



Why Microsoft Windows XP Embedded?

Understanding the Advantages of Microsoft XP Embedded

Abstract

Selecting an operating system is one of the most fundamental decisions a device manufacturer can make for any given device design. When choosing an embedded operating system, device manufacturers often seek a platform that will meet technical and business requirements; be brought to market rapidly at low, predictable costs; and provide flexibility and supportability throughout the device's life cycle.

Microsoft® Windows® XP Embedded meets device manufacturer needs for an embedded operating system for a wide variety of embedded device designs by providing:

- **[A Mature and Complete Technology Portfolio](#)**. When device manufacturers choose Windows XP Embedded, they can meet changing customer requirements more rapidly, flexibly, and predictably with a mature and comprehensive embedded development platform, integrated development tool chain, and the latest innovative technologies.
- **[Low Device Life Cycle Cost](#)**. When device manufacturers choose Windows XP Embedded, they can achieve low device life cycle costs and meet increasingly rapid time-to-market objectives, while managing predictable device life cycle development, support, and maintenance costs.
- **[Business Model Alignment](#)**. Windows XP Embedded is based on a proven commercial software business model that aligns with manufacturer device life cycle needs with the industry's largest partner ecosystem and low cost, extended operating system maintenance support—all based on a low upfront cost “shared success” revenue model.

Microsoft and the Windows XP Embedded operating system and tools provide the technologies, device life cycle cost profile, and business model that is aligned with device manufacturer needs for a complete, cost-effective, and committed partner today and in the future.

The information contained in this document represents the current view of Microsoft Corporation on the issues discussed as of the date of publication. Because Microsoft must respond to changing market conditions, it should not be interpreted to be a commitment on the part of Microsoft, and Microsoft cannot guarantee the accuracy of any information presented after the date of publication. This document is for informational purposes only. MICROSOFT MAKES NO WARRANTIES, EXPRESS OR IMPLIED, AS TO THE INFORMATION IN THIS DOCUMENT.

Complying with all applicable copyright laws is the responsibility of the user. Without limiting the rights under copyright, no part of this document may be reproduced, stored in or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), or for any purpose, without the express written permission of Microsoft Corporation.

Microsoft may have patents, patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from Microsoft, the furnishing of this document does not give you any license to these patents, trademarks, copyrights, or other intellectual property.

© 2005 Microsoft Corporation. All rights reserved.

Microsoft, DirectX, MSDN, Visual Studio .NET, Win32, Windows, Windows Media, Windows Mobile, and the Windows logo are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

The names of actual companies and products mentioned herein may be the trademarks of their respective owners.

Microsoft Corporation • One Microsoft Way • Redmond, WA 98052-6399 • USA

Table of Contents

Abstract	1
Table of Contents	3
Overview	4
Mature and Complete Technology Portfolio	4
Componentized Technologies and Applications.....	4
Broad and Professionally Tested Hardware Support	5
Familiar, Powerful, and Consistent Development Tools.....	5
Low Device Life Cycle Cost	6
Total Development Costs	7
Associated Costs	7
Software Runtime Costs	8
Business Model Alignment	8
Long-Term Commitment and Partner Ecosystem	8
Proven and Flexible Commercial Software Licensing Models that Protect Device Manufacturer Intellectual Property	9
"Shared Success" Revenue Model.....	9

Overview

Selecting an operating system is one of the most fundamental decisions a device manufacturer must make for any given device design. Many device manufacturers are considering migration from an in-house, self-maintained, proprietary embedded operating system to a commercial embedded operating system; or from one commercial embedded operating system to another. If so, they are probably looking for a platform that will meet technical and business requirements; be brought to market rapidly at low, predictable costs; and provide flexibility and supportability throughout the device's life cycle.

Microsoft Windows XP Embedded meets device manufacturer needs for an embedded operating system for a wide variety of embedded device designs by providing:

- **[A Mature and Complete Technology Portfolio](#)**. When device manufacturers choose Windows XP Embedded, they can meet changing customer requirements more rapidly, flexibly, and predictably with a mature and comprehensive embedded development platform, integrated development tool chain, and the latest innovative technologies.
- **[Low Device Life Cycle Cost](#)**. When device manufacturers choose Windows XP Embedded, they can achieve low device life cycle costs and meet increasingly rapid time-to-market objectives, while managing predictable device life cycle development, support, and maintenance costs.
- **[Business Model Alignment](#)**. Windows XP Embedded is based on a proven commercial software business model that aligns with manufacturer device life cycle needs with the industry's largest partner ecosystem and low cost, extended operating system maintenance support—all based on a low upfront cost "shared success" revenue model.

Mature and Complete Technology Portfolio

Windows XP Embedded enables manufacturers to more rapidly develop devices, achieve richer device differentiation, and minimize vendor management and licensing costs by providing:

- A rich, scalable set of componentized operating system technologies and applications.
- Broad and professionally tested hardware support.
- Familiar, powerful, and consistent development tools.

Componentized Technologies and Applications

Windows XP Embedded includes a rich, scalable set of componentized, pre-integrated, and footprint-minimized technologies and applications, as detailed below:

- **Granular Componentization**. Windows XP Embedded has been architected as a componentized operating system and is delivered as a granular and configurable set of over 10,000 individual components. With these components developers can additively assemble an operating system image by using powerful, integrated GUI-based tools to meet footprint requirements, while maintaining operating systems dependencies. Windows XP Embedded is a fully componentized version of Windows XP Professional and can scale as low as eight megabytes (MB) in size with a bootable kernel.
- **Rich, Customizable Applications**. Windows XP Embedded includes dozens of high-level software features and applications that provide additional value to the core Windows XP operating system and networking stacks. Device manufacturers can use these features and applications to enable common embedded device usage scenarios. The applications—which include familiar desktop applications and services, such as Microsoft® Windows Media® Player and Microsoft® Internet Explorer—are

feature complete and of production quality. With full Win32® API support, Windows XP Embedded is fully compatible with the thousands of off-the-shelf applications that are designed for Windows XP Professional.

- **Included Integrated Technologies.** Windows XP Embedded also includes a rich set of integrated technologies, such as multimedia codecs and formats, Bluetooth, DirectX®, and the .NET Framework, which often must be licensed separately for other embedded platforms from multiple vendors. In addition to including nearly all technologies that are available with the desktop version of Windows XP Professional, Windows XP Embedded provides embedded-enabling features that were developed specifically for devices.

In contrast, some other embedded platforms are not nearly as granularly componentized and operating system images are developed by manual subtraction of components. In addition, some other embedded operating systems include fewer value-added technologies and applications. Therefore, if device manufacturers want to include value-added applications and software features on their device, they have three options that entail additional cost, whether realized through license fees or development time: build them internally, license them from a handful of companies who support the platform, or find free versions (if available) and then port and modify them as necessary to meet device requirements.

Broad and Professionally Tested Hardware Support

When device manufacturers choose Windows XP Embedded, they can rapidly and reliably incorporate certified device drivers and other hardware support on a consistent and professionally-tested basis across a wide range of the most popular PC-architecture hardware platforms:

- **Broad Driver Coverage.** Windows XP Embedded includes an extensive set of device drivers that are delivered in source form to optimize embedded development. Windows XP Embedded alone includes about 9,000 Windows Hardware Quality Labs (WHQL) certified drivers for PC-architecture hardware platforms.
- **Consistent Support for Most Popular Hardware.** Windows XP Embedded supports all of the PC architecture processor families and architectures. Whether during the development process, during the lifecycle of the device, or across product lines, device manufacturers are fundamentally assured that they have the flexibility to easily migrate their customized operating systems and applications across different x86-based hardware platforms. This helps maximize hardware price and performance..
- **Professionally Tested.** Microsoft employs thousands of dedicated software test engineers and, through widespread beta programs, Windows XP Embedded benefits from the efforts of thousands more. This enables support for a broad, thoroughly tested (and certified) range of hardware. Moreover, Microsoft stands behind the quality of the operating system and drivers—providing maintenance support for all operating system components and drivers that are included with Windows XP Embedded.

Familiar, Powerful, and Consistent Development Tools

When device manufacturers choose Windows XP Embedded, they benefit from decades of Microsoft tool expertise, an application development community of over six million developers, and a fully integrated development environment that is based on rich, mature, and common APIs to accelerate operating system and application development, as detailed below:

- **Integrated Development Environment.** Device manufacturers can build Windows XP Embedded images by using a single, GUI-based, integrated development environment (Windows Embedded

Studio) that includes tools such as a footprint estimator and device analyzer that reduce the time-costly guesswork that is often involved in building images.

- **Rich Native and Managed Application Tools.** The Windows XP Embedded operating system provides a streamlined set of GUI-based application development tools. Developers can use Visual Studio® .NET to author managed or native applications by using the .NET Framework or native Win32 APIs. Application development tools have always been central to Microsoft's business since its founding. Currently, over six million developers are familiar with the tools and APIs. This large developer base results in the broad spread availability of skilled developers and existing applications.
- **Mature, Common API.** Windows XP Embedded provides the same 10,000 Win32 APIs that are available with Windows XP Professional. Such a large availability of well-documented, widely used, and consistently implemented APIs makes it easy for embedded application developers to write unique and powerful applications or re-use applications that were originally written to be used on Windows XP Professional-based computers.


Other embedded operating systems may lack mature and complete toolsets for building operating system images and developing applications. They may also have multiple non-standard development environments, lack a common API, rich programmability, and can, therefore, lack a large experienced developer community. Developers who use other platforms must often purchase, build, or assemble multiple tools from various internal or external sources, and then ensure that they work together. Moreover, the operating system development tools are sometimes command-line based, which may be challenging to new developers and result in a longer development process. Application development tools for other embedded operating systems may vary widely in quality and may be less widely used or familiar to the developer community. Therefore, it can be difficult to find applications and skilled developers.

Low Device Life Cycle Cost

When device manufacturers choose Windows XP Embedded, they can achieve low device life cycle costs by effectively meeting increasingly rapid time-to-market objectives, while also managing predictable device life cycle development, support, and maintenance costs. In July 2003, a third-party research firm, Embedded Market Forecasters (EMF), published *Total Cost of Development: A comprehensive cost estimation framework for evaluating embedded development platforms*. This report is the first study of its kind in the embedded industry that compared the total cost of development on different embedded operating system platforms. The report, commissioned by Microsoft, analyzed the results of a development experience survey of device manufacturers by using Windows XP Embedded and embedded Linux.

According to the EMF model, the total cost of software development for any embedded device design can be considered as the sum of three separate costs: total fixed development costs, associated costs, and runtime costs. Table A below provides a description of each cost component.

Table A – Factors That Influence Total Cost of Development

<p>Total Development Costs Fixed costs that are associated with developing a product from design start to product shipment as a function of three variables: time-to-market, software engineering team size, and software engineering team cost.</p>	<p>Fixed Costs (per project)</p>  <p>Variable Costs (per unit)</p>
<p>Associated Costs Variable fixed costs that are associated with the tool chain, support, and maintenance costs for a design. Whether during development or after product shipment, these costs vary depending on development team size or vendor terms.</p>	
<p>Runtime License Costs True variable costs that are directly associated with the shipment of every device for the operating system and any other separately licensed software components.</p>	

Considered as a whole, these costs describe the software-related device life cycle cost of an embedded design. By incorporating these factors from the market data that is summarized below, device manufacturers can gauge and compare the expected software-related costs that are associated with the selection of an embedded operating system for a particular project, product lifecycle, and volume expectation.

Total Development Costs

The EMF study measured total development costs by multiplying the average number of development months that were required to finish the project by the average monthly cost of each software engineer. Developer months were calculated by multiplying the software development team size by the length of the project in months. As shown below in Table B from the EMF study, Windows XP Embedded designs required an average of 58 developer months, which translated to a total cost of development averaging \$438,000 per project. In the same study, embedded Linux designs required an average of 203 developer months, which translated to a total cost of development averaging \$1,888,000 per project.

Table B – EMF Total Cost of Development Data

Total Cost of Development Factors	Windows XP Embedded	Embedded Linux	Windows XP Embedded Advantage
Time-to-market (months)*	8.0	14.3	44 percent
Software engineers for each project (number)	7.3	14.2	49 percent
Developer months	58.4	203.1	71 percent
Cost per developer per month**	\$7,500 US	\$9,300 US	19 percent
Total cost of development***	\$438,000 US	\$1,888,000 US	77 percent

Source: Krasner PhD, Jerry. *Total Cost of Development: A comprehensive cost estimation framework for evaluating embedded development platforms*. Embedded Market Forecasters, July 2003.

* Time-to-market duration of time between when software development for the device design began and when the embedded device was released to manufacturing

** Based on averages for device manufacturers who are located in North America and includes overhead for employment.

*** Total cost of development = time-to-market * cost / developer months

Associated Costs

As defined by the EMF model, associated costs are partially fixed and partially variable costs and fluctuate significantly between projects and vendors. Associated costs include development tool, support, and maintenance costs. Table C below summarizes findings from the EMF survey, which gathered pricing data on the wide range of support and maintenance terms that are offered by a variety of embedded Linux distributors.

Table C – Associated Costs

Associated Costs	Windows XP Embedded	Embedded Linux Average
Tools	\$995 US per copy per developer (unlimited number of projects)	\$3,899 US per copy per developer per year
Operating system and tool maintenance*	No cost* for years	\$2,000 US per developer per year
Support**	\$99 US per incident (Web) \$245 US per incident (phone)	\$1,000 US per developer per year
Total associated costs †	\$6,660 US	\$56,697 US

Source: Krasner PhD, Jerry. *Total Cost of Development: A comprehensive cost estimation framework for evaluating embedded development platforms*. Embedded Market Forecasters, July 2003.

* Windows XP Embedded free maintenance requires the latest service pack and is subject to other restrictions. The maintenance period is based on the product release schedule and can be extended to at least 10 years with a fee. Embedded Linux prices ranged from \$750 US to \$10,000 US per developer per year.

** Windows XP Embedded tools include two free support incidents. Embedded Linux support fees ranged from \$500 US to \$2,500 US per developer per year.

† Total associated costs is based on a sample project involving three developers, five year device lifecycles, and three phone-based support calls per year. Embedded Linux distributors who use a subscription based model that bundles tools, support, and maintenance costs together yield a five year cost averaging over \$250,000 US.

Software Runtime Costs

Windows XP Embedded includes a rich set of applications and technologies that are often not included with other embedded operating systems: media player, Web browser, terminal or thin client, desktop synchronization, residential gateway application stack, digital rights management (DRM), device management client, Windows Media® Audio and Video 9 Series encoders and decoders, MP3 decoder, MPEG-4 decoder, graphics package, a wide variety of networking protocols, and several others.

When device manufacturers use other embedded operating systems, they must purchase each of these applications and technologies separately from a variety of vendors. Each additional application and technology increases runtime licensing costs well beyond that of the base operating system and also compounds vendor management costs.

Business Model Alignment

Business model alignment is important because all companies generally want to develop relationships with vendors who understand their needs, help meet requirements, and mitigate risks, while sharing and increasing rewards. Windows XP Embedded is based on a proven commercial software business model that aligns with manufacturer device life cycle needs with one of the industry's largest partner ecosystem and low cost, extended operating system maintenance support—all based on a low upfront cost "shared success" revenue model.

Long-Term Commitment and Partner Ecosystem

Microsoft is committing substantial resources to embedded research and development (R&D) for long-term success. It is also creating strategic alliances with the largest and most dynamic partner base to provide device manufacturers with the choice of expertise and vendors who are needed to most efficiently build designs. The following list illustrates these long term commitments:

- **Research and Development Investment.** Microsoft has made substantial investments in the embedded market for the past ten years, including a large and dedicated development and test staff, as well as continued investments in Windows XP and future Windows operating systems.
- **Product Commitment.** Microsoft recognizes the unique nature of the embedded industry and delivers long support lifecycles for its embedded products.

- **Platform Standardization.** Microsoft offers an increasingly standardized, flexible embedded platform, that includes SDKs for developers, tools, and a common-language runtime that is based on set of common and well-defined APIs and class libraries.
- **Partner and Community Breadth and Depth.** Microsoft is deeply engaged with over 2,000 Windows Embedded partners in 60 countries worldwide, who collectively bring to market over 800 value-added solutions that are built on Windows Embedded operating systems. Microsoft also encourages a thriving community, including the embedded MVPs, and forums for information and communication (such as the Devwire newsletter, MSDN®, blogs, active newsgroups, chats, webcasts, and events). Device manufacturers can use this community to competitively source products and services from a wide choice of worldwide vendors.

With other embedded operating systems, various companies continue to enter and leave the market, which develops competing distributions, tool-chains, and APIs without a commonly adopted standard. Such fragmentation reduces the breadth and depth of third-party support and the developer community skill set. As a result, device manufacturers may assume the risk of relying on a self-support model for their operating system distribution.

Proven and Flexible Commercial Software Licensing Models that Protect Device Manufacturer Intellectual Property

Microsoft's proven commercial software business and licensing model leaves device manufacturers firmly in control of their own intellectual property. Other embedded operating systems often have licensing models that raise issues of accountability, fragmentation, viral licensing, and business viability.

"Shared Success" Revenue Model

The Windows Embedded business model is principally based on runtime license royalties and is structured to provide very low upfront costs, including low cost tools, maintenance, and a "pay as you go" support model. Microsoft, as a vendor to the embedded market, has structured its business model to make money only after the manufacturer ships a product. This model assures that Microsoft has a vested interest and structural incentive to continually invest in and improve its tools and products so that device manufacturers can get to market more quickly, provide more value to their customers, and ship in high volume.

Most other embedded software companies have built a business model that is based on high cost services and tools, which are typically paid upfront, regardless of whether device manufacturers ship the product and it is commercially successful. Under this type of model, manufacturers assume nearly all costs early on, which adds additional risk to the project. Such models with a heavy reliance on development and support services that are charged on a time basis (per hour or per year) result in a structural incentive for the vendor to maximize the length of the development cycle. Therefore, these models often result in high upfront costs, added risk, and longer time-to-market.

Microsoft and the Windows XP Embedded operating system and tools provide the technologies, device life cycle cost profile, and business model that is aligned with device manufacturer needs for a complete, cost-effective, and committed partner today and in the future.