

Time Affordances

The Time Factor in Diagnostic Usability Heuristics

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“The lights are on, but is anybody home?”

Elevator Example: You enter a building at first floor.

- **You step up and push the “up” button**
 - Does some indicator light up in response?
 - If not, do you push the button again and again?
 - Are you in a rush?
- **You look up. You’re looking for a floor indicator**
 - If one is there, you are relieved. You can assess the situation.
 - How many floors is it away? How long will it take?
- **You keep watching.**
 - Is there a direction indicator?
 - If not, does the number (or pointer) go up or down?
 - If up, how many floors are there in this building?
 - Is there another elevator?
- **You listen.**
 - Do you hear a bell? a rush of air?
- **Is there a point where nothing is happening?**
 - Do you look for the stairs?
- **A bell rings at your floor.**
 - Do you expect the doors to open very soon? What if they don’t?

This is an example of a time delay.

Goal: to operationalize conceptual ideas of a time delay into explicit components that can be tested and confirmed.

The Problem

- **People vary in the way that they tolerate delays. Their actions and reactions:**
 - depend on the urgency or consequences of a mistake
 - depend on what they expect normally to happen
 - depend on familiarity with similar delays in the past
 - may differ significantly among individuals
 - may be captured in programs causing machines to react to delays in much the way that humans would

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Consequences. Failures in:

- Medical tests, nuclear power plant controls, remote control material cutting and fastening.
- Anything where *you can't see what's going on* and the *consequence are serious*

Expectations and Familiarity

- Setting expectations is a key factor. “This is going to take a while” (But what’s “a while”?)
- Experience: normal human reaction is to *expect the same thing* each time. Major variations without warning are troubling.

Individual differences

- People disagree about what seems too long or too short.

And it's not just humans! *Machines are programmed with “expectations”!*

Kinds of Delays



- **Task Delay:**

The period between the initiation of a task and the notification of completion or termination of that task.

- **Static Delay (“Is anybody home?”)**

A waiting period after the initiation of a task during which nothing appears to be happening.

- **Dynamic Delay (“There is life!”)**

A waiting period after the initiation of a task during which there is evidence of progress.

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Task delay:

- It has started and it is not done yet.
Do I need to do anything?

Static Delay

- How do I know that something is happening. As the expected time nears, I get more impatient.

Dynamic Delay

- I hear a whirring sound. Something is happening. Is it working correctly? Because there are noises, I assume something is happening, and I may wait a bit longer.

Now let's talk about Affordances.

Definition of Time Affordance

A “Time Affordance” captures the important properties of a time delay, and tells the controller (user or computer) what to expect and how to proceed.

It is a “gestalt” indication of whether “everything is okay” or “something is wrong.”

The challenge is to provide just enough information so that the controller’s actions during a delay properly address the true state of the task.

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Don Norman’s Psychology of Everyday Things (POET) talked about the concept of an affordance.

One example is a Dodge Caravan that has a horizontal handle on the front door and a vertical handle on the sliding door. It is easy to tell just by looking whether to pull toward you or to the side. (Unfortunately, they changed this in 1966 models.)

We extend the concept to time. What can you tell about a delay just by looking (or listening or feeling)?

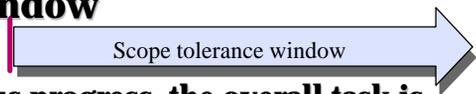
Do you know enough to proceed or are you puzzled about the cause of the delay wishing for more information.

You are a controller and you are **diagnosing** the situation during the delay. You need just enough information to understand what’s happening (but not so much that you are overloaded).

Let’s formalize the time delays a bit...

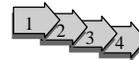
Two Kinds of Tolerance Thresholds

• Scope Tolerance Window



- Even if there is obvious progress, the overall task is taking too long
- Beyond this window, the user/computer will terminate the task

• Progress Tolerance Window



- Indications that “something” useful is happening
- Animated delay mechanisms may or may not help



We introduce two kinds of delay windows.

Scope (or duration) tolerance:

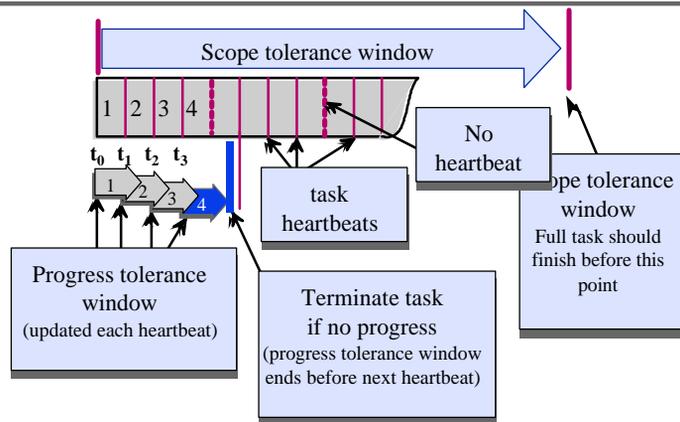
- Even if I know it takes a while, what's my patience level based on expectations?
- Example: I am doing a so-called brief optimization of my disk. How long should it take. (It is 4PM. When can I leave work?)

Progress tolerance

- This is the whirring sound, or the movement of the “thermometer” (the horizontal bar that has become more or less standard).
- Something is happening.
- What about animated delays (hourglass, watch, web browser animations)?

Works for a while, but only if there are frequent more substantial indicators of progress.

Anatomy of a Time Affordance



- **Termination likely if either window exceeded:**
 - **Progress Tolerance Window (step-by-step limits)**
 - **Scope Tolerance Window (overall task limits)**

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This is a graphical indication of those concepts.

- We introduce the concept of “**heartbeat**” as the most frequent “something worthwhile is happening” indication necessary to placate the user.

Without it, the user concludes that something has broken and intervention is needed. *The users actions could be dysfunctional.*

- Animation only works as a heartbeat if it **always** can be trusted to mean the task is alive.

If animation is ever used just to placate (when there is in fact no real progress) the user may never trust the animation again. (Animation will subsequently be interpreted as “the computer has not crashed” and nothing more.)

Consequences of Termination:



minor

- **Minor Inconvenience:**

- **Web Browser stops download of an HTML page**
- **Cancellation of copy, compilation, backup, etc.**

or image
waste
time

- **Major Inconvenience:**

- **Interrupted save or move destroys valid version of file** (systems without automatic versions)
- **Systems without transaction semantics lose data**
- **Physical materials or systems are destroyed**

major

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We will talk about web browsers in a few slides. Especially with Firewalls (that have a relay function) it can be difficult to tell why there is a delay.

Copy, compilation, and similar operations often do not set expectations first. They also do not tend to give progress indicators. Without knowledge of the scope of the task and with no way to indicate progress, users tend to do a lot of cancelling of working tasks.

It's possible to do it without a GUI. Zmodem on VMS provides an initial scope text saying 10 min. at 1200 baud, 5 min. at 2400 baud, 1:15 at 9600 baud, etc.

Damage: Terminating a task can have serious consequences. Examples (where transaction semantics not helpful):

- So-called singularities: a missile is launched, material is cut, chemicals are added, money is delivered.

No chance of transaction rollback

- Systems with a **critical need**: an x-ray is not downloaded to an operating room screen because the doctor is anxious and restarts...

Here are 8 components to check:

With A Time Affordance you can...

1. ...tell whether what you requested is valid

Acceptance

2. ...judge the size and potential time duration required to complete

...determine whether interruption before completion will have serious consequences

Scope

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Whether all 8 components need to be present depends on the task and the length of delay expected.

- Some Time Affordances will combine certain components into one step.
- Other Time Affordances will separate certain components into a separate dialog box.
- Whether the omissions, combinations, or separations are valid depends on whether a “time affordance” is effectively created (i.e., the user knows enough to diagnose without being overloaded.)

Accept:

I'm doing something reasonable

Example: Norton desktop gives no date/size in its warning that one file is about to replace another; file manager does.

Scope

This is how long it will take. (1.5 Meg GIF image)

You can interrupt it safely by doing this at this point...

Example: “Download all the information from the Library of Congress onto your PC or Macintosh?”

With A Time Affordance you can...

- 3. ... tell whether and how to start the task**
... determine when the task has actually started

Initiation

- 4. ... tell that the overall task is being carried out**
... estimate the approximate rate of completion

Progress

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Some tasks will give you an accept indication tell you scope and ask whether you really want to start.

Initiate

- ***Yes, go ahead and start it, and tell me when it has started.***
- If there is no delay: ***tell me when it has started***
- ***(Sometimes the flashing box on Mac or audible beep/click is sufficient.)***

Progress

- ***What have you done so far?***
- ***How rapidly are things happening?***
(significant things that have meaning)
- ***What is happening right now?***

Summary: Are the expected things happening?

With A Time Affordance you can...

- 5. ... quickly observe whether the task is still “alive” or has somehow stalled**

Heartbeat

- 6. ... tell whether errors have occurred
... determine whether and how you need to intervene**

Exception

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Heartbeat

- *Is it dead or alive. Do I need to DO something?***
- *Is there a familiar “purr” or “clicking” or rattling? The wind of an elevator moving.***
- *Animation without noise is usually a sign of trouble.***

Exception

- *If something can go wrong, I need to know about it. Will I be told?***
- *If I am told something is wrong, will I have a chance to do anything?***
- *Should I stop things now and try to figure out what to do or can I delay?***
- *Will I be told what to do and the consequences of alternative steps?***

With A Time Affordance you can...

- 7. ...tell how much is left before the task completes**

Remainder

- 8. ...tell how to terminate the task**

...see when the task does terminate

...determine whether the task was successful, or if there were errors, how to respond

Completion

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Remainder

- How much longer do I have to wait, anyway.***
- Things are progressing, but this could go on forever. When can I go home?***

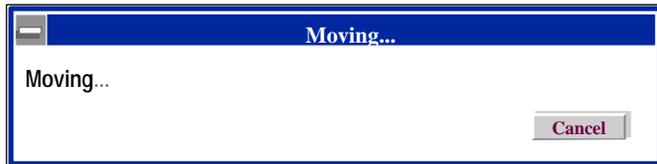
Note: you can have progress without remainder as in ClipArt example below

Completion

- I'll be told when everything has completed***
- I can tell how to stop everything even if there are consequences.***
- When everything is over, I'll know if there were problems and have a good idea what to do about them.***
- When I say "stop" or "cancel" things immediately cease or at least begin a noticeable termination process. If stopping requires a significant delay, a second Time Affordance is presented telling me all about the new delay that is necessary.***

An example from Windows NT (V3.51)

- **Moving files from one directory to another**



- **Time Affordance Components:**

May be earlier box < **Acceptance** **Heartbeat**
Scope **Exception**
Initiation **Remainder**
Progress **Completion?**

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Here is an example from the latest version of NT. It is similar to Windows 3.11.

This box is presumably a move that is the result of a drag and drop operation. An earlier dialog box may have indicated the accept and scope, but

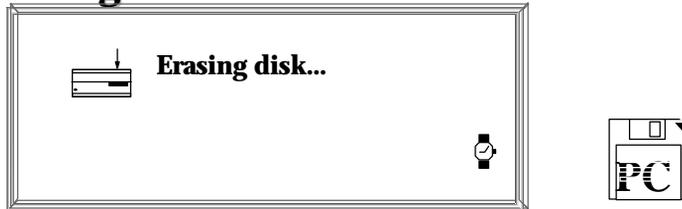
- pushing Enter is often automatic
- the earlier box disappears, so its message cannot be rechecked.

We put a question mark around completion, because it is only implicit (the box disappears). The “Cancel” portion of completion is present.

This box was perhaps sufficient on local systems with small files that are moved almost instantly. But with networks, and multiple moves, and large files, it is totally inadequate.

An example from Macintosh (V7.5)

- **Reformatting a PC disk for Macintosh use.**



Next steps: Verifying format... Creating directory...

- **Time Affordance Components:**

Acceptance
Scope
Initiation
Progress

Heartbeat
Exception
Remainder
Completion



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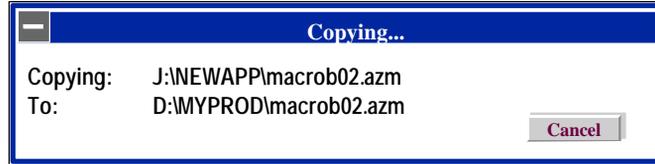
During preparation of the Macintosh version of these slides, I was surprised to run into this dialog box.

- Acceptance is arguably accomplished with the previous dialog box ('Complete erase disk named "untitled" (internal drive)?'). But there is no title for this box indicating the overall operation is an erase and reformat.
- There is also no hint that "Verifying format..." and "Creating directory..." are about to happen. There is no cancellation capability either. Arguably, the watch is a heartbeat, but it is not any more convincing than the animated hourglass in NT.

The worst part is that a PC disk when reformatted as "Macintosh" retains the "PC" icon label until it is ejected and inserted again! Thus, there is no clear-cut indication of the completion component of the Time Affordance.

Another example from Windows NT

- **Copying files from one directory to another**



- **Time Affordance Components:**

Acceptance

Scope

Initiation

Progress

Heartbeat

Exception

Remainder

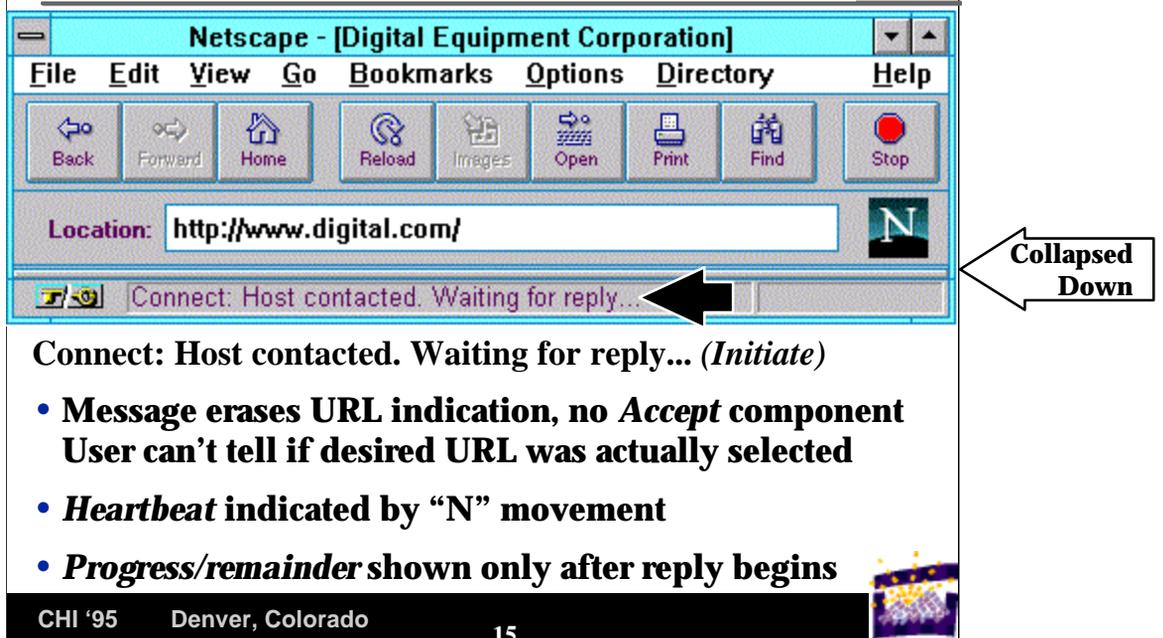
Completion?



Copy is a little bit of an improvement because it adds the Acceptance component. You can see what file you said “yes” to and can cancel if things look wrong (for single files).

A recent version of Norton desktop adds a thermometer progress/heartbeat indicator. However, for small files copied over the network, it immediately goes to 50% before even checking whether the target disk is still available!

Netscape's Most Common Message



Connect: Host contacted. Waiting for reply... (Initiate)

- **Message erases URL indication, no *Accept* component**
User can't tell if desired URL was actually selected
- **Heartbeat indicated by "N" movement**
- **Progress/remainder shown only after reply begins**

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Netscape is one of the most successful browsers for the World Wide Web. The good news:

- The creative changing N is generally interpreted as a heartbeat (it's alive)
- Some gif and ftp actions are indicated as a frequently updated ***mmmm of nnnnn*** telling progress
- A large red stop button is always present (but failed to work for interlaced graphics in a recent version).
- A thermometer roughly indicates remainder.

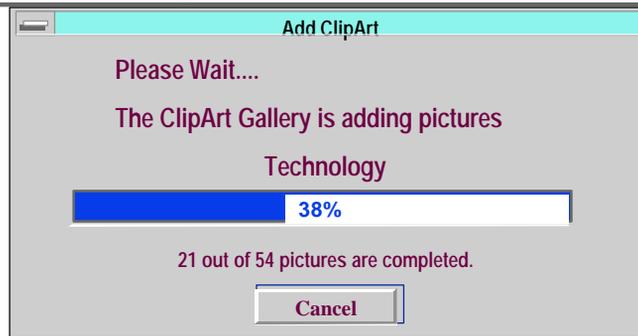
The bad news: Netscape has a number of Time Affordance problems. A few:

- Accept component disappears almost immediately.
- HTML page designer needs to indicate scope. Browser could do it.
- The number of separate component downloads is known but never indicated as a scope/remainder. E.g.,
Processing component 4 of 15
Received 12345 of 54321 bytes

If hierarchy, could visually show hierarchy "walk" or indicate that n of m components are completed (the rest might expand).

- Completion is not properly indicated by the thermometer if complex graphic (e.g., jpeg) still needs to be rendered by the client. There is no way to tell that HTML text is done but still awaiting images.

Another example from the PC



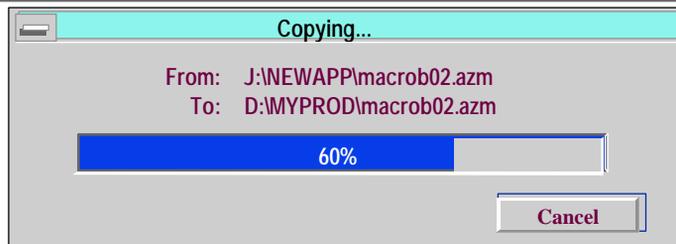
- **Looks good at first glance:**
accept, initiate, progress, heartbeat well done
- **Missing *remainder* component (how many after “Technology”?) or clear indication of *scope***



This is the Time Affordance that was present while I tried to make these slides.

- The major failing here is the lack of scope and remainder.
- It would be very simple to say:
 - processing: Technology group
 - Group: 11 of 15.
- It would be even better to indicate scope with an estimated byte count and indicate remainder as well by percentage done.

Typical Dialog Box on PCs



- **Typical dialog box contains *accept, initiate, progress*. *Remainder* is indicated if single file is being copied.**
- **Frequent change of filenames might be interpreted as *heartbeat*. Box disappears indicating *completion*.**
- **Acceptable for local copies of a few selected files. Network copies of directories could cause problems.**



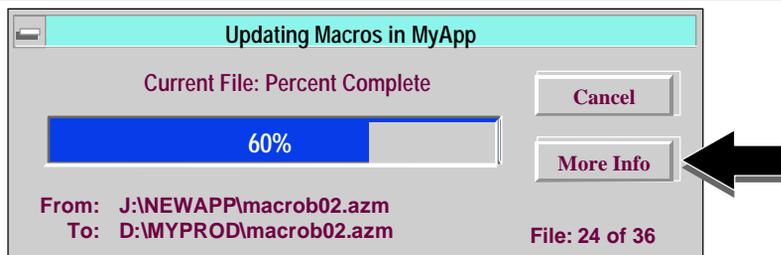
A dialog box like this is a major improvement over the NT and Windows version. The Macintosh and Norton are examples of a box like this one.

Problems:

- Does the thermometer mean the whole task or the current file?
- For copies of a large number of files over a network this is not a good enough Time Affordance.

The Macintosh says “n remaining” (remainder) so that the thermometer is interpreted as a per-file progress indicator.

A “Bare Bones” Time Affordance



- A good Time Affordance need not be a “cockpit”
- This dialog box is similar to previous slide except:
 - Much better indication of *scope* and *remainder*
 - The “More Info” button is the key that can unlock the entire Time Affordance

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Stress: the examples on this and subsequent slides should be considered input to a formal human factors test. Alternate formats for Time Affordance dialog boxes should be evaluated using the 8 components and then tested for effectiveness.

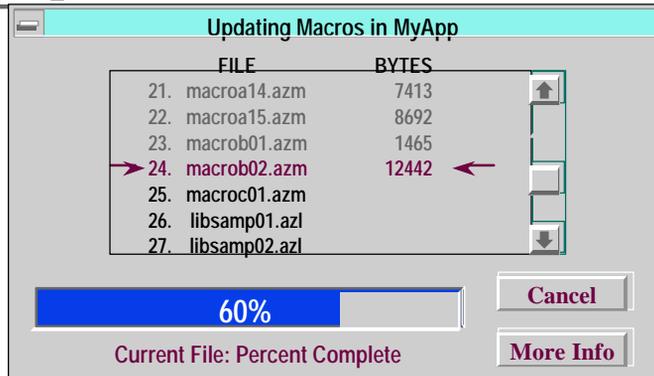
With very little additional information, the previous slide can be made quite effective as a Time Affordance.

- Label what the thermometer means
- Tell where you are in quanta that the user can understand (e.g., files, as shown in the right corner)
- Tell how to get more information

This box is an answer to how to make a Time Affordance simple.

We would expect a separate dialog box to clearly indicate what was being accepted before this box might appear.

Next Expanded View of Time Affordance



- Provides *accept, initiate, progress*. The scroll bar provides means for viewing *scope* and *remainder*.
- *Completion* could be indicated by color change of last entry. *Exception* requires separate box.

This box provides a lot more information than the previous one with remarkably little additional real estate.

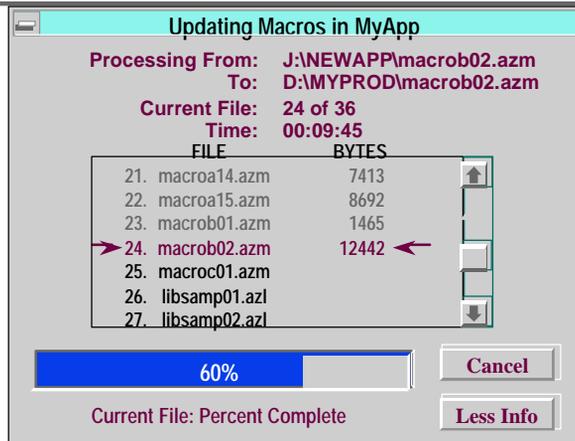
This box is a bit of a tradeoff. You lose the directory from/to information for simplicity, but gain all the other information.

You could introduce the convention that the top of the list shows from/to and all you need to do is scroll up to see it.

(If the number of files is huge, the scroll region might indicate the first few and then window on the current set. That way the user can tell that the process started out okay and determine what is currently happening and about to happen.)

The next slide shows all of the information so far.

Still More Time Affordance Information



- **“Cockpit” view provides a better indication of scope, remainder and completion. Exceptions are displayed in a separate dialog box.**

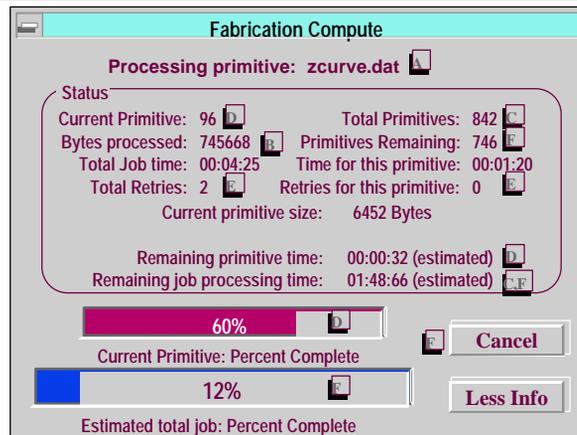
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Here is the full Time Affordance. You can use this during periods where you need to examine the full set of information (for diagnosis).

The “Less Info” button allows you to shrink back to the “bare bones” dialog box if desired.

“Cockpit” Style for Diagnostics



A: Accept, Initiate **D: Progress**
B: Heartbeat **E: Exception**
C: Scope **F: Remainder, Completion**

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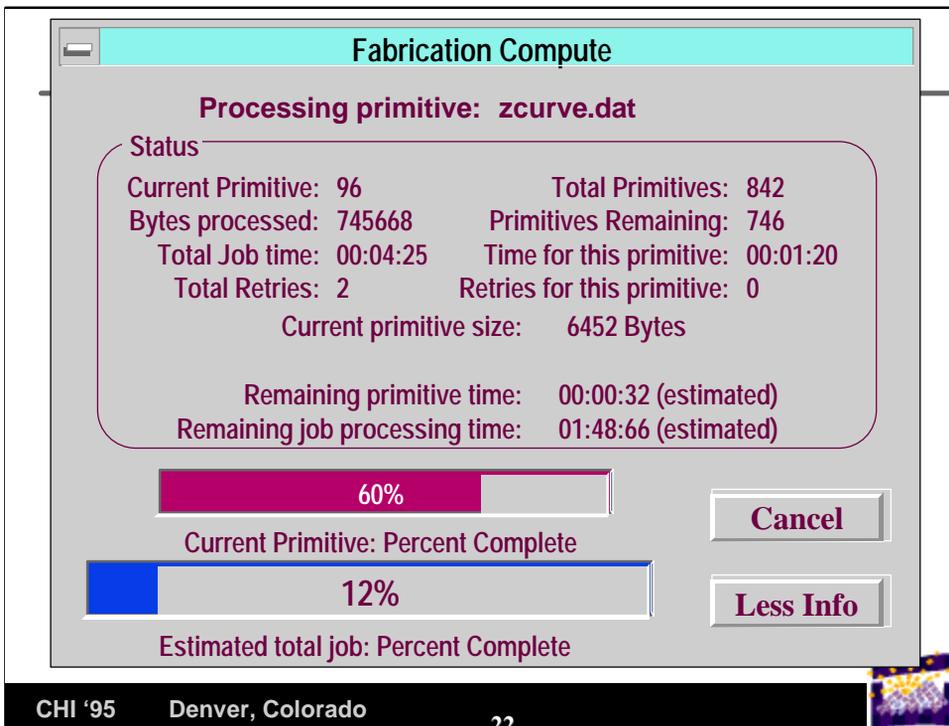


This dialog box should appeal to everyone who likes cockpit displays.

The key things that are displayed here are:

- separate thermometers for progress (red) and remainder (blue)
- A clear indication of errors that have occurred.
- Ample heartbeat indicators via time increments.
- Estimates of remainders in units of time.

Of course, other groupings or graphics might be used more effectively. Tests would of course be carried out.



This display is not presented as an ideal format. It is too cluttered and could probably be simplified. Certainly one or more “less information” formats are needed.

However, when this much information is available and could be presented, not doing so can seriously impair diagnostic efforts.

Some Final Comments

- **Time Affordances are based on experience. Misleading information is soon ignored.**
- **Plan for differences based both on user preference and situation. Information that is distracting in normal mode may be essential when carrying out diagnostics.**
- **Employ the principle of least surprise. Example: Thermometers are expected to be relatively linear.**
- **Consider audible heartbeat indicators.**
- **With multitasking, clearly indicate which Time Affordance is associated with which task.**

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Trust: A Time Affordance is meant to avoid user reactions that are unproductive or damaging. It only works if their experience is to trust what it says.

Provide tailoring or a “More Info” button. Each person and each situation may require different levels of information.

Surprises: Thermometers that, for example, jump part way and then the dialog box disappears (presumably because the task is done) cause surprise and concern.

Heartbeats need not be visible in the dialog box. **Audible** clicks, beeps, etc. could be of value. The new Glidepoint touchpads suffer from the lack of an audible feedback mechanism. When paired with a time delay, it can be hard to tell when initiation took place.

Multitasking: NT, Windows 95, OS/2 Warp, UNIX, VMS... Don't assume that your application is the only one. Pair the Time Affordance clearly with the application!

Time Affordances

The Time Factor in Diagnostic Usability Heuristics

Questions?

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Goal: to operationalize conceptual ideas of a time delay into explicit components that can be tested and confirmed.