages and disadvantages of electronic forms for users?
- What are the critical problems that users have with electronic forms?
- What kind of improvement could be made in electronic form design based on graphic design principles?
- In what kind of occasions do electronic forms need to be used? Could electronic forms be used with paper or other forms? What subject would be appropriate for electronic forms?

CHAPTER 2. REVIEW OF LITERATURE

The first chapter of this thesis is written in order to understand current electronic forms, how people use the electronic forms, for what purpose users utilize electronic forms, and what kind of difficulties users encounter with them. This chapter also refers to the current study in web forms and user interface. Information design principles are discussed as well to improve communication and usability in electronic forms.

2-1. What Are Electronic Forms?

One uses forms to collect information for various purposes. In general, companies or organizations that need information from consumers create forms to collect information about their customers and their needs. Paper forms are the traditional media, whereas electronic forms are common nowadays in online shopping, online applications for schools and jobs, tax returns, and so forth. Electronic forms are also used at hospitals, counseling services, and public service offices. Electronic forms appear not only in websites, but also at electronic check-in machines at airports and in medical questionnaires at hospitals. When this author shopped in Japan to send a gift in December 2011, the store had computers so customers could fill in the delivery information electronically. It is common to use electronic devices to collect information.

Both paper and electronic forms have input fields with labels. Labels give instructions to users about what kind of information they need to fill in input fields. Usually input fields are indicated as an underlined space, box, or check box, etc.

2-2. Electronic Forms vs. Paper Forms

What are the differences between paper forms and electronic forms? One of the differences is interactivity. In paper forms, all possible input fields are visible to users even

though not all users need all input fields. Paper forms need to show all possible options because it is not possible to change visible options depending on contexts. On the other hand, it is possible to change the information and visible input fields in electronic forms.

In this sense, electronic forms are more convenient. Electronic forms are sustainable reducing paper and ink usage. Delivery of electronic forms is faster than delivery of paper forms if both receiver and sender have the necessary device and environment. In paper forms, users can choose where to start. Paper forms can be used more conveniently in some occasions because they require less electronic settings, such as the viewing and interacting device, electricity, and Internet access, etc.

2-3. Problems with Electronic Forms

One of the problems of electronic forms is a lack of user-centeredness in the design process. In *Web Form Design*, the author, Luke Wroblewski (2008), mentioned as follows: “When it comes to update or create one of these records, the organization or computer program simply says ‘here’s the information I need,’ and that request shows up in front of people as a form” (p.2). He states the problems of web forms are that people design the forms based on the information the organization needs. For better usability, however, forms should be designed from the perspective of the people outside the organization or website (Wroblewski, 2008, p.2).

2-4. Usability of Electronic Forms

The purpose of filling in forms is not to fill in forms itself. According to Wroblewski (2008), “What we want to do is to vote, apply for a job, buy a book online, join a group, or get a rebate back from a recent purchase” (p.2). When one fills out forms, there are desires for certain actions. It is important for users to have a comfortable and quick experience with forms, because users have other purposes besides filling in forms.

Also, it would be worth considering the failure when analyzing usability. Designers need to understand what design failure is, how it occurs, as well as how to manage it, because users often encounter failure when they fill out forms. In *Visible Language* 43. Special Issue 2/3, “Recognizing risk-of-failure in communication design process,” a paper by Joyce Yee, Matthew Lievesley, and Louise Taylor (2009), explained what design failure was. They categorized design failures into three types: *Usability Failure, Communication Failure, and Technical Failure*. Usability Failure was “functionality problems that result in misuse of a product, or the user’s failure to perform an intended task due to a fault of the design” (Yee, Lievesley, Taylor, 2009, p. 231). Usability in this context is not just for the user’s convenience but also for miscommunication of the message. Usability failure tends to be more critical in interactive and web-based projects. Communication failure can be divided into two variations. One is miscommunication between designers and stakeholders of the project. The other is miscommunication between designers and other designers. Communication failures are discussed more in design management. Technical failure has three variations: production-related, skills-related, and context-related. Production-related failures are such as “errors in print production, software platform compatibility or inappropriate file formats” (Yee et al., 2009, p. 231). Skills-related failures can be associated with the expertise of the design team. Context-related failures are harder to identify, however, they include “changing external project conditions such as budget and timescales, which are often beyond the apparent control of the design team” (p. 231).

Failures provide good learning opportunities, as Tim Brown at IDEO (IDEO, n.d.), “a design firm that uses a human-centered, design-based approach” in their work, stated that sometimes you must “fail early to succeed early” (Brown, n.d.). To avoid design failure, it is

obvious that “consistent risk monitoring is present in all stages of a design project” (Yee, et al, 2009, p. 229).

2-5. User Experience

In *Web form design*, Wrobleski (2008) described online shopping experiences and how it relates to forms. Wrobleski contrasted real shopping experiences with shopping online. He described it as follows:

Within the cyber aisles of an online store, you can search and browse colorful packaging and marketing promises, stack up what you’d like in a “shopping cart,” and make your way to checkout. But here the parallels end. Instead of a smiling and helpful clerk, you get a form (p. 6).

He expressed one disadvantage of the online shopping experience against a real shopping experience as follows: “When having a conversation with someone, we can see their reactions and hear their voice. When we choose to engage with a group of people, the same types of interactions make us feel welcome or not” (Wrobleski, 2008, p. 7). As Wrobleski pointed out, human factors contribute to user experience. Human factors can be service, casual conversations, and gestures. On the other hand, electronic forms are usually not accompanied with a service that is provided directly by real people. Electronic forms try to play a role as forms for information input as well as human service. It would be impossible to substitute people with an electronic device, however, it would be possible to improve user experience with electronic forms.

In *Interaction Design*, Jennifer Preece, Yvonne Rogers, and Helen Sharp (2002) discussed user frustration. User frustration ranges from feeling mildly amused to extremely angry (p.147). Preece et al listed that such emotional responses occur:

- When an application doesn’t work properly or crashes
- When a system doesn’t do what the user wants it to do

- When a user's expectations are not met
- When a system does not provide sufficient information to let the user know what to do
- When error messages pop up that are vague, obtuse, or condemning
- When the appearance of interface is too noisy, garish, gimmicky, or patronizing
- When a system requires users to carry out many steps to perform a task, only to discover a mistake was made somewhere along the line and they need to start all over again (p.147).

The authors mentioned that user frustration is often caused by bad design, no design, inadvertent design, or ill-thought-out design (p.148). The impact of bad design on the user can be quite drastic and make them abandon the application or tool (p.148). The authors' statement assures that graphic design could improve human computer interaction. Preece et al provided examples of classic user-frustration provokers as:

- Gimmicks. When a user's expectations are not met and they are instead presented with gimmicky display. Level of frustration: Mild.
- Error messages. When a system or application crashes and provides an "unexpected" error message. Level of frustration: High.
- Overburdening the user. Upgrading software so that users are required to carry out excessive housekeeping tasks. Level of frustration: Medium to high.
- Appearance. When the appearance of an interface is unpleasant, Level of frustration: Medium (pp.148-152).

Speaking of appearance, busyness should be avoided. Busyness could be represented as:

- Websites overloaded with text and graphics
- Flashing animations

- Excessive numbers of operations represented at the interface, such as banks of icons or cascading menus
- Childish designs that keep popping up on the screen
- Poorly laid out keyboards, pads, and control panels (p.152).

As design suggestions, Preece et al recommended simple, perceptually salient, and elegant designs that fits usability design principles, graphic design principles, well-thought-out graphic design principles, and ergonomic guidelines as Mullet and Sano (1996) suggested in *Designing Visual Interfaces* (Preece et al, 2002, p.152).

Preece et al discussed how to deal with user frustration. One advice is to provide error messages (phrased as “how-to-fix-it” advice) to explain what the user needs to do (p.153). Another way of providing information is through online help (p.153). “A cartoon-based agent with a catchy tune may seem friendly and helpful the first time round but can quickly become annoying. A help icon or command that is activated by the users themselves when they want to help is often preferable” (Preece et al, p.153).

2-6. Understanding Psychology for Better User Experience

User experience is tied with psychology, because usability is aimed at how users respond to devices, applications, etc. *Designing for the Social Web* is a book about web design. The author, Joshua Porters is an interface designer and founder of Bokardo Design, a design consultancy exclusively focusing on social web applications (Porters, n.d.). In *Designing for the Social Web*, Porters (2008) stated that understanding human psychology is important for successful web applications. “The principles on which successful social software is built are the basics of human psychology. People use software to do all the same things they used to do without it: talk with each other, form groups, gain respect, manage their lives, have fun” (p. viii).

He also emphasized that designers' roles are not just to design interface, but also to "support people's social desires for interactivity, authority, reputation, identity, and control" (p. viii). What does it mean to design and support people's desires? He clearly stated: "If the interface is too confining, people won't use it. If the interface is too flexible, people won't know how to use it. ... Thus the challenge of social software is to design interfaces that support the current and desired social behavior of the people who use them" (p. 9).

As he mentioned, understanding people's desires helps designers predict human behavior and create a comfortable user interface. A comfortable user interface is an interface that allows users to complete tasks in an easy and intuitive way. Users can become frustrated when an interface does not let them do what they want to do in the way they expect. An interface needs to have some degree of flexibility or more choices so users can do things in the way they prefer. However, there is a paradox of having more options. Porters referred to the "Paradox of Choice" theory by Barry Schwartz (2005), who found out that people could not make the right decision when they had information overload. People will even give up making a choice when they have too many options (Schwartz, 2005).

Porters (2008) also had a warning for web application designers. Designers do not meet the people who use the application; therefore they do not know what in the application frustrates users (p.44).

About the decision-making process, Dan Ariely, a professor in Psychology & Behavioral Economics at Duke University wrote a book called *Predictably Irrational*. His statement was that human behavior had some patterns; therefore, it was predictable even though it seemed irrational.

Ariely (2008) pointed out the human nature of keeping as many options as possible. Even though we keep options open to have a better solution or result, there is a danger of risking our main goal by keeping too many options handy. Ariely continued: “We might not always be aware of it, but in every case we give something up for those options. We end up with a computer that has more functions than we need, or a stereo with an unnecessarily expensive warranty” (p. 140).

He also mentioned how expectations affected our decision-making process. He referred to the relationship between decisions, experience and knowledge. Ariely discovered that the decision-making process was affected by knowledge when this knowledge was provided before an experience, while the decision-making process was not affected by knowledge when this knowledge was provided after an experience. In the decision-making process, getting to know something after experiencing it equaled the same as not knowing. The knowledge that came afterwards changed the way people make decisions. Ariely found his results based on experiments, which he conducted at a brewery with his colleagues. They added vinegar in the beer of participants. There were two groups of participants for the experiment. One group was told that the beer contained vinegar *before* they tasted the beer; the other was told that the beer contained vinegar *after* they tasted the beer. Ariely summarized, “As it turned out, the people who found out about the vinegar after drinking the beer liked the beer much better than those who were told about the vinegar up front” (p.162). The people who were told about the vinegar after drinking liked the beer as much as those who were not aware of vinegar in the beer at all.

Then, they did an “extreme” version of the experiments. They told one group about the vinegar in advance (*the “before” condition*) and told the other group about the vinegar after participants finished drinking (*the “after” condition*). Then after participants tasted the beer,

Ariely offered them “a large cup of unadulterated beer, some vinegar, a dropper, and the recipe for the MIT Brew (two drops of balsamic vinegar per ounce of beer)” to see if people would freely add balsamic vinegar to their beer; if so, how much they would add; and how these outcomes would depend on whether the participants tasted the beer before or after knowing about the vinegar (p.163). The “after” participants added the vinegar to the beer because it “didn’t taste too bad the first time around (they apparently reasoned), and so they didn’t mind giving it another try” (p.164). The number of “after” participants who added the vinegar to the beer was twice as many as the number of “before” participants who added the vinegar to the beer (Ariely, 2008, pp.163-164). It suggested that the prior knowledge of the vinegar-adulterated beer had changed how people perceived the experience of tasting the beer.

Understanding how people behave in decision-making is useful not only in a psychology study but also in business, marketing, as well as design. For example, Coca-Cola is a more successful brand than Pepsi. Ariely mentioned that: “The reaction of the brain to the basic hedonic value of the drinks (essentially sugar) turned out to be similar for the two drinks. But the advantage of Coke over Pepsi was due to Coke’s brand – which activated the higher-order brain mechanisms” (p.167).

Stereotypes are a form of expectations. We even behave in order to fit stereotypes unconsciously. Expectations also help communication. “Expectations enable us to make sense of a conversation in a noisy room, despite the loss of word here and there” (Ariely, 2008, p.171). It is worth considering what expectations users have when designing forms.

2-7. Interface Design

To improve user experience with electronic forms, one of the possible suggestions is to have customer service/guide personnel; however, in most cases it would not be the available

solution due to costs and environments. Another solution would be redesign the interface so that the usability could improve. Usability refers to how comfortably a user can accomplish their desired goals. It is worthwhile to redesign interfaces; 2004 CHI paper, *A process for creating the business case for user experience projects*, was by the eBay user experience and design team. The paper is about how they evaluated and redesigned the registration process for a successful usability and business outcome. The registration redesign had a positive impact on the bottom line of the company, and it became a model for how design projects were evaluated and funded (Wrobleksi, 2008, p. 11).

In *Don't make me think*, Steve Krug (2000), the usability specialist mentioned tips for better web usability such as design guidelines for websites, users behavior with websites, as well as principles of usability study.

Krug insists to make things obvious in order not to distract users. "When we're using the Web every question mark adds to our cognitive workload, distracting our attention from the task at hand. The distraction may be slight but they add up, and sometimes it doesn't take much to throw us" (Krug, 2000, p.15). He also mentioned typical behaviors of users in the web environment. Users do not read websites but scan. Also, users do not make optimal choices but satisfice (Krug, 2000, p.24).

As design guidelines, Krug listed five important things, as follows:

- Create a clear visual hierarchy
- Take advantage of conventions
- Break pages up into clearly defined areas
- Make it obvious what is clickable
- Minimize the noise (p.31)

These facts are necessary to consider for better usability because users are in a hurry when they are browsing websites. Visual hierarchy is important to show relationships among contents. Krug also recommended taking advantage of conventions. Conventions in web are mostly derived from newspapers and magazines, etc. For instance, headlines are in big and bold fonts, whereas captions are set near the picture in a small font (Krug, 2000, p.34). Breaking up pages into clearly defined areas will allow users to focus on what they want and to ignore what they can safely ignore. It is important as well to make clickable text and image links look clickable, because web users are looking for the next thing to click (Krug, 2000, p.37). It is possible if the links do not stand out, however, that the result could be that users will leave the website because it will require an extra cognitive load to think what is clickable or not (Krug, 2000, p.37). Krug stated visual noise prevented users to grasp the page easily. There are two kinds of noise; one is the *busy-ness* of many things trying to catch a users' attention on a page. The other is *background noise* that consists of many small distractions. Krug mentioned that people have different levels of tolerances for complexities and distractions; however, many people have problems with busy pages (p.39).

Krug believes that what matters to usability is not the number of clicks that users need to make, but the thinking that users need to employ with each click. Krug states, "three mindless, unambiguous clicks equal one click that requires thought" (p.41). How much thinking users need, will severely affect usability.

Since users do not read in websites, unnecessary words should be omitted to reduce visual noise, to make useful content more prominent, and to allow users to see more of each page at a glance without scrolling (Krug, 2000, p.45). Krug refuses *happy talk* and *instructions*. Happy talk is text that welcomes users to the site, with no content but just a way to be sociable (Krug,

2000, p.46). Instructions are not necessary in websites because nobody reads them. Instead of instructions, designers can make everything self-explanatory or as close to it as possible. When instructions are absolutely necessary, designers should cut them back to the bare minimum (Krug, 2000, p.47).

Navigation is also crucial to the usability of websites. Krug referred to Jacob Nielsen's statement that there are two kinds of users. One is always searching by typing words in the search box, while the other always browses first. Nielsen called the former "search-dominant users," the latter "link-dominant users" (Krug, 2000, pp.54-55). For link-dominant users, Krug suggested to have clear hierarchy in links. Whether users are search-dominant or link-dominant, they will leave the website when they cannot find what they are looking for (Krug, 2000, p.55). Therefore, it is necessary to design how users can find the information they are looking for with keeping user behavior in mind.

Krug compared web experience and real experience when users are searching for information and merchandise. Websites have three oddities of web space. Websites have no sense of scale, direction, or location. Users tend not to know how many pages the website has, whereas users always have, at least, a rough sense of the seen/unseen ration of magazine pages or museum or a department store space. In terms of direction, there is no left or right, although we might mention moving up and down in a hierarchical sense, not in a physical sense. Sense of location is different in websites because users never touch the ground, and instead, users make their way around by clicking links. According to Krug, this lack of physicality is both good and bad (pp.57-58). On the positive side, weightlessness of the web can be exhilarating. On the negative side, "figuring out where you are" is a much more pervasive problem on the Web than in physical spaces. Krug mentioned the problem as, "We are inherently lost when we're on the

Web, and we can't peek over the aisles to see where we are" (p.59). He explained that Web navigation compensates for the missing sense of place and creating the sense of "there" (p.59).

Krug summarized the purposes of navigations as:

- To help us find whatever it is we are looking for
- To tell us where we are
- To give us something to hold on to
- To tell us what's here
- To tell us how to use the site
- To give us confidence in the people who built it (pp.59-60).

For the last point, Krug suggested that clear navigation would be one of the deciding factors of users to determine if they will visit the site again.

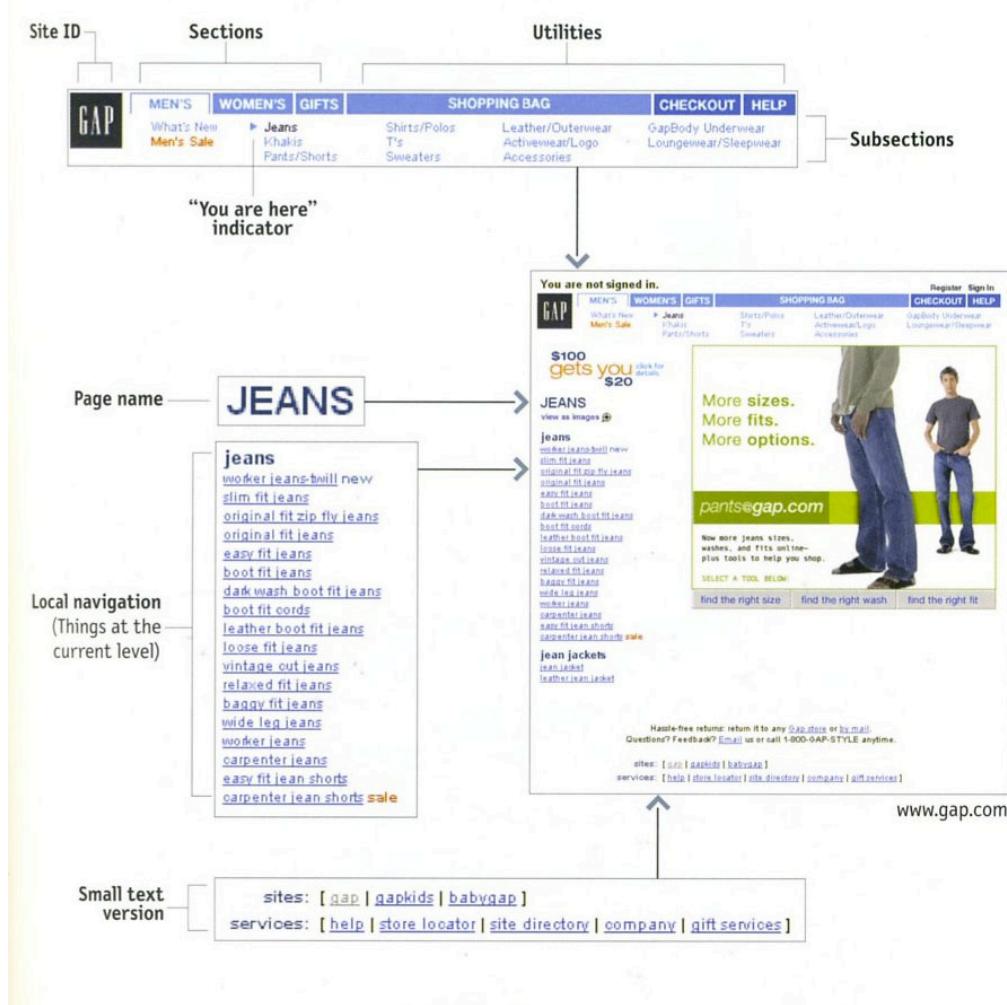


Figure 2. Example of conventions in websites.

Conventions are useful tools when designing websites with high usability. If a website does not follow the convention, it will cause frustrations to users. In website design, convention of navigations are shown in the Figure 2.

Persistent navigation (or global navigation) means the set of navigation elements that appear on every page of a site (Krug, 2000, p.62).

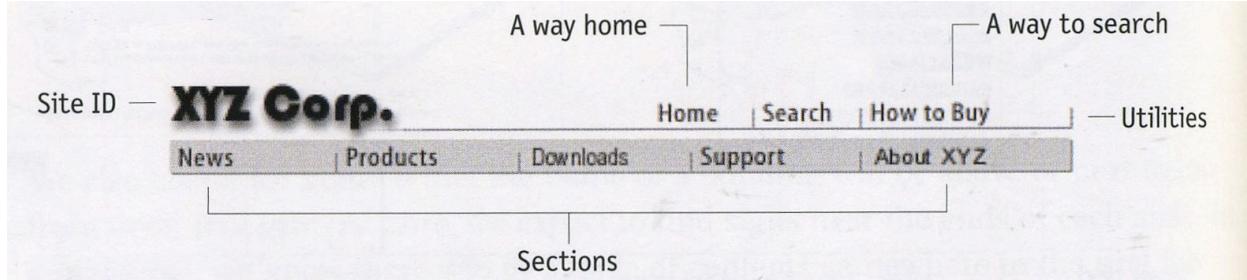


Figure 3. An example of navigation elements.

Krug insisted that it is important to have persistent navigation so that users know that they are still in the site. However, there are two exceptions. In homepage and forms, persistent navigations might not be necessarily the best option. Homepage has a different role from other pages; therefore it can have a unique navigation design (Krug, 2000, p.109). Navigation on the homepage could have section descriptions, different orientation, and more space for identity. However, homepage navigation should not be *too* different (Krug, 2000, p.110).

In forms, persistent navigation could become a distraction. Krug suggested having a minimal version of persistent navigation on forms, with just the Site ID, a link to Home, and any utilities that might help users fill out the form (p.63).

Since it is easy to lose the sense of your current location, it would be nice to have something to tell users where they are. The “you are here” indicators could be presented in many ways, for instance, to put a pointer next to it, to change the text color, to use bold text, to reverse the button, or to change the button color (Krug, 2000. p.75).

Put a pointer next to it	Change the text color	Use bold text	Reverse the button	Change the button color
Sports Business ▶ Entertainment Politics	Sports Business Entertainment Politics	Sports Business Entertainment Politics	Sports Business Entertainment Politics	Sports Business Entertainment Politics

Figure 4. Examples of “you are here” indicator.

The most common failure with '*you are here*' indicators happened when they are too subtle.

Krug suggested applying more than one visual distinction, such as applying a different color and weight to the text (p.63).

Breadcrumbs show where you are as well.

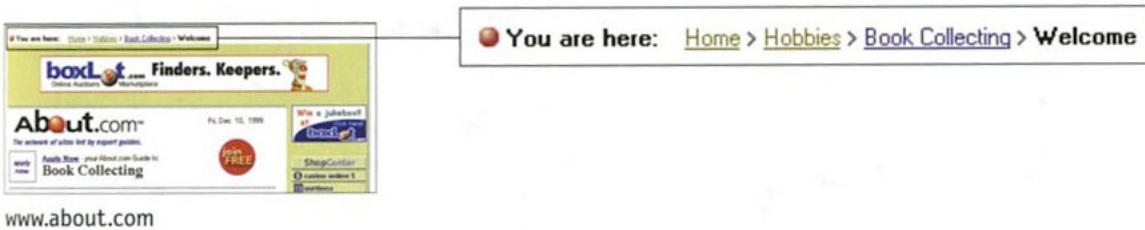


Figure 5. Breadcrumbs in *About.com*.

The difference between breadcrumbs and '*you are here*' indicators is that breadcrumbs show the path users took from the homepage to the page they are in now, while '*you are here*' indicators show where you are in context of the site's hierarchy. Krug metaphorically expressed the difference as '*you are here*' indicators are like maps, while breadcrumbs are like a set of turn-by-turn directions (p.76). Breadcrumbs may not be the best to be used alone, however, it would be useful in large site with a deep hierarchy, or if designers need to tie together a nest of sub-sites (Krug, 2000, pp. 77-78). According to Krug, About.com was the best example with successful breadcrumbs. He made suggestions for breadcrumbs design as follows:

- Put them at the top
- Use > between levels: Use the “greater than” character (>) as a separator between levels
- Use tiny type: to make it clear that breadcrumbs are just accessory.
- Use the word ‘*you are here*’: to make it self-explanatory

- Boldface the last item: the last item should be the name of the current page, so make it prominent.
- Don't use them instead of a page name: if designers mix the breadcrumbs and page names, it conflicts with our expectation that headings should be flush left or centered, not at the end of a list (pp.78-79)

Krug is in favor of tabs in websites. Tabs are the metaphor of a physical action in a user interface that actually works. Tabs are his favorite because they are self-evident, they are hard to miss with visual distinctiveness, they are visually interesting without bulking up the page size, and they suggest a physical space (Krug, 2000, pp.80-81). Krug referred to Amazon.com as a successful example using tabs. Amazon improved the design over time, and there are four key improvements. First, Amazon made a visual illusion to show active tabs in front that stood out from the rest of the tabs (Krug, 2000, p.82). Secondly, the improved tabs load fast. Interestingly, Amazon's single row of tabs requires only two graphics per page. Some sites have graphics for tabs separately for each button because of a misunderstanding and use rollover, however, it took longer to load; therefore, there were risks to cause low usability (Krug, 2000, p.84).



Figure 6. Separate tab graphics for tabs in *Amazon.com* navigation.



Figure 7. Simple graphic for tabs in *Amazon.com* navigation.

Thirdly, color-coding is effective when using tabs. Color makes distinctions as well as tie page elements together. Krug recommends combining color and other visual cues (p.85). Lastly, Amazon created a tab that was already selected when a user entered the site to give impact to the tabs (Krug, 2000, p.86)

In web design, the homepage needs to accommodate the site identity and mission, site hierarchy, search options, teases, timely content, deals, short cuts, and registration (Krug, 2000, p.98). Krug meant ‘teases’ as content promos and feature promos to entice users. He also mentioned that the most popular contents might have their own links on the homepage. Homepage also needs to 1) show what users are looking for, 2) show what they are not looking for but they can offer, 3) show where to start, and 4) establish credibility and trust (pp. 98-99)

Krug analyzed rollovers and pulldowns in perspective of usability. They seem to work because they give you information without cluttering up the page. Nonetheless, there are usability problems, for instance, users need to seek them out, and they are hard to scan (Krug, 2000, pp.113-115). They require users to think and to control the rollover or pulldowns, because they often show up for a moment and close so quickly unless users control with a mouse or touchpad. In addition, designers do not have control over fonts, spacing, or formatting of the list in the pulldowns. Krug mentioned that pulldowns were the most effective for alphabetized lists of items with known names, like countries, states, or products (p.115).

Wrobleksi (2008) also defined design principles of interface as: 1. Minimize the Pain (the process of completing forms should be as simple and easy as possible and should not be painful) 2. Illuminate a Path to Completion 3. Consider the Context 4. Ensure Consistent Communication (p. 19)

Jef Raskin (2000), a human-computer expert who worked on the Macintosh project for Apple, discussed the relationship between human beings and interface in his book, *The Humane Interface*. According to Raskin, interface was not limited to Graphic User Interfaces (GUIs). “The way that you accomplish tasks with the ‘what you do and how it responds’ – that’s the interface” (p. 2). Interface today often accompanies a phrase, “user-centered,” “user-friendly” Raskin distinguished a difference between “user-centered” and “human-centered” design. He argued that producers of interface, such as interface designers, managers in electronics and the computer industry, and domain experts, were aware of the concept of user-centeredness or customer-centeredness, however, do not usually take human psychology into consideration. The producers researched the target users of their product, whereas Raskin insisted that they first needed to understand psychological behavior, which is common in many people (pp. 3-4). Raskin suggested the design choice for the interface might be better with a familiar design to users in a current rapid turnover base, for the sake of productivity (pp. 4-5). The first law of interface design Raskin claimed was, “A computer shall not harm your work or, through interaction, allow your work to come to harm” He defined the second law as, “A computer shall not waste your time or require you to do more work than is strictly necessary” (p. 6). Raskin came up with the ideal interface, which was humane interface. His definition of humane interface was, “An interface is **humane** if it is responsible to human needs and considerate of human frailties”(pp. 6-7). In order to design humane interface, designers needed to understand the

relevant information on how both humans and machines operate. Additionally, designers needed to be sensitive to the difficulties that people experience (Raskin, 2000, pp. 6-7).

What are the aspects of the human psychology that interface designers need to know?

Raskin showed cognetics and the locus of attention as relevant. He explained that people react to some tasks consciously and to other tasks unconsciously. When one encountered new or threatening tasks, one behaved consciously, as Table 8 shows (Raskin, 2000, p. 16).

Property	Conscious	Unconscious
Engaged by	Novelty	Repetition
	Emergencies	Expected Events
	Danger	Safety
Used in	New circumstances	Routine situations
Can handle	Decisions	Nonbranching tasks
Accepts	Logical propositions	Logic or inconsistencies
Operates	Sequentially	Simultaneously
Controls	Volition	Habits
Capacity	Tiny	Huge
Persists for	Tenth of seconds	Decades (lifelong)

Table 1. Property of the Cognitive Conscious and the Cognitive Unconscious.

Persistent use of any interface will cause habits, while Raskin claimed that designers needed to prevent habits that caused problems for users. It is necessary to design interfaces that 1) take advantage of habit development and 2) allow users to develop habits that smooth their flow of work. He noted that unsuccessful interface design lacked a consideration for “*the helpful and injurious properties of habit information*” (p. 20).

When users build habitual actions, there is a risk of making wrong decisions. When users are working to complete tasks, it is necessary for the interface to break habitual behavior and confirm to the user if the decision is the one they really want so that users do not need to make a mistake. One way to do this is to allow users to undo an erroneous command. Raskin also suggested making a required action for confirmation unpredictable. However, designers needed to understand that this kind of action could be obnoxious because it did not allow users to build habitual reaction, which brought comfort to users (Raskin, 2000, p. 23).

When using electronic devices, most commands “involve applying an *action* to an *object*” (Raskin, 2000, p. 59). Raskin stated that there were two ways to sequence the operations as follows: “(1) the verb (change font) first and then select the noun (the paragraph) to which the verb should apply or (2) the noun first and then apply the verb” (p. 59). Raskin added that the order (either noun-verb or verb-noun: also expressed as *object-action* versus *action-object*) created a significant difference in usability. He referred that most interface guidelines recommend noun-verb interaction (Apple 1987, Hewlett Packard 1987, IBM 1988, Microsoft 1995). The benefits were *error reduction*, *speed*, and *simplicity and reversibility* (Raskin, 2000, pp. 59-60).

When one encounters a product, one does not know how it works. A product should be designed so that one can sense what it does, how it works, or how it is accessed. If functions of the product are accessible to a human sense organ – usually eyes – or were recently perceived and remain in short-term memory, the function is visible. Raskin quoted words by Don Norman (1988), a usability expert, “Visibility indicates the mapping between intended actions and actual operations” (p.8). If an interface forces you to memorize the existence of the feature, it is invisible” Raskin mentioned that many computer games have invisible interfaces (p. 63).

Personally, this author does not agree with it, because it depends on the context. Today many game interfaces have a more intuitive way to operate like Wii and a touch panel in Nintendo DS, in addition, many games share similar commands and ways to operate, as well as users, who are familiar with how the games work. For many people, visibility that suggests the functions is apparent by looking at a product. Don Norman called this attribute an **affordance** (p.123).

Norman explained affordance as, “Affordances provide strong clues to the operations of things ... Knobs are for turning. Slots are for inserting things into. Balls are for throwing or bouncing” (p.9). Raskin commented that it depends on the user’s past experience and background whether a feature is an affordance or not (p. 63). He advised designers to consider “how the user knows that an action is possible, and we should always require that each visible feature provides a recognizable affordance” (p. 63).

Raskin stated his idea on navigation and other aspects of humane interfaces. Icons are one of the topics he picked up. He clearly mentioned that words were better than icons. He recommended to use icons only when there was an advantage to use them, because “icons violate the principles of visibility: It is their *meanings* that are not visible” (p. 173). Icons are commonly seen in many interfaces. Designers tend to be attached with images. However, icons are not the best option for usability. The occasion where icons could be effective was when there are “at most a dozen of them and at most a dozen are seen at one time” (Raskin, 2000, p. 170). Additionally, Raskin listed other requirements: icons need to be visually distinct, represent the appropriate concept, and presented at a reasonably large size (p. 170).

Raskin referred to techniques and help facilities in humane interfaces. Raskin claimed that an interface should be self-teaching. In order to assist learning, he suggested,

“A display of instructional text should be presented the first time the product is activated. Also, a tutorial and reference manual should be part of the interface, accessible at any time” (p. 175).

Help text should not require any technique to use it.

Cut and Paste is one of the techniques which users tend to be familiar with and utilize often. The problem with Cut and Paste is, when users cut text, and then cut again before pasting it, the first cut text disappears. Users could lose their work in this way. Raskin listed how humane interfaces should treat deletion.

Any humane interface design

- Have deletion operating no differently from other commands
- Put nothing at risk when text is deleted or moved
- Creates no special buffer or other “system-level” or hidden place to where text is moved
- Treats single-character deletions no differently from multiple-character deletions
- Can be undone and redone (p. 177).

Raskin suggested examining messages that designers were going to deliver before they did so.

Raskin asked, “Whenever you find yourself specifying an error message, please stop; …” (p. 178). He recommended eliminating an error message if it did not require users to react to it (p. 179). In addition, he advised designers to design the interface in a way that users did not have to have an error (p. 178). This principle applies not only to error messages but also other kinds of messages. He concluded, “If a control must always (or never) be operated, don’t provide it” (p. 183).

Raskin pointed out that a simplified sign-on was one of the techniques to improve usability of interfaces. Usually, users need to type their username and password. It means that users need to type the number of characters in a username and password. It is work that users need to do before they can work on their tasks. Raskin questioned a level of security that a

username and password could provide users. He stated that a system-assigned password was more secure than a user-created password. Rather than having a less secure sign-on process, it would be more humane to have a single and secure sign-on (Raskin, 2000, p. 184).

2-7. Principles of Graphic Design

In addition to Wroblewski's principles of interface design, graphic design principles also need to be taken into consideration. Aaron Marcus (1984), a user interface designer, asked questions that designers needed to keep in mind while designing the interface of devices. In *Graphic Design for Computer Graphics*, he solved questions as follows:

- How can we attract people to information?
- How can we hold their attention?
- How can we facilitate their understandings of the information?
- How can we help people to remember what they have learned? (p.51)

He determined the role of the graphic designer as "...graphic designers can affect the communication that takes place between the display and the human mind" (p. 53). As he mentioned, "By carefully structuring words, concepts, and images, these tasks are accomplished more easily in a legible and appealing verbal/visual environment," graphic design could enhance usability (p.54). In *Typographic Design for interfaces of information systems*, Marcus (1982) defined graphic design principles in user interface in terms of design field, typography, grid system, and use of tables. First, he mentioned, "The graphic designer of an interface must consider the visual field, the terminal screen, as an entity whose proportion, size, and distance from the viewer are important to the design of information" (pp.26-27). He also stressed the importance of grids in the computer user interface. Grids emphasize consistency in the visual field. "To assist the overall organization of elements within the frame and consistency from frame to frame, a reference grid of a few horizontal and vertical lines was determined to locate

certain standard positions for elements such as titles, prompts, etc. (Marcus, 1982, p.27). In terms of typography, he adopted a statement from *Typography: How to make it Most Legible* by Rolf Rehe. “Normally there should be approximately 40-60 characters per text line (about 10-12 words)” (as cited in Marcus, 1982, p. 27).

Marcus also thought of the locations of words. The graphic design approach also seeks to emphasize clear spatial groupings over the entire visual field in order to make distinctions of content. At the same time these spatial groupings are limited in their variation so that there is an overall visual consistency or rhythm within and between frames (Marcus, 1982 p.27).

These considerations on what to visually present helps users and builders to understand the function. Marcus stated, “By carefully considering not only what to show, but also when, how, and why to show it, a better understanding of the functionality of the system emerges in the minds of the builders and ultimately in the minds of the users of the information system (p.27).

Ellen Lupton (2004), a designer and educator, listed principles of typography in her book, *Thinking with Type*. Her statement is that typography is not about arranging type, but integrating the needs of both the reader and the author. Typography is a means of delivering information, at the same time; it can be presented as a piece of art. Most relevant topics for interface design to this thesis would be linearity, birth of user, typefaces on screen, bitmap typefaces, although other topics are helpful to know when working on typography. Topics such as mixing typefaces, numerals, line spacing, alignment, captions, hierarchy, and data tables are worthwhile to be taken into consideration as well.

Lupton expressed writing as a discourse between author and reader, quoting words by Roland Barthes, a French critic. Writing was a “one-way stream of discourse” (p.92). The devices such as the index, appendix, abstract, footnote, and table of contents emerged because of

the linearity of the writing; however, they also provided a means to enter and escape from the linearity of writing. She stated, “liberating readers from the bonds of linearity – is among typographer’s most urgent tasks” (p.92). She contrasted the linearity of traditional writing to digital media. Digital media still provide a linear communication, though digital media have a potential as nonlinear communication. However, what style of communication that is possible or not will vary and depend on programs. For instance, page layout software Adobe InDesign allow users to work spatially, whereas Microsoft PowerPoint guides users to work linearly, as Lupton described, “PowerPoint enforces the one-way flow of speech rather than alleviating it” (p.93). She also pointed out the difference between PowerPoint and traditional media, a sheet of paper as a means of organizing information. “While a single sheet of paper could provide a map or summary of an oral presentation, a PowerPoint show drags out in time across numerous screens” (Lupton, 2004, p.93). On the other hand, not all digital media goes with a linear flow over a spatial arrangement, such as the database. Databases provide readers and writers with simultaneous ways to access information. Lupton defined, “Databases are the structure behind electronic games, magazines, and catalogues, genres that create an information space rather than a linear sequence” (p.93). Overall, one aspect of typography is the use of space. Lupton concluded the linearity argument as, “In the digital media, space has become more liquid than concrete, and typography has evolved from a stable body of objects to a flexible system of attributes” (p.93).

Lupton referred to Barthes’s theory on writing that distinguished the difference between text and work. The former was liquid, open, and unstable, while the latter was stable and a closed object. She mentioned that Barthes’s theory shed light on a concept of the user. According to Lupton, a user was neither reader nor writer. The user was: “A figure conceived as a bundle of

needs and impairments - cognitive, physical, emotional. ...The user is a figure to be protected and cared for but also scrutinized and controlled, submitted to research and testing" (Lupton, 2004, p.97). Lupton's definition of the user is different from the user definition by other researchers, because it perceives the user as a powerless figure rather than a figure whose needs should be respected. For instance, the user has been studied in a field of Human Computer Interaction (HCI) in this digital age. Lupton quoted words from Jef Raskin to explain what users were and the relationship between users and computers as: "Design a human-machine interface in accordance with the abilities and foibles of humankind, and you will help the user not only get the job done, but be a happier, more productive person" (Raskin, 2000, pp. 9-10).

Users are also digital readers. One of the features of user/digital reader is their impatience. Lupton stated that the impatience emerged "from culture, not from essential character of display technologies" She pointed out that expectations are different between users of websites and users of print. Digital reading is motivation for changes in print design, "while at the same time affirming print's role as a place where extended reading can still occur" (Lupton, 2004, p.98). Lupton also mentioned that icons are widely seen in digital displays, and are supposed to convey certain meaning in abstract and simplified visual, therefore an icon must communicate quickly without words. Lupton, however, stated that icons are "more to enforce brand identity rather than to support usability" (p. 98). She indicated that text has more potential as a means of visual communication because text is "searchable, translatable, and capable of being reformatted and restyled for alternative or future media" (p. 98).

Lupton also referred to changes in the thinking process in art and design. In 20th century art, form and content were integrated, as seen in Dada and Futurist poems. Layout of the poems came from the meaning of the poem, and meaning created the layout. Meaning, which is

presented by text, and layout were unable to separate from each other. In digital design, form and content can be separated. For instance, style sheet in web design “compel designers to think globally and systematically instead of focusing on the fixed construction of a particular surface” (Lupton, 2004, p.98). She continued that reformatting is possible under this way of thinking. Depending on users, the form can be different no matter what the content it is. Reformatting happens in media, too. Lupton introduced a game as an example. A game might be played with a home game console, a desktop computer, a portable game console such as Nintendo DS, or a cell phone. Moreover, a game can be extended to t-shirts, lunch boxes, and plastic toys. Medium became specific to fluid in art and design. White space is another concept in art and design that has changed due to the arrival of the digital era. Lupton introduced Edward Tufte’s argument to maximize the amount of data presented on a single page of screen. He stated so because readers can compare and connect information as well as find information quickly. However, he did not deny white space. The point was, “a single surface packed with well-organized information is sometimes better than multiple pages with a lot of blank space” (Lupton, 2004, p.99). “The Internet is one of the most influential factors in the digital age. The restlessness of the digital age is not because of computer screens but because of new behaviors engendered by the Internet, a place of searching and finding, scanning and mining” (Lupton, 2004, p.100).

Lupton introduced other principles of typography as well. As font choice is crucial in typography, she discussed how typefaces look on screen compared to print, and briefly introduced the history of web fonts. In the early age of the World Wide Web, there were not many options for fonts. As time goes, more fonts became available for designers to use in the websites. A legendary typographer Matthew Carter designed fonts for digital display in the 1990s. Verdana, designed by Carter, is a sans-serif font with a large x-height, simple curves,

open forms, and loose spacing. Georgia, also designed by Carter, is a serif font with sturdy strokes, simple curves, open counters, and generous spacing (Lupton, 2004, p.72). Other specially formatted fonts on a third-part server are available in the web. Users download them and designers pay a fee. Also, font-face rule in CSS enabled to show digital fonts that are on the server as well. In order to support legibility, anti-aliasing would be useful. Anti-aliasing creates the appearance of smooth lines on screen by changing the brightness of the pixels along the edges of letterforms. However, when displayed at very small sizes, strongly anti-aliased type can look blurry. It also increased the number of colors in an image file (Lupton, 2004, p.73).

Bitmap typeface is typeface that is built with pixels. True bitmap characters contain a fixed number of rectilinear units. True bitmap characters are used on electronic devices such as cash registers, signboard displays, and various small-scale screens (Lupton, 2004, p.73). One example of bitmap typefaces is *Lo-Res Narrow* designed by Zuzana Licko, Émigré in 2001. Another bitmap typeface is Elementar, designed by Gustavo Ferreira in 2009. Elementar is a typeface inspired by the Univers type family, and Elementar has wide variations of weights and styles.

Regardless of screen or print, it is common to use multiple typefaces in design. Lupton explained both advantages and disadvantages of mixing typefaces. She suggested to pursue contrast rather than harmony, and to be aware of the role of each typeface in the composition. Having a clear idea about the relationship between typefaces is important, not only conceptually, but also visually. She recommended that designers usually needed to adjust the point size so that the x-heights align when mixing typefaces on the same line. When placing typefaces on separate lines, designers often needed to create contrast in scale as well as style or weight (Lupton, 2004, p.54).

Numerals contain a different kind of information from letters as well as different characteristics in terms of type treatment. Therefore, it is worthwhile to pay attention to numerals. There are two kinds of numerals, lining numerals and non-lining numerals. Lupton defined them as follows: “Lining numerals take up uniform width of space, enabling the numbers to line up when tabulated in columns. Non-lining numerals, also called text or old style numerals, have ascenders and descenders, like lowercase letters” (p.56).

She also introduced a typeface, Adobe Garamond Pro, which includes both lining and non-lining numerals to contrast lining numerals and non-lining numerals. Lining numerals appear large with text because they have the height of capital letters, while non-lining numerals integrate visually with the text in the example she presented.

Line spacing is one of the key elements in typography, especially for legibility. Line spacing is also called leading. Line spacing is the distance from the baseline of one line of type to another. According to Lupton, the default setting in most design software is 120 percent of the type size. Reducing line spacing creates dense typography as well as conflict between ascenders and descenders. Expanding the line spacing creates lighter typography. Lupton mentioned, “As leading increases, lines of type become independent graphic elements rather than parts of an overall visual shape and texture” (p.108). As she mentioned, line spacing could change not only readability but also the role of text information in the layout.

Alignment of text is also an important factor in typography. As Lupton stated earlier, digital readers prefer to move as quickly as possible. Alignment affects the speed of reading; therefore it is necessary to understand the theory of alignment. Usually, there are four options of alignment: justified, centered, flush left, as well as flush right. Each option has “unique formal qualities, cultural associations, and aesthetic risks” (Lupton, 2004, p.112). Justified alignment

has left and right edges that are both even, therefore it has a clean shape on the page. However, ugly gaps could occur. Centered alignment has lines of uneven length on a central axis. Central text is formal and classical. It has elegant organic shapes. The text block should have variations in line length when they are center aligned to emphasize the characteristics of center-alignment (Lupton, 2004, p.112). Flush left has a hard left edge and a soft right edge. Flush left makes sense with the flow of the language, and avoids awkward gaps in lines. However, designers need to pay attention to the right edge as well to make it natural without excessive hyphenation. Flush right has a hard right edge and a soft left edge. It is unusual for body copy; however, it could help readers to tie captions and sidebars with other elements. Designer needs to be careful in order not to annoy readers (Lupton, 2004, p.113).

Captions are one element to consider, because, as Lupton described, “the placement and styling of captions affect the reader’s experience as well as the visual economy and impact of page layouts” (p.130). From a reader’s perspective, captions and images need to have close proximity for comprehension. In interactive media such as websites, captions can show up with a mouse over, et cetera.

Hierarchy is also an important element in design. Typographic hierarchy affects the organization of information and helps readers understand the content effectively. When design has clear visual hierarchy, readers can scan a text. Lupton set up rules for how to indicate hierarchy. First, each level of hierarchy should be presented by one or more cues to backup each other. Possible cues could be graphic (size, style, color) as well as spatial (indent, line spacing, placement). Secondly, these cues need to be shown consistently through the text. As opposed to writing where writers need to avoid redundancy, typography recommends it. Emphasizing a word or phrase would have different rules from rules of hierarchy in text. The former usually

needs only one signal. A signal for emphasis could be italic, boldface, small caps, or a change in color. Some type families have many weights and styles that work together. Designers can also use a different font for emphasis. When one uses different fonts, one needs to adjust sizes in order to align x-heights.

Data Tables would need a different typographic attention from normal text. Grid structure makes a significant difference in data tables. Columns and rows are designed for readers to scan information quickly and help compare information. Lupton pointed out that designers often emphasize the linear grid of a table too much rather than typography. She showed an example in *Envisioning Information* by Edward Tufte. He came up with “data prison,” which happens when the grid structure overpowered the table therefore it was not easy for readers to scan the information.

In *Beyond Mac is not a Typewriter*, Robin Williams (1996), the author, explained the definition of readability. She made a clear distinction between readability and legibility as follows: “Readability refers to whether an *extended* amount of text – such as an article, book, or annual report – is easy to read. Legibility ... refers to whether a *short burst of text* - such as a headline, catalog listing, or stop sign – is instantly recognizable” (p. 33). When a typeface has distinctive features, it compels readers to stop reading the text and makes them notice the feature, therefore the face is less readable (Williams, 1996, p. 33). Williams stated that the typefaces that made the most readable text were the classic old-style serif faces, because these typefaces were designed for long documents. Old style typefaces have moderate features that readers may not notice. She called such features as “invisible” Williams also listed other features that affect readability. Compared to sans serif, extended amount of text in serif typefaces are easier to read. Her discussion was focused on desktop publishing; therefore more research on typography for

screen display must be necessary. She also made a comparison between caps and lower case.

Caps are harder to read because readers recognize the *shape* of word, not letter by letter. A text set in all caps has a rectangular shape that readers need to read letters instead of words; therefore designers need to be careful when they use all caps. Designers also need to pay attention to letter spacing and word spacing. Williams stated, “Since we read in phrases, uneven letter and word spacing disturbs our natural reading pattern; ...” (p. 37). She claimed that there was no perfect rule that applies to all typefaces and all projects. Designers need to understand the spacing and trust their eyes. Although variations in type styles and weights create visual hierarchy, extra bold/light and italic should be used for light accents because they are harder to read. She also recommended using more line spacing when a typeface has an extra-large x-height. If the typeface has very tall ascenders, designers can use less line spacing (Williams, 1996, p. 41).

Speaking of legibility, Williams mentioned, “Serif typefaces are easier to read when there is a lot of text, but sans serif letterforms are more instantly recognizable when there is a short amount of text” (p. 43). She suggested using a readable typeface when one needed to use important but unfamiliar words, such as long, or foreign words (p. 44). Williams determined that clarity of letterforms was one of the keys to legibility. Clarity of letterforms means how easy it is to distinguish one character from another. X-height is an important factor in letterforms.

Williams mentioned that an exceptionally large or very small x-height decreases legibility (p. 45). Weight and proportion of typefaces affects legibility as well. As she stated above with the factor of readability, extra bold/light decreases legibility. Mono spaced fonts are less legible because of inconsistent letter and word spacing (Williams, 1996, p. 46). Williams also claimed that mixing lower case and caps in the same sentence makes type less legible and less readable

(p. 47). In addition, she mentioned that texts in all caps are the least legible. In conclusion, Williams defined the most legible type as:

- A plain sans serif with an average x-height.
- A regular or medium weight (sometimes bold when appropriate).
- Lowercase letters (plus capitals where they belong).
- Not condensed or expanded or oblique (slanted).
- A little extra letter spacing in small point sizes (below 10 point); less letter spacing in large sizes (above 14 or 18 point)(p. 48)

There would be differences between print and screen display, however, the basic typographic rules above would be applicable in electronic media to some extent.

In addition to typography, color is also a critical factor that determines the characteristics of design. In *Color Design Workbook*, Terry Stone, Sean Adams, and Noreen Morioka (2006) described color as: “... it is a uniquely emotional language and symbolic tool for all designers” (p. 6). They defined ten rules of color that are:

1. Convey information.
2. Create color harmony.
3. Attract and hold attention.
4. Remember that context is everything.
5. Consider that experimentation is key.
6. Know that people see color differently.
7. Assist in mnemonic value.
8. Think about composition.
9. Use standard color systems.

10. Understand limitations (p.33).

The authors continued that the rules are an integration of physics, theory, psychology, economics, aesthetics, and usage (Stone et al., 2006, p.33).

Stone et al. stated that color evoked a response, created a mood, symbolized an idea, and expressed an emotion. Viewers' response to color varies, and the criteria for response depended on personal, social, or cultural status. They also introduced the fact that, "Psychologists have suggested that color impression can account for as much as 60 percent of the acceptance or rejection of a product or service" (p.35). Designers need to consider both the internal and external target audience in order to make an appropriate choice of color. In that case, it is worth knowing that color is relative. A combination of colors might have a different meaning from other combinations even though both palettes have the same color in common.

Stone et al. mentioned, "Most designers seek a color scheme that engages viewers and provides a balanced visual experience" (p.40). Color is one of the key factors that establish relationships among graphic elements. The authors introduced eight rules for building a color palette, based on the research of Hideaki Chijiwa. The rules are:

1. Figure out the purpose (Investigate clients' needs, color meanings and associations.)
2. Review color basics (Such as hue, saturation, intensity. Analyze the relationship of each color.)
3. Choose a dominant color, and then accent colors.
4. Select shades then vary them.
5. Look at compatibility of hues.
6. Limit the number of colors.
7. Put the colors into action (Apply colors to a few typical pieces.)

8. Keep a logbook (Stone et al., 2006, p.41)

With Aaron Marcus, Ronald M. Baecker (1990), a professor of Computer Science, Electrical Engineering, and Management at the University of Toronto, mentioned graphic design principles in their book, *Human Factors and Typography for More Readable Programs*. The fundamental principles were:

- Principle 1 - *Legibility*: Design the individual characters of the textual vocabulary for a program visualization so that they are rapidly and reliably identifiable and recognizable.
- Principle 2 – *Readability*: Design the textual components of a program visualization so that they are easy to interpret and understand as possible.
- Principle 3 – *Clarity*: Design all non-textual components of a program visualization so that their semantics are as unambiguous as possible.
- Principle 4 – *Simplicity*: Include in a program visualization only those elements that communicate something important. Try to be as unobtrusive as possible.
- Principle 5 – *Economy*: Maximize the effectiveness of a minimal set of techniques or cues.
- Principle 6 – *Consistency*: Observe the same conventions and rules for all elements of a program visualization. Be consistent from visualization to visualization. Deviate from current conventions only when there is clear benefit to be gained in doing so.
- Principle 7 – *Relationships*: Use visible language elements to show relationships among those elements of a program presentation that need to be linked, and to show lack of relationship among those that should not be linked.
- Principle 8 – *Distinctiveness*: Use visible language elements to distinguish important properties of essential parts of a program.

- Principle 9 – *Emphasis*: Use visible language elements to emphasize the most salient features of a program.
 - Principle 10 – *Focus and Navigability*: Use visible language elements to position the initial attention of a reader or viewer to the program visualization or one of its components, to direct attention, and to assist in navigating around the material.
- (pp.43-44)

2-8. Principles of Information Graphics

Marcus (1984) also introduced information-oriented graphic design principles and the importance of considering the users' needs.

Information-oriented graphic designers are sensitive to the complex requirements of the senders of information, the detailed structure of the content of the message, the nature of the communication medium, and the needs for the receivers of the message (p.53).

As well as Marcus, in *Beautiful Evidence*, Edward Tufte (2006), an information designer, stressed how to show information, how effectively it can be presented, and how it could be understandable to viewers. As he stated, “The metaphor for evidence presentation is analytical thinking,” designers need to analyze and understand information which they are about to present in visual form (p.9). He also mentioned about the clear arrangement of information graphics as follows:

Most explanatory and evidential images (presented in scientific research, newspapers, textbooks, technical manuals, legal proceedings, engineering reports, and the like) should be mapped, placed in an appropriate context for comparison, and located on the universal grid of measurement (p. 45).

Richard Saul Wurman (1989), an architect and graphic designer, has worked on making information understandable (Wurman, n.d.). In the book *Information Anxiety*, he talks about the usability problems in accessing information as, “we are surrounded by reference materials, but without the ability to use them, they are just another source of anxiety” (p.44). “How do you ask for something if you don’t know how to spell it or you don’t know what it’s called? This is information anxiety” (Wurman, 1989, p. 45). He described the reason of information anxiety as: “Information anxiety is produced by the ever-widening gap between what we understand. Information anxiety is the black hole between data and knowledge. It happens when information doesn’t tell us what we want or need to know” (p.34).

Accessibility is an important concept while making things usable and understandable. He continued, “Accessibility is made possible by the discovery of a structure – the simplest correct form of organization – unique to a specific subject, one that allows readers to find what interests them and feel no guilt about ignoring what does not” (p.45). It is important to consider the organization of information in order to achieve good quality of communication. Before designers start thinking of how to organize information, it is necessary to recognize the level of understanding. “Understanding is the vein of the problem, which is the course to solving it” (Wurman, 1989, p.80).

Then, what is information? Wurman dissembled and described information as five rings. (Figure 8) Five rings represented degrees of immediacy of the information to our lives.

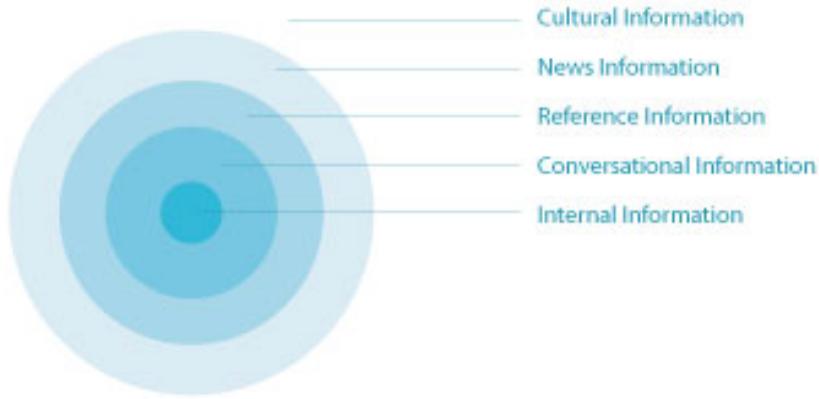


Figure 8. Five rings of information.

The first ring was internal information. The second ring was conversational information, the third was reference information, the fourth was news information, and the fifth was cultural information. Wurman stated, “Information anxiety can afflict us at any level and is as likely to result from too much as too little information” (p.44). He also expressed his concern with public access to experience and to information. To him, giving information is: “... Giving people new ways to look at their environment, their lives. ... I want to test my ideas about how people learn to decode experience, especially experience that relies on visual understanding - shape, color, relationships between objects and empty space” (p.47).

Information affects our lives, it changes our perspectives, our behavior, and our social relationships and so on; however, Wurman pointed out that information was not provided in an understandable form to people. Writers and graphic designers need to arrange words, numbers, and pictures in a way people can easily understand. However, graphic design in particular, focused on stylistic and aesthetic concerns rather than delivery of information (p. 55). In order to make information understandable, accuracy is not the means to do so. It is more important to recognize that “any account is bound to be subjective, no matter how committed the recounting is to being accurate and objective” (Wurman, 1989. p. 57).

2-9. Other Methods to Sign-Up: “Disappearing Forms”



Figure 9. A screenshot from *Jumpcut* website.

Do forms have to appear as forms all the time in the electronic environment? First, users create an account and password, and input their personal information etc.; do we need to consistently follow the steps? The answer is not necessarily. Wroblewski (2008) introduced some web forms where users became engaged with forms or services gradually. He called the style as “gradual engagement (your path out of sign-in dullery)” (p.196). He introduced Jumpcut, an online video editing service as an example of the gradual engagement. The process of adding a video to Jumpcut introduced you to other services the site provided, namely online video editing (Wroblewski, 2008, p.198). The sign up process appeared only when users wanted to publish or

share the movie. Then Jumpcut asked for the name and email so users and others can gain access to the movie just created (Wroblewski, 2008, p. 200).

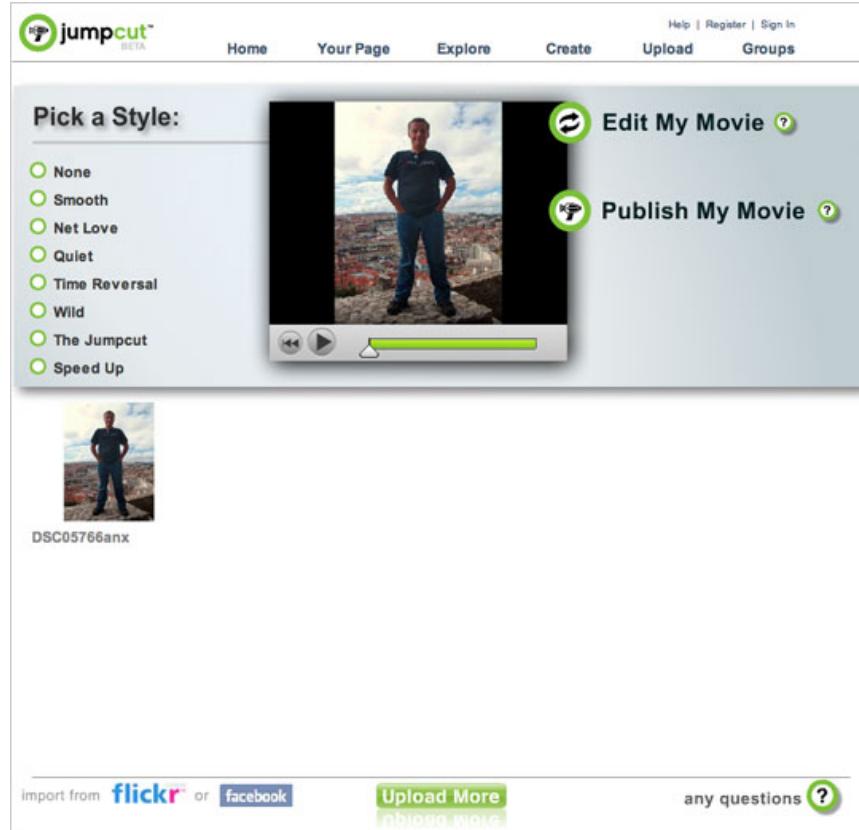


Figure 10. *Jumpcut first allows users to use the websites.
Users need to sign up if users want to publish or share the movie.*

Another example is Geni, a web service that allows users to set up a family tree and share it with family and friends. What are the first thing potential customers need to do when they arrive at Geni? Fill out a registration form? Nope, they make a family tree (Wroblewski, 2008, p.200). Users start to create a family tree by entering their name and email address, and while users are adding more family members, Geni sends the users an email with the username and password so users can get back to their family tree later.

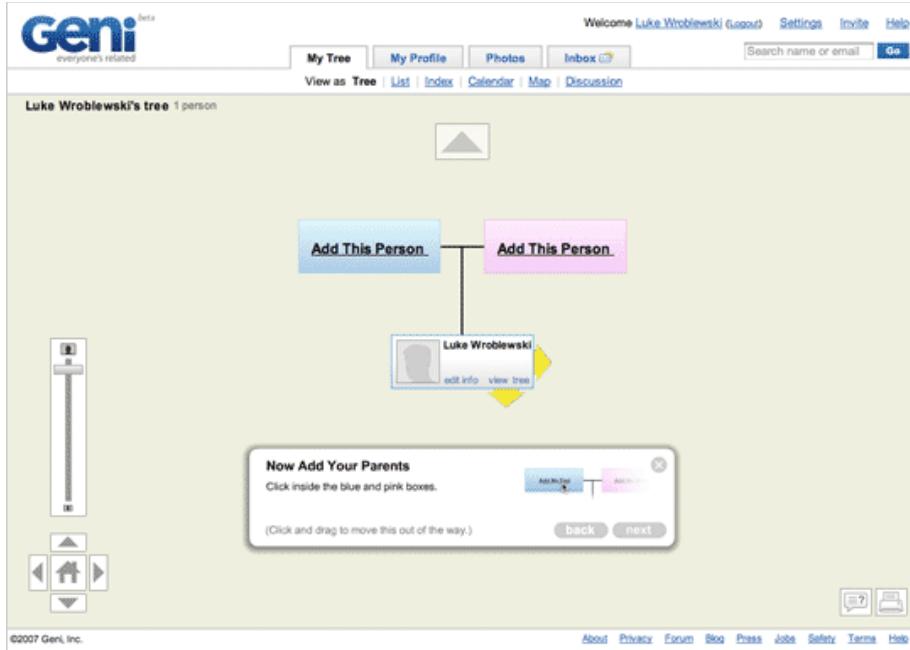


Figure 11. *Geni* asks name and email address first.

While users are creating a family tree, *Geni* sends an email to users.

In these examples, users can explore the service first. The process of inputting personal information is still necessary, however, it is less obvious. Wroblewski mentioned it as, “Gradual engagements like these have the potential to make forms essentially disappear by focusing on the things people want to achieve instead of the data fields required by a back-end database” (p.208). He also referred to dynamic or game-like interactions as a means of disappearing forms. For instance, Uzanto’s Mind Canvas software uses game-like elicitation methods (GEMs) to make the data collection process a more fun and engaging experience (Wroblewski, 2008, pp. 208-209). He also pointed out technology solutions may help for disappearing forms. Systems like Microsoft’s Live ID and the open source project Open ID are single sign-in solutions that allow people to use multiple Web sites with only one account (Wroblewski, 2008, p.209). In order to avoid users’ hesitations or mistakes while filling in forms, disappearing forms as well as well-designed interfaces would help. When creators of forms know user demographic, there is a

chance to consider adaptive interfaces that change depending on the users' behavior. For example, Microsoft's Office menu hides options when users do not use them frequently. However, Wroblewski warned that adaptive interfaces like this are prone to cause confusion when not designed well. He continued, "in a nutshell, when adaptive interfaces work well, they provide a slightly better experience for a few people. When they don't work well, they can provide a lot of confusion for many people" (p.210).

2-10. Social Changes through Design

Design can change society. Societies change as time goes, therefore keys for success would change as well. In *The whole new mind*, the author, Daniel Pink (2006) introduced *six senses* that would become new keys for success and personal happiness in the 21st century, which he called the *Conceptual Age* (p.2). The six senses were Design, Story, Symphony, Empathy, Play, and Meaning (Pink, 2006, p.2). Pink expressed design as "utility enhanced by significance" as well as "an essential aptitude for personal fulfillment and professional success" (p.70). He also mentioned that the ultimate purpose of design was to change the world (p.70). The author agrees with his statement.

Pink introduced how design changed high school education in Philadelphia. The Charter High School for Architecture and Design (CHAD) changed the curriculum to design-centered. The purpose was not to raise the net-generation designers, but to teach a holistic way of problem solving and social interactions learned through art and design education. As a result, CHAD has a higher attendance rate than other public schools in Philadelphia; although 88% of students were racial minorities. Many students enrolled at 2- or 4- year colleges including top US art and design schools, after graduating from CHAD. The deputy principal Christina Alvarez told Pink that the design education provided a modern version of liberal arts education to students (Pink,

2006, p.74). It proved that students learned essential abilities through design education to survive in the *Conceptual Age* (Pink, 2006, p.74). Design was the key for social change at CHAD.

Pink also introduced other examples of social changes that design brought in, such as better interior design, which changed students' performances at school and relieved pains of patients at hospitals. As a bad example, the ballot design confused voters in Palm Beach County, Florida in the 2000 election and did not reflect the people's will accurately. Pink concluded, "Good design, now more accessible and affordable than ever, also offers us a chance to bring pleasure, meaning, and beauty to our lives. But most important, cultivating a design sensibility can make our small planet a better place for us all" (p.86).

Pink referred to CHAD's Barbara Chandler Allen stating, "Think of how much better the world is going to be when CHAD kids pour into the world" (p.74).

Design for democracy by Marcia Lausen showed an attempt to change the design related to elections. By learning from the mistakes in Florida's ballot design, Lausen and her colleagues redesigned ballots, banners, websites, and all materials needed for elections in order to ensure the accuracy as well as to make people more engaged in elections.

Eriko Yamaguchi established *Motherhouse*, the bag company, in order to empower Bangladeshi people through business. Yamaguchi is a founder and designer. She thinks design is important in her business, because *Motherhouse* aims at creating bags that are truly appealing to customers. Yamaguchi mentioned,

It is possible to express your hope for the better society with your fashion in daily lives. Customers nowadays buy goods just because of the appearance; however, from now on customers will seek for stories behind the products. We want to be the company that customers will choose in the future, when they value inner beauty of the products (Yamaguchi, n.d.).

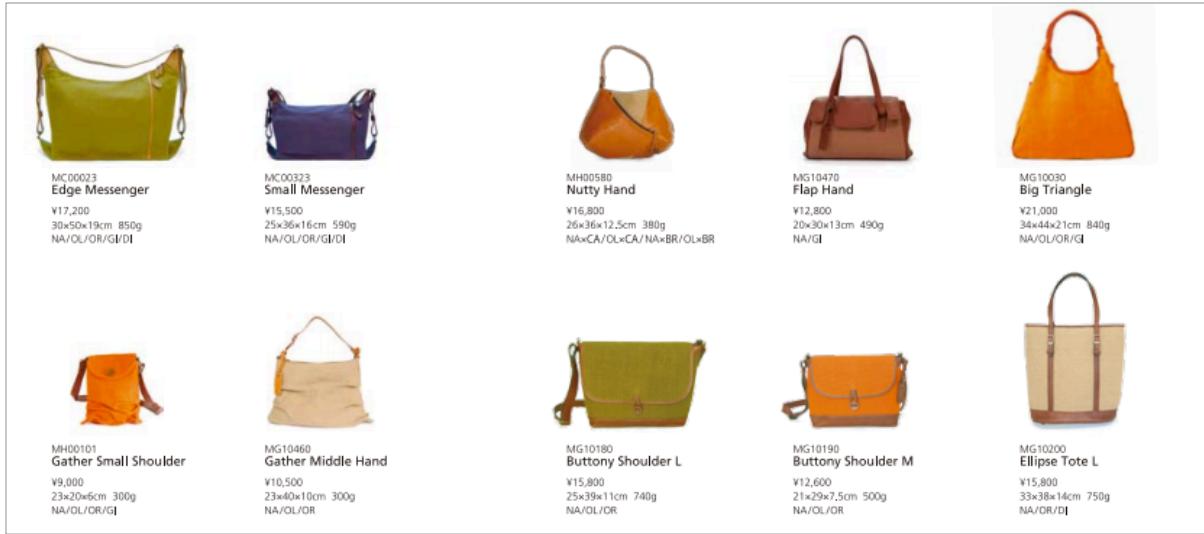


Figure 12. A page of catalogs of *Motherhouse*. Bags are produced in developing countries, sold in Japan.



Figure 13. A page of *Motherhouse* catalog. Bags are designed to appeal people in developed countries.

Yamaguchi uses local Bangladeshi materials such as jute and leather. She does not want customers to buy her bags just because customers want to help developing countries, but because they want to own her bags that have high quality. Yamaguchi thinks it is possible to attract

customers in developed countries to purchase her bags if the design and function are good. If customers are truly content with the products, it becomes stable as business, not as charity.

Design could affect people's lives in many ways, not just as aesthetic artifacts, but also as a means of better education, democracy, and business. Design has potential for social change.

2-11. Summary of Review of Literature

The review of literature showed many things to consider when designing electronic forms with high usability. Both electronic forms and paper forms have the same purpose: to assist users to deliver a variety of information to the receivers; however, electronic forms have different advantages and disadvantages from paper forms. User expectations and behaviors differ depending on which style of form is being used. High usability means users are comfortable with a product. Users can understand and use a product easily and intuitively in order to complete their tasks. Usability in electronic forms turns out to be deeply involved in the behavioral sciences, such as psychology. Usability is embodied on visual design principles, which are frequently based on perceptual psychology. (Figure 14)



Figure 14. Usability is achieved only when based on design that understands psychology.

Visual design principles are set to ensure the communication with users, rather than just to please their eyes. Information design and interface design have special areas of graphic design that have a specific target and purpose. (Figure 15)

General graphic design principles include typography, color, layout, and visual hierarchy.

Information design has a purpose of visualizing information so that viewers can understand large amounts of complex information easily. Interface design focuses on interactivity. Interface design often refers to the interface of electronic devices; therefore there should be consideration for the digital environment as well.

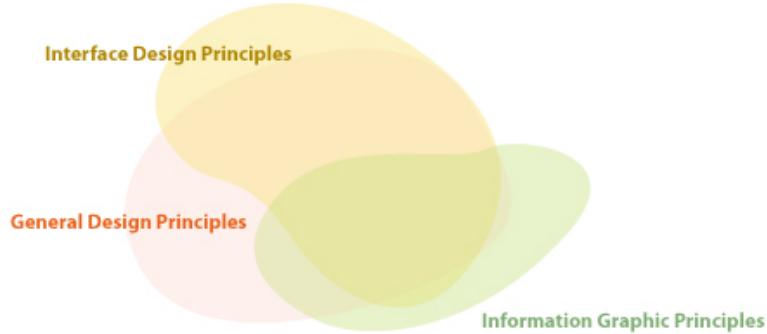


Figure 15. Design principles are co-related.

Although there are already conventions in form design, there are different ways to collect and deliver information, such as Jumpcut and Geni, which use *gradual engagement* forms. Gradual engagement forms allow users to explore online services first and then ask for more user information when users want more services.

Good design has the power to change society for the better. There are some examples of social change through design as Pink introduced Charter High School for Architecture and Design (CHAD) that changed education through design, Yamaguchi changed business in developing countries by focusing on design, and Lausen changed the design of election materials. The challenge in this thesis is to provide the methodology for accessible and socially responsible design, which eventually could change the world into a better place for everyone.

CHAPTER 3. METHODOLOGY

3-1. Overview

Electronic forms need design guidelines. Designers and usability researchers have analyzed electronic forms as a part of websites; however, electronic forms appear in other platforms, such as an airport kiosk. There is no sufficient research on electronic forms in websites as well as on electronic forms in other platforms. This thesis is attempting to establish the design guidelines that apply to electronic forms in electronic devices. Electronic forms would appear not only in websites that are browsed in computers, but also in smart phones, tablets, or even car navigation systems, etc.

Users work on forms to receive certain services, such as purchasing goods, applying for schools, or signing up for memberships. Electronic forms are often involved in the exchange of monetary, private, and confidential information of users. Filling out electronic forms needs more accuracy than other activities done with electronic devices, such as reading the news, uploading photos, and so forth. Forms also require large amounts and wide varieties of information. Organizing large amounts of information requires user concentration, carefulness, as well as patience to complete accurately. Since users' primary purpose is not filling out forms, forms should be designed to help users to finish completing forms and receive the services they want. In order to encourage completion and accuracy, designers need to understand both visual communication principles and the usability in electronic forms.

As a methodology, first, there would be analysis of information that is commonly required in electronic forms. Secondly, design guideline attributes would be determined based on

the review of literature. After analyzing attributes for design guidelines, a matrix would be created to summarize the research.

Again, the research questions are:

- What are current electronic forms like?
- What are the advantages and disadvantages of electronic forms for users?
- What are the critical problems that users have with electronic forms?
- What kind of improvement could be made in electronic form design based on graphic design principles?
- In what type of occasions do electronic forms need to be used? Could electronic forms be used with paper or other forms? What subjects would be appropriate for electronic forms?

3-2. Current Electronic Forms: Sample Information that users need to fill out

Seven existing forms were randomly selected to analyze amount, kind, and format of information that users need to fill in forms. The analyzed forms were:

- Social Security Card application (Figure 16)
- U.S. Passport application (print) (Figure 17)
- U.S. Passport application (online version) (Figure 18)
- Registration form for The Economist.com (Figure 19)
- Creating an account at Amazon.com (Figure 20)
- Sign-up process at Facebook.com (Figure 21)
- Iowa State University Graduate program application (Figure 22)

SOCIAL SECURITY ADMINISTRATION Application for a Social Security Card					
Form Approved OMB No. 0960-0096					
1	NAME TO BE SHOWN ON CARD	First	Full Middle Name	Last	
	FULL NAME AT BIRTH IF OTHER THAN ABOVE	First	Full Middle Name	Last	
	OTHER NAMES USED				
2	Social Security number previously assigned to the person listed in item 1		<input type="text"/> <input type="text"/> - <input type="text"/> <input type="text"/> - <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> - <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
3	PLACE OF BIRTH (Do Not Abbreviate)	City	State or Foreign Country	Office Use Only FCI	4 DATE OF BIRTH MM/DD/YYYY
5	CITIZENSHIP (Check One)	<input type="checkbox"/> U.S. Citizen	<input type="checkbox"/> Legal Alien Allowed To Work	<input type="checkbox"/> Legal Alien Not Allowed To Work (See Instructions On Page 3)	<input type="checkbox"/> Other (See Instructions On Page 3)
6	ETHNICITY Are You Hispanic or Latino? (Your Response is Voluntary) <input type="checkbox"/> Yes <input type="checkbox"/> No	7	RACE Select One or More (Your Response is Voluntary)	<input type="checkbox"/> Native Hawaiian <input type="checkbox"/> Alaska Native <input type="checkbox"/> Asian	<input type="checkbox"/> American Indian <input type="checkbox"/> Black/African American <input type="checkbox"/> White <input type="checkbox"/> Other Pacific Islander
8	SEX	<input type="checkbox"/> Male	<input type="checkbox"/> Female		
9	A. PARENT/ MOTHER'S NAME AT HER BIRTH	First	Full Middle Name	Last	
10	B. PARENT/ MOTHER'S SOCIAL SECURITY NUMBER (See instructions for 9 B on Page 3)	<input type="text"/> - <input type="text"/> - <input type="text"/> <input type="text"/>	<input type="text"/> - <input type="text"/> - <input type="text"/> <input type="text"/>	<input type="checkbox"/> Unknown	
11	A. PARENT/ FATHER'S NAME	First	Full Middle Name	Last	
12	B. PARENT/ FATHER'S SOCIAL SECURITY NUMBER (See instructions for 10B on Page 3)	<input type="text"/> - <input type="text"/> - <input type="text"/> <input type="text"/>	<input type="text"/> - <input type="text"/> - <input type="text"/> <input type="text"/>	<input type="checkbox"/> Unknown	
13	Has the person listed in item 1 or anyone acting on his/her behalf ever filed for or received a Social Security card before?	<input type="checkbox"/> Yes (If "yes" answer questions 12-13)	<input type="checkbox"/> No	<input type="checkbox"/> Don't Know (If "don't know," skip to question 14.)	
14	Name shown on the most recent Social Security card issued for the person listed in item 1	First	Full Middle Name	Last	
15	TODAY'S DATE MM/DD/YYYY	DAYTIME PHONE NUMBER		Area Code	Number
16	MAILING ADDRESS (Do Not Abbreviate)	City	State/Foreign Country	ZIP Code	
Street Address, Apt. No., PO Box, Rural Route No.					
17	YOUR SIGNATURE	18	YOUR RELATIONSHIP TO THE PERSON IN ITEM 1 IS: <input type="checkbox"/> Self <input type="checkbox"/> Natural Or Adoptive Parent <input type="checkbox"/> Legal Guardian <input type="checkbox"/> Other Specify _____		
DO NOT WRITE BELOW THIS LINE (FOR SSA USE ONLY.)					
NPN		DOC	NTI	CAN ITV	
PBC	EVI	EVA	EVC	PRA	NWR DNR UNIT
EVIDENCE SUBMITTED				SIGNATURE AND TITLE OF EMPLOYEE(S) REVIEWING EVIDENCE AND/OR CONDUCTING INTERVIEW	
				DATE	
				DCL	DATE

Figure 16. Social Security Card application.

Social Security Card Application. (Figure 16) The Social Security application is available only in a paper format. This form has clear weight contrast in the typography so the user can scan what types of questions are being asked to fill out. This form uses the space to its maximum with no white space. Nevertheless, there are some concerns. The first concern is in size. If a user has a long name, all of the characters of the name would not fit in the space provided. Size of printed type would not be as large as actual handwriting. This form would be inconvenient and too complicated for those with vision impairments and for senior citizens, due to the lack of negative space used to divide sections.

The second problem is the inconsistency in the way additional instructions are shown. For instance, in questions 13, 14, 15, and 17, users are supposed to write information above the horizontal lines. In questions 13, 14, and 15, additional instructions such as MM/DD/YYYY appear under the lines. In contrast, in question 17 additional instructions such as street address, city, and ZIP code appear way above the horizontal lines. This inconsistency in the placement of instructions could cause confusion to users. Another inconsistency in design is that some questions and input fields are divided by vertical lines, as seen in questions 2, 4, 9, and 10, whereas question 3 has no divider. Questions 2, 9, and 10 have an input box for each number; therefore there is no need to have vertical line to divide the question and the input field.

The third problem is that there is no help provided when users are filling out the form. It might be helpful to attach an example of how to fill out the form using an imaginary figure like John Doe, with Q&A.

APPLICATION FOR A U.S. PASSPORT
Please Print Legibly Using Black Ink Only

OMB APPROVAL NO. 1405-0004
EXPIRATION DATE: 12-31-2013
ESTIMATED BURDEN: 85 MIN

Attention: Read WARNING on page 1 of Instructions.

Please select the document(s) for which you are applying:

U.S. Passport Book U.S. Passport Card Both

The U.S. passport card is not valid for International air travel. For more information see page 1 of Instructions.
 20 Page Book (Standard) 52 Page Book (Non-Standard)

Note: The 52 page option is for those who frequently travel abroad during the passport validity period and is recommended for applicants who have previously required the addition of visa pages.

1. Name List:

First	Middle	<input type="checkbox"/> D <input type="checkbox"/> O <input type="checkbox"/> OP DOTS Code _____ End. # _____ Exp. _____
-------	--------	---

2. Date of Birth (mm/dd/yyyy) **3. Sex** **4. Place of Birth (City & State if in the U.S., or City & Country as it is presently known.)**
 M F

5. Social Security Number **6. Email Address (e.g. my_email@domain.com)** **7. Primary Contact Phone Number**

8. Mailing Address: Line 1: Street/PO Box, P.O. Box, or URL.
Address Line 2: Clearly label Apartment, Company, Suite, Unit, Building, Floor, In Care Of or Attention if applicable. (e.g. In Care Of - Jane Doe, Apt # 100)

City **State** **Zip Code** **Country, if outside the United States**

9. List all other names you have used. (Examples: Birth Name, Maiden, Previous Marriage, Legal Name Change. Attach additional pages if needed)

A. B.

10. Parental Information

Mother/Father/Parent - First & Middle Name	Last Name (at Parent's Birth)
Date of Birth (mm/dd/yyyy)	Place of Birth
Sex: <input type="checkbox"/> Male <input type="checkbox"/> Female U.S. Citizen? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Mother/Father/Parent - First & Middle Name	Last Name (at Parent's Birth)
Date of Birth (mm/dd/yyyy)	Place of Birth
Sex: <input type="checkbox"/> Male <input type="checkbox"/> Female U.S. Citizen? <input type="checkbox"/> Yes <input type="checkbox"/> No	

CONTINUE TO PAGE 2 →

DO NOT SIGN APPLICATION UNTIL REQUESTED TO DO SO BY AUTHORIZED AGENT

I declare under penalty of perjury all of the following: 1) I am a citizen or non-citizen national of the United States and have not, since acquiring U.S. citizenship or nationality, performed any of the acts described under "Acts of Deception"; 2) the most recent copy of this application was signed by me or my authorized agent; 3) the statements made on this application are true and correct; 4) I have not knowingly and willingly accepted or induced another person's support of my application; 5) the photograph submitted with this application is a genuine, current photograph of me; and 6) I have read and understood the warning on page one of the instructions to the application form.

Identifying Documents - Applicant or Mother/Father/Parent on Second Signature Line (if Identifying minor)

<input type="checkbox"/> Driver's License	Issue Date _____	Exp. Date _____	Place of Issue _____
<input type="checkbox"/> Passport			
<input type="checkbox"/> Military	Name _____		
<input type="checkbox"/> Other	ID No. _____		

Identifying Documents - Applicant or Mother/Father/Parent on Third Signature Line (if Identifying minor)

<input type="checkbox"/> Driver's License	Issue Date _____	Exp. Date _____	Place of Issue _____
<input type="checkbox"/> Passport			
<input type="checkbox"/> Military	Name _____		
<input type="checkbox"/> Other	ID No. _____		

Facility Name/Location _____

Facility ID Number _____

Agent ID Number _____

Signature of person authorized to accept applications _____ **Date** _____

For Issuing Office Only → **By** _____ **Card** _____ **Execution** _____ **EF** _____ **Postage** _____ **Other** _____

* DS-11 C 12-2010 | *

DS-11 12-2010

Page 1 of 2

Figure 17. U.S. passport application (print).

U.S. passport application (print). (Figure 17) The U.S. passport application form (Figure 17) has many boxes that are intimidating. The divider between each section could be clearer by adding more space or lines in between. The number of the boxes is already decided. If a user has a name with many characters, the name would not fit in the field. Instructions could be bigger so it is easier to read.

The screenshot shows the 'About the Applicant' section of the online passport application. At the top, there is a header with the U.S. Department of State logo, the text 'U.S. DEPARTMENT of STATE Online Passport Application', and a link 'Need help with this Site?'. Below the header, the section title 'About the Applicant' is displayed in bold. The form fields are organized into several groups:

- Name Fields:** First Name: * (text input), Middle Name: (text input), Last Name: * (text input), Suffix: (text input).
- Personal Information:** Date Of Birth (MM/DD/YYYY): * (text input), City Of Birth: * (text input), Country Of Birth: * (dropdown menu showing 'UNITED STATES'), State/Territory Of Birth: * (dropdown menu showing 'Please Select..').
- Identifying Numbers:** Social Security Number: * (text input).
- Physical Characteristics:** Sex: * (radio buttons for Male and Female), Height: * (text input with dropdown menus for Feet and Inches).
- Other Information:** Hair Color: * (dropdown menu showing 'Please Select...'), Eye Color: * (dropdown menu showing 'Please Select...'), Occupation: * (text input), Employer or School: (text input).

At the bottom right of the form, there are 'Previous' and 'Next' navigation buttons.

Figure 18. U.S. passport application (online).

U.S. passport application (online). (Figure 18) The online application for a U.S. passport (Figure 18) has about six pages in total. The first page asks 12 questions. Some questions are about the biological information of the applicant, such as name, date of birth, and height. The rest are general questions such as social security number and occupation. The second

page asks for contact information including both an email address and mailing address. The third page asks for travel plans. The fourth page asks for an emergency contact. The fifth page asks for information about the most recent passport. Questions on the sixth page depend on answers on the fifth page. This application does not require a large number of questions at once, as the print version does. The online version provides format options for answers, as seen in height and eye color; therefore it would be easier for users to fill this form out versus the print version. The disadvantage of the online version is that users have no clue about the extent or content of the entire form. Questions are presented page by page; therefore it is impossible for users to know what kind of information will be asked. If users do not know some of the information, and they need to look up other documents as references, they might prefer to find references first. Nevertheless, in this style of form, it is impossible to prepare for references to all questions at once since it is not possible to view all questions at once.

The online version does not have an option to save work and quit to continue later. Users would need to start from the beginning if they quit before they finished filling out the entire form.

The screenshot shows the registration page for The Economist. At the top, there's a red header with the magazine's name. Below it, a dark blue navigation bar includes links for Log In, Register, and Subscribe, along with Digital & mobile, Events, Topics A-Z, Newsletters, Jobs, and social media icons. The date Friday May 18th 2012 is displayed, along with a search bar and a magnifying glass icon.

Create a new account

Registration is free, and it only takes a minute.

Given name: [Text input field]

Family name: [Text input field]

E-mail address: [Text input field]

Password: [Text input field]

Confirm password: [Text input field]

Pen name (optional): [Text input field]
Select a pen name to appear next to your comments.
Otherwise, we'll assign one you can change later.

Password must be at least 8 characters long.

Personal details

We want to know who our readers are. Please tell us about yourself.

Country of residence: [Select dropdown menu]

Gender: [Select dropdown menu]

Year of birth: [Select dropdown menu]

Log in to your account

E-mail address: [Text input field]

Password: [Text input field]

Stay logged in?

LOG IN

[Forgot password?](#)

Log in with a social network

Figure 19. *The Economist* registration form.

The Economist registration form. (Figure 19) The Economist registration form (Figure 19) requires only 10 questions and one optional question. Questions and format are straightforward and easy to understand. Since this form does not ask information that is too personal and that could identify who a user is, users would not feel too much emotional burden or commitment. As a user, it is relieving that the instructions assure that the registration is free on the top of the page. On the other hand, “please tell us yourself” would not seem completely necessary. The navigation on top is kept consistent as other pages; therefore it would allow users to move on to other pages easily if they are distracted or quit registration.



The image shows the Amazon sign-in page. At the top left is the Amazon logo. At the top right are links for "Your Account" and "Help". The main heading is "Sign In" in orange. Below it is the question "What is your e-mail address?" in orange. A text input field is labeled "My e-mail address is:" followed by a blue rectangular input box. The next section asks "Do you have an Amazon.com password?" in orange. There are two radio button options: "No, I am a new customer." (unselected) and "Yes, I have a password:" (selected). To the right of the selected option is a blue rectangular input box. Below the radio buttons is a link "Forgot your password?". At the bottom is a yellow rectangular button with the text "Sign in using our secure server" and a blue arrow icon.

Sign In Help

Forgot your password? [Get password help.](#)

Has your e-mail address changed? [Update it here.](#)

[Conditions of Use](#) [Privacy Notice](#) © 1996-2012, Amazon.com, Inc. or its affiliates

Figure 20. Creating account at Amazon.com.

Creating account at Amazon.com. (Figure 20) The Amazon account sign-up form (Figure 20) requires only an email address on the first page, and a name and password on the second page to create an account. The user's phone number is optional. It is interesting that the first page is designed for both returning users and new users. The first page also has a color coding system, which uses the most fundamental information, such as what page it is (Sign In) and questions in orange text, users' answers in black text (My email address is...), and help (Forgot your password?) is in blue. Since this form asks a few questions per page and there are only two pages, the emotional burden on users would not be too heavy. Users will stay on the

page, even though they are not focused on creating an account, because the navigation on this page is simplified compared to other pages. Even though they want to quit signing up before finish signing up, users have to adjust themselves to the simplified navigation bar in the form page. It would be useful for Amazon company side because users might not find a way to the previous pages, therefore they would just stay in the sign up page and sign up. It is unclear whether this treatment is always convenient for customers. Simple interfaces would allow customers to focus on some tasks; yet, they would not allow other tasks that are not intended by designers but users want.

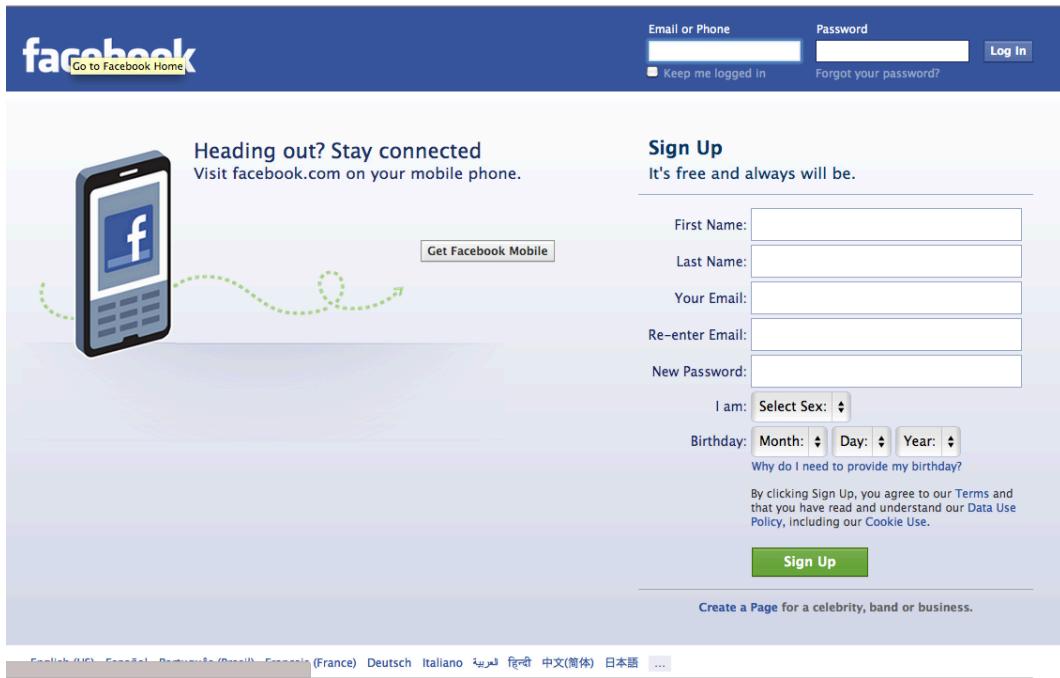


Figure 21. Homepage of Facebook.com. for both sign-up and login.

Sign-up and login at Facebook.com. (Figure 21) The homepage of Facebook.com is designed for both new users' sign-up and returning users' log-in. Color divides sign-up and login fields. Sign-up is in the light blue background, whereas the login form is in the dark blue background. In the page layout, the new sign-up form takes more space than the login form. Not

only is the size of the layout, but also the size of the text and input fields are larger in the sign-up form. This indicates that Facebook focuses more on new users rather than returning users. The left half of the page does not have many graphics or instructions that would distract users.

IOWA STATE UNIVERSITY
Admissions

Main Menu Application Features View Activity Help

International Graduate Application

Please read the [How to Apply](#) section before completing the application.

1. APPLICANT INFORMATION

Full legal name as it appears in passport	Matsunaga (family/surname)	Mikako (first/given)	<input type="text"/> (middle)
Variations of name	<input type="text"/>		
US Social Security # (optional)	<input type="text"/> <input type="text"/> <input type="text"/>	What is your primary language?	<input type="text"/>
(more information)			
Birth Country	Select Country	ISU ID number (if known)	<input type="text"/>
Country of Citizenship	Select Country	Gender	<input type="radio"/> Male <input type="radio"/> Female
Birth date (mm/dd/yyyy)	<input type="text"/> <input type="text"/> <input type="text"/>	Telephone	<input type="text"/> (country code-city code-number)
E-mail address	mik.matsun@gmail.co	Fax number	<input type="text"/> (country code-city code-number)
Foreign permanent address	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>		
(line 1 of street address)			
(line 2 of street address)			
(city)*			
(province/state)*	<input type="text"/> (postal code)		
(country)	<input type="text"/>		
Current residential address (if different from above)	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>		
(line 1 of street address)			
(line 2 of street address)			
(city)*			
(province/state)*	<input type="text"/> (postal code)		
(country)	<input type="text"/>		
Indicate type of visa you wish to hold while enrolled	<input type="text"/>		

Figure 22. A screenshot of the top half of the first page of the Iowa State University Graduate Program application for International Students.

Iowa State University graduate program for international students. (Figure 22) The application for the Iowa State University graduate program for international students (Figure 22) asks 65 questions in multiple pages. The application asks questions such as name, address, and education history as well as visa information. In addition to the online application, applicants are required to submit other documentations such as letters of recommendation, a statement of purpose, and exam scores from The Test of English as a Foreign Language (TOEFL), Graduate Records Examination (GRE), financial statement, official transcript from undergraduate college, and more. The problem with this form is that some of the category names and input fields are not close enough for users to understand they are related. For instance, the postal code and input field are located too far apart. It is useful to have a grid structure to organize information for engineers and designers; however, it can cause confusion on the form. The users' perspectives should be considered when designing how the form looks and functions. This form needs more consideration and research on users to improve usability, since not all countries in the world present information in the way the U.S. does. For example, Japanese and Chinese countries write addresses in a different order. They write the zip code first; then the prefecture, city, town, and street address, whereas in the U.S., this information is written in the opposite order. It is acceptable to use the U.S. way of presenting information; however, it should be understandable for people with different backgrounds as well, so applicants will be emotionally encouraged to apply for the programs.

Basic information about each form. The Social Security Card Application is supposed to be turned in as a printed copy. It can be printed and filled out by hand. It is also available to download and fill in electronically in Adobe Portable Document Format (PDF) and then print. U.S. Passport application has two methods for submission. It can be 1) printed and filled out by

hand or 2) filled out and turned in online. U.S. passport do not have a writable PDF file; therefore it is not possible to electronically fill out the form and then print. All other forms are designed for electronic completion and submission.

Commonality in selected forms. When one starts filling out forms, their name and email address are almost always required (Figure 23, 24). The Social Security Card does not require an email address, which may be due to the fact that the social security card application was never intended to be completed online. It was meant to be filled out by hand in paper form. In order to obtain a form, applicants are supposed to visit a Social Security Office or download a form online. When applicants do not have access to the website or a physical Social Security Office, a form can be completed and submitted over the phone with the assistance of officers at the Social Security Office.

With other forms, an email address is always required, even on paper forms. Email addresses are more commonly asked for than mailing addresses. Email is the most convenient and cost-efficient tool to communicate with users today.

Other commonly required items are date of birth, place of birth, social security number, phone number, and mailing address. It is important to be accurate about the identification of the person filling out the form. This would be the reason why some highly personal information, such as social security number, is required.

Personal identification has three categories. The first category is biological information, such as eye color, race, birthplace, and birth year. This kind of information is required for governmental or international purposes, such as passport application. Personal contact information, such as email and current and permanent addresses comprise the second category. The third category contains personal past history, such as education and marriage. In addition to

these three categories, family information is sometimes required. However family, in this context, meant just the relation in the first degree, such as parents, spouse, and children.

Social Security Card application		U.S. Passport (Adult, First time) - Paper	U.S. Passport - Online
NAME TO BE SHOWN ON CARD (First, Full Middle Name, Last)	I applied: Place, Date What kind: U.S. Passport book/card/both, 28/52 page book	Name (First, Middle, Last, Suffix) Date of birth City of birth Country of birth State/Territory of birth Social Security Number	
FULL NAME AT BIRTH IF OTHER THAN ABOVE	Name Last, First, Middle	Sex	Sex
OTHER NAMES USED	Date of Birth	Height	Height
Social Security number previously assigned to the person listed in Item 1	Place of Birth	Hair color	Hair color
PLACE OF BIRTH City, State or Foreign Country	Social Security Number	Eye color	Eye color
DATE OF BIRTH MM/DD/YYYY	Email Address	Occupation	Occupation
CITIZENSHIP (Check one)	Primary contact phone number	Employer/School	Employer/School
ETHNICITY Y/N	Mailing Address	All other names	
RACE (Select one or more)	[Parental Information] Mother/father/parent name (first & middle, last)	[Parental Information] [Applicant's Info]	
SEX M/F	Date of birth Place of Birth Sex	[One more Parental Information] same as above Signature should be written with an agent [Applicant's Info]	
A. PARENT/MOTHER'S NAME AT HER BIRTH (First, Full Middle Name, Last)	U.S. citizen or not	Name (Last, First, Middle)	Name (Last, First, Middle)
B. PARENT/MOTHER'S SOCIAL SECURITY NUMBER	Name shown on the most recent Social Security card issued for the person listed in item 1 (First, Full Middle Name, Last)	Date of Birth	Date of Birth
Has the person listed in item 1 or anyone acting on his/her behalf ever filled for or received a Social Security number card before? (Y/N/Don't know)	Enter any different date of birth if used on an earlier application for a card (MM/DD/YYYY)	Height	Height
DAYTIME PHONE NUMBER (Area Code, Number)	TODAY'S DATE (MM/DD/YYYY)	Hair color	Hair color
MAILING ADDRESS (Street Address, City, State, Zip)	MAILING ADDRESS (Street Address, City, State, Zip)	Eye color	Eye color
SIGNATURE	SIGNATURE	Occupation	Occupation
RELATIONSHIP TO THE PERSON IN ITEM 1 IS: Self/Natural or Adoptive parent/Legal guardian/Other	Employer/School	Additional contact phone number Permanent address	Additional contact phone number Emergency contact (Name, address)
		Travel Plans (Date of trip, Duration of trip, Countries) Marriage information (Y/N, name of spouse, date of birth, place of birth, marriage date, widowed/divorced)	Travel Plans (Date of trip, Duration of trip, Countries) Marriage information (Y/N, name of spouse, date of birth, place of birth, marriage date, widowed/divorced)
		Previous passport book history (issued before? Y/N, name, book number, status of the book, date issued)	Previous passport book history (issued before? Y/N, name, book number, status of the book, date issued)
		Previous passport card history issued before? Y/N, name, book number, status of the book, date issued)	Previous passport card history issued before? Y/N, name, book number, status of the book, date issued)
		Page 5 Most Recent Passport Book/Card/Both/None	Page 5 Most Recent Passport Book/Card/Both/None
		Page 6 Depends on Page 5	Page 6 Depends on Page 5

Figure 23. Questions asked in sample forms (page 1).

Registration at <i>The Economist.com</i>	
Create account	
1. Name (given, family)	Email Address
2. Email address	Confirm Email address
3. Password	New Password
4. Confirm password	Confirm Password
5. Pen name (optional)	Next page: Applicant information: (Family and First name are already filled if they are filled in with sign-up) Variations of name
Personal Details	
1. Country of Residence	US Social Security Number
2. Gender	Primary language
3. Year of Birth	Birth Country
4. Industry	ISU ID number (if known)
5. Job title/position	Country of citizenship
6. Privacy options (check)	Gender
Birth date	
Telephone (Country code-city code-number)	
Email address (already filled)	
Fax number (Country code-city code-number)	
Foreign permanent address: Line 1 of street address	
Foreign permanent address: Line 2 of street address	
City	
Province/State	
Postal Code	
Country	
Current residential address (if different from above)	
Line 1 of street address	
Line 2 of street address	
City	
Province/State	
Postal Code	
Country	
Type of Visa	
Applicant information: (Family and First name are already filled if they are filled in with sign-up) Variations of name	
US Social Security Number	
Primary language	
ISU Graduate program application (Continued)	
If you are in the US, current visa status	
Any dependents who will accompany you?	
ISU Graduate program application (International)	
Create account	
1. Name (given, family)	(ISU Graduate program application continued) If yes, indicate spouse and/or children
2. Email address	Entry date
3. Password	Major/program desired (Jump to another page)
4. Confirm password	Previous ISU experience
5. Pen name (optional)	If so, indicate month/year
Personal Details	
1. Country of Residence	Previous Education: Dates attended
2. Gender	Name of University
3. Year of Birth	Location
4. Industry	Degree and Date
5. Job title/position	Undergraduate major
6. Privacy options (check)	Graduate major
Birth date	
Telephone (Country code-city code-number)	
Email address (already filled)	
Fax number (Country code-city code-number)	
Foreign permanent address: Line 1 of street address	
Foreign permanent address: Line 2 of street address	
City	
GRE Quantitative	
GRE Analytical Writing	
GRE Subject	
GMAT Verbal	
GMAT Quantitative	
GMAT Analytical Writing	
TOEFL (PBT)	
TOEFL (iBT)	
IELTS	
Create an account at Amazon.com	
Page 1	
1. Email address	Percentile
Page 2	
1. Name	Mo/Yr taken
2. Email address (already filled)	Test Registration Number
2. Type email address again	GRE Verbal
3. Mobile phone number (optional)	GRE Quantitative
4. Password	GRE Analytical Writing
5. Type password again	GRE Subject
Create an account at	
Amazon.com	
Create an account at	
Facebook	
First name	Country
Last name	Type of Visa
Email address	Applicant information: (Family and First name are already filled if they are filled in with sign-up) Variations of name
Re-enter email	US Social Security Number
Password	Primary language
Select sex (M/F)	ISU Graduate program application (Continued)
Birthdate	If you are in the US, current visa status
Any dependents who will accompany you?	

Figure 24. Questions asked in sample forms (page 2).

Structure of forms. Paper forms present the type of items needed for information all at once, while electronic forms can break questions into several pages. The difference is because there is no cost for having multiple pages in electronic forms, whereas printed forms are costlier if they have multiple pages. With paper forms, it is possible to browse how much and what type of information users need to fill in; where it is not possible to browse electronic forms.

Username and password. Users are sometimes asked to register both a username and password. The username and password are necessary if users fill in forms or receive services not just once, but multiple times. *The Economist*, Facebook, Amazon, and Graduate School applications ask users to create an account. Facebook and Graduate School applications do not allow users to proceed further unless they first create an account. For *The Economist*, creating an account was just an option to receive more services. In Amazon, an account is needed when users want to purchase a product, write a review, or receive more services. In contrast, it is possible to access the U.S. passport and Social Security Card application without creating an account. It is unlikely for users to visit and fill out forms electronically for a U.S. passport and Social Security Card; therefore it is not necessary to register a username and password to store personal information online.

The amount of required information varies from form to form. The number of required information per each form is as follows:

- Social Security Card application: 20
- U.S. Passport application (print): 35
- U.S. Passport application (online version): 36+
- Registration form for The Economist.com: 11
- Creating Account at Amazon.com: 6

- Sign-up process at Facebook.com: 7
- Iowa State University Graduate program application: 65

For highly confidential and important information, such as a U.S. passport and Social Security Card, it is necessary to have detailed information for identification, whereas registering at The Economist.com does not require as much information because it does not necessarily involve making a payment or anything unless users want more services, such as subscriptions. The graduate school application needs the most information among the selected examples. In addition to personal identification, it asks for applicants' educational background and examination scores such as GRE. The graduate school application, U.S. passport application, and Social Security Card application ask many more questions compared to the others.

Electronic form users. Anyone can be an electronic form user. English speakers can internationally use Facebook, Amazon, and *The Economist*. It is assumed that users applying for a U.S. passport are U.S. citizens, from young to old, female and male, and from diverse educational, social, and economic backgrounds. Non-U.S. citizens can obtain a Social Security Card when they live in the United States for graduate school applications, however, users would be limited to applicants who understand English and are pursuing higher education.

Styles of electronic forms. There are three styles of electronic forms. The first style is the sign-up form, which requires a minimal amount of information. Sign-up forms are found on Facebook, Amazon, and *The Economist*. On these websites, services occur after users sign-up. As users purchase goods or play games, they have to enter more information, such as a mailing address, credit card information, and so forth. There are a variety of services after users sign-up. This style is similar to the forms Wroblewski (2008) mentioned as "gradual engagement" (p.196).

The second style of electronic forms ask for many types of information all at once, as seen in the Social Security Card application and the U.S. passport application. This style of form could be referred to as an application form. It seems that users are expected to complete these forms once. This is because users do not use these forms frequently. For instance, once one applies for a U.S. passport book, it is valid for ten years if the applicant is 16 years old or older, and it is valid for five years if the applicant is 15 years old or younger (Bureau of Consular Affairs, U.S. Department of State, n.d.). However, users might prefer to fill in part of the form and then quit, in order to find required information. In these forms, once users quit part way through the form, they have to start from the beginning the next time they return to the form. It seems like this style is similar to the printed form; however, there is not enough consideration on usability.

The third style of electronic forms is a combination of the first two; where there is both a sign-up and an application portion, as seen in the graduate school application. This style asks for both a sign-up and a large amount of information. Users need to fill out this kind of form only once, such as to apply to a school. The frequency of visits is high for short-term time period, as opposed to the first style of forms like Facebook, Amazon, and *The Economist*.

Through the analysis of electronic form styles, it was found that the first style of electronic forms occur in commercial websites, the second style in governmental documentation, and the third style in between of those two, such as education. However, more research would be necessary to analyze the relationship between styles of forms and host organizations.

Electronic forms	Style 1: Sign-up forms	Style 2: Application forms	Style 3: Sign-up and application forms
Frequency of visit	Frequent (Multiple times) for a long term	(Supposed to be) Once	Frequent (Multiple times) for a short term
Amount of required information	Small at the beginning (sign-up); More will be asked later	Large and asked at once	Large
Examples	Amazon.com; Facebook; The Economist	Social Security Card application; Passport application	ISU graduate school application
Industry	Commercial	Government	Education

Table 2. Styles and usage of electronic forms.

New Information required in forms. Here is an analysis of questions commonly asked in sample forms. (Figure 25, Table 3)

The most common question asked on a form is name of the applicant, which is asked 11 times in seven forms according to Figure 25. U.S. Passport, Social Security Number, and graduate school applications ask other variations of the applicant's name as well. The second most frequently asked question is the applicant's Email address. Only the Social Security Number application did not require an email address. Both the print and online application for a U.S. passport have the same questions. Surprisingly, the print version asks for the applicant's name three times whereas the online version asks only once.

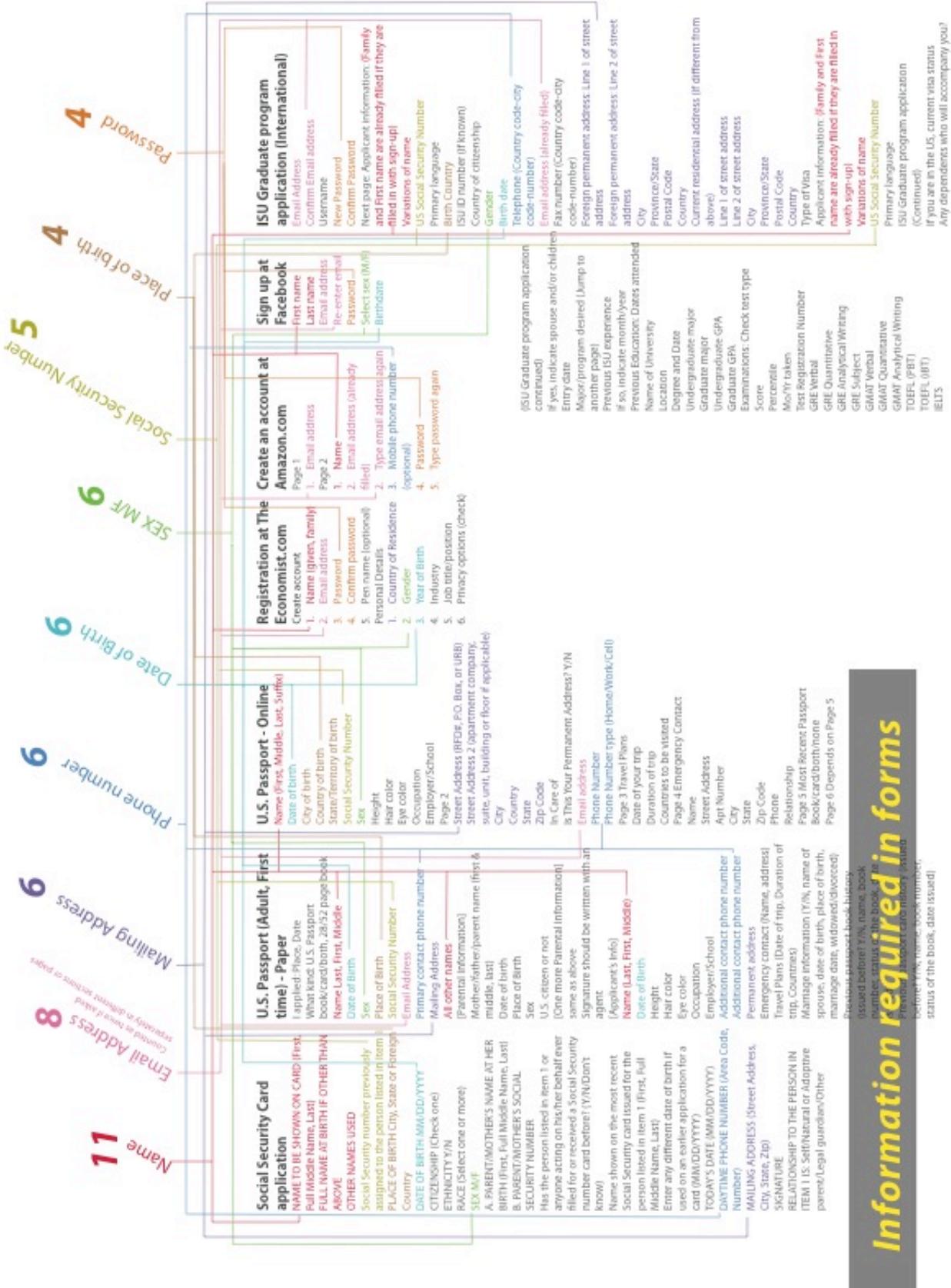


Figure 25. Information required in forms.

	Common questions						Total
Name (Includes other variation of name)	2	3	1	1	1	1	11
Social Security Number	1	1	1				2
Citizenship	1						2
Place of Birth	1	1	1	1	2	1	4
Email address	1						8
Date of Birth	1	1	1	1		1	7
Sex	1	1	1	1		1	6
Mailing address	1	1	1	1		1	6
Phone Number	1	1	1		1**	1	6
Occupation/Employer/School	1	1	1				3
Parental Information	1	1					2
Emergency Contact	1	1					2
Password				1	1	1	4

* U.S. Passport - Paper is for Adults applying for the first time

** Phone number is optional

Table 3. Typical questions asked in forms.

3-3. Advantages and Disadvantages of Electronic Forms

Sustainability. As mentioned above, electronic forms were more sustainable in terms of paper and ink usage. It is possible to rewrite and update without wasting paper.

Accessibility. Electronic forms were accessible wherever and whenever as far as there were appropriate devices. In other words, electronic forms were not accessible if one did not have required devices or Internet connection. Since not everyone in the world has access to electronic devices or Internet, there was unfairness to the accessibility as Aleph Molinari (2012) described as “digital divide”.

Usability. On the other hand, in electronic forms it was often impossible to browse through the entire form at the beginning. Users were allowed to see the only section that they are currently working on.

3-4. Critical Problems with Electronic Forms

Lack of adjustments from print. As seen in the Social Security Card application and U.S. passport application, some electronic forms are just transferred to a PDF and are available electronically without adjustments to fit the user’s need. Since the Social Security Card application is designed for physical completion and submission, there is no option for electronic submission; it might not cause large problems. On the other hand, the U.S. passport application has two options: 1) complete online and print or 2) complete by hand. The Option 1 form and Option 2 form have a different appearance. With both methods, users are to submit the form in person at an Acceptance Facility or Passport Agency (Bureau of Consular Affairs, U.S. Department of State, n.d.). The Option 1 form does not allow users to save and quit their work, and then continue at a later time.

No bird's-eye view. The other problem with the electronic forms is the invisibility of the entire form, because electronic forms tend to divide questions by category. Therefore, it is difficult for users to have an overview of the entire form and prepare for the information needed at the beginning. It is also hard to estimate how long it will take to complete the form.

Sign-up for what? Some forms just ask users to sign-up to use the service. Users are forced to sign-up just to see what the service is like. For instance, Facebook asks users to sign-up at the beginning, otherwise they cannot see what Facebook is like. Facebook provides a brief statement on the sign-up page, “it’s free and always will be,” although it does not provide enough information for first-time users to understand the functions (Facebook, n.d.). In Japan, the English translation of the Facebook statement from the sign-up page converts to, “It is safe because you can adjust how much information you want to share” (Facebook, n.d.). This author’s personal experience supports the fact that users sign-up with no idea about what service will be provided. A few years ago she signed up for *The Economist*, to receive a weekly news summary, however, she is not sure what else the account is for. The account is separate from their upgraded subscription and job services accounts. It was free to sign-up, so she did not hesitate, however, it is not clear what kind of benefits she receives. It is obvious that the disadvantage is this situation is that *The Economist* group has her personal information for further promotion.

3-5. Suggestions for Design Improvements

This author selected graphic design principles for electronic form design from graphic designers and usability specialists. Based on the suggestions here, design guidelines will be created for electronic form design.

Yee, Lievesley, and Taylor on design failure.

- Design failures: *Usability Failure, Communication Failure, and Technical Failure.*
- Usability Failure is related to the design. It is important for success to monitor risk consistently and to learn from failure (Yee et al, 2009, p.231).

Wrobleski on form design.

- Forms should be designed from the perspective of the people outside of the organizations (Wrobleski, 2008, p.2).
- It is important to recognize the lack of human factors such as service, casual conversations, and gestures in electronic forms.

Porters on designers' roles and human psychology.

- Designers need to support people's social desires for interactivity, authority, reputation, identity, and control (p. viii).
- Interface design should be neither too confining nor too flexible. Too many options to select from should be avoided as well (Schwartz, 2005).
- In the design process, it is recommended for designers to meet people who use the application to understand their reactions to the application (Porters, 2008, p.44).

Ariely on decision-making (user behavior).

- It is human nature to keep as many options as possible; however, it might be a risk to the users' main goal (Ariely, 2008, p.140).
- Expectations affect the decision-making process.
- Expectations help communication, therefore it is crucial to analyze what users expect from electronic forms.

- Experience could change depending on expectations as well as knowledge that came before the experience.
- Reaction to products would change whether it has a strong brand identity or not, since the brand activates higher-order brain mechanisms (Ariely, 2008, p. 167). Establishing strong brand identity would be a tool to create an emotional connection between users and organizations that provide forms.

Krug on interface design. Suggestions to keep in mind in designing of websites:

1. Create visual hierarchy
 2. Take advantage of conventions
 3. Break pages up into clearly defined areas
 4. Make it obvious what's clickable
 5. Minimize the noise (p.31)
- Hierarchy would be achieved through visual distinction by size, color, weight changes, and spatial arrangements.
 - The most important rule for the interface design is to show contents obviously and to minimize the distraction (p.15). There are two kinds of distractions.
 - One is the *busyness* that tries to catch users' attention.
 - The other is *background noise* consisting of many small distractions (p.39).
 - It matters to the usability if users have to think when they click. The number of clicks does not matter to usability unless it requires intensive thinking (p.41). Design should clearly show the contents to avoid unnecessary thinking.
 - Users do not read but scan, therefore unimportant elements such as instructions and welcome message should be eliminated (Krug, 2000, p.45). Instead, designers need

contents to be self-explanatory. If instructions are absolutely necessary, designers could provide bare minimum (p.47).

- Nielsen's definition of users in terms of reaction to the links: "Search-dominant users" always search by typing words, whereas "Link-dominant users" always browse first (Krug, 2000, p.54-55). Understanding the characteristics of users would be helpful to keep users engaged in the tasks they are working on.
- Web space and physical space are different.
- Functions of navigation as:
 - To remind locations of users and of the contents they are looking for
 - To tell users what the contents are and how to use them
 - To build users' trust in the site (p.59-60).
- Clear navigation would be one of the factors that bring the users back to the site again. It would be taken into consideration in the products that expect users to come back again, such as websites with sign-ups.
- In web forms, navigation should be minimal with site ID, a link to home, and any utilities so it will not distract users (p.63).
- "You are here" indicator and breadcrumbs could be utilized to indicate the current location of the users in websites and forms.
- "You are here" indicator and breadcrumbs should stand out on the page without distracting users. Design guidelines for breadcrumbs are:
 - Put them at the top
 - Use > between levels
 - Use tiny type

- Use the word '*you are here*'
- Boldface the last item
- Don't use them instead of a page name (Krug, 2000, pp.78-79).
- Tabs are useful when organizing contents because it is a reflection of the physical action that works in the electronic environment (p.80-81).
- Homepage of websites need to show what users are looking for, what they are not looking for but they can offer, and where to start while establishing credibility and trust (Krug, 2000, pp98-99).
- Homepage could contain elements such as site identity, mission, site hierarchy, search options, teases, timely content, deals, short cuts, and registration (Krug, 2000, p.98).
- Web functions such as rollovers and pulldowns seem useful when organizing elements, however, rollovers and pulldowns require users to think, therefore designers need to be careful when using them.

Wrobleki on interface design. Principles of interface design:

1. Minimize the pain
2. Illuminate a path to completion
3. Consider the context
4. Ensure consistent communication (p.19).

Raskin on Interface design and human behavior.

- Ideal interface design is humane interface, which meets users' needs and considers human behaviors (pp6-7).
- Users complete some tasks consciously and other tasks unconsciously (p.16).

- When an action becomes unconscious, it is a type of habit. Interface design should take advantage of habit development and allow users to develop habits that smooth their flow of work (p.20).
- Habits have risks to make wrong decisions, therefore interface needs to break the habits when confirming users' actions in important questions.
- In order to break the habits, the confirmation needs to be unpredictable, although users might not be comfortable with unpredictability (p.23).
- When presenting commands, “noun first and then apply the verb” is more effective than the opposite order because the former has the benefits such as error reduction, speed, simplicity and reversibility (Raskin, 2000, pp.59-60).
- Raskin stated all products including interface should have affordance, which Norman defined as visibility that explains function of the products and knowledge of how to use them when users just look at them (Norman, 1988, p.8).
- It is necessary to understand the users' background when designing affordances, because whether the feature is affordance or not would differ depending on users past experience and background.
- Icons seem to be useful in interface design; nonetheless Raskin does not recommend icons because the meanings of icons are not visible (p.173).
- “Icons are most effective when there are at the most a dozen of them and when at most a dozen are seen at one time” (p. 170). Icons need to be visually distinct, represent the appropriate concept, and presented at a reasonably large size (p.170).
- A display of instructional text should be presented the first time the product is activated.

- A tutorial and reference manual should be part of the interface, accessible at any time (p.175).
- Regarding cut and paste of text, the interface should:
 - Have a deletion operation operating no differently from other commands
 - Put nothing at risk when text is deleted or moved
 - Create no special buffer or other “system-level” or hidden place to where text is moved
 - Treat single-character deletions no differently from multiple-character deletions
 - Be able to be undone and redone (p.177).
- Do not show error and other kind of messages unless users need to take action on them (p.179).
- Ultimately, designers should design interfaces where users will not make errors (p.178).
- Use simplified sign-ons for better usability.
- System-assigned password is more secure than user-created password (p.184).

Marcus on graphic design.

- Designers need to think about the following questions in the design process:
 - How can we attract people to information?
 - How can we hold their attention?
 - How can we facilitate their understandings of the information?
 - How can we help people to remember what they have learned?
- Consider the visual field: terminal screen, proportion, size, and distance from the viewer (pp.26-27)
- Use a grid system for consistency

- Typography: 40-60 characters per line
- Spatial groupings of words should be considered to maintain visual consistency
- Think about what to show as well as when, how, and why (p.27).

Lupton on typography.

- Digital media has a potential as nonlinear communication
- Digital space is more liquid than concrete
- In digital space, typography is a flexible system of attributes
- The user has needs and impairments, needs be protected but also controlled (p.97).
- Interfaces not only help users complete their jobs but also help users be happier and more productive (Raskin, 2000, pp9-10).
- Users are digital readers who are impatient
- Icons are for brand identity rather than for usability
- Text has more potential as a visual communication tool because text is “searchable, translatable, and capable of being reformatted and restyled for alternative or future media” (p.98).
- When mixing typefaces, pursue contrast rather than harmony (p.54).
- Contrast in typography could be achieved by:
 - Line spacing
 - Weight, style (bold, italic)
 - Alignment
- Captions and images need to have close proximity.
- Captions can be in interactive, i.e.) appears with a mouse over
- Levels of hierarchy should be indicated by one, or more than one, cues

- Visual cues to show hierarchy are:
 - Visual (size, style, color)
 - Spatial (indent, line spacing, placement)

- Visual cues should be consistent

Williams on typography.

- Choice of typefaces: avoid a typeface that has distinctive features
- Since extra bold/light and italic are harder to read, should be used for light accents
- Serif typefaces are easier to read when there is a large amount of text, whereas sans serif typefaces are more recognizable when there is a short amount of text (p.43).
- Use readable typefaces for important but unfamiliar words such as long or foreign words (p.44).
- Mono spaced fonts are less legible
- Most legible type is:
 - A plain sans serif with an average x-height
 - A regular or medium weight
 - Lowercase letters
 - Not condensed or expanded or oblique (slanted)
 - A little extra spacing in small point sizes, less letter spacing in large sizes (p.48).

Stone, Adams, Morioka on color.

- Ten Color rules:
 1. Convey information
 2. Create color harmony

- 3. Attract and hold attention
- 4. Remember that context is everything
- 5. Consider that experiment is key
- 6. People see color differently
- 7. Assist in mnemonic value
- 8. Think about composition
- 9. Use standard color systems
- 10. Understand limitations (p.33).
- Color impression can account for as much as 60 percent of the acceptance or rejection of the product or service (p.35).
- Color establishes relationships among graphic elements
- Eight Rules when building a color palette by Chijiwa:
 - 1. Know the purpose
 - 2. Review basics
 - 3. Choose a dominant color, and then accent colors
 - 4. Select shades, then vary them
 - 5. Look at compatibility of hues
 - 6. Limit the number of colors
 - 7. Apply colors to a few typical pieces
 - 8. Keep a logbook (Stone et al., 2006, p.41).

Marcus and Baecker on Graphic design principles for programs.

- Legibility
- Readability
- Clarity
- Simplicity
- Economy
- Consistency

- Relationships
- Distinctiveness
- Emphasis
- Focus
- Navigability

Marcus on principles of information graphics.

- Consider 1) senders' requirements, 2) content of message, 3) communication medium, and 4) the needs of receivers (Marcus, 1984, p.53)
- Information as five rings: internal < conversational < reference < news < cultural
- Information anxiety occurs from too much information or too little information (p.44).
- Designers arrange words, numbers, and pictures in a way people can easily understand (p.55).
- Perfect accuracy is impossible; therefore, do not let it prevent information from being understandable (p.57).

Wrobleksi on alternative sign-up forms.

- Gradual engagement would eliminate forms and emotional burden on users
 - Users explore services first without sign-up
 - The sign up process shows up only when users want to do more activities with the application
 - Sign-up is less obvious in gradual engagement because users focus on services instead of data fields to be filled in (Wrobleksi, 2008, p.208).
- Single sign-in: log in multiple websites with only one account (p.209).
- Adaptive interfaces are likely to cause confusion unless designed well and only a few people would benefit (p.210).

Preece on user frustration.

- User frustration ranges from feeling mildly amused to extremely angry (p.147). Preece et al listed that such emotional responses occur:
 - When an application doesn't work properly or crashes
 - When a system doesn't do what the user wants it to do
 - When a user's expectations are not met
 - When a system does not provide sufficient information to let the user know what to do
 - When error messages pop up that are vague, obtuse, or condemning
 - When the appearance of interface is too noisy, garish, gimmicky, or patronizing
 - When a system requires users to carry out many steps to perform a task, only to discover a mistake was made somewhere along the line and they need to start all over again (p.147).
- User frustration is often caused by bad design, no design, inadvertent design, or ill-thought-out design (p.148). The impact of bad design on the user can be quite drastic and make them abandon the application or tool (p.148).
- Examples of classic user-frustration provokers are:
 - Gimmicks. When a user's expectations are not met and they are instead presented with gimmicky display. Level of frustration: Mild.
 - Error messages. When a system or application crashes and provides an "unexpected" error message. Level of frustration: High.
 - Overburdening the user. Upgrading software so that users are required to carry out excessive housekeeping tasks. Level of frustration: Medium to high.

- Appearance. When the appearance of an interface is unpleasant. Level of frustration: Medium (pp.148-152).
- In appearance, busyness should be avoided. Busyness could be represented as:
 - Websites overloaded with text and graphics
 - Flashing animations
 - Excessive numbers of operations represented at the interface as banks of icons or cascading menus
 - Childish designs that keep popping up on the screen
 - Poorly laid out keyboards, pads, and control panels (p.152).
- Preece et al recommended simple, perceptually salient, and elegant designs that fit design principles (p.152).
- How to deal with user frustration.
 - One advice is to provide error messages (phrased as “how-to-fix-it” advice) to explain what the user needs to do (p.153).
 - Another way of providing information is through online help (p.153).
 - A cartoon-based agent is not recommended.
 - A help icon or command that is activated by the users themselves when they want to help is often preferable” (Preece et al, p.153).

3-6. Selection of Design Criteria

Design Criteria are selected based on the literature review. Based on the criteria, design guideline for electronic forms are defined.

The figure shows keywords that appeared often in the literature review and researchers who mentioned the keywords (Figure 26)

KEYWORDS (CONCEPT)	KELIG	BASSKIN	WIRBLESMI	PORTERS	MARCUS	MARCUS & BACKER	WURMAN	ABEY	YEE, LEVESLEY, & TAYLOR	STONE, ADAMS, & MOROKA	WILLIAMS	LIPTON	TOTAL
Design process													3
Visual hierarchy	✓												6
Interface		✓											3
Emotion, trust	✓	✓	✓	✓	✓								5
Error, failure													3
Space	✓						✓						2
Sign-on		✓					✓						3
Flexibility (too many options etc)			✓					✓					3
User behavior	✓							✓					2
Expectations		✓							✓				5
Human Factor													1
Consistency										✓			3
Scannability										✓			2
Text, typography										✓			3
Self-explanatory, instructions	✓												3
Design goal											✓		4

Figure 26. Design Keywords and researchers who mentioned keywords.

3-7. Matrix

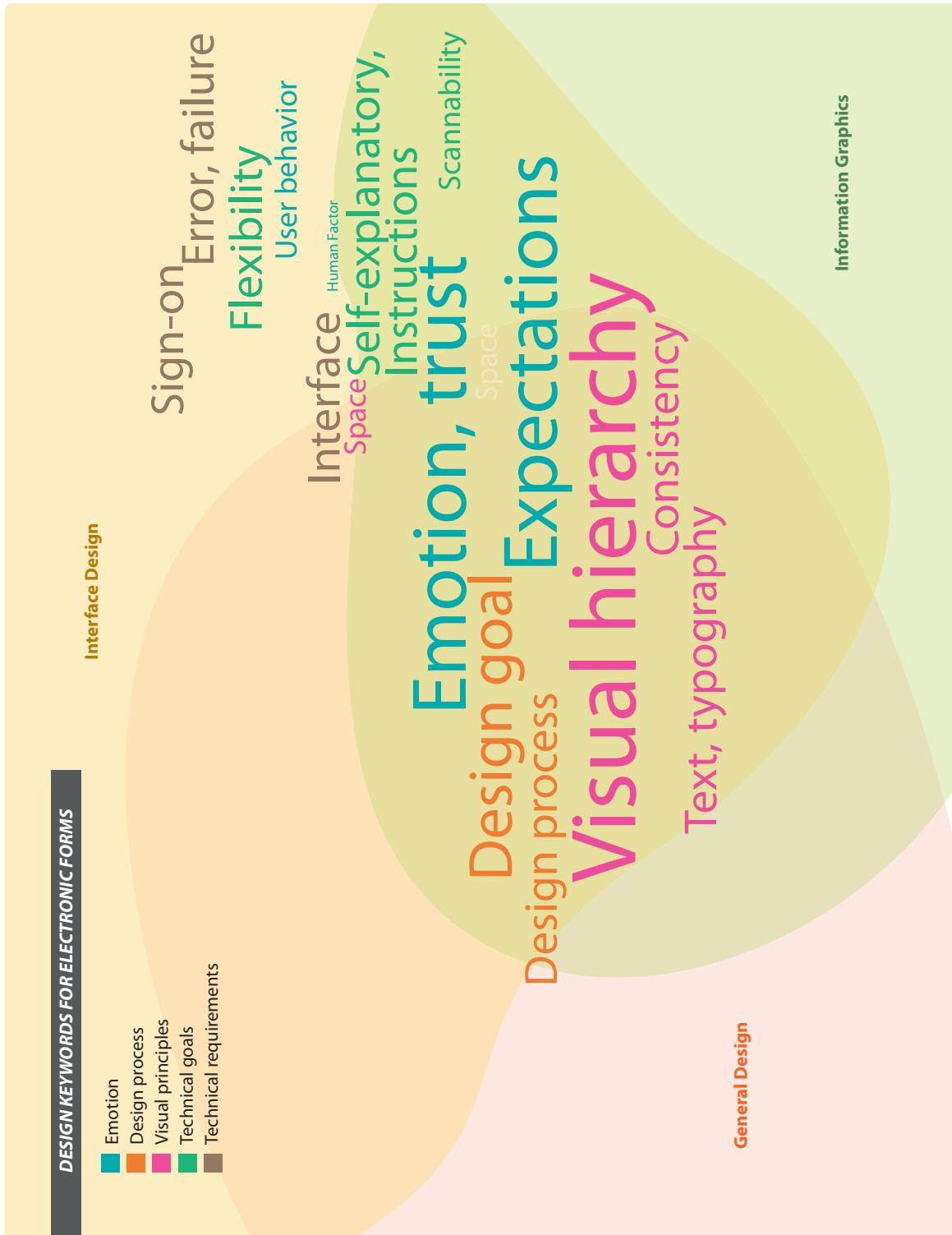


Figure 27. Word cloud for electronic form design guidelines.

Based on Figure 26, a word cloud is created to describe relationships among keywords. (Figure 27) Size suggests degree of importance. Location and proximity express which design fields that key words belong to and how the keywords co-relate to others. Color represents categories of keywords: emotion, design process, visual principles, technical goals, and technical requirements. Based on Figure 26 and 27, Figures 28-46 are created to organize design guidelines for electronic forms.

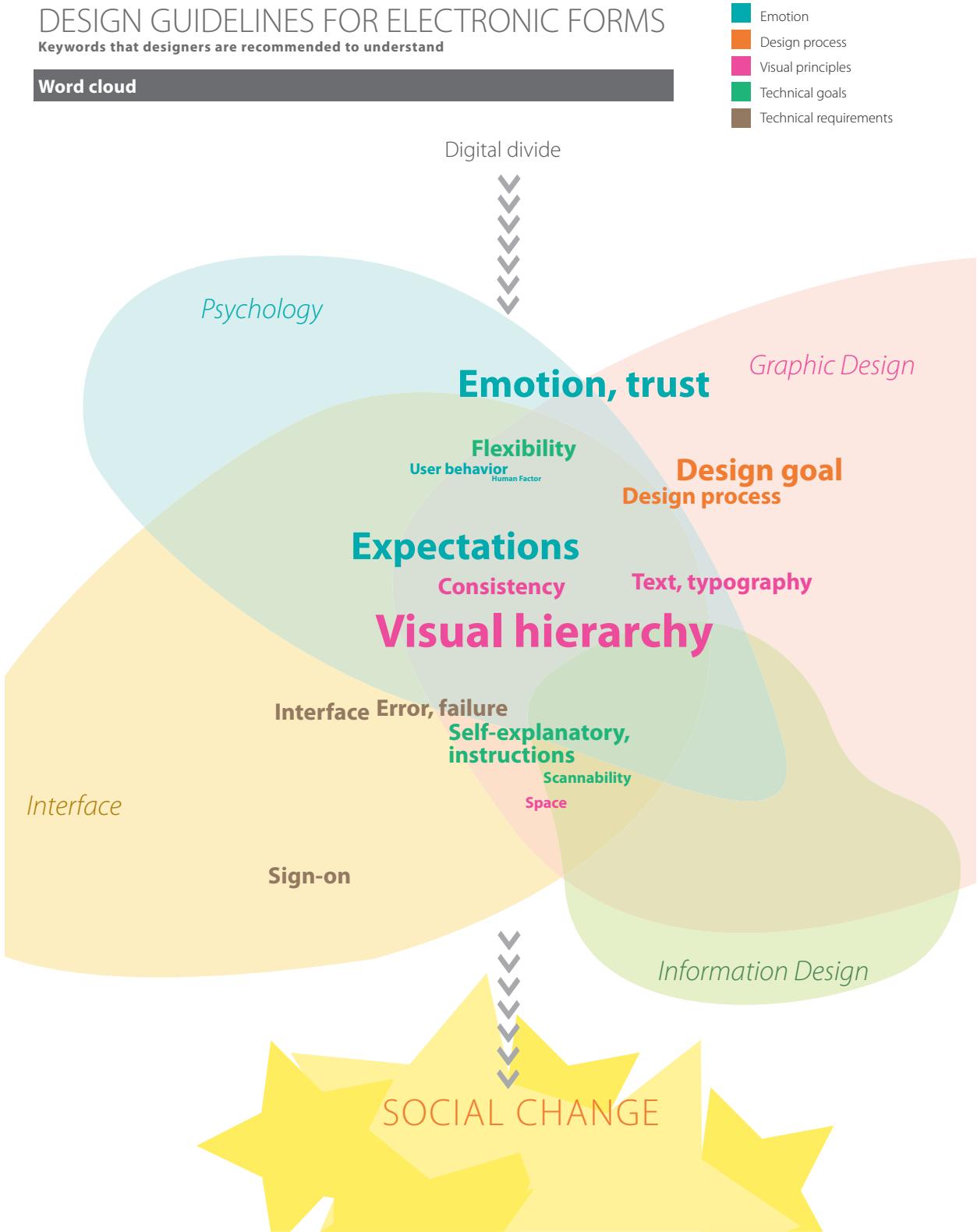


Figure 28. Word cloud.

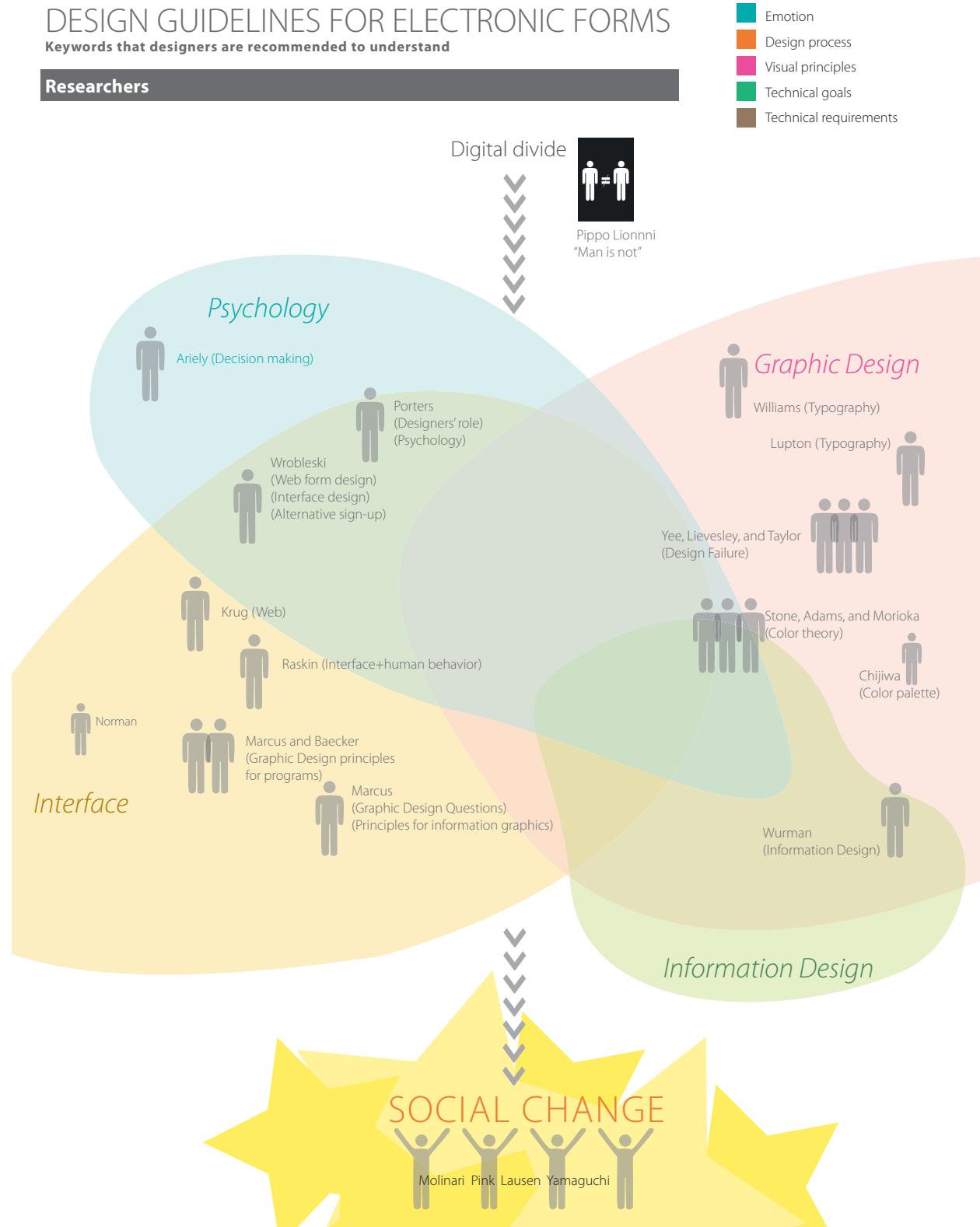


Figure 29. Researchers.

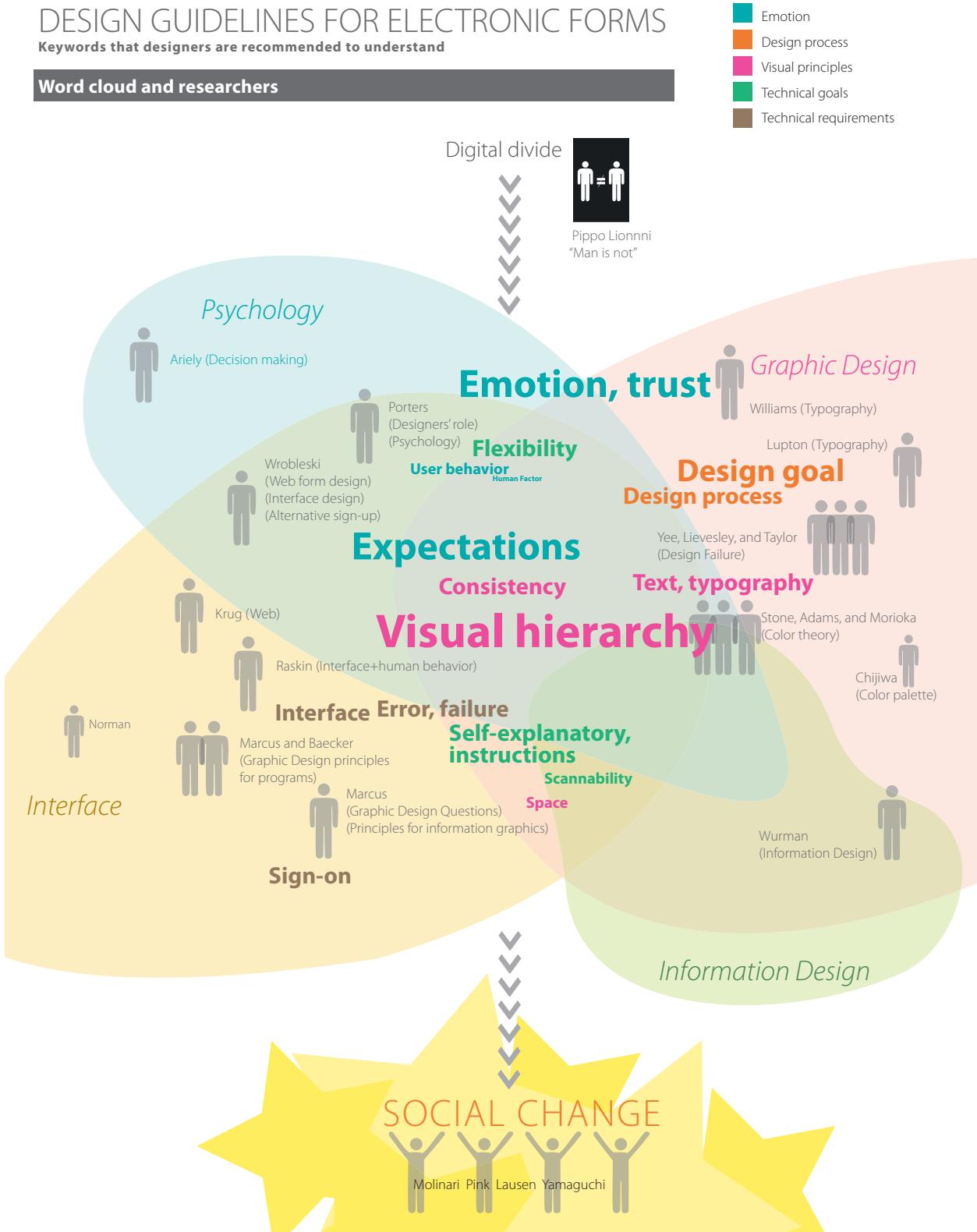


Figure 30. Word Cloud and researchers.

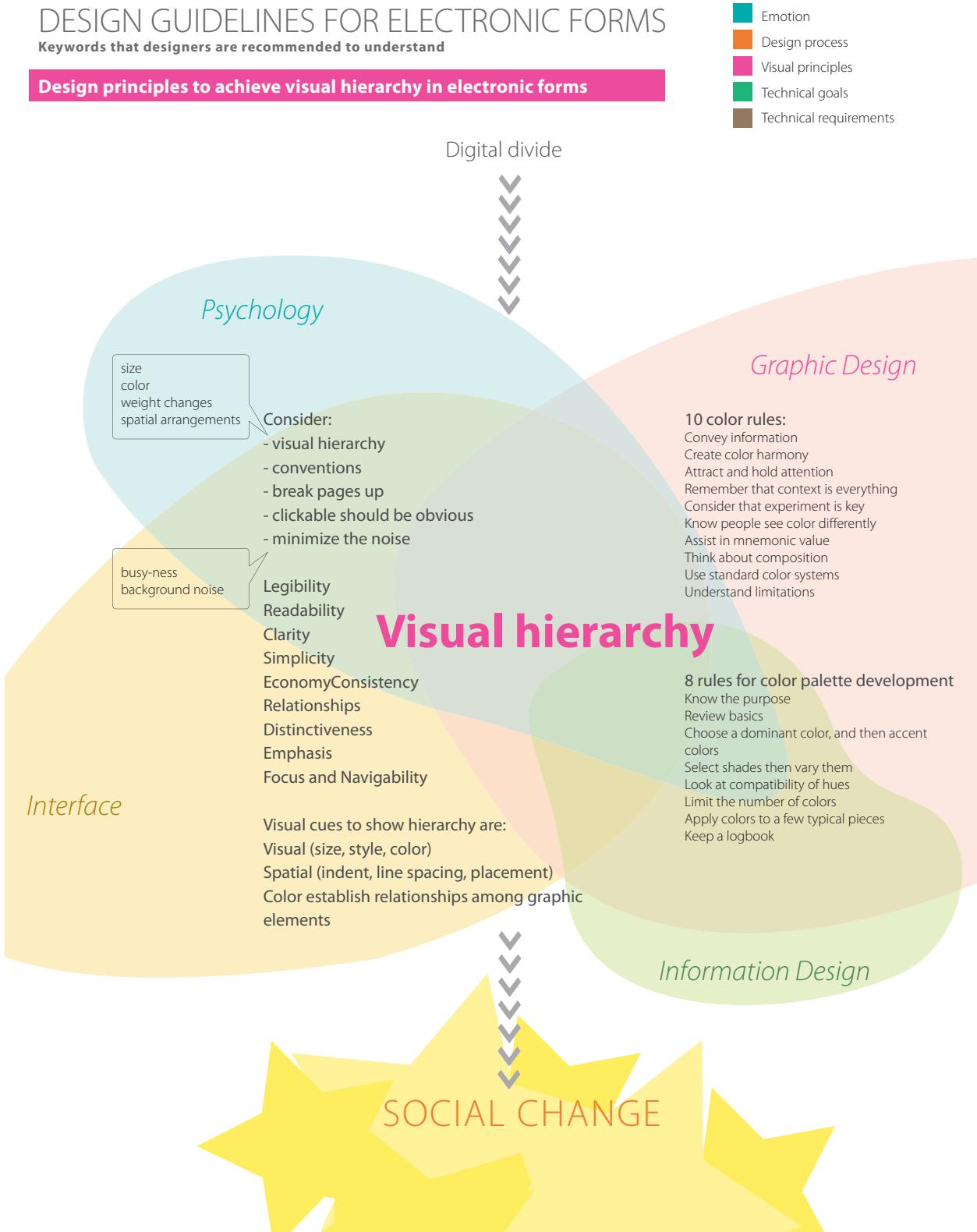


Figure 31. Design principles to achieve visual hierarchy in electronic forms.

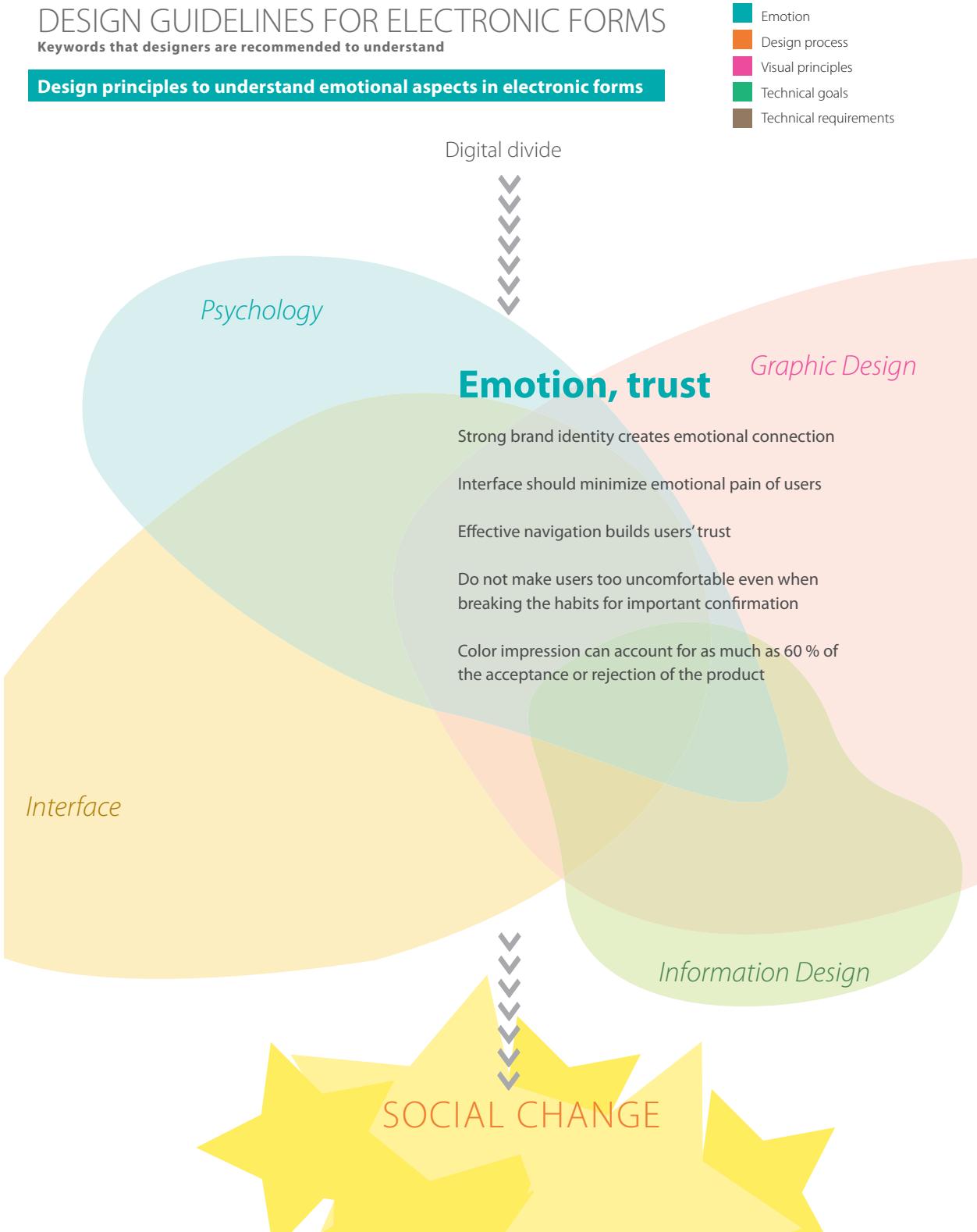


Figure 32. Design principles to understand emotional aspects in electronic forms.

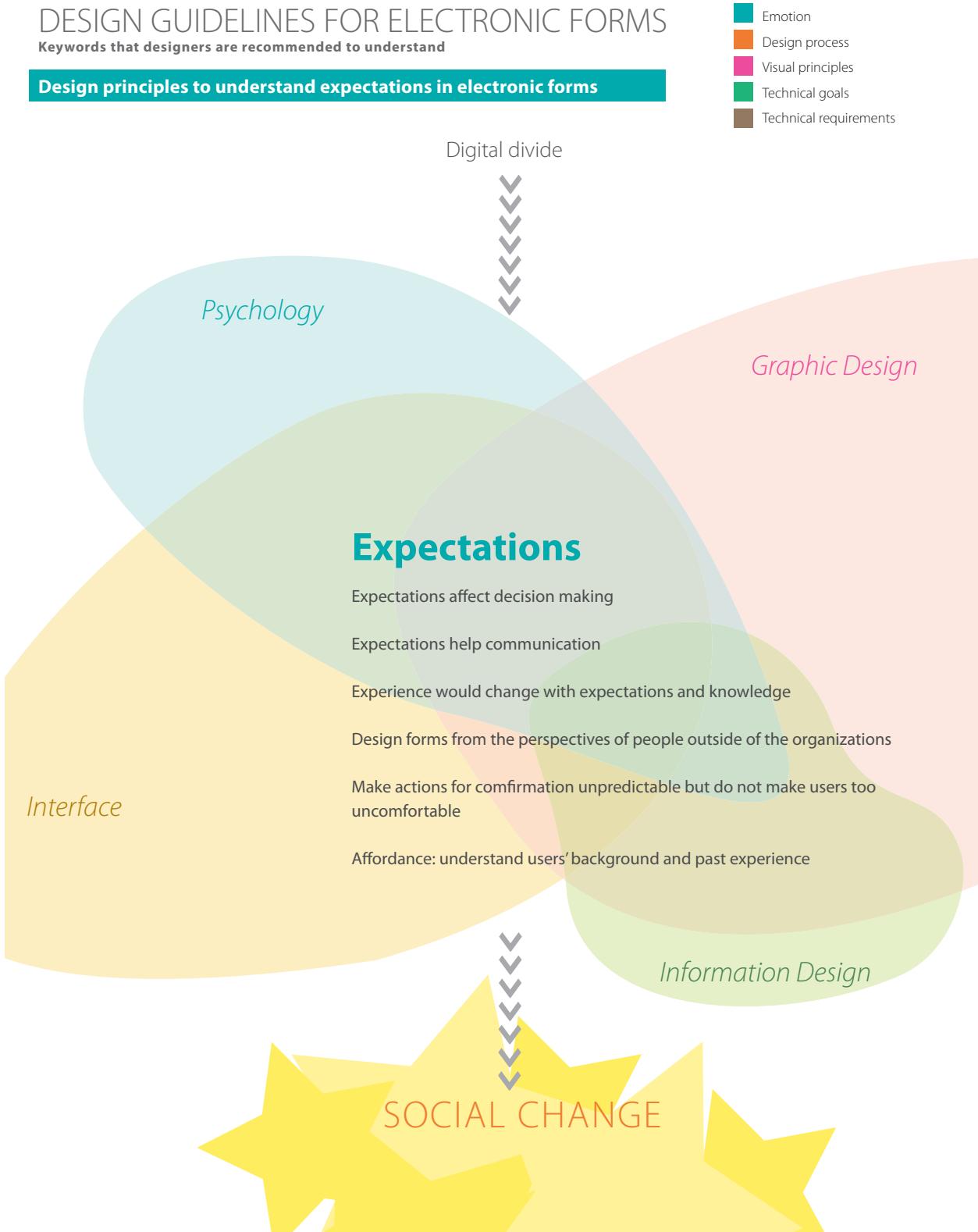


Figure 33. Design principles to understand expectations in electronic forms.

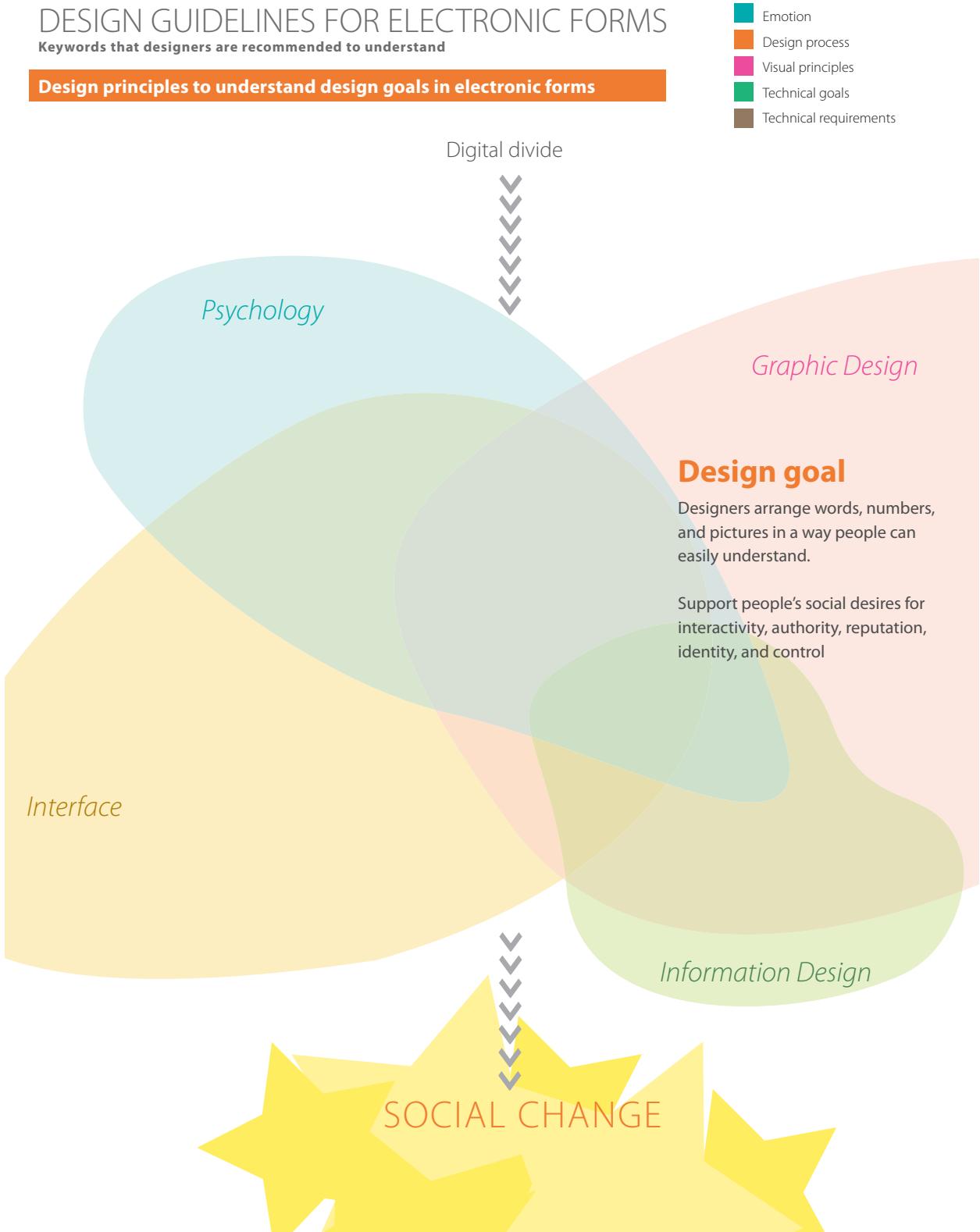


Figure 34. Design principles to understand design goals in electronic forms.

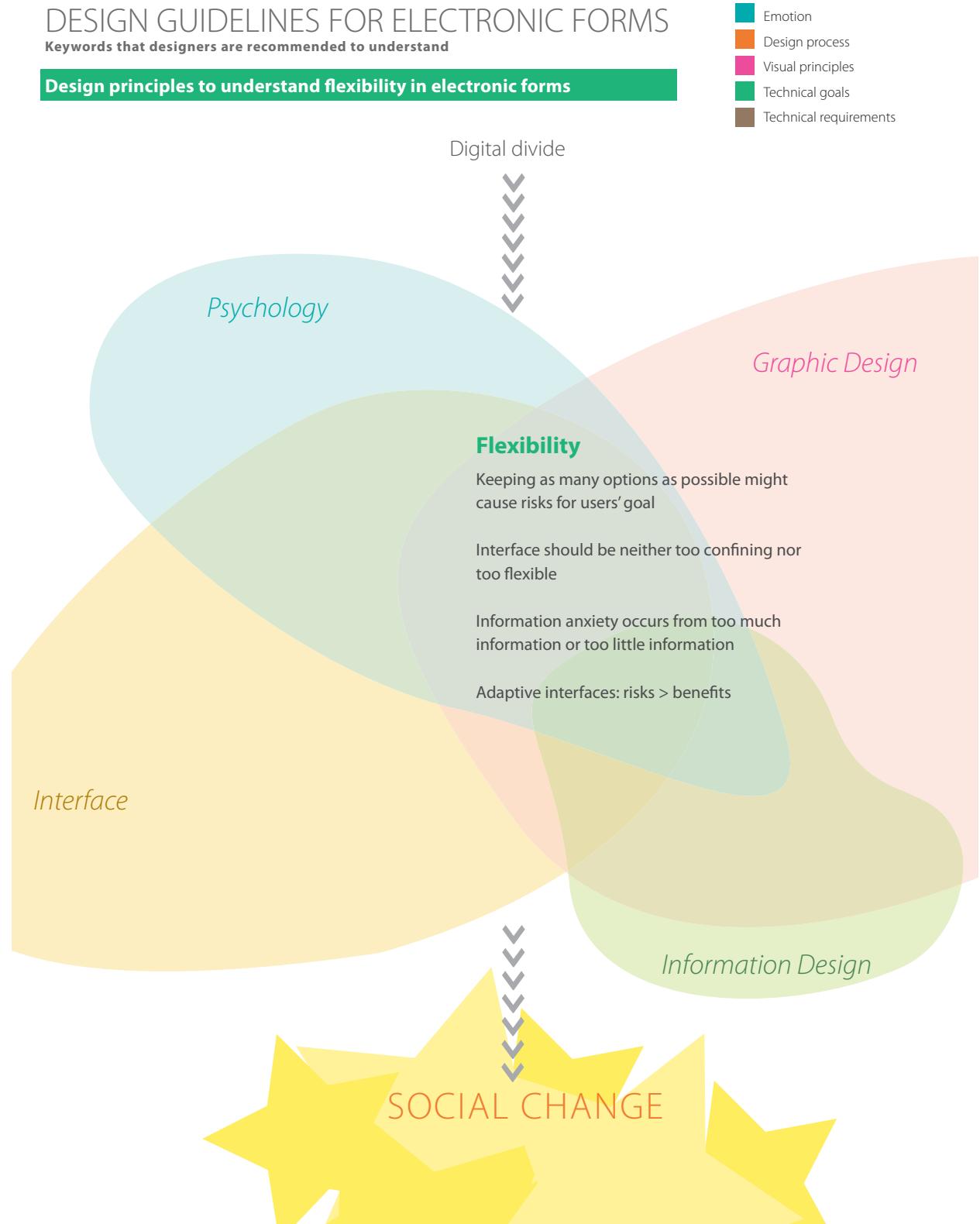


Figure 35. Design principles to understand flexibility in electronic forms.

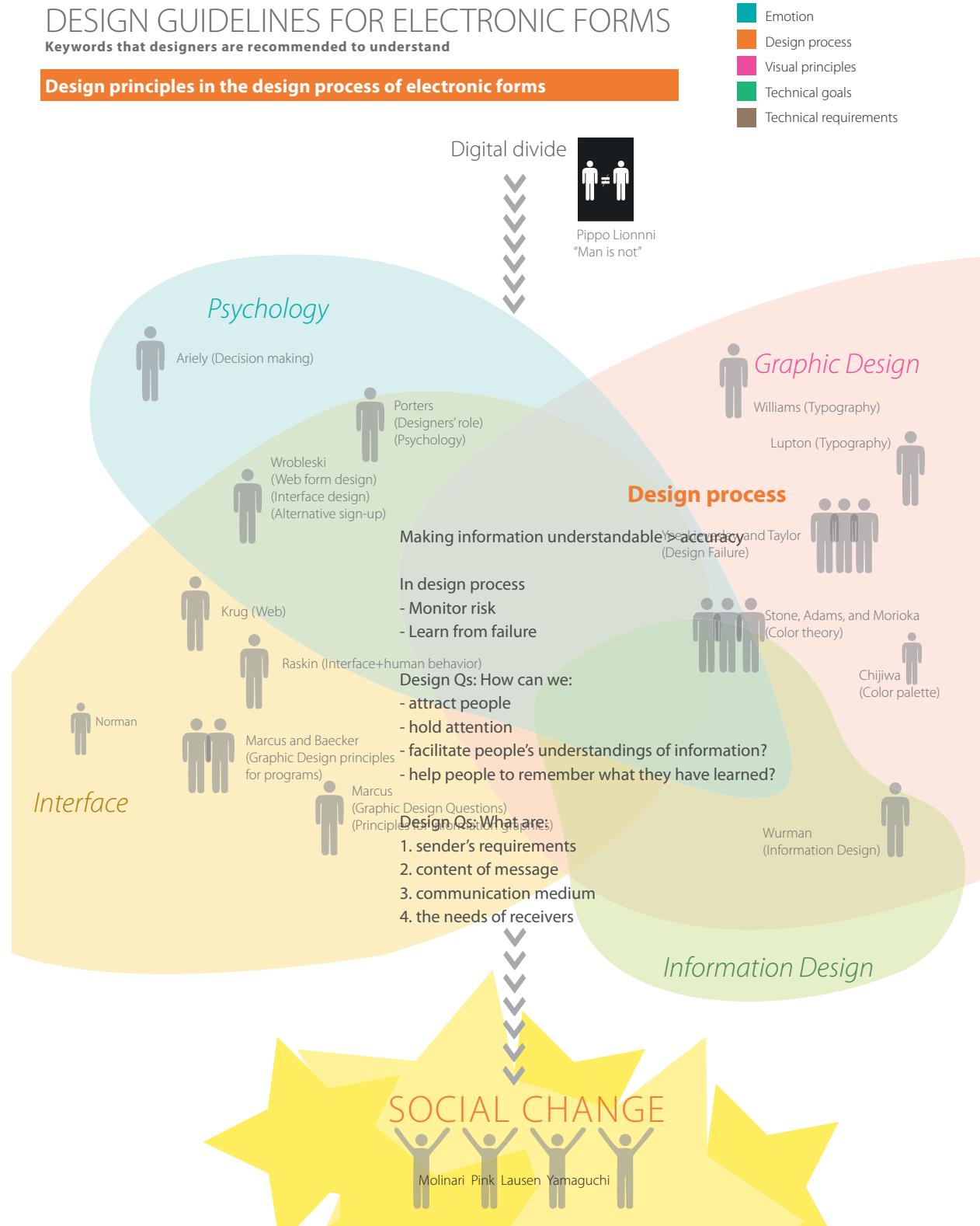


Figure 36. Design principles to understand design process in electronic forms.

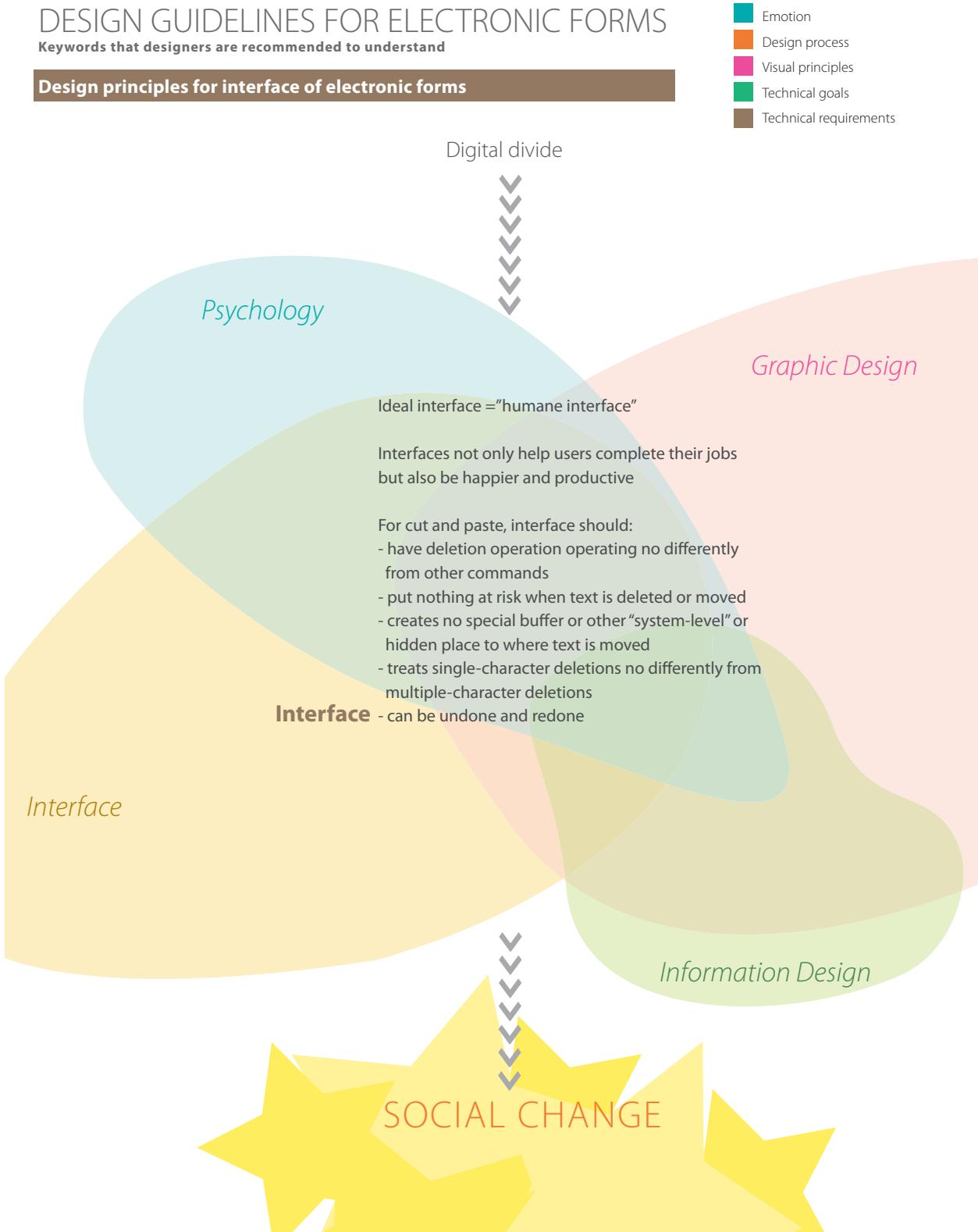


Figure 37. Design principles for interface of electronic forms.

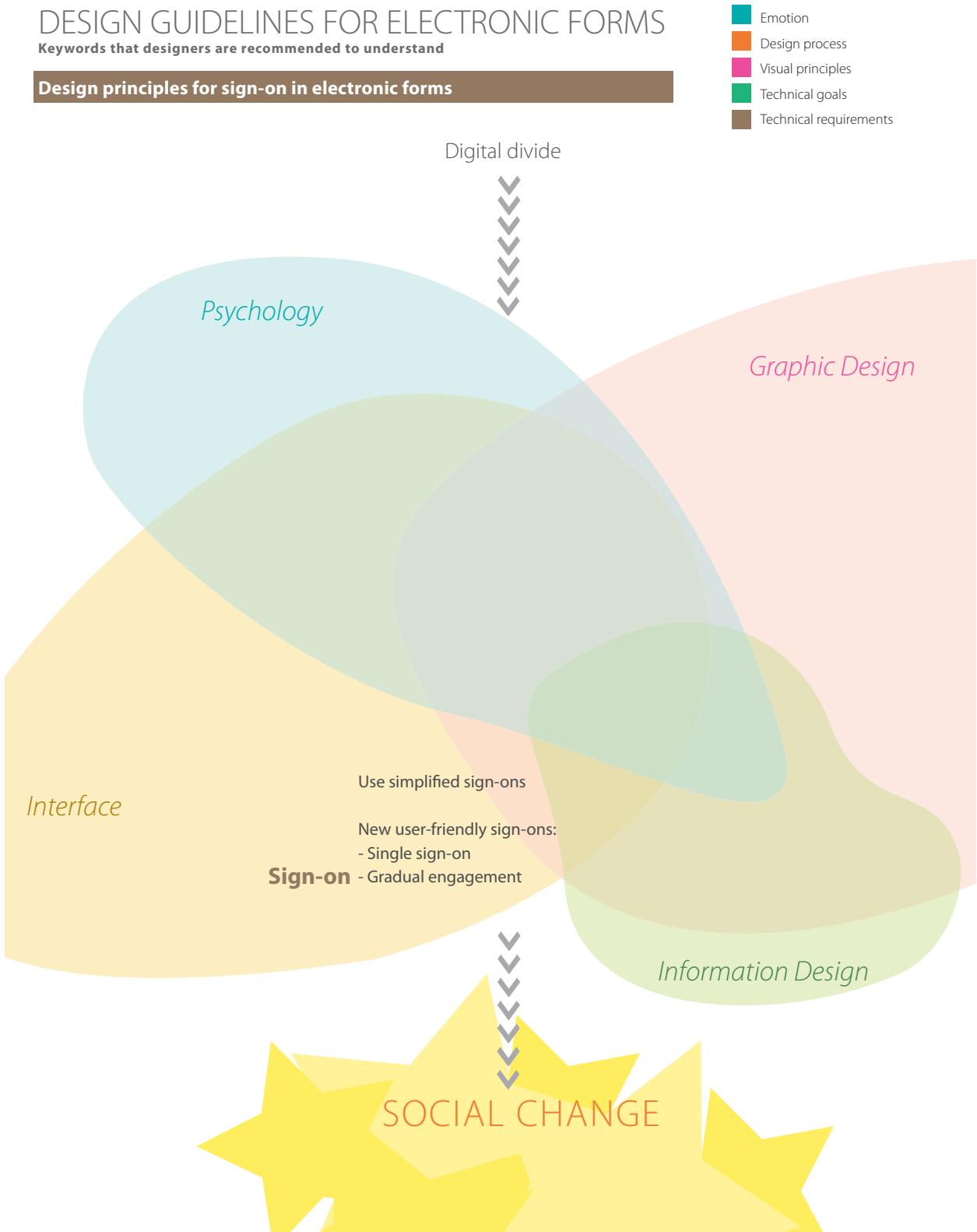


Figure 38. Design principles for sign-on in electronic forms.

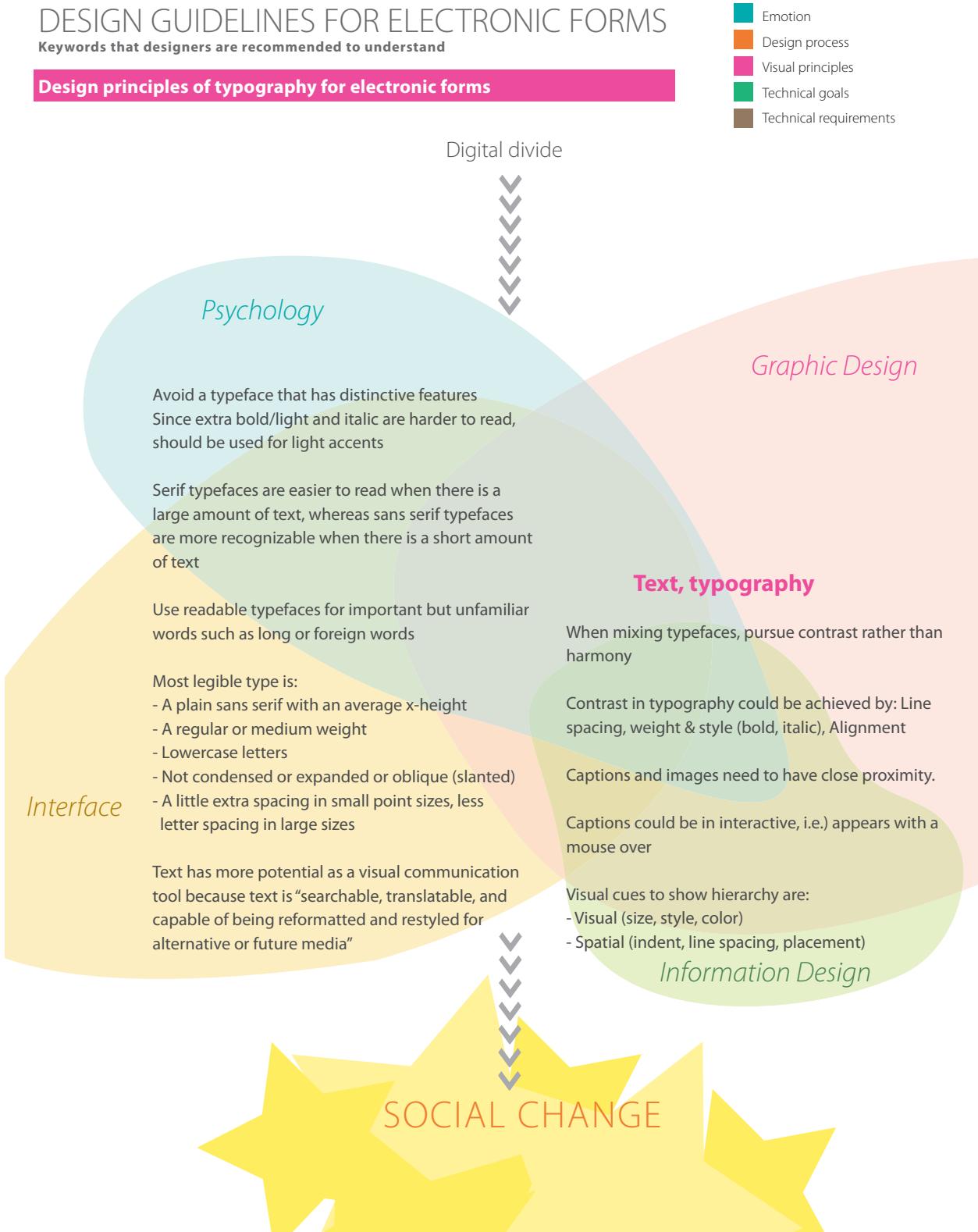


Figure 39. Design principles of typography for electronic forms.

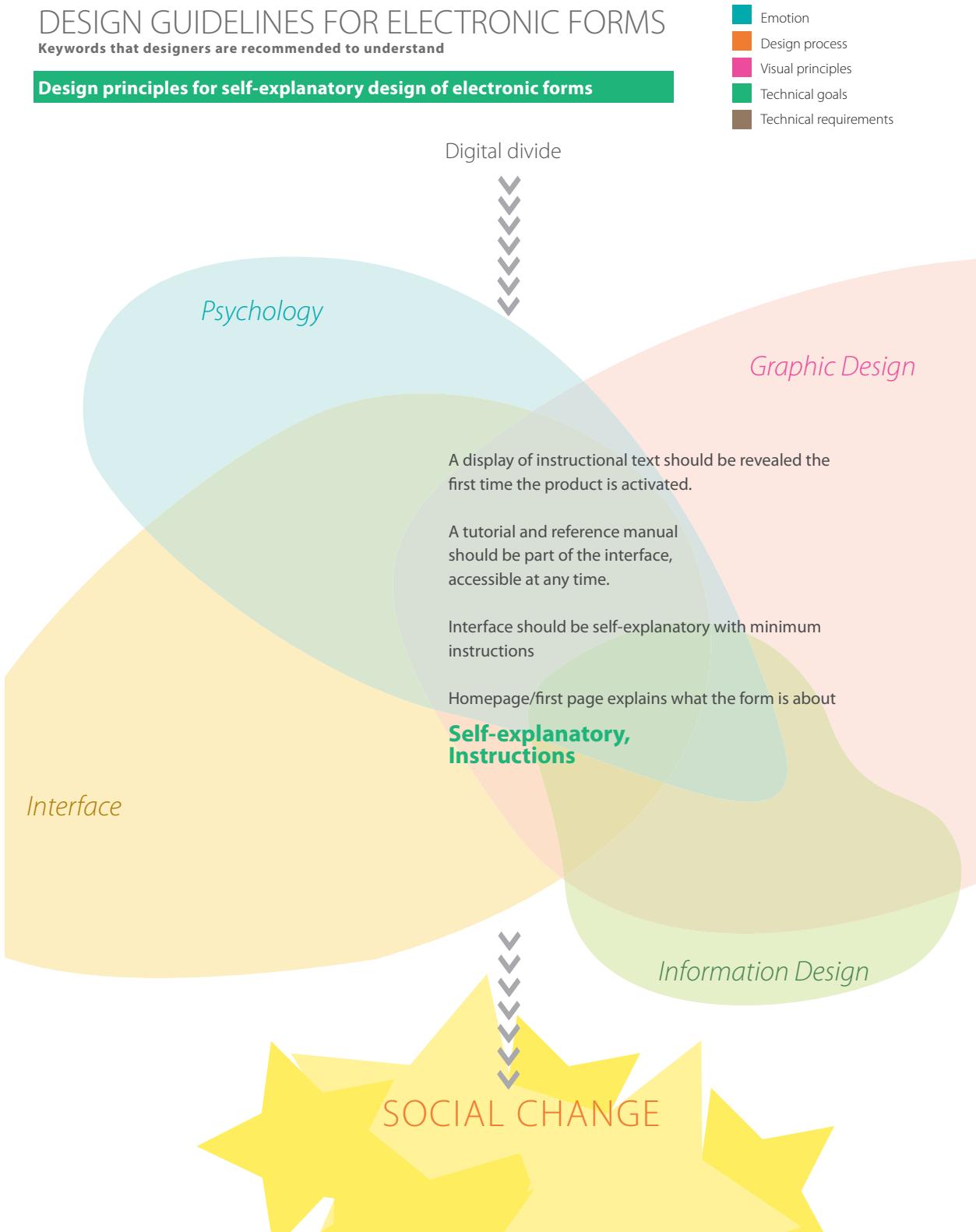


Figure 40. Design principles for self-explanatory design of electronic forms.

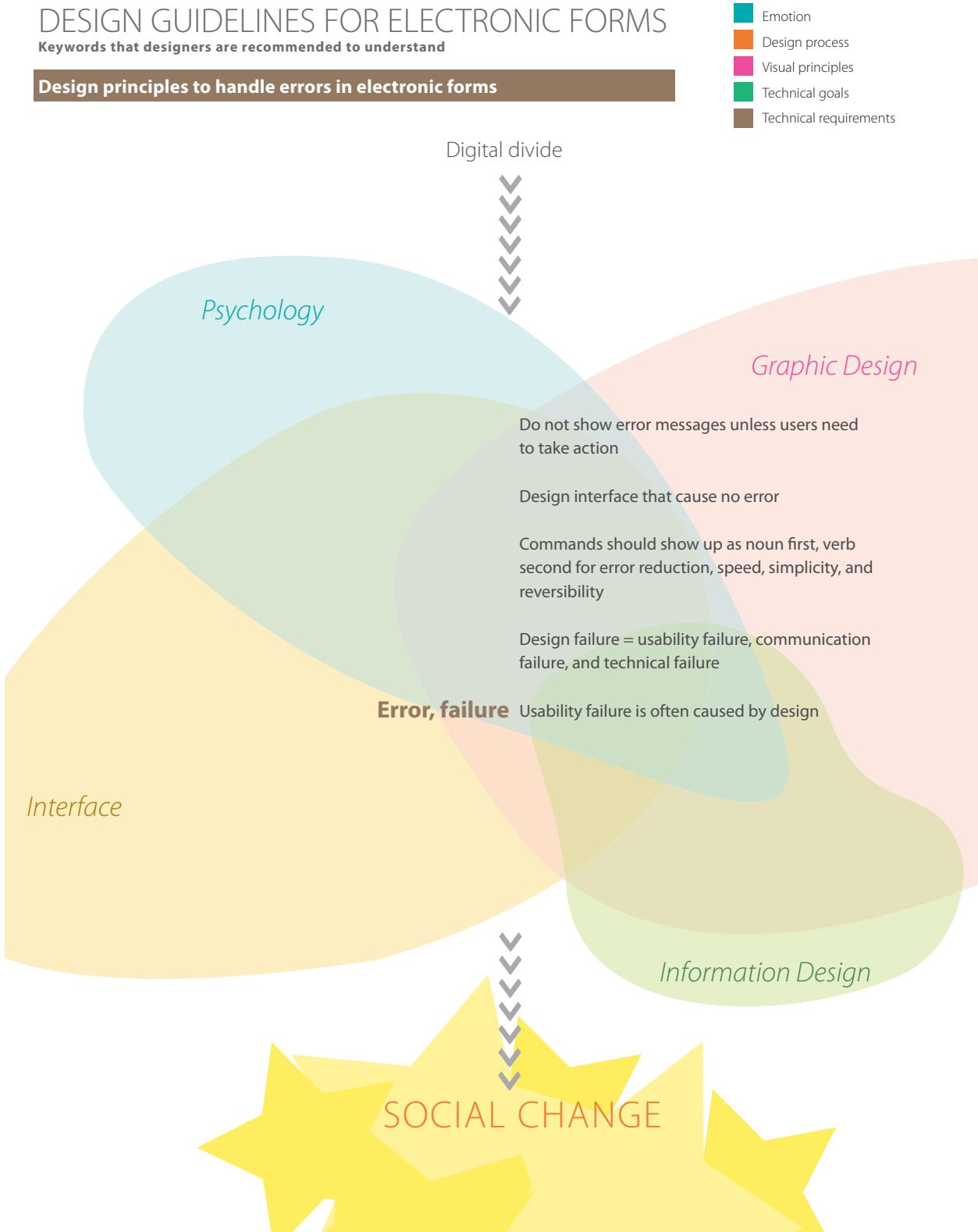


Figure 41. Design principles to handle errors in electronic forms.

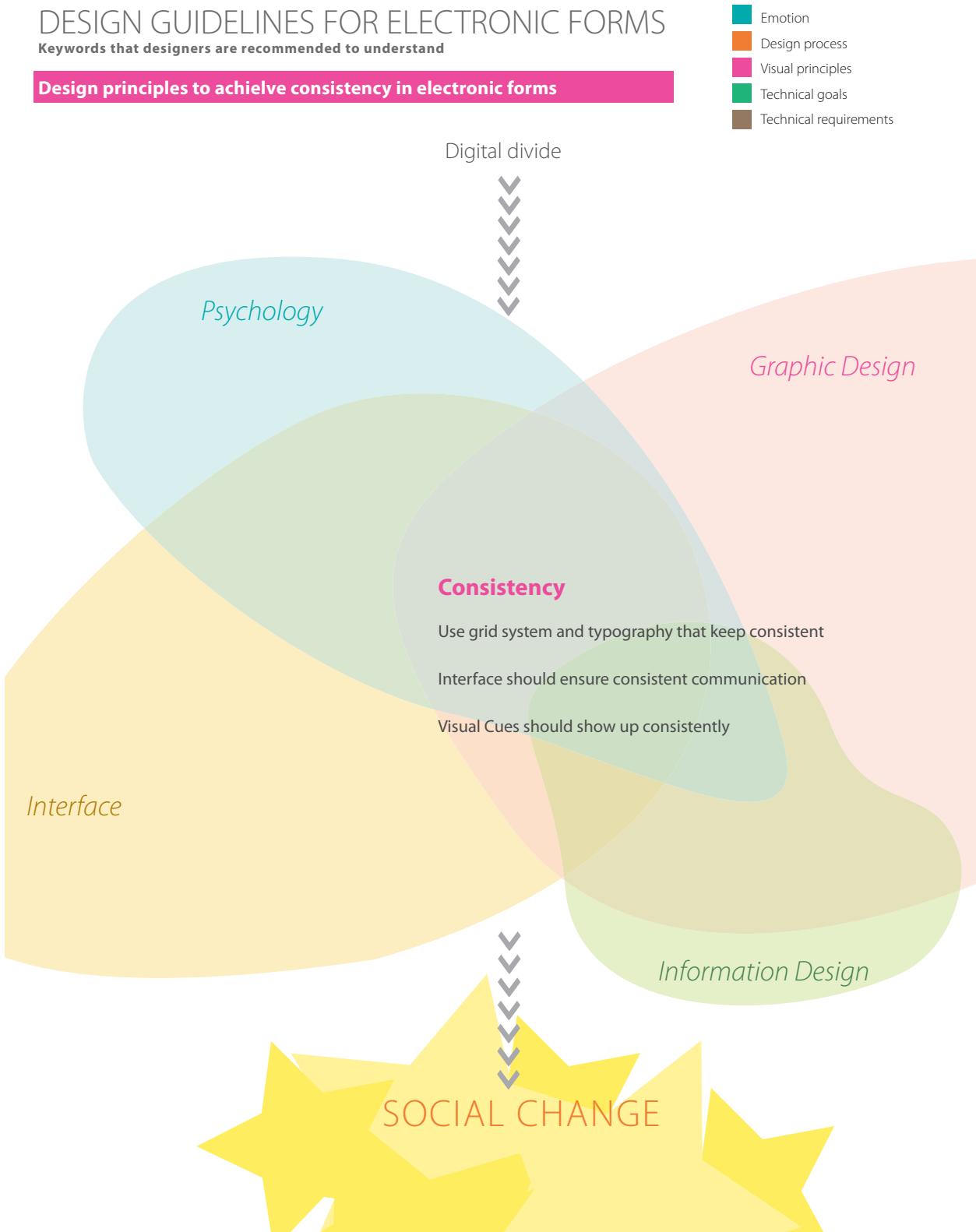


Figure 42. Design principles to achieve consistency in electronic forms.

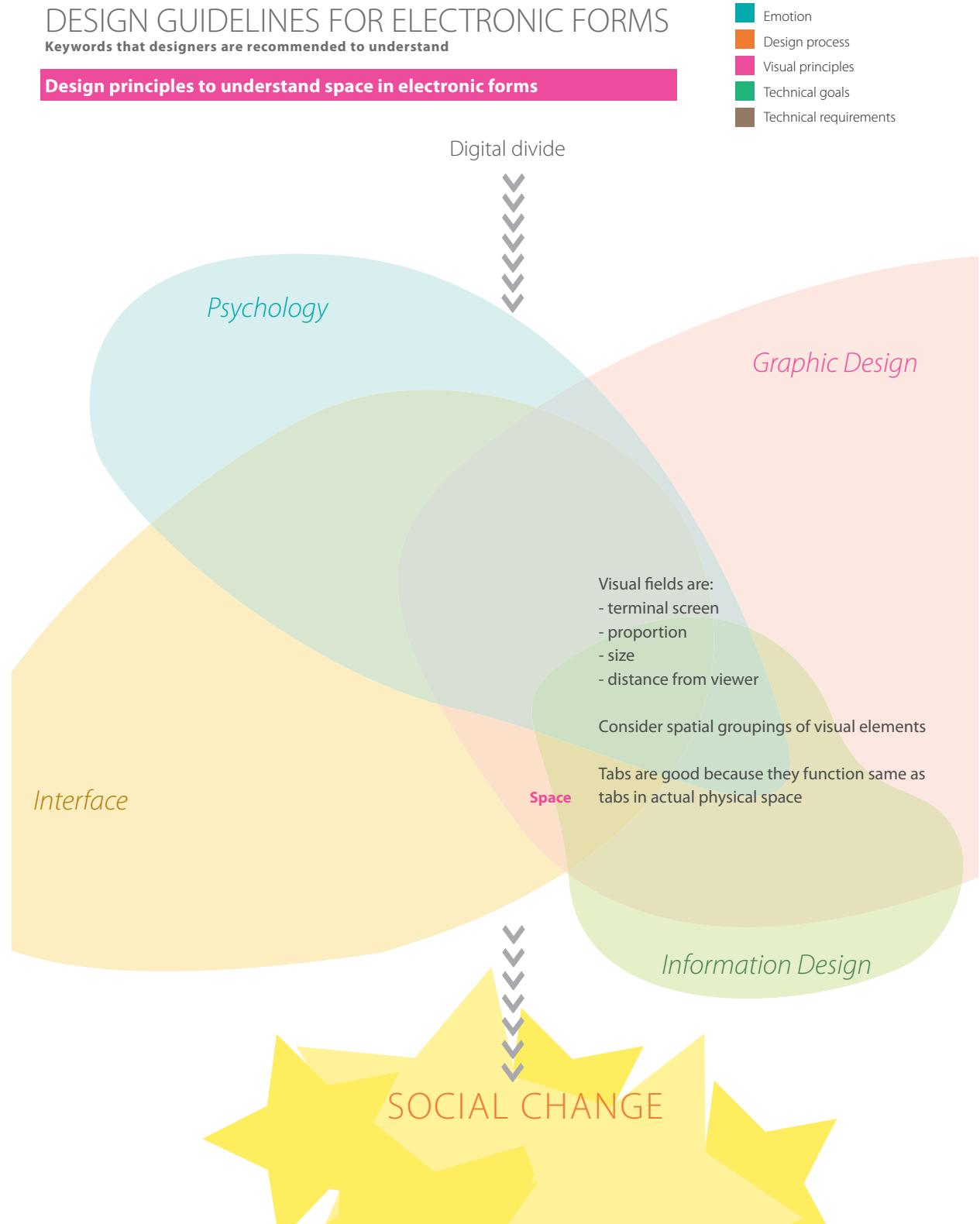


Figure 43. Design principles to understand space in electronic forms.

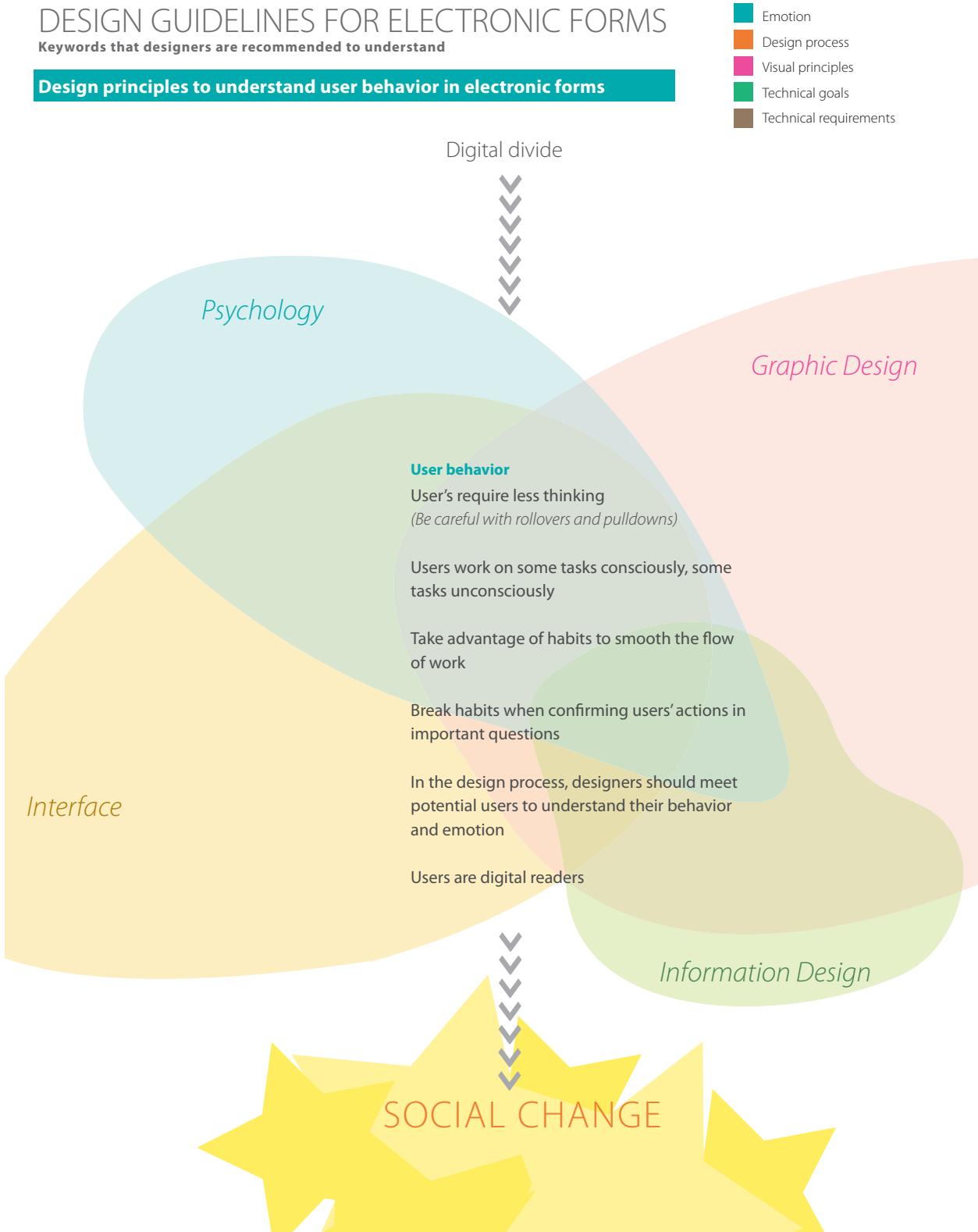


Figure 44. Design principles to understand user behavior in electronic forms.

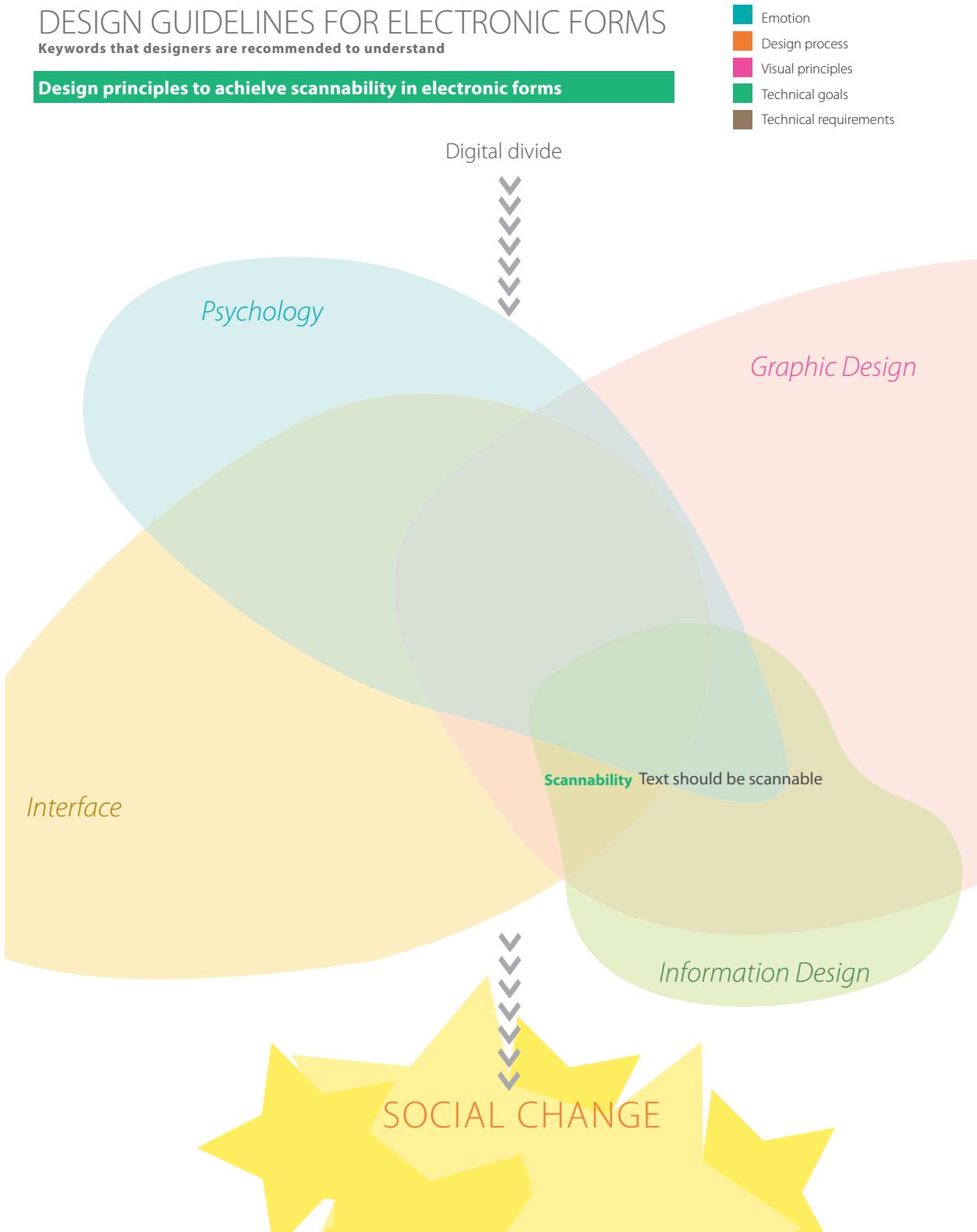


Figure 45. Design principles to achieve scannability in electronic forms.

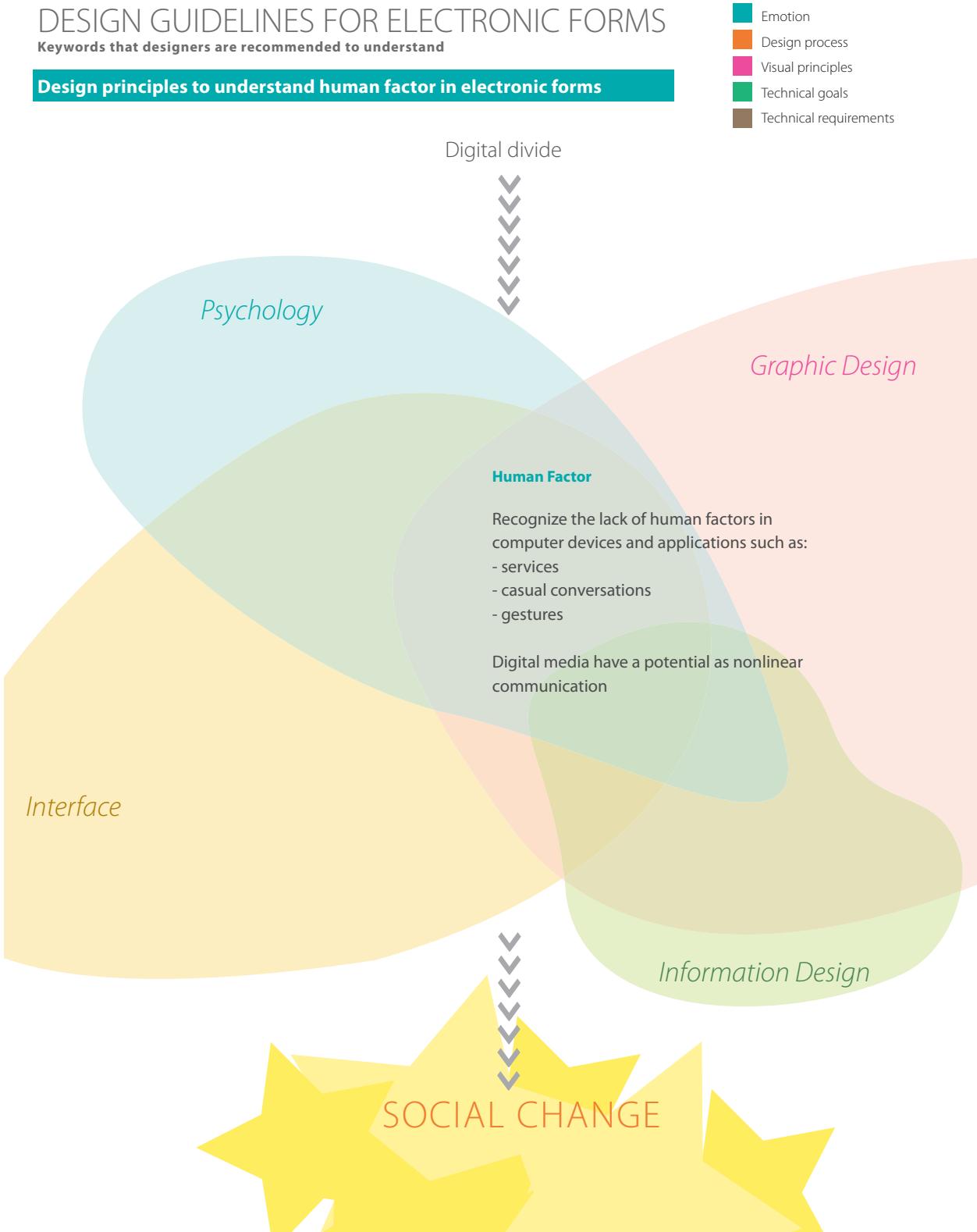


Figure 46. Design principles to understand human factor in electronic forms.

3-8. Redesigning forms based on design guidelines.

In order to assess the design guidelines for electronic forms, an online version of the Social Security card application was designed based on the design guidelines. Currently, there is not an online application for the Social Security card.

The online form is supposed to be filled out and submitted electronically, provided as a part of Social Security website. (Figure 47) The design process is presented in Figure 48-54.

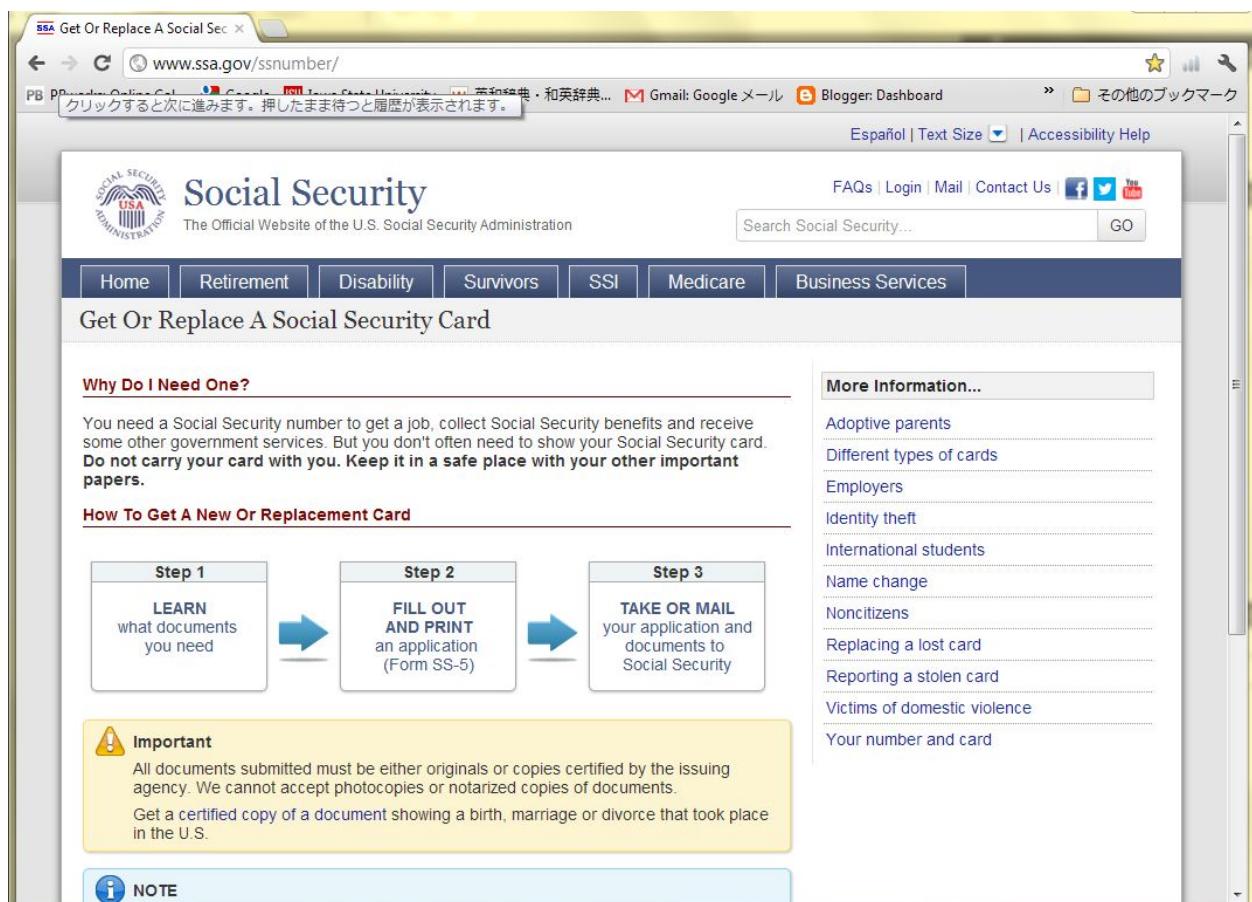


Figure 47. A screenshot of Social Security website.

Redesigning the electronic form for Social Security Card Application

SOCIAL SECURITY ADMINISTRATION Application for a Social Security Card			
Form Approved OMB No. 0800-0006			
NAME TO BE SHOWN ON CARD FULL NAME AT BIRTH IF OTHER THAN ABOVE OTHER NAMES USED		First _____ Last _____ Full Middle Name _____ Last _____ First _____ Last _____ Full Middle Name _____ Last _____	
2 Social Security number previously assigned to the person listed in Item 1		_____ - _____ - _____	
3 PLACE OF BIRTH (Do Not Abbreviate) City _____		DATE OF BIRTH Month Day Year MM/DD/YYYY	
5 CITIZENSHIP (Check One)		U.S. Citizen <input type="checkbox"/> Legal Alien <input type="checkbox"/> Allowed To Work <input type="checkbox"/>	
ETHNICITY Are You Hispanic or Latino? (Your Response is Voluntary) <input type="checkbox"/> Yes <input type="checkbox"/> No		RACE Select One or More (Your Response is Voluntary) <input type="checkbox"/> Native Hawaiian <input type="checkbox"/> Alaska Native <input type="checkbox"/> Asian <input type="checkbox"/> Black/African American <input type="checkbox"/> American Indian <input type="checkbox"/> Other Pacific Islander <input type="checkbox"/> White	
8 SEX		<input type="checkbox"/> Male <input type="checkbox"/> Female	
A. PARENT/MOTHER'S NAME AT HER BIRTH		First _____ Last _____ Full Middle Name _____	
B. PARENT/MOTHER'S SOCIAL SECURITY NUMBER (See Instructions for B on Page 3)		_____ - _____ - _____ <input type="checkbox"/> Unknown	
A. PARENT/FATHER'S NAME		First _____ Last _____ Full Middle Name _____	
B. PARENT/FATHER'S SOCIAL SECURITY NUMBER (See Instructions for B on Page 3)		_____ - _____ - _____ <input type="checkbox"/> Unknown	
Has the person listed in Item 1 or anyone acting on his/her behalf ever filed for or received a Social Security number card before?			
<input type="checkbox"/> Yes (If "yes" answer questions 12-13) <input type="checkbox"/> No <input type="checkbox"/> Don't Know (If "don't know," skip to question 14)			
Name shown on the most recent Social Security card issued for the person listed in Item 1			
First _____ Last _____ Street Address, Apt. No., PO Box, Rural Route No. _____			
Zip Code _____ State/Foreign Country _____			
14 TODAY'S DATE (Do Not Abbreviate) MM/DD/YYYY		15 DAYTIME PHONE NUMBER City _____	
Enter any different date of birth if used on an earlier application for a card			
_____ MM/DD/YYYY			
16 MAILING ADDRESS (Do Not Abbreviate) _____		17 YOUR SIGNATURE	
I declare under penalty of perjury that I have examined all the information on this form, and on any accompanying statements or forms, and it is true and correct to the best of my knowledge.			
18 YOUR RELATIONSHIP TO THE PERSON IN ITEM 1 IS:			
DO NOT WRITE BELOW THIS LINE (FOR SSA USE ONLY) NPN _____ PBC _____ EVIDENCE SUBMITTED _____			
DDC _____ EVA _____ EVC _____			
FRA _____			
CAN _____ INTL _____ NWR _____ DNR _____			
UNIT _____ SIGNATURE AND TITLE OF EMPLOYEE(S) REVIEWING EVIDENCE AND/OR CONDUCTING INTERVIEW _____			
DATE _____ DATE _____ DATE _____			

Figure 48. Designing process of the electronic version of Social Security Card application, Introduction.

Redesigning the electronic form for Social Security Card Application

- Paper -> Electronic (computer, web use setting)
- One page -> multiple pages
- Electronic submission and print options available

Step 1: Changing the order of questions

"Design from the perspectives of the people outside of the organization."

Before

1. Name
2. Social Security Number issued in past
3. Place of Birth
4. Date of Birth
5. Citizenship
6. Ethnicity (Voluntary) Hispanic or Latino?
7. Race (Voluntary)
8. Sex
9. Parent/mother's name at her birth
10. Parent/mother's social security number
- Parent/father's name
- Parent/father's social security number
11. Has the person listed in item 1 or anyone acting his/her behalf ever filled for or received a Social Security number card before?
12. Name shown on the most recent Social Security card issued for the person listed item 1
13. Enter any different date of birth if used on an earlier application for a card
14. Today's date
15. Daytime phone number
16. Mailing address
17. Your signature
18. Your relationship to the person in item 1 is:

"The number of clicks does not matter to usability unless it requires intensive thinking."
-> So the questions are divided and will be asked in 5 pages

After



Figure 49. Designing process of the electronic version of Social Security Card application, Step 1.

Redesigning the electronic form for Social Security Card Application

Step 2: Form layout_page 1 About the applicant

"Design from the perspectives of the people outside of the organization."

You are here indicator stays on top of the page

Size contrast suggests visual hierarchy

Step 1: About the applicant

- Given Name *
- Last Name *
- Date of Birth (MM/DD/YYYY) *
- City of Birth *
- Country of Birth *
- Citizenship *
- Sex *
- Father's Hispanic or Latino? *
- Mother's Hispanic or Latino? *
- Save
- Next

Step 2: Fill Out and Print

- Take or Mail
- Fill Out and Print an application (Form SS-5)
- Learn what documents you need
- Important
- Note

Simplified navigation of the form page

Minimum navigation for form page in order not to distract users.

Asterisk indicates required fields

Uses verbs for actions

Color indicates button-like texture

Contrast in color and shape

More than two cues to show hierarchy

Grid System

- Paper -> Electronic (computer, web use setting)
- One page -> multiple pages
- Electronic submission and print options available

Figure 50. Designing process of the electronic version of Social Security Card application, Step 2-1.

Redesigning the electronic form for Social Security Card Application

- Paper -> Electronic (computer, web use setting)
- One page -> multiple pages
- Electronic submission and print options available

Step 2: Form layout_page 2 Contact Information

A grouping of information has a different colored background to indicate the information shows the mailing address

You are here indicator shows where users are as well as how much more work they need

The screenshot shows the 'Step 2: Contact Information' page of the application. At the top, there's a navigation bar with links like 'Get Or Replace A Social Sec' and 'www.ssa.gov/ssnumber/'. Below the navigation is a header with the 'Social Security' logo and the text 'The Official Website of the U.S. Social Security Administration'. The main content area is titled 'Step 2: Contact Information'. It contains several input fields: 'Street Address line 1 (P.O. Box, etc.)', 'Street Address line 2 (Apartment number, etc.)', 'City*', 'State*', 'Zip code*', and 'Phone number'. To the right of these fields is a 'Save' button. Above the input fields, there's a 'Help menu stays consistent in each page' link. The entire page has a light gray background, except for the input fields which have a white background.

Auto format like xxx-xxx-xxxx, as users input numbers. It is not indicated in the interface because users do not need to respond to it

Contrast in color and shape to differentiate text fields and dropdowns
Users can save their work
Users can go back and browse previous page

Simplified navigation remains consistent so that users would not be distracted

Redesigning the electronic form for Social Security Card Application

- Paper -> Electronic (computer, web use setting)
- One page -> multiple pages
- Electronic submission and print options available

Step 2: Form layout_page 3 Parental Information

Space indicates that there are two groups of information

Get Social Security Card

Step 1 > Step 2 > Step 3 > Step 4 > Confirmation

The Official Website of the U.S. Social Security Administration

Step 3: Parental Information

Need Help?

Help menu stays consistent in each page

Parent/Mother's First Name at her birth *

Parent/Mother's Last Name at her birth *

Parent/Mother's Social Security Number *

Parent/Father's First Name *

Parent/Father's Last Name *

Parent/Father's Social Security Number *

Save

Next

Previous

Auto format like xxx-xxx-xxxx,
as users input numbers.
It is not indicated in the interface
because users do not need to respond to it

Simplified navigation remains
consistent so that users would
not be distracted

Figure 51. Designing process of the electronic version of Social Security Card application, Step 2-3.

Redesigning the electronic form for Social Security Card Application

- Paper -> Electronic (computer, web use setting)
- One page -> multiple pages
- Electronic submission and print options available

Step 2: Form layout_page 4 Past Social Security Number Information

Contrast in typography (by weight) allows users to scan

Step 4: Past Social Security Number Information

Has the applicant ever had Social Security Number in the past? *

Yes No

Social Security Number issued in part *

Name shown on the most recent Social Security card issued for the applicant *

Enter any different date of birth if used on an earlier application for a card *

Help

Save **Next**

Simplified navigation remains consistent so that users would not be distracted

Auto format like xxx-xxx-xxxx,
as users input numbers.
It is not indicated in the interface
because users do not need to respond to it

These questions appear only when
users choose "yes" for the first question

Redesigning the electronic form for Social Security Card Application

Step 2: Form layout_page 5 Confirmation

Paper -> Electronic (computer, web use setting)
 - One page -> multiple pages
 - Electronic submission and print options available

Simplified navigation remains consistent so that users would not be distracted

Help menu stays consistent in each page

Need Help?

Confirmation

Your relationship to the applicant: *

Please Select... ▾

Has the applicant or anyone acting on his/her behalf ever filed for or received a Social Security number card before? *

Yes

No

Today's Date (MM/DD/YYYY) *

Auto format like MM/DD/YYYY as users input numbers

Your Signature *

By signing your name, you are confirming that you agree with our terms and conditions

Save Next ▶

Previous ◀

E-signature Progressive website?

Figure 53. Designing process of the electronic version of Social Security Card application, Step 2-5.

Redesigning the electronic form for Social Security Card Application

- Paper -> Electronic (computer, web use setting)
- One page -> multiple pages
- Electronic submission and print options available

Step 2: Form layout_page 6 Review and submission

On this page, users will review all information they input by scrolling down

Social Security
The Official Website of the U.S. Social Security Administration

Get Social Security Card Step 1: Step 2 > Step 3 > Step 4 > Confirmation

Help menu stays consistent in each page

Review Your Information

About the applicant

Given Name *	Roger	Middle Name	Alan
Last Name *	Coyle	Suffix	

Date of Birth (MM/DD/YYYY) *

07/03/91

City of birth *

Ames

Has the applicant or anyone acting on their behalf ever filed for or received a Social Security number card before? *

No

Today's Date (MM/DD/YYYY) *

07/03/2012

Your Signature *

By typing your name, you are confirming that you agree with our terms and conditions.

Roger Alan Coyle

Submit

Figure 54. Designing process of the electronic version of Social Security Card application, Step 2-6.

3-9. Final Matrix: interactive design guidelines.

The design guidelines are revised in the interactive format to show information in more organized manner so that designers can use it conveniently when they design electronic forms. Design guidelines are organized based on timing in design process and keywords from the previous design guidelines. When users click an empty cell, the design guidelines that apply to the timing and keyword show up on the right.

The interactive design guidelines are available online at <http://mikakodesign.com/p15.html>. Figures 55-57 are the examples of the interactive design guidelines.

Design Guidelines for Electronic Forms

Design fields	Keywords	Timing	Begin Form Design	In Design Process	User Evaluation
Graphic Design					
<i>Visual presentation</i>	Visual hierarchy				
	Text, typography				
	Consistency				
■ Visual principles	Space				
Interface Design					
	Interface				
	Sign-on				
	Error, failure				
	Self-explanatory, instructions				
■ Technical requirements					
■ Technical goals					
Information Design					
	Flexibility				
	Scannability				
	Design goal				
	Design process				
	<i>To make information easily understandable</i>				
	■ Technical goals				
	■ Design process				
Psychology; User assessment					
<i>Human reactions</i>	Emotion, trust				
	Expectations				
	User behavior				
	Human Factor				
	■ Emotion				

Figure 55. A screenshot of interactive design guidelines (Home).

Click the cells on the left to see guidelines

Design Guidelines for Electronic Forms

Design fields	Keywords	Timing	Begin Form Design	In Design Process	User Evaluation
Graphic Design Visual presentation	Visual hierarchy				
	Text, typography				
	Consistency				
■ Visual principles	Space				
Interface Design Communication between users and forms	Interface				
	Sign-on				
	Error, failure				
■ Technical requirements ■ Technical goals	Self-explanatory, instructions				
Information Design To make information easily understandable	Flexibility				
	Scannability				
	Design goal				
■ Technical goals ■ Design process	Design process				
Psychology; User assessment Human reactions	Emotion, trust				
	Expectations				
	User behavior				
■ Emotion	Human Factor				

Figure 56. A screenshot of interactive design guidelines
(Guidelines for Typography, text at Begin Form Design).

Design Guidelines for Electronic Forms

Design fields	Keywords	Timing	Begin Form Design	In Design Process	User Evaluation
Graphic Design	Visual hierarchy				
<i>Visual presentation</i>	Text, typography				
	Consistency				
	Space				
Interface Design		Interface			
<i>Communication between users and forms</i>		Sign-on			
		Error, failure			
	Self-explanatory, instructions				
Information Design			Flexibility		
<i>To make information easily understandable</i>			Scannability		
			Design goal		
	Technical goals			Design process	
	Design process				
Psychology; User assessment				Emotion, trust	
<i>Human reactions</i>				Expectations	
				User behavior	
				Human Factor	
				Emotion	

Figure 57. A screenshot of interactive design guidelines
(Guidelines for Emotion, trust at User Evaluation).

CHAPTER 4. CONCLUSION

As Heraclitus stated, “everything flows”, nothing stays the same. This idea is a universal concept, as Buddha also mentioned a concept of impermanence. No matter what culture one belongs to, no matter what time period one lives in, consistent attempts for problem solving are necessary to improve human lives.

Electronic forms are one of the current topics that need solutions. Electronic forms are relatively new in human lives. Electronic forms have been often designed from the perspectives of the people in organizations, not from the users' perspectives. Users suffer from troubles, errors, and emotional burdens that have accompanied electronic forms. It was found that problems in electronic forms were due to the design of the forms. First, the research analyzed current electronic form design. Secondly, the research provided design guidelines for electronic forms in order to improve user the experience.

4-1. Response to Research Questions

The most important research question in this thesis is:

- What kind of improvements could be made in electronic form design based on graphic design principles?

To answer this question above, it is helpful to find answers for following question, which investigates the design and usability of current electronic forms:

- What are current electronic forms like? How are they used? How often are they used?

This question would include the following three questions:

- What are the advantages and disadvantages of electronic forms for users?

- ❖ What are the critical design problems that users have with electronic forms?
- In what kind of occasions do electronic forms need to be used?

In conclusion, this thesis is attempting to find out 1) how the form is used, 2) what is the most effective electronic form design that helps users to complete tasks with a pleasing experience and what is the least effective electronic form design that is discouraging for users, 3) what the most significant problems are, and 4) what kind of improvements should be made as soon as possible.

Current electronic forms: What are they? How are they used? Current electronic forms often appear on the web services of commercial, governmental, and educational organizations. Electronic forms are also used in other formats, such as airport kiosks. (Figure 58, 59) The website Airport-technology.com stated, “According to a survey conducted by analyst firm Forrester, out of 2,869 airline passengers travelling for leisure, 86% had used a self-service check-in kiosk” (Airport-technology.com, n.d.).



Figure 58. Airport Kiosks to check in.

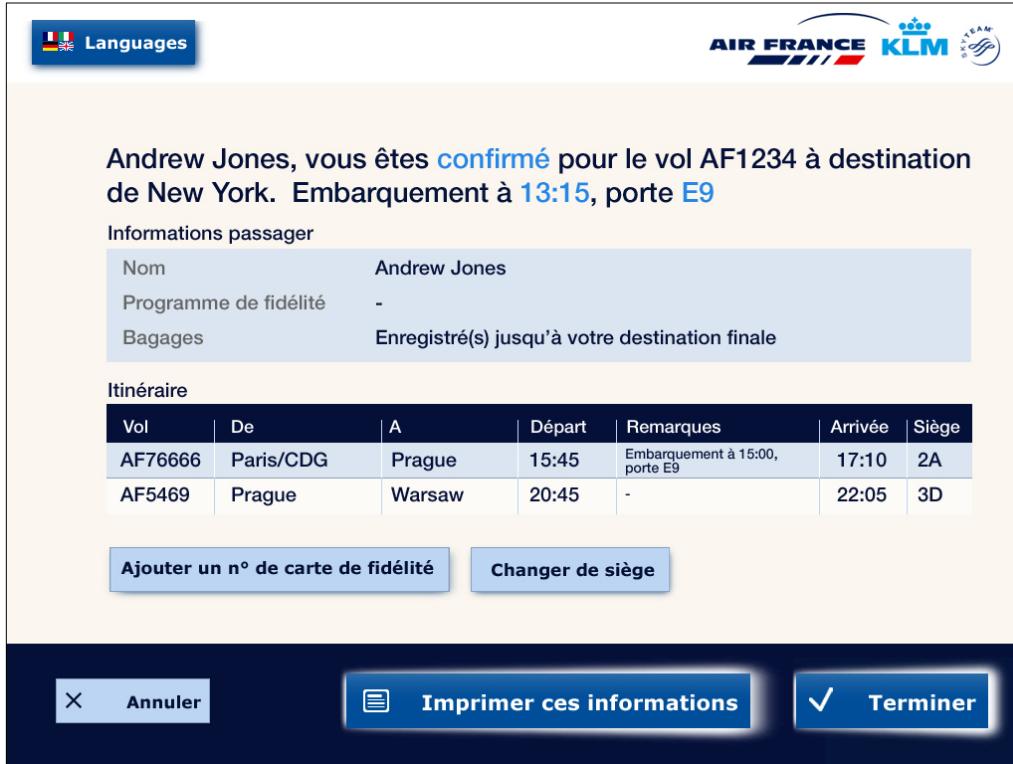


Figure 59. An interface of airport kiosk.

Lawson, a Japanese convenience store, uses their own system called *Loppi* (Figure 60), which is the most popular self-service electronic ticket dispensing system in Japan, providing instant-print tickets for venues such as museums. Tickets are typically printed and paid for at the store's counter, which also allows people who do not own credit or debit cards to purchase their tickets with cash (Wikipedia, n.d.). In Japan, it is more common to use cash to shop daily commodities than to use credit, debit, or check.

Both the airport check-in kiosk and *Loppi* are operated with touch panels, whereas web forms are operated with an interface such as mouse or touchpad, depending on the users.

In this thesis, the term “electronic forms” means user interfaces that ask multiple questions about users when offering commercial, governmental, or educational services.

Usually, user interfaces of electronic forms have multiple colors and a grid system. Size of the monitor/touch panel differs. Font size could be adjustable depending on users' preferences. In web forms, the forms are part of the websites. When users fill out the forms, users are in pursuit of services.



Figure 60. Loppi at Lawson, a Japanese convenience store.

Advantages and disadvantages of electronic forms from the users' perspectives.

Electronic forms have advantages over paper forms. Electronic forms do not need paper, ink, or have printing costs; therefore they are more sustainable. Users can reach web forms from any place as long as they have Internet, although users need to have the electronic devices that could show the forms, such as laptops, desktop computers, or tablets. If users do not have the devices, they cannot access the forms. If users have the devices, electronic forms are convenient, because

users can access forms without help of a service personnel that could be disturbing. On the other hand, users cannot receive instant help that is specific to each user.

Critical design problems that users have with electronic forms. It was found that electronic forms have a variety of styles depending on industries or purpose of the forms (Table 2).

Electronic forms	Style 1: Sign-up forms	Style 2: Application forms	Style 3: Sign-up and application forms
Frequency of visit	Frequent (Multiple times) for a long term	(Supposed to be) Once	Frequent (Multiple times) for a short term
Amount of required information	Small at the beginning (sign-up); More will be asked later	Large and asked at once	Large
Examples	Amazon.com; Facebook; The Economist	Social Security Card application; Passport application	ISU graduate school application
Industry	Commercial	Government	Education

Table 2. Styles and usage of electronic forms.

The design concerns that are common in all forms are in visual representation, the number and contents of information. When a form has a large numbers of questions, how could they be presented to users? Users would feel reluctant to work on the form if all of the questions are presented at once, in a random order, with no visual hierarchy or with a busy colorful background that disturbs users' concentration. If the form does not have a grid system or a not-well-thought-out grid system, users would be confused. If the form shows a dropdown for a name field instead of a simple input text field, it would require users more work and attention to browse options.

How to show information is an important factor in design. What to show is also worthwhile to be considered. Instructions and error messages should appear only when users

absolutely need them to proceed, although many electronic forms have unnecessary instructions and frequent appearances of error messages.

Recommended occasions to use electronic forms. Web forms are accessible with electronic devices and Internet. If potential users were likely to have devices and Internet access, electronic forms would be convenient resources. Users would operate airport check-in systems only when they check-in at airports, therefore it is reasonable to set up electronic forms. In both cases, it would be helpful to prepare for online help and service clerks to assist users.

In terms of accessibility, paper forms would be helpful as a back up when some of the potential users might not have access to the device and/or Internet. Electronic forms would be more convenient for the visually impaired, because electronic forms could be available with digital readers.

Suggestions for electronic form design based on graphic design principles. The suggestions for electronic form design are presented in the design guidelines. (Figure 28-46, 55-57) Overall, clear visual hierarchy should be consistent with the hierarchy of information. Visual hierarchy would be achieved with grid systems, simple and well-thought-out layout with a minimum of distractions. Color should be intentionally utilized as a tool to achieve visual hierarchy and consistency, not as a decoration. In order to assure users' a comfortable experience with electronic forms, help menus should be visible and available anytime in the process of filling out forms. When users employ help menus, the help information should be browsed without affecting the work that a user has already completed.

4-2. Future Studies

The study was focused on electronic forms on the web rather than in other systems such as airport kiosks. The study has a potential to be extended to forms in different systems other than the forms on the web.

The design guideline could be enriched if the study includes analysis from more samples of electronic forms. Possible research could be carried on with online job application forms, forms available on a bank websites, and forms for tax return.

The design guidelines would be more convincing if the guidelines include statistic data on usage of electronic forms worldwide as well as demographic research on users of the forms. Usability studies need to be conducted to measure the effectiveness of the design guidelines.

Additionally, it is necessary to add more guidelines for user evaluation. User evaluation is usually not a part of the design process; however, user evaluation should be included in the design process because it would validate the design guidelines.

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