Increase Your Organization’s Productivity With LabVIEW
**Introduction**

The pressure of achieving short time to market and the reality of cost cutting mean that today’s engineer is frequently focused on improving the productivity of the product-development process. You need to carefully choose tools that provide the best results, and discard or replace those that don’t meet your needs. You must evaluate criteria such as performance, cost, functionality, and quality, while ensuring that these tools can work within your current environment, increase productivity, and maintain scalability. At National Instruments we build products with these criteria in mind – better productivity, lower cost, integration, performance, and reduced development time.

National Instruments LabVIEW™ encompasses these criteria through its powerful graphical development environment. Since 1986, engineers and scientists have relied on LabVIEW for their testing, measurement, data acquisition, and control needs. Whether in research, design, validation, production test, or manufacturing, LabVIEW has proven to be an invaluable tool in reducing development time. Because LabVIEW offers unique advantages over traditional development environments, it is the standard for measurement and automation. LabVIEW has evolved along with PC technology, providing the ability to seamlessly upgrade your applications while taking full advantage of continuous improvements in processing speed and performance of commercial technology.

You realize several benefits by standardizing on proven development tools such as LabVIEW. You lower your risk, because many companies have successfully adopted LabVIEW for a wide variety of applications, ranging from simple to sophisticated, in virtually every industry. You have a large number of resources available at National Instruments, such as technical support and technical insight from our Web page, as well as other resources in the industry that are committed to your success. In addition, your company can readily find engineers and scientists with previous training and expertise in LabVIEW, so your projects can get done faster.

** Significant Productivity Gain**

Your choice of software is important because software is generally the central component that ties your entire system together. Choosing the right software can maximize productivity, while a software package that doesn’t fit your needs could drain time and productivity. LabVIEW can help you get more projects done in less time, by streamlining the process from inception through completion. There are several areas in LabVIEW that contribute to a significant gain in productivity when compared to other development software:

1. **Easy to Learn** – The one factor that greatly contributes to starting your application faster is the initial learning curve generally associated with any software tool. A tool can be used to its full potential only when you become proficient and understand the intricacies associated with it. LabVIEW significantly reduces the learning curve, by providing an intuitive interface and a set of tools that encapsulate functionality, while abstracting the underlying enabling technology. By browsing through the examples included, online help, and the LabVIEW Getting Started Guide, you take measurements from plug-in measurement devices and stand-alone instruments in the very first hour of usage. Just as quickly, you are able to graph, analyze, and save data. The exercises, designed to quickly teach you the principles of graphical programming,
help you become familiar with powerful LabVIEW development and debugging tools. Once you feel comfortable with the introductory material, you are ready to start your project. While you develop your application, you have numerous resources available such as online help, printed manuals, Web-based help, and tutorials. One feature that enhances your initial experience with LabVIEW is the fact that the development environment relies almost exclusively on a drag-and-drop interface, which is second nature to users of computer technology.

2. **Easy to Use** – Beginning with the release of LabVIEW in 1986, National Instruments has focused on providing an easy-to-use tool that enhances productivity for engineers and scientists just as the spreadsheet empowered the financial community. In every release, LabVIEW continuously improves based on usability research, customer feedback, and better technology. LabVIEW simplifies even the most challenging tasks, such as multi-threaded parallel execution, through the LabVIEW patented Dataflow technology. For example, you can program ActiveX through simple drag-and-drop interactions, and publish to the Web with just a few mouse clicks.

3. **Complete Functionality** – Ease of use is not the only factor that provides the best productivity. You want to be sure that the products and tools satisfy all your requirements and those of the project. You often have to make decisions on products that result in trade-offs, where ease of use and functionality are the most commonly opposed characteristics. LabVIEW satisfies both. With LabVIEW, you will easily scale to meet current and future requirements, whether you need to create a small and easy-to-use instrument control application or a solution that monitors and controls your entire factory. You can select from different development packages with varying degrees of functionality. Even if you initially select a basic LabVIEW package, you can easily upgrade to the more complete versions to increase power and flexibility. You can build a complete solution with LabVIEW, as it offers all the necessary tools and features for any measurement and automation application:

   • **Powerful Built-In Functionality** – LabVIEW development systems include a complete set of tools geared specifically for data acquisition, instrument control, and other hardware. Other tools include Web and network connectivity, visualization, storage, report generation, measurement analysis, and simulation.

   • **Add-On Software for Special Needs** – Powerful LabVIEW toolsets have been developed by National Instruments and other companies. These toolsets expand and enhance the core functionality of LabVIEW for specialized tasks.

   • **Configuration-Based Tools** – National Instruments offers tools that help you satisfy specific needs in a nonprogrammatic configuration-based environment. For example, NI DIAdem offers simple ways to transfer LabVIEW-acquired data for the purpose of interactive postacquisition analysis and report generation.

   • **Third-Party Tools** – Many companies continuously develop and sell tools that work with or use LabVIEW for industry-specific needs such as biomedical applications, telecommunications, automotive, and others.
4. **Modular Development** – When you have a large project, you break it down into functional solvable units. You can more easily manage and test these subtasks, as you reduce dependencies that might cause unexpected behavior. Once you solve these subtasks, you can put them together to complete the system. The ease with which you accomplish this division of tasks depends greatly on the underlying architecture of your software.

Breaking down a problem into smaller pieces is the main principle of LabVIEW. Fully-featured modules or subroutines make up the code in LabVIEW, and you can individually execute, edit, and test each of them. Developing your applications in such a paradigm offers several advantages:

- Reusability of code modules saves time and effort
- More clarity of system functionality with a high-level diagram rather than lines of code
- Modules that can be debugged, tested, and easily integrated into high-level systems

LabVIEW reduces the time it takes to reach a solution by giving you the necessary tools to increase productivity. From rapid prototyping to design and delivery, LabVIEW helps you gain efficiency, because it was built with the goal of helping you rapidly create measurement and automation solutions.
Solid Performance

Performance may be the most important criterion to consider when evaluating software tools. Often a company accepts software with inferior ease of use, cost, or openness if it guarantees solid performance. However, this may be a perception of performance that does not equal reality, and the trade-off often proves unwise for the organization.

LabVIEW has a significant advantage over many application development environments, because LabVIEW does not generate intermediate code or any type of script. Every VI developed in LabVIEW compiles directly into machine code that can run on several computing platforms. A VI (originally for virtual instrument) is the name for a program developed in LabVIEW; a VI consists of a file containing a front panel (user interface) and a diagram (code). LabVIEW automatically takes advantage of multithreaded operating systems to deliver parallel execution.

You can deploy LabVIEW anywhere, even in such demanding applications as manufacturing test and control, as well as enterprise-wide network solutions. For example, at Knowles Electronics, implementing a LabVIEW-based test system resulted in a 5 to 1 reduction in test time at their high volume manufacturing facility for microphones and receivers. (NI Customer Solution, Knowles Increases Production with NI PC-based DSA.)

Lexmark, using a National Instruments high-speed digitizer device and LabVIEW, increased the quality of their products and production yields, and maintained test performance with minimal development expenses. (NI Customer Solution, Lexmark-When Speed and Accuracy Matter.)

With LabVIEW, you can generally distribute your applications as stand-alone executables free of charge and even build your own installers. This is important for solutions that need to be deployed to a large number of systems.

Considerations When Selecting Software Tools

You are ultimately responsible for making the right choice that will satisfy your needs and those of the organization in the short term as well as the long term. Long-term vision is important not only for cost purposes, but also for scalability and adaptation to future needs. There are several factors to consider when evaluating for long-term viability:

1. **Can the software scale to different platforms?** – The majority of computer systems use some variation of the Microsoft Windows operating system. Nevertheless, there are other options that offer clear advantages for certain types of applications. Real-time and embedded development continues to grow rapidly in most industries, as computing power is packaged into smaller and more specialized form factors. Minimizing your losses resulting from transitioning onto new platforms and choosing the right software for this purpose is a key factor.
LabVIEW minimizes this concern, because it runs on Windows XP, 98, 95, Me, 2000, NT, and NT embedded, as well as Mac OS, Sun Solaris, and Linux. LabVIEW also compiles code to run on the VenturCom ETS real-time operating system through the LabVIEW Real-Time Module. At National Instruments we understand that legacy support is important, and therefore continue to make available older versions for Windows, Mac OS, and Solaris operating systems. LabVIEW is platform-independent; programs that you write in one platform can transparently port to any other LabVIEW platform simply by opening the VI.

2. **Can people with varying degrees of software expertise use it?** – The software you use should be versatile enough so that different types of users, with varying levels of knowledge can use it. You don’t want your tools to be limiting or complicated, to the point that only the original programmer can modify the application. This person might be transferred off the project, and you want the application to be easily maintained by others.

LabVIEW can be used by a wide range of users with varying levels of expertise. Users range literally from NASA rocket scientists to university undergrads to kindergartners programming LEGO-based robots with LabVIEW-based ROBOlab. Software expertise in other languages or previous experience is a minor factor when working with LabVIEW. People with little or no experience programming, as well as experts in object-oriented programming, find that LabVIEW covers their design and productivity needs. A useful comparison is Microsoft Excel, where both beginner and experienced users find the tool very useful and scalable. In a similar fashion, users uncover increasing functionality as their proficiency in LabVIEW increases. As mentioned above, LabVIEW is easy to learn, but as you become more proficient, the problems you can solve grow along with your experience.

3. **Does it adapt to new technology?** – To ensure the best investment of your resources, you try to minimize your company’s experimentation with new technologies, doing so only when absolutely necessary. However, when you discover breakthroughs and significant innovations that significantly improve performance, lower costs, and offer your company a competitive advantage, you need to adapt. Software that is ahead of the technology curve integrates these technological innovations with minimum time and effort. This is the best way to incorporate new technology into your products and processes.

LabVIEW consistently embraces new computing platforms; communication buses; technologies such as multi-threading and ActiveX; and most recently the Internet, networking, XML, wireless, and distributed applications. LabVIEW selectively incorporates such technologies and makes it simple for you to take advantage of them, effectively minimizing your learning curve and helping you keep pace with rapid technology changes.

4. **Is it open to other software and hardware? Does it conform to open standards?** – Standardization of software relies greatly on the ability of the package you select to work well with other software, measurement and control hardware, and open standards, which define interoperability between multiple vendors. By selecting software that meets these criteria, you ensure that your company and applications take advantage of the products offered by several suppliers. In addition, adopting open commercial standards reduces overall system cost.
A large number of third-party hardware and software vendors develop and maintain hundreds of LabVIEW libraries and instrument drivers to help you easily make use of their products with LabVIEW. However, this is not the only way to provide connectivity to your LabVIEW-based applications. LabVIEW offers simple ways to incorporate ActiveX software, dynamic-link libraries (DLLs), and shared libraries from other tools. In addition, your LabVIEW code itself can be shared as a DLL, shared library, or via ActiveX.

With LabVIEW, you can easily integrate hardware, such as stand-alone instruments, data acquisition devices, motion control and vision products, GPIB/IEEE 488 and serial/RS-232 devices, and PLCs, to build a complete measurement and automation solution. LabVIEW also incorporates major instrumentation standards such as VISA, an interoperable standard for GPIB, serial, and VXI instrumentation; PXI and software and hardware based on the PXI Specification managed by the PXI Systems Alliance; IVI interchangeable virtual instrument drivers; and VXIplug&play, a driver standard for VXI instruments.

LabVIEW also maintains a full range of options for communications and data standards, such as TCP/IP, OPC, SQL database connectivity, and XML data formats.

The success of customers best illustrates the long-term value and flexibility of LabVIEW. An engineer at ORTHSTAR, a systems integrator for factory automation, process control, and other industries since 1974, made the following comments:

“[W]e like using LabVIEW because we can develop a customized system to meet each customer’s unique requirements. Also, the flexibility of LabVIEW ensures that we can scale the system to increase its capabilities as the customer needs increase or as changes need to be applied.”

ORTHSTAR delivered a production line system for Toshiba Display Devices where Toshiba specified LabVIEW, no downtime after installation, continuous operation 24 hours a day, and flawless execution the first time out. This system had to interface with hundreds of individual pieces of manufacturing and test equipment to provide just-in-time delivery from the line. ORTHSTAR estimates that had they written this application using C/C++, the length of development time would have been too great to meet Toshiba’s target date. However, they completed the project within 16 weeks using LabVIEW – and were so successful that as of the beginning of 2001, they now control 10 of 15 lines in the same facility using LabVIEW.

**Industry-Standard Software**

As mentioned previously, you lower your risk when you use software that is considered an industry standard. In the case of LabVIEW, many companies have successfully used it for a large number of applications. The preference of engineers across the globe speaks for itself. In 2001, National Instruments sold products to more than 24,000 different companies in more than 60 countries around the world.

Market research shows the widespread adoption of LabVIEW for data acquisition and control applications. The following charts, based on data obtained from Cahners Research, illustrate that many engineers and scientists prefer LabVIEW over other software environments for particular application needs.
Figure 1 shows the awareness and preference of National Instruments software for data acquisition over other software available in the industry.

![Data Acquisition Software](image1.png)

**Figure 1.** Data Acquisition Software

Figure 2 shows that, among customers using PC-based software for instrument control, the majority are aware of and prefer National Instruments software above that of other companies in the industry.

![Instrument Control Software, PC Based](image2.png)

**Figure 2.** Instrument Control Software, PC Based
Figure 3 shows a sampling of test and measurement engineers who use data acquisition products, and shows a clear preference for using National Instruments products.

![Figure 3. Data Acquisition Products](image)

Figure 4 shows that LabVIEW ranks highest in usage among the most commonly used software for data acquisition and instrument control.

![Figure 4. Software Used for Data Acquisition and Instrument Control](image)

“LabVIEW is a programming language, equivalent to C++, Visual Basic, or any other language. It is the ONLY widely accepted graphical programming language. Graphical programming is a language of the future and carries with it many important programming concepts. I feel, it is the responsibility of universities (such as Penn State) to expose, at least, every Computer Science and Engineering student to these new concepts.” – Scott Deno, Associate Director, Center for Electronic Design, Communications, and Computing, Penn State University

**Quality and Integration**

As you evolve your applications to cover all phases, from design, to research, development, manufacturing, and finally production, you realize that quality and integration play a very important role. National Instruments produces industry-leading hardware and software with a high level of integration for a broad range of applications. In order to achieve this integration, quality is paramount. National Instruments achieves this quality through the expertise of software engineers, digital and analog hardware engineers, chip designers, measurement and signal processing experts, and many more people who work closely with each other to ensure this level of integration.
Using standard measurement services architecture, LabVIEW integrates tightly with a complete array of National Instruments hardware. This layer of services includes data acquisition, instruments, motion control, vision, GPIB, FieldPoint distributed I/O, PXI systems, and VXI systems. This architecture makes it possible to abstract the particulars of the diverse instrumentation and I/O and to present a uniform interface in LabVIEW to help you quickly build your custom application. National Instruments completes the platform with the powerful TestStand test management software, as well LabWindows/CVI for C and Measurement Studio tools for Microsoft Visual Basic and Visual Studio .NET. With all this in mind, you see how easily you can integrate LabVIEW with existing systems, eliminating the need to modify your equipment, while extending its usefulness with state-of-the-art software tools.

For further information on National Instruments and our Measurement and Automation Software Framework, go to [ni.com/revolution](http://ni.com/revolution)

A good example of integration is portrayed in a customer solution from Motorola called “Using TestStand for Testing Cellular Base Solution.” Here, the challenge was to “[develop] a single test software application capable of testing a wide variety of Motorola cellular base station products.” The goal of this project was to “[maximize reuse while minimizing duplicated effort]” and “dramatically reduce future time-to-test.” They decided to use LabVIEW as the development environment, because “[the] LabVIEW graphical programming language is perfect for test automation. It is simple to code and offers numerous functions for maximum productivity.” In this solution they mention that “creating a common test application resulted in a large cost reduction” and that “[their] combined annual maintenance costs were reduced from $700,000 to $400,000. [Their] annual projected new product test development costs fell from roughly $200,000 to $25,000.” (NI Customer Solution, Using TestStand for Testing Cellular Base Solution.)
LabVIEW has maintained the position of leader in its field since 1986. This feat can be achieved only by an absolute commitment to quality.

Global Service and Support

LabVIEW offers a large number of options for technical support in addition to the standard options that National Instruments makes available for you. There is a large community of LabVIEW users willing to share their knowledge through books and user groups, as well as system integrators and consultants, university professors, and the Web.

National Instruments Service and Support

National Instruments offers you comprehensive service and worldwide support for LabVIEW and all other products:

- Free training seminars at locations in your area or on site
- Direct local offices with expert field engineers who can help verify your system configuration and design, significantly reducing the possibility of unexpected problems
- Phone, e-mail, and fax communication directly with qualified applications engineers with bachelor, masters, and PhD degrees in science and engineering
- Consulting and start-up assistance
- Customer education classes available at more than 300 locations worldwide
- Maintenance and platinum-class service and support options to automatically deliver upgrades and provide prioritized service for your needs

National Instruments also offers online Web service with:

- NI Developer Zone, which contains hundreds of tutorials, tips, and techniques from National Instruments engineers and expert customers
- NI Developer Exchange, where you can ask your question and receive answers from LabVIEW experts worldwide, or browse and search for past questions and answers
- NI KnowledgeBase, where you can search thousands of entries of common questions, view current product issues, and keep up to date on top support issues and their solutions
- NI Business Center, where you can check order status, status on returned materials, and repair
- NI Catalog, where you can browse all product datasheets, obtain pricing information worldwide, and order online
- NI Support Web site, which provides direct online access to applications engineers and helps guide your questions to an answer as fast as possible but with the highest level of quality

In addition, if you need additional training, system integration services, or have other service and support needs regarding National Instruments products, you can refer to more than 600 Alliance Program partners worldwide with expertise in specific industries or applications.
For a technical journal on LabVIEW development news, tips, and techniques, subscribe to the LabVIEW Technical Resource, published quarterly by LTR Publications. For books including LabVIEW Graphical Programming, Internet Applications with LabVIEW, LabVIEW Signal Processing, and other LabVIEW-related reference material, order online at amazon.com or check with your local bookstore.

You can also stay up to date and find expert contacts in your community by attending local user group meetings, held regularly in hundreds of locations worldwide. In addition, you can subscribe to the online community through NI Developer Zone, and independent newsgroups and e-mail lists including info-labview@pica.army.mil and comp.lang.labview

Take Advantage of LabVIEW

“Using LabVIEW, we lowered the bottom-line development costs leading to a groundbreaking cordless phone line.” – Stephen Swain, Siemens Communications Devices.

A large number of companies has already standardized on LabVIEW software for developing test, measurement, control, and automation applications. The clear benefits you gain in productivity, performance, and integration combined with its high quality and flexible development environment, make LabVIEW the industry standard graphical development environment for PC-based Measurement and Automation.

Because engineers and managers today face multiple challenges and shorter development cycles, increased project loads, often in the midst of reduced budgets, they must find software that can handle those needs. With the benefits of LabVIEW and the comprehensive global service and support available from National Instruments, you can meet the challenges of today while preparing for tomorrow. By taking advantage of LabVIEW, you can start your projects faster, build your applications faster, and finish first.