*Global*STORE®

Touch-screen Point of Sale Software: Strategies for Evaluating the Technology

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High-tech, touch screen software has come of age at a time when many retailers are ready to upgrade their POS systems. Is it cost-effective for these retailers to move to touch-based software technology? A full-featured, completely touchable POS system will eliminate the need for a keyboard and mouse, and reduce the hardware profile of the checkout desk. But retailers need to know if touch screens are tough enough to hold up under daily usage. They want to have confidence that touch screen POS software can really do all that is needed by touch alone, without being too complex to customize. Just as important, retailers must be sure that their sales associates and register operators, both current and future, can truly work faster and easier with a touch screen POS system.

This white paper focuses on three important components of a touch screen software POS system:

- **Touch Screen Technology**
- **Software Technology**
- **Software User Experience**

We’ll explain the role that each component plays in a successful touch screen POS implementation and give you strategies for evaluating these components for your retail environment.

Touch Screen Technology: How reliable are touch screens and which technology is best for retail?

Touch screen technology has come a long way in the past few years. New technology is arriving rapidly, and existing technology is improving.

We'll start with an overview of the technologies that are already proven in the marketplace. Then we'll identify the qualities you should look for in evaluating touch screen technology, now and in future.

The first touch screens were **resistive**. They were activated by a finger or stylus press that distorted a flexible screen overlay. Today's **resistive** screens work the same way in principle, but are more sophisticated and robust, so they require less pressure and can withstand more individual presses by a finger or stylus. Even so, resistive screens still rely on a media overlay that receives and interprets pressure from physical contact. This media overlay has two drawbacks: its lifespan is limited relative to newer technologies, and it reduces the optical clarity of the screen. Periodic calibration is required. However, it is the most economical choice in terms of initial cost. Typical uses are PDAs and consumer electronics.

Another type of touch screen technology is the **capacitive** screen, which uses a specialized coating material that interprets changes in electrical current. Since the human finger can conduct electricity, it can activate the screen through a touch. One drawback of these screens is that non-conducting objects, like a gloved finger or stylus, cannot activate the screen. Another drawback is that the coating material can reduce optical clarity. In addition, scratches on the surface of this material can create a "dead zone" on the screen, affecting operation and requiring repair. They also require periodic recalibration. However, with a protective covering these screens are highly reliable in all kinds of outdoor weather situations. Typical uses are ATMs and pay-at-pump gas machines.

Surface acoustic wave (SAW) touch screen technology uses sound waves transmitted over a glass overlay. When touched with a finger, the sound waves are absorbed, which causes the screen to be activated. Calibration only needs to be done once. The screens have high optical clarity, but their responsiveness can be affected by dust and dirt as well as noise. To avoid these drawbacks, they require sealing. Typical uses are ATMs and kiosks.

Infrared touch screens do not use overlays or coatings. A grid of infrared beams is transmitted across the screen. When an object breaks through that grid, a touch is recorded by the screen. This means that the object doesn't have to make contact with the screen's glass, enabling fast touch activation, maximum optical clarity, and high durability of the screen. In addition, calibration needs to be done only once. The drawback to these touch screens is that a minimum size is required for activation, typically at least 3 to 5 mm in diameter.

This means that a ballpoint pen tip, a fingernail tip, or the edge of a credit card usually does not work well to activate the screen. Users with very long fingernails typically have to adapt their touch orientation or use a stylus. Infrared screens are found in high-usage, multifunction environments, like casinos and POS checkout stations, where durability, speed, and optical clarity are critical. Their cost is typically higher than other types of touch screens.

Fujitsu's TeamPOS registers and the *Global*STORE® PoS software support a variety of touch screens, including infrared. The Resources section at the end of this white paper gives you links to more information about touch screens.

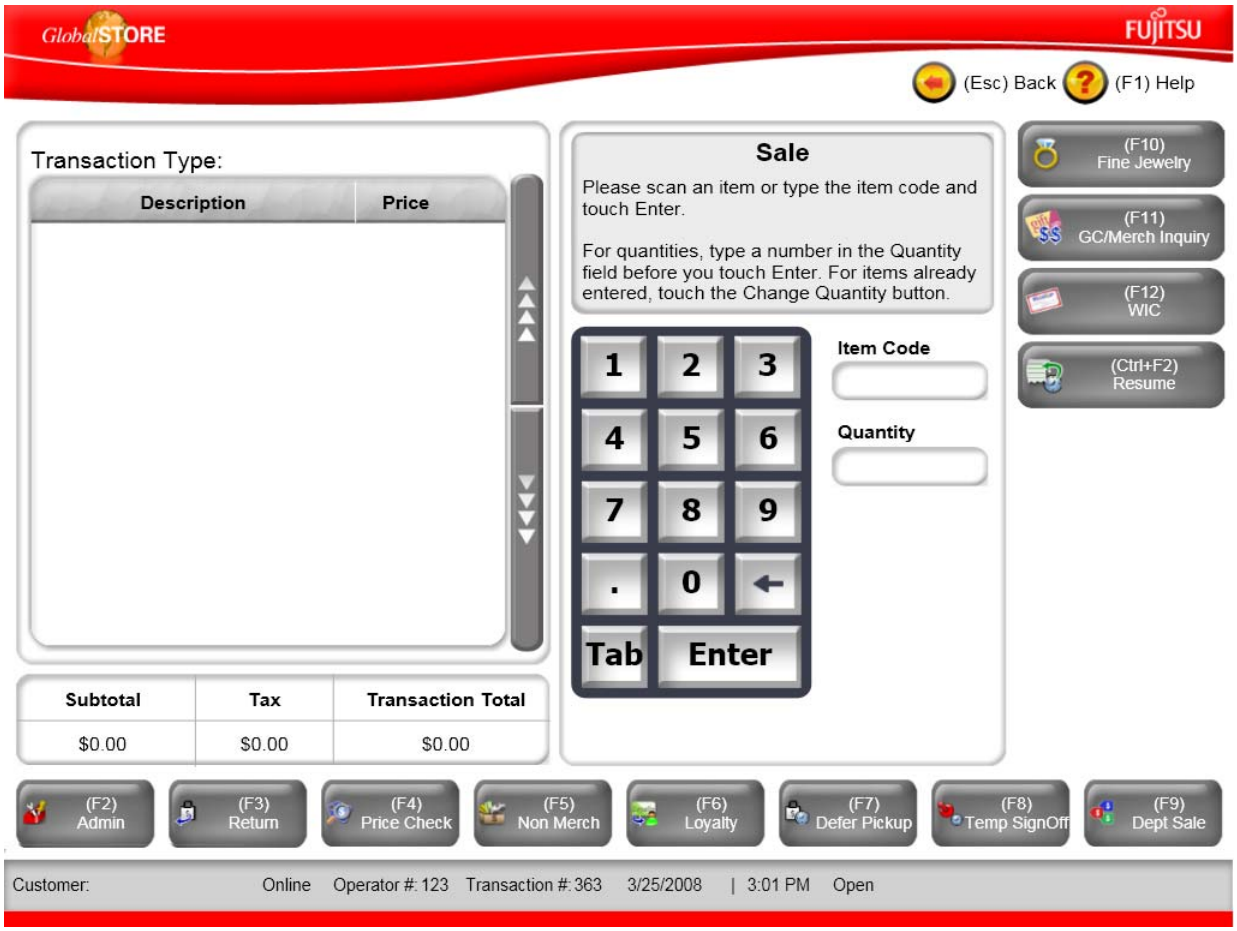
As a general strategy for the retail environment, you will want to maximize the **optical clarity of the screen** so operators can see the details of transactions and function buttons on the user interface (UI). You will also want to maximize **touchability**; so operators can use fingers, a stylus, or any pen or pencil that is handy at their register, without worrying about minor scratches affecting screen sensitivity or calibration. Finally, **durability and ease of maintenance** will keep your repair costs under control, even with heavy usage. You want store operators to be able to clean their screens with standard cleaners, and you don't want to replace equipment simply because of the wear and tear to the screen that is normal in a retail environment.

Touch Screen Evaluation Matrix for Retail Users

	Optical Clarity	Durability & Touchability	Maintenance	Initial Cost
Infrared	**Best** (no overlay)	**Best** (sealed system, monitor doesn't need to be touched, finger or stylus > 6 mm)	**Best** (calibrate once, clean with household cleaners, unaffected by surface defects)	Good
Surface Acoustic Wave (SAW)	Better (glass overlay)	Better (requires proper sealing, finger or soft stylus only)	Better (calibrate once, appropriate cleaning required)	Better
Capacitive	Good (screen coating)	Good (sealed system, monitor surface must be touched, affected by scratches, uncovered human skin touch only)	Better (periodic recalibration required, surface defects must be repaired)	Better
Resisitve	Good (media overlay)	Good (overlay affected by rough handling, finger or stylus)	Good (periodic recalibration required, media defects must be repaired)	**Best**

Software Technology: Which software technology will adapt to technical advances while providing ease of maintenance and customization?

From high-end development environments to open source and freeware, there are many programming tools available to vendors who create POS software. The more powerful software development tools offer 3-D and multimedia graphics capabilities—exactly the enhancements needed to make touch-screen POS software easy to use. For example, high-resolution icons, 3-D buttons, unlimited type fonts, sounds, and rich color palettes all play a dramatic role in the quality of the user experience for touch-screen software. They work together to give store operators immediate, obvious, and clear feedback for touch interaction. Equally important, these visual effects greatly improve an operator's ability to see where on the screen something needs to be done and how to do it.



When evaluating a touch screen-based POS offering, retailers should look for a **rich graphical user interface** that makes the UI intuitive and begging to be touched. Visual signals can be obvious and unambiguous if they conform to the human psychology of color and shape. When a button is touched, does it change appearance to let the operator know that it was touched? Does the system make a unique sound to indicate that a correct touch was received? Do buttons have colorful, detailed, high-resolution icons to help operators remember a button's function? Are the right color signals used for system messages and alerts? Is the color palette professionally designed and appropriately muted for long periods of use on a daily basis? Are the objects on the UI pleasing to look at, or simplistic repetitions of rectangular shapes with hard, thin edges?

The absence of rich visual effects in the UI indicates that the underlying software technology has limited graphical capabilities or else those capabilities are difficult to implement and maintain. With today's programming tools, there is no good reason for software not to have a rich graphical appearance. It makes sense for retailers to expect POS software companies to choose powerful software development tools so they can create an excellent user experience for store operators.

If you do see a rich graphical user interface in POS software that you are evaluating, you also will want to know how difficult it is to change some of its graphical properties. For example, you may want to use a special store logo and a different color palette. Or, you may want to remove some buttons, rename them, or move them to a different location on the screen. With the right underlying software technology and sound development practices, these kinds of changes are simple, low-cost customizations. An important step in your evaluation is to ask about **customization** of the UI and the resources required for it.

When you are evaluating **application maintenance** costs, you will want to know how easy it is to apply business enhancements and system upgrades that affect the UI of your POS software. The ease of making these changes depends significantly on the underlying software technology. It's important to know that the company who makes the underlying technology will provide solid support to your POS software vendor. In addition, that company's position in the software industry should be sound for the future and independent of the shifts that may take place in the POS software vendor marketplace.

Of the software technologies available that meet these evaluation criteria, Fujitsu Transaction Solutions has selected the .NET framework and Microsoft® Windows Presentation Foundation (WPF). As part of the.NET framework, WPF provides tools, like Expression Blend™, that Fujitsu uses for designing *Global*STORE's full-featured, rich, graphical UIs. These tools are also integrated into Microsoft's Visual Studio® development environment.

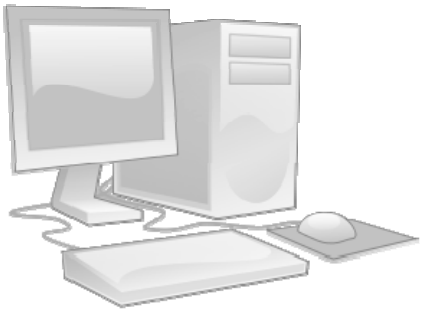
As a result of our development team's sound choices in underlying programming technology and software process, *Global*STORE provides:

- Rich graphical UIs
- Ease of UI customization
- Ease of UI maintenance in future

Fujitsu is committed to leading-edge software development tools that will allow us to continually advance the technical capabilities of our POS software. For the relatively new technology of touch-screen software, we believe this is a critical consideration for the future success of our customers.

Software User Experience: What features are needed for store operators to work faster, easier, and more accurately with touch screen POS software?

We've discussed the qualities of touch screens and software technology that are important for a successful touch-screen POS system. But these alone are not sufficient. To make a sound decision, retailers need to be able to evaluate the quality of the user experience of a touch-screen POS system. If the move to a full-featured, touch-screen POS system does not help store operators work faster, easier, or more accurately, then the ROI of the system likely won't to be better than the ROI of upgrading an existing keyboard and mouse-based POS system.



Are touch-screens faster and easier to use than a keyboard/mouse combination? A significant amount of human factors research has been done in the area of touch screen technology, and the results are clear (refer to the resource section at the end of this paper). First, we know that in general, a touch screen is faster, easier to use, and more accurate than a keyboard/mouse combination. The reason is that human eye-hand coordination is highly refined and accurate, particularly in the act of pointing. And touch screens take maximum advantage of this because their control surface, that is, the surface that a human aims at and touches, is the same surface that the human is looking at. As a result, "target acquisition" is very quick and accurate when users can aim at and touch the very thing that they are looking at.

Second, we know that looking down at a keyboard, and/or finding a mouse, then grabbing and orienting it, then looking back up at a screen requires working with two, physically separated surfaces, which slows users down. Touch screens eliminate this division of a user's attention.

Third, multiple functions on multiple screens cannot be directly mapped to the limited set of keys on the keyboard. This means that the same key or the same sequence of keys must be mapped to more than one function. The F3 on the keyboard, for example, may mean "Go To Tender" on one screen, and "Void Item" on a different screen. This complexity increases the learning burden on operators because they have to remember which keys to use for a particular function on a particular screen. Cardboard key/function mappings are often placed over the keyboard to help train operators, but the memory burden and the time required for training remain significant. Changes to the software often require new mappings, as well. Touch-screen software can eliminate this burden by using virtual keys. Each screen can contain the function buttons that apply only to that screen. When the screen changes, the buttons will change as well. The keyboard mapping is essentially provided by these virtual keys.

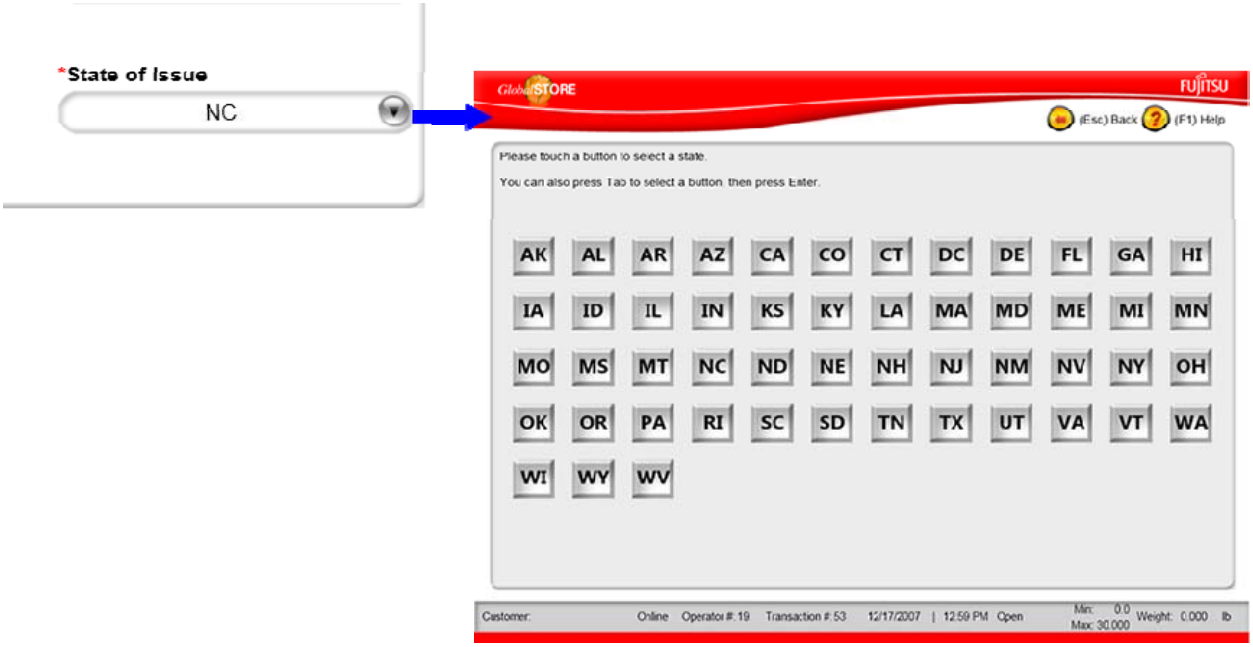
For these three reasons, we know that touch-screen software can translate into greater speed and accuracy for operators. In today's marketplace, the restaurant and food service industries present the most dramatic evidence of this.

The POS software requirements for the retail industry, however, include more functionality and a greater variety of tasks than the food service industries. The key to achieving the same usability benefits for the retail industry lies in maximizing the software's user interface for a touch model rather than a keyboard/mouse model. As POS software vendors have come to realize, this involves significant challenges, both from an underlying application technology perspective and from a human factors perspective. We'll look at some of these challenges now and discuss how to evaluate a few solutions that have been devised.

One challenge centers on the **selection of options** from a list and the associated **scrolling** that is sometimes required. For example, suppose an operator needs to enter check verification information from a driver's license. If the license is from a different state, the operator needs to quickly select the correct state. In the hard keyboard/mouse world, this is typically done by scrolling through a dropdown list and selecting an option with the mouse. But this doesn't work well at all in the touch screen world because the size of the options in the list and the scrollbars are too small for easy and accurate selection by finger touch.

One solution is to keep the keyboard/mouse model, but simply make everything larger. The user must still select a line from a list and touch scrollbars to sort through the options. Does this maximize the operator's point-and-touch capabilities?

At Fujitsu we've found a faster and easier solution that takes advantage of the touch screen. Instead of a dropdown list of text lines, we've changed the user interface presentation to a list of buttons. In *Global*STORE, the operator touches the dropdown list for changing the state and is immediately presented with a screen of 50 buttons. Each button contains a state abbreviation, and the buttons are arranged alphabetically from left to right. Now the operator only has to touch the button for the desired state. No scrolling or sorting through a vertically stacked list of text lines is required. The entire operation is accomplished with 2 point-and-touch operations. This implementation for choosing options is not only fast and accurate; it also creates a better user experience than the scrolling/mouse selection action. When evaluating touch-screen user interfaces, it's important to realize that making a screen object bigger is not necessarily the best solution.



Another challenge is providing **full touch screen functionality** for operators, including **data entry**. Many retailers need the capability of entering customer names, mail addresses, and email addresses. Data entry like this requires both alphanumeric *and* special characters, such as @, #, *, -, !. In addition, it requires both upper and lower case letters for first and last names and proper names, like streets and businesses. Can the hard keyboard be eliminated for these tasks? An onscreen keyboard may not be optimal for data-entry software. But with the right design, it can be a good solution for POS software, which requires only occasional data entry.

What won't work is putting a virtual keyboard on the screen that is missing special symbol keys or uses keys that are too small or crowded. Users will find it hard to touch the correct key, or they may not be able to complete an operation. To design a usable onscreen keyboard, the entire screen layout must be carefully considered to allow for large-enough keys without squeezing or covering other objects on the screen. Simply popping up a keyboard without knowing how it will fit on the screen is not a usable solution.

Fujitsu's *Global*STORE offers the option of a full touch-screen keyboard with all characters available. We've made it easy to use by creating smart-capitalization behavior for quick entry of capital letters. For example, to enter the last name of *Smith*, the operator touches the onscreen capitalization key, then touches the onscreen key "S." The smart-capitalization features automatically turns the keyboard back to lower case so the operator can immediately enter the rest of the name. The operator doesn't have to worry about turning capitalization off.

Training is another challenge. **Ease of training** is critical for retailers, because their work force has rapid turnover and seasonal fluctuations. How can touch screen technology help reduce training time for new employees?

A full touch-screen implementation helps the operator focus only on the screen and not worry about the keyboard. Operators quickly become more comfortable because they know that the screen will show them what to do. They look for the buttons on the screen to move forward with

a task, and they don't get bogged down trying to figure out which key on the keyboard they need to press. And they don't waste time taking guesses about keys, pressing random keys to get the screen to do something.

Our new WIC implementation is a good example of using touch screens to guide users. We know that WIC transactions can be a complex task for grocery store operators to learn. Our new touch screen implementation virtually eliminates operator errors by offering the operator only the button that is relevant for the next step in the WIC transaction flow. We validate the WIC voucher, and only after validation succeeds do we show the next button that should be pressed to move forward. If validation doesn't succeed, we give the operator a clear message as to what to do next. In some cases, we will present a manager authorization screen at exactly the point it is needed. Taking advantage of the touch-screen model allows us to **guide a new operator through a procedure**, making the training process faster and giving the operator more confidence. When evaluating touch-screen POS software, it's important to see if it helps operators flow through a task.

There is another side to the training challenge, however. If a retailer invests in touch screen technology, it is going to take time to phase all store operators in to the new system. Can a touch-screen POS system make it easy for store management and store operators to transition from the keyboard and mouse to the touch-screen?

To ease the transition and make the learning curve faster, the touch-screen POS system should be **fully functional by touch, by keyboard, and by a combination of the two** (for example, *Global*STORE). This feature allows stores to use their current keyboard-based hardware with the new POS software while they are phasing in the touch screen hardware. Stores will also avoid significant operator downtime from a technology transfer because operators can continue to use a keyboard as a backup while they learn to work with the touch screen.

Even better, Fujitsu's usability studies have found that in this dual-function situation, operators are more willing to train themselves to go from the world of the hard keyboard to the world of the touch screen. We believe this happens because they can make the technology transfer at their own speed, without fear of impacting productivity. As long as the touch-screen software provides a positive user experience, most operators—some sooner, some later—put away the keyboard and never want to go back to it.

*Global*STORE enhances this self-training experience by **clearly labeling every button on the screen with an F-key assignmen**t. Store operators don't need a cardboard mapping to put over their hard keyboards. They can either touch the button on the screen or press the hard keyboard F-key that is shown on the button's label (for example, F2 / Accept). As their comfort level increases, they typically find themselves touching the button instead of reading the F-Key label and then looking down at the keyboard to press the key. It's simply much faster and easier to touch than to type. In this way, they quickly transfer their skills to the touch screen environment.

Finally, by providing a virtual keyboard map on the screen, *Global*STORE also improves usability with the hard keyboard. Companies who are not ready to move to touch technology can still achieve faster operator training times with *Global*STORE's UI.

These usability features make the move to touch-screen POS software easy, from a deployment perspective and from a human, technology-transfer perspective. Looking into the future, it's important to recognize that new hires are likely to be unfamiliar with hard keyboard and numeric keypad data entry, but completely familiar with cell phone texting and PDAs as well as self-checkout systems and kiosks. When they enter the workforce, they will be more comfortable with the touch screen usage pattern than the hard keyboard. To benefit from this situation, retailers will need touch-screen POS systems that maximize a human's ability to point and touch to complete a task.

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Touch-screen POS User Experience Criteria for Retail Users

Evaluation Criteria	Qualities To Look For
Option Selection	➢ Minimizes the number of touches required ➢ Uses buttons for options instead of lists ➢ Avoids the need for scroll bars
Data Entry	➢ Touch entry of dates and numbers is easy ➢ Onscreen keyboard provides all characters, including special symbols ➢ Onscreen keyboard does not cover other screen elements ➢ Onscreen keys are large enough for accurate touch with easy-to-read labels ➢ Easy to switch between upper- and lowercase
Screen Layout	➢ Buttons are spread out to allow accurate touch ➢ All buttons needed for the screen are available (no need for a More option to see additional choices because there is only one point-and-touch action) ➢ Objects on the screen do not appear squeezed together ➢ Layout of objects on the screen is symmetrical ➢ Navigation items are arranged in a standard orientation (e.g., buttons always read from left to right, or top to bottom) ➢ Frequently used buttons occupy the same position on the screen (e.g., Back, Tab, Help, Accept, Cancel) ➢ Room is available on the screen for customized objects without squeezing (e.g., logos, additional buttons) ➢ Objects can be removed from the screen without compromising readability
Full Touch Implementation	➢ All functions are supported with buttons, including the generic functions attached to special keys (e.g., Escape key, Tab, F1-Help) ➢ All data entry tasks are supported by onscreen keyboards
Full Keyboard/Mouse Implementation	➢ All onscreen buttons are clearly labeled with a mapping to the hard keyboard ➢ All data entry tasks can be done with the hard keyboard alone or in combination with touch screen and hard keyboard ➢ All option selection tasks can be done with the mouse alone or in combination with touch screen and the mouse

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Summary

Human factors research and the experience of the food services industry show that touch-screen PoS software offers an opportunity to improve a store operator's speed and accuracy at checkout. Three system components play a critical role in achieving these improvements: the touch screen hardware, the underlying software technology, and the software user experience. For retailers to reap the benefits of touch-screen PoS software, these three components must meet the specific needs of the retail environment. Retailers who are considering new PoS technology need strategies for evaluating the relative merits of these components.

The most important qualities for touch screens are optical clarity, fast finger-touch capability, resistance to wear and tear, and low maintenance requirements. These qualities can increase the initial cost of the touch screen, but decrease the long-term maintenance and repair costs.

The underlying software technology used to create the PoS software must be able to enrich the user interface with 3-D graphics and multimedia visual effects. These qualities enable users to receive the visual and auditory feedback they need when touching the screen to perform actions. The provider of the programming tools should be a robust player in the software tools industry. The PoS software vendor must rely on this provider to ensure its retail customers long-term support and technology upgrades over the life of the system.

Finally, the human interaction, or more specifically, the user experience of the solution, must take advantage of the touch-screen and underlying software technology to provide the right user interface design. Using rich visual effects and guided task flows in the user interface will enable store operators to learn the system more easily, work faster, and work more accurately than they would with a keyboard and mouse system. The primary quality required to achieve this is a screen design that maximizes touch interaction, rather than trying to extend the keyboard/mouse interaction pattern to the touch screen. These two usage patterns model the user experience very differently. The user interface controls for critical tasks such as option selection and data entry will have very different screen designs under each paradigm.

To move forward with a user experience that can satisfy the workforce of the future, Fujitsu's has focused on maximizing *Global*STORE's usability and user experience through touch interaction. The *Global*STORE PoS has a rich, graphical user interface that invites touch activation and uses customized controls that support quick-touch data entry.

This whitepaper gives retailers strategies for evaluating touch-screen PoS software systems based on the critical hardware, software, and user experience qualities needed in the retail environment.

Carla Merrill, Ph.D., is the Human Factors Architect for Fujitsu Transaction Solutions (FTXS). She has published articles and given presentations on how to achieve customer satisfaction through excellent software user interface design. At Fujitsu, Dr. Merrill works directly with software development teams to help them understand our customers' daily store operations tasks. She is responsible for designing the user interfaces that our teams build and ensuring that they meet human factors best practices. To gather the critical knowledge about customer tasks, Carla has established the **FTXS User Experience Forum** (FTXS-UEX). As part of her FTXS-UEX work, Carla interacts directly with our customers through store visits—where she learns the flow of their daily operations; through webex conferences—where she presents prototypes of our upcoming PoS software to customers and gathers their feedback; and, through on-site usability testing of our software—where customers are invited to our usability lab to try out early versions of our software and provide their feedback. If you would like to participate in any of these activities, Carla would love to hear from you. You can contact her at: cmerrill@ftxs.fujitsu.com

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Resources

The links below are either subject articles or references to additional links on the stated subject.

Touch screen technology:

http://en.wikipedia.org/wiki/Touch_screen

http://www.fujitsu.com/us/services/retailing/

Software development technology:

http://en.wikipedia.org/wiki/.NET_Framework

www.microsoft.com/net/basics.mspx

http://en.wikipedia.org/wiki/JavaPOS

http://www.javapos.com/

Software user experience:

- Research on touch screens:

  http://72.14.205.104/search?q=cache:O4XHV29N_dEJ:www.almaden.ibm.com/u/zhai/papers/TouchScreen.pdf+Fitts+law+and+touch+screens&hl=en&ct=clnk&cd=1&gl=us
  http://psychology.wichita.edu/surl/usabilitynews/2w/touchscreen.htm

  http://www.stcsig.org/usability/topics/devices.html

- Touch screen and kiosk UI design and usability:

  http://infocentre.frontend.com/infocentre/articles/designingfortouchscreenkiosks.html

  http://www.jacobsen.no/anders/blog/archives/2004/07/17/athens_2004_info_kiosks_usability.html

  http://www.sapdesignguild.org/resources/TSDesignGL/Index.htm