Building ease of use into the IBM user experience

by K. Vredenburg

This issue of the *IBM Systems Journal* explores the topic of building ease of use into the IBM user experience with hardware, software, Web sites, and services. This paper provides an overview of the process and organizational transformation that IBM has gone through in improving the user experience with our offerings. IBM's process for building ease of use into the user experience is described and two versions of the process are introduced and contrasted. The IBM User-Centered Design (UCD) approach, which has been used for the last several years, is contrasted with the traditional approach to the development of offerings. A recent major enhanced version of the process, called User Engineering (UE), which is optimized for the IBM e-business on demand™ strategy, is contrasted with the existing UCD process. The key elements of our enablement, leadership, and guidance strategy for these processes are outlined, including mission, process integration, education and training, communication, collaboration, and tools and technology. An overview of the papers in this issue is also provided.

User experience is the day-to-day interaction that a customer has with all aspects of an offering. For many customers, the user experience is the offering. It is therefore critically important to ensure that customers have a positive experience. However, research from across the industry indicates that the user experience is too often less than positive due to a lack of ease of use. In one study,[1] participants searching for information at a Web site were only able to find the desired information 42 percent of the time. In another study,[2] 39 percent of participants were unable to complete an on-line purchase. It has been found[3,4] that 40 to 50 percent of users who have a negative experience at a Web site do not return to it. A study of software[3] found that the average program has 40 design flaws that impair the ability to use it. Alan Ganek summarized it best when he stated in a previous issue of this Journal, "The computer industry has spent decades creating systems of marvelous and ever-increasing complexity. But today, complexity itself is the problem."[4]

According to a recent Forrester report, "Improving user experience can increase both revenue and customer satisfaction while lowering costs."[5] A Gartner study[6] concluded that customer satisfaction can be increased by 40 percent by applying appropriate user experience methods. Of companies that have used some ease-of-use methods, a recent study[7] found that 72 percent reported these methods had a significant impact on product development, and 82 percent reported the methods had improved the ease of use of products developed in their organizations.

In response to these challenges across the industry, we at IBM developed an industry-leading User-Cen-

tered Design (UCD) process in the mid-1990s to build ease of use into the user experience of our hardware, software, Web sites, and services. UCD has become a core enabler of our business process, and a corporate leadership team has successfully driven adoption and execution of UCD across all divisions of the company.

An enhanced version of our UCD process, called User Engineering (UE), was developed recently to further improve upon UCD and to optimize it for e-business on demand*. User engineering is the mechanism through which customer changes can be detected. Its processes and methods are used to understand market, business, and user requirements, which are subsequently rigorously modeled and then engineered with iterative user feedback. This approach is critically important to achieving the e-business on demand elements of integration and autonomic computing, ensuring that core business processes are integrated inside and outside an organization and that user tasks are made more efficient by having systems increasingly take over time-consuming and error-prone user tasks. Note that although UE is optimized for IBM's e-business on demand strategy, it is not restricted to being used with it.

The following section provides: (1) An overview of the process transformation we have introduced at IBM, including a description of core characteristics that differentiate UCD from a traditional approach and how UE is a significant further enhancement of UCD with regard to these characteristics; (2) an outline of the key elements that were put in place to enable and guide the requisite organizational transformation to optimally execute the process; and (3) an outline of the papers in this issue of the *IBM Systems Journal* and how they relate to our overall strategy.

Process transformation

IBM used various isolated usability and human factors methods for decades, but these were not part of an overall integrated process. Typically, these methods introduced user testing late in the development cycle and, as a result, were not very successful.

The IBM version of UCD was developed in the 1990s,[8] based on the seminal work of Norman and Draper[9] and Hamel and Prahalad.[10] Our version of UCD is an approach for designing ease of use into the total user experience with products and systems. The total user experience includes everything the user sees and touches. Unlike the isolated usability and human factors methods used previously, our UCD approach covers the entire design and development cycle with particular focus on the early phases. Most important, UCD is directly integrated into our corporate-wide offering development process. UCD has been used successfully across all our divisions on hardware, software, services, and Web projects for the past seven years.

Although minor updates and modifications were made to the UCD process over those years, a major set of enhancements has recently been made to yield a further "quantum leap" improvement in the process and the resulting user experience with our offerings. The new version of the process is called User Engineering (UE). To date, numerous early deployment projects have successfully used UE (or selected methods within it), and the new process will be used across the company as projects complete their current releases using UCD and begin their next releases with UE.

It is important to point out that our UCD and UE approaches are different from most in the industry. Other approaches are typically one-dimensional, emphasizing only one or two particular methods or types of method to the exclusion of others. For example, some focus on persona and scenarios,[11] while others focus on contextual design.[12] Yet others focus on rapid iterative development.[13] Each of these methods or systems has much to offer but, in our view, they do not offer a complete solution. Our approach has been to evaluate the relative benefits of each method and system across the industry, develop our own methods where there are gaps, and then incorporate the best methods into a comprehensive, integrated, multidimensional process.

A recent study[7] found that very few companies across the industry report having a process as complete as IBM's. Only 13 percent of companies surveyed had an end-to-end UCD process involving users in all phases, and only 5 percent used full multidisciplinary teams. None reported focusing on the total user experience. Benchmark studies carried out by the author with major IT vendors suggest that these companies tend to have a more complete process than the average company involved in the survey described above. However, these studies also reinforce the fact that the IBM approach, particularly with respect to the UE enhancements to UCD, is quite novel across the industry.

A detailed description of UCD and UE will not be provided here. For more details about UCD, see Reference 14. Further details about UE are provided in Reference 15, later in this issue. The following is a brief high-level general summary of the basic elements of the process that are common to UCD and UE. The next section will detail how UCD and UE differ.

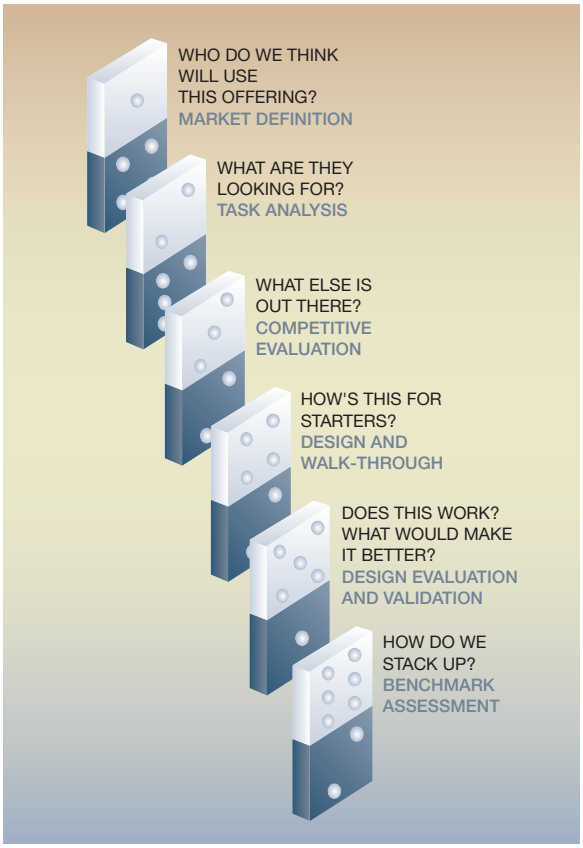
Process overview. A simplified generic depiction of the design process is shown in Figure 1, illustrating the major phases of the process together with the type of activity performed within the phase and the basic question being addressed. The design process starts with the collection of relevant market definition information to answer the basic question, "Who do we think will use this offering?" This involves understanding the target markets, types of users, prime competitors, market trends, high level needs and preferences, and so forth. Next, detailed information is collected from representative users within the target markets to understand their goals and tasks to answer the question, "What are they looking for?" Following this, we attempt to understand how the tasks described in the prior step are carried out today either with a competitor's product or an analog method. This answers the question, "What else is out there?"

At this point, conceptual design of the user experience starts, and early feedback is gathered from users, answering the question, "How's this for starters?" This leads to several cycles of iterative detailed design and user feedback through design evaluation and validation sessions, answering the questions, "Does this work?" and "What would make it better?" At the end of the development cycle, a user feedback benchmark assessment session is conducted to answer the question, "How do we stack up?"

A variety of characteristics illustrate the progression from a traditional approach to our UCD approach and then to our UE approach. These characteristics are shown in Table 1. The three approaches will now be contrasted using these characteristics.

From a technology-driven approach to a business-value-driven approach. The most obvious difference between traditional approaches and UCD concerns the involvement of users. Traditional approaches are fundamentally technology driven. Although they may collect customer requirements at the start of a project, these are typically not at a level appropriate for design. Little or no input from users is gathered during the design and development process itself. Design is typically "inside-out"; that is, the internal architecture is defined first and then a user interface is created for users to get access to the system functions. In contrast, UCD is fundamentally user driven. Users are involved in all stages of design and development. The user experience is designed first, and the product or system architecture is created to support this design. In other words, UCD is design that is "outside-in." It is important to point out that this user focus is not simply one of designers and developers taking the perspective of the user into account. Rather, representative samples of real current and future users of the product or system are involved during design and development.

Figure 1 Generic process overview illustrating basic questions and activities by phase



UE differs from UCD on this dimension by broadening the perspective from being simply user driven to being business value driven. The UE process starts

Table 1 Progression from traditional to UCD and then to UE approach

Traditional Approach	UCD Approach	UE Approach
Technology driven	User driven	Business value driven
Component focus	Solutions focus	Enterprise focus
Limited multidisciplinary cooperation	Multidisciplinary teamwork	Multidisciplinary role-based work allocation
No specialization in user experience	Specialization in user experience	Specialization in all disciplines
Some competitive focus	Focus on competition	Detailed focus on competition
Development before user validation	Development of user-validated designs only	Engineering of user-validated models
Product defect view of quality	User view of quality	System view of quality
Limited focus on user measurement	Prime focus on user measurement	User measurement driven
Focus on current customers	Focus on current users and customers	Focus on all stakeholders

by collecting detailed market requirements, business requirements, and user requirements, creating a business model that rigorously integrates all of these requirements and focuses on the design aspects that affect the "bottom line." Project design directions are then specified, together with measures and targets to assess the business value obtained. This critically important UE extension to UCD ensures that the design of offerings is based on a combination of factors that contribute to business value rather than being based solely on user input. This also prevents, for example, the situation in which the design is improved to support tasks that users carry out today when the users' employers would like to eliminate those very tasks entirely. It also increases the likelihood of innovative "quantum leap" improvements in the design of offerings as opposed to small incremental enhancements.

From a component focus to an enterprise focus. Traditional product development focuses on components in isolation. The advertising is developed separately from the product user interface, which is developed separately from the user assistance or help facility, and so on. The full solution is often first seen altogether when it is shipped to customers, who may be ill served by the lack of product integration. UCD introduced the notion of *designing the total user experience*. This involves designing all of the individual elements of the entire solution-level user experience together (see Figure 2). This includes the advertising, the ordering process, packaging, overall appearance, user interface or physical layout, user assistance, and support and upgrade capabilities. User input guides the design of this total customer experience.

UE builds on this end-to-end focus by (1) broadening it to include not only the single user experience but also the experience of multiple users in many roles across an enterprise working with various components to carry out their work, and (2) making more rigorous the analysis and design of all aspects of the total user experience. UE accomplishes both of these enhancements by introducing a set of rigorous modeling methods by using Unified Markup Language (UML**)[16] to capture this voluminous information in a series of diagrams that enable the careful analysis of patterns and relationships. These methods are based on the "Object, View, and Interaction Design" (OVID)[17] method developed at IBM. These techniques are crucially important to achieving the levels of integration outlined in the IBM e-business on demand strategy.

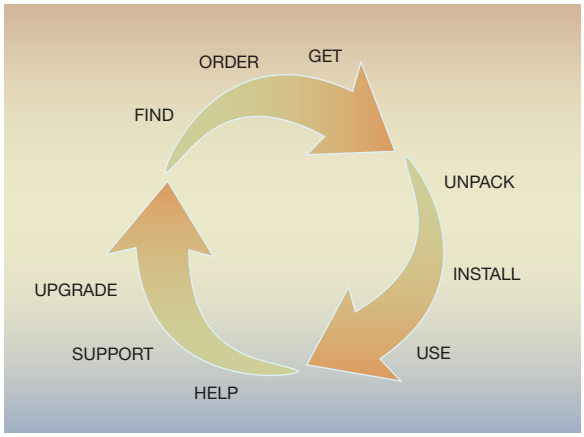
From specialization to multidisciplinary cooperation and role-based work allocation. Traditional product development usually involves "specialists" working on their own, with their efforts only being brought together late in the product development cycle. Unfortunately, because these specialists often have limited interaction during design and development, there are often disparities in their vision for the product, their implementation, and so on. The result of such an approach is often a product that looks as though different factions created its different pieces. UCD, on the other hand, is defined by a strong multidisciplinary emphasis. A team of specialists works closely together throughout the process so that everyone is working toward the same goal and so that the resulting product appears to the customer as if a single team, all thinking alike, designed and developed the solution.

UE drives multidisciplinary teamwork even further by carefully articulating the skills required by each role on the team, exactly which work products need to be led by each role, and finally, which work products need to be used by which role to carry out the work. Whereas UCD reinforces the need to bring all specialists involved in the design of the total user experience together, UE provides the details, linkages, and workflow to ensure that the right work gets done at the right time by people with the requisite skills, and that the work is used properly by the appropriate team members.

From no specialization to specialization in all user experience disciplines. Key specialists in traditional organizations include experts in software and/or hardware architecture and engineering. Individuals with experience and training in these areas of specialization are typically the most influential and powerful in the organization. However, in an organization practicing UCD, these disciplines are equivalent to other key disciplines such as visual design, human-computer interaction design, user assistance architecture, and others.

UE specifies the core roles for a project, together with the requisite skills for each type of role and the necessary cross-team skills. The roles include user experience leadership, market planning, user research, user experience design, visual and industrial design, and user experience evaluation. These roles are central to creating the user experience of an offering with each team member (or group) contributing specific skills, which only they possess. One member of a small team can serve in several of these roles if he or she has the requisite skills. On larger teams, there may be several members in each role, depending on the requirements of the project.

Figure 2 Design touch points in the total user experience cycle



It is important to point out that the roles in UE constitute an advancement over the typical definition and organization of roles across the industry. For example, we created a user experience leadership role with the responsibility for leading the team and driving all aspects of the total user experience for the offering. This is a unique role in the industry. We also include market planning as a core role on the team, given the importance of market and business requirements to UE and the focus on overall business value. This role is typically not included in user experience teams. We have separated what is normally a single human factors or usability specialist role across the industry into two roles—user research and user experience evaluation. This was done to draw attention to the unique skills required for conducting and analyzing user type research versus the skills required for conducting and analyzing user evaluation sessions in a laboratory. We have also combined the software and Web visual design role with the hardware industrial design role. All roles are expected to have a set of core skills, previously relegated to "specialists"; accessibility and globalization are two such skills. Finally, and most important, we have incorporated all other design disciplines, including user interface design, human-computer interaction design, and information architecture and design into a single user experience design role. This ensures that all specialists serving

in the user experience design role have a comprehensive set of skills that none of the constituent disciplines have individually.

From some competitive focus to detailed competitive focus. Most traditional approaches involve collecting requirements and translating them into product design. If any targets for such metrics as "time to install" are required, they are often arrived at by estimation or guesswork. UCD, in contrast, focuses on using the competition as the target. Competition in this context refers to the ways in which the majority of users currently accomplish the specified tasks. If a competitor's product has the majority of market share, it is then seen as the competition. If, on the other hand, there is no current competitor and no computer-based solution exists, then the analog method is the competition. For example, Visicalc, the first spreadsheet program, had to beat the paper-and-pencil spreadsheet techniques that were used before it.

The primary method for performing a task today should form the comparison and benchmark for the design and development effort. Specifying a target for time to install using UCD would involve examining the primary competitive solution to determine its installation time, determining customer satisfaction with this, and then specifying a target based on this information, together with the overall objective for the product's performance versus the current competitive solution.

UE takes this further by standardizing the specific methods used and the detailed measurements taken to ensure that all project targets are based on the best understanding of how users carry out the relevant tasks today. These targets are then tracked against all of the other measurements that are made throughout the iterative user evaluation sessions carried out for the project. Project and executive management are then able to track over time how the offering design is faring relative to the competitive targets set for the project, and can make critical midcourse corrections if such actions are required, based on the information collected. This information is normally only available after an offering has been completed.

From no user validation to engineering user-validated models. Often, traditional approaches to design and development do not include any user validation. In fact, the first customer shipment of a product is often the only user validation. With this approach, each version of the product is the prototype for the next version. Of course, if it takes ten iterations or prototypes to get the design right, that requires ten versions of the product which may mean five to ten years of development effort, assuming that users will wait that long for a product that finally meets their needs. In traditional approaches, if user validation of designs is done, it is carried out after the product design and implementation is virtually complete. Of course, little or no change to the product can be made at this point in the development cycle without significant expense and time.

By contrast, user input is central to UCD, and user evaluation of the design occurs iteratively throughout the design and development cycle. The first versions of the design shown to users are created with pencil and paper, and subsequent higher-fidelity prototypes that users evaluate are also comparatively inexpensive and easy to change. Final versions of the design are fully implemented and are as expensive and difficult to change as those developed using traditional methods; however, very few changes are typically required then, given all of the user input gathered up to that point.

UE includes all of the user evaluation within UCD and enhances it in a number of ways. First, user evaludations are augmented by heuristic expert reviews throughout the project, ensuring that all aspects of the user experience with an offering are evaluated relative to industry and project-level design heuristics and attributes. Second, the metrics from user evaluations and validations in UE are directly linked into the design and project management and decision mechanisms.

From a defect view of quality measurement to an entire system view. Quality in most traditional approaches to design and development is understood to mean the lack of technical defects, such as code defects, that impact the reliability of the product. Some companies go to great lengths to reduce the number of these types of defects to zero, often at the expense of other aspects of quality. In addition, organizations that follow traditional approaches often discount problems encountered by users. If the product works as designed, the problem is not logged as a defect and instead is recorded as "user error" or "working as designed." Little or nothing is ever done about problems in the latter category. In contrast, UCD focuses on quality as specified by the user. In fact, if users cannot proceed to complete a critical task using the product, even if the product is

working perfectly with regard to reliability, it has to be fixed prior to product shipment. The focus on the user view of quality ensures that products and systems work the way users expect them to, as well as at the level of reliability that is desired.

UE again takes an even broader view by considering all measures of quality, from product defect issues through user experience issues as well as the effect on business measures, simultaneously. All of these indicators of quality are tracked together, and a full picture is displayed. Project and executive management have the ability to view quality measures during development as well as after the offering is complete.

From no user measurement to user measurement centrality. In traditional approaches, benchmarks, throughput, and similar metrics are the most important measurements. User measurements are seen as subjective and not useful. In UCD, customer measurements are primary, as it is the users who define whether a product is successful. Core UCD measurements exist that can be taken at various points throughout the design and development cycle, as design input and as in-process indicators for project management.

UE involves not only the collection of appropriate measurements throughout the project, but also the specification of targets for each metric, the careful use of these measures, and the tracking of the metrics over the development cycle of the project. Final measurements for one version of a project become the baseline measurements used in improving the next.

From a focus on current customers to a focus on all stakeholders. The "voice of the customer" credo championed by some traditional approaches focuses on gathering input from existing customers, even when the product concerned may have only garnered 5 percent of market share. Although making current customers more satisfied is a worthy goal, in this example, 95 percent of the market was voting with its pocketbook against the current product and in favor of one or more competitors. UCD focuses on users in the entire market segment, including those users currently using a competitor's product. In this way, the product is designed for the entire market.

Consistent with the other characteristics described above, UE broadens the perspective further by including current and future customers, all types of users, and all stakeholders. It is critically important to understand the needs of all users and stakeholders, especially in cases where trade-offs need to be made. For example, in one company, a collection of tasks may be carried out by multiple specialists using a software product. However, the same product used in a smaller company may involve having a single person carrying out all of the tasks. The design of the offering would have to accommodate both types of situation. In another situation, an individual user may report in user studies that he or she would like to have support for a certain set of tasks. However, the manager may well prefer that the product automate those tasks so that the workload on his or her staff is reduced. This "goal analysis" work with multiple user types and stakeholders provides the mechanisms for gleaning the optimal insights for the design of the offering.

Alignment with e-business on demand. Recently, IBM introduced the e-business on demand strategy. The on demand user experience is a crucial element of this corporate strategy. UE enhancements to the established UCD process provide the elements that are required in order to successfully engineer the on demand user experience.

The e-business on demand strategy addresses requirements from business leaders around the world for "technology to help them integrate business processes end-to-end across the enterprise . . . to help them respond with flexibility and speed to any customer demand, market opportunity, or external threat."[18] UE provides the mechanisms through which these customer and competitor changes can be detected and the processes and methods with which appropriate solutions can be engineered to satisfy customers.

UE is used to collect appropriate information about users in the context of an enterprise (their needs and preferences), to create a rigorous business model, to engineer a user experience for the product, and to evaluate it iteratively to ensure that it will satisfy users. It is flexible and can be tailored to a particular project, large or small, internal or external, product- or service-based. It uses IBM's own sophisticated tools and technologies within an internal Workbench for guidance, modeling, and execution of the process (see the section "Organizational transformation").

Although UE enables virtually all of the core elements of e-business on demand, it is particularly important

to two fundamental elements, integration and autonomic computing.

Integration, within the e-business on demand strategy, goes far beyond connecting computing assets so that they can share information. The strategy calls for a much deeper and wider level of integration, as " . . . processes will have to be integrated from one end to the other—so a customer order, for example, creates a ripple effect in which every part of the organization responds appropriately to the impact of the order: logistics, manufacturing, distribution, individual stores. The level of integration necessary to make this happen is an enormous challenge—but a huge opportunity."[19] This level of integration requires a fundamental knowledge of what needs to be integrated rather than enabling simple integration points. This level of integration requires UE and its focus on user experience modeling. UE ensures that products are designed to be integrated with others that are likely to be used together with them in a seamless, natural manner.

To achieve this, UE is done at the product and solution level. Solutions can also include partner company products. Key UE information is used for all products and components that will potentially be used together in solutions. This ensures that all work relating to the user experience is grounded in the same core information.

The concept of autonomic computing is that routine system tasks and functions within an information technology system should run automatically or with minimal user intervention, much like the autonomic nervous system in humans handles tasks and functions like breathing so that a person can instead focus on cognitive tasks like reading. This attribute of e-business on demand is at the very heart of the principles on which UE is based, namely, the allocation of function to the user versus the computer and the goal of moving as many functions from the user to the system, based on user input. The architects of UE as a process and toolset have worked hard at eliminating routine tasks and automating as many of them as possible, to increase the time practitioners spend on substantive work. UE is required to collect and analyze the information from representative users to determine what to automate. It is also required in designing the automation itself to ensure, for example, that the introduction of the autonomic features is gradual, allowing the user to build trust in the decisions the system is making. The autonomic elements of DB2* Universal Database* (UDB) Version 8.1 were identified and designed in this manner, using the activities and principles underlying user engineering.

Organizational transformation

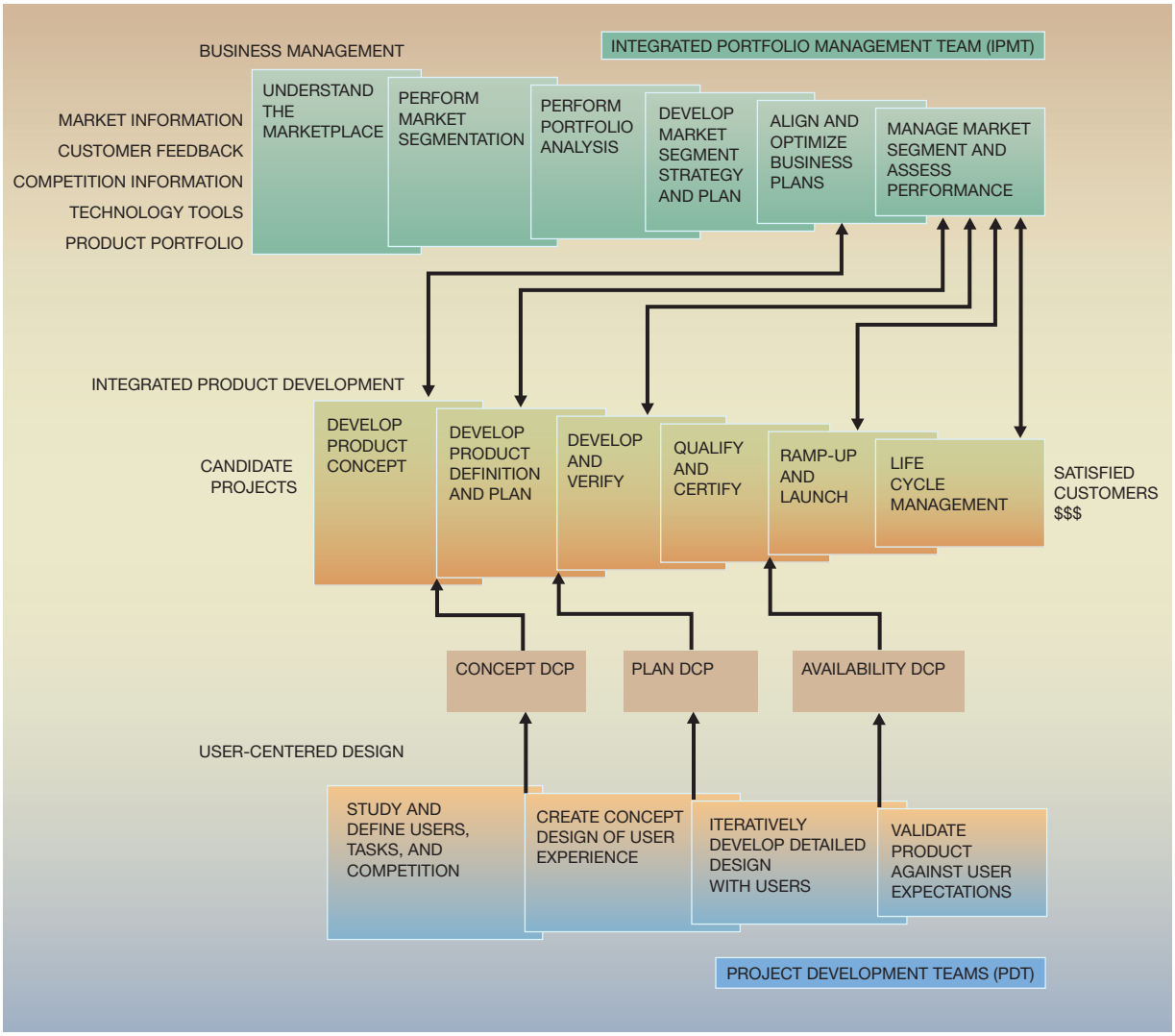
Developing a new process and further enhancing it is only one component, albeit an important one, in the overall strategy of building ease of use into the total user experience at IBM. Organizations need to be enabled to carry out new processes and be provided with leadership and guidance while executing them. The following are the elements of our enablement, leadership, and guidance strategy.

Mission. We created three corporate-wide positions to provide leadership for our UCD and UE programs: First, a Vice President (VP) of Ease of Use who provides overall corporate strategy on user experience and who communicates regularly with executives across the company; second, a Director of User Technologies who leads the integration of ease of use programs into IBM's management system with divisional ease-of-use champions, including regular cross-company tracking; third, a Program Director of Corporate UCD and UE who leads the further development of UCD and UE methods, processes, and tools and provides leadership of and communication to IBM's user experience practitioners.

Process integration. UCD is a core enabling process in the overall integrated product development (IPD) process, which is the business checkpoint mechanism used for all funding and project-milestone reviews within IBM. Having UCD and UE included directly in the corporate-wide IPD process ensures that decisions made about an offering will be required to take UCD and UE information into account. Figure 3 illustrates how UCD relates to the IPD process, and to the overall Business Management process.

Education and training. We developed a set of classes to teach UCD: a half-day introductory class for executives, a one-day introductory class for the entire development and engineering team, and a three-day project team workshop class. Development of a three-day UE class is nearing completion. In addition to traditional classroom education, we have developed on-line self-paced training, and offer monthly on-line education webcasts. The webcasts are two hours in duration and focus on selected methods or tools, with an expert leading the session. We also host a "Make IT Easy" conference several times a year, which includes executive speakers, panel

Figure 3 Relationship of UCD to IPD and Business Management



presentations, demos, exhibits, and education workshops. These are held at various locations and are available to IBM staff and customers.

Communication. It is critically important to have a multifaceted communication strategy in order to transform an organization. We have two monthly newsletters—the *Ease of Use* newsletter and the *User Experience Practitioner* newsletter. The former is available to IBM employees as well as the public, and includes feature stories, success stories, ease-of-use-related press releases, and other information that would be of interest to a broad general audience. The practitioner newsletter is for IBM user experience practitioners and includes community news, information regarding upcoming webcasts, due dates for update reports, brief polls, and practitioner profiles. In addition to newsletters, there is a monthly cross-company webcast which includes corporate news and updates as well as a feature presentation, typically from one of the practitioner teams from across the company on some method innovation, interesting research findings, or best practices case study.

In addition to newsletters and webcasts, we have a comprehensive Web site, www.ibm.com/easy, which provides information to anyone inside or outside of IBM about our overall ease of use strategy, our processes, and the education and consulting services we provide.

Collaboration. Direct collaboration at various levels of the organization with all divisions of the company is required to provide the requisite guidance, management and tracking, as well as continuous improvement. We established three corporate-level teams to drive this collaboration. The first is the Design Consultancy for Ease of Use. This is a group of corporate-level senior experts in the various disciplines of UCD and UE that meets every six weeks or so for a week to look in detail at particular projects and to provide advice and guidance for improvement. This team is under the direction of the VP of Ease of Use. The second team is comprised of "Ease of Use Champions." Each division in the company has an ease-of-use champion, whose role is to provide leadership on UCD and UE adoption, transformation, education, and tracking. These champions are typically at the director or vice-president level within an organization and handle this role in addition to their "regular" job. The Director of User Technology leads this team and runs a regular Ease of Use Progress Management meeting for the champions to provide an update on ease-of-use progress within their divisions. Critical issues are identified at this meeting, and are subsequently tracked and brought to a resolution. Key connections between related projects are made and best practices are shared across divisions by this team. These connections and best practices are the focus of periodic (usually quarterly) full-day meetings to facilitate information sharing among champions and with the corporate leadership team.

The third team is the UCD/UE Advisory Council. This council is comprised of user experience practitioners from across the company who, in addition to their project work, have the responsibility to further develop UCD and UE methods, processes, and tools. This council is led by the Program Director of UCD/UE and has three types of members: discipline leaders, division representatives, and geography representatives. This team has strong experience and skills in the various aspects of UCD and UE from their day-to-day work on hardware, software, and Web and services offerings, and typically forms work groups to investigate areas that need guidelines, standards, or tools developed. The team meets monthly by teleconference and quarterly for more in-depth meetings.

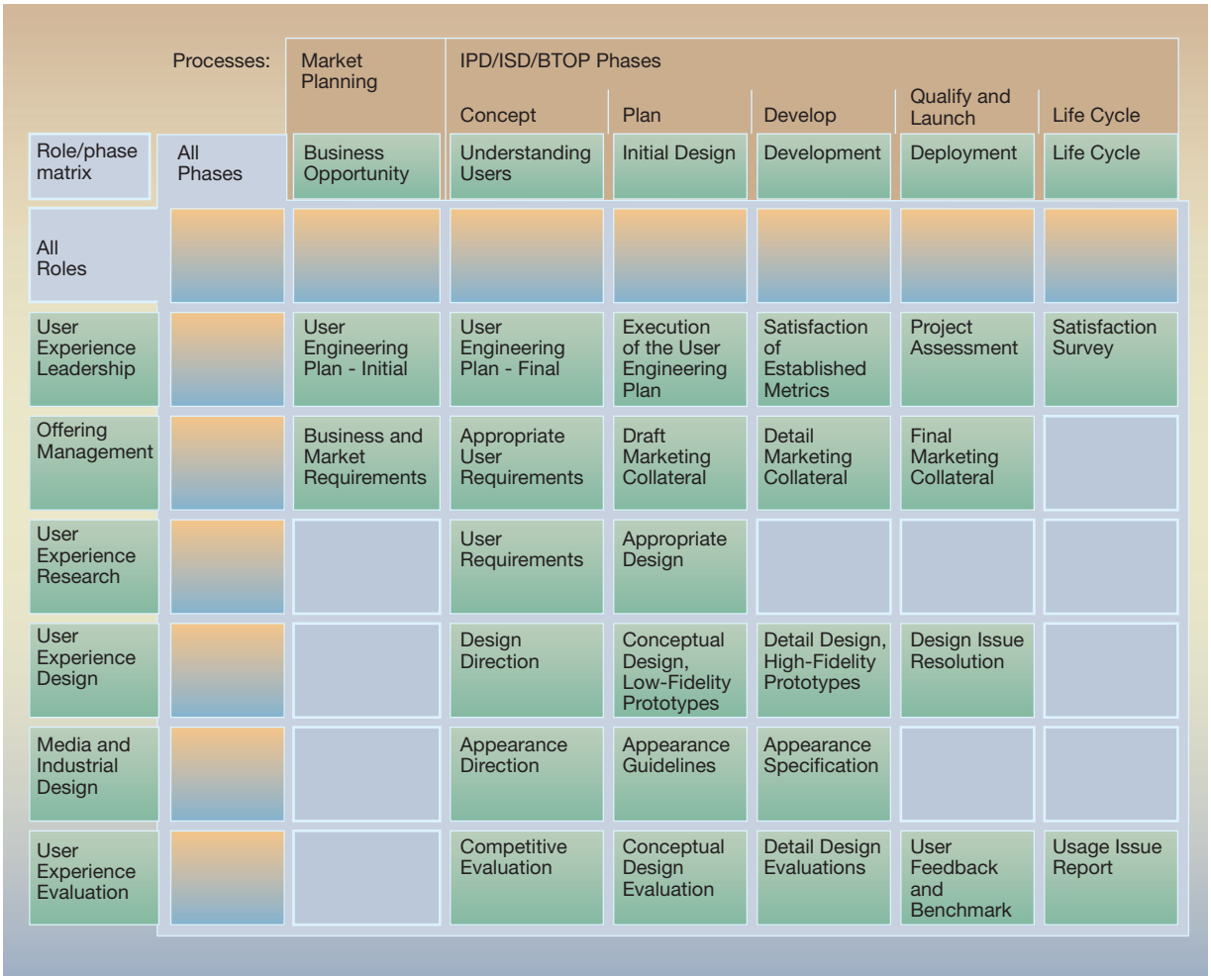
Tools and technology. We subscribe to the "tools and not rules" approach to enabling processes. As such, we have built a UCD/UE Workbench that supports and optimizes the work of user experience practitioners across the company. This Intranet Web site includes practitioner information and tools for user experience teams and management. It includes information on getting started, process information, a database for recruiting participants for studies, tools for Web surveys and other remote studies, tools to download for electronic card sorting, task modeling, digital session logging, etc. (see "Optimize the performance of UCD and UE"). Metrics from across the company are collected and reported on the site. It also includes news and webcast information and replays.

The initial releases of the Workbench were designed and developed by using the UCD process, and the next release will use the UE process. It is built using IBM products and technologies including WebSphere*, DB2 UDB, Lotus Domino*, Lotus Sametime*, and Web Services. The design objectives for the Workbench are outlined below.

Provide a single source of UCD and UE information. We needed a single location for all information relevant to UCD and UE that was easy to find, easy to navigate, had the right level of detail, and provided the right information to get started with the process. In addition, this information needed to include the ongoing performance support information required for help in carrying out the process. This objective was addressed by providing the most intuitive URL to locate the Workbench (the Intranet URL w3.ibm.com/ucd), a navigation mechanism that organized a large set of information about the process into a set of vertical and horizontal tabs (see Figure 4), and streaming audio-video education for teams to get started with the process, with in-depth activity-specific performance information and tools.

Optimize the performance of UCD and UE. Many of the UCD methods used across the industry are quite labor-intensive. We therefore wanted to provide tools and technology to eliminate time-consuming tasks, make other tasks more efficient, and automate others so that our user experience practitioners' time and quality of work would be optimized. We eliminated one of the most time-consuming and labor-intensive activities—that is, the recruiting of user par-

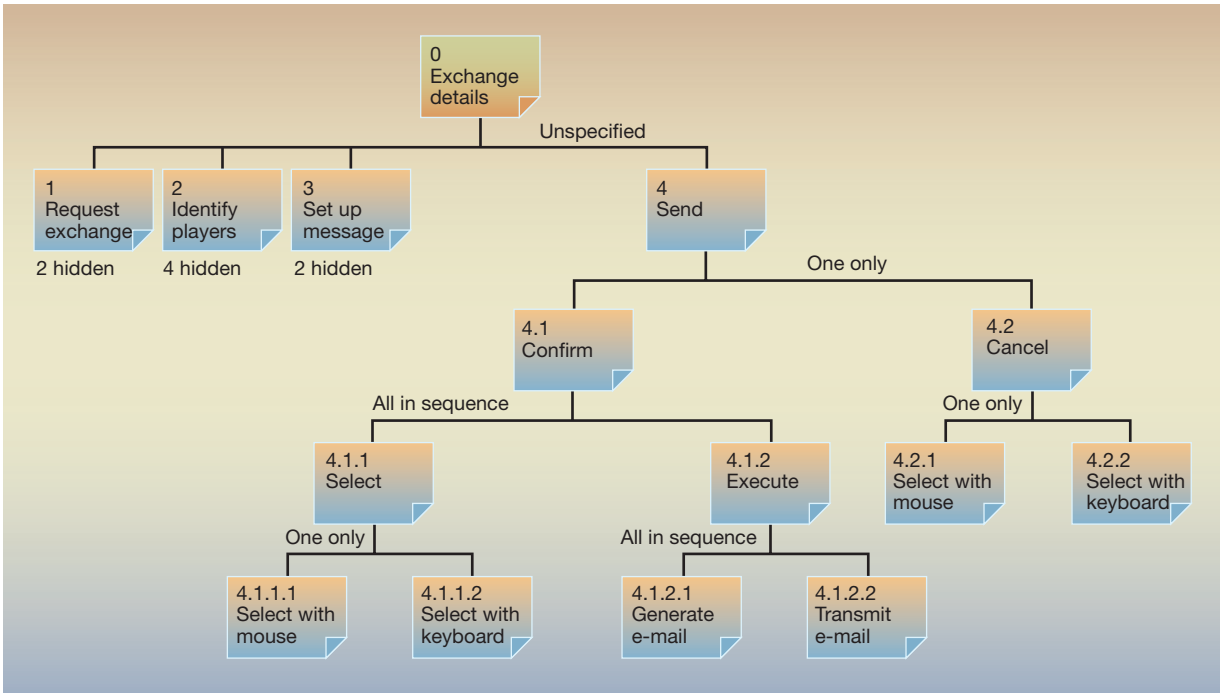
Figure 4 UE process navigator role-by-phase matrix



ticipants for our UCD and UE studies. We developed a form on our Web site for potential participants to register to be considered for studies and built a query and tracking application for our practitioners to use in selecting, inviting, and managing session participants.

Task analysis is another traditionally laborious method for which we developed a practitioner tool. The TaskModeler (see Figure 5) enables practitioners to collect task information and flexibly build, analyze, and refine task models by using familiar representations. Card sorting is another method that is a perfect candidate for partial automation. The technique normally involves giving users a stack of cards with all of the items that will go on a Web site navigator, for example, and asking them to place the cards that they feel belong together in piles. The aggregate results of this exercise are entered into a statistical software package, which then performs cluster analysis on the data and comes up with the group clusters. We have developed a tool that automates the analysis by doing the cluster analysis "under the covers" so that the practitioners can actually just move slider bars to select how many categories they'd like to see, thereby determining which items should be in those clusters, and in turn, which elements should be considered for grouping together in the user interface. In the output diagrams (see Figure 6), the group membership of the cards is indicated

Figure 5 Example of Task Modeler tool output



by line colors, shading, and spatial separation. The alternating blue and red text and line colors indicate low-level groupings, and the orange and blue background colors indicate the high-level groupings. The criteria for group membership are determined by two thresholds, indicated by vertical bars, a low-level threshold in green and a high-level threshold by magenta. The groupings change dynamically as the bars are moved, providing immediate visual feedback for finding the most appropriate groupings. Other tools are provided to encourage organizational learning, worldwide team communication, and the sharing of best practices regarding UCD and UE.

Provide project and executive management tracking. A common challenge experienced across the industry with UCD processes concerns how to manage and track the user experience aspects of projects. We therefore developed a single database that captures critical user experience information about all projects across the company and provides the ability for project and executive management to track the progress of UCD and UE within their organizations.

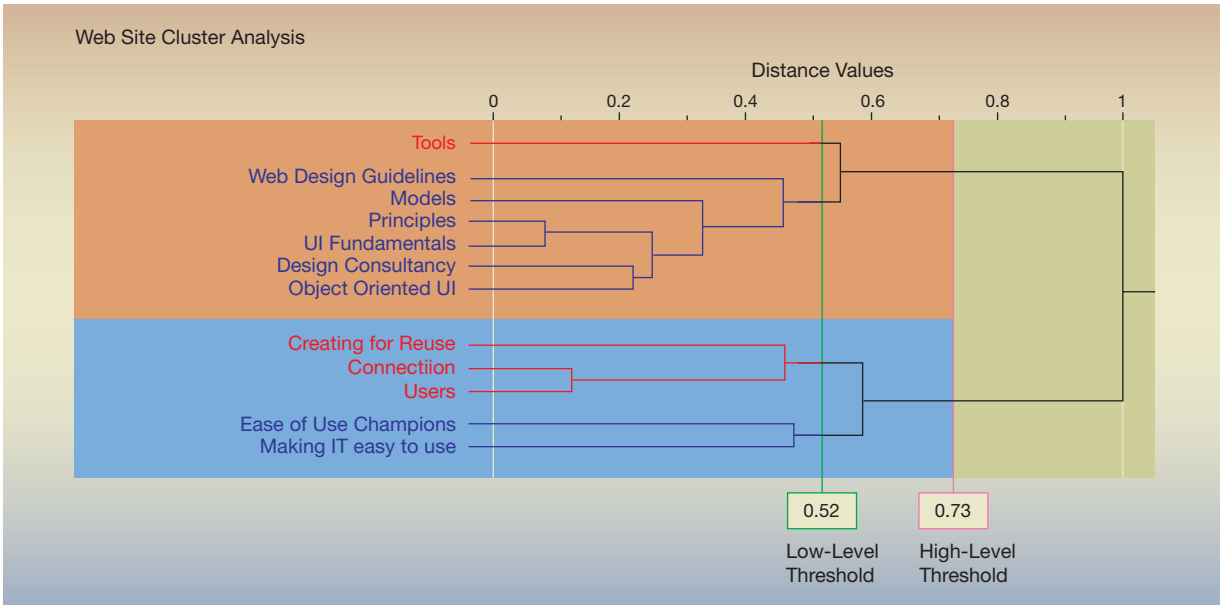
All of these factors combined have made our introduction, deployment, and management of UCD at IBM highly effective. The same mechanisms are being used for the introduction, deployment, and management of UE.

Overview of the issue

This issue of the *IBM Systems Journal* includes papers on processes, methods, case studies, techniques, methods, and research studies related to our UCD and UE work.

The first three papers provide an overview of the field. In "The evolution of user-centered focus in the human-computer interaction field," Karat and Karat (two widely published professionals from our Research Division) provide a cross-industry historical view. It describes the origins of the field of human-computer interaction, outlines the ways in which the field has changed over the past 20 years, and identifies a series of current and emerging focus areas and trends in the field. As pointed out above, halfway through this period, the IBM version of UCD was developed. In contrast to the general trend in the industry outlined by Karat and Karat, the IBM approach was very specific about the definition of UCD, the roles and processes that comprise it, as well as

Figure 6 Example of EZSort tool output



its core principles and methods. The major enhancement of our UCD process, called UE, is even more specific and detailed in this regard.

The second overview paper, "Delivering expected value to users and stakeholders with User Engineering" by Berry, Hungate, and Temple (three members of our Corporate User Experience organization) provides a detailed description of our new UE process. A case study is also provided, which examines the use of UE methods in the redesign of the business partner Web experience on the IBM Web site. The third paper, "Usability and design considerations for an autonomic relational database management system" by Telford et al., provides an in-depth description of the autonomic computing elements of IBM's e-business on demand strategy and provides a case study of the application of UCD with selected UE methods to build numerous autonomic components into our DB2 UDB product. The authors of this paper are from our Autonomic Computing organization, our Research Division, and our DB2 product team.

The next three papers explore methodological issues. The first, "Methodology for remote usability activities: A case study" by Krauss (of our Storage Systems Division) outlines the use of a number of tools provided internally to IBM via the UCD/UE Workbench. These tools facilitate the remote use of UCD and UE methods throughout the development cycle, that is, with the user experience practitioner and the users in different locations. An illustrative case study of the use of these remote methods is presented on the design of the Design Solutions application for IBM MicroElectronics Division customers within the IBM Customer Connect Web portal. The numerous benefits of this technology are detailed, as are the challenges involved. The next paper, "Iterative development in the field" by Greene et al. of our Research Division describes a contrasting method of carrying out UCD called Iterative Development in the Field. In the last paper in this section, "Extended prototyping," Van Buskirk and Moroney (of our Printing Division) outline a variety of innovative uses of prototyping and illustrate them with two print-interface case studies.

The next three papers describe UCD work in challenging design environments. The first paper in this group, "Developing a voice-spelling alphabet for PDAs" by Lewis and Commarford of our Pervasive Computing Division examines the challenge of entering data into small pervasive devices like personal digital assistants (PDAs). The second paper, "No wires attached: Usability challenges in the connected mo-

bile world" by Gorlenko and Merrick of our Corporate User Experience team explores the ease-of-use challenges of designing for the fully mobile wirelessly connected world. The final paper in this section, "Developing accessible software for data visualization" by Willuhn et al. of our Software Group laboratory in Germany describes approaches for the design of accessible software for highly visual interface products.

The final two papers in the issue provide case studies on the application of our methods. In "Access ThinkPad: The right information at the right time and place," Sawin, Calcaterra, and Olka describe the use of UCD with selected UE methods in the design of a core element of our ThinkPad* notebook computers. In "Personalizing the user experience on ibm.com," C. M. Karat et al. outline work done on personalizing the user experience of our IBM Web site. The book review section of the issue also includes a review by Tharon Howard of the book *User-Centered Design: An Integrated Approach* (Vredenburg, Isensee, & Righi, 2002) and a review by Heather Kreger of *Out of the Box: Strategies for Achieving Profits Today and Growth Tomorrow through Web Services* (Hagel, 2002).

For additional case studies, research, and information regarding our UCD and UE program at IBM, see the special issue of the *International Journal of Human-Computer Interaction* entitled "Designing the Total User Experience at IBM."[20] For more information about IBM's work in this area, see www.ibm.com/easy. In addition to detailed information about our processes, the site also provides mechanisms for subscribing to our newsletter and for getting involved in our user studies, registering for our Make IT Easy conferences, and learning about the education and consulting services we provide for UCD and UE.

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