People, Activities, Contexts and Technologies
- a framework for designing interactive systems

Aims

An essential part of our approach to designing interactive systems is that it should put people first; it should be human-centred. We use the acronym **PACT** (People, Activities, Contexts, Technologies) as a useful framework for thinking about a design situation. Designers also need to know about the features of interactive technologies and how to approach designing interactive systems.

1 Introduction

People use technologies to undertake activities in contexts. For example, teenagers use cell (mobile) phones to send text messages to their friends whilst sitting on a bus. Secretaries use Microsoft Word to write documents in a firm of solicitors. Air traffic controllers work together to ensure the smooth operation of an airport. A septuagenarian woman uses an intruder alarm system to set alarms in her house. People use internet-based dating services to make contact with other people when sitting in an internet café.

In all these settings we see people using technologies to undertake activities in contexts and it is the variety of each of these elements that makes designing interactive systems a difficult but interesting challenge. Technologies are there to support a wide range of people undertaking various activities in different contexts. If the technology is changed then the nature of the activities will also change. This issue is summed up in the following figure:

This figure shows how activities (and the contexts within which they take place) establish requirements for technologies which in turn offer possibilities that change the nature of activities. And so the cycle continues as the changed activity results in new requirements for technologies and so on. Designers need to keep this cycle in mind as they attempt to understand and design for some domain.(The word ‘domain’ here means an area of study, a ‘sphere of activity’).

For example as personal computers have become more common so the domain of e-mail has changed. Originally e-mail was all in text only, but now it is in full colour with pictures and video embedded. Other items can be attached to e-mails easily. This has led to a need for better facilities managing it for organising pictures, and documents and addresses. Software now keeps track of threads of e-mails and links between e-mails.

To design interactive technologies we need to understand the variety inherent in all these four elements. We also need to understand what is involved in interactive systems design and how to undertake design.

2 People

People differ from one another in a variety of ways.

Physical differences:

People differ in physical characteristics such as height and weight. People have different personalities and different cognitive skills and preferences. Variability in the five senses - sight, hearing, touch, smell and taste - has a huge effect on how accessible, how usable and how enjoyable using a technology will be for people in different contexts. For example, colour blindness (usually the inability to correctly distinguish between red and green colours) affects about 8 percent of western males, short-sightedness and long-sightedness affect many, and many people are hearing impaired. In Europe there are 2.8 million wheelchair users so designers must consider where technologies are placed and many people have dexterity impairments involving the use their fingers. All of us have relatively large fingers compared to the small size we can make buttons.

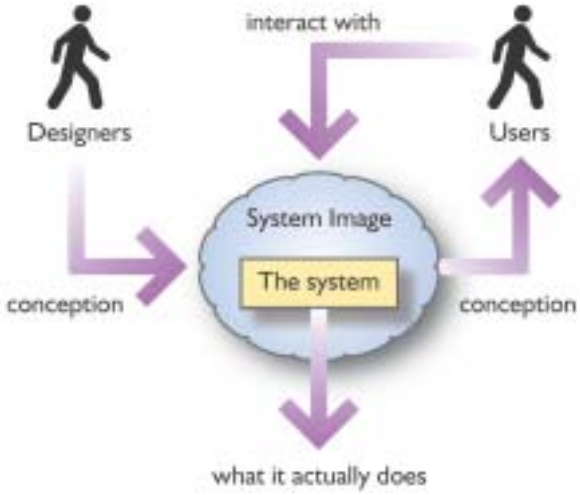
Psychological differences:

Psychologically, people differ in a variety of ways. For example, people with good spatial ability will find it much easier to find their way around and remember a web site than those with a poor ability. Designers should design for people with a poor ability by providing good signage and clear directions. Language differences are of course crucial to understanding and cultural differences affect how people interpret things. For example, in Microsoft Excel there are two buttons, one labelled with a cross and the other a tick. In the US a tick is used for acceptance and the cross rejection, but in Britain a tick or a cross can be used to show acceptance (e.g. a cross on a voting paper).

People also have different needs and abilities when it comes to attention and memory and these can change depending on factors such as stress and tiredness. No-one can remember long numbers or complicated instructions. All people are better at recognizing things than they are at remembering things. Some people can quickly grasp how something works whereas for others it can take much longer.

When people have had different experiences they will develop different conceptual ‘models’ of things. The understanding and knowledge that we possess of something is often referred to as a ‘mental model’ If people do not have a good mental model of something they can only perform actions by rote. If something goes wrong they will not know why and will not be able to recover. This is often the case with people using software systems, but is also the case with ‘simpler’ domestic systems such as central heating systems, thermostats and so on.

Designers have a conceptual model. So does each user, based on interaction with the system. The system image results from the physical structure that has been built (including documentation, instructions and labels). The designer expects the user's model to be identical to his. However, the designer does not talk directly with the user. All communication takes place through the system image. If the system image does not make the designer's model clear and consistent then the user will end up with the wrong model. So a key design principle is to design things so that people will form correct and useful mental models of how they work and what they do.



Usage differences:

Novice and expert users of a technology will typically have very differing requirements. Experts use a system regularly and learn all sorts of details, whereas a novice user of the same system will need to be guided through an interaction. An interesting type of system user is the 'discretionary' user – a person who does not have to use a system and who is often quickly put off if things are difficult to do. Designers need to entice these people to use their systems.

Designing for homogeneous groups of people – groups who are broadly similar and want to do much the same things - is quite different from designing for heterogeneous groups. Web sites have to cater for heterogeneous groups and have particular design concerns as a result. A company's intranet, however, can be designed to meet the particular needs of particular people. Representatives from a relatively homogeneous group – secretaries or managers or laboratory scientists, say – could be made part of the design team and so provide much more detailed input as to their particular requirements.

3 Activities

There are many characteristics of activities that designers need to consider. The term is used for very simple tasks as well as highly complex, lengthy activities, so designers need to be careful when considering the characteristics of activities. Below is a list of the most important characteristics of activities that designers need to consider. **First and foremost, the designer should focus on the overall purpose of the activity**. After that the main features are:

Temporal aspects:

1. How regular or infrequent activities are. Something that is undertaken everyday can have a very different design from something that happens only once a year. People will soon learn how to make calls using a cell phone, but may have great difficulties when it comes to changing the battery. Designers should ensure that frequent tasks are easy to do, but they also need to ensure that infrequent tasks are easy to learn (or remember) how to do.
2. Other important features of activities include time pressures, peaks and troughs of working. A design that works well when things are quiet can be awful when things are busy.
3. Some activities will take place as a single, continuous set of actions whereas others are more likely to be interrupted. If people are interrupted when undertaking some activity the design needs to ensure that they can 'find their place' again and pick up. It is important then to ensure that people do not make mistakes or leave important steps out of some activity.
4. The response time needed from the system must be considered. If a Web site takes two minutes to deliver a response when the server is busy that may be frustrating for a normal query but it could be critical if the information is needed for some emergency. As a general rule people expect a response time of about 100ms for hand-eye coordination activities and 1s for a cause-effect relationships such as clicking a button and something happening. Anything more than 5s and they will feel frustrated and confused.

Co-operation:

5. Another important feature of activities is whether they can be carried out alone or whether they are essentially concerned with working with others. Issues of awareness of others and communication and coordination then become important.

Complexity:

6. Well-defined tasks need different designs from more vague tasks. If a task or activity is well defined it can be accomplished with a simple step-by-step design. A vague activity means that people have to be able to browse around, see different types of information move from one thing to another and so on.

Safety-criticality:

7. Some activities are 'safety-critical' i.e. where any mistake could result in an injury or a serious accident. Others are less so. Clearly where safety is involved designers must pay every attention to ensuring mistakes do not have a serious effect.
8. In general it is vital for designers to think about what happens when people make mistakes and errors and to design for such circumstances.

The nature of the content:

9. Consider the data requirements of the activity. If large amounts of alphabetic data have to be input as part of the activity (recording names and addresses, perhaps, or word processing documents) then a keyboard is almost certainly needed. In other activities there may be a need to display video or high quality colour graphic displays. Some activities, however, require very modest amounts of data, or data that does not change frequently and can make use of other technologies. A library, for example, just needs to scan in a bar code or two so the technology can be designed to exploit this feature of the activity.
10. Just as important as data is the medium that an activity requires. A simple two-tone display of numeric data demands a very different design from a full motion multi-media display.

4 Contexts

Activities always happen in a context, so there is a need to analyse the two together. Three useful types of context are distinguishable; the organisational context, the social context and the physical circumstances under which the activity takes place. Context can be a difficult term. Sometimes it is useful to see context as surrounding an activity. At other times it can be seen as the features that glue some activities together into a coherent whole.

For the 'Withdraw cash from an ATM' activity, for example, an analysis of context would include things such as the location of the device (often as a 'hole-in-the-wall'), the effect of sunshine on the readability of the display and security considerations. Social considerations would include the time spent on a transaction or the need to queue. The organisational context for this activity would take into consideration the impact on the bank's ways of working and its relationships with its customers. It is important to consider the range of contexts and environments in which activities can take place.

Physical environment:

The physical environment in which an activity happens is important. For example the sun shining on an ATM display may make it unreadable. The environment may be very noisy, cold, wet, or dirty. The same activity – for example logging on to a web site - may be carried out in geographically remote environments where internet access is slow, or with all the facilities of a large city and fast networks.

Social context:

The social context within which the activity takes place is also important. A supportive environment will offer plenty of help for the activity. There may be training manuals available, tuition or experts to hand if people get into trouble. There may be privacy issues to consider and an interaction can be very different if the person is alone than if they are with others. Social norms may dictate the acceptability of certain designs. For example, the use of sound output is often unacceptable in an open-plan office environment, but might be quite effective where a person is working alone.

Organisational context:

Finally the organisational context is important as changes in technology often alter communication and power structures and may have effects on jobs such as deskilling. The circumstances under which activities happen (time, place, and so on) also vary widely and need to be taken into consideration.

5 Technologies

The final part pf the PACT framework is the technologies. Interactive systems are typically systems that consist of hardware and software components and which transform some input data into some output data. They can perform various functions and typically contain a good deal of data, or information content. People using such systems engage in interactions and physically devices have various degrees of style and aesthetics. Interactive systems constitute the medium that interactive system designers work with. Some important features of technologies are:

Input:

Input devices are concerned with how people enter data and instructions into a system securely and safely. The characteristics of the data are important for choosing input methods. Bar codes, for example are only sensible if the data does not change often. Touch screens are useful if there are only a few options to choose from. Speech input is possible if there is no noise of background interference and if there are only a few commands that need to be entered

Output:

Output needs to be considered including the characteristics of different displays (e.g. video vs. photographs; speech vs. screen). 'Streamy' output such as video, music and speech has different characteristics from 'chunky' media such as icons, text or still photographs. Most important, perhaps, is that streamy media doesn't stay around long. Instructions given as speech output, for example, have to be remembered whereas if displayed as a piece of text, they can be read over again.

Communication:

Communications between people and between devices needs to be considered. Here issues such as bandwidth and speed are critical. So too is feedback to people so that they know what is going on and indeed that something is going on! In some domains the transmission and storage of large amounts of data becomes a key feature. Communication between devices is another important consideration.

Content:

This concerns the data in the system and the form it takes. Good content is accurate, up-to-date, relevant and well-presented. There is little point in having a sophisticated information retrieval system if the information, once retrieved, is out-of-date or irrelevant. In some technologies content is just about everything (e.g. Web sites are usually all about content). Other technologies are more concerned with function (e.g. a remote control for a TV). Most technologies have a mixture of function and content.

6 Scoping a problem with PACT

The aim of human-centred interaction design is to harmonise the PACT elements in a particular domain. Designers want to get the right mix of technologies to support the activities being undertaken by people in different contexts. A PACT analysis is useful for both analysis and design activities; understanding the current situation, seeing where possible improvements can be made or envisioning future situations. To do a PACT analysis the designer simply scopes out the variety of P, A, C and Ts that are possible. This can be done using brainstorming and other envisionment techniques (e.g., draw pictures, sketches, cartoons, cut out pictures from magazines and stick them on a board).and by working with people through observations, interviews and workshops.

The results can be written up as detailed concrete '**scenarios** of use'. Scenarios are stories about people undertaking activities using technologies in contexts. Develop conceptual scenarios that cover the main activities that the technology has to support. Develop concrete versions of these for specific designs of the technology. For example - a conceptual scenario might say 'Pete logs onto the computer', and a concrete version might be 'Pete clicks on the "log on" icon'

The designer should look for trade-offs between combinations of PACT and think about how these might effect design.

For people, designers need to think about the physical, psychological and social differences and how those differences change in different circumstances and over time. It is most important that designers consider all the various stakeholders in a project, not simply the 'end users'. There are often groups of people who have an interest, or stake, in a project who will never use the system; managers, administrators, customers can all be affected by changed systems that other people are using.

Developing 'Personas' can be useful here: A **persona** is a profile of a typical user; it is a description of an archetypal user synthesized from a series of interviews with real people and includes a name, a social history, and a set of goals that drive the design of the product or web site. By closely adhering to the goals of a specific persona, the designers satisfy the needs of the many users who have goals similar to those of the persona. The process is even more effective when designers design for several personas simultaneously, as they can satisfy an even larger number of users.

Persona: Rhonda Wilson, Nurse Unit Coordinator

Rhonda is a 36-year-old registered nurse who has worked at several skilled nursing facilities. She started out in acute care but moved to long-term care so she could have more autonomy. Rhonda was promoted to Unit Coordinator four years ago because she is very competent and generally well organised.

Rhonda is entirely overwhelmed and is drowning in paper, even more so than the average nurse. She often misses eating dinner with her boyfriend because she has to work late, filling out forms and reports.

Rhonda's goals are to:

Spend time on patient care and staff supervision, not paperwork.

Be proactive. Rhonda needs to understand trends in order to solve problems before they happen, instead of just reacting to crises.

Know that things are being done right. Rhonda supervises the unit because she's good at what she does. If nurses aren't following procedure or documenting things, she wants to know right away.

A financial services company was looking to redesign its website. There were thousands of users, each with very different goals, coming to the site every week, and the firm did not know how to approach the design. The firm was advised to develop several personas, one for each major class of audience member. In talking with the client, designers determined that the firm could get by with a couple of key personas: a seasoned investor and an infrequent investor.

For activities designers need to think about the complexity of the activity (focused or vague, simple or difficult, few steps or many), the temporal features (frequency, peaks and troughs, continuous or interruptible), co-operative features and the nature of the data. For contexts they think about the physical, social and organisational setting and for technologies they concentrate on input, output, communication and content.

As an example, let us assume that we have been asked by a university department to consider developing a system controlling access to their laboratories. A PACT analysis might include:

People

Students, lecturers and technicians are the main groups. These are all well educated and understand things such as swipe cards, passwords and so on. People in wheelchairs need to be considered as do other design issues such as colour blindness. There may be language differences. Both visitors and frequent users need to be considered. However, there are other stakeholders who do need access to rooms such as cleaning staff and security personnel. What are the motivations of management to control access in the first place?

Activities

The overall purpose of the activity is to enter some form of security clearance and to open the door. This is a very well-defined activity that takes place in one step. It happens very frequently with peaks at the start of each laboratory session. The data to be entered is a simple numeric or alpha-numeric code. It is an activity that does not require cooperation with others (though may be done with others of course). It is not safety-critical, though security is an important aspect.

Contexts

Physically the activity takes place indoors, but people might be carrying books and other things that makes doing anything complicated quite difficult. Socially it may happen in a crowd, but also may happen late at night when no-one else is about. Organisationally, the context is primarily about security and who has access to which rooms and when they can gain access. This is likely to be quite a politically charged setting.

Technologies

A small amount of data has to be entered quickly. It must be obvious how to do this to accommodate visitors and people unfamiliar with the system. It needs to be accessible by people in wheel chairs. The output from the technology needs to be clear; that the security data has been accepted or not and the door has to be opened if the process was successful. Communication with a central database may be necessary to validate any data input, but there is little other content in the application.