Healthy Computing

Microsoft Hardware's Guide to Ergonomics at Work

Microsoft®

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Ergonomics 101: What is it?

As a word, ergonomics may not roll easily off the tongue, but it does affect nearly everyone, every day. Ergonomics is the applied science of design—especially in the workplace—intended to make products more comfortable and user friendly, particularly during extended use.

Ergonomics first emerged as a discipline during World War II to improve the design of sophisticated military systems. Since then, the science has expanded and is now used in a variety of industries. For example, ergonomics is now used in the design of the followng:

• Industrial workplaces
• Transportation systems
• Aerospace systems
• Office spaces
• Computer hardware and software
• Consumer products

Today, ergonomics, scientists trained in this field, design and test everything from industry assembly lines to sports equipment, from chairs to computer peripherals. It is their job to make sure that people are safe, comfortable, and productive while at work, home, or play.

Did you know?

• Polish professor Wojciech Jastrzebowski coined the word "ergonomics" in 1857 in a philosophical narrative "based upon the truths drawn from the Science of Nature."

• The word is derived from the Greek "ergon" (work) and "nomos" (laws).

Ergonomics and You

How you sit, type, swipe, point, and click—and the products you use to do these things—can affect your daily performance and long-term health.

In fact, the Occupational Safety and Health Administration (OSHA), an arm of the U.S. government, believes ergonomics to be so important to health that last year it formed a national advisory committee dedicated to reducing the number of ergonomic-related injuries and illnesses in the workplace.[1]

Think about the tools you use most every day, whether it's a mouse, chair, cash register, keyboard, or hand truck. Tools should do the following:

• Be easy to set-up and use
• Evolve with you and match your skill level whether you're a new user or an expert
• Be designed for the location in which you use them, whether working in the office, relaxing at home, or traveling on a plane

For your optimal health and comfort, products should be designed according to how your body naturally functions.

Enter the ergonomist. These scientists know risk factors for occupational injuries, such as repetitive strain injury (RSI), and understand ways to reduce the likelihood for developing these injuries. Ergonomists take these factors into account, working to create products that will be fundamentally comfortable by design.

By becoming more aware of the ergonomics of the products around you and the way you use them, it is possible to become more comfortable—and therefore more productive—at work or play.

[1] *"OSHA Announces Formation of National and Advisory Committee on Ergonomics," OSHA Trade News Release, April 30, 2002*

er·go·nom·ics

1. The applied science of equipment design, as for the workplace, intended to maximize productivity by reducing operator fatigue and discomfort.

2. Design factors, as for the workplace, intended to maximize productivity by minimizing operator fatigue and discomfort.

Related terms: er'go·nom'ic or er'go·no·met'ric (-n⁹-mᵉ t'rʲk) *adj*. er'go·nom'i·cal·ly *adv*. er·gon'o·mist (ûr-g⁹n'⁹-mʲst) *n*.[2]

[2] *The American Heritage Dictionary of the English Language, Fourth Edition. Copyright © 2000 by Houghton Mifflin Co.*

Putting Ergonomics to Work

Ergonomics isn't just a practice for doctors, scientists, and physical therapists to follow. In fact, corporations as varied as AT&T Wireless, the Boeing Company, General Motors Corp., Johnsonville Sausage, Microsoft Corp., and the U.S. Postal Service all employ licensed ergonomists. Many companies have led their industries in helping people be more comfortable at work and therefore more productive, regardless of whether their workplace is a supermarket, factory or office building.

It is no surprise that these companies place such an importance on ergonomics. The applied science of equipment design has been found to directly affect a company's bottom line. Researchers have found that individual performance increased 25 percent when employees used an ergonomically designed workstation.[3] From helping to ensure a safe and productive workplace to making products that are comfortable to use, ergonomics offers important benefits for many leading companies.

[3] *Ergonomics, Work, and Health, Stephen Pheasant, 1991, Macmillan Publishing*
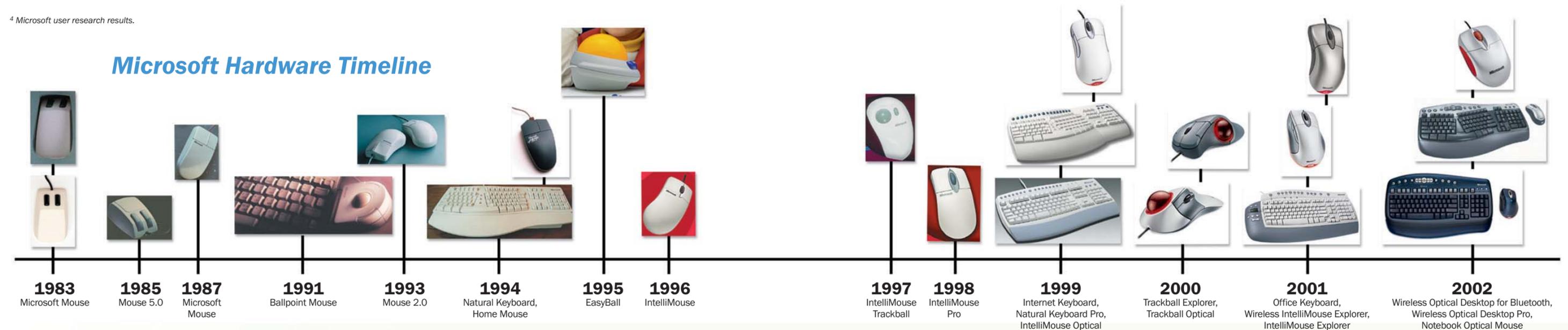
Ergonomics at Microsoft

You may not think of hardware or the study of ergonomics when you think of Microsoft. But you should. In fact, while it is known primarily for software innovations, Microsoft leads the input device industry in the design and production of ergonomic keyboards, mice, and trackballs, with more than 200 patents and numerous industry awards.

Why does a company such as Microsoft focus so closely on the ergonomics of it's hardware products? Research has shown that a majority of computer users have their hands on a mouse or keyboard for a large part of the day; a recent survey showed these were the objects people used most often, second only to a pillow.[4]

Starting with a gray, box-shaped mouse, Microsoft Hardware has evolved into a maker of a full line of mice, keyboards, and wireless desktops, with the goal of creating a computing experience that is beneficial for the user. Every single Microsoft® mouse or keyboard sitting on a retail shelf has met the company's rigorous testing requirements for unparalleled comfort and performance. For example, the keys on Microsoft keyboard designs are pressed 10 million times by machinery, helping to ensure a durable and high-quality product.

[4] *Microsoft user research results.*

Microsoft is one of the few desktop peripherals manufacturers with staff ergonomists, who have pioneered the design of comfortable and user friendly products. The Hardware Group has won many design and technology awards, ranging from Best Input Device from both PC World and PC Magazine, to the prestigious Business Week IDEA Awards. Microsoft ergonomists also are members of ergonomic associations and consortiums worldwide, including the Office Ergonomics Research Committee, which funds research into how ergonomics improves health in the workplace.

We'll provide more information on five groundbreaking products from Microsoft Hardware. Each represents hundreds of hours of research, design work, and ergonomic and usability testing, and reflects major advancements in the hardware category.

Volunteer users from around the world have pointed, clicked, and typed their way into Microsoft designs, as natural hand positioning, button actuation, and common keystrokes and functions are monitored to help determine the best user experiences. The evolution of Microsoft Hardware's products has much to do with the research and biomechanics studies it conducts.

PC WORLD WORLD CLASS 2001

Microsoft® IntelliMouse® Explorer
Best Input Device, 2001

"Microsoft believes that products used as much as mice and a keyboard should be comfortable and designed with ergonomics in mind."
—Hugh McLoone, Microsoft Hardware Ergonomist

Microsoft Hardware Timeline

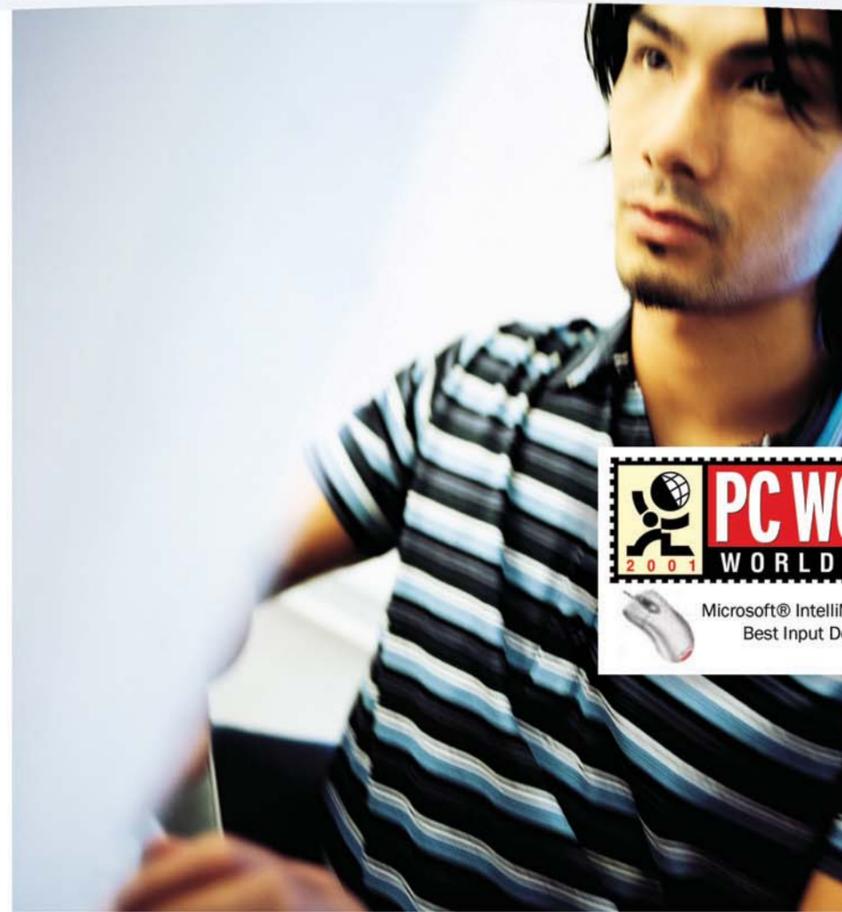| Year	Product
1983	Microsoft Mouse
1985	Mouse 5.0
1987	Microsoft Mouse
1991	Ballpoint Mouse
1993	Mouse 2.0
1994	Natural Keyboard, Home Mouse
1995	EasyBall
1996	IntelliMouse
1997	IntelliMouse Trackball
1998	IntelliMouse Pro
1999	Internet Keyboard, Natural Keyboard Pro, IntelliMouse Optical
2000	Trackball Explorer, Trackball Optical
2001	Office Keyboard, Wireless IntelliMouse Explorer, IntelliMouse Explorer
2002	Wireless Optical Desktop for Bluetooth, Wireless Optical Desktop Pro, Notebook Optical Mouse

pro·duc·tive

1. Producing or capable of producing.
2. Producing abundantly; fertile.
3. Yeilding favorable or useful results; constructive.
4. Of or involved in the creation of goods and services to produce wealth or value.

Related terms: pro·duc'tive·ly *adv.* pro·duc'tive·ness *n.*[5]

[5] *The American Heritage Dictionary of the English Language, Fourth Edition. Copyright © 2000 by Houghton Mifflin Co.*
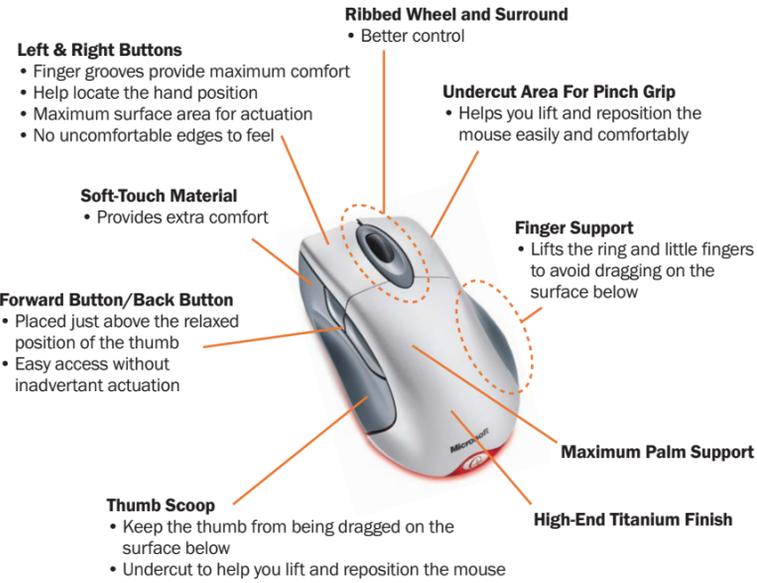
Making of a Mouse

Today, mice are found next to almost every personal computer. However, this gadget had a humble beginning, originally designed as a strictly utilitarian tool. Its sole objective was to get a cursor up to the toolbar and back down to a document—a very basic task for a seemingly simple device.

The first mouse was much bulkier, heavier, and more expensive than today's, without the sophisticated finishes, optical technology, or scroll wheels that are now commonplace. The first commercial mouse shipped with the Xerox Star 8010, and was introduced on April 27, 1981, at the National Computer Conference in Chicago. For $16,000, buyers received a system with a point-and-click interface along with a device called a mouse.

Two years later, Microsoft introduced its first mouse, designed to allow users to easily navigate a new computer processing application called Word. This square mouse—commonly referred to as the "green-eyed mouse" because of its two green buttons—sold for $195.

Before the mouse came along, users inserted punch cards, typed keyboard commands, or used a joystick to operate a computer. Once introduced, mice quickly evolved; the first mouse designed by an ergonomist was introduced in 1993, the first scroll wheel integrated with desktop software in 1996, and the first optical sensor in 1999. Each of these innovations, important to the advancement of how mice are used today, was brought to market by Microsoft Hardware.

Mouse diagram labels

Ribbed Wheel and Surround
• Better control

Left & Right Buttons
• Finger grooves provide maximum comfort
• Help locate the hand position
• Maximum surface area for actuation
• No uncomfortable edges to feel

Undercut Area For Pinch Grip
• Helps you lift and reposition the mouse easily and comfortably

Soft-Touch Material
• Provides extra comfort

Finger Support
• Lifts the ring and little fingers to avoid dragging on the surface below

Forward Button/Back Button
• Placed just above the relaxed position of the thumb
• Easy access without inadvertant actuation

Maximum Palm Support

Thumb Scoop
• Keep the thumb from being dragged on the surface below
• Undercut to help you lift and reposition the mouse

High-End Titanium Finish

Did you know?

• Douglas Engelbart, an electrical engineer at the Stanford Research Insitute, is credited with inventing the first mouse in 1963.

• Engelbert patented the mouse in 1970 under the name "X-Y Position Indicator for a Display System."

• Over 150 million mice were sold worldwide in 2002.[6]

[6] NPD data

Of Mice and Hands

Ergonomic and usability testing is factored into the final design of a Microsoft Hardware product and IntelliMouse® Optical, introduced to consumers in 1999, is no exception. The shape of this mouse was slightly unusual at the time and was designed based on findings about the metacarpophalangeal ridge, the pad on the palm under the knuckles, by staff ergonomists.

The findings were simple, yet they represented a breakthrough in the design of computer peripherals. Research showed this portion of the hand played a key role in people's perception of comfort. As the amount of support is increased at this ridge, users find a mouse more comfortable. Using gloves with pressure sensors, and later infrared thermography, Microsoft ergonomists designed a mouse with the most contact across this ridge. A new way of "seeing" the human hand had forever shaped the industry regarding hand-mouse interaction.

The unusual shape of Wireless IntelliMouse Explorer, unveiled in 2001, was also a direct result of these findings. This product offers many ergonomic features—including finger grooves and a thumb scoop—that help make the computing experience more comfortable. These features would not have been present had an ergonomist not been involved in the design process from day one.

Wireless IntelliMouse Explorer's thumb scoop is a place where the thumb can comfortably rest. Ergonomists found that this feature aids in guiding the hand to a comfortable, ergonomically correct resting position in which the wrist and forearm are aligned. It also reduces the need to drag the thumb on the desktop. Made of a unique soft-grip material, the thumb scoop provides extra comfort to an oft-forgotten digit.
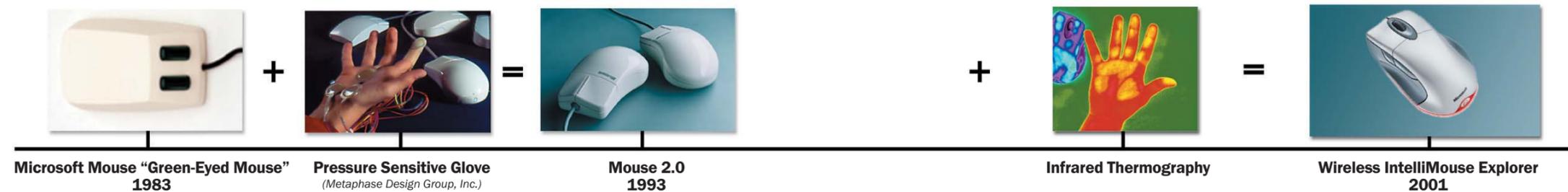
In addition to the shape and size, software innovations also affected the ergonomic benefits of the Microsoft mouse. IntelliPoint software, included with Wireless IntelliMouse Explorer and other Microsoft mice, improves on the already popular scroll wheel. The accelerated scrolling option allows users to scroll through documents more quickly and with fewer finger actions, increasing scrolling speed 28 percent on average for three or more pages.

Give your mouse the comfort test:

1. Place your hand palm-down on a flat surface and let it rest naturally.

2. There should be a cavity under your palm as the hand and fingers form a natural arch.

3. Now place it over a mouse. The mouse should feel natural, supporting the arch of the hand but not pressing hard against any one area of the palm.

(Source: Gartner, Inc. "Buying a Better Mouse," 2001)

Evolution of a Mouse

**Microsoft Mouse "Green-Eyed Mouse"
1983**

+

Pressure Sensitive Glove
(Metaphase Design Group, Inc.)

=

**Mouse 2.0
1993**

+

Infrared Thermography

=

**Wireless IntelliMouse Explorer
2001**

"Selecting a mouse that is comfortable to use is the single most-important decision that a buyer must make."

–Martin Reynolds, Gartner, Inc., February 2003

"Wireless Intellimouse Explorer is designed to be as natural to use as shaking another person's hand."

–Hugh McLoone, Microsoft Hardware Ergonomist

ev·o·lu·tion

1. A gradual process in which something changes into a different and usually more complex or better form.

Related terms: ev'o·lu'tion·al or ev'o·lu'tion·ar'y (-shə-nĕr'ē) *adj.* ev·o·lu·tion·ar·i·ly *adv.*[7]

[7] *The American Heritage Dictionary of the English Language, Fourth Edition. Copyright © 2000 by Houghton Mifflin Co.*

The Keyboard Evolves

Compared to the mouse, the layout of the computer keyboard has not changed much since it was first introduced, primarily due to the legacy of the typewriter, in use for well over 100 years. Early ergonomists did attempt to introduce alternative key layouts; however, these did not get much mainstream attention. For example, in the 1930s August Dvorak designed a keyboard system that placed nine of the most-used letters in the middle row of the keyboard. This format, referred to as Dvorak, is not widely used but was an innovative attempt to evolve how the keyboard is designed and used.

Split Keyboards

A major change to the keyboard came when the first affordable ergonomic keyboard hit store shelves. Microsoft brought ergonomic computing to the masses with the introduction of the Natural® Keyboard in 1994. Previously, these specially designed keyboards were extremely expensive, often costing more than $300, and hard to find.

Now a Microsoft signature design for comfort, this popular product has undergone numerous advancements. The company recently introduced Natural MultiMedia Keyboard, the fourth ergonomic or "split" keyboard from Microsoft, and Wireless Optical Desktop Pro, a mouse and keyboard combination that includes the company's first wireless ergonomic keyboard.

Microsoft's Natural Keyboard design has been found to significantly reduce one of the risk factors associated with RSI: awkward posture. Biomechanic research revealed this design encourages ergonomic benefits by influencing natural wrist and arm positioning.[8] In addition, research shows that users are able to type just as quickly on a split keyboard as they can on a straight keyboard.[9]

Following are some quick ergonomic keyboard statistics:

- Ergonomic keyboards consistently receive the highest customer satisfaction ratings.[10]
- One out of every 10 keyboards sold is an ergonomic keyboard.[11]
- The price of ergonomic keyboards is comparable to that of standard keyboard designs.

[8] Honan, M., E. Serina, R. Tal, and D. Rempel, "Wrist Postures While Typing on a Standard and Split Keyboard." Proceedings of the Human Factors and Ergonomics Society 39th Annual Meeting–1995. Human Factors & Ergonomics Society, Santa Monica, CA, Vol. 1, pp. 366–368
[9] Tittiranonda, P., S. Burastero, M. Hudes, and D. Rempel. "Productivity and Long Term User Comfort: Effects of Four Computer Keyboards on Users With Musculoskeletal Disorders," Marconi Research Conference 1997 Proceedings, Ergonomics Program, University of California and Center for Ergonomics, University of Michigan. April 13–16, 1997. paper #19
[10] Microsoft focus groups and retailer feedback
[11] NPD Group data

Microsoft Natural Keyboard Timeline

1994	1998	1999	2002
Natural Keyboard	Natural Keyboard Elite	Natural Keyboard Pro	Wireless Optical Desktop Pro/Natural Multimedia Keyboard

Bimanual Control

When Microsoft Hardware executives met in late 1998 to discuss the next phase of product design, the topic continually came back to designing a keyboard that could make users more productive, yet would be tailored to fit personal computing styles.

Bimanual control, the ability to use both hands in a complementary role while performing tasks, was proposed as a means to allow users to get the most out of their time and effort while working on the computer. Ten percent of computer users are left-handed, yet 50 percent of those users use the mouse in their right hand.

By designing a computer input device that offered bimanual control, Microsoft could ensure seamless interaction with the computer and lessen the interruption users experience when switching hands or peripherals to complete a task. The group combined this data with information from the Microsoft Office team regarding what functions people use most on the computer to develop a groundbreaking new keyboard design.

Office Keyboard was introduced in 2001 and was the result of nearly three years of research, exhaustive studies of 1,000 users, and examination of nearly 6 million common keystroke actions.

The information gained from these studies allowed Microsoft to develop a keyboard that was in tune with how people actually worked and would allow them to get more out of the applications they use most. Office Keyboard features a left-hand Single Touch Pad that provides one-touch access to everyday commands. These bimanual controls satisfied 95 percent of users[13].

Internet Buttons
Go back and forward within Web sites on the Internet with a single touch.
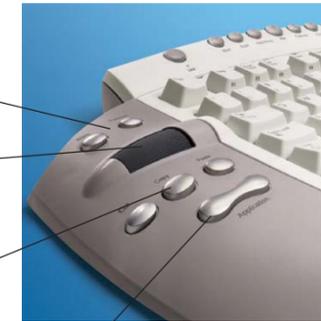
Scroll Wheel
Scroll easily without using the on-screen scroll bar. Used in combination with the mouse scroll wheel, you can navigate using whichever hand is free.

Shortcuts
These easy-to-use buttons allow you to cut, copy and paste. The buttons were customized to fit to finger pad size when resting on the keys.

Application Switch
Toggle between program windows with a quick touch. This key replaces the ALT+TAB method of switching between program windows.

Office Keyboard showed the industry that the split keyboard design, such as that of the Natural Keyboard, is only one way to revolutionize how people use their input devices with the computer. The addition of these new shortcuts and tools improved efficiency by reducing the number of steps needed to complete commonly performed actions. Research shows these additions help eliminate common keystrokes by up to 40 percent.[14] Other peripheral manufacturers, marking the mainstream acceptance of a pioneering innovation, have since imitated this award-winning design.

[13] Microsoft user research results [14] Microsoft internal research (2001)

Did you know?

- The number of keys on a keyboard varies per country. There are 104 on a standard flat keyboard in the U.S., 109 in Japan, 105 in Italy and 107 in Brazil.
- The keys on the original typewriter, developed by Christopher Latham Sholes in 1873, were arranged alphabetically. However, people became so adept at typing the keys would jam when hit in quick succession. Sholes rearranged the letters so the most frequently used keys were as far apart from each other as possible in order to slow down the speed of typing. His keyboard became known as the QWERTY keyboard, the standard key arrangement still used today.
- The average typist on a conventional QWERTY keyboard will move their fingers between 12 and 20 miles per day.

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com-fort-a-ble

1. Providing physical comfort.
2. Free from stress or anxiety; at ease.
3. Producing feelings of ease or security.
4. Sufficient to provide financial security.

Related terms: com·fort·a·ble·ness n. com·fort·a·bly adj.[12]

[12] The American Heritage Dictionary of the English Language, Fourth Edition. Copyright © 2000 by Houghton Mifflin Co.

in-no-vate

1. To begin or introduce (something new) for or as if for the first time.
2. To be creative.

Related terms: in'no·va'tor n. in'no·va·to'ry (-v⁹-tôr⁻ē, -tⁱr⁻ē) adj.[15]

[15] The American Heritage Dictionary of the English Language, Fourth Edition. Copyright © 2000 by Houghton Mifflin Co.

Looking Ahead

Microsoft's team of ergonomists and usability experts continually looks forward, searching for new designs and technologies and striving to make the computing experience more comfortable, more intuitive, and more productive. From lessening keystrokes to facilitating proper hand and wrist postures, ergonomics at Microsoft is one of the most important design considerations in the development of new hardware products.

Look to Microsoft to continue to investigate and advance the use of computer peripherals, striving to ensure they are pragmatic, productive and, above all, comfortable.

For more information on Microsoft Hardware products, visit http://www.microsoft.com/hardware/. For more information on the ergonomic benefits of Microsoft products, or to read more about how to be comfortable at work, visit http://www.microsoft.com/hardware/ergo/.

Frequently Asked Questions:

Q. How many ergonomists work at Microsoft Hardware?
A. Microsoft Hardware employs one ergonomist as part of the Hardware Design Group, which is composed of more than 20 professionals, and additional ergonomists can be found elsewhere at Microsoft. No other peripherals manufacturer employs an in-house ergonomist

Q. When did Microsoft's first ergonomist join the Hardware Group?
A. The first ergonomist joined the Hardware Group in 1993. This was the same year the company introduced its first ergonomic mouse, Microsoft Mouse 2.0.

Q. Do Microsoft's hardware products eliminate the risk of repetitive strain injury?
A. No, there are many factors that contribute to the development of RSIs, including stress, lifestyle and repetitive motion. Although Microsoft's mouse and keyboard products are designed by ergonomic researchers to be comfortable, using them is not a sure-fire way to avoid RSI.

10 Tips to Getting Comfortable

Both at work and at home, it is important to create an environment that is as conducive to comfort as possible. Choosing computer peripherals designed with ergonomics in mind can make a big difference where comfort is concerned and is an important consideration—but not the only one. Factors such as chair height, posture and the placement of items on your desk can also affect comfort. The 10 tips below, recommended by Microsoft ergonomists, can be implemented immediately to make your workplace more comfortable.

1. Select a good chair. Choose an office chair that provides support for your lower back. When you are sitting, the natural hollow should stay in your lower back at all times. A special pillow or backrest may help. Be sure to adjust your chair and work surface height to assume a comfortable position. Use a footrest if your feet do not rest comfortably on the floor.

2. Clean under your desk. Do you run into clutter every time you stretch your legs? Clear away items from beneath your desk to allow comfortable leg positions and movement.

3. Be aware of your posture. Use the following guidelines to locate your perfect pointing and typing position:

- Place your keyboard and mouse or trackball at the same height; these should be at about elbow level. Your upper arms should fall relaxed at your sides.
- When typing, center your keyboard in front of you with your mouse or trackball located close to it.
- Keep your wrists straight. Use a natural, relaxed posture for arms, hands and fingers.
- Type with your hands and wrists floating above the keyboard, so that you can use your whole arm to reach for distant keys instead of stretching your fingers.
- Use a light touch to depress keys and buttons and grip your mouse.

4. Know your easy-reach zone. Place frequently used items comfortably within arm's reach, without an obstacle course of coffee cups and clutter in the way. This may include a calendar, telephone, task list or file folders. Your ERZ should be within 26 to 34 inches in front of your body.

5. Use a headset. If your job calls for constant phone use, consider using a headset. Cradling the phone between your shoulder and neck is a sure way to see life sideways.

6. Position your monitor. Center your monitor in front of you at about arm's length, with the top of the screen positioned near eye level. Consider using a holder to position your documents near eye level. Place your monitor away from light sources that produce glare, or use window blinds to control light levels. Remember to clean your screen regularly, and if you wear glasses, clean them also.

7. Take breaks. Plan your work and play so that one activity isn't performed for extended periods of time. Be sure to take breaks throughout the day to exercise your mind and body.

8. Think when you lift. Do you try to win the office Olympiad every time physical labor is involved? When lifting heavy objects, be sure to stand with your legs apart for a good base of support. And avoid bending at the waist; only your knees should bend.

9. Integrate your tools. Work more efficiently by using software and hardware features to reduce your effort and increase your productivity. For example, you can press the Windows® logo key on Microsoft keyboards to open the Start menu.

10. Ask for help. If you experience pain or constant discomfort while completing a common task at work, make an appointment with your doctor immediately, even if symptoms occur while you're not doing this particular task.

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http://www.microsoft.com/hardware