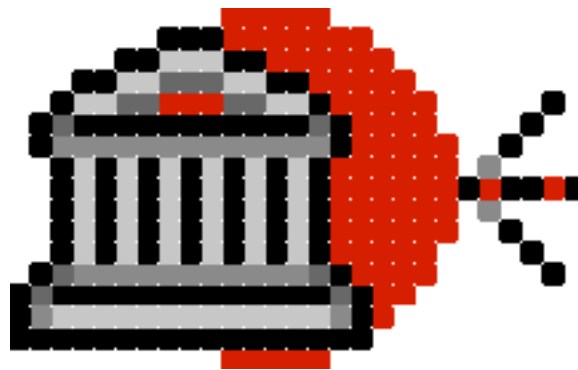


# Palm Banking Client

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## Evaluation Report



User Interface Design and Development  
Marcel Büchi  
25 March 1999 - 23 April 2000, Revision 1.0.1

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## Introduction

This third report describes the evaluation of the redesigned Palm Banking client (design report), which sports a greatly improved user interface and interaction style. During the initial analysis (see analysis report) and iterative re-design real users were not heavily involved in the development process.

To increase the effectiveness of the evaluation a combination of two methods is proposed. First, usage simulations with HCI experts reviewing the documentation and second, low-fidelity (lo-fi) usability testing with potential customers will be conducted, to obtain as efficient feedback as possible in the short time frame and with the available resources. The field experiments based on standard tests followed by a brief interview are used to verify the experts' suggestions. Part of the usability tests should be done in a professional laboratory with video equipment.

I was really curious to prove the usability of my redesign including new ideas on how to offer financial services for customers on the move. Some design aspects such as the navigation with pop-up menus I judged skeptical and the time to involve prospective users was overdue. The evaluation of the mobile companion for the Telebanking application – to instantly manage your finances and investments, anytime, anywhere – may begin.

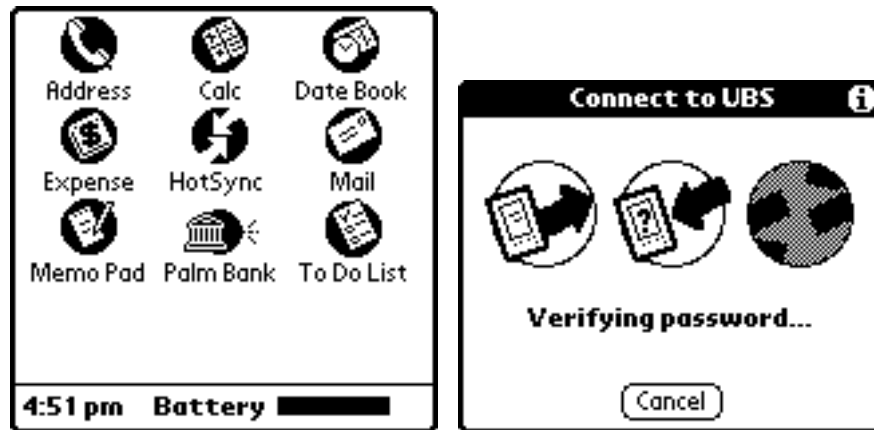


Figure 0.1 Application launcher with Palm Bank icon and opening of a connection

# 1. Evaluation Techniques

## a) Choice of Methods

For the evaluation of the Palm Banking client I decided to use usability testing and expert reviews. I have chosen these techniques as a result of my knowledge and excellent experience with them. The user interface design team which supported me partly during the evaluation also promotes a mix of methods to accomplish complementary results. An interpretive evaluation was not suitable because of the lack of a self running software prototype to get an understanding of the real world. Cognitive and pluralistic walkthroughs were rejected in favor of a combination of expert reviews and usability tests with prospective users.

The lo-fi user testing was performed by monitoring consumers' performance on carefully constructed benchmark tasks in the field and only notes were taken in comparison to the video and protocol recordings in a lab. To gather information about the users' attitude towards the system, investigations with semi-structured interviews were prepared (see appendix B). Unfortunately I had not enough time to ask the questions after every test and I decided to integrate the feedback in chapter 2.

The usage simulation should be done by four colleagues with a human-computer interaction background, but due to heavy workload the evaluation had to be postponed and is not included in this paper. Their aim was to review the design report and to spot usability problems based on their broad experience with bank related systems. They were requested not to provide a detailed report as usual but to write their comments and suggestions into the report. The first analysis paper, the animated demonstration and a draft of this document was handed out to them as well.

## b) User Involvement

The recruitment of real users was no problem and I could choose from a pool of novel and experienced Piloteers with different levels of Telebanking know-how, various ages and gender. Some test persons used another or no PDA at all and the home banking experience ranked from none to Videotex respectively Internet. During two lo-fi tests a couple worked together mainly because of the English user interface and tasks descriptions. The characteristics of the seven test users are described as follows:

- Three female (43%) and four male (57%).
- One 20-29 (14%), four 30-39 (57%) and two 60-69 (29%) years old.
- Three had a PalmPilot or Palm III (43%) and one a Psion 5 (14%).
- Two had a mobile phone (29%), but not for PDA communication.
- Two used Internet banking (29%) and one Videotex (14%).
- Four Mac (57%) and three PC (43%) users.
- Five used the Internet at home or at work (71%).
- Three computer beginners (43%) and four experts (57%).
- Two UBS employees (29%), one GUI Designer (14%).

### c) Constraints, Purpose and Validity

Time was the primary constraint for the usability tests and data analysis since most people were very busy but nevertheless interested in the project. For two empirical test I was given an explicit time limit. For the field observations no video camera was available to log user interactions. The off-line tests should take place in the user's familiar environment whenever possible. The English documentation was a more or less severe handicap for about half of the people

The purpose of this evaluation is to find usability problems and to improve the redesigned Palm Banking client. Engineering towards a target is expressed as metrics in the form of the expected success rate for the prescribed benchmark tasks. A percentage bandwidth is defined between novice and expert users to measure the ease of use against the my anticipated estimates.

<b>Difficulty</b>	<b>Novice-Expert</b>	<b>Tasks</b>
Easy	100%	4
Medium	90-100%	9
Difficult	80-100%	4
Very difficult	50-75%	3

Table 1.1 Planned level of successfully solved tasks

The expected validity of the findings should be very objective because of two different evaluation methods and the involvement of a small number of real users and HCI experts. For the measurements there may be biases in the data collection since there is a danger to influence or help the users too much during the test process. Selective data gathering by the reviewers and manipulation of the evaluation situation by users or evaluators must be considered too.

For the detailed task descriptions including complexity see benchmark tasks in the appendix A.

## 2. Redesign Evaluation

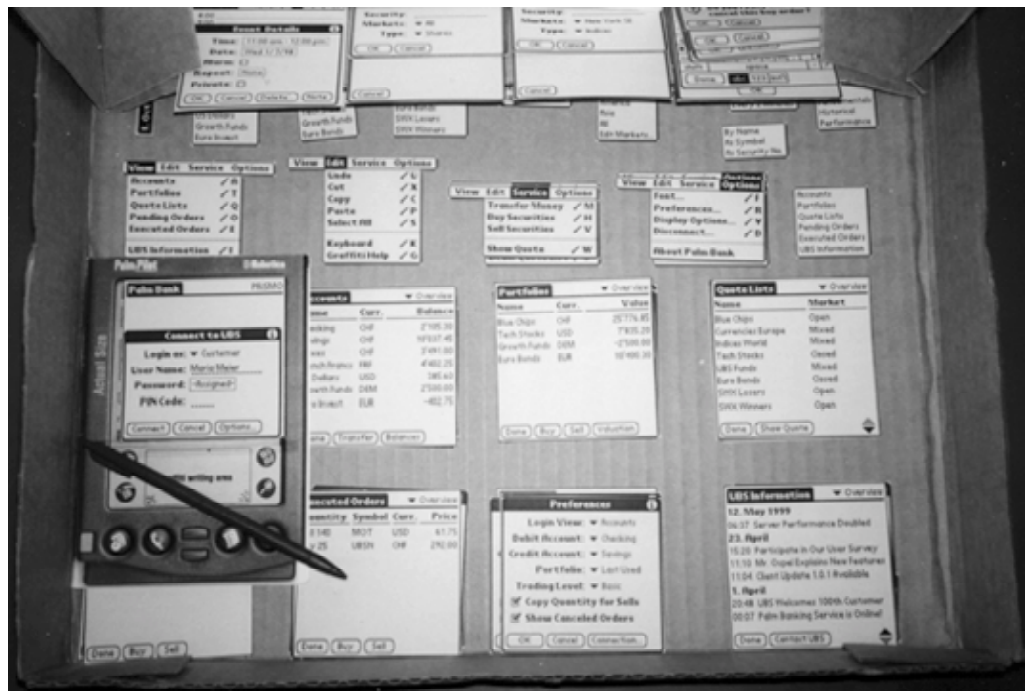
### a) Usability Testing

The method for the evaluation I carried out was lo-fi usability testing with prospective consumers and paper screens. At the beginning of the usability test users were briefly introduced into the project and the test procedure. They were further informed about the aim of the test and their rights, including privacy issues and the freedom to withdraw from the trial at any time. No test session had to be stopped although some users skipped one or more tasks for which they could not find a solution.

All trials were managed with direct observation and subject to the Hawthorne effect. Even though I took notes, the record of the observations was incomplete as a result of the single pass at the data collection.

The requisites for all tests were a Palm III Organizer with two styluses, a PalmPilot prospectus and 1:1 screen mock-ups for most relevant user interfaces which were printed in black on green paper to resemble the real display. I played the computer and handled all communication with the test person. Everything of the paper prototype was hidden except for the PalmPilot prospectus showing the handheld device at its actual size, the stylus and the screenshots for the current situation.

Since the system is still in development not all possibilities were designed and some screens were missing during the evaluation. The printouts of the user interface were organized by tasks to give fast access during the evaluation. Inputs were directly written on the digitizer and simultaneously spoken out, while selecting and tabbing was done with the pen.



Picture 2.1 Cardboard box filled with screen stacks and PalmPilot mock-up including stylus

The duration of the empirical testing ranged from one to one and a half hour. Appendix A contains the benchmark tasks the users performed covering almost the entire client functions. These tasks to evaluate the software were selected from my extensive Telebanking experience and incorporate a broad portfolio of everyday jobs mixed with infrequent, more complicated ones. The interview took approximately 15 to 20 minutes (see appendix B).

## **b) Analysis of Results**

The chosen evaluation technique proved to be sufficient for the virtual banking system. After the first two usability tests the benchmark tasks had to be formulated more precisely and several missing screens had to be painted to better accommodate all interaction possibilities. In the end the five tests delivered enough information and I believe the main usability problems were identified.

The trials were in contrast to the the planned expert reviews more subjective to influences by the tester. No retrospective was done after the usability tests due to the lack of video recordings. The lo-fi tests were easy and cheap to conduct and very effective at this early design stage.

All users except two had seen the animated Palm Banking demo in advance and most people checked out the functionality by exploring the various menus, pop-ups and buttons. The task to buy securities revealed the high complexity and information density of stock exchange orders. The identified problems, questions and comments are listed below for each affected benchmark task or topic.

### **2. Login and demo mode**

The guest login was not associated with the demo mode, so the wording and/or presentation must be changed. People guessed the meaning of “Guest” to start the product trial.

### **3. Account statement and details**

Currency not shown in statement therefore account info checked. Account information displays currency as well as branch, and the application is considered for only a small number of objects. What is a UBS Multimat?

### **4. Account balances**

Sum symbol in button not obvious or guessed. Investment type and currency icons not clear. Present the total under the account and portfolio overview lists (maybe with a pop-up menu to select the currency). But what happens with the total when the list doesn't fit on one screen?

### **5. Account information**

Utilize label Type instead of Category identical to the Account Balances (also applies to the Portfolio Info).

### **6. Account transfer**

Account selections with pop-up menu not intuitive for non PalmPilot user. The task sequence lead to uncertainty because the transfer must first be checked (what now, I want to transfer money) and then be placed (has the order been executed after the exchange rate is presented). This is a common problem for two step transaction and can be diminished by two different buttons. The label of the button unfortunately toggles and the Palm OS has no disabled interface elements (again due to space constraints). Be consistent for all orders and provide a confirmation when the user cancels a checked order.

**7. Portfolio statement and position details**

Navigation from account to portfolio part causes a definitive navigation change from pop-up menus to drop-down menus (portfolios overview not found). What means “Share” in position details? Port. Share, % of Port. or Port. % might be more understandable. The price label suggested the current trading price which was reachable in the full quote via the Quote button (e.g. previous close or price with time stamp).

**8. Portfolio valuation**

What is the meaning of the sum symbol? Valuation dialog displays the investments by currency but what about bonds. How do I continue? Help icon recognized to get assistance. Context-sensitive aid solves the problem to open the view sorted by type. Investment type icon unclear. Sum and diamond icons are problematic. Use Total, Value or Valuation (Portfolio Value) instead of sum symbol, but not enough space. Remove Disconnect button? The total row could be displayed bold.

**9. Sell securities from the portfolio**

Good reminder for position quantity. Unsure with valid for today (date from equals to?). Quantity interpreted once as denomination.

**10. Quote list and detailed quote**

What is the meaning of “SE” in “Swiss SE” (stock exchange, trading place)? What about the word “mixed” under market? Quote icon not international. The Bid/Ask output field uses a slash to separate both values which are also used for prices with fractions.

**11. News headlines and story**

NSCP guessed as symbol for Netscape. Afternoon story selected with similar headline. News icon guessed, design it clearer. News information not found in the menu. Why can I only access news information after looking at a quote?

**12. Chart**

Dow Jones (INDU) not found. Is there a direct access to chart without seeing the full quote? Will the trading volume be presented for stocks as well? Yes, possible except for indices through the scroll arrows or the hardware up and down buttons.

**13. Add security from quote list**

Symbol SCMN for Swisscom N not obvious. Why not add the security automatically since only one match was found? How are dynamic quote lists like SWX Winners or Losers defined? What is the Show button for, show quote? Portfolio and quote list with same name mixed confused test persons. Dynamic stock lists are managed with the desktop client or maintained by UBS.

Why does the dialog to add a security only has a Cancel but no OK button? If only one security matches the search criteria it is added without the additional chooser dialog. A single account, portfolio or quote list could automatically be selected too. Does this make sense?

**14. Cancel pending order**

Unfamiliar with the words pending and executed for orders. No Cancel Order in menu. Cancel... button not clear enough, use Cancel Order.

The confirmation message to cancel a pending order must have a Yes/No button pair instead of OK/Cancel (cancel in this context should clearly stand for no).

Even with a Cancel Order entry (/J) in the Service menu, the user must always choose an order first (present the pending orders or display a dialog with the same orders). Cancel Order dialog with a Cancel button to escape? Customers should not be animated to cancel their stock exchange orders.

Why can't I just edit a stock exchange order instead of being forced to cancel the order and create a new one? Allow editing of pending orders.

#### **15. Executed orders**

How much did this order cost me including all charges? Combine pending and executed orders in one single overview. Do I have to sell the order with the offered Sell button? Eventually complement order details with basic calculation data accessible by toggle icons or a pop-up menu.

#### **16. Buy securities**

No access to menus and quote lists to get market data. How do I write a “/” for the price limit with Graffiti? Forgot to set validity. How to search for a security if symbol is not known?

Provide meaningful defaults for the validity of an order (maybe even customizable in the preferences) and extend the Set Validity dialog so that the user can set both dates in only one dialog step. Allow prices for example to be entered either with fraction stroke as 36 1/4 or decimal point as 36.25 for US securities.

Use a trigger selector in place of the security input field (display -Not selected- if not chosen). The Show Quote dialog is opened if the security is undefined for the requested full quote screen.

#### **17. Preferences**

Assumed to be in the Options menu but not found. Is “Last Used” the name for a portfolio? I would like to express all stock prices in decimals.

The preferences appear logically unstructured and the grouping is not clearly visible. Either separate the settings in two dialogs (account & portfolio and quote list & stock exchange orders) or divide the screen in different views like the Connection Options by toggle icons. Use bold labels to group items and apply a plain font for check boxes.

#### **18. Display options**

Strange wording for label “List View”. How are updates visualized? Visualize quote updates with reverse video. Update interval not displayed within list. Place an Options button below every quote list instead of the menu entry under Options.

#### **19. UBS information and contact**

Are sender details and sent messages stored?

#### **20. Logout**

Was not sure about the Disconnect button on the UBS Information screen. Is the Disconnect button on every overview screen necessary? User can simply turn the PalmPilot off to logout. Put Disconnect into the navigation pop-up menu. Is the disconnect dialog and security question to logout really necessary?

Skip “Disconnect from UBS” dialog and show confirmation alert instantly (e.g. Do you really want to disconnect from UBS after 3:21 minutes?). Display of online time necessary?

**Navigation**

The title “Overview” together with the upper right navigation pop-up menu was confusing. Since the menu to switch views displayed an ever changing selection, users were unsure about its functionality. On the second level (with statement or quote list) a go back possibility was desired (plus a Home button for the main page).

The navigation between functionality modules requires the user to either step back via pop-up menus, to use the menu bar or menu shortcuts. No browser-like Back button is provided to get up in the hierarchy.

The sequence of dialogs opening sub-dialogs is not consistent and not always predictable (e.g. “Quote” vs. “Quote...” buttons). More detailed window charts are required on the deeper levels to clarify the logic.

Successful navigation with pop-up menus until a problem arose, then switch to menus only after this dead end situation.

**Help**

The help icon in dialogs was interpreted by a non PalmPilot user as information symbol but not for user assistance. True Piloteers knew about the help facilities.

**Menus**

Even experienced PalmPilot users did not frequently access the menu bar during the test, as most Palm OS programs are usable without menus.

**General remarks**

Screens are readable and green is very good as background color. The critics didn't complain about any visual sugar and the overall aesthetics conveyed positive feelings.

The security symbols are better guessable than the nine digit security numbers, but not all financial instruments have a stock exchange symbol. Symbols are usually very short, consist of letters and can be readily kept in memory or being remembered.

Click on the form title tab to see the transaction time stamp was used once by accident (more a hidden feature). Some lists are missing the header lines and for consistency, the design should provide equal size for similar dialogs.

A critical task is the input of a security for buying stocks (lookup or selector field). Different choosers were shown to select a security for a search (lookup and add security, show quote) and from portfolio positions (sell securities).

**c) Interpretation**

During the evaluation two user behaviors became evident. One group followed strictly the given tasks while the other users were exploring the program and for example checked out the available menus and buttons. Usually more experienced customers took the trial and error approach to learn about the possibilities but also novices played with the user interface.

The complexity of the program was manifested by the full menu bar. The use of the same names for portfolios and quote lists in the task description resulted in minor confusions. As mentioned earlier, a German version of the interface would have been familiar for most test persons than the available English one.

People had as expected the biggest problems with the navigation, especially when trying to switch from one functionality part to another (e.g. from the account to the portfolio part as in task 7). The navigation pop-up menus were not always intuitive and the possibility to go one level up in the hierarchy was frequently overseen and users mostly preferred the View menu from the menu bar. The conceptual model behind these navigation pop-ups on the overview and details level was not understood. Users wanted a “home page” together with a “go back” function (similar to a Web browser). After a test person didn't succeed to navigate with a pop-up menu she then automatically switched to the drop-down menus for the remaining tasks as a typical pattern.

The late addition of the not required services to open the account balances and portfolio valuation was the second most task that lead to trouble. This features turned out to be problematic because they were added to the redesign in the last minute, and were due to space constraints implemented as buttons with the sum symbol. Few users recognized or guessed the icon to get the requested information (the difficult tasks 4 and 8). Design tip: don't add functionality late in the design process just because you think it's a cool feature, without carefully considering the whole user interface. When designing desktop applications the interface preparation for future operations is much easier than for a hand-held GUI, where screen real estate is an essential design element.

Additional research is needed for the security input respectively selection procedure for buying stocks. The possibility to enter a symbol, company name or security number to initiate a search request after pressing the Check or Quote button were simply not clear. Users expected a security lookup or choice options that was not visible for them. A professional buyer has less problems entering stocks while novice users prefer the selection after a search query. In this case I missed the opportunity to respect the two different user levels (basic and advanced trading level in the preferences).

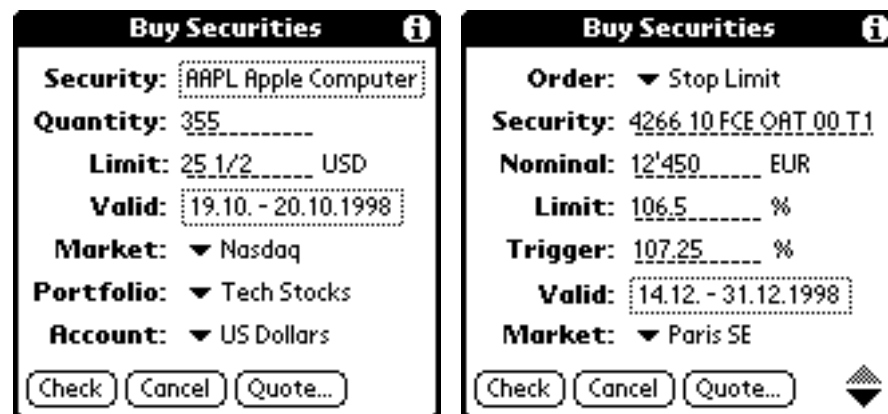


Figure 2.1 Different security inputs for basic and advanced trading mode (selector vs. field)

The menu bar was used to open the View menu for changing the overview screen and the Options menu to customize the settings. The operations from the Service and Edit menus were never executed.

It was interesting to see the various ways the benchmark tasks were solved. Sometimes the users found an unexpected answer to solve their problem correctly which I didn't predict in the task descriptions. These short cuts were possible on account of the test data and flexibility of the program.

Difficulty	Novice-Expert	Tasks	Results
Easy	100%	4	100%
Medium	90-100%	9	97%
Difficult	80-100%	4	85%
Very difficult	50-75%	3	73%

Table 2.1 Planned and measured level of successfully solved tasks

I did not differentiate the conclusion by knowledge groups due to the few trials and balanced experience of the users. All easy assignments were solved without problems while the other difficulty levels revealed more or less the expected success rate. The question about how to access the demo was responsible for the not fully perfect result on the medium tier. Users either answered this issue incorrectly or simply ignored the query. The difficult benchmark tasks revealed more problems than anticipated because of the non intuitive sum buttons. The level rated very difficult caused less trouble and the restrictions prescribed for the buy order required the most attention.

The task 4 and 8 (sum button), 13 (add security) as well as 17 and 18 (options) were once not resolved. Number 2 (demo mode) was partially finished and 16 (buy securities) was correctly submitted by solely one person. The other users disregarded to fill out the validity or correct portfolio, or in one case failed to copy the correct price limit. This reiterates the importance to propose meaningful defaults for stock exchange orders.

#### d) Limitations

Effective low-fidelity usability testing requires a deep understanding of the software to be evaluated and a minuscule test preparation when playing the silent computer. Expect that at least one or two screens will be missing during each trial because you can't predict all user actions.

Form filling is notably difficult since a lot of interaction takes places which is not under your control. For me this is the main limitation I experienced during the evaluation. Software with navigation and information retrieval (e.g. overviews, statements and details) is without difficulties. But systems depending a lot on interaction dialogs and form fills, which require the user to enter data (e.g. account transfer and stock exchange orders), are far more complicated to foresee and test without interfering with the user's behavior. In every experiment I always had to explain at least once the actual contents of a dialog where the customer could type in data.

Be ready for everything and don't forget that even your paper computer might crash, since a strong sneeze could blow away your screen stacks or your cardboard box might fall down.

A good advice is to number all screens on the back, to store them in card staples chronologically for the benchmark tasks and to make a plan of your card-board box' organization. You could also draw a hierarchical system map to understand the interaction and navigation between all screens.

A usability lab together with 6-8 real users had been ideal for this experiment to gain more knowledge but would not justify the additional cost. No performance aspects can be measured with this method and don't use pop-up menus with a preset selection which disturb the user.

Another handicap was the English version of the program and my explanation or translations affected definitely the tests. To take notes while concentrating on the session was not easy at the beginning, yet a good organization led to acceptable protocols. People got used to the relatively slow but human processor.

Interpretive evaluation to understand better the real world cannot be achieved with observation or usage simulations. To cause as little disturbance as possible a prototype running on a PalmPilot is essential to learn, how users work with the system in their natural environment and how the use of this system integrates with other activities. Improving the design to fit the mobile consumers environment was almost impossible although half of the tests were done at the user's familiar home.

For a further study I would involve HCI experts for usage simulations and do supplementary usability testing with the re-redesign in a professional laboratory and real consumers. Interviews with these test persons and online user surveys to reach more people will help to shape the product and better meet the customers' opinions and their requirements.

The results from the evaluation are very encouraging because merely a minority of the tested users own a portfolio or have ever placed a stock exchange order. Evaluation plays an important part in the development process and can uncover usability deficits early during the design. The software engineering principle, that the longer a problem remains unrecognized in the system the more expensive it will be to fix the defect later, also applies to user interface design. I also learned once more that there does not exist the "perfect" design, but some interfaces are better suited for the user, her work, her environment and the used technology than others. This early evaluation also helped me to verify the user requirements and to test out ideas quickly like the date setting for the validity of a buy or sell order.

Many supplementary screenshots were required for these tests so the final mock-up was flexible enough to accommodate the different working styles (e.g. right dialog of figure 0.1). The benchmark tasks were gradually enhanced to better suit the users' environment and language. The tests persons enjoyed the one hour usability session and were surprised how intuitive the software felt. They were also impressed by the novel appliance of the PalmPilot and today's technology.

### 3. Summary

#### a) System Analysis

The original system was not designed as a genuine PalmPilot program respecting the design constraints (i.e. small screen size) and clearly lacked the usability and elegance of the built-in software. The user interface was an exact copy of the browser-based solution with frames and required too many interactions to perform everyday functions, which were largely hidden behind menus.

The navigation between screens was not natural and numerous actions ended without a path to continue the work flow. Order dialogs required too much handwriting input from the users and they were forced to memorize more information than necessary (e.g. lengthy account numbers). The Palm user interface guidelines were severely violated and the look and feel, including the wording, was largely inconsistent. The application offered too much functionality, was complex and cumbersome to pilot.

A product with such a bad usability could have been easily rejected by the consumers requiring costly redesign cycles to improve the ease of use in future releases.

#### b) Redesign of the System

The task analysis provided an improved task structure and a simpler navigation scheme. The user can do most of his work effectively with the stylus and is not forced to use menus for common tasks. The functionality can not only be reached via menus but remains accessible through context-related buttons and tap selections in the interface.

The system's state is now clearly visible to users. The system presents what actions the user can take and doesn't hide functionality in menus. From an attentional point of view the next action in a process is made more obvious. Furthermore the user is given many options where he can select items from a choice and is not forced to type in arbitrary numbers.

The interface applies a direct manipulation interaction style wherever possible to minimize handwriting recognition input. The overall number of stylus taps and the amount of data users have to enter has been reduced for all major goals.

If at all possible, the entire interface is now shown at one time, especially for the fill-in forms to minimize up and down scrolling. The limited screen real estate is used more efficiently and the visual appearance is more attractive. The look and feel as well as the wording is consistent and the behavior of the application is identical with the resident Palm programs.

The space constraints led to a concentration on the essential aspects of the financial service and the redesign featured an optimal mixture between functionality and simplicity.

### c) Reflection on the Evaluation

A couple of readers of the analysis report told me that this design would have been barely usable. Besides the following usability flaws, the redesign was highly successful and the expected results were exceeded with the exception of the difficult tasks (see table 2.1).

- The navigation concept failed and users didn't understand my conceptual model. No “home page” and “back button” were provided.
- The account balances and portfolio valuation were hindered by an obscure sum button. The underlying concept of the icons to toggle between the currency and type view was not meaningful for people.
- The security entry field in the buy order dialog is suited for professionals but not for novices, who prefer a search and lookup mechanism.
- The term “cancel” was accidentally used for buttons and error messages, causing dangerous situations which could result in the loss of data.
- The wording of interface elements led sometimes to confusion. Business as well as language specialists will be required to localize the system. Internationalization won't be easy as foreign languages consume as a rule more room than English.
- Minor inconsistencies in the screen layout were unveiled.
- The demo mode was not visible enough to attract potential customers.
- The resemblance icon for news needed a redraw and the quote icon was not thought for an international audience.

Instead of the one-man show to do lo-fi usability tests I would prefer a video camera or supplementary observers for data recording in the future. At the beginning I probably helped the users too much but corrected my influence to the absolutely minimum the more experience I gained (computer normally don't talk). Without video recording the retrospective was not as effective as with laboratory equipment. The informal discussion after the observation was also very fruitful and disclosed interesting background information. The feedback I received was very positive and I hope to conduct more usability test in a professional laboratory with the redesigned client. The user' subjective opinions about the system was also be of interest but the interview questions were asked sporadically to save time.

The prescribed benchmark tasks proofed as an excellent selection to reveal major and even hidden minor problems. The things I had misgivings after the redesign were concluded, such as the navigation or sum buttons. Points that surprised me, were the poorly designed cancel order process. The tasks were arranged in a linear manner in place of a more distributed fashion among the financial service offerings. The users also got clues from the task headers where to look for the answer. A more mixed order of the standard tasks with no functionality titles would have made the trial even more realistic and not implied part of the solution, as I learned during one observation.

The evaluation of all aspects for the already extensive Palm Banking system was quite work intensive. To usability test just selected functions would have been a clever idea to reduce the work load. During the design only right-handed people were considered so additional experiments with left-handed testers are highly recommended.

One user appreciated the natural task flow for selling stocks (such as opening a portfolio, selecting a position and selling it), while another test person was unsure where to start a stock exchange order, irritated by the numerous buy and sell buttons. The narrowing down of a task's flexibility might not be recognized or led to misunderstandings, since in the sell order example the choice of securities is logically restricted with every step (i.e. all positions, positions of the chosen portfolio and the selected position). The customer is then forced to select the correct portfolio to see the desired position. Adding an "All" option in the portfolio pop-up menu would solve the dilemma and allow the selection of all marketable positions (target customers usually have a small number of portfolios with a few holdings).

Building a prototype with HTML and image maps would also have been a way to visualize the interface for usability testing. English was for some test customers a bigger handicap than I anticipated and most problems arose from special banking terms (e.g. difference pending between executed orders). Missing knowledge about advanced transactions like stock trading was responsible for some misinterpretations during the tests too.

The time spent with real users during the evaluation to improve the usability, leads to more customer satisfaction, reduced support costs and a better company image. Evaluation is a powerful HCI instrument to ensure high-quality user interfaces and to guarantee more user-friendly software. Finally, playing the computer is really enjoyable as the designer of the software, but test guidance can affect user activity and might also be subject to bias.

#### **d) Recommendations**

I only make recommendations and present design alternatives for part of the findings from the usability tests (see 2. Analysis and Interpretation of Results). The redesign should be improved based on the evaluation for at least another iteration. Together with the intended expert reviews this evaluation should lay the ground for the implementation of the first software prototype. Incremental prototyping is in my opinion best suited for building the final system, since the Palm Banking client has a highly modular architecture. The overall design is readily split into an account, portfolio, quote, stock exchange order and support (i.e. authorization and preferences) module, allowing consumers to tailor the installation to their needs.

To solve the critical navigation issue a new Palm Bank main view is introduced at the top level to better match the users' mental model (figure 3.1 and 3.17). The so called home page also improves the system image. This entry screen presents a list with all available overviews and is shown when the consumers signs in for the very first time. The welcome view can again be customized via the preferences. The Disconnect buttons on every overview screen were discussed too and later removed in favor of only one occurrence on the main overview page.

The symbols before the words are the same list view icons used in the application launcher. An extra Help button or icon provide information about the services offered within each module and should answer question like “where can I place a stock exchange order?”. The term “orders” on the overview page can lead to confusion because the pending and executed transactions are related to stock exchange orders and not payments (e.g. benchmark task 3).

A more visible and uniform hierarchy is furthermore achieved by the additional Done buttons on the overview and statement respectively quote list screens (figure 3.3-3.6) to virtually close the form and return to the previous screen (browser back button). Unfortunately the back navigation from deep within the hierarchy depends on this Done button, which can be troublesome as no direct way is reachable except for the View menu. These push buttons didn’t cause any problems closing dialogs during the usability tests.

To clearer visualize the current context for the user, the labels of the register and pop-up menu on the overview level were interchanged. The navigation pop-up menu remains now constantly named Overview while the form title clearly states the current list contents. For example the Accounts register with the Overview pop-up menu containing all other views (figure 3.3). The navigation with the pop-up menus remains strictly limited to the same level with this design (figure 3.2).

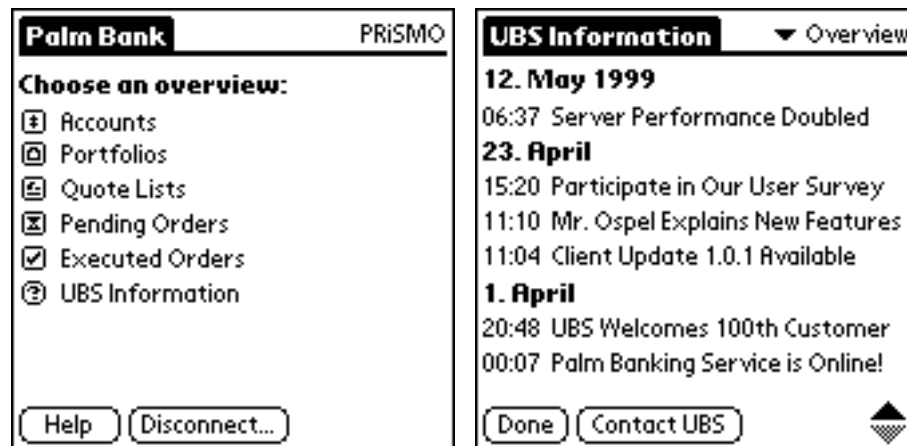


Figure 3.1 Palm Bank main page with all available overviews and UBS information overview

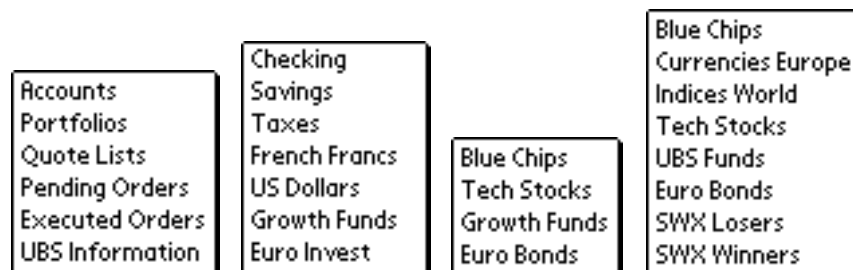


Figure 3.2 Overview together with account, portfolio and quote list selection pop-up menus

Accounts			Account Stat.		
Overview			Checking		
Name	Curr.	Balance	Date	Note	Amount
Checking	CHF	2'105.30	31.12	Safe custody fee	-91.15
Savings	CHF	10'037.45	28.12	ixMicro Ultimate...	-395.00
Taxes	CHF	3'491.00	24.12	Salary UBS AG	5'417.30
French Francs	FRF	4'402.25	15.12	Transfer Savings	-950.00
US Dollars	USD	385.60	14.12	Aquilana Baden	-126.50
Growth Funds	DEM	2'500.00	14.12	Expenses Novem...	84.35
Euro Invest	EUR	-402.75	12.12	Transfer Tasme...	-303.70
			11.12	25 UBS N shares	7'342.55

Figure 3.3 Accounts overview and account statement with Done and Balances buttons

Portfolios			Portfolio Stat.			
Overview			Blue Chips			
Name	Curr.	Value	Shares	Security	Curr.	Value
Blue Chips	CHF	25'776.85	40	Ciba SC N	CHF	4'880.00
Tech Stocks	USD	7'835.20	25	CS Group N	CHF	5'031.25
Growth Funds	DEM	-2'500.00	15	SAirGroup N	CHF	4'867.50
Euro Bonds	EUR	10'400.30	10	Swisscom N	CHF	4'650.00
			30	UBS N	CHF	12'585.00

Figure 3.4 Portfolios overview and portfolio statement with Done and Valuation buttons

Quote Lists	Quote List			
Overview	Blue Chips			
Name	Symbol	Last	Change	%
Blue Chips	CSGN	240.0 ↓	-8.0	-3.2%
Currencies Europe	CIBN	131.5 ↑	+3.0	+2.3%
Indices World	SCMN	470.0 ↑	+6.0	+1.3%
Tech Stocks	SMI	7'083.1 ↓	-133.3	-1.8%
UBS Funds	SRN	308.5 ↓	-7.0	-2.2%
Euro Bonds	SXGE	4'462.9 ↓	-71.7	-1.6%
SWX Losers	UBSN	420.0 ↓	-10.0	-2.3%
SWX Winners				

Figure 3.5 Simplified quote lists overview and quote list with Done buttons

Pending Orders				Executed Orders			
Quantity	Symbol	Curr.	Limit	Quantity	Symbol	Curr.	Price
Buy 15	UBSN	CHF	417.50	Sold 140	MOT	USD	61.75
Buy 185	COMS	USD	27.25	Bought 25	UBSN	CHF	292.00

Figure 3.6 Pending and executed orders overview Done buttons

For the executed orders the descriptions Sold respectively Bought are more precise than the previous Sell and Buy (figure 3.6).

The login process was streamlined by replacing the Login as radio buttons with a pop-up menu to receive more space (figure 3.7). The visibility of the two login modes is decreased but the wording of the labels is unambiguous.

Figure 3.7 Simplified connect to UBS dialog with customer or demo user login and no status

Instead of the sum symbol in the accounts and portfolio overviews I labeled the two buttons Balances and Valuation. The screen real estate was gained from the former logout button (figure 3.3 and 3.4). The toggle icons in the account balances and portfolio valuation were exchanged by more visible Currency and Type radio buttons (figure 3.8 and 3.9).

Currency	Amount	%
CHF	15'633.75	69.4
DEM	2'500.00	11.1
EUR	-402.75	-3.2
FRF	4'402.25	19.6
USD	385.60	1.7
Total in CHF	22'518.85	100.0

Type	Amount	%
Checking	2'088.15	9.3
Savings	17'930.70	79.6
Funds	2'500.00	11.1
Total in CHF	22'518.85	100.0

Figure 3.8 Account balances with toggle buttons instead of icon buttons

Portfolio Valuation <span style="float: right;">i</span>			Portfolio Valuation <span style="float: right;">i</span>		
Currency	Amount	%	Type	Amount	%
CHF	25'776.85	62.1	Shares	33'612.05	81.0
DEM	-2'500.00	-6.0	Bonds	10'400.30	25.0
EUR	10'400.30	25.0	Funds	-2500.00	-6.0
USD	7'835.20	18.9	Total in CHF	41'512.35	100.0
Total in CHF	41'512.35	100.0			

Figure 3.9 Portfolio valuation with presentation by currency and investment type

The same wording and layout is applied to the account and portfolio info (figure 3.10). The former way to set the from and to validity date required the user to tap on either in the left or right side of the selector and was divided onto two separate dialogs. The corrected version which was supplied during the later tests offers one joined date picker (figure 3.11). Figure 3.12 presents the full quote screen with the enhanced News icon.

Account Info <span style="float: right;">i</span>	Portfolio Info <span style="float: right;">i</span>
<b>Name:</b> Taxes	<b>Name:</b> Blue Chips
<b>Branch:</b> ZH-Hauptsitz	<b>Branch:</b> ZH-Hauptsitz
<b>Number:</b> 230 649.722.01M	<b>Number:</b> 230 649.722.51
<b>Type:</b> Savings Account	<b>Type:</b> SWX Shares
<b>Holder:</b> Maria Meier	<b>Holder:</b> Maria Meier
<b>Balance:</b> CHF 4'531.85	<b>Value:</b> CHF 25'776.85

Figure 3.10 Account and portfolio information with identical layout

Set Validity		Set Validity											
From:	14.12.98	To:	31.12.98										
◀ December 1998 ▶		◀ December 1998 ▶											
M	T	W	T	F	S	S	M	T	W	T	F	S	S
	1	2	3	4	5	6		1	2	3	4	5	6
7	8	9	10	11	12	13	7	8	9	10	11	12	13
(14)	15	16	17	18	19	20	(14)	15	16	17	18	19	20
21	22	23	24	25	26	27	21	22	23	24	25	26	27
28	29	30	31				28	29	30	31			

Figure 3.11 Combined date picker to set valid from and to date in one dialog

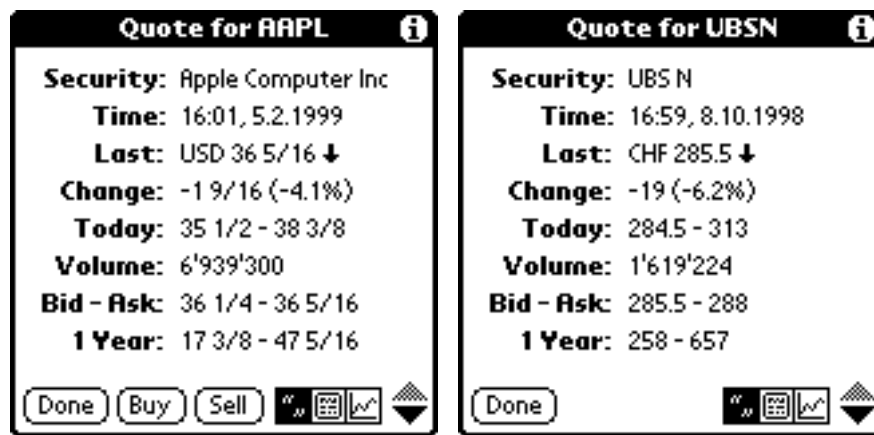


Figure 3.12 Detailed quotes with better bid / ask presentation and news icon

The misleading Cancel... button was replaced by a Cancel Order... button in the order details and the corresponding confirmation alert doesn't include a Cancel button anymore (figure 3.13). Cosmetic changes were made in the order details for executed order, the security selection and display options (figure 3.14 and 3.15).

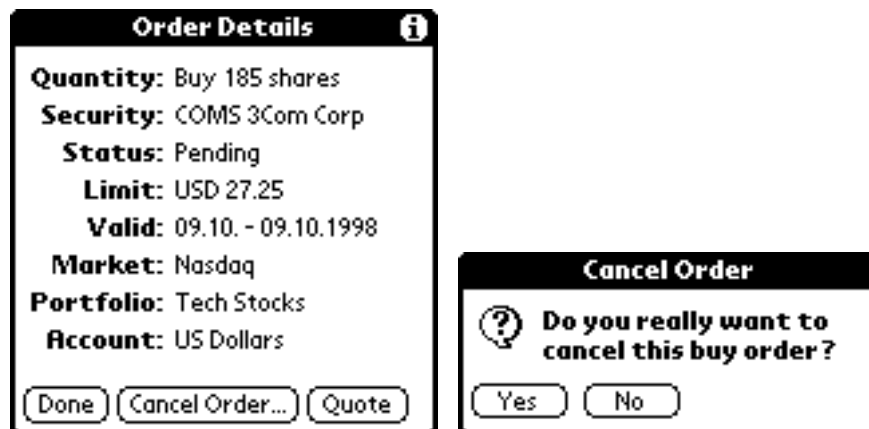


Figure 3.13 Order details with Cancel Order button and confirmation to cancel a pending order

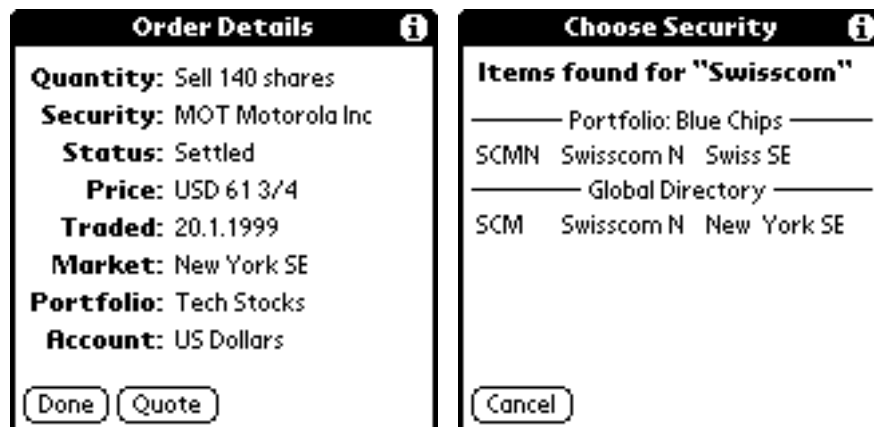


Figure 3.14 Order details for executed order and security selection for add or lookup security

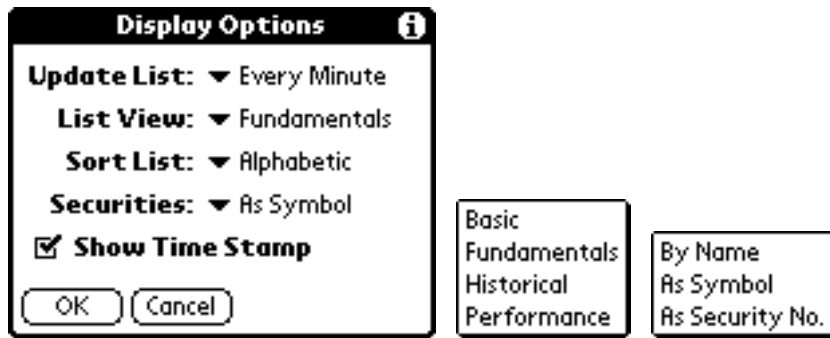


Figure 3.15 Display Options with list view and show securities pop-up menus

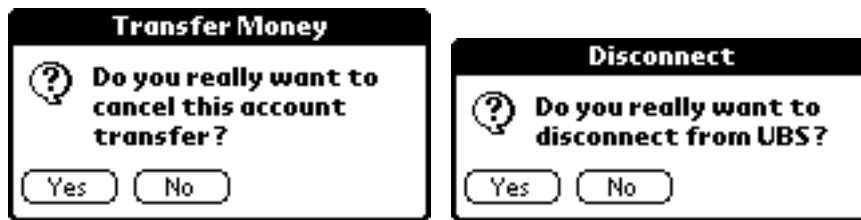


Figure 3.16 Consistent confirmation alerts with Yes/No buttons instead of OK/Cancel

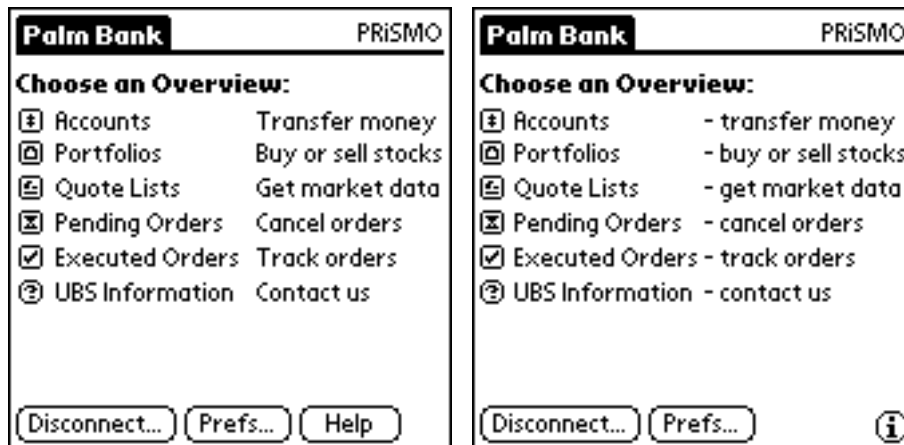


Figure 3.17 Two screen layout alternatives for the main page offering function descriptions

The third suggestion of all three Palm Bank home pages (right screen of figure 3.17) is quite acceptable because the design builds on existing knowledge with the help button and gives the user some hints about the dormant operations. Without the short explanations for each overview she will have difficulty on how to do certain actions like buying stocks. Both order links remain ambiguous and the customers must be informed in advance that payments are not part of the wireless system. I personally favor the straightforward main page with help icons and disclosure triangles for accounts, portfolios and quote lists as presented in figure 0.2.

## Conclusion

Evaluating the system was the most exciting and challenging task during the whole development of the Palm Banking application. The preparation and data analysis of the evaluation was very time consuming. The next step is the implementation of a software prototype to prove the feasibility of the entire banking service. Additional usability tests in a professional laboratory will ensure that further improvements based on the recommendations and adaptations for today's Telebanking capabilities do not hurt the achieved ease of use. Palm Banking has to be fun and exceed customers' expectations.

The evaluation revealed no risky show stopper and the suggested refinements are easy to fix. To be successful in user interface design, the designer must not only understand the user, but also know the work activities, environment and technology. The Telebanking know-how including analyzing user feedback and usability testing, as well as the intense study of the Palm OS programs proved invaluable to produce an impressive design within the given restrictions. The goal to focus on visibility and affordance, the key principles of human-computer interaction, resulted in an excellent user interface. Future Telebanking products will be measured against this high usability standard.

Designing user interfaces for handheld computers is an emerging market and mobile computing – supported by wireless communication and maybe speech recognition – will become ubiquitous in the future.



Figure 0.2 Palm VII with wireless Internet access and innovative main page with tree view

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## Appendix

### A) Benchmark Tasks

The test user received the paper below without the solutions, difficulty levels and answers, while the observers was given the whole information.

#### Introduction

Please solve one task after another and try to think aloud while doing your work, which helps us to follow your progress. Tell us what you write and say “click” when you tap on something with your stylus. The aim of this evaluation is **not** to test you, but to detect jointly usage problems in the software being evaluated. The system exists only as a paper prototype and the displayed data might be incorrect or outdated. And finally, forgive the person playing the computer for not refreshing the screens as fast as your own PalmPilot.

Thank you very much for your cooperation and enjoy this exceptional banking service.

#### Startup and Login

1. Turn on your PalmPilot and start the “Palm Bank” application which is already installed on your device.

Solution: Press on button and start application from Application Launcher. (check all categories until found). If one of the four hardware buttons is pressed, the Applications silk-buttons opens the launcher.

Difficulty: Easy.

2. Login as the customer “Maria Meier” or her spouse with the stored password and the PIN code “4711” to begin your online session. How would you access the demo mode to first try out the product?

Solution: Connect to UBS and enter PIN code.

Difficulty: Medium.

Answer: Login as guest to run the demonstration.

#### Account

3. Who is the beneficiary of the “ixMicro Ultimate Rez” payment in the “Checking” account, which was executed the 28 December?

Solution: Accounts Overview or View menu, Account Statement and Transaction Details.

Difficulty: Medium.

Answer: Macintosh Users Switzerland in 8023 Zürich.

4. How much money do you have in all your accounts?

Solutions: Accounts Overview or View menu and Account Balances or by calculating to total.

Difficulty: Difficult.

Answer: CHF 22'518.85.

5. What is the full account number for the account “Taxes”?

Solution: Account Statement and Account Info.

Difficulty: Easy.

Answer: 230 649.722.01M.

6. Transfer US\$ 1'500 from your “Checking” to your “US Dollars” account. What is the current exchange rate?

Solutions: Transfer Money from Accounts Overview, Account Statement or Service menu. Enter amount, choose accounts and currency. Check and transfer order.

Difficulty: Medium.

Answer: 1 US\$ equals 1.2884 Swiss francs.

### Portfolio

7. How much did you gain or loose in percent with your “SAir Group N” shares in the “Blue Chips” portfolio?

Solution: Portfolios Overview or View menu, Portfolio Statement and Position Details.

Difficulty: Medium.

Answer: Loss of 26.5%.

8. What percentage do you have invested in bonds at the moment?

Solution: Portfolios Overview or View menu, Portfolio Evaluation and Type view.

Difficulty: Difficult.

Answer: 25%.

9. Sell half of your “UBS N” position at best from your “Blue Chips” portfolio. Make the order valid for today without a price limit and keep the other settings.

Solutions: Sell Securities from Portfolios Overview or View menu, Portfolio Statement, Position Details, detailed quote or Service menu. Enter quantity, check order and sell stocks.

Difficulty: Difficult.

### Quotes

10. Get the last trading price for the “UBS N” stock in the “Blue Chips” quote list?

Solutions: Detailed quote from Quote List or Position Details, or Show Quote from Quote Lists Overview, Quote List or Service menu.

Difficulty: Easy.

Answer: CHF 285.50.

11. Read the oldest news story about the Netscape and AOL merger from the morning of the 23 November. You will find one of the two shares in the quote list “Tech Stocks” (symbols NSCP and AOL).

Solutions: See task 10. Detailed quote, News view and Story.

Difficulty: Medium.

12. Display the one year chart for the “Dow Jones Industrial” index which is also in the “Tech Stocks” quote list (symbol INDU).

Solutions: See task 10. Detailed quote and Chart view.

Difficulty: Medium.

13. Add the security “Swisscom N” to your “Blue Chips” stock list.

Solution: Quote List and Add Security. Find and choose stock.

Difficulty: Difficult.

Answer: Not possible because the security is already in the quote list.

### Stock Exchange Orders

14. Cancel your order to buy 185 “3Com Corp” shares from the 9 October.

Solution: Pending Orders Overview or View menu and Order Details.

Difficulty: Medium.

15. Have you successfully sold your “Motorola” investment for US\$ 61 3/4 per share?

Solution: Executed Orders Overview or View menu.

Difficulty: Medium.

Answer: Yes.

16. Buy 355 “Apple Computer” shares from the “Nasdaq” stock exchange. Set the limit to the actual bid price and your order should be valid for one week from today. Use the “Tech Stocks” portfolio and debit your “US Dollars” account.

Solutions: Buy Securities from Portfolios Overview or View menu, Portfolio Statement, Position Details, Pending Orders or View menu, Executed Orders or View menu, detailed quote or Service menu. Choose security and market, enter quantity, set limit (via detailed quote) and select portfolio and account. Check order and buy stocks.

Difficulty: Very difficult.

### Customization

17. Define in the preferences the “Quote Lists Overview” as your welcome view, and the “Blue Chips” portfolio as your default portfolio for future investments.

Solution: Preferences from Options menu.

Difficulty: Very difficult.

18. Display the performance view for the “Tech Stocks” quote list and present the securities by name instead of symbol. What is the update interval for data in this list? Can you change this option?

Solution: Quote List and Display Options from Options menu or Options menu for all quote lists.

Difficulty: Very difficult.

Answer: One minute and yes.

### Bank Information and Logout

19. Where can you retrieve information about the Palm Banking service and how could you easily contact UBS?

Solution: UBS Information or View menu and Contact UBS.

Difficulty: Medium.

20. Logout to terminate your banking session and turn off your Palm connected organizer.

Solution: Disconnect from all overview screens or Options menu. Press off button or wait for auto-off.

Difficulty: Easy.

### Final Word

You just finished your last task. Congratulations for your valuable assistance to improve the usability of the Palm Banking client. Again thank you very much for help.

## **B) Interview Questions**

These semi-structured interview questions were asked after the usability test.

1. What is your first spontaneous impression of this application?
2. Did you experience something very positive?
3. Was there something you really did not like? What would you change?
4. Did you always know where you were in the work flow and what the next step would be?
5. Did you feel supported by the system and if necessary guided as well?
6. What do you expect from a help system (context-sensitive assistance)?
7. Did you notice terminology or names which you did not understand?
8. Do you have further comments? Did I miss anything important?