Tablet PC Report

by

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This report analyzes the emergence of the Tablet PC market and product category, with special emphasis on what IT needs to know to successfully deploy Tablet PCs. The report includes information on the following topics:

- The Tablet PC's key values.
- Tablet PC form-factors.
- Handwriting recognition.
- The top three horizontal applications.
- Tablet PC application software.
- Vertical applications.
- Pen tablets versus the Tablet PC.
- Tablet PC price premium.
- Tablet PC OEMs and ODMs.
- Short-term impediments to adoption.
- Analysts' and author's market projections.
- Tablet PC technology trend predictions.
- Tablet PC product trend predictions.
- Tablet PC action item checklist for IT.
- Sources of additional information.

INTRODUCTION

After more than a three-year gestation period, the Microsoft Tablet PC finally came to life on November 7, 2002. Now, seven months later, there are 26 hardware OEMs marketing 14 distinctly different Tablet PCs, and 37 software vendors marketing 60 identified Tablet PC applications. Even with this high level of market activity and support, there are still lots of unanswered basic questions, for instance:

- Is the Tablet PC a serious business tool or just a cool techie gadget?
- How compatible is the Tablet PC's operating system with other Windows versions?
- Why are there two form factors and which one should IT consider?
- Why are Tablet PCs so expensive?
- Does handwriting recognition have to be used?
- How well does handwriting recognition work?
- How can you use a PC without a keyboard?
- Are Tablet PCs useable in both vertical and horizontal applications?
- What are the risks and rewards of implementing vertical applications with Tablet PCs?
- Is reviewing and annotating Office documents a realistic Tablet PC application?
- And many, many others…
TEN BASIC FACTS ABOUT THE TABLET PC

A lot has been written in the press about the Tablet PC since the concept was first publicly proposed by Microsoft in May 1999. A surprising amount of it is misinformed, and some of it is simply wrong. To create a solid foundation for the remainder of this report, here are ten basic facts about the Tablet PC:

(1) The Tablet PC is a full-fledged Windows notebook. It’s not a webpad, a Smart Display, a PDA on steroids or a high-tech Etch-A-Sketch.

(2) The Tablet PC’s operating system is a superset of Windows XP Professional. This means that the Tablet PC can run any application that’s capable of running on Windows XP. Special “pen-enabled” applications are not required.

(3) Tablet PCs are available in two form-factors—“convertibles” (sometimes called “swivel-display notebooks” and “pure tablets” (often called “slates”).

(4) All Tablet PCs have keyboards. Convertibles have integrated keyboards, just like any standard Windows notebook. Pure tablets use external keyboards, connected via USB or wireless (or attachable, in the case of HP’s Tablet PC).

(5) All current commercial Tablet PCs are members of the “ultraportable” class of notebooks. This means they have 10” or 12” XGA-resolution LCDs and a single spindle (no internal optical drive), are around 1” thick and weigh 3-4 pounds. Ultraportables are a distinct class of notebooks, different from the “thin-and-light” class (14” or 15” XGA- or SXGA-resolution LCDs, two spindles, 1.5” thick, 5-6 pounds) that make up the bulk of enterprise notebooks. According to IDC, ultraportables account for only 15% of notebooks sold today.

(6) The pen on a Tablet PC works like a mouse. Tapping once with the pen is the same as doing a left-click with a mouse. Tapping twice is a left double-click. Pressing the side-button on the pen and tapping (or holding the pen against the screen for more than two seconds) is a right click. Almost anything that can be done with a mouse can be done with the pen. This means that when a Tablet PC is used as a standard Windows notebook, the user doesn’t have to learn anything new.

(7) The pen on a Tablet PC is a special electronic pen. Unlike a PDA or a Smart Display, a Tablet PC cannot be used with a finger or a “stick” pen. The screen on a Tablet PC is not touch-sensitive; it works only with the special electronic pen.
(8) Handwriting recognition does not have to be used on a Tablet PC. Even with a pure tablet and no external keyboard, data entry (e.g., creating a new file name) can still be accomplished by tapping with the pen on a keyboard displayed on the screen.

(9) All Tablet PCs are legacy-free, that is, they have no PS/2, serial or parallel ports. These ports are replaced by USB and/or FireWire (IEEE-1394). All Tablet PCs also support external monitors, wireline modems, 10/100 Ethernet, audio input and output, wireless LAN (Wi-Fi) and PC cards—just like any standard Windows notebook.

(10) All Tablet PCs include speech recognition, which is integrated into the operating system. The speech recognition engine is the same as in Office XP (2002). Speech recognition and handwriting recognition are closely integrated—you can freely intermix them. For example, you can speak a few words and then write a few words, or speak and then make corrections with the pen, or vice-versa.

**ENHANCED MOBILITY**

The Tablet PC is one result of a multi-faceted effort by Microsoft to increase the value of a PC by increasing the amount of time that it is used. Standard notebooks are terrific productivity enhancers, but they can't be used everywhere. For example:

- Walking while using a notebook is impractical.
- Using a notebook in a coach airline seat is difficult.
- Typing on a notebook during a meeting is usually considered rude.
- Handing an open notebook to someone (to view the screen) is awkward.
- A notebook screen can present a physical barrier between a sales rep and a customer.

A Tablet PC is a highly mobile product that can be used in “slate” form in all of these situations, just like a traditional pad of paper. A Tablet PC is therefore likely to be used more often and in more places than a standard notebook. Microsoft's positioning of the Tablet PC emphasizes this fact with tag lines such as “the most mobile PC ever” and “the evolution of the PC”. To emphasize the fact that a Tablet PC is a full-fledged Windows notebook, Microsoft also often refers to the Tablet PC as “a superset of the laptop”.

Because of the obvious connection between wireless and enhanced mobility, Microsoft recommends that all Tablet PCs should include internal wireless LAN (Wi-Fi). Consequently, all the first-generation Tablet PCs except one (PaceBlade) have an internal 802.11b radio. This makes it possible, for example, to sit in a
meeting with the Tablet PC on your lap like a pad of paper and access not only all your own files, but also information on the company intranet and on the Internet.

None of the first-generation, commercial (non-rugged) Tablet PCs have any provision for any other form of internal wireless, such as Bluetooth, GPRS or CDMA2000. As with most standard notebooks, PAN or WAN wireless connectivity must be achieved via PC or CF cards, a USB dongle or connection to an external radio (e.g., a cellphone).

DIGITAL INK

After enhanced mobility, the second key value of a Tablet PC is “digital ink.” To better understand the concept of digital ink, consider what happens when you type text into Microsoft Word. The ASCII characters that make up the text are stored in the Word file, along with property records that define the font size and color, the author of the text, the path name of the file, when it was created, and a host of other information. Digital ink is the same concept, except instead of ASCII characters, the series of digitizer points that make up each continuous pen stroke are stored in the file. Digital ink’s property records can include per-point properties such as pressure, per-stroke properties such as color, global properties such as text equivalents (recognized words), and unique application-defined properties.

Because of the Tablet PC, digital ink will become a standard data type. This contrasts significantly with the way ink was handled previously by Windows, where it was stored as just a bitmap (a series of display pixels) with no property records. Stored digital ink can easily be manipulated or modified, unlike a bitmap. For example, it can be bolded, italicized, highlighted, colored, cut and pasted, scaled or erased.

Digital ink opens the door to a wide range of applications for the Tablet PC, many of which haven’t even been imagined yet. Here are just a few possibilities:

- Taking notes in meetings, often leaving them as ink.
- Reviewing and annotating Microsoft Office documents.
- Collaborating in an increasingly mobile environment.
- Annotating architectural drawings or GIS maps.
- Marking up medical images and x-rays.
- Sending handwritten instant messages (without recognition).
- Creating music.
- Sending ink emails.
- Performing educational activities such as learning penmanship.
- Playing games such as Microsoft's “Inkball”.
- Doing psychological evaluations of children through their drawings.
- Attaching yellow “sticky notes” to magazine articles.
- Clipping something out of a web page, adding an ink note, and emailing it.
- Creating works of art.
- Processing ink in a structured application such as FranklinCovey’s TabletPlanner.
FORM-FACTOR

Tablet PCs today are available in two form-factors, “pure tablets” (devices without an integrated keyboard), and “convertibles” (devices with an integrated keyboard). In assessing the applicability of the two form-factors, it's useful to understand the background of both.

The pure tablet has been the “Holy Grail” of pen computing for 35 years, beginning with Alan Kay's vision of the “Dynabook” in 1968. A device the shape and thickness of a pad of paper that can be driven exclusively with a pen, but with all the functionality of a full PC, would be extremely attractive. Unfortunately, it still doesn't exist today. Handwriting recognition still isn't good enough to allow eliminating the keyboard, and there's nothing on the horizon that will change that fact in the next five years. It will take at least another 10 years of development (as well as continued progression along the Moore's Law curve) to reach the desired goal.

According to one of Microsoft's original Tablet PC architects, when Microsoft first decided to build their own Tablet PC hardware prototype in 1999, they debated whether to build a pure tablet or a convertible. They decided to build a pure tablet to ensure that the Microsoft engineers would take a very serious approach to the development of digital ink and the problem of using Windows with just a pen, even though most people at Microsoft believed that the convertible would be the most popular form-factor for the Tablet PC.

In the 17 months between the first public exposure of the Microsoft prototype (June 2000) and the appearance of the first Acer convertible prototype (November 2001), the Microsoft pure tablet prototype was the only Tablet PC hardware available. During this period, “pure tablet” and “Tablet PC” were synonymous. Microsoft's positioning during this period was that the Tablet PC was “the evolution of the laptop,” implying that users were somehow going to evolve beyond their keyboards into a world where an extremely light and thin pure tablet could replace a notebook. The press heard this message and published a lot of “I don't think so!” stories about the Tablet PC during 2001.

Most Tablet PC OEMs/ODMs started developing their products during this period, using the Microsoft prototype pure tablet as a reference design. Although Microsoft pushed the OEMs/ODMs to develop convertibles, most of them considered convertibles to be too risky. This explains the preponderance of pure tablets in the first generation of Tablet PCs, where there are only three convertibles (Acer, Panasonic and Toshiba) out of 14 products. Note: the HP/Compaq Tablet PC isn't a true convertible; it's a pure tablet with a particularly clever attachable keyboard.

When Acer showed the prototype of their TravelMate C100 convertible Tablet PC at Comdex 2001, Microsoft bought 1,500 of the prototypes and never looked back. Every demo, conference and trade show that Microsoft did during the next nine months used the Acer (although other pure tablet prototypes were available, such as Fujitsu's). After Comdex 2001, Microsoft changed the Tablet PC positioning to “a superset of the laptop” – you can't be a superset if you don't have an integrated...
keyboard! From that time forward there was no doubt Microsoft believed that an integrated keyboard was essential. Now, a year and a half later, most of the press has adopted the realistic view that convertible Tablet PCs will be the mainstream form-factor, and pure tablets will remain mostly in the realm of vertical applications.

**HANDWRITING RECOGNITION**

Handwriting recognition is the process of transforming digital ink into equivalent ASCII text. The handwriting recognizer used in the Tablet PC is a combination of original Microsoft development and the “Calligrapher” recognizer developed by Paragraph, the rights to which Microsoft purchased in 1999. The handwriting recognizer on the Tablet PC is generally acknowledged as the best that's been developed on any pen computer to date. That said, it's still far from perfect. As it exists in Version 1 of the Tablet PC operating system, the recognizer has three fundamental problems: (a) the recognition accuracy varies widely from person to person, (b) the recognizer can't be trained, and (c) recognition isn't context sensitive except in custom applications.

For example, suppose two users write the same 50-word paragraph. Although their handwriting may appear readable and very similar, the recognition accuracy experienced by the two users can range between approximately 60% (20 words wrong out of 50) and 95% (one word wrong out of 50). The 60% user will spend an inordinate amount of time correcting his handwriting, probably getting very frustrated in the process. The 95% user will wonder what all the fuss is about. Unfortunately, there's no foolproof method for the 60% user to improve his accuracy. Writing slower and more carefully will improve it somewhat, but not to 95%. The recognizer expects letters to be written a certain way, and since it isn't trainable, trial-and-error is often the only way to figure out what works.

Mechanical issues also contribute to the recognition accuracy problem. All of the first-generation Tablet PCs have very slippery screens; using them is a little like writing on ice. Also, many of the electronic pens provided by the manufacturers are uncomfortable to use—they're too thin, oddly shaped, too slippery or they have awkwardly placed side-buttons. Both the screen and the pen issues tend to make handwriting less controlled, as the pen tip slides on the screen and the writer's fingers become cramped.

The lack of context-sensitivity means that there's no intelligence in the recognition. Trying to write a URL in Internet Explorer or an email address in Outlook is very difficult because the recognizer is trying to match what you're writing against a dictionary of standard words. Similarly, trying to get a license plate number properly recognized is an exercise in frustration as the recognizer mixes up alphas and numerics, and adds a space in the middle while attempting to make the license plate number into words.

Microsoft is well aware of these issues. In fact, these issues are the reason why Microsoft's promotion of the Tablet PC heavily emphasizes the value of “ink as ink”
and de-emphasizes handwriting recognition. It’s likely that Microsoft will make the recognizer trainable in Version 2 of the Tablet PC operating system (in 2005). Similarly, it’s likely that the Tablet PC OEMs will improve the writing surface and the pen ergonomics in their second- or third-generation products, as they become aware of negative feedback from users. Microsoft is aware that the lack of contextual recognition is a significant problem; it’s likely that version 1.5 of the Tablet PC operating system (due in late 2003) will include improvements in this area. In addition, third-party (ISV) utilities that modify the behavior of the Tablet PC operating system will start to become available during 2003.

The bottom line is that the Tablet PC’s handwriting recognizer is not ready today to be employed in applications where accurate recognition is required across a broad range of users. For example, consider a home-inspection application. In a paper-based environment, inspection results are typically recorded on a paper form containing hundreds of checkboxes and dozens of spaces for handwritten comments about each major subsystem in the house (plumbing, roofing, etc.). The checkboxes become input to a report-generation program that outputs blocks of canned text based on which boxes are checked, and the comments are manually transcribed in appropriate places throughout the report.

While the checkbox portion of the application is terrific on a Tablet PC, the handwritten comments portion is unlikely to work well because of the wide variation in recognition accuracy. One solution is to use a convertible Tablet PC and type the comments rather than handwriting them. However, that requires the user to switch from “slate” mode to “laptop” mode and find a place to put the Tablet PC every time a comment is required—which may not be practical. Another solution is to structure the application to allow notes to be taken in digital ink when needed—but not recognized. In this solution, the user types the comments later while referring to his own ink notes. The plain truth is that the Tablet PC is simply not ready for applications that require extensive free-text input while standing or walking around.

**Top Three Horizontal Tablet PC Applications**

There are at least three significant mobile business activities that should benefit substantially from the availability of a Tablet PC. These are note-taking, reviewing and annotating Office documents, and collaborating with other people in the enterprise. Each of these applications is examined in detail in the following sections.

**Taking Notes on a Tablet PC**

Note-taking in digital ink is one of the more highly promoted applications of a Tablet PC. To some extent this is due to Microsoft’s emphasis of “ink as ink”, driven by highly variable handwriting recognition accuracy as noted above.
The Tablet PC’s very high-resolution active digitizer (>1,000 dpi) and relatively high-resolution LCD (123 dpi on most models), along with significant mathematical smoothing of the ink, allows very realistic digital ink to “flow” from the electronic pen. It is therefore possible to write notes in digital ink that appear reasonably similar to those in a traditional spiral notebook. Note, however, that the actual screen area available for note-taking on a 10.4” LCD is only about half the size of an 8.5” x 11” sheet of paper.

One of the key values of taking notes in digital ink is that they can easily be printed, stored, recalled later or emailed to others—all of which can be difficult to do with paper-based notes. Another significant value is that the digital ink can be searched, without explicitly converting it to text. This is possible because the Tablet PC’s operating system is always doing handwriting recognition in the background as you write. Lists of alternative text equivalents are stored in the property records of each ink word. These word lists are used when searching digital ink.

Note, however, that if a user’s handwriting places him or her on the low end of the recognition accuracy scale, searching digital ink simply won’t work well enough to be useful. For some users, this is enough to disqualify the Tablet PC as a note-taking device.

**WINDOWS JOURNAL**

Version 1 of the Tablet PC operating system includes a program called “Windows Journal” that’s intended as a note-taking utility. It offers a lot of flexibility in how you can take notes. For example:

- Ink size and color can be varied.
- The pen can be made pressure-sensitive (if your Tablet PC supports pressure).
- Ink can be highlighted, erased, moved, bolded or italicized.
- Simple shapes such as circles and squares can be recognized and cleaned up.
- Photos or other image files can be included in the middle of note pages.
- Space can be inserted or removed in the middle of an ink note.
- Ink can be converted into text and inserted into the note file or the clipboard.
- Ink notes can be saved or printed.
- Stationary (note lines, colors, title format, background, etc.) can be changed.
- Templates can be used to standardize the format and structure of notes.

Although Windows Journal makes a very effective demo, in actual use it’s somewhat clunky. It’s excessively modal and requires too many pen taps to accomplish simple things. Fixing incorrectly recognized text is an arduous process. Journal notes files (of type .jrn) can only be modified by Windows Journal running on a Tablet PC. A Journal file viewer is available for Windows 2000 and XP that allows non-Tablet PC users to view Journal ink files.
MICROSOFT ONEWOTE

A new Microsoft Office 2003 program called “OneNote” is very likely to make Windows Journal obsolete. OneNote is a note-taking program based on extensive research of how people actually take notes. The program is designed for use on laptops, desktops and Tablet PCs. In addition to most of the Journal features above, OneNote includes the following capabilities:

- Multiple folders, sections and pages with tabbed access.
- Write or type anywhere on the page, not just starting in the first column.
- Non-scrolling notes title area (like Freeze Panes in Excel).
- Automated outlining, bulleting and numbering.
- Drag-and-drop reordering and combining of notes and pages.
- Multiple Note Flags to mark key or urgent items (integrated with Outlook 2003).
- Global find function with ability to display list of results (like a search engine).
- History navigation (like History in a web browser).
- Automatic save.
- Ability to record audio synchronized to handwritten or typed notes.
- Automatic insertion of a URL with information clipped from web sites.
- Quick Pane (like a yellow “sticky note” with OneNote capabilities).

OneNote, currently in beta, will be available in the fall of 2003. It will be a standalone Office application (like Project, Visio and FrontPage), not bundled in any of the Office suites.

REVIEWING AND ANNOTATING OFFICE DOCUMENTS

Today, when a complex Office document that includes text and graphics is reviewed by everyone in a group, it is often done on paper. The Tablet PC has the potential to change that situation, depending on the degree of integration of digital ink in future versions of Office. Marking up a document with a pen on the screen is just about as easy as on paper, and it’s a lot more versatile—color can be used, pictures can be inserted, and the marked-up copy can be shared, transmitted and stored just like any other file. Given the dominance of Office in the enterprise, this is very likely to be one of the top horizontal applications of the Tablet PC.

OFFICE 2002

The “Microsoft Office XP Tablet Pack for Tablet PC” is a free, downloadable add-on to Office XP (v10, 2002). The Tablet Pack enables the use of digital ink in Word, PowerPoint, Excel and Outlook, as well as OLE-compatible programs such as
Project and Visio. However, since the Office applications were not designed for use with digital ink, and the Tablet Pack is simply an add-on, the depth of integration of digital ink in Office 2002 is very shallow.

- In Word 2002, ink drawing and writing areas can be located in a comment balloon, or directly in the document. In the former case, the ink is displayed in the margin of the document or in the Reviewing pane. Note that in the latter case, since the ink is treated the same way that a graphic would be, re-flowing the text changes the spatial relationship between the text and the ink. In normal editing, the spatial relationship between a given ink mark (such as an insert caret) and the text to which the ink mark refers must remain unchanged. This means that it's not practical to use ink for annotation in Word 2002.

- In Excel 2002, multiple ink drawing and writing areas can be inserted anywhere on the worksheet. The same spatial relationship restriction that exists in Word applies in Excel.

- In PowerPoint 2002, ink can be added to slides during creation or presentation. During creation, you can use ink to add comments during the review process, add ink to highlight something in the slide that you want to emphasize during the presentation, or use ink as a temporary placeholder for graphics that will be inserted later. During the presentation, you can use ink to take notes that are viewable by the audience, record questions or add comments. The ink can be saved for later reference. The inking capability in PowerPoint is probably the most practical application of the Office Tablet Pack.

- In Outlook 2002, ink can be inserted into a new, reply or forwarded email. The ink can be used to send a handwritten message, or a quick drawing such as a map. The ink appears as an embedded object to the recipient of the message, similar to the way a table or graphic appears. Note that if the recipient uses plain text as their email format, they will not be able to see the ink, since plain text email editors can't display embedded objects. Word 2002 must be used as the email editor in order to enter ink. A keyboard or the Tablet PC Input Panel (the operating system's main handwriting text-entry box) must be used to enter other information such as the “To” or “Subject”.

**OFFICE 2003**

Microsoft has promised substantially more integration of digital ink in Office 2003 (v11). One example is the ability to write anywhere in a Word document and have the ink maintain its spatial relationship with reflowed text. Since the Beta
version of Office 2003 was just released shortly before this report was written, detailed information is not yet available. While it is very likely that Microsoft understands how critically important ink support in Office is to the future of the Tablet PC, it’s worth remembering that Microsoft typically takes more than one release of any new product to reach a fully acceptable level of functionality.

Collaboration in an Increasingly Mobile Environment
Collaboration software today is a niche in traditional notebook computing, but the Tablet PC is likely to cause substantial growth in this field. The enhanced mobility of the Tablet PC, described earlier in this report, is likely to drive the creation of new software that will solve the biggest problem in today’s meetings: effectively sharing information that’s created in group settings—not only after the meeting, but also during the meeting.

MobileTrax Spotlight: Collaboration Software Companies

  Adobe’s Acrobat program provides streamlined document review through review management, extensive editing capability and comment consolidation, all based on the PDF standard format.

- Colligo Networks (www.colligo.com)
  Colligo’s Workgroup Edition allows creating peer-to-peer wireless LAN collaborative networks on the fly whenever and wherever needed, without requiring central access points, servers or Internet connections.

- Groove Networks (www.groove.net)
  Groove Workspace is desktop/laptop collaboration software that leverages email and Microsoft Office for small-group interaction across technical (network) and organizational boundaries.

- Sigma Designs (www.sigmadesign.com)
  Sigma Designs’ “eZ” is Internet conferencing software that allows users to view and mark up the same documents in real time, regardless of location.

- SPANworks (www.spanworks.com)
  SPANworks offers a family of products that provide spontaneous wireless networking and allow drag-and-drop file exchange, electronic business cards, private messaging and group presentations on PCs and PDAs.

- WebEx (www.webex.com)
  WebEx provides on-line meeting and web conferencing services that allow application and data sharing, live video conferencing and integrated teleconferencing.
TABLET PC APPLICATION SOFTWARE

Application software is the ultimate driver of the Tablet PC concept. Without application software that makes using a pen desirable and useful, the Tablet PC will fail. Successful vertical applications aren't enough to make the Tablet PC into a mainstream product.

A substantial amount of software has been announced for the Tablet PC during the last seven months. Table 1 on the next two pages lists 37 companies with 60 different applications for the Tablet PC. The 60 applications can be grouped into three categories, as follows (the fact that there’s exactly 20 applications in each category is purely coincidental):

- Horizontal applications (20)—book & magazine readers, business graphics, collaboration, productivity tools and games.

- Vertical or technical applications (20)—3D design & graphics, architecture, enterprise reporting, geographical information systems (GIS), healthcare, insurance, real estate and sales force automation.

- Utility applications (20)—character recognizers, file viewers, form tools, gesture recognizers, ink email, shape recognizers, speech recognizers, sticky note programs and user interface modifiers.

Table 1. Tablet PC Application Software

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<tr>
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<td>Journal Viewer</td>
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<tr>
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<td>Sticky Notes</td>
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<tr>
<td>Ngrain</td>
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<td>Parascript</td>
<td>riteMail, ritePen, riteShape SDK</td>
<td>Ink email, utility</td>
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<tr>
<td>(Pen&amp;Internet)</td>
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<td>MySAP CRM</td>
<td>Sales force automation</td>
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<td>e2</td>
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<td>Suite for Developers</td>
<td>Utility</td>
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<td>Site Enterprise</td>
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<td>Home Appraisal</td>
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<td>Reader</td>
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<td><a href="http://www.zinio.com/">www.zinio.com/</a></td>
</tr>
</tbody>
</table>
The degree of adaptation for the Tablet PC in the 60 applications in Table 1 varies considerably. Some applications, such as Corel Grafigo and FranklinCovey TabletPlanner, are written from scratch to take maximum advantage of every capability in the Tablet PC SDK (Software Development Kit). Some applications, such as WebEx Meeting Services, just add simple ink support such as an ink chat function. And finally, some applications, such as Allscripts TouchWorks, are not modified at all for the Tablet PC—because of their nature, they are already ideally suited for use on a highly mobile PC that can be used while standing or walking.

As noted earlier in this report, the three most important horizontal applications for the Tablet PC in the next several years are expected to be (1) note-taking, (2) reviewing and annotating Office documents, and (3) collaboration. These applications are well-represented in Table 1, but it’s only a beginning. Many more relevant applications are needed to make the Tablet PC into a mainstream success.

MobileTrax Spotlight: Collaboration Software Companies

Of the 37 Tablet PC application software companies listed in Table 1 on the previous two pages, the 10 companies that are most likely to have a significant impact on the Tablet PC are as follows (see Table 1 for URLs):

- **Adobe (Acrobat)**
  Pen-based annotation capability is a natural fit for Tablet PC; PDF-based document review avoids every user needing Microsoft Office.

- **Alias Wavefront (Sketchbook)**
  Innovative pen-based user interface; powerful artistic-oriented sketching and rendering capability.

- **Autodesk (Autodesk Envision™ 8, AutoCAD® 2004, AutoCAD LT® 2004)**
  Powerful PC tools and Tablet PC interface options give mobile users, in the areas of architecture and infrastructure design and management, the flexibility to view and manage data on site and in the field. Autodesk Envision™ 8 is an easy-to-use tool for professionals who integrate, visualize, analyze, and present mapping and design data—including spatial, mapping, and civil engineering formats—on the desktop, Tablet PC, or web browser. AutoCAD® 2004 is the 2D drafting, detailing, and 3D design tool for creating design data faster and sharing it more easily than ever before. AutoCAD LT® 2004 is the drafting and detailing solution for design professionals in all industries who require full DWG file format compatibility and do not need to customize their software.
• Corel (Grafigo)
  Easy-to-use business graphics sketching and annotation tool; Corel’s focus on Tablet PC and .NET capabilities in vertical applications.

• ESRI (ArcMap)
  Thoughtful application of Tablet PC capabilities to a natural Tablet PC application area (Geographic Information Systems).

• FranklinCovey (TabletPlanner)
  Robust planning application designed for the Tablet PC; maintains look and functionality of FranklinCovey’s paper planner.

• Groove Networks (Groove Workspace)
  High degree of integration with Microsoft software on both client and server levels; extensive range of plug-ins.

• Leszynski Group (multiple applications)
  Essential Snipping Tool for screen capture, annotation and emailing of website content; consulting services.

• Microsoft (Office 2003 & One-Note)
  Integration of digital ink in Office 2003; superior note-taking application.

• Parascript Pen&Internet (multiple applications)
  Most prolific ISV creating tools and utilities to enhance Tablet PC usability and handwriting recognition.

**VERTICAL APPLICATIONS**

The term “vertical” refers to the fact that in most enterprise applications of pen tablets or Tablet PCs, all the users run the same application and do similar activities (their usage is narrow, or “vertical”). For example, pharmaceutical sales people using Tablet PCs typically run customized software that gives them the ability to quickly demonstrate the key benefits of a new drug (including showing a 30-second video), while walking down a hospital hallway with a doctor. Traditional notebook users, on the other hand, tend to use a wide (“horizontal”) variety of productivity software, including Microsoft Office, photo editing tools, Internet metasearch tools, sketching tools, collaboration tools, etc., while working in their office, in a meeting, or on the road.

In vertical applications, the pure tablet (slate) form-factor is often used rather than a convertible. Vertical applications are typically written so that a keyboard isn’t required, so the extra weight of a convertible (keyboard, hinge, additional housing
layers, etc.) is a detriment. Vertical application users often work on their feet (e.g., a nurse, or the above-mentioned pharmaceutical sales person), so the carrying weight of the Tablet PC is very important.

Most vertical applications of pen tablets or Tablet PCs share a common set of characteristics, as follows:

- Automation of a business process is the focus of the project.
- Specialized or customized software is employed.
- ROI (Return On Investment) is a primary consideration.
- Hundreds or thousands of computers are involved.
- A significant amount of planning takes place before the rollout.
- Hardware and software support are required throughout the project life.
- Project implementation takes 6-24 months.
- Project life is about three years.
- A VAR (Value-Added Reseller) is involved.

During the last ten years, focusing on business process automation has been the key to successful implementation of pen tablets in vertical applications. These applications are typically aimed at meeting business goals such as the following:

- Treating more patients without adding staff.
- Selling more products per sales rep.
- Getting data on the competition back to headquarters faster.
- Improving customer satisfaction.
- Servicing more stores in the same amount of time.
- Handling more insurance claims per day.

Table 2 lists a wide range of potential vertical Tablet PC applications. Almost all of these applications already exist with pen tablets.

### Table 2: Potential Vertical Tablet PC Applications by Market

<table>
<thead>
<tr>
<th>Market</th>
<th>Potential Vertical Tablet PC Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td>Recording performance data on jet engine testing in the field; informing astronauts of possible re-entry paths</td>
</tr>
<tr>
<td>Agriculture (Precision Farming)</td>
<td>Monitoring planting, fertilizing and harvesting with GPS</td>
</tr>
<tr>
<td>Architecture</td>
<td>Updating (red-lining) architectural drawings in the field</td>
</tr>
<tr>
<td>Automotive Repair</td>
<td>Completing customer workorders; selling more services; performing diagnostics; accessing documentation</td>
</tr>
<tr>
<td>Automotive Sales and Auctions</td>
<td>Completing customer orders in an interactive sales process; recording automotive auction sales via wireless LAN</td>
</tr>
<tr>
<td>Aviation (Commercial)</td>
<td>Calculating engine power settings just before takeoff</td>
</tr>
<tr>
<td>Aviation (Private)</td>
<td>Navigating and planning with an “electronic flight bag”</td>
</tr>
<tr>
<td>Construction</td>
<td>Inspecting highways and commercial buildings</td>
</tr>
<tr>
<td>Distribution and Wholesaling</td>
<td>Doing direct store delivery (DSD or “route accounting”)</td>
</tr>
<tr>
<td>Department of Defense (DOD)</td>
<td>Accessing and displaying information in a helicopter at night</td>
</tr>
</tbody>
</table>
Table 2: Potential Vertical Tablet PC Applications by Market (cont.)

<table>
<thead>
<tr>
<th>Market</th>
<th>Potential Vertical Tablet PC Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education (K-12, College)</td>
<td>Performing exercises in class rather than in a computer lab</td>
</tr>
<tr>
<td>Entertainment and Media</td>
<td>Tracking and managing the logistics of a movie production</td>
</tr>
<tr>
<td>Federal Government Agencies (DOL, DOT, EPA, FEMA, HUD, VA, etc.)</td>
<td>Completing insurance claims after a natural disaster (FEMA); surveying the “weekly market-basket of goods” prices (DOL)</td>
</tr>
<tr>
<td>Field Engineering</td>
<td>Searching for oil and gas wells; doing mobile process control</td>
</tr>
<tr>
<td>Field Service (Workforce Management)</td>
<td>Completing workorders; finding parts; scheduling repairs; being dispatched to the next call</td>
</tr>
<tr>
<td>Finance (Auditing)</td>
<td>Performing mobile audits at a client’s site</td>
</tr>
<tr>
<td>Finance (Banking)</td>
<td>Selling commercial loans to small businesses on-site</td>
</tr>
<tr>
<td>Finance (Stock Markets)</td>
<td>Trading options and commodities on the exchange floor</td>
</tr>
<tr>
<td>Forestry</td>
<td>Grading lumber-grade trees; assessing fire loading</td>
</tr>
<tr>
<td>Geodesy (GIS, Mapping &amp; Surveying)</td>
<td>Surveying; locating and servicing underground pipes; inspecting assets that can only be located geographically</td>
</tr>
<tr>
<td>Graphics/Artistic</td>
<td>Sketching or modifying advertisement ideas at a client’s site</td>
</tr>
<tr>
<td>Healthcare (In-Building)</td>
<td>Matching bar-coded patients &amp; medicines; doing patient assessments; accessing patients records and lab reports</td>
</tr>
<tr>
<td>Healthcare (Home)</td>
<td>Completing government paperwork for insurance</td>
</tr>
<tr>
<td>Hospitality (Hotels &amp; Restaurants)</td>
<td>Checking in hotel guests at mobile registration counters; helping customer select wine at high-end restaurant</td>
</tr>
<tr>
<td>Hospitality (Rental Car Agencies)</td>
<td>Checking in frequent rental customers on the bus</td>
</tr>
<tr>
<td>Insurance (Auto Damage Estimation)</td>
<td>Creating a repair estimate on a wrecked car at a repair shop</td>
</tr>
<tr>
<td>Insurance (Commercial &amp; Life)</td>
<td>Selling commercial insurance; assessing insurance risks in buildings in order to set underwriting rates</td>
</tr>
<tr>
<td>Law Enforcement (Police, Sheriff, Highway Patrol)</td>
<td>Investigating accidents; checking license plates for violations; reporting incidents</td>
</tr>
<tr>
<td>Legal</td>
<td>Accessing case histories or research material in court</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Doing inspections, mobile process control or quality engineering on the manufacturing floor</td>
</tr>
<tr>
<td>Mining</td>
<td>Recording data from a laser used to map the mine face</td>
</tr>
<tr>
<td>Pest Control</td>
<td>Inspecting for termites; surveying a home before sale</td>
</tr>
<tr>
<td>Public Safety (Emergency Medical Services)</td>
<td>Recording data on ambulance patients; sending critical data wirelessly to the emergency room in advance</td>
</tr>
<tr>
<td>Public Safety (Fire)</td>
<td>Performing fire safety inspections; incident reporting</td>
</tr>
<tr>
<td>Real Estate</td>
<td>Selling commercial real estate; accessing the Multiple Listing Service; home inspections</td>
</tr>
<tr>
<td>Recreation</td>
<td>Recording information on baseball games for use in scouting</td>
</tr>
<tr>
<td>Sales Force Automation (Consumer Products)</td>
<td>Merchandising at video game stores; selling life insurance in the home; surveying competition in CPG products</td>
</tr>
<tr>
<td>Sales Force Automation (Commercial and Industrial Products)</td>
<td>Using “smart product configuration” (AI) software to select the right product for the customer; showing application videos</td>
</tr>
<tr>
<td>State and Local Government</td>
<td>Doing property tax surveys; inspecting highways and commercial buildings</td>
</tr>
<tr>
<td>Surveys</td>
<td>Surveying consumers in malls regarding their buying habits</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>Repairing telephone lines; planning new switching centers</td>
</tr>
<tr>
<td>Transportation (Ground)</td>
<td>Managing and optimizing short-haul trucking and delivery routes; recording inventory during a household move</td>
</tr>
<tr>
<td>Transportation (Commercial Air)</td>
<td>Servicing customers in airports and in-flight; managing baggage handling on the ramp; inspecting airplanes</td>
</tr>
<tr>
<td>Transportation (Ocean and Rail)</td>
<td>Optimizing the loading of containers on a ship; retrieving locomotive performance data</td>
</tr>
<tr>
<td>Utilities (Electric, Gas, Water &amp; Cable)</td>
<td>Asset management; accessing data for installations and repairs; customer service; fleet maintenance; tree trimming</td>
</tr>
<tr>
<td>Warehousing</td>
<td>Doing inventory surveys; updating inventory information</td>
</tr>
</tbody>
</table>
During the next two or three years, most existing vertical pen tablet applications will transition to the use of Tablet PCs. As OEMs begin to offer more refined Tablet PCs, with more options required by vertical applications (e.g., indoor-outdoor screens), this trend will accelerate. The transition to Windows XP as the standard enterprise client operating system, the steady movement towards higher-resolution screens, and the ongoing replacement of legacy peripherals with USB models will also help cement this change.

It’s important to realize that not all vertical applications are automatically suited for or supported on the Tablet PC. For example, Siebel 7 (a popular CRM application from Siebel Systems) is not supported on the Tablet PC. In a document entitled “ALERT 609: Siebel 7 Support for the Windows XP Tablet PC Platform”, Siebel makes that clear with the following statements (among others):

- Siebel applications are not certified on the Tablet PC.
- Customers must reproduce any issues encountered on XP Tablet on XP Pro.
- If an XP Tablet issue cannot be reproduced on XP Pro, contact Microsoft.
- Performance issues specific to XP Tablet cannot be addressed by Siebel.
- Siebel applications do not leverage Tablet PC-specific functionality.

THE TABLET PC AS A THIN CLIENT

It’s natural to assume that pen-enabled software running on a Tablet PC makes use of most or all of XP Tablet’s features. However, in healthcare, that’s not generally the case. The great majority of Tablet PCs used in healthcare vertical applications are running as thin clients, where the majority of the computing activity takes place on the server. For example, InteGreat (www.igreat.com), a supplier of electronic medical record (EMR) software, recently issued a press release in which one of their customers said that “[InteGreat’s software] browser-based design…allows us to easily incorporate the Tablet PC going forward”. The key word here is “browser-based”—that’s a code word for “thin client”. The client operating system requirements specified on InteGreat’s product website include only “Windows 95, 98 or NT4”. In healthcare, the primary appeal of the Tablet PC seems to be the hardware form-factor and light weight, rather than the capability of the operating system.

DEVELOPING CUSTOM TABLET PC APPLICATIONS

Microsoft provides an SDK (Software Development Kit) for the Tablet PC (see www.tabletpcdeveloper.com). It is currently at version 1.5, so it’s been through some initial refinement. It includes 400+ pages of documentation. The Tablet PC

Three new books on developing Tablet PC applications are currently available from Amazon, as follows:

- “Building Tablet PC Applications”, by Rob Jarrett and Philip Su.
- “Developing Tablet PC Applications”, by Clayton Crooks and Clayton E. Crooks II.

**TABLET PC TECHNOLOGY**

As previously noted, a Tablet PC is simply an ultraportable notebook with a pen. This means that the very great majority of the technology inside a Tablet PC is standard notebook hardware. The CPU, chipset, memory, video controller, audio controller, wireless LAN, I/O ports, hard disk, battery, etc. are all identical to those used in ultraportable notebooks. There are really only five unique technologies in a Tablet PC—the active digitizer, the LCD, the writing surface, the swivel hinge (in a convertible), and the Tablet PC operating system.

**Active Digitizer**

The active digitizer is the key differentiating technology in a Tablet PC. It’s what allows the cursor to track the pen when it’s moved above (not touching) the screen. This behavior, called “mouseover” or “hover”, mimics a mouse in that you can move the cursor without clicking. With a passive (touch) digitizer, you can’t move the cursor without touching the screen, and touching the screen normally registers as a mouse click. The resolution of the active digitizers used in Tablet PCs is greater than 1000 dpi, about 10X higher than that of a passive (touch) digitizer, which helps create very smooth and natural-looking digital ink.

Today there are only two active digitizer manufacturers whose products are currently used in Tablet PC–Wacom (www.wacom.com) and FinePoint Innovations (www.finepointinnovations.com). The majority of Tablet PCs use the Wacom digitizer. The two companies’ technology is relatively similar. Both use low-frequency RF to communicate between the pen and the system. FinePoint uses a small battery in the pen to create an RF signal; Wacom transmits RF energy from the system to the pen, which absorbs it and re-radiates it back to the system. Wacom’s pen is batteryless—although it still contains electronics.
**LCD**

The LCD in a first-generation Tablet PC is exactly the same as an LCD in an ultraportable notebook with one critical difference—there is a “pocket” immediately behind the LCD that holds the active digitizer sensing grid. The grid is the “RF antenna” used to sense the location of the pen on the screen. Any metal between the grid and the pen interferes with the sensing, so the grid must be located between the LCD glass and the LCD driver electronics. This means that a Tablet PC LCD is mechanically different from a notebook LCD.

Only one LCD vendor (Toshiba, www.toshiba.com/taec) was willing to risk developing LCDs with new mechanical parts for the first generation of Tablet PCs. Initially Toshiba was only willing to develop a 10.4” LCD; in mid-2002 (relatively close to the November launch date) they decided to also develop a 12.1” LCD. This is the reason there are so many 10.4” Tablet PCs in the first generation—it’s not because 10.4” is the optimum size LCD for a Tablet PC, it’s all that was available! All first-generation Tablet PCs (except PaceBlade) use only Toshiba’s 10.4” XGA or 12.1” XGA LCD.

The Toshiba LCDs were originally designed for notebook applications, so the LCDs are optimized for wide horizontal viewing angle. (Since you can easily adjust the vertical angle of a notebook screen for maximum clarity, wide vertical viewing angle isn’t important in a notebook LCD.) This means that in portrait mode, all current Tablet PCs have relatively narrow, asymmetric viewing angles (-10° +20° from center), which requires holding the Tablet PC in one specific off-axis position for maximum screen clarity. This limitation can cause a substantial usability problem in an application designed for portrait mode.

As the Tablet PC begins to mature, more LCD manufacturers are entering the market and creating LCDs that are more suited to the particular demands of a Tablet PC. For example, Hydis (Hyundai Display Technology, www.boehydis.com) has announced 10.4” and 12.1” Tablet PC LCDs with 160° viewing angles both horizontally and vertically. AU Optronics, IDT, LG.Philips and Samsung are all developing Tablet PC LCDs, as are possibly other LCD vendors.

The availability of more Tablet PC LCDs (along with the ever-present need to differentiate their products) will lead some OEMs to begin development of larger-screen Tablet PCs. Acer announced earlier this year that they intend to ship a 14.1” convertible Tablet PC by the end of 2003. Motion Computing has indicated in interviews with their executives that they will probably use a 14.1” screen in their next-generation pure tablet. Finally, although no public announcement has been made, Fujitsu may be planning a 14.1” Tablet PC—an either a pure tablet or a convertible. Given Microsoft’s forecast that “50% of all notebooks will run Windows XP Tablet PC Edition within five years”, and given that mainstream notebooks today all use 14.1”, 15” or larger LCDs, it’s clear that Microsoft expects Tablet PCs to be available with larger LCDs in the future.
Writing Surface

The writing surface of a Tablet PC is simply a sheet of glass or plastic over the LCD (most OEMs currently use plastic). It serves two main purposes, (1) protecting the LCD from the pen (by providing a writing surface), and (2) reducing the glare from the screen (through filtering action). The degree of glare reduction varies substantially among the various brands of Tablet PC. Because the liquid crystal material in current LCDs “pools” or “blooms” when you touch the surface of the LCD, there must be an air gap between the LCD and the writing surface to allow for flex in the writing surface. The air gap also increases the visual parallax error (where the pen tip and cursor seem to be at the same location, but actually aren't). Different OEMs chose different air gap dimensions, with the result that the degree of pooling and the amount of parallax error varies quite a bit between the various brands of Tablet PC. Pooling doesn't damage the LCD, but it can be distracting to the user when writing on the screen.

When comparing first-generation Tablet PCs and evaluating differences in screen clarity, glare, pooling and parallax error, it's useful to remember that all the products use the same Toshiba LCDs, so any differences are due to the OEMs' implementation.

Swivel Hinge

The swivel hinge used to support the screen in a convertible Tablet PC is a critical element of the product's durability. As more convertible Tablet PCs are developed, new and improved hinge designs are likely to appear. For example, the swivel hinge in the Toshiba Tablet PC, which was developed well after the Acer Tablet PC, is clearly an improvement over the hinge in the Acer product.

To judge the durability of a Tablet PC hinge, IT should ask the vendor for documented test results. At absolute minimum, a Tablet PC hinge should be rated for 30,000 open-swivel-close cycles (20 cycles/day x 5 days/week x 50 weeks/year x 3 years life x 100% safety factor).

Windows XP Tablet PC Edition

The Tablet PC operating system (Windows XP Tablet PC Edition, often called just “XP Tablet”) is a completely separate version of Windows XP. It isn't just some files added on top of XP Professional.

XP Service Pack 1 (full version) is the vehicle for distribution of XP Tablet version 1. SP1 was also used to maintain a common code base in Windows XP. In order to support digital ink in XP Tablet, Microsoft had to make some very low-level changes in XP. Instead of isolating these changes in XP Tablet, Microsoft used SP1 to migrate those changes back into all versions of XP, thus maintaining a common code base. The moral of the story is that service packs may contain
changes to the operating system that have nothing to do with the version you’re currently running. Service packs can contain far more than just bug fixes and enhancements to your current version, which may have an adverse effect on your systems’ stability.

XP Tablet is available only from an OEM on a new Tablet PC, not through retail distribution. Unlike XP Professional, hardware drivers for XP Tablet must be obtained from the hardware OEM rather than from a central repository at Microsoft.com. These differences have substantial impact upon deployment of XP Tablet by IT, as follows:

- A complete image of XP Tablet must be maintained separately from XP Professional. You cannot install XP Tablet by installing just Tablet PC CD #2 on top of XP Professional.

- Different product identification codes (PIDs) are required when installing XP Tablet and XP Professional over a network.

- If you’ve already deployed XP Professional, you must use Windows XP SP1 Full Version (slipstream version) for deploying to Tablet PCs, since the downloadable version of XP SP1 doesn’t include XP Tablet.

- Reloading the image on a Tablet PC may require using whatever recovery method the OEM provided for their Tablet PC, since the version of XP Tablet provided through Microsoft’s Select and MSDN channels doesn’t include OEM-specific drivers.


**Tablet PC CPUs**

Although they’re not unique to Tablet PCs, the processors (CPUs) used in Tablet PCs warrant a closer look. The majority of first-generation Tablet PCs use Intel ULV Pentium 3-M CPUs, running at 733-933 MHz. “M” stands for “mobile”; “ULV” stands for “ultra low voltage”. As the voltage on which the CPU operates gets lower, the power dissipation goes down substantially, which reduces heat and lengthens battery life–ULV therefore effectively means “very low power”. ULV Pentium 3-M CPUs are only available in 733, 800, 866 and 933 MHz clock speeds. 733 MHz was obsoleted by Intel in late 2002, and 933 MHz was added in early 2003. The only Intel-based Tablet PC that doesn’t use a ULV CPU is the Toshiba; at 1.33 GHz it uses the “low voltage” version of the Pentium 3-M (rather than Ultra Low Voltage). Toshiba traded off a small amount of battery life (less than 10%) for more performance (a 43% faster clock speed).
Most enterprise users would probably agree that this is a desirable tradeoff.

Three of the first-generation Tablet PCs (FIC, HP and PaceBlade) use the Transmeta Crusoe TM-5800 CPU. Transmeta is known for their unique approach to CPU architecture, in which “code-morphing” software is used to determine which instructions to execute and when, instead of hardware (transistors) as in Intel CPUs. The advantages are substantially lower cost and lower power consumption; the disadvantage is substantially lower performance. Using a Transmeta CPU instead of an Intel CPU extends a Tablet PC’s battery life by 5-10% (assuming equal size batteries), but decreases performance by about 30%. In benchmark tests, a 1 GHz Transmeta-based Tablet PC performs roughly equivalent to a 700 MHz Intel-based system. Most enterprise users would probably agree that this is not a desirable tradeoff. Thus, we’re seeing a number of Tablet PC vendors switch to Intel’s new Centrino offering that incorporates the new Pentium M CPU and wireless LAN support.

Most Tablet PCs going forward will use Intel’s newest mobile CPU, the Pentium M. The Pentium M is a redesign of the Pentium 3-M, heavily optimized for mobile applications. The optimizations include some new architecture features, a faster internal bus, 1 MB of L2 cache and support for Enhanced SpeedStep. The Pentium M has improved performance and lowered power consumption (it’s like having your cake and eating it too). Using the MobileMark 2002 benchmark, Intel reports that a Pentium M running at 1.6 GHz is 16% faster than a Pentium 4-M running at 2.4 GHz (!), with 30% longer battery life than a Pentium 3-M running at 1.2 GHz. The Pentium M is available in a ULV version at 900 MHz, an LV (low voltage) version at 1.1 GHz, and normal voltage versions from 1.3 to 1.6 GHz. Using a more realistic apples-to-apples comparison, a 900 MHz Pentium M should deliver around 30% more performance and 15% more battery life in a Tablet PC than a 933 MHz Pentium 3-M. As of the date of this report, Acer, Motion Computing and Panasonic have announced Tablet PCs that use the Pentium M.

The Pentium M is a component of Centrino, Intel’s new mobile brand. Centrino consists of the Pentium M CPU, the matching “chipset” (memory and I/O connection IC), device drivers and an Intel Wi-Fi (802.11b) mini-PCI card. Intel’s Wi-Fi card is relatively generic; it doesn’t have any unique features, other than the fact that it’s made by Intel. Centrino’s positioning focuses on the overall platform benefits including high performance and long battery life advantages of the Pentium M, and stable platform for at least 18 months that enterprise IT can rely on for specifying and deploying Tablet PC systems.

Centrino is the future for mobile processors for Intel, and the company has created a total solution to support mobility. Intel will slowly migrate the Centrino offering over time, integrating higher performance at low power, wireless communications, device drivers all designed to provide image stability that enterprise IT requires. Intel chose the 802.11b Wi-Fi offering in their first
Centrino offering since that represents 95% of today’s enterprise Wi-Fi networks and virtually 100% of all public networks. Combination wireless offerings including both “a” and “g” will be added in the future when the market needs such offerings. Intel will likely integrate wide area wireless networking (wWAN) in the future along with roaming software so that users will be able to go from a wireless LAN to a wireless WAN and back again seamlessly without having to change any device drivers or settings.

PEN TABLETS VS TABLET PCS

Pen tablets have been used in vertical applications since the early 1990s. Microsoft didn’t invent the Tablet PC, they just legitimized the concept. Fujitsu is generally credited with developing the pen tablet market, starting in 1993. According to IDC, by 1999 Fujitsu had a 60% market share of the pen tablet market. Essentially 100% of Fujitsu’s pen tablets were sold into vertical applications in healthcare, insurance, sales automation, utilities and the Federal Government.

What’s the difference between a Tablet PC and a pen tablet? They’re both pen computers, running standard Windows operating systems. Table 3 below shows the key differences:

**Table 3: Comparison of Tablet PCs and Pen Tablets**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Tablet PC</th>
<th>Pen Tablet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td>Win XP Tablet PC Edition only</td>
<td>Win 98SE, NT4, 2000 or XP Pro</td>
</tr>
<tr>
<td>Digitizer</td>
<td>Active only</td>
<td>Passive (touch) or active</td>
</tr>
<tr>
<td>Legacy ports (PS/2, serial, parallel)</td>
<td>No</td>
<td>Yes (most)</td>
</tr>
</tbody>
</table>

For marketing reasons, most OEMs selling pen tablets have renamed their products as “Tablet PCs”—even though, as the table above shows, there are clear technical differences. For example, there are five “Tablet PCs” on the Fujitsu PC website (www.fujitsupc.com), summarized in Table 4 below. Only one of them (the first one in the table) is actually a Tablet PC according to the Microsoft definition.

**Table 4: Fujitsu’s “Tablet PCs”**

<table>
<thead>
<tr>
<th>Fujitsu PC Product</th>
<th>Operating System</th>
<th>LCD</th>
<th>Digitizer</th>
<th>Legacy Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stylistic ST4000</td>
<td>Win XP Tablet PC Edition</td>
<td>10.4” XGA indoor-only</td>
<td>Active</td>
<td>No</td>
</tr>
<tr>
<td>Stylistic ST4000P</td>
<td>Win 2000 or XP Pro</td>
<td>10.4” XGA indoor-only</td>
<td>Passive</td>
<td>No</td>
</tr>
<tr>
<td>Stylistic 3500</td>
<td>Win 98SE or 2000</td>
<td>10.4” XGA indoor-only; 10.4” SVGA indoor-outdoor or outdoor-only</td>
<td>Passive</td>
<td>Yes</td>
</tr>
<tr>
<td>Stylistic LT P-600</td>
<td>Win 98SE or 2000</td>
<td>8.4” SVGA indoor-only or indoor-outdoor</td>
<td>Passive</td>
<td>Yes</td>
</tr>
<tr>
<td>PenCentra</td>
<td>Windows CE 2.11 or H/PC 2000</td>
<td>8” VGA indoor-only or indoor-outdoor</td>
<td>Passive</td>
<td>Yes</td>
</tr>
</tbody>
</table>
When should IT consider implementing pen tablets rather than Tablet PCs? The following are some general guidelines.

- Pen tablets are typically used only in vertical applications. If you’re equipping horizontal users such as “road warriors” or “corridor cruisers”, you should consider only Tablet PCs.

- If you’re not ready to migrate your vertical application to any version of Windows XP, a pen tablet running Windows 2000 is a viable alternative.

- Commercial (non-rugged) Tablet PCs currently don’t have indoor-outdoor viewable screens. If your application requires usage outdoors in sunlight (for example, in utilities or home inspection), a pen tablet is your only option today. (This situation will change by the end of 2003, but even in 2004 there won’t be a lot of indoor-outdoor screens.)

- If your application demands touch, rather than the use of a relatively fragile and expensive electronic pen, a pen tablet is your only option—except for the PaceBlade Tablet PC, which has both an active and a passive (touch) digitizer.

- If your vertical software is written for SVGA resolution and it’s impractical to change it, a pen tablet with an SVGA screen may be more appropriate than running the software in a small SVGA window on a Tablet PC’s XGA screen.

- If you have many legacy peripherals that are impractical to replace, a pen tablet with legacy ports may be more appropriate than attempting to use USB-to-legacy-port external dongles—which may not work if the peripherals expect a “real” hardware port.

Your best source of information on these considerations is the hardware OEMs. It’s worth noting that Fujitsu expects the majority of their hardware sales in 2003 to be pen tablets rather than Tablet PCs. Some OEMs, such as Kontron AG (www.kontron.com), maker of the ReVolution rugged swivel-screen notebook, are currently offering only a pen tablet version of their product—they’re waiting until the demand for Windows XP Tablet PC Edition increases before offering a Tablet PC version.

**TABLET PC PRICE PREMIUM**

As previously noted, all first-generation Tablet PCs are in the ultraportable notebook class. The OEM cost of the added Tablet PC functionality is about $115, which translates into a $200 premium in the street price of a Tablet PC over an
equivalent ultraportable notebook. (In round numbers, the $100 is made up of $50 for the active digitizer, $30 additional license fee for XP Tablet, $22 for the special LCD, $5 for the swivel hinge, $3 for the writing surface and $5 for increased assembly complexity.) At the end of 2002, the average street price for an ultraportable notebook was around $2,000. Adding the $200 price premium for the Tablet PC functionality produces an average street price of $2,200 for a Tablet PC.

The problem is that many buyers aren’t aware that ultraportables themselves carry a price premium of $600 or more. At the end of the first quarter of 2003, the average price of a mainstream “thin-and-light” notebook was slightly under $1,400. This is what everyone thinks of as a “standard notebook”. This means that the “perceived price premium” for a Tablet PC is actually $600 + $200 = $800. This is a serious sales impediment for the first-generation Tablet PCs. The situation is made worse by the fact that a fully functional, low-end notebook can be purchased for under $1,000, which makes the worst-case “perceived price premium” for a Tablet PC more than $1,200. (Note that even a “low-end” notebook typically includes a 15” screen, 256 MB of RAM, a 40 GB hard disk, and a CD burner!)

It’s clear that if the Tablet PC is going to enter the mainstream, prices have to fall significantly. In a recent Business Week story on the Tablet PC, Ted Clark (HP’s vice-president of Tablet PCs) said “HP has discovered that customers are willing to pay a $200 to $250, or a 20% to 25%, premium over regular laptops”. Doing the math yields the assumption that a “regular laptop” is only $1,000. HP says that clients such as 7-Eleven, who bought 30 Tablet PCs in November 2002, are holding off on mass purchases until prices on tablets fall to 5% to 10% above the price of traditional notebooks.

The easiest way for the OEMs to reduce Tablet PC prices is to migrate the functionality into the “thin-and-light” category of notebooks, eliminating the ultraportable premium. However, this raises the question of the usage model for a larger-screen Tablet PC. It’s already been noted that several OEMs are starting to develop Tablet PCs with 14.1” LCDs. Will users be willing to hold a five-pound Tablet PC in their arms while conducting a stand-up meeting in a hallway? What are the design differences in a Tablet PC that’s optimized for use as a lap-held tablet rather than an arm-held tablet? Is an LCD that folds flat on the table (180°) the right way to go? Will the greater movement of a 14.1” screen be acceptable when tapped with a pen in “laptop mode”, or will a completely different hinge design be required? Is good docking less important or more important in a larger-screen Tablet PC, where the LCD may be large enough to be used as the primary display, rather than being replaced by a 17” LCD or 19” CRT monitor? There are many unresolved issues in developing Tablet PCs in the “thin-and-light” category. OEMs who are going to be successful in the Tablet PC market must be very sensitive to the ergonomic factors in their products.
TABLET PC OEM SUMMARY

As of May 2003, there are 26 OEMs marketing 14 different Tablet PCs. Table 5 below summarizes this matrix.

<table>
<thead>
<tr>
<th>14 Tablet PC Manufacturers</th>
<th>26 Tablet PC OEMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aplux (Taiwan)</td>
<td>Samwell (Taiwan)</td>
</tr>
<tr>
<td>Compal (Taiwan)</td>
<td>Motion Computing (USA), Gateway (USA), Legend (China)</td>
</tr>
<tr>
<td>First International Computer (Taiwan)</td>
<td>Leo Systems (Taiwan), Rosetta (USA), Time (UK), Torspoal (UK), Viglen (UK)</td>
</tr>
<tr>
<td>Fujitsu (Japan)</td>
<td>Fujitsu PC (USA), Fujitsu Siemens (EMEA)</td>
</tr>
<tr>
<td>LG Electronics (Korea)</td>
<td>HP (USA)</td>
</tr>
<tr>
<td>Itronix (USA)</td>
<td>Itronix (USA)</td>
</tr>
<tr>
<td>NEC (Japan)</td>
<td>NEC (Japan)</td>
</tr>
<tr>
<td>PaceBlade (Taiwan)</td>
<td>PaceBlade (Taiwan)</td>
</tr>
<tr>
<td>Panasonic (Japan)</td>
<td>Panasonic (Japan)</td>
</tr>
<tr>
<td>Tatung (Taiwan)</td>
<td>Electrovaya (Canada), Research Machines (UK), ViewSonic (USA)</td>
</tr>
<tr>
<td>Toshiba (Japan)</td>
<td>Toshiba (Japan)</td>
</tr>
<tr>
<td>WalkAbout (USA)</td>
<td>Intermec (USA), WalkAbout (USA)</td>
</tr>
<tr>
<td>Wistron (Taiwan)</td>
<td>Acer America (USA), Sotec (Japan)</td>
</tr>
<tr>
<td>Xplore Technologies (USA)</td>
<td>Symbol (USA), Xplore (USA)</td>
</tr>
</tbody>
</table>

TABLET PC OEM DESCRIPTIONS

The following paragraphs provide information about each of the current Tablet PC OEMs. The paragraphs are arranged by the type of Tablet PC (commercial pure tablets, rugged pure tablets, commercial convertibles and rugged convertibles) and then alphabetically within type.

MobileTrax Spotlight: Tablet PC OEMs–Commercial Pure Tablets

- Electrovaya (Canada, www.electrovaya.com)
  Electrovaya is known primarily for their PowerPad™ lithium-ion superpolymer “slab” batteries for use under standard notebooks. Electrovaya created their first-generation Scribblers of Tablet PCs by designing their own housing around a motherboard from Tatung and integrating a slab battery capable of running the product for 12-16 hours. Scribblers have a 10.4” XGA LCD, a choice of 733 or 866 MHz ULV Pentium 3-M CPU, and a weight of only 3.9 pounds. A fingerprint sensor is available in the top-end model.

  Electrovaya's strategy of creating a Tablet PC that runs three times longer than the average Tablet PC warrants some consideration. After all, it's hard to take notes in an all-day meeting if your battery life is only three hours. In an application far removed from the conference room, Air-Grid (www.air-grid.com) has been testing Scribblers for delivery of interactive media...
services to fans at major sports events. Using an 802.11a wireless network, Air-Grid delivers live video and play-by-play audio of action featuring a selection of camera angles, on-demand video and audio replay of any action sequence, television and radio broadcasts, Internet access, e-commerce services, etc. In a video-intensive, wireless application such as this, the Scribbler's extended battery life allows the Tablet PC to last through all the pre-game, game-time and post-game activities.

• **Fujitsu PC (USA, www.fujitsupc.com)**
  Fujitsu is the senior player in the Tablet PC business. They've been building and selling pen tablets (and now Tablet PCs) for more than 12 years. Fujitsu PC markets mostly in North America. As noted earlier in this report, Fujitsu currently has five different models on their website, offering a range of screen sizes, types and resolutions. In the latest roundup of Tablet PCs in PC Magazine (“Tablet PCs: Ready for Prime Time”, April 8, 2003), the Fujitsu Stylistic ST4000 Tablet PC won Editor's Choice in the pure tablet category. If you're just starting to research Tablet PCs, Fujitsu is a good place to start.

• **Fujitsu Siemens (Germany, www.fujitsu-siemens.com)**
  Fujitsu Siemens, the leading European computer company and a joint venture between Fujitsu Limited and Siemens AG, sells the same Tablet PCs and pen tablets as Fujitsu PC, with minor modifications to meet EMEA (Europe, Middle East & Africa) market needs. For example, Fujitsu Siemens offers the Stylistic 3500 with Windows NT-4, which is more popular in Europe than in the USA, but doesn't offer the Stylistic ST4000P (the pen tablet version of the ST4000 Tablet PC). Fujitsu Siemens and Fujitsu PC are both independent subsidiaries of Fujitsu Limited in Japan (www.fujitsu.com).

• **Gateway (USA, www.gateway.com)**
  Gateway rebrands and resells the Tablet PC from Motion Computer. The product is identical to Motion's M1200 Tablet PC except for a slightly higher-performance hard disk. Two models are available, one with Office XP and one without.
  
  At their recent annual financial analyst meeting, Gateway demonstrated a convertible Tablet PC. This “future business product”, part of Gateway's transition to becoming a “branded integrator”, is likely to be introduced before the end of 2003.

• **HP (USA, www.hp.com)**
  HP's TC1000 Tablet PC, bearing the Compaq brand, is unique in that it has an attachable keyboard that turns the device into as quasi-convertible (it
could be called a “transformer”). The core product is a 3.1-pound pure tablet with a 10.4” XGA LCD and a 1 GHz Transmeta Crusoe CPU; as a pure tablet it's quite useable (although the Transmeta CPU usually comes in last when benchmarked against Tablet PCs with Intel CPUs). When the keyboard unit is attached (in notebook mode), however, the product becomes somewhat awkward. The display sits very close to the keyboard, which is fully forward, leaving no room for a wrist rest. The display's vertical adjustment range is limited, making it difficult to use in cramped quarters. And when the unit is on your lap, it has a tendency to fall over backwards. Nevertheless, the TC1000 is a very clever industrial design.

- **Legend Group** (China, [www.legend-holdings.com](http://www.legend-holdings.com))
  Legend is China's largest PC OEM, with about 30% of the market and revenues of over $2B. Legend has a licensing agreement with Motion Computing that allows in-country sale of Motion's Tablet PC. The Legend Tablet PC, called the Soleil Shangyu T100 and based on Motion's M1200, started shipping in December 2002.

- **LEO Systems** (Taiwan, [www.leosys.com](http://www.leosys.com))
  LEO Systems is the largest high-tech marketing service company in Taiwan; it is part of the FIC (First International Computer) Group. LEO's SlateVision Tablet PC is made by FIC; it has a 10.4” XGA LCD and a Transmeta Crusoe CPU at up to 1 GHz.

- **Motion Computing** (USA, [www.motioncomputing.com](http://www.motioncomputing.com))
  Motion was founded in 2001 by a group of ex-Dell employees. Focused on pure tablets, Motion's first product (the M1200) has a 12.1” XGA LCD, a 933 MHz ULV Pentium 3-M CPU, a magnesium chassis and a weight of 3.3 pounds. Motion has just announced a Centrino (ULV Pentium M at 900 MHz) version of the M1200 called the M1300. Motion uses Compal Electronics in Taiwan as their ODM; Motion's deep relationship with Compal allows them to use a very effective build-to-order strategy, which provides a major competitive advantage.

  In addition to selling through their rapidly expanding VAR channel, Motion Computing sells the M1200 tablet to Gateway who brands and resells it. Motion also has licensed their design to the Legend Group, China's largest PC OEM.

- **NEC** (Japan, [www.neccomp.com](http://www.neccomp.com))
  NECs Versa LitePad Tablet PC is distinguished by being the thinnest and lightest Tablet PC on the market (0.6” thick and 2.2 pounds). It has a 10.4” XGA LCD and a 933 MHz ULV Pentium 3-M CPU. Battery life is a little short at two hours.
• PaceBlade (Taiwan, www.paceblade.com)
PaceBlade sells both a Tablet PC and a pen tablet version of their PaceBook product. It's one of the few 12.1" Tablet PCs, along with those from Motion and Toshiba. The system uses an 867 MHz Transmeta Crusoe CPU and weighs 4.0 pounds. The PaceBook is the only Tablet PC that has both an active and a passive (touch) digitizer integrated into the same product. This allows navigating Windows with a finger or any sharp object while still allowing the use of the electronic pen for handwriting recognition.

• Research Machines (UK, www.rm.com)
Research Machines (RM) is the largest supplier of systems, software and services to the United Kingdom's education market, with revenues exceeding £200M in 2002. RM's Tablet PCs are made by Tatung and are visually similar to the ViewSonic Tablet PC. There are three models, all with 10.4" XGA LCDs; the Student model uses a 733 MHz Mobile Celeron, the Staff model uses a 933 MHz ULV Pentium 3-M, and the Teacher model uses Intel's brand-new 900 MHz ULV Pentium M.

• Rosetta (USA, www.rosettatabletpc.com/rosetta/details.htm)
Rosetta, a Florida-based startup, resells FIC's Tablet PC. The system has a 10.4" XGA LCD and a Transmeta Crusoe CPU at up to 1 GHz. At $1,500, the Rosetta is one of the lowest-priced Tablet PCs on the market in the USA. The company was founded by Brad Nolan, previously known for founding UR There, the developer of the “@migo” Pocket PC.

• Samwell Group (Taiwan, www.samwell.net)
Samwell's Model iVTVM2C Tablet PC is made by Aplux in Taiwan; it's based on VIA's Tablet PC reference design (see www.via.com.tw/en/vinternet/tablet.jsp). It has a 10.4" XGA LCD and a VIA Eden x86-compatible CPU.

• Time Education (UK, www.timeeducation.com/tablet.asp)
Time is an OEM focused on the United Kingdom's education market, with total revenues exceeding £250M in 2002. Time's Tablet PC is made by FIC. It uses a 10.4" XGA LCD and a Transmeta Crusoe CPU at up to 1 GHz.

• Torspoal (UK, www.torspoal.com)
Torspoal is a UK startup aiming to provide “digital lifestyle devices for the connected home.” Torspoal's Fahrenheit 933 Tablet PC is made by FIC. It uses a 10.4" XGA LCD and a Transmeta Crusoe CPU at up to 1 GHz.

• ViewSonic (USA, www.viewsonic.com)
ViewSonic is a well-known monitor company who has expanded into the mobile computer space in the last several years. ViewSonic's V1100 Tablet
PC is made by Tatung. It is distinguished by the relatively wide bezel around the LCD, which actually makes it one of the most comfortable Tablet PCs to hold and use. It has a 10.4” XGA LCD and an 866 MHz ULV Pentium 3-M CPU. ViewSonic is the only OEM whose product line includes all of the following: a Tablet PC, a pen tablet, a webpad, two sizes of Smart Display, a wireless mobile thin client and a PDA.

- **Viglen (UK, www.viglen.co.uk)**
  Viglen is the UK's largest direct PC manufacturer. Viglen's Exaro Tablet PC, focused on the education market, is made by FIC. It has a 10.4” XGA LCD and a Transmeta Crusoe CPU at up to 1 GHz.

**MobileTrax Spotlight: Tablet PC OEMs–Rugged Pure Tablets**

- **Intermec (USA, www.intermec.com)**
  Intermec is a leader in the development, manufacture and integration of wired and wireless automated data collection, RFID hardware, mobile computing systems, bar code printers and label media. Intermec resells WalkAbout Computers' Hammerhead XRT Tablet PC as the Intermec CT60. It is offered only with XP Tablet (Intermec doesn't sell a pen tablet version).

- **Itronix (USA, www.itronix.com)**
  Itronix is a global leader in the development of wireless, rugged notebooks and handhelds. Itronix has just announced a rugged, wireless, pure-tablet form-factor Tablet PC. It will be the first “mid-sized” rugged Tablet PC with an 8.4” SVGA (800 x 600) outdoor-readable display, and the lightest rugged Tablet PC on the market at 3.7 pounds. The size, weight and degree of ruggedness were specifically formulated for Itronix's prime target users, primarily insurance and telecommunications field workers. This should allow Itronix to expand the opportunity within current clients and enter new markets served by other tablet vendors such as Fujitsu.

- **Microslate (Canada, www.microslate.com)**
  Microslate has been building rugged pen tablets since the mid 1990s. Microslate recently began reselling the rugged CA25 pen tablet made by Getac (www.getac.com, a joint venture between Mitac International in Taiwan and General Electric Aerospace Group in the USA) as the Microslate MSL 3800. Phoenix Technologies recently announced that Microslate has licensed the Phoenix Tablet PC BIOS; the implication is that Microslate will be announcing a rugged Tablet PC sometime in the near future.
• Symbol Technologies (USA, www.symbol.com)
Symbol is a very well-known manufacturer of rugged handheld computers, scanners and wireless networks, with revenues of $1.3B in 2002. Symbol resells Xplore Technologies' Tablet PC into several exclusive markets.

• WalkAbout Computer (USA, www.walkabout-comp.com)
WalkAbout has been building rugged pen tablets since the mid-1990s. WalkAbout's Hammerhead XRT Tablet PC is distinguished by several factors, including (1) a housing that's milled from a solid block of aluminum, (2) the ability to be configured as either a Tablet PC or a pen tablet, and (3) an optional 10.4" SVGA transflective TFT LCD for excellent indoor-outdoor viewing. The XRT also offers integrated Wi-Fi, CDPD, GSM, GPRS, Data-TAC, Mobitex and GPS wireless.

• Xplore Technologies (Canada, www.xploretech.com)
Xplore has been building rugged pen tablets (and now Tablet PCs) for seven years. Xplore's iX104 Tablet PC has a 10.4" XGA LCD with a high-brightness option for outdoor use. The CPU is an 866 MHz ULV Pentium 3-M. The system can support two simultaneous internal wireless radios, in any combination of mini-PCI card, PC Card, or OEM module. The system has two integrated antennas covering 900 MHz-1.8 GHz and 2.5-5 GHz. Xplore also makes two other models of rugged pen tablets, the GeneSys Maximum and GeneSys II.

MobileTrax Spotlight: Tablet PC OEMs–Commercial Convertibles

• Acer (Taiwan, www.acer.com)
Acer was the first OEM to develop a convertible Tablet PC. Their initial prototype, first available at Comdex 2001, achieved very wide exposure through Microsoft's use of several thousand units as primary demo machines. The Acer C100 series of Tablet PCs, built by Wistron, have a 10.4" XGA LCD, an 800 or 900 MHz ULV Pentium 3-M, and a system weight of only 3.1 pounds.

Acer is one of the first OEMs to announce a second-generation Tablet PC, the TravelMate C110 convertible. This system uses Intel's new ULV Pentium M processor running at 900 MHz. The system offers integrated, coexistent dual-band 802.11b or 802.11a/b and Bluetooth radios. Answering essentially all of the objections to Acer's first-generation product, the C110 supports DDR memory up to 2 GB, hard disk up to 60 GB, two USB 2.0 ports and a FireWire port, a 100-pin docking connector, automatic switching from landscape to portrait mode and a stronger display hinge. Total weight gain over the C100 is only 0.1 pounds. The C110 provides an excellent example of the rapid evolution that can be expected in Tablet PC hardware.
• Sotec (Japan, www.sotec.co.jp)
Sotec is one of the leading computer OEMs in Japan. Sotec resells Acer's Tablet PC as the AFiNA Tablet PC in the Japanese market.

• Toshiba (Japan, www.toshiba.com)
As the only first-generation convertible from a tier-one PC OEM, the Toshiba Portege 3500 Tablet PC is an extremely popular product. With a 12.1” XGA LCD, a 1.3 GHz Pentium 3-M CPU (the fastest in any Tablet PC) and a full-size (0.75”) keyboard, the Toshiba is a serious no-compromise ultraportable notebook with the added benefit of Tablet PC functionality. System weight is slightly high at 4.1 pounds. In the latest roundup of Tablet PCs in PC Magazine (“Tablet PCs: Ready for Prime Time”, April 8, 2003), the Toshiba Portege 3500 Tablet PC won Editor’s Choice in the convertible category.

In the first generation of Tablet PCs, Toshiba seems to be the clear winner. Toshiba was third in the 2002 notebook market in the USA with a 12.8% share. Toshiba has the relative luxury of focusing only on laptops (no desktop distractions), so they have a good chance of remaining in the first or second slot as the Tablet PC market expands—at least until Dell jumps in.

MobileTrax Spotlight: Tablet PC OEMs—Rugged Convertibles

• Panasonic (Japan, www.panasonic.com/computer/notebook)
The Toughbook CF-18 is one of the very latest Tablet PCs and currently the only rugged convertible Tablet PC on the market. It uses Intel's newest CPU, the ULV Pentium M, running at 900 MHz. The LCD is 10.4” XGA with an anti-reflective coating for outdoor viewability. The battery in this product at 49 watt-hours is one of the largest in any Tablet PC except Electrovaya’s Scribbler (the CF18’s battery life spec is 4-6 hours). System weight is 4.4 pounds. In addition to integrated Wi-Fi, Panasonic also offers integrated CDMA-2000, GPRS, Bluetooth or GPS wireless. The Toughbook CF-18 is available in both a Tablet PC version and a pen tablet version with Windows 2000 or XP Pro, a touchscreen and legacy ports.

• Kontron AG (Germany, www.kontron.com)
Kontron’s ReVolution is a rugged convertible pen tablet. Currently it’s offered only in pen tablet form with a touchscreen, legacy ports and Win 98SE, 2000 or XP Pro. However, Kontron has signed up with Microsoft to develop a Tablet PC version of the product in the future. The ReVolution has a 12.1” XGA LCD and a 1.06 GHz Pentium 3-M CPU.
THE NON-PLAYERS: DELL, IBM AND SONY

Dell, IBM and Sony are conspicuous by their absence from the Tablet PC market. Each company has its own reason for not participating. For example, a product as new as the Tablet PC clearly doesn't fit Dell's business model. Dell enters a market only when it's well established, and when they can sell sufficient volume to drive the price down (consider the PDA market as an example). In a story in the April 13th edition of the San Francisco Chronicle, Joe Marengi, senior vice-president for Dell's Americas business, cited the Tablet PC market as one that Dell is not yet prepared to enter. “The Tablet PC may become a great product,” he said. “We've never said we won't support tablets… We don't want to be in the business of having a solution for a market [that isn't fully developed]. We'd rather have the market there and have the solution.”

Actually, Dell is already quietly reselling the Motion Computing Tablet PC through its healthcare enterprise sales force. When the Tablet PC market hits several million, look for Dell to enter the market aggressively with a Dell-branded convertible at that point (perhaps during 2005).

Sony was burned by the failure of the desktop VAIO Slimtop Pen Tablet in early 2002; as a result Sony has been reluctant to enter the Tablet PC market. Mark Hanson, Sony's GM of VAIO PC Marketing, recently said the following in an interview in Laptop Magazine: “We're just watching [the Tablet PC market] right at the moment. We're still struggling with the advantage that it brings to end-users. The initial launch of those products was really oriented towards a productivity slant–vertical application usage–and it's not really our bag. Once we can see that there's something we can implement from an [audio-visual] or entertainment point of view, we might start to adopt those types of things in [a Tablet PC]. You never know, we haven't made any decisions.”

IBM was burned by the failure of the Transnote notebook in early 2002; as a result IBM has so far been unwilling to enter the Tablet PC market. IBM made several public statements disparaging the Tablet PC market during 2002, emphasizing that target customers for their ThinkPad line of notebooks (corporate road warriors) are not interested in a Tablet PC. IBM has been emphasizing security and wireless in recent product announcements. However, according to a recent story on ZDNet (www.zdnet.com), written by Jack Gold and others from the Meta Group (www.metagroup.com), IBM has developed several Tablet PC prototypes and can move into the market quickly when demand materializes.

OTHER NOTEBOOK OEMS

Samsung and Sharp are also missing from the list of Tablet PC OEMs. Samsung (www.samsung.com) is rumored to have a 12.1” convertible Tablet PC under development. It's likely to be an updated, swivel-hinge, Pentium M version of their current Q10 ultraportable. Announcement seems likely in the second half of 2003.
Sharp (www.sharpsystems.com) has been working on a convertible Tablet PC for the past year, and the company plans to launch the new system at the end of July. Their current “Actius” line of ultraportables would make an excellent starting point for a convertible Tablet PC.

**TABLET PC ODMS**

In the first generation of Tablet PC products, the ODMs (Original Design and Manufacturers) were relatively important players because everyone was creating something new. In the second and later generations, the importance of the ODMs will decrease and the OEMs will make most of the decisions that matter. An ODM really isn’t motivated to include a better pen (for example) in his next-generation Tablet PC. His motivation is to (a) build the product specified by his OEM customer for the lowest possible cost, in order to preserve his relatively small profit margin, and (b) re-use as much of his existing development knowledge and intellectual property as possible, in order to minimize his development cost. Therefore, even though new ODMs are entering the Tablet PC business as this is being written, their effect on the features and specifications of next-generation Tablet PCs is likely to be small.

The ODMs that have developed Tablet PCs for OEMs so far include the following (refer to Table 5 to see which OEMs are marketing each ODM’s Tablet PC):

- Compal Electronics (Taiwan, www.compal.com).
- LG Electronics (Korea, www.lge.com).
- Tatung (Taiwan, www.tatung.com).
- Wistron (Taiwan, www.wistron.com).

A number of additional ODMs have signed up with Microsoft to develop Tablet PCs but haven’t announced an OEM customer yet, as follows:

SHORT-TERM IMPEDIMENTS TO RAPID ADOPTION OF TABLET PCS

(1) It takes a substantial amount of time to develop and/or customize software and roll out thousands of machines in a vertical application. The absolute minimum is 6 months, and a more typical average is 12 months. Healthcare markets have the slowest adoption rates, with rollout times of up to 24 months. This means that although there is a substantial amount of Tablet PC hardware available in 2003, software and project logistics will limit the rate of increase of deployed vertical applications.

(2) Enterprise IT is historically reluctant to adopt a new Microsoft OS before the first service pack (SP1) is released. Microsoft expects to release SP1 for XP Tablet before the end of 2003, probably in the fourth quarter. Even after the release of SP1, IT in large corporations takes a substantial amount of time to test and qualify a new OS for broad internal use. Six to nine months is not uncommon.

(3) In vertical applications, the reluctance to move to a new operating system is very strong because many of the applications are mission critical, line-of-business applications that must be very stable. This is the reason that such a large percentage of installed vertical pen tablet applications (estimated to be 50%) are still on Windows 98. In horizontal/enterprise applications, the reluctance to upgrade operating systems is somewhat less. This is because upgrading (a) tends to reduce support desk cost after an initial spike (as the users experience the increased stability of Win 2000 or XP), and (b) in small-to-midsize businesses, there is often lots of “guerrilla buying” that results in the new OS penetrating the organization anyway.

(4) Only a few of the Tablet PC hardware OEMs are on “approved notebook vendor lists,” which means that in addition to qualification time for the new operating system, there may be additional qualification time for a new vendor. Currently Acer, Fujitsu and Motion are probably not on most corporations’ approved lists, since they have insignificant (or non-existent, in the case of Motion) presence in the enterprise notebook market. HP and Toshiba are likely to be the only Tablet PC OEMs already on corporations’ approved lists.

(5) The availability of funds for new IT projects in 2003 is very low, due to the “technology recession” currently under way. Projects involving new technology such as Tablet PCs are seen as especially risky, with little hope of significant ROI.
(6) The $800+ price premium for an ultraportable class notebook with Tablet PC functionality is a serious impediment for many buyers. As a result of the premium, the Tablet PC currently has an image as a “high-end” product.

(7) Many ISVs are (a) waiting to see if the Tablet PC will be successful, (b) waiting for their next major product release to add ink support, or (c) relying on the enhanced mobility of the Tablet PC to attract buyers to their existing application. The problem is that software drives hardware. Once buyers get past the relatively simple things you can do with XP Tablet by itself, then sales of the Tablet PC will be driven by application software that takes advantage of the capabilities of XP Tablet and the hardware. This is no different than for any other version of Windows.

(8) The Tablet PC is a new technology that must go through the same adoption curve as any other new technology. There’s nothing inherent in the Tablet PC that will drive faster-than-usual adoption. Microsoft’s good marketing will help, but the Tablet PC simply isn’t going to be a million-unit success in the first year. The same factors that drive the growth of the notebook market will drive the growth of the Tablet PC market. Specifically, these are (a) the need to use a PC away from a desk (mobility), (b) the availability of relevant software and the degree to which it becomes essential in one’s work (applicability), and (c) the degree to which notebook technology keeps up with desktop PC technology (relative functionality).

(9) Windows XP Tablet PC Edition is definitely a “version 1” Microsoft product. It’s quite rough around the edges. Most of the end-user tools provided by Microsoft (e.g., Journal, Sticky Notes, Input Panel, text correction method, etc.) are very clunky and need a lot of refinement. ISVs who have used the Tablet PC SDK say that while the ink API is fairly good, there are some significant pieces missing (for example, the Journal file format is currently closed with no API, and there’s no documentation whatsoever of the complex interaction between the Input Panel API and the Speech API). It’s going to take another two versions of XP Tablet to get it right. (Version 1.5 is scheduled for the end of 2003, and version 2 is scheduled for 2005 at the same time as Longhorn, the next major release of the Windows client.) This is of course consistent with the conventional wisdom that it takes Microsoft three tries to get any new product right. Remember that (a) Microsoft’s nature is to do incremental development (they can never meet all the market requirements the first release without delaying the product excessively), and (b) Microsoft has exceptionally deep pockets and can outwait a long stretch of market rejection and/or indifference (think of Windows CE as an example—it took 5 years to get from the roundly rejected v1.0 to the finally successful v3.0).
The bottom line is that there are quite a few demand-suppression factors operating in 2003, and relatively few demand-generation factors. Nevertheless, in the longer term (five years), the author believes that the Tablet PC will become a mainstream success.

ANALYSTS’ MARKET PROJECTIONS

In-Stat/MDR (www.instat.com) recently projected that Tablet PCs will account for 1%-2% of the worldwide notebook market in 2003 and 2004. Using numbers from DisplaySearch (www.displaysearch.com) for the notebook market in 2003 and 2004 (34.3M and 39.7M respectively), this puts In-Stat’s 2003-2004 projections at 343K to 794K units. In-Stat also projects that Tablet PCs will “break out” in 2005, increasing to 3.5% of notebook sales, which would be 1.6M. Based on interpolation of a graph published by In-Stat, their projections for 2006 and 2007 are 2.7M and 4.2M respectively. 4.2M is only 7.5% of the notebook market in 2007. The CAGR (compound annual growth rate) for 2003-2007 represented by these numbers is 47%, which seems very low.

In-Stat ranks North America first, Europe second, and Japan third in market importance. The author believes that In-Stat is underestimating the importance and influence of Asian OEMs and ODMs who are targeting Asian markets first, based on the high value of handwriting recognition in Asian languages. It’s possible that sales in Asian markets could equal or exceed those in North America over the next five years because the appeal of the Tablet PC is wider in Asian markets than in the business-dominated North American market. In a recent PC Magazine story, Duane Zitzner, executive vice president at HP, said “the [HP] Tablet PC is also doing very well in the Asian rim, where the handwriting recognition is a very big deal.”

IDC’s (www.idc.com) latest projection for the Tablet PC market in 2003 is 675K units, which is slightly under 2% of the worldwide notebook market—double In-Stat’s projection. During 2002, IDC estimated the 2003 market size at 1%-2% of notebook sales; after the Tablet PCs relatively solid start in 1Q03, they chose the high end of their previous projection.

Last fall, Gartner (www.gartner.com) predicted that Tablet PC shipments would reach 425K units in 2003 (1.2% of worldwide notebook shipments), and 3% in 2004. Gartner also predicted that by 2007, 35% of all notebooks sold would be Tablet PCs—that’s a CAGR of 161%, which seems too aggressive. Gartner hasn’t updated their projections yet in 2003.

In February 2003, Rob Enderle from Giga Information Group (www.gigaweb.com) made the most outrageous new prediction. As quoted in a story in Business Week, he apparently believes that the number of notebooks including Tablet PC capability will jump from 2% at the end of 2003 to 25% at the end of 2004. That would mean going from less than a million units to almost 10 million units in two years. That’s simply absurd—it must be either a typo or a reporting error.
AUTHOR’S MARKET PROJECTIONS

The author’s projections for growth of the Tablet PC market are expressed in the following two tables. Table 6 below shows the predicted overall Tablet PC growth for 2003-2007. The notebook data shown is from DisplaySearch (April 2003). As can be seen, the percentage of all notebooks that are Tablet PCs in five years is 21.0%—lower than both Microsoft’s prediction of 50% and Gartner’s prediction of 35%, yet higher than In-Stat’s 7.5% prediction. The author’s predictions were derived bottoms-up by estimating the growth and market share for each OEM in each form-factor. Note that the author agrees with In-Stat’s prediction that 2005 will be the “break-out” year.

Table 6: Author’s Predicted Overall Tablet PC Growth

<table>
<thead>
<tr>
<th>Year</th>
<th>Notebooks (millions)</th>
<th>Tablet PCs (thousands)</th>
<th>Tablet PCs (% of notebooks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>29.4</td>
<td>60</td>
<td>0.2%</td>
</tr>
<tr>
<td>2003</td>
<td>34.3</td>
<td>696</td>
<td>2.0%</td>
</tr>
<tr>
<td>2004</td>
<td>39.7</td>
<td>1,557</td>
<td>3.9%</td>
</tr>
<tr>
<td>2005</td>
<td>45.9</td>
<td>4,579</td>
<td>10.0%</td>
</tr>
<tr>
<td>2006</td>
<td>51.0</td>
<td>7,615</td>
<td>14.9%</td>
</tr>
<tr>
<td>2007</td>
<td>56.4</td>
<td>11,865</td>
<td>21.0%</td>
</tr>
</tbody>
</table>

(Notebook data from DisplaySearch, April 2003)

Table 7 below shows the author’s predicted Tablet PC growth by form factor. As can be seen, the balance shifts markedly from 54% pure tablets in 2003 to only 12% pure tablets in 2007. This reflects the predicted dominance of convertibles in the mainstream. The overall Tablet PC CAGR is 103%, meaning that on average the total number of Tablet PCs sold doubles every year for five years. The CAGR for pure tablets is much lower, reflecting the much more limited range of applications for pure tablets. The CAGR for rugged tablets is the lowest of all, reflecting the fact that buyers only purchase rugged tablets when they have absolutely no other choice. Rugged convertibles, on the other hand, are much more likely to succeed as a category, especially in light of Panasonic’s current annual sales for the entire Toughbook line (rumored to be around 150K units).

Table 7: Author’s Predicted Tablet PC Growth by Form-Factor

<table>
<thead>
<tr>
<th>Form-Factor</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial pure tablets</td>
<td>345</td>
<td>558</td>
<td>815</td>
<td>1,050</td>
<td>1,340</td>
<td>40.1%</td>
</tr>
<tr>
<td>Commercial convertibles</td>
<td>305</td>
<td>895</td>
<td>3,555</td>
<td>6,230</td>
<td>10,030</td>
<td>139.5%</td>
</tr>
<tr>
<td>Rugged pure tablets</td>
<td>31</td>
<td>54</td>
<td>64</td>
<td>85</td>
<td>95</td>
<td>32.3%</td>
</tr>
<tr>
<td>Rugged convertibles</td>
<td>15</td>
<td>50</td>
<td>145</td>
<td>250</td>
<td>400</td>
<td>127.2%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>696</td>
<td>1,557</td>
<td>4,579</td>
<td>7,615</td>
<td>11,865</td>
<td>103.2%</td>
</tr>
</tbody>
</table>
**TECHNOLOGY TREND PREDICTIONS**

The following technology changes in the Tablet PC are likely to occur during the next several years:

- LCDs with wider viewing angles, reduced pooling and increased resolution.
- Improved writing surface and pen ergonomics.
- More accurate digitizer with no jitter (vibration) in the displayed cursor.
- Lighter, thinner products as the level of integration keeps rising in the core product.
- Longer battery life through the use of “slab” lithium-polymer batteries.
- Faster suspend and resume times (effective instant-on).
- Improved features for keyboardless use, such as ergonomic navigation buttons.
- Integration of biometric fingerprint scanners.
- Embedded array microphones for arm’s-length speech recognition.
- Increased CPU speeds (following Intel’s mobile CPU roadmap).
- Technology changes that affect all notebooks, such as faster HDD interfaces.
- Continued improvement in the Tablet PC operating system.
- Expanded support for digital ink in Microsoft Office applications.
- Substantial increase in the number of applications optimized for the Tablet PC.
- Trainability and context sensitivity in the handwriting recognizer.
- Slow but steady improvement in handwriting recognition accuracy.

**PRODUCT TREND PREDICTIONS**

There is little reason for a horizontal user to choose a pure tablet over a convertible. It is always easier and more convenient to have an integrated keyboard rather than struggling with external keyboards, desk stands, docks, “portfolio-style” carrying cases and other peripherals that attempt to make a pure tablet into a notebook. The notebook is a 20-year-old, highly refined form-factor, and it’s not going away any time soon. The pure tablet form-factor will be relegated mainly to vertical applications. Because of that, it will never achieve widespread adoption and critical mass. Although the number of vertical application users is expected to increase significantly during the next few years, there are still too many pure tablets on the market for the expected number of users. Accordingly, some of the current pure tablet OEMs will drop out of the market during the next few years.

On the other hand, the number of convertible Tablet PCs will increase significantly over the next few years. The very positive market reaction to the Acer and Toshiba convertibles makes that clear. Current pure-tablet OEMs who have the resources to develop a convertible Tablet PC (such as HP) will likely do so; OEMs
who don’t currently sell a Tablet PC (e.g., Dell, IBM, Samsung, Sharp, etc.) are likely to enter the market with a convertible as their first product.

A very important product trend during the next few years will be the expansion of the Tablet PC beyond the ultraportable notebook category into the “thin-and-light” notebook category. Microsoft is assuming that this will take place when they say they expect that “50% of all notebooks will be Tablet PCs in five years”.

Another product trend that will occur over the next few years is the reduction of the $200 street-price premium for Tablet PC functionality. The most pressure will be exerted on the most costly item, the $50 active digitizer. Two Taiwanese digitizer companies have already entered the market; one or two more may enter by the end of 2003. Competition and volume is likely to drive the digitizer price down to $25 in several years. As the volume of Tablet PCs increases, and as more LCD vendors enter the market, the $22 premium for the special LCD will vanish. The $7 premium for assembly complexity will also vanish as Tablet PCs become more commonplace. Microsoft conceivably might reduce the $30 XP Tablet license fee to $20. Finally, some form of hinge and writing surface ($8) will always be necessary, so the net will be at least a 50% reduction (to $100) in the street-price premium for Tablet PC functionality.

**TABLET PC ACTION ITEM CHECKLIST FOR IT**

When deciding on Tablet PC form-factor:

- Obtain a realistic assessment of the user’s need for instant access to a keyboard.

When selecting any Tablet PC:

- Evaluate the device the same way you would any ultraportable notebook.
- Ensure there’s a backup if the user loses the electronic pen.
- Assess the feeling of the pen on the writing surface.
- Assess the amount of pooling in the LCD when pressing hard with the pen.
- Check for glare from the writing surface.
- Look for a shock-mounted hard drive (rare in commercial Tablet PCs).
- Check the video performance of the system in portrait mode.
- Determine the overall durability of the system (ask for MTBF & failure details).

When selecting pure tablets for a vertical application:

- Consider the vendor’s experience and anticipated longevity.
- Look for a complete system (a wide variety of accessories and peripherals).
- Assess the vendor’s VAR and ISV relationships.
When selecting convertibles for a horizontal application:

- Consider the vendor’s reputation for standard notebooks.
- Demand documentation of swivel hinge life testing.
- Obtain a realistic assessment of the user’s need for docking peripherals.

When considering implementing pen tablets instead of Tablet PCs:

- Consider pen tablets only for vertical applications.
- Focus on Windows 2000 and XP Professional.
- Look for daylight-readable screens.
- Realize that most pen tablets use touch screens.
- Consider that many pen tablets have SVGA resolution rather than XGA.
- Take advantage of the fact that pen tablets support legacy peripherals.
- Look for pen tablets that can be converted or upgraded to Tablet PCs.

When considering implementing a new vertical application with Tablet PCs:

- Look for users or applications that can benefit in the short term from the Tablet PC.
- Recognize that deriving value often requires development (e.g., electronic forms).
- Look for implementations that have been too big for PDAs (CPU, screen, storage).
- Interact with target end-users to determine requirements (critical for success).
- Verify that your enterprise software (e.g., Siebel 7) is supported on the Tablet PC.

When considering new horizontal applications for Tablet PCs:

- Realize that not every user is a candidate–everyone doesn’t need an ultraportable.
- Be aware that Tablet PCs have higher hardware cost and more user-support issues.
- Realize that if you don’t already have Wi-Fi, the Tablet PC may drive its acquisition.
- Be prepared to support “guerilla buying” of Tablet PCs.

When considering portrait-mode applications:

- Evaluate the screen viewing angle (consider waiting for the second generation).
• Obtain Pivot software from Portrait Displays for improved video performance.

When deciding on the use of handwriting recognition:

• Be very cautious of any application that requires lots of free-text entry.
• Develop a custom vocabulary (dictionary) for your application.
• Minimize the amount of handwriting required by using pull-down lists, etc.
• Avoid handwriting anything other than standard words (no URLs, etc.).

When considering note-taking as a primary application:

• Forget Windows Journal and obtain Microsoft One-Note.
• Don’t count on being able to search digital ink.

When considering review and annotation of Office documents as a primary application:

• Skip Office 2002 and go directly to Office 2003.

When considering collaboration as a primary application:

• Explore a range of software to find something that fits your organization’s work style.
• Realize that if you don’t already have Wi-Fi, the Tablet PC may drive its acquisition.

When evaluating “thin-and-light” Tablet PCs (second- or third-generation products):

• Think hard about the ergonomics of a 5-6 pound Tablet PC.
• Don’t accept XGA resolution in a 14” screen.
• Insist on SXGA+ resolution or higher so that the quality of digital ink scales properly.
SOURCES OF ADDITIONAL INFORMATION ON THE TABLET PC

The number of websites devoted to the Tablet PC keeps increasing. The following sites exist as of May 2003 (listed in alphabetical order):

- www.sportinit.com
- www.tabletcentral.com
- www.tabletpc2.com
- www.tabletpcbuzz.com
- www.tabletpcdeveloper.com
- www.tabletpchome.com
- www.tabletpcs.net
- www.tabletpctalk.com (the author’s favorite)
- www.thetabletpc.net