# The ROI from Optimizing Software Performance with Intel® Parallel Studio XE

**Intel® Parallel Studio XE delivers ROI solutions to development organizations. This comprehensive tool offering for the entire software development life cycle helps improve productivity, enhance quality, increase performance, and reduce overall costs.**

Driven by market demands, software makers face challenges in ensuring that application offerings are richer and more robust within an increasingly competitive environment. To be successful, they must deliver high-performance, quality applications and support the latest processor technology, while meeting software schedules on time and within budget.

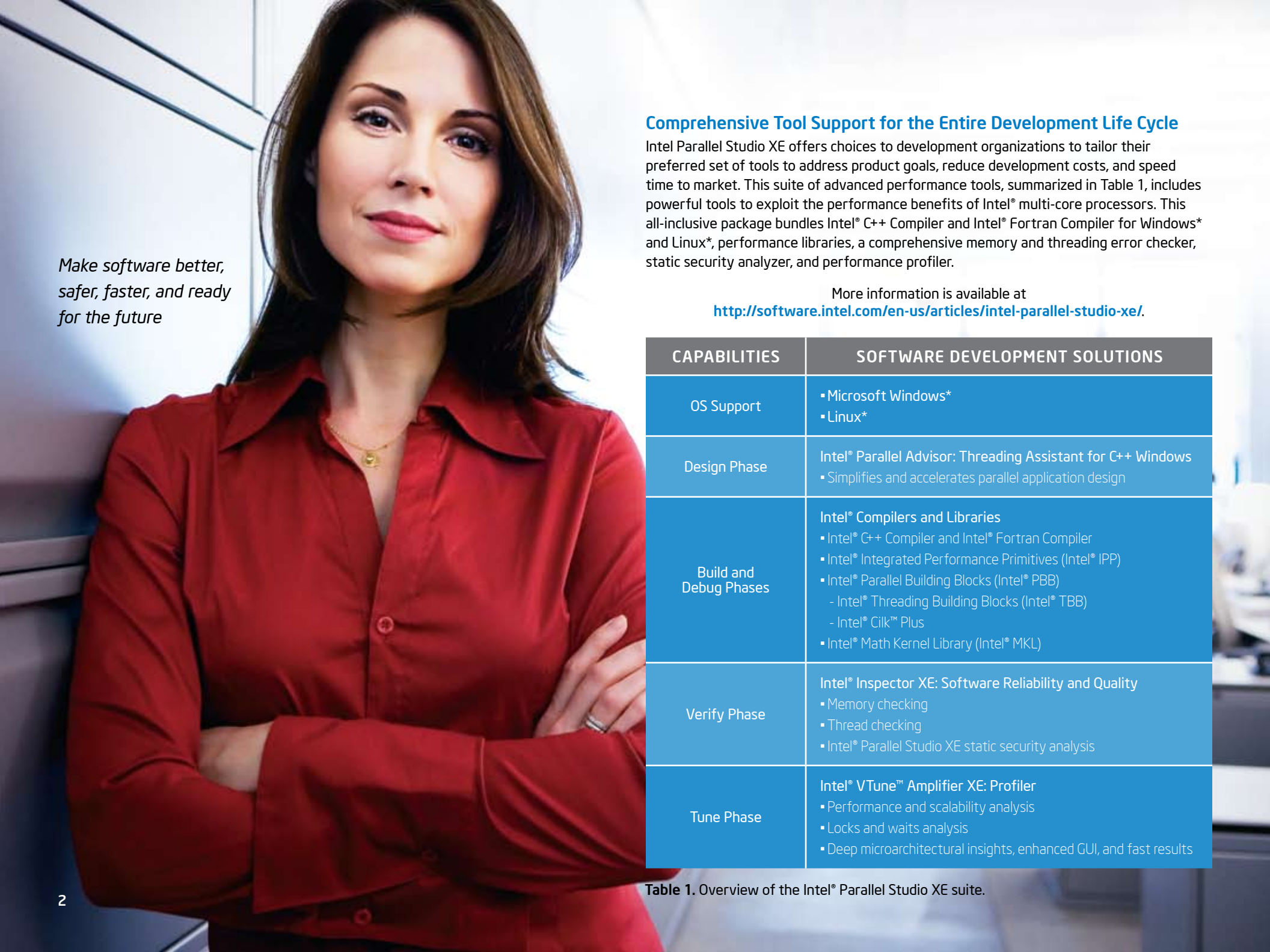
Intel® Parallel Studio XE is a suite of tools that can help development organizations increase ROI across the application life cycle, including the design, build, debug, verify, and tuning phases. These essential tools help make software better, safer, faster, and more ready for the future. Executives can see benefits to their bottom line, while developers will enjoy dramatic savings in the time it takes to generate quality code. And development managers value savings and being better able to meet production schedules. ROI benefits include enhancements along three key vectors:

- **Productivity**. Essential analysis, tuning, and modeling tools make it easier for developers to find defects quickly, rapidly tune for performance, and efficiently transition serial code to parallel code, saving both time and costs.
- **Quality and reliability**. Tools effective in catching software defects earlier in the life cycle can save dramatically on the time and cost required to correct them, which increases ROI.
- **Performance and scalability**. Vital threading, profiling, and performance-optimization tools enable developers to design applications that take advantage of speed and scalability opportunities from multi-core processor architectures.

Employing the right tools enables software organizations to stay competitive, achieve their strategic and tactical goals, and increase ROI.

## BOTTOM LINE

**Annual Savings in Your Pocket**
**Increased ROI**
**Faster Payback**



*Make software better, safer, faster, and ready for the future*

## Comprehensive Tool Support for the Entire Development Life Cycle

Intel Parallel Studio XE offers choices to development organizations to tailor their preferred set of tools to address product goals, reduce development costs, and speed time to market. This suite of advanced performance tools, summarized in Table 1, includes powerful tools to exploit the performance benefits of Intel® multi-core processors. This all-inclusive package bundles Intel® C++ Compiler and Intel® Fortran Compiler for Windows* and Linux*, performance libraries, a comprehensive memory and threading error checker, static security analyzer, and performance profiler.

More information is available at
**http://software.intel.com/en-us/articles/intel-parallel-studio-xe/**.

| CAPABILITIES | SOFTWARE DEVELOPMENT SOLUTIONS |
|---|---|
| OS Support | ▪ Microsoft Windows*<br>▪ Linux* |
| Design Phase | Intel® Parallel Advisor: Threading Assistant for C++ Windows<br>▪ Simplifies and accelerates parallel application design |
| Build and Debug Phases | Intel® Compilers and Libraries<br>▪ Intel® C++ Compiler and Intel® Fortran Compiler<br>▪ Intel® Integrated Performance Primitives (Intel® IPP)<br>▪ Intel® Parallel Building Blocks (Intel® PBB)<br>- Intel® Threading Building Blocks (Intel® TBB)<br>- Intel® Cilk™ Plus<br>▪ Intel® Math Kernel Library (Intel® MKL) |
| Verify Phase | Intel® Inspector XE: Software Reliability and Quality<br>▪ Memory checking<br>▪ Thread checking<br>▪ Intel® Parallel Studio XE static security analysis |
| Tune Phase | Intel® VTune™ Amplifier XE: Profiler<br>▪ Performance and scalability analysis<br>▪ Locks and waits analysis<br>▪ Deep microarchitectural insights, enhanced GUI, and fast results |

**Table 1.** Overview of the Intel® Parallel Studio XE suite.

## Value Vectors That Generate ROI for Software Companies

**Productivity: Development Tools Can Improve Project Efficiency, Predictability, and Cost**

Intel Parallel Studio XE improves developer productivity with time-saving tools for the entire product development life cycle. These tools can help decrease the time spent finding defects, addressing performance bottlenecks, and transitioning from serial to parallel code, as shown in Table 2. Intel Parallel Studio XE helps software organizations improve project success rates while staying within budget, with a comprehensive tool set:

- **Robust analysis tools** provide early detection of crucial software defects before a product ships.
- **Fundamental tools** easily enhance application performance.
- **Threading assistant tool** helps speed up the process of transitioning serial code to parallel code.

| DATA AVERAGES AND ASSUMPTIONS | PRODUCTIVITY TOOLS | PRODUCTIVITY INCREASE FACTOR |
|---|---|---|
| Typical time to find and fix defects per KLOC:[1]<br>▪ Average 3 to 50 defects per KLOC (more complex: 100+)<br>▪ Average 2 to 15 hours to find and fix defects (more complex: 100+) | Intel® analysis tools can help find many coding defects, pinpointing location, source, and severity:<br>▪ Intel® Parallel Studio XE Static Security Analysis can help find security vulnerabilities<br>▪ Intel® Inspector XE Dynamic Analysis can help find memory leaks and corruption, plus data races and deadlocks | Up to 10x productivity increase—reduced time spent in locating defects, eliminating trial and error<br>▪ Assumption without tools: Defect rate = 10 per KLOC, and average time to find and fix defects = 15 hours<br>▪ Projection with Intel® Inspector XE: Average time to find and fix defects = 1.5 hours |
| Average proportion of time developers spend on improving application performance: 5 to 10 percent[2] | Industry-leading Intel® Compilers and popular profiling tools expedite the process of tuning application performance:<br>▪ Intel® C++ Compiler and Intel® Fortran Compiler and performance libraries<br>▪ Intel® VTune™ Amplifier XE can help find hot spots, locks, and waits | Up to 10x productivity increase—reduced time spent to tune application performance[1]<br>▪ Assumption without tools: Time spent = 2.4 weeks per year<br>▪ Projection with Intel® VTune™ Amplifier XE: Average time = .24 weeks; saves 2.2 weeks per year |
| Transitioning serial code to parallel code efficiencies[3] | Intel® Parallel Advisor, a threading design tool, provides easier migration to parallel code with steps, correctness, and methodology for implementing parallelism | Up to 10x productivity increase—easier migration of serial code to parallel code<br>Reduces learning time and loss of efficiency due to trial and error; provides correctness and performance analysis |

**Table 2.** Industry data on software defect count data and productivity factor.[1,5]

### Quality and Reliability: Catching Defects Early Improves Software Quality and Saves on Costs

Catching software defects as early as possible in the life cycle can save dramatically on time and costs, as shown in Table 3. Intel Parallel Studio XE provides developers with essential tools that catch a wide range of security vulnerabilities, memory errors, and threading defects. Sub-optimal initial application quality and performance contribute to high development costs, project overruns, and excessive after-market support cost.

As documented in the CERT Research Annual Report 2009,[4] the software development industry widely recognizes that fixing software defects after a product ships can be 10 to 200 times more costly than doing so beforehand. The study also finds that ROI increased by 12 to 21 percent when software analysis tools were used early in the development cycle.

| INTEL QUALITY TOOLS | COST SAVINGS FACTOR |
|---|---|
| Intel® Parallel Studio XE Static Security Analysis Tool:<br>▪ Finds more than 250 security vulnerabilities and defects<br>Intel® C++ Compiler and Intel® Fortran Compiler<br>▪ Provides code coverage and performs profile-guided testing<br>Intel® Inspector XE Dynamic Analysis Tool:<br>▪ Finds memory leaks and corruption defects<br>▪ Pinpoints hard-to-find thread data races and deadlock defects that cause stalls and crashes | Cost example:<br>Finding defects earlier in the life cycle can increase ROI by 12 to 21 percent[4]<br>Defects fixed pre-release:<br>Assuming 5 defects at an average cost of USD 100 per defect = USD 500<br>Defects fixed post-release 10–200 times more costly:<br>Assuming 5 defects at an average cost of USD 500, times 10x additional cost = USD 5,000 |

**Table 3.** Sample cost savings generated using Intel® Parallel Studio XE.

### Performance and Scalability: Using Optimizing Tools Makes Good Business Sense

Intel® Parallel Studio XE provides a wide range of enabling tools for developers to design applications that take fuller advantage of the performance and scalability advantages of multi-core processor architectures, as illustrated in Table 4. An under-performing application can affect a company's business in terms of lost revenues, weakened customer relations, and increased support costs. To thrive in a competitive market, software organizations need the right technology and tools to address the performance demands they face, meeting challenges associated with factors such as the following:

- **Designing complex applications** with high transaction volumes that demand fast response times
- **Scaling** to support growing business services
- **Protecting business continuity** while improving business efficiencies and productivity

The value of Intel Parallel Studio XE can be demonstrated as an overall cost savings in developer productivity, application quality and security, scalable performance, and an easier and faster ramp to modernizing code. These tools protect investments in software and hardware, and can help save on after-market support costs.

**Table 4.** Sources of cost savings from Intel® Parallel Studio XE components.
Based on benchmarks published on the Intel product Web site[5]

| PERFORMANCE TOOLS | PERFORMANCE DIVIDENDS |
|---|---|
| ▪ Intel® compilers and performance libraries, binary and source compatible with Visual Studio* C++ and GCC* (mix and match compilers)<br>▪ Parallelism solutions for all types of applications:<br>- Guided Auto Parallelism offers advice that helps build performance<br>- Intel® Parallel Building Blocks and libraries' task and data parallel models: Intel® TBB, Intel® Cilk™ Plus, Intel® IPP, and Intel® MKL<br>▪ Intel® VTune™ Amplifier XE profiler finds hot spots, and locks and waits | Time-saving, forward-scaling tools for optimizing application performance that scales as processor core count increases:<br>▪ Substantial performance boost with the Intel® C++ Compiler and Intel® Fortran Compiler<br>▪ Substantial performance increase with Intel parallel models<br>▪ Substantial performance increase with Intel® VTune™ Amplifier XE profiler |

## Intel Parallel Studio XE ROI Analysis

Intel Parallel Studio XE gives software-development organizations the ability to improve operations at all stages of the application development life cycle. ROI benefits are available across a variety of value vectors, including productivity, quality and reliability, and performance and scalability. Both Windows and Linux development organizations are realizing ROI benefits with Intel Parallel Studio XE. Here is an example of the bottom line return you may see from the Intel Parallel Studio XE for Windows. The ROI analysis is as follows:

### In this example, you can get:

**Annual Savings:** Up to USD 21,275

**First Year ROI:** Up to 1120 percent

**Payback period:** Less than a month

This analysis is based on averaged industry data, customer feedback, and published performance benchmarks and may vary from case to case. The combined savings from saved time, improved software quality, and increased performance provided by Intel Parallel Studio XE can enable software organizations to realize cost-savings benefits, based on the factors shown in Tables 5 and 6.

| ROI ANALYSIS DETAILS | INTEL® PARALLEL STUDIO XE FOR WINDOWS* | INTEL® PARALLEL STUDIO XE FOR LINUX* |
|---|---|---|
| Assuming annual developer burden costs[6] | USD 125,000 | USD 125,000 |
| Calculated developer weekly salary | USD 2,604 | USD 2,604 |
| Product price (first year includes maintenance) | USD 1,899 | USD 2,249 |
| Yearly maintenance | USD 759 | USD 899 |
| Developer time savings | 6.2 developer-weeks | 6.2 developer-weeks |
| Developer cost savings (6.2 weeks times USD 2,604 weekly salary = USD 16,275 plus USD 5,000 annual savings from catching defects early) | USD 21,275 | USD 21,275 |
| Payback period | 0.5 months | 0.5 months |
| ROI first year | 1120 percent | 946 percent |

**Table 5.** Summary provides an example of potential cost savings.

**Table 6.** Basis for calculations in the ROI analysis.

| CATEGORY | WITHOUT ANALYSIS TOOLS | WITH INTEL® PARALLEL STUDIO XE TOOLS |
|---|---|---|
| Productivity | Assuming monthly average to find and fix: 10 defects takes 15 hours = 4.5 weeks per year | **Here is what you may expect:** 10x speedup in time = .5 weeks; saves four weeks |
| Tuning | Assuming 5 percent of time spent performance tuning: 2.4 weeks per year | **Here is what you may expect:** 10x speedup = .24 weeks; saves 2.2 weeks |
| Quality | Assuming 5 defects post-release can cost 10x to 200x **more to fix:** 5 defects USD 500 times 10 = USD 5,000 | **You may expect to save** USD 5,000 by catching defects before product ships |

# Learn More: **www.intel.com/software/products**

[1] Industry data software defect count data based on:

- Watts Humphrey, "Sweet Predictability." Dr. Dobbs, February 1, 2006: **http://drdobbs.com/architecture-and-design/184415470**
- Watts Humphrey, "The Personal Software Process (PSP)." Carnegie Melon, November, 2000: **http://www.sei.cmu.edu/library/abstracts/reports/00tr022.cfm?DCSext.abstractsource=SearchResults**
- Steve McConnell, "Gauging Software Readiness With Defect Tracking." Best Practices IEEE Software Vol. 14, No. 3, May/June 1997: **http://www.stevemcconnell.com/ieeesoftware/bp09.htm**

[2] Average time developers spend performance-tuning data based on "IBM Rational PurifyPlus for Windows ROI Analysis." IBM Corporation, 2003: **ftp://ftp.software.ibm.com/software/rational/web/whitepapers/2003/tp614.pdf (PDF)**

[3] Jackson Marusarz and John Pieper, "Using Serial Tools to Parallelize Your Application." Dr. Dobb's, February 23, 2010: **http://drdobbs.com/223100392**

[4] CERT Research Annual Report, 2009, page 51: **http://www.cert.org/research/2009research-report.pdf (PDF)**

[5] Data based on specifications, customer testimonials, and case studies on the Intel® Parallel Studio XE Web site: **http://software.intel.com/en-us/articles/intel-parallel-studio-xe/**

[6] Average developer salary – Evans Data Corporation: Developer Marketing Patterns Annual Report 2010.

Disclaimer: This paper provides example calculations based on industry and customer data from case studies (CERT/Carnegie Melon, IBM, Microsoft)

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