

Chapter 11

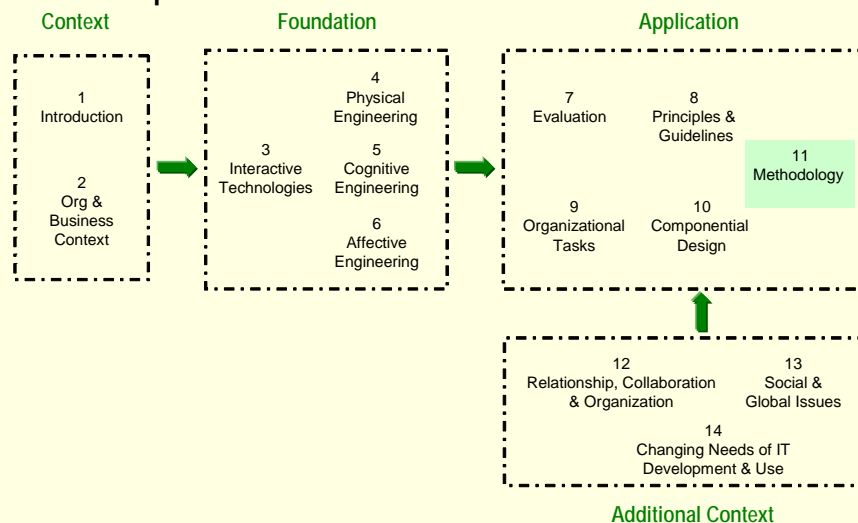
HCI Development Methodology

HCI: Developing Effective Organizational Information Systems
Dov Te'eni
Jane Carey
Ping Zhang

Copyright 2006 John Wiley & Sons, Inc

HCI Development Methodology

Roadmap



Copyright 2006 John Wiley & Sons, Inc

HCI Methodology

■ **System Development Methodology:**

- a standardized development process
- defines a set of activities, methods and techniques, best practices, deliverables, and automated tools
- systems developers and project managers use to develop and continuously improve information systems.

Copyright 2006 John Wiley & Sons, Inc

The Role of HCI Development in SDLC (Systems Development Life Cycle)

- **System Development Philosophy:** follow formal scientific and engineering practice, yet make room for a strong creative element.
- The general principles of user-centered systems development include
 - (1) involving users as much as possible
 - (2) integrating knowledge and expertise from different disciplines
 - (3) encouraging high interactivity

Copyright 2006 John Wiley & Sons, Inc

The Role of HCI Development in SDLC (Systems Development Life Cycle)

- **SDLC**: a commonly used methodology for information systems development that breaks the whole systems development process into manageable phases.

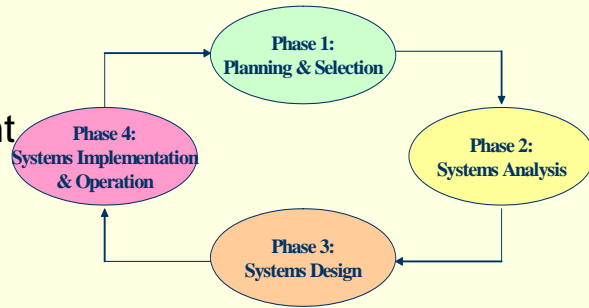


Figure 11. 1 Modern SDLC (from Valacich et al, 2004)

Copyright 2006 John Wiley & Sons, Inc

The Role of HCI Development in SDLC (Systems Development Life Cycle)

- Iteration through each of the phases and back to the previous phases is key to creating successful systems.
- Figure 11.2 illustrates the importance of iteration.

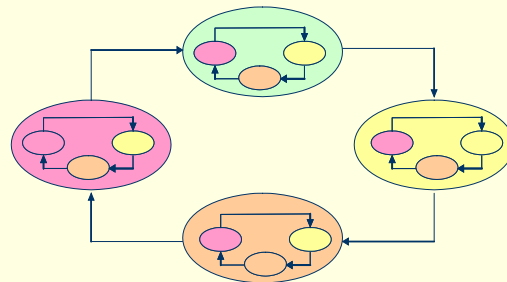


Figure 11. 2 Modern SDLC: Iteration, Fast Feedback, Accuracy, User-centered

Copyright 2006 John Wiley & Sons, Inc

The Human-Centred SDLC Model: HCSDLC

- **HCSDLC**: a human centered systems development methodology where organizational needs and human needs are considered together throughout the systems development life cycle.
- The next slide depicts the HCSDLC. The left side (a) is a typical SDLC model while the right side (b) is the HCSDLC model that covers both SA&D and HCI concerns and activities

Copyright 2006 John Wiley & Sons, Inc

The Human-Centred SDLC Model: HCSDLC

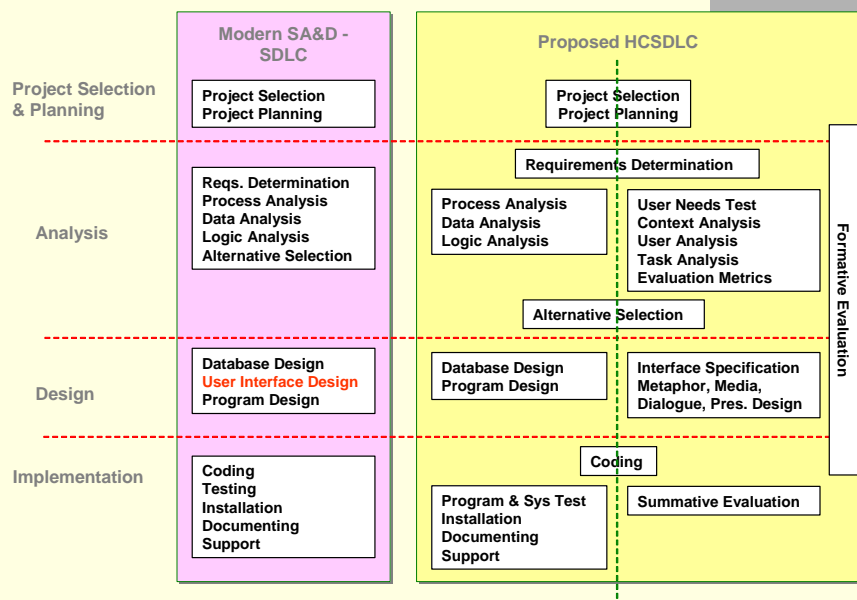


Figure 11.3. The HCSDLC Methodology

The HCI Development Methodology

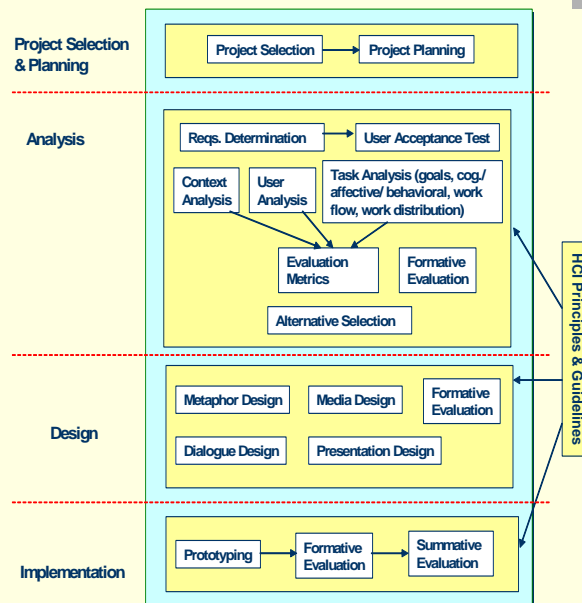


Figure 11.4. The HCI Development Methodology

Philosophy, Strategies, Principles and Guidelines

- **HCSDLC philosophy**: information systems development should meet both organizational and individual needs
- Thus all relevant human factors should be incorporated into the SDLC as early as possible.

Philosophy, Strategies, Principles and Guidelines

HCI Development Strategies

- Focus early on users and their tasks (at the beginning of SDLC).
- Evaluate throughout the entire system development process.
- Iterate when necessary.
- Consider all four levels of HCI concerns: utility, usability, organizational/social/cultural impact, and holistic human experience.

Table 11.1. HCI Development Strategies

Copyright 2006 John Wiley & Sons, Inc

Philosophy, Strategies, Principles and Guidelines

HCI Development Principles

- Improve users' task performance and reduce their effort.
- Prevent disastrous user errors.
- Strive for fit between the tasks, information needed, and information presented.
- Enable enjoyable, engaging and satisfying interaction experiences.
- Promote trust.
- Keep design simple.

Table 11.2. HCI Development Principles

Copyright 2006 John Wiley & Sons, Inc

Philosophy, Strategies, Principles and Guidelines

HCI Development Guidelines

- Maintain consistent interaction
- Provide the user with control over the interaction, supported by feedback
- Use metaphors
- Use direct manipulation
- Design aesthetic interfaces

Table 11.3. HCI Guidelines

Copyright 2006 John Wiley & Sons, Inc

The Project Selection and Planning Phase

- **Project selection and planning**: the first phase in SDLC where:
 - an organization's total information systems needs are analyzed and arranged,
 - a potential information systems project is identified, and
 - an argument for continuing or not continuing with the project is presented.

Copyright 2006 John Wiley & Sons, Inc

The Project Selection and Planning Phase

- One important activity during project planning is to assess project feasibility. This is also called a feasibility study. Most feasibility factors fall into the following six categories:
 - Economic or cost-benefit analysis
 - Operational
 - Technical
 - Schedule
 - Legal and contractual
 - Political

Copyright 2006 John Wiley & Sons, Inc

The Interaction Analysis Phase

- **Analysis**: studies the current system and proposes alternative systems.
 - From the HCI perspective, requirements determination is one of the most important activities
 - Alternative generation and selection are also necessary before subsequent design is conducted.
 - In addition, HCI analysis includes user-acceptance tests on the system requirements

Copyright 2006 John Wiley & Sons, Inc

Requirement Determination and User-Acceptance Test

- **User acceptance test**: a test during the analysis stage using simple mockups to test the likelihood of the system's functionalities being accepted by its potential users.

Copyright 2006 John Wiley & Sons, Inc

Requirement Determination and User-Acceptance Test

Intention to Use

Assuming I had access to the system, I intend to use it.

Given that I had access to the system, I predict that I would use it.

Perceived Usefulness

Using the system will improve my performance on my job.

Using the system in my job will increase my productivity.

Using the system will enhance my effectiveness in my job.

I find the system would be useful in my job.

Perceived Ease of Use

My interaction with the system will be clear and understandable.

Interacting with the system will not require a lot of my mental effort.

I find the system will be easy to use.

I will find it easy to get the system to do what I want it to do.

Note: all items can have 7-point Likert scale; the verb tenses can be modified appropriately to reflect future/current interactions, depending on the point of measurement.

Table 11.4. User Acceptance Test Instrument

Context Analysis

- *Context analysis* includes understanding the technical, environmental and social settings where the information systems will be used.
- There are four aspects in Context Analysis:
 - physical context,
 - technical context,
 - organizational context, and
 - social and cultural context.

Copyright 2006 John Wiley & Sons, Inc

Context Analysis

- Physical context:
 - Where are the tasks carried out?
 - What entities and resources are implicated in task operation?
 - What physical structures and entities are necessary to understand observed task action?

Context Analysis

■ Technical context:

- What are the technology infrastructure, platforms, hardware and system software, network/wireless connections?
- For example, an E-commerce website may be designed to only allow people with certain browser versions to access.
- The website may also be designed to allow small screen devices such as PDAs or mobile phones access.

Copyright 2006 John Wiley & Sons, Inc

Context Analysis

■ Organizational context:

- What is the larger system into which this information system is embedded?
- What are the interactions with other entities in the organization?
- What are the organizational policies or practices that may affect the individual's attitude and behavior towards using the system?

Copyright 2006 John Wiley & Sons, Inc

Context Analysis

- Social and cultural context:
 - What are the social or cultural factors that may affect user attitudes and eventual use of the information system?
 - Any information system is always part of a larger social system.

User Analysis

- **User Analysis:** identifies the target users of the system and their characteristics.
 - Demographic data
 - Traits and intelligence
 - Job or task related factors

Task analysis

- **Task Analysis**: studies what and how users think and feel when they do things to achieve their goals.
- Possible points of analysis in task analysis
 - User goals and use cases
 - Cognitive, affective, and behavioral analysis of user tasks
 - Workflow analysis
 - General work distribution between users and the website/machine

Copyright 2006 John Wiley & Sons, Inc

Evaluation Metrics

- **Evaluation Metrics**: specifies the expected human-computer interaction goals of the system being designed. There are four types of HCI goals.

Copyright 2006 John Wiley & Sons, Inc

Category/Type	Example Measures
Usefulness	Support individual's tasks Can do some tasks that would not so without the system Extend one's capability
Usability	Fewer errors and easy recovery Easy to use Easy to remember how to use Easy to learn Safe to use
Organizational, Social, Cultural Impact	Increased organizational productivity Reduced cost for training Reduced cost for user/ customer support Improved customer service Improved customer retention Reduced job turnover Reduced loss of business opportunities Increase in sales Improved organizational image
Holistic Human Experience	Aesthetically pleasing Enjoyable, entertaining, fun Motivating, engaging Trustworthy Supportive of creativity Rewarding Satisfying

Table 11.5 Evaluation Metrics

Alternative Generation and Selection

- Although SA&D emphasizes functionality in selecting design strategies, the approach of generating and selecting best alternatives can also be applied to HCI design strategies. The deliverables include
 - (1) three substantially different design strategies (low, middle, and high range)
 - (2) a design strategy judged most likely to lead to the most desirable system

The Interaction Design Phase

- **Design**: to create or construct the system according to the analysis results.
- *Interface specification* includes:
 - semantic understanding of the information needs to support HCI analysis results
 - syntactical and lexical decisions including metaphor, media, dialogue, and presentation designs.

Copyright 2006 John Wiley & Sons, Inc

The Interaction Design Phase

- **Metaphor and visualization design** helps the user develop a mental model of the system.
 - It is concerned with finding or inventing metaphors or analogies that are appropriate for users to understand the entire system or part of it.
 - There are well accepted metaphors for certain tasks, such as:
 - a shopping cart for holding items before checking out in the E-Commerce context
 - light bulbs for online help or daily tips in productivity software packages.

Copyright 2006 John Wiley & Sons, Inc

The Interaction Design Phase

- Media design is concerned with selecting appropriate media types for meeting the specific information presentation needs and human experience needs.
 - Popular media types include
 - text
 - static images (e.g., painting, drawing or photos)
 - dynamic images (e.g., video clips and animations)
 - sound

Copyright 2006 John Wiley & Sons, Inc

The Interaction Design Phase

- Dialogue design focuses on how information is provided to and captured from users during a specific task.
 - Dialogues are analogous to a conversation between two people.
 - Many existing interaction styles, such as menus, form-fill-ins, natural languages, dialog boxes, and direct manipulation, can be used.

Copyright 2006 John Wiley & Sons, Inc

The Interaction Design Phase

- Presentation design
 - maximize visibility;
 - minimize search time;
 - provide structure and sequence of display;
 - focus user attention on key data
 - easily comprehended;
 - provide only relevant information; and
 - don't overload user's working memory.

Copyright 2006 John Wiley & Sons, Inc

Formative Evaluations

- *Formative evaluations* identify defects in designs, thus informing design iterations and refinements.
 - A number of different formative evaluations can occur several times during the design stage to form final decisions.
 - In fact, it is strongly recommended that formative evaluations occur during the entire HCI development life cycle

Copyright 2006 John Wiley & Sons, Inc

The Implementation Phase

- HCI development in this phase includes
 1. prototyping,
 2. formative evaluations to fine-tune the system,
 3. summative evaluation before system release
 4. use evaluation after the system is installed and being used by targeted users for a period of time.

Copyright 2006 John Wiley & Sons, Inc

Documenting HCI Development Activities and Deliverables

ID	HCI Development Activity	Deliverables
1.1	Project Selection and Planning	Schedule of IS project development: Cost-benefit analysis: Other feasibility analyses:
2.1	Requirements Determination	The specific system functionalities:
2.2	User-Acceptance Test	Sample profile: Data collection time and setting: Sketches or mockups used: Test results: Suggestions for revising system functionalities:
2.3	Context Analysis	Physical context: Technical context: Organizational context: Social/cultural context:
2.4	User Analysis	Demographic: Traits/skill sets: Job or task related factors:
2.5	Task Analysis	User goals and use cases: Cognitive, affective, behavioural analysis of user tasks: Workflow analysis: General work distribution between users and the system:
2.6	Evaluation Metrics	Usefulness: Usability: Organizational/social/cultural impact: Holistic human experience:

Documenting HCI Development Activities and Deliverables

2.7	Alternative Selection	Three alternatives: The main constraints: The chosen alternative:
2.8	Formative Evaluation	Evaluation target, method, timing and results:
3.1	Interface Specification	Metaphor and visualization design: Media design: Dialogue design: Presentation design:
3.2	Formative Evaluation	Evaluation target, method, timing and results:
4.1	Prototyping	Tools used:
4.2	Formative Evaluation	Evaluation target, method, timing and results:
4.3	Summative Evaluation	Sample profile: Data collection time and setting: Test results: Conclusions in light of evaluation metrics:
Table 11.6 HCI Development Report Template		

Copyright 2006 John Wiley & Sons, Inc

Applying the HCI Development Methodology: e-Gourmet example

ID	HCI Activity	Deliverables
1.1	Project Selection and Planning	A decision is made to develop the e-Gourmet website. A cost-benefit analysis and other feasibility analyses are done.
2.1	Requirements Determination	(1)Taking online orders of international gourmet foods using credit cards, (2)Providing recipes of certain dishes, (3)Providing explanations/history of certain ingredients and dishes, (4)Providing a buddy-forum for buyers to exchange recipes, cooking experiences (this function is added after initial user acceptance test)
2.2	User Acceptance Test	<u>Sample and data collection setting</u> : shoppers from a supermarket answered a paper based survey <u>Sketches or mockups used if any</u> : drawings on paper demonstrated systems functionalities and some design ideas. <u>Results</u> : shoppers suggested having a buddy-forum for specialty food discussions among interested shoppers.
2.3	Context Analysis	<u>Physical context</u> : users may order or browse the website from anywhere that they have access to the Internet <u>Technical context</u> : users may use web browsers from PC, Palm PDAs, or mobile phones <u>Org context</u> : none. Buyers' organizational context should not play any role in their using the system. <u>Social/cultural context</u> : the website can be accessed from any country with any culture that can provide credit cards with USD exchange. A cost-benefit analysis in the project planning phase determined that the e-Gourmet company will support only English at this moment.

2.4	User Analysis	<p><u>Demographic:</u></p> <ul style="list-style-type: none"> -Upper middle income male and female shoppers with any occupation -Cosmopolitan and immigrant US users, and users outside US (see context analysis above) -Users who speak English <p><u>Traits/skill sets:</u></p> <ul style="list-style-type: none"> -Basic computer knowledge and experience <p>-Basic understanding of buying things through the Internet</p> <p><u>Job or task related factors:</u> the frequency of users buying from the e-Gourmet website can range from once per month to daily with any dollar amount.</p>
2.5	Task Analysis	<p><u>User goals and use cases:</u></p> <ul style="list-style-type: none"> -Case 1: buy particular foods or ingredients that users already know about. -Case 2: look for ingredients that make a known dish. -Case 3: learn about a particular dish, its ingredients, and how to make it. -Case 4: browse to decide what to cook for a particular occasion. -Case 5: recommend the site to others <p><u>Cognitive, affective, and behavioral analysis of user tasks:</u></p> <ul style="list-style-type: none"> -In case 1, a user may forget the official name but remembers the characteristics of the foods (thus may first need to do a query on certain attributes of foods to find it) (cognitive) -When examining an ingredient, users may need to refer to the dishes where this ingredient is used. The same is true when examining a dish where ingredients/receipt would be needed (cognitive, behavioral) -Aesthetically pleasing presentation would encourage browsing (cases 3 & 4) and eventually purchasing (cases 1 & 2) and recommending (case 5) (affective, behavioral) -A forum for peer recommendations and exchange of receipts or cooking experiences (case 5) (behavioral) <p><u>Workflow analysis:</u></p> <ul style="list-style-type: none"> -Case 1 would need a sequence of actions to be finished; abortion of the task can occur at any stage of the sequence; and users may want to go back to previous stages -Case 4 may lead to any of cases 1-3. <p><u>General work distribution between users and the website/machine:</u></p> <ul style="list-style-type: none"> -Users make selections -The website provides selections and all related and relevant info for each choice.

2.6	Evaluation Metrics	<p><u>Usefulness goals:</u></p> <ul style="list-style-type: none"> •Customers can order the type of foods that they normally cannot get from a local store. •Customers can order small amount of foods with an affordable price and shipping. •Customers can learn new ways of cooking international gourmet meals. <p><u>Usability goals:</u></p> <ul style="list-style-type: none"> •New users (never used the website) should be able to navigate and use the main functions within 1, 3 or 5 minutes (for high, middle, low range solution respectively). •Users should be able to get to the main tasks with maximum two clicks for middle range solution <ul style="list-style-type: none"> •Ordering task should be done within 1 minute in normal situation (normal network traffic, user has no interruption) and with no more than 2, 4 or 6 clicks/actions (for high, middle, low range respectively). •The error rate should be less than 1 in every 10 users for each main task. •The complaint rate of usability problems should be less than 1 in every 10 users. •Credit cards are safe and secure to use. <p><u>Organizational, social, cultural impact goals:</u></p> <ul style="list-style-type: none"> •Cost for handling online ordering should be about half of that for telephone ordering (due mainly to phone cost and more employees needed to take orders). •Customer retention rate should be increased by 30% over a year. <p><u>Holistic human experience goals:</u></p> <ul style="list-style-type: none"> •80% of the tested shoppers should have (a) aesthetic, (b) enjoyable, (c) engaging and (d) satisfactory rating of at least 4 out of 5 •At least 50% of the shoppers would participate in the buddy-forum at least once every three months (read or send postings) •At least 80% of the potential target users would trust the website for their credit card use.
2.7	Alternative Selection	Developed three (high, middle, and low ranges of potential solutions) alternatives from the HCI evaluation metrics perspective and system functions perspective. Decided to go with the middle range alternative after trade-off debate.
2.8	Formative Evaluation	Conducted several tests on analysis results including evaluation metrics using paper drawings, mockups, simple screen snapshots. Participants were friends and relatives of the developers who are interested in international gourmet meals.

	Interface Specification	<p><u>Metaphor and visualization design:</u></p> <ul style="list-style-type: none"> -“Product catalog” is used as a metaphor to help shoppers to navigate the e-shop to find what they are looking for. -“Shopping cart” is used as a metaphor for holding items before checking out. <p><u>Media design:</u></p> <ul style="list-style-type: none"> -Dishes are represented by images (photos of the master cooked dishes with great presentation) to make them look delicious. Certain ingredients will also be shown in realistic photos. Recipes will be brief, concise, and use common format. Forum will be similar to most successful online forums.
		<ul style="list-style-type: none"> -Other media types include text, buttons, hyperlinks, threaded discussion posts. <p><u>Presentation design:</u></p> <ul style="list-style-type: none"> -The homepage consists of virtual store map (with English), plus the section of language selection. It also indicates the main system functionalities.
	Formative Evaluation	Conducted several tests on various design decisions at semantic, syntactic or even lexical levels using paper drawings, mockups, simple screen snapshots. Participants were friends and relatives of the developers who are interested in international gourmet meals.
	Prototyping	State of the art web development techniques were used to do this.
	Formative Evaluation	Conducted tests on various prototypes using laptop computers. Participants were friends and relatives, and some shoppers recruited from a gourmet shop.
	Summative Evaluation	Real shoppers of the website are recruited to test the website on the Evaluation Metrics measures.
Table 12.7 HCI Development Report for e-Gourmet		

Copyright 2006 John Wiley & Sons, Inc

Applying the HCI Development Methodology: e-Gourmet example

- Figure 11.5 depicts two possible designs for the top level layout, media selection and presentation design considerations that should help users develop appropriate mental models of the website.

Copyright 2006 John Wiley & Sons, Inc

Applying the HCI Development Methodology: e-Gourmet example

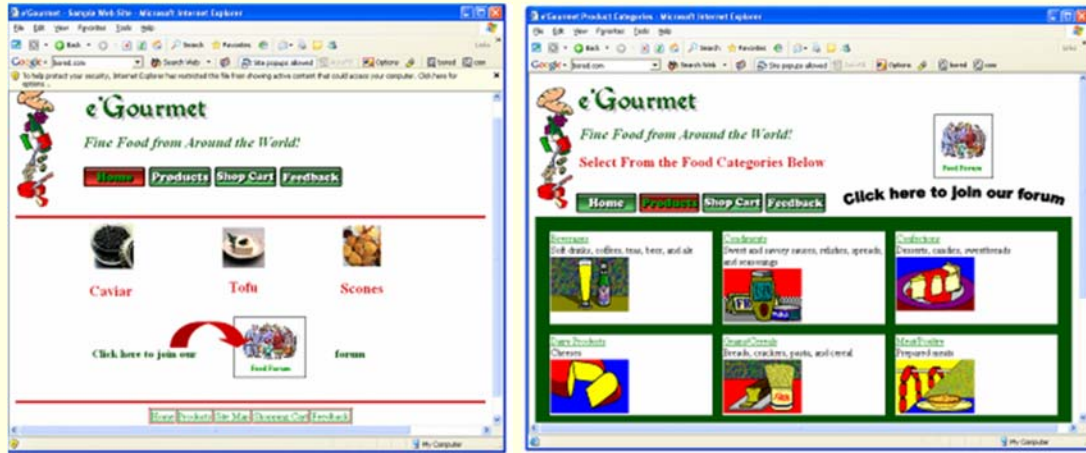


Figure 11.5 Two Top Level Design Choices for e-Gourmet

Copyright 2006 John Wiley & Sons, Inc

Applying the HCI Development Methodology: e-Gourmet example

- Figure 11.6 shows two possible designs for supporting this task.
- The (b) design allows a user to easily navigate the website,
- while the (a) design requires the user to go back to the previous page in order to go to other places of the website.
- Such a small difference in design can cause a big difference in user's experience in using the website. Having the navigation bar on the page is the result of a workflow analysis during task analysis.

Copyright 2006 John Wiley & Sons, Inc

Applying the HCI Development Methodology: e-Gourmet example

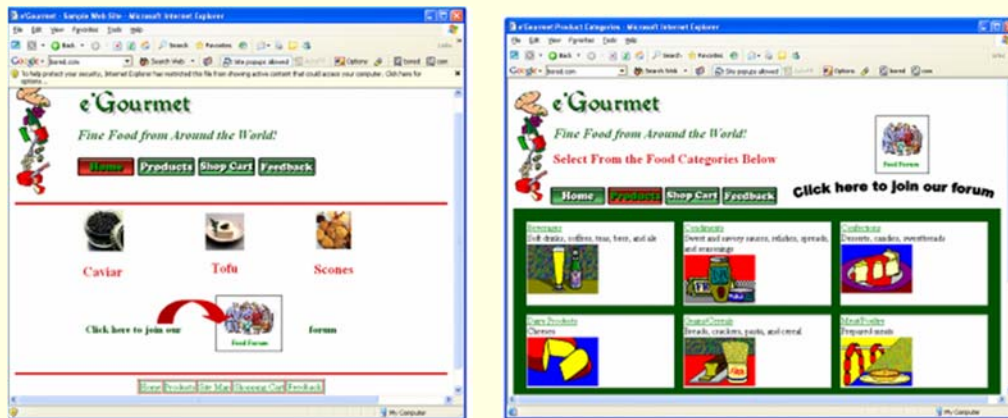


Figure 11.6 Two Design Choices for entering the Food Forum in the e-Gourmet website

Summary

- This chapter posits the HCI development in the overall system development life cycle by presenting the human-centered SDLC (HCSDLC) model first, and then emphasizes the HCI development aspect.
- HCSDLC is an integrated methodology that emphasizes human-centeredness and considers HCI issues together with SA&D issues throughout the entire system development life cycle.
- The HCI part of the HCSDLC methodology can be used alone to concentrate on the HCI development of an information system.
- In this chapter, we provide very detailed materials on HCI development methodology.
- A HCI Development Report template is used to summarize the activities and deliverables of the methodology.
- Examples are also used to illustrate how to apply the methodology.