CHAPTER

Bottom-Up Versus Top-Down Design

13

Highlights

- Bottom-up design is designing for existing work practice.
- The role of biases and constraints in design.
- Abstract work activities.
- Top-down design is designing for an abstract work activity.
- Bottom-up design and top-down design are both appropriate in different situations.

13.1 INTRODUCTION

13.1.1 You Are Here

We begin each process chapter with a "you are here" picture of the chapter topic in the context of The Wheel, the overall UX design lifecycle template (Fig. 13-1). In this chapter, we set the stage for the Design Solutions UX design lifecycle activity.

Before we get to the next chapter on generative design, we discuss two quite different approaches to design creation: bottom-up design and top-down design.

13.2 BOTTOM-UP DESIGN: DESIGNING FOR EXISTING WORK PRACTICE

Bottom-up design is an approach to design that starts with the details known about the work domain, work practice, and how a product or system is being used and will be used. The design is then built up in a way that will support this known usage behavior.

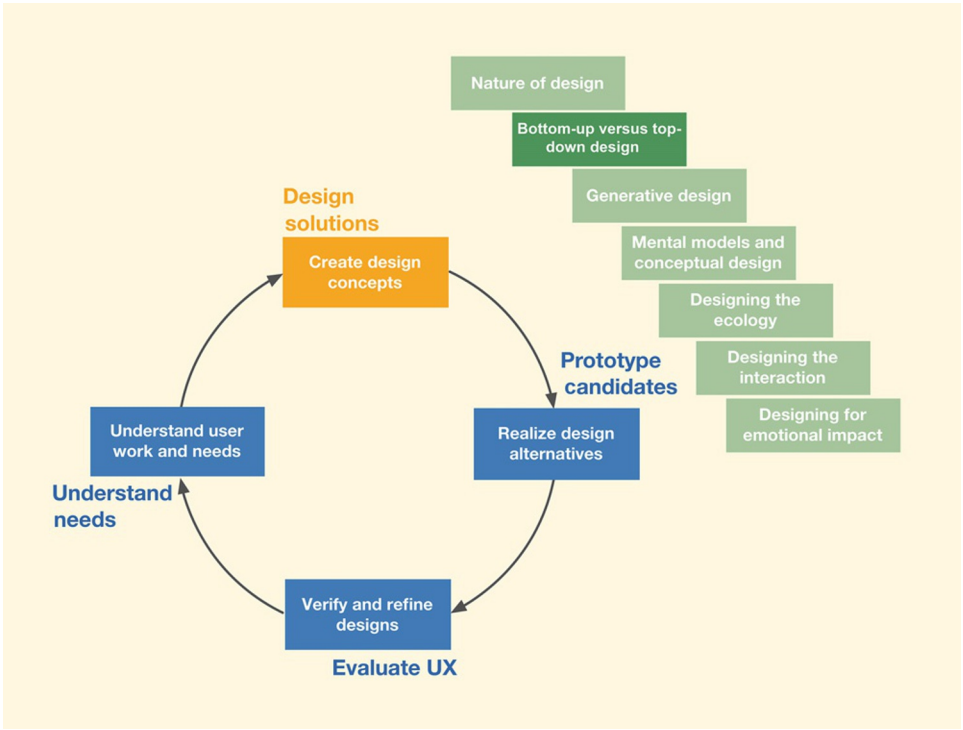

Fig. 13-1

You are here in the chapter describing two approaches to the subactivity of creating a UX design within the Design Solutions lifecycle activity, in the context of the overall Wheel UX lifecycle.

13.2.1 Recap of Our Process Steps Thus Far

So far in our discussion, the act of UX design covered the following steps:

- Project briefing and kick off: Client approaches design team with a "problem."
- Usage research data elicitation: Inquire into the users (e.g., work roles), the nature of work, artifacts used, challenges faced, and the breakdowns encountered.
- Usage research data analysis and modeling: Represent what designers learned about current work practice.
- Usage research user stories and requirements: Extracted actionable user needs to support in design.

13.2.2 The Process so far is Bottom Up

As the summary of the steps above shows, what we have done so far in this book is to immerse ourselves in the current work practice with the objective of designing a solution in a bottom-up way. We call this approach bottom up because we based all our investigations and analyses on data gathered from users in the existing work practice, avoiding other insights and inputs. We involved

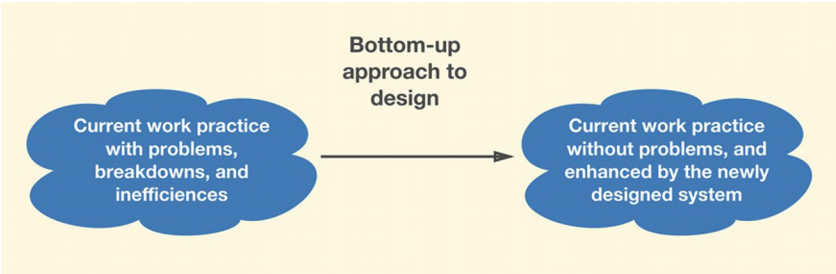

Fig. 13-2
Nature of a bottom-up approach to UX design.

users (in the form of walkthroughs of the artifacts we produced) to ensure that what we are doing is consistent with the way they get work done.

This bottom-up approach is predominantly a translation exercise done through a series of transformations on a path from work activity notes to models to UX requirements to design. The premise is that these requirements, if met in the new design solution, will solve the problems of the users in this work practice, help users be more productive, and satisfy business mandates (Fig. 13-2).

Work Activity Note

A brief, clear, concise, and elemental (relating to exactly one concept, idea, fact, or topic) statement used to document a single point about the work practice as synthesized from raw usage research data (Section 8.1.2).

13.2.3 Human-Centered Design or User-Centered Design: Common Names for Bottom-Up Design

"Human-centered design" (HCD) and "user-centered design" (UCD) are established terms in the discipline of human-computer interaction. "User-centered design" was coined by Norman and Draper back in 1986 (Norman & Draper, 1986). The plain English meaning of the term "user-centered design" puts the central focus of design on the user, which of course is true in some way for all approaches to UX design. No UX designer would deny this goal. So the term at face value does little to distinguish approaches.

But, as with so many other terms arising in the discipline, much more meaning is packed into the term by various researchers and practitioners.

To start with, HCD/UCD philosophy is based on understanding user needs and emphasizes empathy toward their goals and aspirations. It's about fitting technology to the user, rather than vice versa. As Wikipedia[1] defines it: UCD is "a framework of processes… in which the needs, wants, and limitations of end users of a product, service, or process are given extensive attention at each stage of the design process."

And many define HCD/UCD more in terms of a process than a focus on users. UCD is popularly characterized as being driven by usage research

[1] https://en.wikipedia.org/wiki/User-centered_design.

(contextual inquiry (Beyer & Holtzblatt, 1998)), and guided by UX evaluation/testing. This means that most of what is known as UCD is about a bottom-up approach based on existing work practice. And, despite the word "design" being in the name, there is usually little emphasis on design.

13.2.4 Designing for Existing Work Practice is Practical

Bottom-up design, designing for existing work practice, is often the most practical approach. It does not create conflicts or friction with stakeholders because the introduction of the design solution only solves problems and removes breakdowns in the existing work practice. There are no disruptions in, or undue transformation of, how work currently gets done.

The philosophy underlying this approach is that users and current stakeholders are the experts in that work domain and they know best how work should be structured. We as designers are only to support that broader work structure with the solution we are introducing.

It is easy to understand why, when the discipline of HCI started, there was a strong push for user-centeredness. There was a need to get designers (who were all engineers at that time) to prioritize users and their needs over all else. The fear was that introducing ideas that are not substantiated by user data will take us to a place where designers create solutions that they think are good for users, but are in fact not.

This weight of history and tradition continues to exert great influence on even experienced designers in limiting their purview to creating solutions that support existing users and how they do work. As we move on to the discussion of constraints and biases, keep in mind that it is easier and more practical to just design something as called for by the initial design brief as compared to risking something boldly different.

13.2.5 The Role of Biases and Constraints

A bias in the UX design process is an influence on the data, how it is collected, or how it is viewed and analyzed, based on something the analyst knows outside the data.

13.2.5.1 Bias and inertia from existing usage and user preferences

When designing for the existing work practice, the ceiling is set through the lens of current user behavior and work practice, current revenue, current product, and current organizational biases and ways of doing things.

The bias of customer preference can subdue even an experienced designer's enthusiasm to adopt what they think is a better design. Going against such strong preference also goes against the "you are not the user" tenet and the need to have empathy toward users. And your whole team, the product people, the developers, and the sales specialists all need to be convinced as to why you are going with an idea that is counter to what users want.

Consider the example of the Blackberry smartphone. Before the introduction of the iPhone, the Blackberry phones were by far the market leaders in smartphones. While they were never known for their ease of use (in fact, they were pretty difficult to use with convoluted interaction patterns), they became the smartphone of choice in the corporate world. Their rise was predominantly due to three things: the first truly capable smartphone for a working professional, unbreakable security, and physical keyboards.

If Apple did usage research and analysis of existing work practice, they would have found a consistent and almost unanimous preference for a physical keyboard. This preference was so strong that it was widely reported that Blackberry users would never adopt the iPhone, considered by many to be a toy. It must have taken superhuman persuasive powers to convince the Apple design team, sales, engineering, and senior executives that, despite current preferences for the familiar, the touch paradigm is the future!

The designer who normally works in a framework of centering everything around satisfying customers and users will find it incredibly hard to not succumb to the biases and pressures of the usage data and other organizational and cultural trends in place.

And how does a designer know when it's the right thing to do, to break from relying entirely on usage research data about the existing work practice? It takes a special vision, a bold sense about the future, and an ability to close your eyes to risk. And, after all, what if the designers turn out to be wrong?

13.2.5.2 Bias and inertia from market success

When a product becomes successful and popular in the market, there is a natural tendency to stick with what works and continue that same line of design with incremental refinements over time. This introduces a design complacency that can block innovation. The downfall of Blackberry is a good example for existing market success acting as a bias against continuing to be innovative in design.

Perhaps the most striking example of this kind of bias is the case of Kodak, which was the market leader in film photography and the inventor of the digital camera. The work practice of film photography was less flexible and more

expensive than the subsequent digital work practice, which allowed instantaneous feedback and an immediate opportunity to fix any problems.

But Kodak had bias and inertia from market success, so they didn't embrace the new digital technology. They couldn't bring themselves to risk their hugely successful business of selling the film, paper, and other supplies for film photography, a business that had been their bread and butter for almost a century. So they missed out on what could have been an amazing future. The rest, sadly, is history. Kodak is, for the most part, irrelevant in today's photography market.

13.2.5.3 Effects from advances in technology

Existing work practice is often limited by what was possible with yesterday's technology. Advances in technology can open up the work practice to a new world of usage possibilities. At the time of this writing, solid-state battery technology is just becoming a reliable power source and is beginning to upend traditional fuel sources in a wide range of devices, including home lawn mowers, snow blowers, recreation vehicles, and automobiles. But they are more expensive and difficult to get repaired compared to the ubiquitous internal combustion engines.

Of course, incremental advances in existing technology can hit a threshold point needed to make a product idea feasible, practical, and profitable. The iPhone and iPod were not the first attempts at these kinds of devices, but they emerged when advances in technology favored increased reliability of touchscreens, reduction of device size and weight, enhanced battery life, and greatly increased storage capacity.

Abstract Work Activity

A description of the fundamental nature of work in a particular work domain, stripping it to its essentials (Section 13.3.2).

13.2.6 Bottom-Up Design is Less Likely to Lead to Innovative Possibilities

While any introduction of a system into a work practice will change that practice, in bottom-up design it is only about changes to accommodate that system. It was never a goal of bottom-up design to see if the practice can or should be changed at a fundamental level.

Top-Down Design

A UX design approach starting with abstract descriptions of work activities, stripped of information about existing work practice and working toward a best design solution independent of current perspectives and biases (Section 13.4).

13.3 ABSTRACT WORK ACTIVITIES

To create a new design that does more than just improve an existing work practice, we must approach the problem differently, from the top down. To understand this, we need to unpack the nature of work and work practice. In particular, much of the understanding of top-down design depends on the concept of an abstract work activity.

13.3.1 Nature of Work and Work Practice

We have used the term "work practice" extensively in Part 2 (Understand Needs) of the book. As we have seen, the term work practice includes two aspects:

- The nature of what needs to be done.
- How it gets done.

The nature of what needs to be done. This is *the problem*, the essence of the work itself. It is a distillation and abstraction of why the work practice exists. It includes the end goal of the practice.

How this work gets done. This is the *solution*, a question of procedure and protocol that is shaped by factors such as tradition, history, regulations, constraints, available tools, business goals, culture, people, and evolution.

The nature of work might be similar in two different work sites, each with an entirely different work practice. To expand on this difference, we introduce the idea of an abstract work activity.

Abstraction

The process of removing extraneous details of something and focusing on its irreducible constructs to identify what is really going on, ignoring everything else (Section 14.2.8.2).

13.3.2 Abstract Work Activity

An abstract work activity is a description of the fundamental nature of a work activity in a particular domain, stripping it to its essentials. It is the essence of work in that domain involving only the central work roles, the simplest description without variations and modifications due to biases and constraints due to historical, business, political, or other influences.

It's about the work and not about work practice—the *what* of the work, not the *how*. For example, the abstract view of the act of voting is simply about people making choices among candidates.

13.3.3 Work Activity Instances

An abstract work activity can be instantiated into multiple different work practices. Each is one solution to the abstract work activity problem, one way of doing the work. It is how that work gets done in a given concrete context.

A work activity instance (work practice) is richer and more concrete, including all work roles, something we try to capture in those detailed and even overlapping models that we build during our user research phase.

13.3.4 Why is it Useful to Start Top-Down Design with Abstract Work Activities?

Abstract work activities are a useful way to start into top-down design by:

- Providing a clearer understanding of work.
- Illuminating possible design targets.

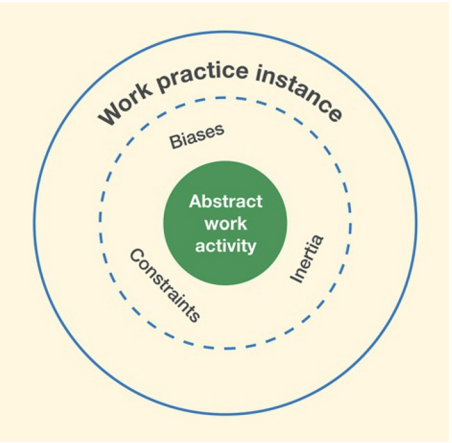

Fig. 13-3

The abstract work activity as work kernel.

13.3.4.1 Provide a clearer understanding of the essence of work

Abstract work activity descriptions help understand the work domain at a level where the layers of constraints and biases are removed. The process of describing the abstract work activity gets at the very kernel of the work (Fig. 13-3).

13.3.4.2 Illuminate possible design targets

A bottom-up design approach will generally lead to a design target supporting existing work practice. Top-down design will generally lead to design targets with the potential for radically different work practice (Fig. 13-4).

13.4 TOP-DOWN DESIGN: DESIGNING FOR THE ABSTRACT WORK ACTIVITY

In a top-down UX design approach, you start with abstract descriptions of work activities, stripped of information about existing work practice and work toward a best design solution independent of current perspectives and biases.

13.4.1 Top-Down Design Goal

In top-down UX design creation, the goal is to create the best design solution that enhances and supports the fundamental nature of work irrespective of current practices, preferences, traditions, or constraints. The primary driver in the top-down approach to design is the designer and the designer's knowledge, skills, experience, and intuition.

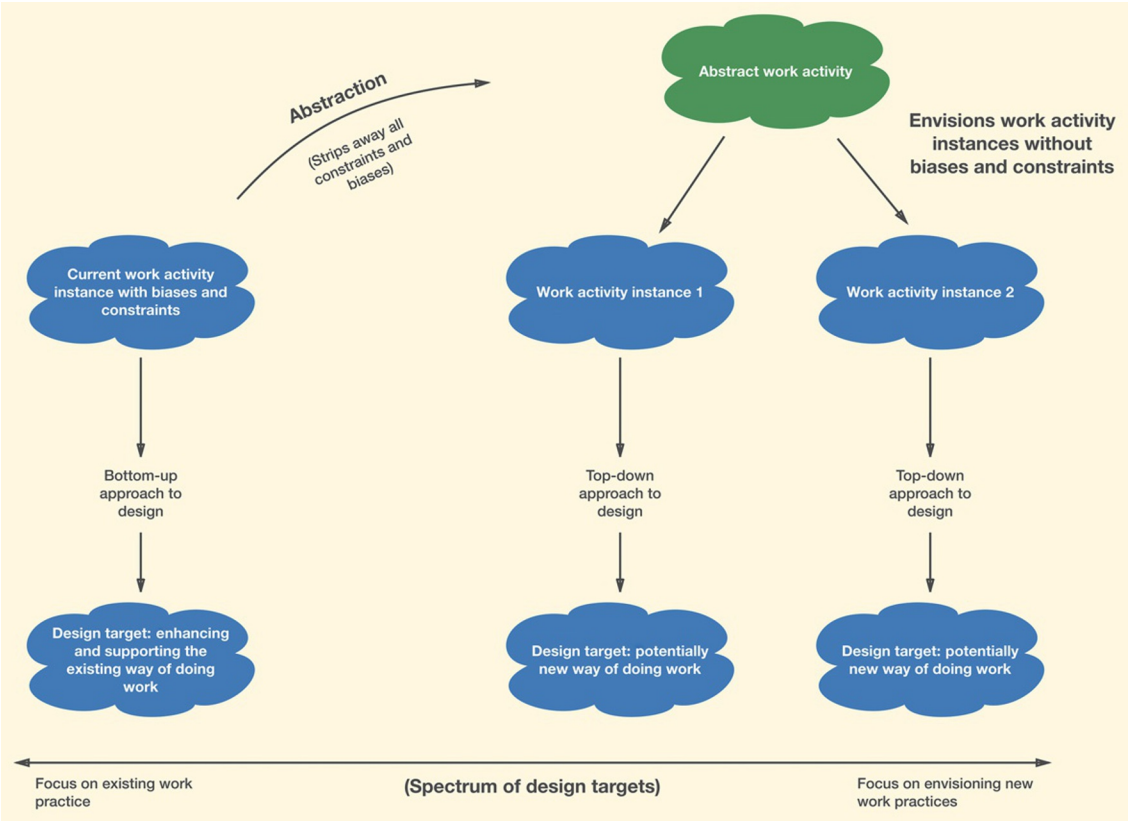

Fig. 13-4

Different design targets: Bottom-up design based on existing work practice versus top-down design based on an abstract work activity description.

As a general matter, however, user/work/usage/domain knowledge still can be, and is, used to inform design creation but does not *drive* the process. Both approaches need usage research, but it is used in different ways:

- In bottom-up design, usage research is to analyze and model the existing work practice to improve it.
- In top-down design, usage research is to formulate and understand the abstract conceptualization of underlying essentials of the work.

Example: Voting in a Democracy

Imagine a business brief to design a voting booth for the state of Virginia in the United States. The state is in the process of updating their systems and is interested in going digital with touchscreen voting booths. This is a typical design brief where a client asks for a solution to support or solve specific problems facing a known practice.

Work Activity Affinity Diagram (WAAD)

A hierarchical bottom-up technique for organizing disparate pieces of data, used to sort and organize work activity notes in usage research analysis, pulling together work activity notes with similarities and common themes to highlight common work patterns and shared strategies across all users (Section 8.7).

The bottom-up approach: Designing for the existing work practice. In a bottom-up approach, we would conduct usage research studies of voting with election booths to understand the current voting work practice in Virginia. We create work activity affinity diagrams, flow models, and other models to describe:

- Prevoting preparation:
  - How citizens register to vote.
  - How they find the nearest voting stations.
  - What they need when they show up at the voting stations.
- The onsite configuration:
  - How voting booths are set up.
  - How voters interact with the booths.
- The workflow of voting:
  - Voter identification.
  - Checking voters off the rolls.
  - Guiding voters to the appropriate booths.
- Postvoting follow-up:
  - Counting ballots.
  - Combining tallies from all sites.
  - Announcing winners.

Flow Model

A simple graphical diagram giving a big picture or overview of work by representing how information, artifacts, and work products flow among work roles and system components within the work practice of an organization (Section 9.5).

The design activity focuses on specifics of this particular work practice:

- Physical design of the voting booth.
- Clear labels on the touchscreen, accessibility issues with the booth, color contrasts and other sensory issues, ergonomics of the booth, error avoidance and recovery in case of user mistakes during voting, materials for the booth, etc.
- Making sure it all fits with the already established ecology.

Ecology

In the setting of UX design, the ecology is the entire set of surrounding parts of the world, including networks, other users, devices, and information structures, with which a user, product, or system interacts (Section 16.2.1).

The top-down approach. Using a top-down approach based on an abstract work activity, we would:

- Focus on designing the best way to get eligible users to elect someone from a list of candidates.

- Bring into consideration all ways, including voting booths, to make this work happen.
- Consider a smartphone app or a website to vote from the comfort of the home?
- Or a 1-800 number where citizens can call and cast their votes?
- An Internet-connected device in the home that could be used for voting and that could also be used for other expressions of opinions, including petitions, surveys, and likes or dislikes of products.
- Allow for possibilities where citizens can vote over a period of time leading up to a deadline.
- Even provides for flexibility, allowing citizens to change their vote after it is cast up to the deadline—something mail-in ballots do not allow:
  - Perhaps new information about a candidate was unearthed in the interim.
- Emphasize designing for a very different envisioned ecology (in fact, defining the ecology is part of the design).
- Design for the interaction (workflows, etc.), information needs (for example, full display of candidates and their party affiliations, which offices a given voter can cast ballots for, full description of each side of all issues and proposals up for a vote) and emotional needs after ecological design is completed.

Abstraction redirects designer thinking. Many questions can be uncovered by this new way of thinking of work. Designing for the abstract work activity can result in a system that is significantly better at supporting the act of voting. It even questions the need for a voting booth. Whereas in the bottom-up case, the discussion for the most part centered on one particular way of casting a vote.

Although it is almost certainly apocryphal, Henry Ford is reputed to have once said, "If I'd asked people what they wanted, they would have asked for a better (or faster) horse." Regardless of the pedigree of attribution, the quote does point out the lack of regard Ford had for bottom-up inputs from customers and, to an extent, his genius at top-down design.

Indeed, cars have become much more than highly improved horses and carriages and, through a shift in technology and lots of design, more than even horseless carriages. Ford knew to interpret what the users were saying not as needs and not as design solutions but as inputs to inform and inspire a new concept.

The point of this example is to illustrate how thinking of the abstract work activity provides a different design target than that of a specific work activity instance.

13.4.2 Characteristics of Top-Down Design

Top-down design can be perceived as visionary. Because top-down designs are not constrained by current work practice, they can turn out startlingly different and even futuristic designs, which shows how top-down design can be visionary.

Ecological Design

Design that pertains to the foundational layer of the needs pyramid, focused on designing for the overarching system needs of users and how they are supported in broader work practice. Includes designing for activities, the flow, sharing, and communication within the network of devices, other users, systems, and a pervasive information infrastructure (Section 16.2.1).

Abstraction

The process of removing extraneous details of something and focusing on its irreducible constructs to identify what is really going on, ignoring everything else (Section 14.2.8.2).

Top-down design is heavily driven by domain knowledge. Designers need extensive domain knowledge to be able to abstract the nature of work in that domain. This usually translates to the need for designers to envision multiple work activity instances in that domain.

Being a potential user in the domain is good for a designer. An important factor in the success of Apple designers practicing top-down design is the fact that they could see themselves as users of the iPod and iPad, etc.

Another example of a domain in which designers can see themselves as users is photography. To design a photo editing and management application, it would help, perhaps even be essential, for designers to be experts in photography and even avid users of such a product, which would help with immersion necessary to be able to creatively think about the problem.

13.4.3 Top-Down Design is not Always Practical

Sometimes, however, constraints, conventions, regulations, history, and traditions that we discussed as biases in Section 13.2.6 can be too difficult to overcome in practice. They may even be decreed by law.

Business constraints can take priority. As an example of business "constraints," all parties that benefit from the current practice such as the booth vendors, the electronic voting machine manufacturers, and perhaps even the candidates on the ballot will resist any new ideas.

Can conflict with human comfort from familiarity. Humans are not naturally open to drastic changes. It unsettles and perturbs comfortable routines and practices. Our evolutionary biology prefers harmony and consistency to change and disruption.

Can work against short-term goals. Because of the upheaval of the work practice, designing for the abstract work activity usually results in disruption. It can be more expensive and take longer to introduce. This flies directly in the face of the unyielding push toward shorter-term returns and the reluctance to tackle larger projects, a mindset of business these days.

Technology constraints can limit innovation. Sometimes the requisite technology is not quite ready. UX designers must do a thorough exploration of the available technology (Gajendar, 2012).

13.4.4 Easing the Transition for Customers and Users

Tread carefully; ease potential trauma. Redesigning work practice can be traumatic to clients and users who value stability and naturally resist change. And that can put you in a position of defending your plans to all stakeholders.

You are changing something important in the lives of clients and users, taking them dramatically, and even traumatically, out of their comfort zones, which can be chaotic, disruptive, expensive, and offputting for employees. Tread with care and respect. You *have* to get buy-in before proceeding.

13.4.5 Hedging Against Risks of Top-Down Design

In top-down design, you need to be cautious because you have to recognize the high risk (and high potential for a huge payoff). You need to hedge against the risk through follow-up validation activities, such as usage research, prototyping, and evaluation to get user feedback early and often.

13.4.6 Extreme Top-Down Design is the Path to Disruptive Design

Top-down design can be disruptively innovative. The top-down approach carries a high risk because the envisioned solution may not be embraced by existing users because of the potential disruption to their work practice. Sometimes, when a design comes along at the right time and place in such a way that the benefits of going through the upheaval outweigh the discomfort of going through change, it becomes a disruptive idea that moves the status quo to the next step in the innovation ladder. Therefore, top-down design sometimes results in an innovative next-generation product (e.g., the iPod) where bottom-up design would have ended up solving problems people don't even yet know they have (Moore, 2017). Another way to put it is a good bottom-up design fills a niche, but a good top-down design can *create* a niche.

Example: Top-Down Design in Architecture

Frank Lloyd Wright serves as an archetypal example of a disruptive top-down design practitioner in architecture. He was supremely confident that he, as designer, knew best what was good for the user. Wright and Kevin Costner agree, "If you build it, they will come." Wright took top-down design to the extreme. It was no longer about what users thought: "I don't build a house without predicting the end of the present social order. Every building is a missionary… It's their [the users] duty to understand, to appreciate, and conform insofar as possible to the idea of the house" (Lubow, 2009).