

6

Work Models

Each of the five types of work models has its own concepts and symbols representing one aspect of work for design. The five models were developed over time to meet the needs of the design problems we encountered. They represent the key aspects of work that design teams need to account for in their designs. We have found these five to be necessary to almost every problem and sufficient for most.

Work models are first built to describe work from the point of view of the one person interviewed. They do not and are not intended to represent everything that a person or his organization does. Each interviewer learned about some part of the customer's work as it related to the project focus. They also learned something about the work of the organization, as understood by this one customer. The first models we build represent this *individual* perspective. We even use conventions to show which parts of a model are built from the customer's actual experience and which represent the customer telling us how his organization is supposed to work.

THE FLOW MODEL

To get work done, people divide up responsibilities among roles and coordinate with each other while doing it:

A rush order comes in. The woman who receives it calls the person responsible for filling it and mentions, in passing, that a rush order is on the way. The rush order will be shipped on time only because of her informal advance warning. When a new order-processing system is introduced, it does not allow this advance warning and rush orders start shipping late.

A purchasing department is responsible for paying invoices as they come in. But they don't know if the goods were

actually received; they have to figure out who received the goods, send the invoice to him for approval, and pay it only when he returns it signed. Making the purchase and paying for the goods have been separated from the actual work of the organization. Formal sign-off and review processes keep the system working. The purchasing department gets so involved in maintaining these formal processes that they cannot handle finding vendors and making purchases well.

A specialist in another organization gets ready to produce a report. In times past he would have had a secretary type in and format the report; these days he not only creates the content, but he also defines the formatting and layout, checks spelling, and proofs the document as well. He has more control over the document in his own hands, but it's not clear that it's cost-effective for a highly paid professional to do basic stenographic and editorial tasks.

In each of these cases, the key issue is how people's roles are defined and how they communicate to get the job done. The *order*

*No real work happens
in isolation*

receiver had to communicate with the *order processor* to get rush orders accomplished on time; the *invoice payer* had to communicate with the *goods user* to find out if the invoice should be paid; the *content provider* became the *page designer*, instead of

handing the content off to a secretary who could have played that role. All work in this world involves other people to some extent. Books are written for an audience, based on sources, submitted to reviewers, and passed to publishers. Code is written by developers for its users, from requirements, tested by a testing group, marketed by a product marketing group, and distributed to customers. Departments exist because a single person alone can't get the work done; the work must be broken into parts, which then must be coordinated. Different departments coordinate the different parts of the work, and people within a department coordinate to get its work done. The flow model represents this communication and coordination necessary to make work happen.

RECOGNIZING COMMUNICATION FLOW

Work flow (Figures 6.1 and 6.2) defines how work is broken up across people and how people coordinate to ensure the whole job gets done.

FLOW MODEL DISTINCTIONS

The *individuals* who do the work. In the consolidated models, the roles they play (see Part 3 for a discussion of consolidation). Each person or group is shown as a bubble. The interviewee's bubble is annotated with user number and job title. Everyone else's bubble just has job function.

The *responsibilities* of the individual or role. This is a list of what is expected of them—"coordinate schedules of all managers," "ensure samples are processed in the shortest possible time." Every bubble and place on the flow model is annotated with responsibilities.

Groups, sets of people who have common goals or take action together. Outside people may interact with the group as a unit, without knowing any individuals in the group. They say things like "I sent it to purchasing," the particular person in purchasing doesn't matter. Groups are represented when a person has the same interaction with all its members. We may also show the interaction between a group member and the group as a whole.

The *flow*, the communication between people to get work done. Flow may consist of informal talk and coordination, or it may consist of passing artifacts. Flow is shown as arrows between individuals.

Artifacts, the "things" of the work, which are thought of and manipulated as if they were real. An artifact may be physical, such as a document or message. It may also be conceptual; for example, if a design conversation is thought about as though it has members, a history, attributes (public or private), and an existence separate from any one member or topic, it may warrant representation as an artifact. Where appropriate, the *mechanism* is shown—email vs. paper, for example. Artifacts are shown as small boxes on a flow.

The *communication topic or action* representing the detail of the talk or coordination represented by a flow. These are actions as opposed to artifacts, such as talk to set up meetings, arranging for review, asking for help. Examples might be "question about the system" or "request for help." Communication is written on a flow without a box.

Places that people go in and out of in order to get their work done, if it is central to the work of coordinating and collaborating. This is often a meeting room or communal space such as a coffee area. It is shown as a large box annotated with name of place and responsibilities.

Breakdowns or problems in communication or coordination, represented as a red lightning bolt (black in this book). □

How do job responsibilities get assigned to people? What are the different roles people take on to get work done? How do new tasks get passed to a person? Who do they get help from? Who do they have to work with to accomplish their tasks? How do they use physical places and artifacts to help them coordinate? Who do they give the results to and in what form? Work flow is the rich pattern of work as it shuttles between people, the interweaving of jobs and job responsibilities that gets the work done. Work flow represents every phone call between

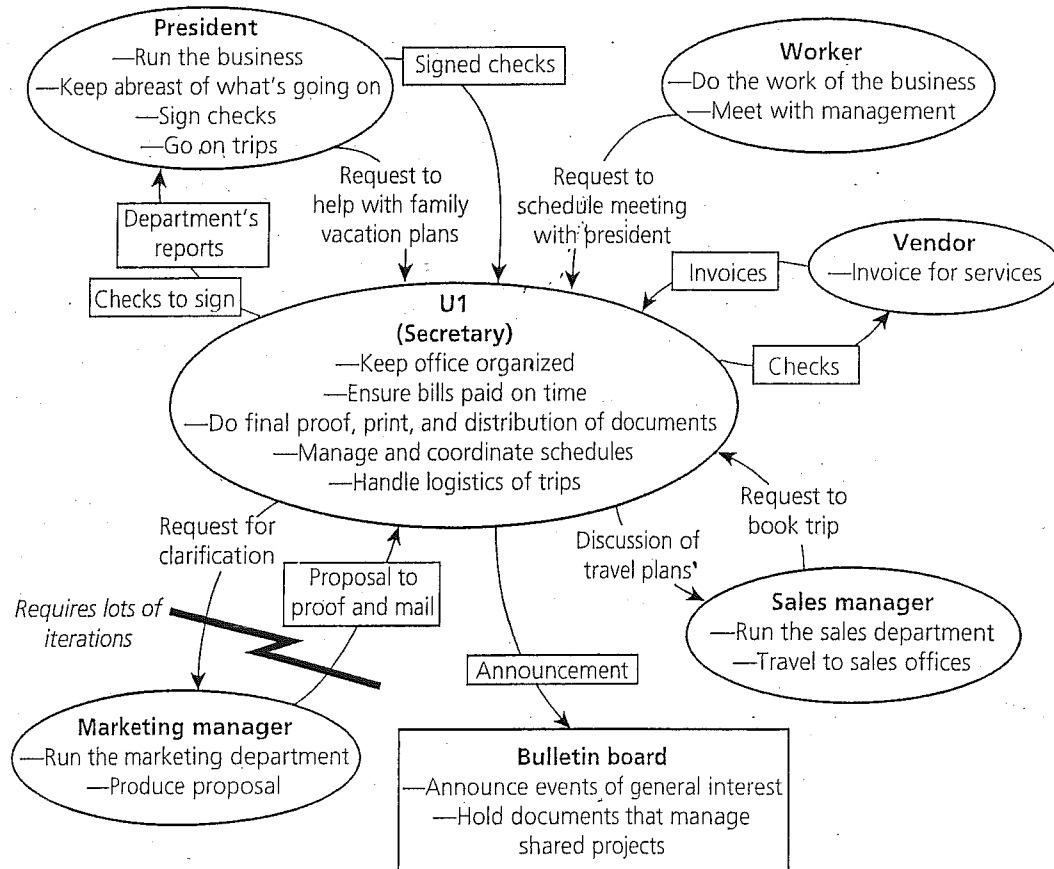


FIGURE 6.1 Secretarial work. This flow model is typical of secretarial work. Secretaries often act as the center, the hub, of a department. In this model, we see this graphically in the many lines that diverge from the central bubble. We can see the great diversity of the hub function in the many types of communication on the lines—everything from formal reports being passed up the management hierarchy to informal requests to smooth the personal lives of people in the department. The accretion of hub responsibilities in one person is natural; once a person is coordinating one aspect of an office, it is natural for them to coordinate other aspects as well. From this diagram we see the nature of hub work—lots of different activities, communication with lots of different people, lots of interruptions, and lots of tasks going on at the same time.

two people, every document passed for review, every email message, every conversation between people in the hall. These are all instances of passing an artifact, communicating information, or coordinating to

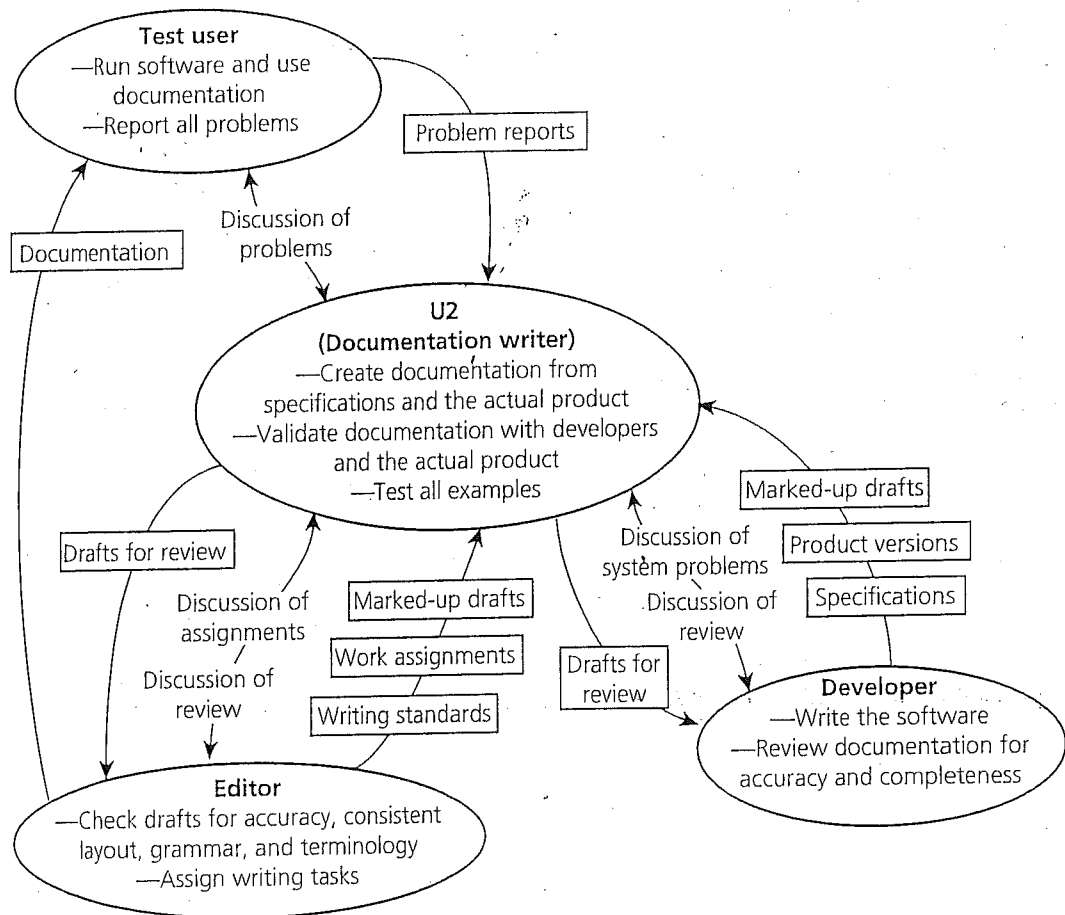


FIGURE 6.2 Creative work. This flow model is typical of creative work. We see communication with those who depend on the work and with those who assist in the creation. But most of the interactions are focused on the task of creation. Compared with the “hub” type of job, this work is much more continuous and coherent.

do a job, whether as part of a formal process or as an informal way to get the job done.

When people coordinate through email or paper, it's easy to see. It's harder to see how casual conversation and handwritten notes support work flow. Here's what to watch for in an interview.

COORDINATION. Any artifact received or handed on indicates coordination with someone else. Where did it come from? Who created

*Represent every contact
people make.*

it? Who will see it next? Find out the whole story to see how the work fits together. Any discussion with someone else, through a phone call, email, or by dropping in personally, also indicates coordination. Is this discussion critical to the work? Where are the problems in coordinating? Do people forget? Do they spend a lot of time on it? Look for opportunities to automate communication that is currently manual and haphazard. See if you can eliminate the need for coordination by providing information directly or by combining roles that are currently separated.

STRATEGY. What strategy is implicit in how the roles are organized? Listen to how the customers talk about their job. How do they see themselves in the organization? What do they consider to be their unique contribution to their department? What is the unique contribution of the department to the company? How does it further the business? Ask whether the role is really critical to the business. If not, why was it put in place? Could that intent be accomplished more directly, or is the intent irrelevant to the business? (One purchasing department has a role devoted to providing PO numbers. PO numbers support their process, but give no direct benefit to the business.)

*Note what responsibilities
people take on—even
responsibilities that are
not part of their jobs*

ROLES. What makes a coherent role? Watch the tasks people do. How do they hang together? Which tasks require similar knowledge, tools, procedures, or data? When does doing a task require knowledge of the progress made in doing another task? These tasks tend to be performed by the same role. Technicians, for example, need to know the history of a problem and of prior attempts to fix it in order to serve the customer well. If problem calls are handed out to the first available person, regardless of history, service will be poor.

INFORMAL STRUCTURES. Look at the ways people go beyond the formal structure: A secretary becomes known as the expert on creating forms. Soon whenever anyone has a particularly difficult form to create, they pass it to her and she does it for them. A scientist has special instructions to communicate to her lab technician. She writes a note on a materials tracking tag, knowing he will see it. A

manager has to assign resources to get things out on time. He invents a status meeting to get it all done. He consciously runs it like a combination bingo game and commando operations center to keep people involved and excited. Each of these people is inventing process and communication mechanisms to support the work they need to do. They show where the formal process definition of the organization is inadequate and reveal opportunities for supporting people's needs more directly. Could you give scientists a better channel to their technicians? Could you eliminate the need for the status meeting with a work assignment and coordination tool? Study the meeting to see what the tool needs to do—and don't overlook the way people ask for and get help around the edges.

Look at the actions people take without thinking

CREATING A BIRD'S-EYE VIEW OF THE ORGANIZATION

The flow model offers a bird's-eye view of the organization, showing the people and their responsibilities, the communication paths between people independent of time, and the things communicated—either tangible artifacts or intangible coordination. People and organizations are bubbles on the model, annotated with their position and responsibilities (roles are not represented directly until we consolidate models across people). Flow is indicated as arrows between bubbles, with the kind of communication written on the line. Artifacts are shown in boxes on the line; informal communication and actions are written without a box.

Where places such as meeting rooms or virtual places such as shared areas support communication, the flow model shows them as well. When a place is important to coordination—meeting rooms, bulletin boards, and shared drop-off areas—they appear as large boxes at the end of a flow. Just as individuals are annotated with their responsibilities, places list their responsibilities in supporting communication and coordination. Automated systems and databases usually should not go on the flow. The only exception is when they are acting like a physical place or like an automated person, and they are critical to coordination between people. Then they are shown as a large box with responsibilities.

Represent locations, things, and systems when they make a place to coordinate

When communication breaks down—people don't get something they should have received or don't respond when a response is needed—we show the problem with a lightning bolt.

Do not limit the model to the formal definition of how work is supposed to be done. The defined process of the organization is not a

*The real interactions
between people reveal
glitches in the work*

good guide to how work is actually accomplished.

Every day, the people in the organization design how their jobs will really be done. As they encounter problems and obstacles, they create solutions, and the solutions become part of the real work. The flow

model needs to capture how work is really done,

including all the informal interactions that make it work. From this representation, you can find good work practice to incorporate into a system, identify problems to eliminate, and see the pattern of communication a system must allow for.

THE SEQUENCE MODEL

Work tasks are ordered; they unfold over time. But the steps people take aren't random; they happen the way they do for a purpose:

A man reads a mail message and, after replying, saves it in a folder called "Phone book." He'll never need that message again. He's just saving it because it has the sender's telephone number on it, and it's a convenient way to look it up. So telephone numbers matter even when email is the primary form of communication, and telephone calls may be triggered by email. Anyone trying to build the complete personal organizer can build on this to tie phone contacts and email together.

A woman paying her bills first gets out her checkbook, bills, paper record of accounts, envelopes, and stamps; then records the amount of every bill and makes sure she can pay them all; then writes each check in turn; and then puts each in an envelope and addresses it. So the stages of paying bills are collect and organize; plan what to pay and how, making sure not to overdraw the account; actually pay the bills; and put them in envelopes to send out. A home accounting program can build these steps in directly.

A scientist is interpreting the results of an experiment. He puts the raw numbers in one column, then in each successive column shows the result of one transformation. He needs to see not just the final result, but the process by which those results are achieved. An analysis tool that hid the calculations, and only revealed the result, would not be acceptable.

The actions people take in doing their work reveal their strategy, their intent, and what matters to them. A system that builds on these can improve the work they do. Understanding the real intent is key to improving work practice; you can redesign, modify, and remove steps as long as the user can still achieve their underlying intent. An intent is stable—for example, people have had the intent of communicating over a distance for ages. The steps, the way that intent has been achieved, have changed over time—from handwritten messages to the telegraph, the telephone, and videoconferencing. Supporting the current work steps just automates the way things are done currently (and because paper is almost always faster than computers, if the system does nothing but automate existing steps, it almost always loses). The goal is to change the work steps to make work more efficient. But the system must support all the intents concealed in the work, not just the primary espoused intents. If users have an intent of planning how to pay bills before they start writing checks, and the system doesn't support planning, the system will not be accepted.

Understanding customers' intent is the key to design

All work, when it unfolds in time, becomes a sequence of actions—steps to achieve an intent. A sequence model (Figure 6.3) represents the steps by which work is done, the triggers that kick off a set of steps, and the intents that are being accomplished. They are your map to the work that your new system will change. Sequence models supply the low-level, step-by-step information on how work is actually done that designers need to make detailed design decisions. The sequence model is most similar to flow diagrams or task analysis (Carter 1991), but is unique in stating the intent and trigger for the sequence. A sequence model starts with the overall intent of the sequence and the trigger that initiates it. Then it lists each step in order, at whatever level of detail the interviewer collected. Any steps that cause problems are labeled with a lightning bolt. When modeling the work of an individual, the

From any one person's point of view, all work is a series of actions

Intent: Plug in

Intent: Handle emergencies

Intent: Get back to people easily

*Had to put off issue of
unhappy user*

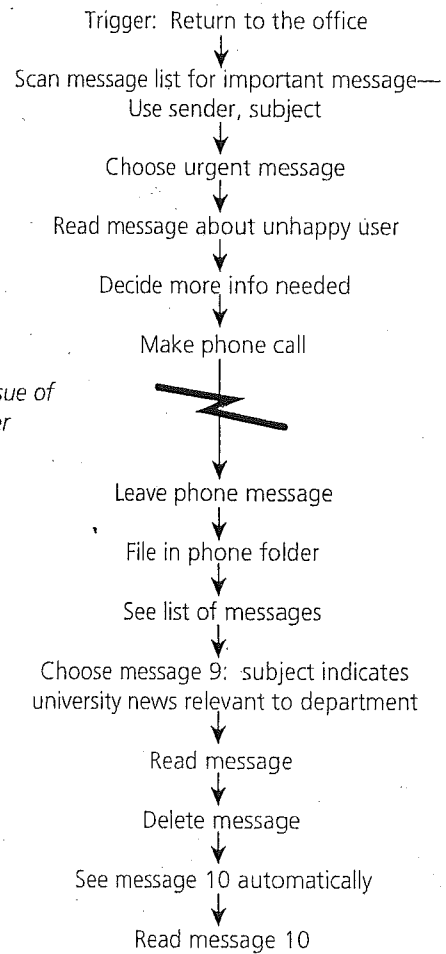


FIGURE 6.3 Sequence model for handling mail. This sequence model shows how one user handled mail on one specific day. The intent is stated at the top left: "Plug in." This conveys the nature of handling mail for this user: much of his communication is through email, and when he left his office, he separated himself from this communication. Returning and checking mail was a reconnection, a "plugging in." This is implied by the trigger for starting this sequence, which indicates he does it whenever he returns to the office. The arrows indicate the sequence of steps. When he completed handling an emergency, he saved the message in a folder he uses as a phone book. This action indicates an unrelated intent, keeping a contact list up-to-date, which he handles opportunistically.

sequence model does not attempt to show pattern or repetition; we identify those when we consolidate. Sequences may be studied at any level of detail, from the high-level work to accomplish an overall task to the detailed interaction steps with a particular user interface.

COLLECTING SEQUENCES DURING AN INTERVIEW

Collect sequences in an interview by watching people work or by getting a detailed retrospective account of their work. The hardest thing about seeing sequences is knowing what to pay attention to, and this changes depending on the project focus.

STEPS. If you are studying the work across the department, or if you are learning about a new market, you'll collect sequences at a fairly high level of detail. You want the actions people take, but not necessarily broken down into each movement. So writing a letter might look like: Get project information from project manager. Extract deliverables and delivery dates important to the customer. Write

SEQUENCE MODEL DISTINCTIONS

The *intent* that the sequence is intended to achieve. Secondary intents will be embedded in this primary intent, and they are named as they are identified.

A *trigger* causing the sequence of actions. It is the notification to the user to take action. Triggers we have seen include the height of a stack of paper on a desk, the arrival of mail, receiving a request, and seeing a misplaced line of text in a document.

Steps, the action or thought preceding an action. In an actual sequence model, a step represents what actually happened. As we step back from the actual steps and look for purpose and strategy, the steps become more abstract. They move away from specific behaviors toward fundamental purpose.

Order, loops, and branches indicated by arrows connecting the steps. These reveal strategic and repetitive patterns of work. When the customer must make a decision about how to proceed, we show that as a branching path. The order gives us an access road map to ensure smooth transitions between tasks and allows us to see what steps could be combined or skipped without serious violation to the users' conception of what is going on in their work.

Breakdowns or problems in doing the steps shown with a red lightning bolt (black in this book). □

introductory paragraph describing current project state. Enter dates. . . . This level of detail shows the overall structure of the work and how it fits together without giving huge amounts of detail about each task.

If you are designing a system or tool, study the tasks the tool supports in more detail. Look at what people do and also *how* they do it.

Capture actions at the level that matters for your project

So writing a letter might look like: Scroll window to find last letter written. Open it. Delete all content. Save under new name. Enter name of recipient. Pull Rolodex closer. . . . At this level of detail, we see the structure of the task and the actions that make it happen.

If you are designing the user interface, look at eye movement, hand movement, hesitations, everything. So writing a letter might look like: Use vertical scroll bar until icon for last letter written comes in view. Double-click on item to open. Read recipient name and scan first paragraph to make sure this is the right letter. Choose "Select All" from Edit menu. . . . This level of detail shows how the user interacts with the UI and reveals the issues for the UI to address.

In practice, the levels of detail blur somewhat, and it's safer to get more detail rather than less. Each action has a purpose in the user's

Customers' actions are never purposeless

mind. If it looks random to you, that's only because you don't know what the purpose might be. In a word processor, we repeatedly saw the user, with the cursor at the end of the line, hit the right arrow, see it move to the next line, then hit the left arrow to

move it back. Even this was not random; he was checking to see if he was really at the end of the line or if there was extra white space because, in that word processor, the white space would make the line wrap.

HESITATIONS AND ERRORS. Notice when the customer hesitates or makes errors. These are your clues to his thoughts. Intervene and ask questions to find out what he is thinking about. Hesita-

Any glitch reveals a thought step

tions and errors indicate places where the customers' understanding of work is being contradicted by the tools they are using. This is an opportunity for your system to do better. If a task is largely a thinking task, hesitations reveal decision points in the process.

Stop the customer and ask him to explain what he is trying to decide at that moment. Try to get him to think aloud, to reveal more of the issues.

TRIGGERS. Every sequence has a trigger—the event that initiated it. Triggers may be discrete events, such as the ringing of a telephone, the arrival of an invoice, or a person arriving at the door. Triggers may be based on time, like the first of the month or the first thing in the morning. Triggers may be less tangible, such as the pile in the in-box getting too large. Whatever the trigger, if the work is automated, it must have an analog in the new system. The system needs a way to tell the user there's something to be done. Otherwise, the user won't take action—for example, one mail product simply gets slower the larger the in-box gets. This doesn't act as a trigger for the user to clean it out; it just makes the product more and more frustrating to use.

Watch how automation removes effective prompts to action

INTENTS. The intent defines why the work represented by a sequence matters to the user at all. Every sequence has a primary intent, which applies to the whole sequence. Then there will be secondary intents, which drive the particular way the work is carried out. So our bill payer has a secondary intent of not overdrawing her account and of redefining who to pay and how much to pay so that important bills are paid and the account is not overdrawn. Intents are usually identified after the sequence is written, when there is time to look it over and think about what lies behind the customer's actions.

Find the intents implied by the actions

Sequences capture the most basic information about work practice. Not only do they tell you how work is *really* done, they show how it is structured and the intents people care about. They present the detailed structure of work that designers will need when it comes time to structure the system. And they cut across the other models, tying them together. Because sequences are time-ordered, they show how different roles interact in different places, using artifacts to support communication and actions to get the work done.

Sequence models reveal the detailed structure of work

THE ARTIFACT MODEL

People create, use, and modify things in the course of doing work. The things they use become *artifacts*, like archaeological findings. They each have their own story to tell about the work:

In one organization, a first-level supervisor prints the spreadsheet he uses to track projects weekly and gives it to his manager. His manager makes check marks against each project to indicate his approval and may make additional notes on the side. Then he signs at the bottom and gives it back. In this way the supervisor's personal tracking sheet becomes a sign-off mechanism and a way for the manager to communicate problems and issues. It suggests that sign-off and feedback are part of the job; an automated project-tracking system could build these features in.

Another woman builds a spreadsheet to calculate end-of-year results. The calculations take 15 minutes to do—then she spends the next 45 minutes making the spreadsheet look good so she can hand it out at the next management review. When a spreadsheet is given careful formatting, it's clear that the way information is presented is an important consideration and that spreadsheets are presentation tools as well as calculation tools. The original spreadsheet tools only displayed text; they were replaced with tools that could do fancy fonts and gave full control over the look.

Another organization has the goal of raising the level of cost consciousness among its people. They have a standard form for making a request for a purchase. The form has a place to describe the item and a place to justify why it's needed but no place to show the cost. When a purchasing form has no place to show cost, it suggests that cost is not a big concern in the organization. An automated purchase order request system could raise cost consciousness just by making cost prominent on the screen.

Artifacts are the tangible things people create or use to help them get their work done. When people use artifacts, they build their way of working right into them. The artifacts show what people think about when they work and how they think about it. An artifact reveals the assumptions, concepts, strategy, and structure that

*Artifacts capture traces of
people's work practice*

guide the people who work with it. Artifacts might be to-do lists, forms, documents, spreadsheets, or physical objects under construction (circuit boards, cars, airplanes). Artifacts may be bought, designed intentionally, or created on the fly. They are manipulated in the sequence models and passed between people in the flow model.

In their structure—how they are arranged into parts and the relationship between the parts—artifacts show the conceptual distinctions of the work. When displays showing the status of a network are separated from displays of trouble alerts, this indicates that tracking ongoing status is different work from responding to alerts. When notes are written on a presentation handout, not where there is white space to write them on, but jammed in next to the text they refer to, this indicates that the close spatial relationship of text and note matters to the writer. When the list of things that a person would like to get is separated from the shopping list, this indicates that a clear distinction exists in the person's mind between the nice-to-have-someday items and the I-will-buy-this-today items. An automated shopper's planner had better provide a way to track long-term possible purchases separately from today's shopping list (Johnson et al. 1988).

Artifacts make customers' conceptual distinctions concrete

An artifact model (Figure 6.4) is a drawing or photocopy of the artifact, complete with any handwritten notes. The model extends the information on the artifact to show structure, strategy, and intent. Highlight structure with lines and labels marking the different parts. Annotate the location of the parts showing how they are placed to give them prominence or support the artifact's usage. And write intents directly on the part of the artifact that supports the intent. Lightning bolts show where the artifact interferes with the work, whether because the defined structure does not match the work, because needed information is missing, or because it is too cumbersome to use.

COLLECTING ARTIFACTS DURING AN INTERVIEW

Artifact models always require interpretation to reveal their intent and usage. You can do this best with the customer during the interview. Look for and inquire into:

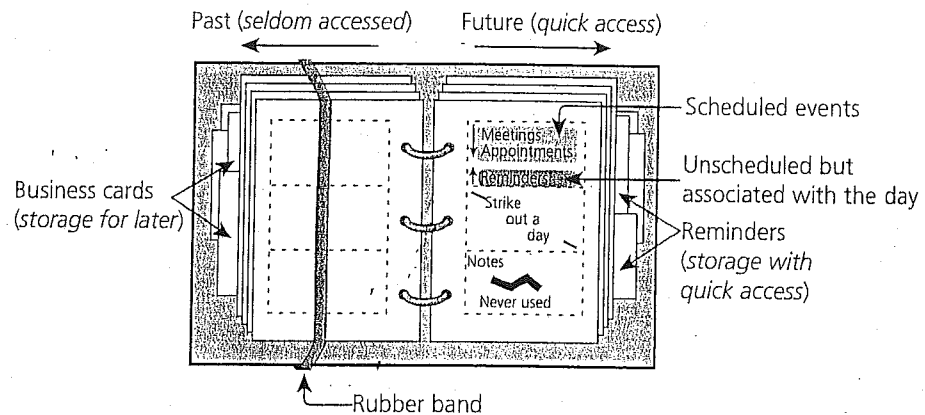


FIGURE 6.4 Artifact model. This physical model shows the structure of an artifact, in this case a personal calendar. The usage of this calendar reveals that it is not only about managing time; it is organizing an entire life. The rubber band makes the distinction between past and future. The calendar is acting as a storage place for reminders and to-do lists as well as a calendar. When the calendar gets too fat, this is a convenient trigger for dealing with the to-do lists. The usage of the day view shows additional distinctions: meetings are listed from the top of the day down, but reminders of a more general nature are written from the bottom going up. Reminders are attached to a day; they are not kept in the provided "notes" area, so it is not used.

Structure reveals how the work is organized

STRUCTURE. All artifacts have structure, even the most informal. People naturally create a structure to represent their thought, even when they start from a blank page. If they didn't create the artifact on the fly, they may start from a given structure, either because it came as part of an artifact they bought or because they designed it themselves before starting the actual work. In this

case, the structure inherent in the work wars with the given structure, and the artifact will show every place there is a mismatch. So the notes space on a daily calendar may be used for notes, but it may be left blank or used as a rolling to-do list. If everyone uses it like a to-do list, then organizing the day and scheduling are intimately intertwined.

Look to see how the artifact is structured. How does the presentation—layout, fonts, formatting, and white space—reveal structure? Assume every grouping of information corresponds to a conceptual distinction in the customer's work. Can you and the user figure out what it is? Can you make these distinctions real in your system?

ARTIFACT MODEL DISTINCTIONS

Information presented by the object, such as the content of a form (e.g., a doctor's name, nurse's name, patient's name, and diagnosis).

Parts of the object, which are distinct in usage, such as page, kind of page (table of contents vs. title page), headline, or figure in a diagram.

Structure of the parts explicitly in the object as given and implicitly in its usage: the division of a form into a section for the doctor's use and a section for the nurses; the grouping of cells in a spreadsheet to represent part of the data for a single purpose, or the way some people use the top of a day within a calendar for meetings and the bottom for reminders.

Annotations, which indicate the informal usage of the object beyond that allowed for by its explicit structure: Post-its stuck to a document, highlighting, and notes written on the side of a report.

Presentation of the object: color, shape, layout, font, white space, emphasis, and how they support usage.

Additional conceptual distinctions that are reflected in an artifact and that matter in its creation and use: past, current, and future in using a calendar; structure and content that repeats in a report from month to month; x-height and caps height in page layout.

Usage of the artifact—when created, how used, how people move through the parts of the artifact.

Breakdowns or problems in using the artifact, represented as a red lightning bolt (black in this book). □

INFORMATION CONTENT. The content of an artifact is the information, specific to the work, that the artifact carries. The content of an artifact tells the story of a part of the work—how the content was put in, how it was used, and who used it. The content fits into the structure of the artifact—or it doesn't, in which case customers modify the defined structure. Seeing how the content is manipulated reveals the artifact's usage—how it supports the work and also the detailed interaction with the artifact in the course of working. So each meeting on a personal calendar suggests the story of the work task that the meeting supports, but it also suggests the detailed story of how the user interacted with the calendar to put the meeting on it.

Look for the information the artifact carries and how it is used. Use the artifact to drive a retrospective account, as we discussed when describing interview principles in Chapter 3. Why is this artifact an

*Content is the trail left by
real events*

appropriate carrier for this information? Who will see it and when? What would happen if the artifact didn't exist? Can you make the needed information available more simply in your system?

INFORMAL ANNOTATIONS. Informal notes and annotations are a gold mine of information. They tell you about the actual usage of the artifact. Did the defined structure get used? Was it extended? Was the artifact used to carry additional information by writing notes on it? Why was it used? What made the artifact the convenient carrier for the message? Can you put other channels in place to make this unnecessary? Can you see how the artifact didn't match the work, and can you see how to make your system fit the work better?

*Annotations reveal usage
and communication*

PRESENTATION. Content and structure are revealed in the artifact's presentation. Look at formatting, the layout of parts on the page, and the use of white space. How does the artifact attract attention to some parts of the content and downplay others? The presentation supports the intent of the work if well designed and gets in the way if not. If the artifact is redesigned or put online, how should your system present it for easy interpretation in the same kind of way?

*Presentation directs the eye
and reveals importance*

INQUIRING INTO AN ARTIFACT

There are two levels of inquiry into artifacts. The first is to see how an artifact supports the customer's intent. The presentation, content, and structure are all clues to what matters in the work. So notes scribbled on a materials-tracking card telling the technician how to handle the material show that direct communication between user and handler is important. Any system that interrupted the communication (such as an automated tracking system) would cause problems in the work. To be successful, such a system would have to provide another way to accomplish the same intent. At this level of inquiry, we look at structure and usage to derive intent, to show why the artifact matters and what any automated system needs to account for. (See Muller et al. [1995] for an example of such an inquiry.)

*Walk through artifacts
with the customer to see
what they mean*

If you think that the artifact might be supported or automated, then a detailed inquiry into the interaction with the artifact provides clues in how to structure the system. Things that cluster in the artifact are conceptual groups that should be kept together. The natural pattern of interaction with the artifact is a good guide to appropriate interaction with the system. So the notes on the materials-tracking card indicate that, if we want to automate materials tracking, we have to support informal communication between user and handler. This communication may happen at any time after the materials are received, so a single note that can only be entered when the materials are received won't do. Since the handwritten note is its own record, and having the record matters, the automated system needs to keep instructions related to the material available over time.

Bring back copies of used artifacts

Artifacts are the concrete trail left by doing work. They capture multiple stories of how work happened, making it possible to walk through a retrospective account of those events. As a physical object, an artifact makes the way customers think about their work tangible, so you can see and inquire into it. But artifacts do not speak on their own; collect examples that have been used and interpret them with the customer during the interview to reveal their meaning.

THE CULTURAL MODEL

Work takes place in a culture, which defines expectations, desires, policies, values, and the whole approach people take to their work:

A vendor creates a product that helps development teams control their development process. The product is well designed and well made, but fails in its target market of UNIX shops. UNIX shops pride themselves in getting code out without needing a formal process.

Another vendor makes an instrument so straightforward that unskilled operators can run it with ease. Their customer base won't buy it because they consider themselves highly skilled professionals who can run complicated systems.

Another company gives their scientists software that simplifies the reporting of experimental lab results. The scientists

reject the system because they consider proper reporting of results to be part of the job of a scientist and don't want it simplified.

In each of these cases, there was nothing wrong with the system delivered. It was designed and built well and solved a real problem.

Successful systems fit with their customers' culture

There was no technical roadblock to its use at all. In each case, what prevented the system's success was the culture of its proposed users. If a system conflicts with its customers' self-image, or doesn't account for the constraints they are under, or under-

cuts the values important to them, it will not succeed.

The *cultural context* is to us like water to a fish—pervasive and inescapable, yet invisible and intangible. Cultural context is the mind-

Culture is as invisible as water to a fish

set that people operate within and that plays a part in everything they do. Issues of cultural context are hard to see because they are not concrete and they are not technical. They are generally not represented in an artifact, written on a wall, or observable in a

single action. Instead they are revealed in the language people use to talk about their own job or their relationships with other groups. They are implied by recurring patterns of behavior, nonverbal communications, and attitudes. They are suggested by how people decorate and the posters they put on their walls.

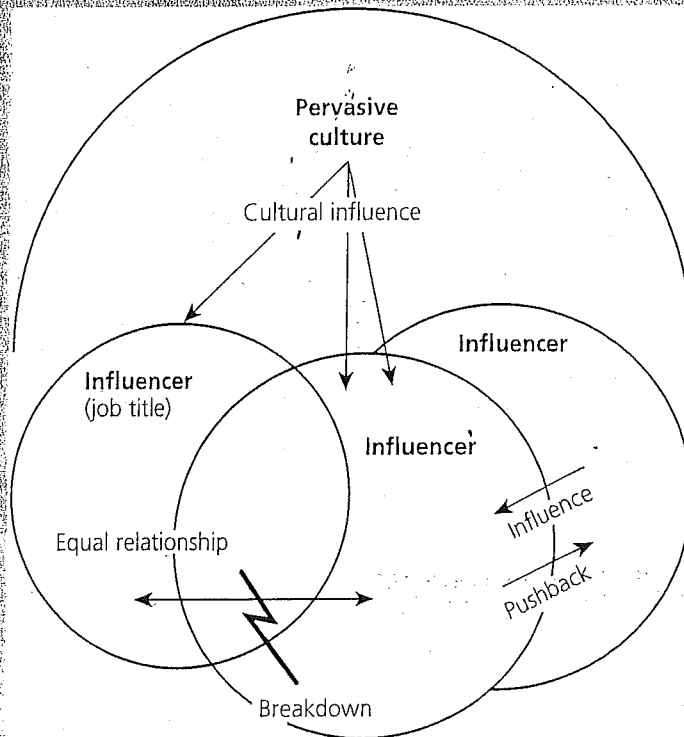
The cultural context includes the formal and informal policy of an organization, the business climate created by competitors and by

The cultural model makes influences concrete

the nature of the business, government requirements, the decor of the site, the self-image of the people doing the work, and the feelings and fears created by the people or groups in the organization.

• Culture influences work by altering the choices people make. Because they don't want to have to deal with a certain group, or because they consider themselves professionals, or because they are worried about what their competitors are doing, people change the way they do their work. Design teams that understand these constraints can build their systems to account for them.

CULTURAL MODEL DISTINCTIONS



Influencers who affect or constrain work, shown as bubbles. These may be individuals or formal groups in the organization. They may be a collection of people who are not a formal group but are thought of together ("management"). They may be external influencers such as customers (and possibly multiple customer organizations), government regulatory bodies, standards groups, or competitors. They may represent the overall culture created by the organization or shared by the people doing the work.

The *extent* of the effect on the work shown by the amount the bubbles overlap. It suggests whether essentially everything about the work is affected by this influence or whether the influence is more partial. So the Food and Drug Administration influences the work of food and drug companies through its reporting and testing requirements, but this influence does not constrain everything about developing the food or drug product. On the other hand, everything an assembly line worker does is affected by the requirements of the assembly process.

Influence on the work. Arrows represent the direction of influence (who is primarily affecting whom) and how pervasive it is (whether this is an influence of one individual or ☐)

group on another or whether it is more pervasive across an organization). We also represent pushback; in real situations it is rare that influence is all in one direction.

Breakdowns or problems interfering in the work, represented as a red lightning bolt (black in this book). Because all influences restrict work in some way, we only show breakdowns on the cultural model when they are especially harmful.

The following kinds of influence tend to be relevant to design:

Standards and policy that define and constrain how work is done or what can be used or bought, or the lack of such standards as a policy. So many companies define a standard PC configuration that they will support: "Use this configuration or you're on your own." Other companies live with standard procedures defined by themselves or imposed on them by the government or by customers: "Prove your process is compliant or we'll use another vendor."

Power, both formal in the organizational structure and informal through people's networks, expertise, and history. Power shows up in who has the right to decide who will do what in their work and the extent of autonomy a person can have. So one boss sets up his secretary's computer environment, limiting her ability to recover when anything breaks down: "I'll fix your machine in the way I think is important." In another organization, reimbursement for expenses is controlled by administration, which enforces the requirements for filling out paperwork and can choose to allow exceptions: "Jump through my hoops and I'll let you have your money."

The **values** of a company or team: what they stand for that produces a set of expectations about how people will interact and work. So one organization has the expectation that a project will be completed the same way as it was the last time, resulting in a feeling that innovation is unwelcome: "If it's a different plan, be prepared to justify it."

A group's own sense of **identity**, the way in which what they do is affected by how they think of themselves. So one UNIX shop held that they did not need to do formal up-front analysis and design because "we don't do process."

People's **emotions** about what they do, including fear about being laid off or getting in trouble for raising issues, or people's pride in what they do. So knowing that "email can be read by anyone, including management" led people in one organization to discontinue its use.

The idiosyncratic **style, values, and preferences** of an individual or team, creating a work environment that circumscribes others. So one boss will not use the computer, forcing his secretary to handle all his email communication: "Use the computer for me because I won't." Or a team can't work past 4:30 because everyone has outside activities that pull them away: "We are committed to home activities; schedule around them." □

RECOGNIZING THE INFLUENCE OF CULTURE

Culture is invisible, but can be deduced from things you see and hear.

TONE. When you walk in the door, what is the tone of the place? Industrial and sterile? Carefully designed and trendy? Formal and elegant? Messy and haphazard? When the customers design their workplace for elegance, they are unlikely to accept a system that looks haphazard. When they spend little time designing their workplace, just the bare minimum so that they can work, they are unlikely to accept a system that is overdesigned, which looks like time and money was wasted on elegance.

*A valuable system helps
people be who they
want to be*

POLICIES. What are the policies people follow, and how are they recorded? Are there policy manuals, and are they used? Do people wanting guidance on doing their work routinely check them? Or is the operational policy—the policy that affects work on a day-to-day basis—really passed by word of mouth? If so, how much is based on real directives, and how much is folklore? Is policy generated by fear of a regulatory agency, of another organization, or of a manager? You can hear policy in the words people use: “We won’t buy anything but UL-rated power supplies. They had a non-UL supply catch fire over in building 10 a while back.” If UL rating matters, you can highlight UL-rated equipment in the catalog you develop. “Better get these procedures documented properly. One of our competitors was cited for out-of-date documentation, and their stock dropped three points.” If written records are an important part of the work, you can implement systems that maintain them. The policies that people care about point to problems you can solve.

*A valuable system makes
conforming to policy easy*

ORGANIZATIONAL INFLUENCE. Are there organizations, individuals, or job functions that keep showing up, either as troublesome or helpful? What are the organizations or job functions that always seem to get in the way? Who are the people who constantly show up as the ones who can solve the problem? Listen to how people talk about others: “Don’t call maintenance about this. They’ll take it

away to check it out and you won't see it again for a week." Can you change the design of your system so that maintenance doesn't have to take the machine away to run diagnostics? "Oh, I can't give this report to Mike looking like this. He runs this whole place—I'll put it in my word processor and make it look really good." If the reports that your product creates are given to management, you can make them high-quality presentations.

A valuable system reduces friction and irritation in the workplace

MAKING CULTURE TANGIBLE

The cultural model (Figures 6.5 and 6.6) provides a tangible representation for these intangible forces. In a cultural model we represent

influencers (people, organizations, and groups) in the customer's culture, showing how they influence each other. Influencers are shown as large bubbles. Because culture is felt as a weight or pressure influencing actions, the bubbles sit on one another, showing how one organization forces another to

The cultural model speaks the words people think but don't say

take or not take actions. We represent *influences* as arrows piercing the bubbles and label the arrows to represent the type of influence. Influences are labeled with language representing the experience of the people doing the work, so the influence from an internal help organization might read, "We are unreliable and will wipe your hard drive on a whim." No one in that help organization would ever actually *say* those words, of course, but the people who use their services operate as though they were saying exactly that. Using direct language on the model makes the culture it represents stand out. Where an influence stands out as being particularly harmful and counterproductive, we mark it with a lightning bolt, our universal symbol for problems or breakdowns.

Cultural models do not map to organization charts. They show how power is experienced by people, rather than the formal power of the organization. So it's unusual to see the whole management chain represented on a cultural model. Individual managers will appear when they are part of the work, as when a manager makes his secretary interact with the computer for him. There's often a bubble to represent the organization's culture, with

An organization's culture is not reflected in its organization chart

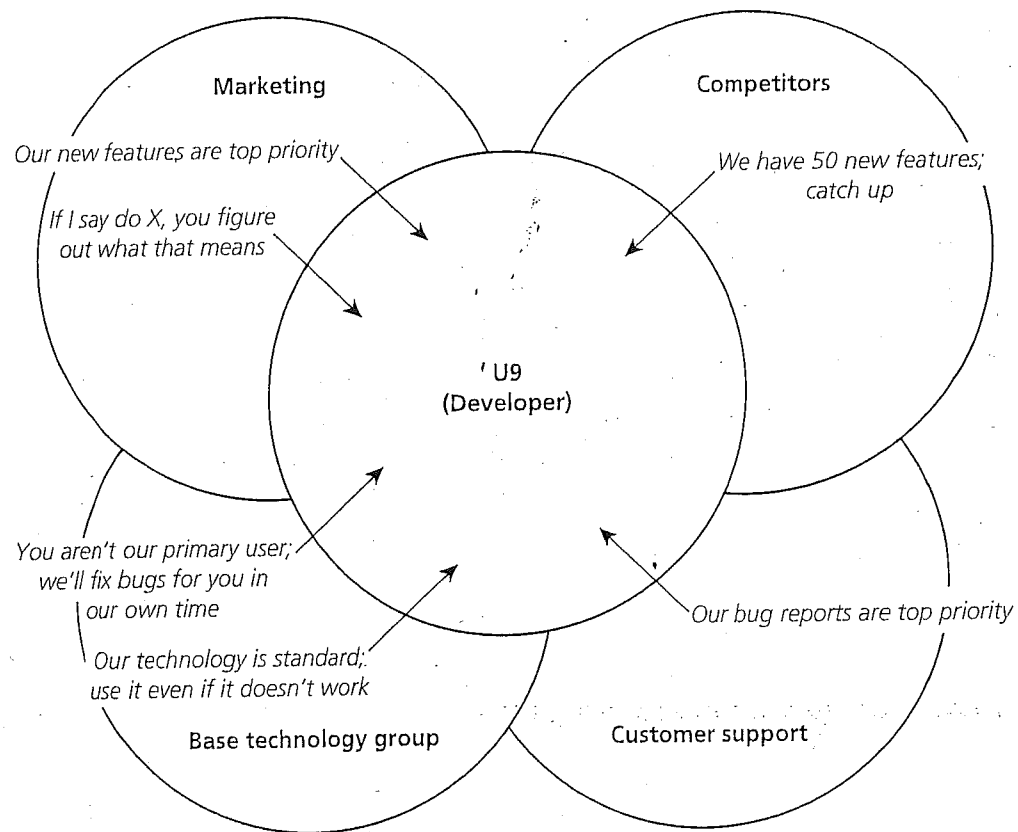


FIGURE 6.5 The culture of a product development organization. This is a typical cultural model in a product development organization. In the center we see the interviewee, U9. Since cultural models are initially built as the result of an interview with one person, they represent the point of view of that one person. U9 is in the development organization, and the model shows two major constraints on them. The marketing organization constrains them through ill-specified product requirements. Competitors constrain them by creating a climate in which keeping up with the number of features is the primary goal. The basic appearance of this model—the interviewee surrounded by influencers—is very typical.

influences like “We are totally customer-focused” or “Spending money is not a problem.” In adversarial situations, “management” may appear to represent how “they” do things to “us”—“We think you salesmen are children who need to be watched every moment” might be an example. Individual managers appear as managers only when they are charismatic figures who define the organization’s culture. In this case,

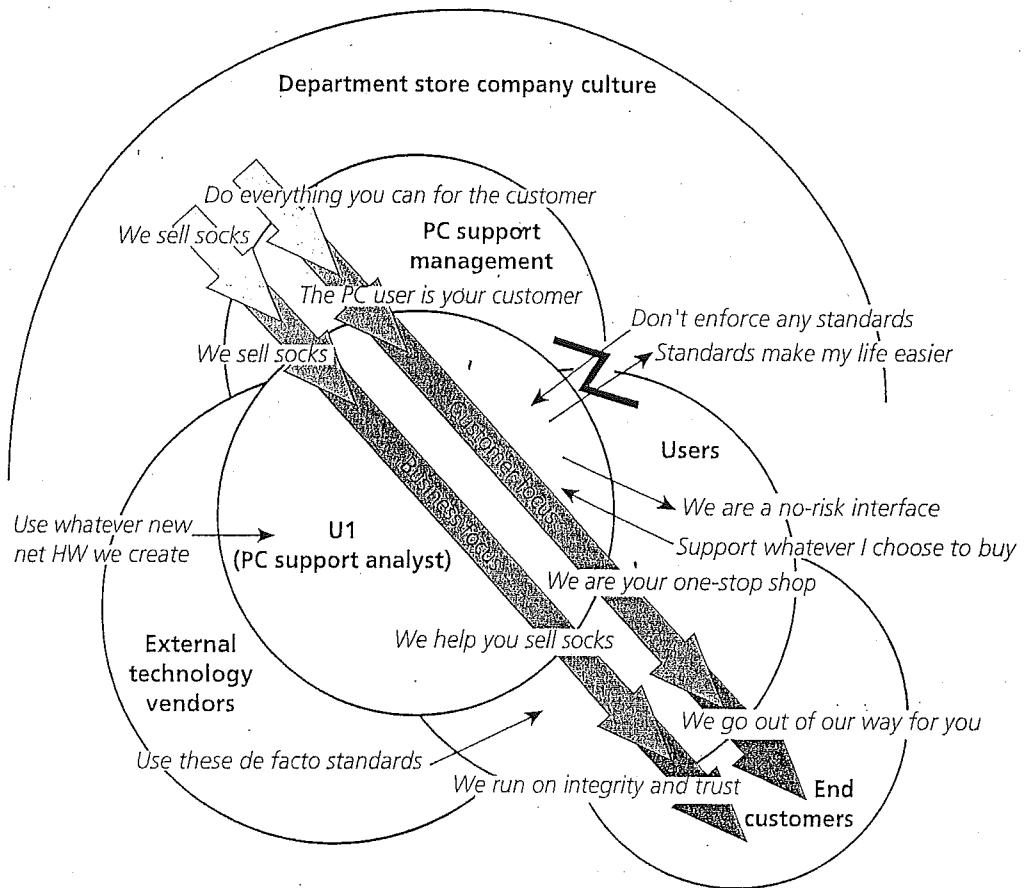


FIGURE 6.6 The culture of a customer-centered organization. This cultural model is typical when there is a definite corporate culture to account for. This cultural model represents a department store that has made customer satisfaction its first priority. Unlike many places that espouse that goal, this company has really done it—so much so that people throughout the organization are conditioned to think who their customer is and how to give them the best service. Paired with this focus on the customer is an equally pervasive understanding of the business—so much so that “We sell socks” is a watchword within the company. We show the pervasive company culture as an umbrella over everything, with individual influences going back and forth between the bubbles. The lightning bolt indicates a place where two values conflict: being customer-centered leads the store to avoid setting standards for computer configurations, but such standards would make the PC support analyst’s life easier.

their power is experienced as direct and personal. McDonald's franchise owners used to tell about how Ray Kroc, then CEO of McDonald's and a fanatic about cleanliness, canceled a franchise because he found one fly in its kitchen (Boas and Chain 1977). Everyone lived in fear that he would show up in their kitchen next. Ray Kroc would appear on a cultural model.

THE PHYSICAL MODEL

Work happens in a physical environment that either supports and enables the work or gets in the way:

One company creates a page design product in which the look on-screen doesn't quite match that of paper. They think it is close enough because they expect their users will print draft versions and use the paper output for the final draft. They don't know that most of their users don't have printers by their desks, or even close by. So users spend time running back and forth to the printer and copying good drawing elements from one document to the next.

Another company gives their sales force portable computers to do presentations. They don't know that salespeople are only given a few minutes at a site. The salespeople don't have time to bring up a computer, and they depend on leaving materials behind with their customers. The portable computer doesn't fit either need.

A utility company gives their electricians documentation in a three-ring binder. Only later do they discover the electricians are trying to balance this awkward binder on a cherry picker in all types of weather. They redesign the documentation as a small, spiral-bound flip book with laminated pages and a clip so it can be hung from a belt.

Any product or system must live with the constraints of the physical environment as it exists. If it ignores those constraints, it creates problems for its users. In each of the above examples, a system created problems for its users because it assumed things about the workplace that were not true. Studying the users' workplace ensures that the system accounts for the physical environment.

The physical model reveals design constraints

*Model both site and
workplace*

The physical environment constrains what people can do, but within those constraints people do have some control over their environment. Studying the workplace offers important clues to the way people structure and think about work. People restructure their workplace to support doing work in the way they prefer, to the extent they can. Because they structure their environment to be convenient, the structures they create mirror their thought. The structures show what people group together into conceptual units and coherent tasks. An office worker sets up places in her office to keep her work organized. The chair receives urgent messages from coworkers; the space next to the computer is kept clear so that when she starts a task, she has a place to lay it out; the in-box is the "guilt pile"—things she feels that she ought to deal with, when she has time. The places she creates mirror the way she thinks about her work: urgent, current, guilt pile. They make work distinctions concrete. A system that makes these distinctions real will fit with the work easily. The workplace shows us issues in doing work; from the elaborate system of piles that people create, we can deduce that tracking multiple little tasks is a problem, and people might benefit from better ways to track them.

*People reorganize their
environment to reflect the
work they do*

The physical environment is the world people live in: the rooms, cars, buildings, and highways they move about and work in; how each of these spaces is laid out so that it supports work; and how they use these spaces in the process of working. It includes how they move about, how the space supports or hinders communication, and the location of the tools people use (hardware, software, networks, machines) to do work. The physical environment affects how work is done at every scale: the multiple sites and their relationships to each other, the structure of a single site, and an individual's workplace. The work site may be structured as an open "bull pen" with supervisors' offices around the outside. It may consist of many individual cubicles dividing up a large room. A person's workplace may be an entire building or buildings, if they are maintaining equipment. It may be a car or airplane if they work on the road. Within a work site there are places to do work, which may be offices, labs, workbenches, or workstations. Workstations may be dedicated to one person or shared.

PHYSICAL MODEL DISTINCTIONS

The *places* in which work occurs: rooms, workstations, offices, and coffee stations. The model shows whether the space is small or large, a primary or secondary workplace, private or open, cluttered, or empty space available for changing work activities.

The physical *structures* that limit and define the space: sites, walls, basements, desks, file cabinets, and other large objects.

The *usage and movement* within the space—how people move about in it and move things about in it in the course of accomplishing their work.

The *hardware, software, communication lines*, and other *tools* (calculator, Rolodex, in-basket, measuring tools, Post-its, printer, fax) that are present in the space and support the work or seem related. We show network connections, not to model the network itself, but to emphasize who is connected to whom and therefore what communication among people we can automate.

The *artifacts* that people create, modify, and pass around in support of the work—folders, spreadsheets, to-do lists, bills, ID cards, approvals, piles of stuff. The physical model shows the artifact and its location, not the detailed structure and usage of the artifact.

The *layout* of the tools, artifacts, movable furniture, and walls in relationship to each other to support specific work strategies.

Breakdowns or problems showing how the physical environment interferes in the work, represented as a red lightning bolt (black in this book). □

SEEING THE IMPACT OF THE PHYSICAL ENVIRONMENT

The physical environment is easy to see—it's all right there. It's harder to tell what matters. What will affect the design problem, and what will not? Here are some things to look for.

ORGANIZATION OF SPACE. Are there stations, and how do they relate to the work? Are stations grouped to follow the flow of work to make work efficient, or are similar stations placed together to make management efficient? Are the people who made the decision conscious of the trade-off? This will indicate what they care most about and therefore what the most important problems for you to solve are.

*Planned space
reflects organizational
assumptions*

DIVISION OF SPACE. Where are the walls, and how do they break up the work? Do they follow the structure of the work, or do

they interfere with it? If they interfere, how do people overcome them? Do they run back and forth a lot? Do they shout? (During one interview, the user directed a question at the wall, and the wall answered. It was so thin he could carry on a conversation with his colleague on the other side.) Every communication breakdown creates an opportunity for you to ameliorate it: Who needs to communicate? How and when? Can you obviate the need by providing information where it's required, or can you make it easier?

Look at how people ignore walls or create walls that aren't there

GROUPING OF PEOPLE. How are people grouped into the spaces? By function or by project? Does each person have their own separate office area, or do they mix and share spaces? Often specialists sit with other specialists, not with the project they are assigned to. Creating a sense of belonging to the project team becomes difficult. Conversely, developers who are seated with their internal clients tend to identify with them. They

Find barriers to community and communication

tend to adopt their perspective against that of the development organization. What can you do to make the whole interrelated set of information systems apparent to all developers, so they are continually reminded of the effect their short-term fixes will have on the whole?

ORGANIZATION OF WORKPLACES. How are the individual stations, offices, or work areas organized? How do they support the work? What is kept out (immediately visible), ready to hand (accessible without moving), and available (in a drawer or across the office)? What does this say about what's most important to the work? Things kept together tend to be used together. What does this say about the structure of a task? Can you see what makes

Placement of objects and piles makes the work efficient

up a whole task in what is kept together for easy access? Can you design your system so that the most important function is available where needed and so that whole tasks are coherent in the system?

MOVEMENT. When do people move? Why do they leave one place and go to another? What triggers them to do so? Is this intrinsic to the work, as when a maintenance person goes to look at a machine? Does it

provide an opportunity for informal discussion and problem solving? Do the customers see it as a problem, or are they like system support people, who generally enjoy getting out of their offices? Understanding why the movement happens will help you decide whether it makes more sense to support it better or eliminate it.

Movement reveals human preference and work needs

SHOWING WHAT MATTERS IN THE PHYSICAL ENVIRONMENT

A physical model (Figures 6.7 and 6.8) is a drawing of those aspects of the workplace that are related to the project focus. The physical model shows how the physical environment affects the work. It is annotated to show how the space is used and to show strategies, intents, and cultural values that are revealed by the way space is used. A good physical model evokes the experience of the workplace in the same way as a caricature. Aspects of the environment are only represented if they matter to the work; for example, "basement" might mean "far away, uncomfortable, and inconvenient to get to." If the worker must nonetheless go there or worry about what happens there, we represent it in the model. Wherever the physical environment interferes with the customer's work—things are too far away, or too cramped, or the right tools aren't where they are needed—we show it with a lightning bolt.

The physical model is a caricature of the workplace, not a floor plan

The physical model shows how people respond to the environment by restructuring it. Do people accept the workplace as it is, or do they work around it? If the environment consists of doorless cubicles, do they put things in front of the door to gain a measure of privacy? How else does the work as it is experienced mismatch work as the environment wants it to be? What do people do about it?

A physical model is not a floor plan for the work site. Nor is it an inventory of the computer room. Either a floor plan or an inventory can be collected easily, without resorting to contextual techniques. A physical model does not show extraneous detail unrelated to the project focus—potted plants, kids' toys, and family pictures are usually not relevant and can be omitted when you're designing a system. If you were designing the work environment itself, you might have to take them into account.

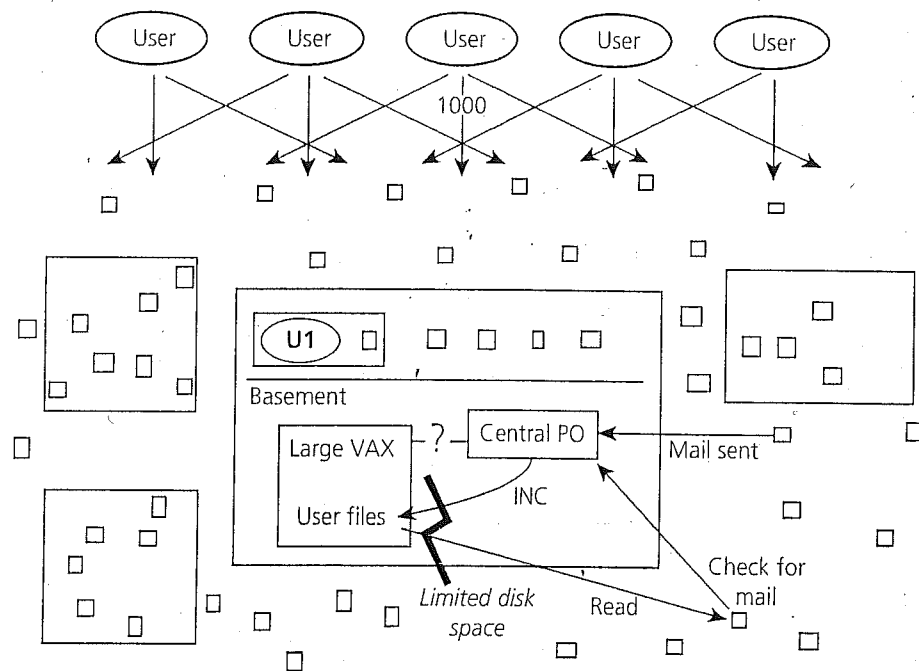


FIGURE 6.7 Physical model for a university environment. This university has set up its workstations so that anybody can use any workstation. The small boxes represent the workstations—over 1000 distributed all around the campus. To indicate their independent nature, we show them as standing alone and show the users separated from them, to indicate any user can access any workstation. “U1” means “user 1” and indicates the office of the user we talked to in a central building, with the central VAX machines in its basement. All user files are stored on the VAX. The “central PO” is a piece of software that routes mail between users. We have shown the routing of one message because we were designing a communications product. This work model shows the value of choosing a representation that is expressive of the data—in this case, that there are many workstations spread out over the campus according to no particular plan.

THE FIVE FACES OF WORK

Each of the above work models presents a different perspective on the work. These perspectives interlock: a person plays roles; a role has responsibilities, undertakes tasks, and exchanges artifacts with other people to discharge these responsibilities. The sequence models show how these tasks are accomplished in detail and how artifacts are used in accomplishing them. The responsibilities and manner of accomplishing

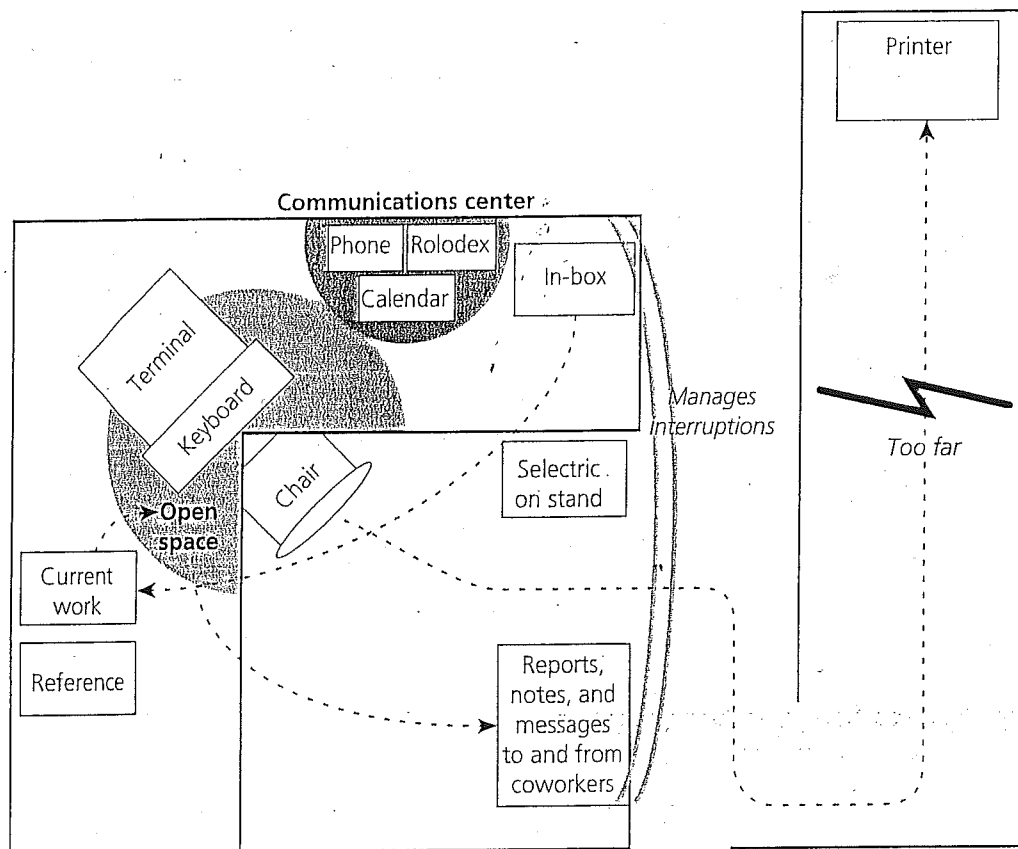


FIGURE 6.8 Physical model for an office. This physical model shows the workplace of one user. The model represents a cubicle and shows how she has structured her environment to help her get work done. The placement of her IBM Selectric in the doorway, the in-box next to the door, and the shelf used as a drop-off place all suggest a strategy to minimize interruptions caused by working in an open cubicle. The phone, Rolodex, and calendar are all grouped together, suggesting that these tools work together to support communicating and coordinating with others. And the open space around her workstation suggests an intent to keep this area clear so she can lay out her next task. The team has annotated the model to reveal these distinctions and to show breakdowns, such as the printer being too far.

them are driven by organizational context and culture as shown on the cultural model. The work represented by the sequences is done within the work environment described by the physical model. Stepping back and looking at the models together reveals all the different

aspects of work and how they relate to each other. It reveals how the whole work of one person hangs together.

Seeing how customers work drives design. A design team needs to know what they should make—what work might be supported, what

Work models show designers what to account for

the big problems are, what the customers care about. They need to know what they must account for in their design: the roles and how they interact, physical and cultural influences and constraints. They need to know how to structure their design: the strategies people use to get their work done, the

way they break up and think about their work conceptually. By organizing and presenting customer work clearly, work models make it possible to answer these design questions. They provide an integrated view of the customer's work practice and also show the details of work structure that guide the fine points of design.

The individual work models as described above represent the work of each customer that a team interviewed independently. In Part 3,

What you see in the work determines what you will think to build

we'll see how to consolidate models so that instead of showing each customer independently, they show the common structure and pattern of work across all the customers a system needs to support: a whole market, a department, or multiple departments. With consolidated models the design team has a single

statement of the work they need to address, rather than trying to support each individual separately. We do this by first observing, inquiring into, and representing the work of specific individuals. Then we consolidate the models of each type. We bring all individual flow models together into one consolidated flow model to reveal the common roles and their interaction. We consolidate all the cultural models, all the physical models of whole sites, and all the physical models of individual workplaces. We consolidate all the sequences representing similar tasks and all the artifacts achieving the same intent.

These consolidated models make the underlying patterns of work across customers explicit. At the same time, they capture the variation between customers by showing any unique structure or details put into practice by each customer site. The design team can then decide what aspects of work they want to support. They can take a good idea for approaching the work implemented by one customer site and build it into the system to make it available to all. They can streamline

the work, removing extra steps and taking advantage of technological possibilities. From this redesigned work practice, they can design a system that supports the new work practice and drives the design of the user interface and system implementation. The rest of this book discusses these steps.

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