THE APPLE LISA COMPUTER: A RETROSPECTIVE

INTRODUCTION

This paper is an attempt by a long-time Lisa user to clarify the significance of the Apple Lisa personal computer for the computing industry. The audience is anyone who has an interest in innovative computing technology, and wants to learn a little about Apple Computer's brief foray into this area via the Lisa computer.

This paper hopes to show why the Lisa was significant in its time, and how some of what was called "Lisa Technology" is slowly migrating to other computer systems, notably the Apple Macintosh computer series.

The author has never worked for Apple, and so is not privy to any "insider secrets" about this machine. All information contained herein was obtained from Apple's cornucopia of Lisa and Macintosh literature, from discussions with other Lisa owners, and through my personal involvement with and observation of both machines since 1984.

This paper is loosely based upon the excellent article "The Legacy of the Lisa" (MacWorld magazine, Sep. 1985) as written by Mr. Larry Tesler, one of the Lisa's main designers and currently Chief Scientist at Apple Computer.

A LITTLE BIT OF HISTORY

Apple began developing the Lisa in 1979. The Lisa's charter was to build a revolutionary device that was truly easy to use, and thereby mitigate the limitations of existing computers. Developing a computer which was an order of magnitude easier to use than traditional computers required several major departures, not all of which were obvious.

Even the name "Lisa" has always been rather enigmatic for most computer users, including Lisa owners. To set the story straight (as far as I know) here are the facts: Officially, Apple states that "Lisa" stood for "Local Integrated

Software Architecture." Unofficially, "Lisa" has been associated with the name of a child fathered by one of the Lisa designers.[2]

The Lisa had several design goals:

* Be intuitive,

* be consistent,

* conform to the ways people actually work,

* have enough performance to do the jobs that need doing,

* provide an open software and hardware architecture,

* be reliable,

* be pleasing, and

* fit into an everyday work environment.

The Lisa was based on sophisticated hardware technology. The single compact desktop unit contained a 12-inch black-and-white screen, and two revolutionary floppy disk drives called "Twiggy" — after the English supermodel of the day, because she, and they, were so thin. The Lisa contained a Motorola 68000 processor and 1 megabyte of memory, expandable to 2 megabytes. Cabled to the Lisa's case were a keyboard, and a (then) uncommon peripheral called a "mouse," which was a key element of the Lisa's design.

Apple introduced the Lisa to the general public in January 1983 at a price of $9,995. In April 1985, after only one and a half years, Apple discontinued the Lisa in favor of its sibling, the Macintosh.

Lisa development was a tremendous undertaking for Apple and basically required most of the company's resources, both financial and personal. Apple reports that Lisa cost $50 million to develop and required 200 man-years of development effort. The story behind the development is fascinating and should be more fully recorded, but this paper can provide only a "Reader's Digest" version of the development history; a more complete history can only be written by the developers themselves, and this author, sadly, believes that such a treatment will never see the light of day.

The Lisa may be considered a computer that sprang from the loins of a host of predecessor systems, and many of its "revolutionary" ideas were not really new — notwithstanding the cries of Apple marketers, who think everything Apple does is new. Work by many computer companies over decades (yes, decades) was drawn on by Apple to design the Lisa. For example, Apple borrowed several key ideas from Xerox and its early Alto system.

In 1979 Mr. John Couch, Apple's head of software, was made General Manager of a new Apple division called POS, Personal Office Systems. Mr. Couch's charter was to develop and promote the Lisa for the office system market, and provide a return on Apple's substantial Lisa investment.

From meager beginnings, POS blossomed into a 300-person division, with around 100 people devoted to the software and hardware development effort. The Lisa had begun as a rather humdrum text based system, not a good sign for a "revolutionary" computer. Couch assembled a team of very talented people from within Apple and throughout Silicon Valley. After some field trips to neighboring Xerox PARC (Palo Alto Research Center), the developers (and some ex-PARC people who became Apple employees) embarked upon what became the Lisa computer as known to the public. Perhaps the key change at this point was the migration from a text-based system to a window-based system inspired by Xerox's Smalltalk development environment.

Apple unveiled the Lisa in late 1982 to selected outsiders. On 19 January 1983, after repeated delays and two years beyond the originally projected introduction date, Apple officially declared Lisa a working system that would be deliverable in May 1983. Apple at this time hoped to mark the beginning of a new era in personal computers & establish the software technology standard of the 80's.

Apple's comprehensive Lisa introduction also included a suite of revolutionary and sophisticated programs called the Lisa Office System (later renamed "Lisa 7/7" by Apple). This suite consisted of seven application programs — LisaWrite, LisaDraw, LisaCalc, LisaGraph, LisaProject, LisaList, and LisaTerminal — and was bolstered by extensive well-written documentation and an innovative self-paced training

course for new Lisa owners, based upon the LisaGuide program, which Apple called an "interactive manual." For hardware diagnostic purposes Apple provided the LisaTest program, though Apple appears to have discontinued the release of this program to owners in favor of referring them to the local friendly Apple dealer for Lisa servicing. For a user "operating system" Apple created the Desktop Manager. This program was a file organizer and program manager which created the illusion of a "desktop," on which users could place, move, rename, and delete files, and run programs.

Apple supplied three different printers for Lisa, all capable of printing exactly what the user saw on the screen. The dot-matrix printer could print both high-resolution text and graphics. The daisy-wheel printer was unique in that it could also print graphics, though the ribbon was used up very quickly for this task. Later in the Lisa's life Canon provided a color inkjet printer for it. Apple appears to have had plans to support a laser printer with the Lisa, but these plans were abandoned, although Apple did have a $30,000 in-house laser printer which was used by the Lisa developers.

Apple's internal software development centered around the Lisa Monitor environment, which was text-based, and resembled the environments Apple provided for its Apple II and Apple III computer systems. The majority of Lisa programs were written in the Pascal language by Apple, except for a few written in 68000 assembler. A COBOL and a BASIC were also available. To give an idea of the size of this effort: The Lisa operating system source contained about 90,000 lines of Pascal, and the Office System applications contained approximately 50,000 lines each. The programmers used a wonderful window- and mouse-based editor called LisaEdit. Outside developers were offered a development kit called the Lisa Workshop, a descendant of the Lisa Monitor environment. With the Workshop a programmer could develop rather sophisticated programs, primarily in Pascal.

A major software development effort by Apple focused on the Lisa Desktop Libraries, a collection of about 100 software modules which provided the software foundation for Lisa Technology. These modules were used by all Lisa programs and were the mainstay of the Lisa's consistent user interface. A key component of the Desktop Libraries was QuickDraw, a fast and versatile graphics module written in around 40,000 lines of 68000 assembly language.

During the Lisa's rather short life, very few programs were written for it by outside developers who could exploit its revolutionary user interface. The main reason for this was the lack of any fairly simple development environment that would allow outside developers to write "Lisa-like" programs without a tremendous amount of technical knowledge. After Apple developed the major Lisa programs, they attempted to develop a universal "framework" for programming called the Lisa ToolKit; but development of this, though basically finished, was halted when Apple withdrew resources from Lisa software development to accelerate Macintosh development. Apple had also not documented fully, nor designed in an easily understandable fashion, the code which formed the basis for the software component of Lisa Technology. Finally, third-party developers hesitated to commit to the Lisa given its high perceived price and its low sales numbers.

A major headache for Apple during the development effort was the pair of Twiggy disk drives in each Lisa. The single 5.25-inch high density floppy (860K bytes) with software-controlled automatic ejection and micro-stepping technology proved a little too revolutionary, and held back the Lisa schedule. After introduction Apple wisely abandoned Twiggy in favor of the new, more reliable 3.5 inch Sony micro-floppy drives with 400K bytes per disk. Complementing the floppy drives was a ProFile hard disk drive with 5M bytes capacity, originally offered for the Apple III. A 10M byte ProFile was later developed by Apple for the Lisa 2.

Apple spent a lot of time during Lisa's development testing Lisa features with real users. Apple's literature on this topic shows that the Lisa developers were occasionally surprised by the user testing results, but the end product of these tests was a better Lisa system. Apple also gave high priority to understandable foreign

language translations for the Lisa software, developing a useful technical solution to the problem of "localization" through Phrase files which contained all the phrases that a Lisa program could display to the user. With access to the Phrase files, a translator with minimal computer skills could translate the program's messages and create a national-language version, without having to delve into the highly technical underlying source code. The Lisa at power-on also supported foreign language diagnostic messages, which could be keyed in from the keyboard.

Apple projected sales of 10,000 Lisas in the last half of 1983 and 40,000 in 1984. In retrospect, Apple was able to sell around 80,000 Lisas during its 18 month life — an average of 4,500 units a month or 13,000 per quarter, figures very close to initial sales projections. (I believe Apple's sales were less than expected in the first months after the Lisa's introduction, but sales picked up near the end of the Lisa's life).

DEVELOPMENT RISKS

Apple confronted several significant risks with Lisa's introduction.

On the technical front, the software development effort was immense, and could easily have delayed the introduction. The Twiggy disk drive proved barely workable, but the more reliable Sony 3.5 inch disk drives were substituted. The Lisa's printing technology was a risk, since Apple was basically trying to get dot-matrix and daisy-wheel printers to emulate a high-resolution laser printer. Font and printer problems were eventually resolved.

On the business front, Apple had several very high hurdles to jump. The company was unable to invest enough time in helping outside developers. The seven programs of the Office System were basically all the programs Apple had for the Lisa's introduction. Product planners were on the dangerous edge of confusing the Lisa and Macintosh product lines. Finally, Apple's data communications strategy appeared primitive; Apple did develop a network for the Lisa, called AppleBus (later AppleTalk,) but Lisa networking never achieved popularity with users.

After a year with the Lisa product line, Apple's management came to the conclusion that Apple could only support one line of computer with a graphical interface. Lisa lost out to the Macintosh. The Lisa's name was changed to Macintosh XL (quoted variously as standing for "Extra Large" or "X-Lisa"). In April 1985 the Lisa was discontinued and the Macintosh became Apple's top-end computer; after the discontinuation Apple supported the Lisa hardware with a 5-year program of spare parts and repair services.

To ease the transition to the Macintosh, Apple developed a program called MacWorks that allowed the Lisa to run most contemporary Macintosh programs. MacWorks supported Apple's strategy: to sell its remaining inventory of Lisas to the Macintosh public, which desired a Macintosh more powerful than the original 128K and 512K models.

The bulk of Apple's remaining Lisa inventory was sold to a Utah company called Sun Remarketing.[3] Sun continues to sell the Lisa today as a Macintosh. Apple's final Lisa collection was placed in a landfill by Apple several years ago; I'm not certain of the reason for this, but believe it may have been a result of a lawsuit concerning the Lisa brought by several Apple stockholders.

The Lisa legacy at Apple is still somewhat alive, at least in a physical sense. The Apple Corporate Museum houses a few functioning Lisas for display purposes, but I believe they may be running Macintosh rather than Lisa software. [Unfortunately, the Apple Museum is currently closed indefinitely. — Ed.]

LISA TECHNOLOGY

The Lisa has proven to be one of the most underrated personal computer systems in the industry's history. When Apple introduced the Lisa in 1983, very few people seemed to understand the revolutionary concepts implicit in its design. In retrospect, we can say that Apple itself shared this lack of understanding.

Apple's revolutionary "Lisa Technology" combined tight integration of hardware and software with a simple design goal: to make the computer as easy to use as possible, without

sacrificing power that would enable the user to accomplish significant computing tasks. In Apple's words, Lisa Technology was based upon "the extensive use of graphics, consistent user interface, and pointing device (the 'mouse') which together emulate the way an individual works in the office".

To quote one of Apple's Lisa documents, the Lisa hardware and software combination "must be seen to be believed;" but in fact it must be used, extensively, before it can be appreciated. Discussing Lisa's important differences will only bring on skepticism; demonstrating the system is some help, but often not a lot. The non-Lisa user meeting a Lisa for the first time will perennially ask, "Can something that looks so gimmicky really do serious work?" But I think that most people who spend several hours with a Lisa accomplishing some-thing real — aside from those few who have tried it and really don't like it — will come away with positive conclusions about the Lisa's value, or at least the value of its technology.

One effective presentation tool used by Apple for Lisa customers was the Lisa Concept Pyramid. The apex of this pyramid represented the solutions required by the target customer, the information professional, who was called a "knowledge worker" by Apple). The generic applications are all tools which can be used by almost anyone.

The middle layer of the pyramid represented the underlying technology of a truly "easy to use" system. The prototype of this technology was created within Xerox PARC, but Apple's refinement of it consumed the bulk of Lisa's 200-man-year development effort. Many contri-butions by Apple were enhancements of inte-gration and of the user interface; keys to that accomplishment included the one-button mouse and its driver software. Another cornerstone is Visual Fidelity, or the correlation between screen image and printed output now referred to as "WYSIWYG."

The bottom layer is the foundation for the layers above. The major design issues were all dictated by the needs of the software, rather than the traditional domination of the design by the hardware.[4] The Lisa operating system needed to be multi-tasking, to allow multiple programs to co-exist on the screen. The Graphics/Mouse technology was the key to making the Lisa's user interface possible.

All Lisa user actions were centered around the one-button mouse. The user moved the mouse pointer (usually a small arrow-shaped pointer) to the screen object of interest. For example, to activate a menubar command the user moved the mouse pointer to the appropriate command group label, e. g. Edit, and pressed the mouse button. The selected menu would then "pull down" showing a list of the specific commands the user could work with. Still holding the mouse button down, the user dragged the mouse pointer to the desired command, e. g. Copy, and released the mouse button when the mouse arrow touched the Copy command and the command name in the menu was highlighted. At this point the selected menu command was activated and per-formed its function on the selected window object. For example, if you were using Lisa-Write, the Lisa's word processor, you could copy data from a LisaWrite document by first selecting with the mouse pointer the text to copy, and then activating the Edit menu Copy command.

The Lisa's technology has now been copied extensively by other systems, both within Apple and elsewhere. But in my opinion sev-eral aspects of the Lisa's design made it unique. These aspects have not, so far, been adopted to any significant degree by other mi-crocomputer systems.

SOFT POWER-ON AND POWER-OFF

The Lisa was powered on and powered off by a button on the front plate of the computer case, but its power button was not a true "hard" power switch; a Lisa, once plugged in, was always running. When the Lisa was "off" it was really in a low-power mode (what might now be called a sleep mode) that toggled to full power when the user pressed the power button. Conversely, if the user pressed the power button to turn the Lisa "off," the hardware called to the operating system (really to the Lisa Desktop Manager) which commanded all executing programs to save their documents. When all programs indi-

cated that they had committed their documents to disk, the Lisa toggled to its low-power mode.

SELF-ORGANIZING DESKTOP

The Lisa maintained an orderly desktop for the user. At power-down, the Desktop Manager would save the state of the desktop as well as all open document data. When the user powered-up the Lisa, the Desktop Manager restored the desktop state as it was on power-down.

DOCUMENT-CENTERED VIEW

The Lisa supported a document-centered view which gave priority to documents, not programs. To start a new document in any application, the Lisa user tore off a sheet of "stationery" from a pad icon that resided on the screen. When "opened" by the user a stationery pad automatically duplicated itself, set its name and the current date, and created a window on-screen for the user. (Stationery pads survive in Macintosh System 7, but the Macintosh does not use a document-based view.) Lisa program icons rarely came into play except to move the program file to another disk. Generally, Lisa users kept document stationery pads easily accessible on the screen and kept program icons in a folder, which they opened only to add new programs or delete old ones.

RELIABLE FILE DATA STORAGE

Several design decisions made the Lisa's file system unusually reliable. To reduce the impact of a system crash, the file system maintained distributed redundant information about the files, in different forms and in different places on disk media. For example, information about a file in the central disk catalog was repeated in a special disk block at the head of that file. Also, each block on the disk specified the part of the file to which it belonged, in a special string called a "block tag." Since all files and blocks on a disk were able to identify and describe themselves, there were several ways to recover lost information. A utility called the Scavenger was able to reconstruct damaged disk catalogs from the re-

dundant information stored in and about each file.

The Scavenger is activated automatically whenever the Lisa determines that a disk has problems. At this point the Lisa's low-level operating system informs the Desktop Manager, which displays a dialog for the user. The user may elect to have the Lisa repair the disk or eject it. In my experiences with the Lisa I've only had one disk that the Scavenger could not fix.

The Lisa's ProFile hard disk and Twiggy floppy drives also included extensive reliability features. One such feature was disk block sparing. When a disk block (of 512 bytes) was detected as beginning to fail, the Lisa's disk drive (whether ProFile or Twiggy) moved the data to a spare area of the disk and marked the failing block as "bad". Whenever a program attempted to access a bad block, the drive automatically substituted a "spared" data block.

The original Macintosh supported block tags at the hardware level, but Apple never provided a Mac Scavenger program to monitor and use these tags. Neither did Apple's Finder program (the Desktop Manager equivalent for the Mac) support checks for failing disk blocks. After several years Apple abandoned disk block tag use. Newer Macintoshes have introduced block sparing for high density floppies and hard drives.

UNIQUE SYSTEM SERIAL NUMBERS

Each Lisa contained a unique serial number, stored in a special electronic chip, which the Desktop Manager could read. The Lisa used the serial number for program protection, and to establish uniquely identified communication nodes within Lisa data networks.

PROGRAM ANTI-PIRACY AND DATA PROTECTION

All Lisas provided a simple and effective method of protecting user programs from piracy, and data files from overly curious co-workers.

When the user installed a new program, the Lisa "serialized" the disk copy of the program by writing the ROM-based serial number to the program floppy disk. The user of this disk would then be unable to copy this "protected master" program file to another Lisa. The user could still execute the protected program from the floppy disk, but this was tedious, given that Lisa programs tended to be large and floppy-disk-based program execution would try the patience of most users.

Document protection was provided by pass-wording. The user could select a document icon with the mouse and, through a menu-driven dialog, obtain general information about the document. This information included the document's size and a field for the protection password. If the user typed a password into this field, the document was protected. When any user attempted to open a protected docu-ment, the Lisa displayed a dialog asking for the password.

NON-PHYSICAL FILE NAMES

The Lisa did not display physical file names to the user. Instead the Desktop Manager pre-sented a "document name view" which allowed descriptive names with up to 63 characters. The underlying filesystem allowed file names up to 31 characters long, which could not contain the directory separator character "-". For each document the Desktop Manager maintained a user document name (e. g. "Vacation Plans - 1983") and a physical low-level file name (e. g. "{T3D456}").

This non-physical file name scheme allowed the use of multiple documents with the same user-defined name, whose underlying physical file names were different. In this regard the Lisa mimicked the physical working desktop, where a worker might have five photocopies of the same document at the same time.

To the best of my knowledge, no other cur-rently available microcomputer supports non-physical document names.

PULL-OUT HELP CARD

The Lisa keyboard contained small pull-out firm plastic sheets of helpful information. The first sheet showed the keyboard itself and a layout of all the keys that the could be typed in combination with the Option key. Other cards gave concise information about Lisa op-erating features and techniques, such as how to copy documents. Another blank card allowed users to write down important personal infor-mation pertaining to the Lisa; for example, the phone number of the local Apple service center or representative.

HARDWARE BASED MEMORY MANAGEMENT

The original Lisa contained 1 megabyte of physical memory, with about half of it used for the Lisa Desktop Manager and the Desktop Libraries. A sophisticated hardware-based mem-ory virtualization allowed Lisa programs to access more memory than was physically in-stalled. This strategy also allowed the Lisa to segregate executing programs so that they could not access other programs' data at inap-propriate times. If memory protection was vio-lated, the Lisa would stop the errant applica-tion and alert the user that the program had been terminated.

ENVIRONMENTS WINDOW

Through the Environments Window, Lisa pro-vided a simple method for the computer to run radically different operating environments. On boot-up, Lisa ran a special low-level pro-gram called the Environment Selector, which located and ran a default operating environ-ment, if one was present. Otherwise, the Selec-tor displayed a window allowing the user to select a run-time environment. Apple supplied two different environments: the Office System environment for non-technical end users, and the Workshop environment for programmers. Other companies supplied additional environ-ments, e. g. an implementation of UNIX.

ADJUSTABLE SCREEN CONTRAST AND DIM DURATION CONTROL

Lisa screen contrast could be adjusted by the user with a special program called Preferences. This program also allowed the user to define a duration of inactivity, after which the screen would automatically dim and lessen contrast. This feature prevented screen "burn-in," which happens when screen images at high contrast "burn into" the screen's phosphors. The Lisa automatically, gradually dimmed the screen in pleasing increments — a nice touch on Apple's part which prevented a jarring change in screen brightness and contrast.

SCREEN PRIVACY FEATURE

For users who dealt with sensitive data, the Lisa provided a simple screen privacy feature. The user could press Option-Shift-[numeric keypad zero] at any time and the screen would immediately dim.

SELF-TEST AND FOREIGN LANGUAGE USAGE VIA KEYBOARD

The Lisa, when powered on, ran a special hardware self-test which made certain that it could safely run user programs and manipulate user data. Hardware failure would trigger a specific failure error number which could be used by an Apple service center to isolate the defective part.

During these diagnostic tests (which took around 3 minutes to execute) the Lisa displayed icons and messages to the user. The messages could appear in either English, French, or German, according to which keyboard was attached; Lisa keyboards were self-identifying and provided the Lisa with information including the keyboard "language". For example, if the keyboard was a German keyboard, then all diagnostic messages appeared in German.

Unfortunately, this language-sensing compatibility didn't extend to the menus of Office System applications and programs like LisaWrite!

SPECIAL SERVICE MODE

Lisa firmware contained a "service mode" which could be activated when the computer was powered on; this special feature allowed the knowledgeable user to run additional diagnostic tests. Also supported was a cross-hatch display pattern which made it easier to adjust the screen contrast.

EASY SYSTEM DISASSEMBLY

Any subassembly of a Lisa, except for dangerous portions like the monitor CRT, could be disassembled by the end-user, readily and with few if any tools. For example, users could remove and replace a disk drive with ease by just gripping the tabs at the base of the front panel, popping the front off, and unscrewing a single screw which held the drive in place.

MACINTOSH XL, MACWORKS, LISA-TO-MAC MIGRATION KIT

When Apple planned to discontinue Lisa, the company was left without a high-end system. All Apple had to offer at the time was the Macintosh 128K or 512K models, which were more compact than the Lisa but lacked the appeal of its bigger screen, bigger memory, and hard disk.

Apple's hardware and software engineers quickly developed a special program named MacWorks that allowed a Lisa owner to turn that computer into a "big" Macintosh. Apple produced three versions of MacWorks before turning over all MacWorks development to Sun Remarketing (see endnote).

Apple combined the new MacWorks with a renamed Lisa called the Macintosh XL. This gambit sold a rather surprising (to Apple) number of Lisas. MacWorks is still a commercial product for Sun Remarketing, which went on to develop an enhanced MacWorks Plus that lets a Lisa emulate a Macintosh Plus. (I wonder how many Lisas/Macintosh XLs Sun really sells now, but the company has been prodigious in developing and producing XL hardware peripherals, including larger hard disks and a board that allows SCSI devices to work with the XL.)

Apple solved the problem of transferring Lisa data to a Macintosh with the Macintosh XL Migration Kit, consisting of a special Lisa program called Lisa-to-Macintosh and a set of Macintosh data conversion programs. The Lisa program (primarily) wrote Lisa data files to a Macintosh disk; the Macintosh data conversion programs took the resulting files and converted them to Macintosh data files in an appropriate format. For example, LisaWrite documents could be converted to either MacWrite or Microsoft Word files for use by the Macintosh.

MACINTOSH: BACK TO THE FUTURE

Though the Lisa is now over a decade old, Lisa Technology still influences the Macintosh. As the Macintosh product line matures, it has in many ways circled back to approach the Lisa of 1983.

When Apple introduced the Lisa in January 1983, the Macintosh was already under development. In January 1984 Apple introduced the Macintosh which, at a casual glance, resembled a physically smaller Lisa in many ways. But underneath, the Macintosh and the Lisa were totally different. The Lisa depended on a multi-tasking operating system, the Macintosh only on single-tasking. The Lisa's extra memory (8 times that of the original Macintosh 128) and hard drive allowed use of comparatively sophisticated Lisa programs and larger data files. The Lisa's Desktop Manager and its distinctive user interface were drawn on by the Macintosh developers as a foundation for the Macintosh Finder.

A short list of Lisa legacy items from Mr. Larry Tesler's article "The Legacy of the Lisa" (MacWorld magazine, Sep. 1985) appears below (I've added the Software development list):

* User interface

- Menubar, pull-down menus, keyboard-activated menu commands

- Printing dialog boxes

- Appearance, structure, and operation of windows and scroll bars

- Ability to move windows and icons by dragging with the mouse

- Windows that zoom to open and close

- Dialog and alert boxes with buttons and check boxes

* Applications

- QuickDraw graphics package

- LisaDraw converted to MacDraw

- LisaProject converted to MacProject

- LisaWrite, LisaCalc, LisaTerminal influenced Macintosh applications

- Lisa Desktop Manager influenced the Macintosh Finder design

- Lisa printing architecture influenced Macintosh printing

* Software development

- Lisa Pascal converted to MPW Pascal

- Lisa Clascal influenced MPW Object Pascal

- Lisa Workshop influenced design of Macintosh Programmer's Workshop

- Lisa Workshop editor (LisaEdit) influenced editor design

- Lisa ToolKit influenced heavily the Macintosh MacApp framework

* Hardware

- Single-button Mouse design

- ImageWriter printer

The Lisa legacy may also be seen in its influence, through the Macintosh at least, on environments for non-Apple microcomputers, including Microsoft Windows, Digital Research's GEM, and Commodore's AmigaDOS. Close examination of these systems will show a superficial resemblance to the Lisa (and Macintosh) environments. But many times below the surface one finds behavior that is reminiscent of the PC-DOS and CP/M systems from (relatively) long ago.

Other Macintosh technical areas influenced by the Lisa were:

* System 7 Stationery

* System 7 Apple Events

* Finder's Print Monitor

When I work with the Macintosh (e. g. a Macintosh II series machine) in 1993, I notice two prominent differences from the Lisa of 1984.

First, the Macintosh is much faster than the Lisa. Editing complicated images in LisaDraw is almost an exercise in futility. Apple has made excellent progress in enhancing the speed of its Macintosh series. If Apple had kept the Lisa product line one could only assume that hardware speed improvements would have followed advancing technology. I've heard that Apple developed a prototype Lisa based upon the 68020 processor, but canceled this project along with the Lisa as a whole. This might have made the Lisa a much faster machine.

Second, the Macintosh seems comparatively incomplete in some ways. For example, the Macintosh Finder does not save the desktop, open application location, and data states, as did the Desktop Manager. I miss being able to press the Lisa's power-off button and just walk away from the computer, knowing that the computer would save all my application data and turn off automatically. Whenever I wished to resume work, I just pressed the power-on button and the Lisa showed me a screen matching the one I had left.

I don't mean to criticize the Macintosh unfairly, since it has in its own right contributed much to the field of personal computing. But the Lisa benefited in general by resulting from a total system approach that delivered integrated functions with a consistent and high quality user interface. I can only speculate how this "total approach" originated, but think it may have something to do with the experience and age differences of the Lisa and Macintosh development teams. From my readings it appears that the Lisa developers were about a decade older than their Macintosh counterparts. The Lisa developers came mainly from large computer companies like Xerox, HP, and DEC, which had created and manufactured minicomputer systems, while the Macintosh developers came mainly from within Apple's II and III computer divisions. The Lisa developers also appear to have had a different programming philosophy than the Macintosh developers. The Lisa's core software was primarily written in Pascal, a high-level language. Macintosh core software, on the other hand, was written in 68000 assembly language.

I can only hope that Apple will resurrect some Lisa Technology that is appropriate for Macintosh (and newer) systems. This hope assumes that Apple will preserve the Lisa development materials as best it can. Unfortunately, my experiences in this area suggest that Apple has lost some Lisa materials already and does not put a high priority on saving (what many there may consider) the "antiquated" Lisa technology that remains. I see the preservation of Lisa design notes and Lisa Office System source code files as crucial for the continuation of the Lisa's legacy.

Hopefully Apple will remove the confidentiality status of its Lisa materials in the upcoming years so that outsiders like myself may have access to this body of knowledge.

SYSTEM 7 LISA DEDICATION: THE LAST WORD?

The Lisa was considered by many at Apple to be a failed experiment. Even so it appears that some people working there understand, and wish to commemorate, the Lisa's legacy to the Macintosh. These people provided a short dedication to the Lisa Desktop Manager and its designers in the Macintosh System 7 operating system, which first appeared in 1990, almost a decade after the Lisa's debut.

On a Macintosh running System 7 you may obtain a dialog showing a Lisa dedication. Hold down the Option key and select the menu item "About the Finder" (this item is called "About this Macintosh" if the Option key is not held down). You should see a pretty mountain scene with a list of names at the bottom edge. Wait about 15 seconds and the bottom names will scroll, showing more names of contributors to various versions of the Macintosh Finder. Eventually you will see a dialog describing the Lisa Desktop Manager.

REFERENCES: GENERAL

Many reference materials for the Lisa exist but, unfortunately, most have become difficult to obtain. Fortunately, the author of this paper

appears to have almost everything ever written about the Lisa, both in the general press and by Apple Computer. All my Lisa materials are available to others if they pay for the copying and shipping.

This discussion of Lisa references mainly covers reference works pertaining to the original Lisa, not to the "Macintosh version" Macintosh XL. The original Lisa ran its own operating system (called the Lisa OS) while the Macintosh XL ran the Macintosh OS.

For general Lisa information I recommend the following books and articles:

* The Complete Book of Lisa
  (Kurt Schmucker, 1984)

* The Lisa Computer System
  (BYTE magazine, Feb. 1983)

* The Lisa 2: Apple's Ablest Computer
  (BYTE magazine, 1984)

* A First Look at Lisa
  (*Personal Computing* magazine, Mar. 1983)

* Apple's Lisa (The Seybold Report on Professional Computing, Jan. 1983)

* Lisa Makes the Scene
  (*Apple Orchard* magazine, Mar. 1983)

* Background Information: How Lisa Works
  (Apple Computer, 1983)

* Introducing Lisa: Apple's Personal Computer for the Office (Apple Computer, 1983)

* Apple Introduces Lisa: A Revolutionary Personal Computer for the Office
  (Apple, 1983)

* The Apple Lisa (*Officemation* Product Reports, Apr. 1983)

* Lisa/Mac XL Handbook
  (Michael Posner, Lisa Lives User Group, 1992)

* How Apple presents Lisa
  (*Softalk* magazine, Sep. 1983)

* Personal Computer Series: Apple Lisa 2
  (*Electronic Design*, Jul. 1984)

* Lisa Owner's Manual
  (Apple Computer, 1984)

Three books were written for the Lisa, but only Schmucker's book may be considered worth reading. Michael Posner's 123 page handbook is worthwhile for a decent overview of the Lisa's history and operational information. This handbook is also noteworthy for its recent publication date, which demonstrates the longevity of the Lisa. To join Posner's *Lisa Lives* user group write to him at 5170 Woodruff Lane, Palm Beach Gardens, Florida 33418.

REFERENCES:
NEWSLETTERS AND PRODUCT SHEETS

Several Lisa-specific magazines were also around for a while.

* Semaphore Signal

* ICON

* The LisaTalk Report

Semaphore Signal was a very detailed Lisa newsletter which produced around 30 issues. ICON was also good. The LisaTalk Report was the newsletter of the Lisa NetWorkers, a group which tried to breathe some life into the Lisa after Apple discontinued it.

Many other general Lisa references exist, ranging from general magazine articles to press clippings. For information about the Lisa's first operating system, Lisa Office System or Lisa 7/7, see the following:

* Reviewing Lisa's Office System
  (*St. Mac* magazine, Mar. 1984)

* Venerable Lisa Software Improved
  (*Personal Computing* magazine, Mar. 1985)

* The Lisa Office System
  (Apple Computer, 1984)

* Lisa Product Data Sheets
  (Apple Computer, 1983-1984)

* LisaGuide screen prints (David Craig, 1984)

The Product Data Sheets are worth reading for their descriptions of the programs Apple created for the Lisa, including LisaWrite, LisaDraw, LisaCalc, LisaGraph, LisaProject, LisaList, and LisaTerminal, as well as the Lisa itself. The screen prints are a complete collec-

tion of the 126 screens shown by Apple's interactive tutor for new Lisa users, LisaGuide.

REFERENCES: HISTORICAL/ARCHITECTURAL

For historical information about the Lisa see the following.

* The Legacy of the Lisa
  (*MacWorld* magazine, Sep. 1985)

* The Apple 32 Line: Past, Present, and Future (*A+* magazine, Jul. 1984)

* Lisa Chronology (Orphan Support column, *MACazine*, 198?)

* *Fire in the Valley* (Freiburger and Swaine, Osborne-McGraw-Hill, 1984)

* *The Little Kingdom: The Private Story of Apple* (M. Moritz, 1984)

The Lisa Legacy article is especially worth reading, since it was written by one of the Lisa's main designers, who provides a concise narrative of how the Lisa changed personal computing.

Lisa development history and details are documented in the following references:

* The Past, Present, and Future of the Macintosh Desktop (*Semaphore Signal*, Mar. 1986)

* An Interview with Wayne Rosing, Bruce Daniels, and Larry Tesler (*BYTE*, Feb. 1983)

* The Birth of the Lisa
  (*Personal Computing* magazine, Feb. 1983)

* Lisa's Design
  (*Popular Computing*, Mar. 1983)

* Lisa: A Vision for the Couch at Apple
  (*Softalk* magazine, Jul. 1983)

* Racing to a Draw: How Apple Gets its Software out the Door (*St. Mac*, Jun. 1984)

* Apple's Second Try at UNIX
  (*UnixWorld* magazine, Mar. 1988)

* A Death in the Family
  (*ICON* magazine, Vol. 2, No. 3)

The BYTE article is an excellent interview with the main Lisa designers. "Racing to a Draw" is worth reading for its fairly detailed

description of LisaDraw and MacDraw development. The "Couch" article is a good discussion of Mr. John Couch, the General Manager for Lisa, who may be considered Lisa's "father".

REFERENCES: TECHNICAL

Readers with technical aptitude can search out a smorgasbord of Lisa references that should satisfy the hungriest technophile:

* The Architecture of the Lisa Personal Computer (*Proceedings of the IEEE*, Mar. 1984)

* Lisa User Interface Guidelines
  (Apple Computer, Nov. 1983)

* Lisa's Alternative Operating System
  (*Computer Design*, Aug. 1983)

* Lisa: Up Close and Personal
  (*Softalk* magazine, Sep. 1983)

* Network Introduction Package
  (Apple Computer, 1983)

* The Lisa Applications ToolKit
  (Apple Computer, 1983)

* Lisa Workshop User's Guide
  (Apple Computer, 1984)

* Lisa Development System Internals Documentation (Feb. 1984)

* Lisa Desktop Libraries Interface Listings
  (David Craig)

* Lisa Hardware Manual
  (Apple Computer, May 1983)

* Guide to the OS
  (Apple Computer, Oct. 1982)

The Lisa Architecture paper is a tremendous resource of Lisa technical design and implementation facts, written by a primary Lisa designer, but it is extremely difficult to find. The Lisa User Interface Guidelines is a wonderful 100 page document that describes the design behind the Lisa's user interface. The Desktop Library interface listings describe the routines and data structures developed to implement Lisa Technology. The Lisa Hardware Manual is a lengthy tome describing Lisa's hardware in extreme detail; if you are an electronic-hard-

ware fanatic, this manual is for you. The author also has a 1981 preliminary version of the hardware manual which runs to only 80 pages, versus 200 pages for the 1983 version. "Guide to the OS" is an internal Apple manual describing the Lisa Monitor development environment, precursor to the public Lisa Workshop environment. This document should be of interest to those who yearn for information about the Lisa's early development years and the tools used for the programming effort.

REFERENCES: LISA TOOLKIT

Shortly after Apple introduced the Lisa in 1983, an enterprising computer engineer from Seattle started a programming group called the ToolKit User's Group (TUG). This group centered around the Lisa ToolKit, which was based on the Pascal language derivative Clascal, as developed by Apple for long-term Lisa development. Those with an interest in the ToolKit will find the following resources beneficial.

* Software Frameworks: The Lisa ToolKit (*BYTE* magazine, Dec. 1984)

* Professor Overrider's Almanac (David Redhed, TUG's newsletter, 4 issues)

* Save the ToolKit: A Call to Arms (Call A.P.P.L.E., Jun. 1984)

* An Introduction to Clascal (Apple Computer, Jul. 1984)

* The Lisa Applications ToolKit Reference Manual (Apple Computer, 1984)

* Object-Oriented Programming for the Macintosh (Kurt Schmucker, 1986)

* ToolKit source code (David Craig)

The Schmucker Macintosh book is recommended for its concise introduction to the Lisa ToolKit and the Clascal language. Though devoted to the Macintosh and MacApp, Apple's ToolKit son, this book does provide an excellent chapter on both the ToolKit and Clascal. The ToolKit source code is a wonderful collection of well-written modules which any programmer could profit from reading.

REFERENCES: MACWORKS

Those inquiring about MacWorks, which allows a Lisa to run (most) Macintosh software, should pursue the following:

* MacWorks XL User's Manual (Apple Computer, 1984)

* MacWorks Plus: Making a Lisa Speak Macintosh (*MacTech Quarterly*, Spring 1989)

Several articles and manuals describe how to transfer Lisa data to a Macintosh using the Macintosh XL Migration Kit; the most accessible is probably:

* Using the Macintosh XL Migration Kit (Apple Computer, 1985)

REFERENCES: PATENTS

Several U.S. patents filed by Apple cover key Lisa technologies:

* Lisa Twiggy disk drive front panel (Patent #Des. 266,426, Oct. 1982)

* ProFile hard disk case (Patent #Des. 273,295, Apr. 1984)

* Lisa case (Patent #Des. 277,673, Feb. 1985)

* Lisa mouse (Patent #4,464,652, Aug. 1984)

* Twiggy disk drive (Patent #4,466,033, Aug. 1984)

* Lisa QuickDraw "regions" (Patent #4,622,545, Nov. 1986)

* Lisa Memory Management Unit (Patent #4,926,316, May 1990)

REFERENCES: REPAIR

There are several good Lisa hardware repair books which current Lisa (or Macintosh XL) owners should seriously consider purchasing:

* Macintosh Repair & Upgrade Secrets (Larry Pina, 1990)

* Lisa/Macintosh XL Do-it-yourself Guide (Sun Remarketing, 1990)

* Apple Service Technical Procedures: Lisa/Macintosh XL (Apple Computer, 1988)

The Apple Service Technical Procedures manual is a very detailed document describing how

to fix errant Lisas or Mac XLs. The original Lisa systems came with a wonderful disk called LisaTest that allowed a novice Lisa owner to diagnose the Lisa's maladies.

REFERENCES: PRECURSORS

For an overview of prior art that Apple liberally "borrowed" for the Lisa design, see various papers from Xerox and others (the entries marked "*" are contained in the Xerox publication "Xerox Office Systems Technology: A Look into the World of the Xerox 8000 Series Products" [OSD-R8203A, Jan. 1984]).

* The Star User Interface: An Overview (*)

* Designing the (Xerox) Star User Interface (* [also in BYTE, Apr. 1982])

* Alto: A Personal Computer (Computer Structures, Principles, and Examples, 1982)

* The Smalltalk Graphics Kernel (*BYTE*, Aug. 1981)

REFERENCES: MISCELLANEOUS

Finally, this article's author has written several other, more specific Lisa papers:

* Apple Lisa Graphical Object-Oriented User Interface (Oct. 1987)

* A Review of Apple's Lisa Pascal (Oct. 1988)

* A Review of Apple's Lisa Workshop (Oct. 1988)

* Apple Lisa 7/7 Tool Deserialization (1988)

SUMMARY

The Lisa may be seen in retrospect as an experiment that both succeeded and failed. It succeeded by introducing several concepts to the computing industry which revolutionized the way (some) computers were built and the ways (some) users used them. It failed to convince its dual target market (both power users and normal users) that it had met its goals of being easy to use, powerful, and reliable. Lisa marketing was both imaginative and aggressive for its time but, even so, could not measure up to the accomplishments of the system itself.

Apple Computer is one of the few companies in the world with the gumption to attack Lisa-sized, Lisa-radical projects. Apple's successful demonstration that a desktop system could be both powerful and easy to use, and its attempt to migrate Lisa Technology features to its newer computers, should be considered a feather in the hats of all participants in the Lisa adventure. In a few short years, a relatively small group of talented and dedicated people developed a system meant to endow ordinary men, women and children with computing resources barely even dreamed of. Whatever provoked this conjunction of technical talent, it resulted in a brief, unparalleled flash of brilliance that is now a fading but alluring image.

We can only hope that this fading flash will somehow be rekindled in the future. Having the Lisa legacy without learning from it would be worse than not having it at all.

NOTES

1 An earlier version of this article was published in LISA LIVES, the newsletter of the Lisa Lives Users' Group, for Spring 1993.

This paper will shortly be available in an updated version which will include considerably more Lisa operational and technical information. To request a copy, please send 2 or 3 Macintosh 3.5" disks and a SASE to:

David T. Craig
941 Calle Mejia, Apt. 509
Santa Fe NM 87501

2 Interesting conjectures as to "Lisa's" identity can be found in Robert X. Cringely's *Accidental Empires* (Addison-Wesley, 1992) and in Owen Linzmayer's *The Mac Bathroom Reader* (forthcoming).

3 Sun Remarketing
  Box 4059
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4 This, too, was a philosophical inheritance from Xerox PARC. See Aaron Alpar, "LOGO and Smalltalk," ANALYTICAL ENGINE V1#2, page 8.