



# Selecting the wearable that will deliver maximum value in your enterprise environment



## EXECUTIVE SUMMARY

The use of wearable computers continues to rise in enterprise applications, as the technology has evolved from an interesting concept to a deployable application with tangible business benefits. In fact, according to Venture Data Corporation (VDC), wearable computers represent the fastest growing segment in the small rugged computing market, outperforming the rugged PDA and handheld market with a 36 percent increase from 2006 to 2007 —more than double the growth in the PDA/handheld sector (16%).

Companies — including global retailers, pharmaceutical and grocery distributors, and parcel handling giants — realize that hands-free computing can empower workers to achieve new levels of efficiency, productivity, and accuracy in package handling and warehouse applications.

However, choosing the right wearable solution can be a challenge. This paper helps demystify the process by examining key criteria for evaluating wearable computers and exploring the ways enterprise organizations can ensure they reap maximum benefit from their investment.

## Introduction

Confronted with the rising cost of doing business, ever increasing competitive pressures, and new regulatory challenges, today's enterprise organizations seek new ways to gain a competitive edge. Companies face constant pressure to streamline operations, increase productivity, and reduce labor costs. Fortunately, recent advancements in wearable computing technology help enable them to do just that.

In applications that demand the constant use of hands, wearable systems give workers the hands-free convenience to handle more tasks, while keeping the technology needed to further improve productivity and accuracy right at their fingertips — including bar code scanning and mobile computing. The advantage of freedom of movement is clear. Without having to constantly juggle a handheld computer, workers' hands are always free and ready to pick the next item or package — resulting in fewer disruptions to workflow. Companies involved in transaction-intensive applications like picking, cross-docking, receiving, and replenishment can achieve real improvements in daily productivity.

Companies considering wearable systems should understand how to evaluate the performance and overall effectiveness of this technology. Key factors to consider when selecting a wearable computing solution are usability and ergonomics, as both product functionality and design will significantly impact the overall results in your enterprise.

With technological advancements, there's no reason to sacrifice computing power or functionality, despite the smaller form factor. An ideal wearable solution should provide the flexibility to meet the needs of a wide range of applications, yet provide the durability required for demanding enterprise environments.

And in wearable systems, perhaps more than in any other type of handheld enterprise device, ergonomic design is key. User comfort is an absolute imperative when it comes to wearable solutions. Wearable products must be optimized for maximum comfort every minute of every shift — so as not to compromise employee productivity, satisfaction, or safety. An optimal solution should incorporate user comfort throughout the entire design and include crucial details to minimize worker fatigue.

## Usability: the right tool for the job

### Maximum application flexibility

The flexibility to meet multiple application needs with a single device maximizes a company's technology investment by eliminating the need to purchase, deploy, support and manage multiple devices for various applications. A solution that supports a combination of voice-directed and text-based picking gives companies the ability to automate warehouse functions, as well as effectively handle a wide variety of conditions without disrupting workflow. Voice-directed picking increases picking speed in some applications, as workers hear a simple command for each transaction in the work assignment. Should workers encounter an exception, a short, text entry and a visual display give them a direct interface with their company's Warehouse Management System (WMS) or other business system — enabling on-the-spot handle of exceptions.

### Standardized platform architecture

When evaluating wearable computers, it's important to consider this investment within the larger picture of your company's overall mobility solution. Mobile computing devices are in use throughout the enterprise, from sales associates and delivery personnel, to field service technicians, warehouse workers, and key executives. A standardized platform across all your mobile devices can bring significant cost savings by enabling applications to be easily ported between devices. Benefits include the ability to maximize application investments, a familiar software interface that can reduce training requirements, and fewer operating systems to support for simplified integration and management.

### Powerful computing platform

With technological advancements, there's no reason to sacrifice computing power for the freedom of a hands-free solution. You should ensure that the wearable computer offers the processing power, memory, and development environment needed to support complex enterprise applications that can streamline operations.

In addition, a wearable computer should offer integrated 802.11a/b/g WLAN connectivity for real-time connection to your business systems. With a real-time wireless connection, cross-checks can be

executed to ensure the accuracy of every step in your warehouse processes, and immediate feedback can prevent a wrong item from being picked or a package from being placed on the wrong truck or staging area on the loading dock. In addition, WLAN connectivity gives your company real-time visibility into warehouse or dock functions, including inventory stocking levels and shipping status.

### **Durability**

Wearable computers are deployed in challenging environments, often exposed to bumps and drops, dust, wide temperature swings, and moisture. In order to ensure the ability to hold up to intensive use day in and day out, wearable computing devices need to:

- Support thousands of daily bar code scans in a typical warehouse environment
- Withstand damage that occurs when the unit is dropped on a concrete floor
- Mitigate the effect of moisture caused by condensation when the wearable computer is taken in and out of coolers and refrigerated areas
- Be able to handle the large amount of surface abrasion caused by daily contact with cardboard and other warehouse materials.

A rugged design, modular construction, and strong support plan are essential to minimizing overall maintenance costs. A rugged design can dramatically reduce breakage and the associated cost of repairs and employee downtime, while a modular construction allows users to replace or exchange individual components in the field, without taking the unit out of service. And a strong support plan should be structured to provide maximum protection against costly employee downtime, should the device malfunction and require repair.

### **Ease of management**

Managing mobile devices can be a time-consuming task with many hidden costs. Devices typically have to be sent to IT for troubleshooting or upgrading, resulting in down time and loss of productivity. Furthermore, IT departments can be overwhelmed with the difficult tasks of managing and tracking units scattered across multiple locations. Look for a system that offers a remote management solution that will reduce the time typically required to manage remote devices — and enable your IT department to focus on more strategic business initiatives.

## **Ergonomic design considerations**

### **Maximum comfort throughout an entire shift**

Comfort is a prime factor in determining user acceptance rates of wearable computers. Devices must be comfortable to wear for extended periods of time and not impede movement or the ability to perform tasks, or cause discomfort. According to the Wearable Group at Carnegie Mellon, it is critical that wearable computers blend seamlessly with the existing work environment, providing as little distraction as possible.

To achieve maximum comfort, wearable computer manufacturers should consult heavily with Human Factors experts throughout the entire design process. The solution should be designed to accommodate a wide range of user sizes with an optimized weight distribution. The device should not slide — once the device is situated and secured on the body, it should not move. The device should be just as easy to slip on as it is to take off, ensuring fast and easy removal for lunch and coffee breaks. And finally, the design should ensure comfort in all areas touched by the wearable, such as the arm, hand, and fingers.

### **Designed to facilitate easy sharing among workers**

Design elements should consider that devices might be shared across the enterprise, for example, for different shifts or rotating work assignments. Therefore, a single device must be able to support right- or left-handed use, as well as a wide range of arm and hand sizes. Users should be able to switch hands within seconds.

### **Hygiene considerations**

For improved hygiene, parts with prolonged skin contact, such as an arm pad, should be independent, removable, and machine-washable components. In this way, while employees may share computer terminals, they retain a personal pad or strap for improved cleanliness and safety.

### **Intelligent keypad design**

Keypad ergonomics are a critical part of the overall design. Keys should be selectively placed based on use. The most frequently used keys should be easy to strike— larger than other keys and in an easily accessible location. Typing mistakes can impact productivity and frustrate users, so the key-to-

key spacing needs to accommodate a wide range of finger sizes, with or without gloves, to enable accurate text entry. And last, keys should provide good tactile feedback, so users immediately know that a key has been actuated properly and the action recognizable by the application.

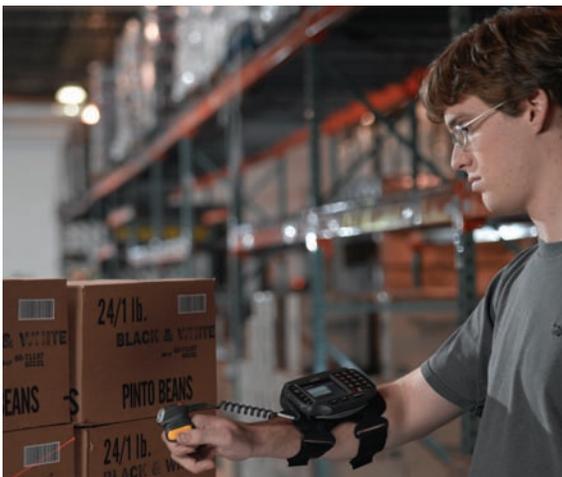
### Easy viewing to minimize eyestrain

The visual interface needs to be optimized for at-a-glance viewing in a wide range of lighting conditions — from bright sunlight on a loading dock to a pitch black storage room. Backlit keys are also necessary to allow full usage in the dark. In addition, users should be able to adjust the display angle based on personal viewing ergonomics and comfort.

## Introducing the next generation in wearable enterprise computers — Motorola's WT4000 Wearable System

Motorola's WT4000 Wearable System meets all of the criteria in this paper exceptionally well, introducing new advancements in ergonomics, performance, and reliability in wearable mobile computing solutions. The complete system consists of:

- The WT4000 Series Wearable Terminal providing high-performance computing power, reliable



WT4000 Series Wearable System helps increase warehouse worker productivity with unparalleled freedom of movement and user comfort with the functionality to streamline processes and reduce workflow disruptions.

802.11a/b/g WLAN connectivity, and a lightweight ergonomic design that can be worn comfortably on the hip or wrist. The terminal offers a shifted keyboard for easy text entry and a bright 2.8" QVGA screen for at-a-glance readability in nearly any lighting condition.

- Flexible scanning options with the lightweight RS409 ring scanner and back-of-the-hand RS309 scanner. Enhanced scan engines provide superior scan performance, enabling first-time reading of even damaged or poorly printed bar codes.

### Next-generation usability features of the WT4000 Wearable System

The WT4000 Wearable system leverages the knowledge and insight gained from Motorola's unique and extensive industry experience — 30 years as a market leader in bar code scanning and more than 12 years developing wearable mobile computing solutions. This next-generation system offers the features and functionality needed to ensure maximum usability and value in the enterprise, as well as maximum all day every day comfort for users.

### Full voice and data application flexibility

The WT4000 Wearable System delivers maximum application flexibility, offering voice-only, text-only and combination voice- and text-based applications. This robust functionality enables enterprises to provide a single device for voice-picking as well as text based applications, and combination



The WT4000 is designed with two identical ports on either side of the product. Each port can be used for either data (scanning) or voice (headset and microphone). This construction allows users to connect peripherals based on mounting preference — left or right arm or belt-mounted.

applications can provide the ‘best-of-both-worlds,’ allowing companies to direct workers via voice while still enabling text-based input to manage exceptions, capture information for regulatory compliance and more.

Identical ports on either side of the device add to flexibility — each port is capable of providing support for either data (bar code scanning) or voice (headset with microphone).

And in the event the battery is rapidly released during use, the built-in super-capacitor allows a proper operating system shut down. In addition, the back-up battery ensures that data isn’t lost during battery changes.

### **High-performance computing power to support enterprise applications**

The WT4000 features a high-performance computing platform that easily supports complex and demanding enterprise applications — with Intel’s XScale PXA270 @ 520 MHz processor, 64MB or 128 MB Flash, 128MB SDRAM, and Windows CE 5.0 Professional Version operating system.

### **A powerful platform architecture**

Motorola brings a “platforming” approach to one of the broadest vertical product portfolios of bar code scanners and mobile computers in the industry — from wearable computers to forklift-mounted devices, retail front room scanners, and enterprise-class mobile computers. A shared hardware and software architecture enables:

- Easy porting of applications between devices, effectively reducing the need and cost for application development.
- Translation of common applications into a common user interface, reducing training needs and related costs.
- Translating fewer operating systems to support a simpler mobility architecture that is easier to deploy and manage, reducing the demands on an already over-tasked IT staff.

### **Real-time wireless networking**

The WT4000 Wearable System offers 802.11a/b/g wireless LAN connectivity, providing a real-time connection to your business systems. This connectivity enables real-time processing that:

- Reduces errors by providing an instant cross-check as items are picked
- Improves customer service through the reduction in errors in orders
- Provides real-time inventory information, since inventory can be reduced with the picking of every product

A real-time window into your operations also provides the information you need to make decisions that can positively impact profitability and service quality. For example, real-time inventory visibility could enable a reduction in stocking inventory levels, which can lead to more stock turns and a major reduction in capital expense. Or you might opt to provide a window into your data to allow sales personnel or even your customers to check the status of an order in real-time.

### **Management simplicity**

One of the most time consuming and costly aspects of any mobility solution is post-deployment — the day-to-day support and updating of devices, which can be located anywhere in your enterprise, and for larger organizations, in any of your enterprise locations throughout the world. But Motorola’s Mobility Services Platform (MSP) can provide your IT staff with the power to remotely manage your mobile devices, including the WT4000, from a central location. MSP enables your IT staff to remotely provision, upgrade, support, track and monitor all your mobile devices, regardless of where in the world they may be located. The result is a dramatic reduction in the time and costs typically associated with management of mobility solutions.

### **Durable construction**

Critical to the enterprise environment, the WT4000 Series Wearable System is built to endure rigorous use in demanding industrial environments: warehouses, logistics depots, distribution centers, and manufacturing sites. Its IP-54 sealing protects the device in damp, dusty conditions, and a speaker grill helps prevent dirt collection which can lead to reduced speaker performance. Motorola performs one of the industry’s most stringent impact tests to ensure the WT4000 will keep working even when dropped to concrete. Unlike typical competitive tests, Motorola’s drop tests are performed across the entire operating temperature range. And Motorola is the only manufacturer to subject devices



The WT4000 Series Wearable System has been designed to endure the rigors of every day use, including bumps, drops and scrapes against a wide variety of surfaces to minimize wear in harsh environments.



A low profile minimizes interference while in use and reduces the possibility of damage.

to a second impact test, the tumble test, where devices are placed in a rotating drum, similar to an industrial clothes dryer. The WT4000 delivers reliable operation even when subjected to 1,000 one-half meter tumbles.

Since workers now enjoy the freedom to constantly handle packages, cartons and more, the WT4000 Wearable System is subjected to constant rubs and bumps against cardboard and other surfaces. The WT4000 System is designed to minimize wear and tear from this constant abrasion:

- A rounded form at each corner helps deflect wear against cardboard.
- The keypad and display are surrounded by strategically placed high points, or walls, to protect against wear and tear and accidental drops.
- Keypad graphics are protected from wear, ensuring legibility in spite of constant abrasion and use.
- The thoughtful selection of materials improves durability while offering improved user comfort. For example, metal is used in areas prone to extensive wear and tear and abrasion, while lighter materials in other areas help minimize weight on the user's arm.

- The scanning and headset port connectors on either side of the device are recessed, eliminating a common point of vulnerability.

Rugged design combines with modular construction, which allows users to replace or exchange individual components in the field without taking the unit out of service, delivering superior uptime. For example, the field-replaceable trigger assembly on the RS409 ring scanner allows the device to be rejuvenated in minutes should the trigger assembly malfunction, minimizing user and device downtime.

### Next-generation ergonomic design of the WT4000 Wearable System

As a pioneer in wearable computing, Motorola has brought significant ergonomic advancements to this next generation design. These advancements leverage the company's more than decade-long experience in wearable computing, as well as the expertise of internal and outside Human Factors experts. Shape design and selection of materials have all been optimized for maximum user comfort over extended periods of time to ensure the comfort and safety of users every minute of the workday.

### User selectable mounting options

While the typical worker in your environment may prefer the convenience of on-the-arm accessibility, you may have other workers who are simply not

comfortable wearing the lightweight device on the forearm. The WT4000 Series Wearable System is a modular solution that can be worn on the arm or the belt/hip, providing a cost-effective, single flexible solution that can easily meet the different user preferences to ensure your ability to deliver on-the-job comfort.

### Easy on and off

When worn on the arm, the WT4000 Series offers a low profile to minimize any interference and distraction to the user. The terminal's holder is designed to mount on the arm independently of the terminal itself, enabling the terminal to be removed and mounted quickly should the user want to remove the device for a lunch or coffee break. But easy mounting and dismounting doesn't increase the risk of the device accidentally dislodging. A sophisticated cleat mechanism keeps the terminal mounted securely, and the release paddle design ensures the terminal can be easily released by the user's thumb—but not accidentally disengaged with incidental contact. In addition, tactile and audible feedback tells the user that the device has been properly inserted and is securely locked in position.

### Designed for a wide range of users

The WT4000 Series has been designed to provide comfort for right- and left-handed users with a wide range of arm, hand and finger sizes. The entire system can switch between right- and left-handed use in seconds, and variable length wrist straps are available to accommodate any size hand. The two identical ports on either side of the WT4000 terminal enables instant connection of scanning peripherals

and headsets regardless of arm preference. And the RS409 ring scanner features a turret mechanism that allows the trigger to easily rotate from side to side to accommodate left- or right-handed use.

### Improved user hygiene

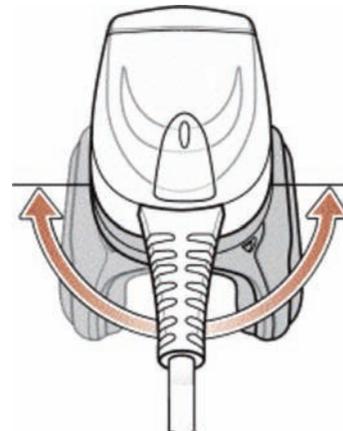
Wearable computers and scanners are often shared among a company's employees. With this in mind, those elements that are in constant contact with the user's body—for example, the WT4000's arm pad and the RS409 ring scanner's finger strap—are designed as removable independent components. You can easily provide workers with their own personal arm pads or ring straps, providing improved hygiene even when devices are shared between shift workers. The pad and straps are also washable and can be easily replaced as needed.

### Keypad design

The WT4000 Series' keypad has been optimized for ease of use and accuracy with features that help reduce keying errors. The key-to-key spacing accommodates a wide range of finger sizes, with or without gloves. An optimal combination of high key travel and low actuation force provides good tactile feedback even when users are wearing gloves. Common keys also feature a bottom ledge to provide a better grip for fingers. "Action" keys for quick execution of functions are placed below the display and are larger than other keys for easy access as well as visual and tactile identification. Since these keys will likely be used much more than others, the internal construction is designed to allow these keys to be replaced independently, without requiring replacement of the entire keypad. A keypad



The entire system is designed to easily adjust for right or left mounting.



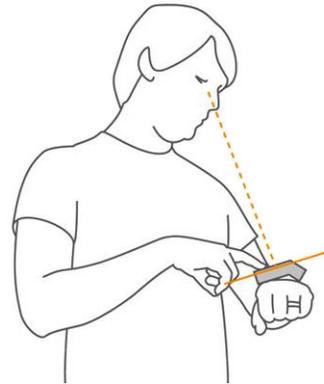
The ring scanner's turret mechanism provides quick and easy adjustment for left- and right-handed users.



Instead of a shared element, the arm pad is designed as an affordable personal component for improved hygiene.



Key-to-key spacing has been optimized to provide quick actuation of keys and minimize error rates.



The WT4000 Series gives users flexibility to position the terminal based on their own viewing ergonomics and comfort.

backlight keeps the keys visible, even in complete darkness. And all keys are software 'mappable' to enable the development of easy-to-use applications.

### Display design

An easy-to-see visual interface can help enable rapid and more precise goods processing for improved warehouse and depot accuracy. The WT4000 features a bright 2.8" QVGA screen that provides at-a-glance readability in nearly any lighting condition — from bright sunlight to dimly lit areas of the warehouse. The bright high-contrast graphical color display also allows the adjustment of font size, type, boldness, color and value to ensure easy reading of text. In addition, users can easily adjust the position of the terminal on the arm to best fit personal viewing and comfort preferences.

## Summary

Wearable technology can enable the enterprise to achieve new levels of employee productivity and operational efficiencies critical to success in today's economy. To realize the full potential of wearable

computing, companies need to consider ergonomics, performance, reliability, flexibility, and manageability of the overall solution.

The WT4000 Series Wearable System represents the latest in hands-free wearable solutions, offering the best of Motorola's real-world experience, gained over decades, factored into every aspect of the system. Its innovative design, maximum application flexibility, and durable construction provide a robust computing platform that can meet the enterprise needs today and tomorrow. The rugged design and built-in manageability combine with comprehensive support services to deliver an outstanding total cost of ownership. With these features, you can spur major productivity gains and quickly realize benefits, providing a rapid return on this valuable investment.

For more information on how you can improve the productivity and accuracy of your supply chain operations with wearable computing technology, please visit us on the Web at [www.motorola.com/wt4000](http://www.motorola.com/wt4000) or access our global contact directory at [www.motorola.com/enterprisemobility/contactus](http://www.motorola.com/enterprisemobility/contactus)



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