



A benefit analysis: The advantages of multi-modal speech-directed solutions



Executive summary

In the online direct-to-consumer world, retailers, consumer packaged goods manufacturers and their supply chain partners are faced with tremendous challenges. Their business processes are geared towards shipping larger bulk orders to stores. But now, they must ship smaller orders with fewer items directly to customers. This is driving a massive increase in order volumes and shipping locations. And customers expect fast shipping — overnight and two-day shipping has become the new norm. As a result, warehouses need to find a way to streamline and error-proof every aspect of order fulfillment and inventory management.

Voice Directed Picking (VDP) solutions have helped address these challenges by increasing productivity — the ability to listen and respond to voice-based directions allows workers to process tasks in a more natural way, successfully decreasing task cycle times. But today's order-of-magnitude increase in order volume and zero-tolerance for errors in order fulfillment are overwhelming, leaving today's warehouses looking at new solutions that can provide a much needed boost in productivity.

Multi-modal speech-directed solutions can help solve the problem. Like VDP solutions, multi-modal speech-directed solutions also utilize spoken instructions from the system. However, multi-modal speech-directed solutions enable additional input modes that are available on wearable systems to simplify and increase task completion speed and accuracy. For example, for workers picking multiple orders simultaneously, in addition to providing voice instructions to the next pick location, a diagram of where to place the item can also be displayed on the screen. Instead of speaking to verify that the right item was selected, workers can simply scan the barcode or RFID tag on the item, shaving seconds off of the validation process and ensuring pick accuracy. And the touchscreen enables workers to enter information with a press of a finger, instead of waiting for the completion of a voice prompt.

Benefits shootout:

Multi-mode vs. Voice-only speech-directed solutions

A comparison of voice-only and multi-modal speech-directed solutions reveals incremental benefits for nearly all aspects of the picking process.

TOTAL ORDER COMPLETION TIMES

Compared to voice-only solutions, multi-modal system users spent:

- 14.0% less total walking time to complete an order
- 18.1% less time picking all items in an order
- 15.4% less time overall fulfilling an order

AVERAGE PICK TIME PER ITEM

Multi-modal system users pick items an average of 16.7% faster than voice-only users.

REPEAT REQUESTS

Voice-only system users were forced to repeat information 381% more than multi-modal system users.

ERROR RATES

The error rate of the voice-only systems is 63% higher than multi-modal systems.

USER SYSTEM PREFERENCE

Participants prefer multi-modal to voice-only systems for:

- Overall system performance
- Mental effort
- Frustration level
- Clarity of instructions
- Easy to learn

DISPLAY USE

Participants found information on the display very helpful. All users utilized the display multiple times during the picking of an order — and some referred to the screen with every item pick.

THE BENEFITS OF MULTI-MODAL

The use of multiple modes in your workflows delivers a substantial increase in productivity and accuracy. While VDP solutions provide a substantial productivity increase, their multi-modal cousins deliver an additional 15 percent increase in productivity and an additional 39 percent reduction in errors compared to voice-only solutions.

Now, workers can pick more orders per day, more accurately, helping improve the top warehouse performance metric — orders per hour, along with the top two order fulfillment metrics: 1) on-time order delivery and 2) order accuracy.

These benefits are driving a sharp rise in the adoption of multi-modal speech-directed solutions. In 2015, only 17.6 percent of warehouses utilized multi-modal speech-directed solutions. By 2020, that number is expected to more than triple to 57.8% — a compound annual growth rate (CAGR) of 26.85% per year for five years.¹

But how and why do multi-modal speech-directed solutions provide such a major productivity and accuracy improvement? To find the answers, we conducted a side-by-side test of multi-modal and voice-only speech-directed solutions for one of the most crucial high-volume tasks in the warehouse — order picking. In the following pages, we examine the details of those results, as well as system performance, the user experience and user preference.

The testing

Each participant performed order picking with both voice-only and multi-modal speech-directed systems.

EXPERIENCE LEVEL

Users were familiar with voice-only speech-directed systems, with an average of 3.6 years experience per user. Work experience included order picking, warehouse operations and inventory control for grocery, automotive, dry goods, cosmetics and home goods companies.

COMPLEX ORDER PICKING

Participants were presented with complex orders that required piece picking of 26 to 43 items in 17 to 20 locations. A mock warehouse was created for the testing. Workers were directed to the pick location,



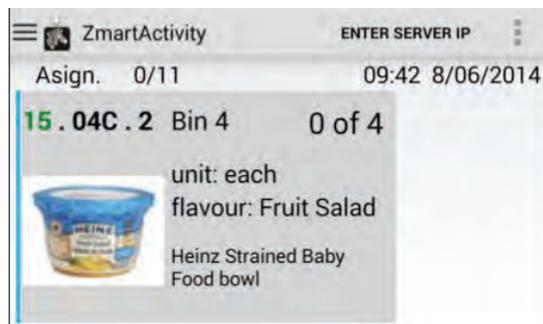
Mock warehouse where testing was conducted.

and directed to place items in one of four bins on their cart. Participants utilizing the voice-only speech-directed solution utilized only spoken information throughout the entire picking process, while participants using multi-modal speech-directed solutions wore a ring scanner to capture barcodes and utilized the display to view and enter information, in addition to listening and replying to spoken information.

METRICS COLLECTION

The following metrics were collected and analyzed during the testing phase:

1. Errors — Errors could be one of three scenarios — incorrect item selection, incorrect quantity picked or item placed in the wrong bin.
2. Time to task completion.
3. System performance — frequency of user requests to repeat information.
4. Usability issues — defined by user behavior and feedback.
5. User system preference.
6. User system feedback — comfort, ease of use, effort, mental workload and efficiency ratings based on Likert and Borg scales.



Sample of information displayed on touchscreen of the multi-modal speech-directed solution.

Results

Multi-modal is the clear winner, delivering benefits well above and beyond voice-only speech-directed solutions. Benefits include:

- Individual items are picked 16.7% faster
- Users can walk to and correctly identify pick locations 14% faster
- Users can complete picking for an order 18.1% faster
- Users can complete order fulfillment 15.4% faster

INDIVIDUAL ITEM PICK TIMES

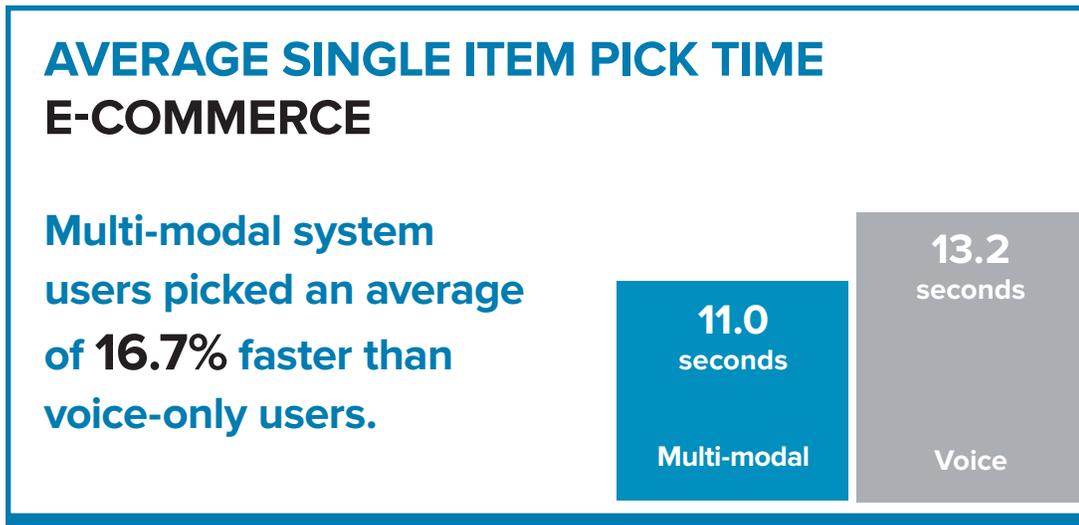


Figure 1

TOTAL ORDER COMPLETION TIMES

The following times reveal the time savings for total walk time per order, total time spent picking per order and the total time to complete an order.

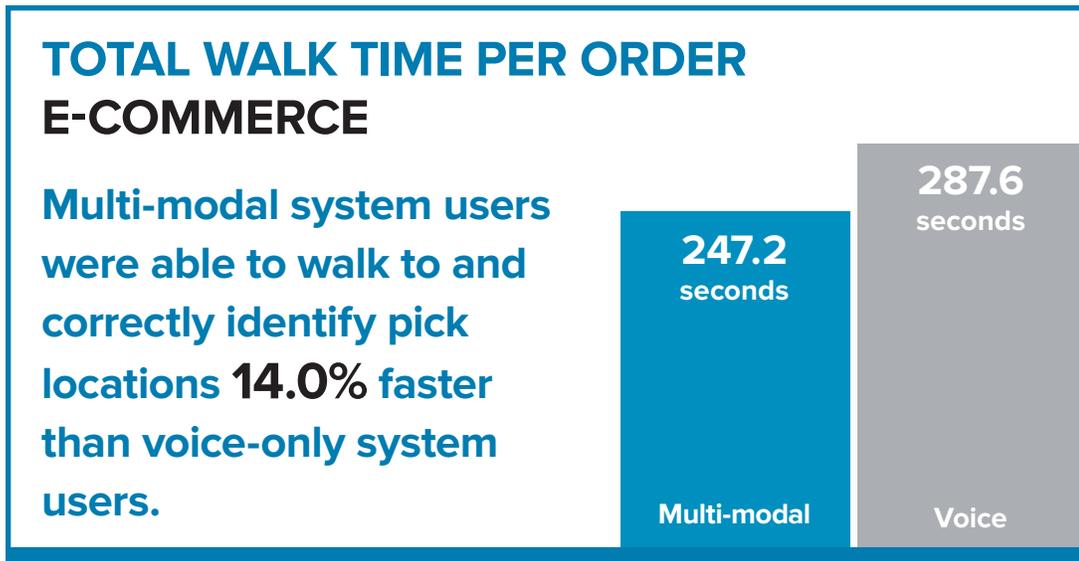


Figure 2

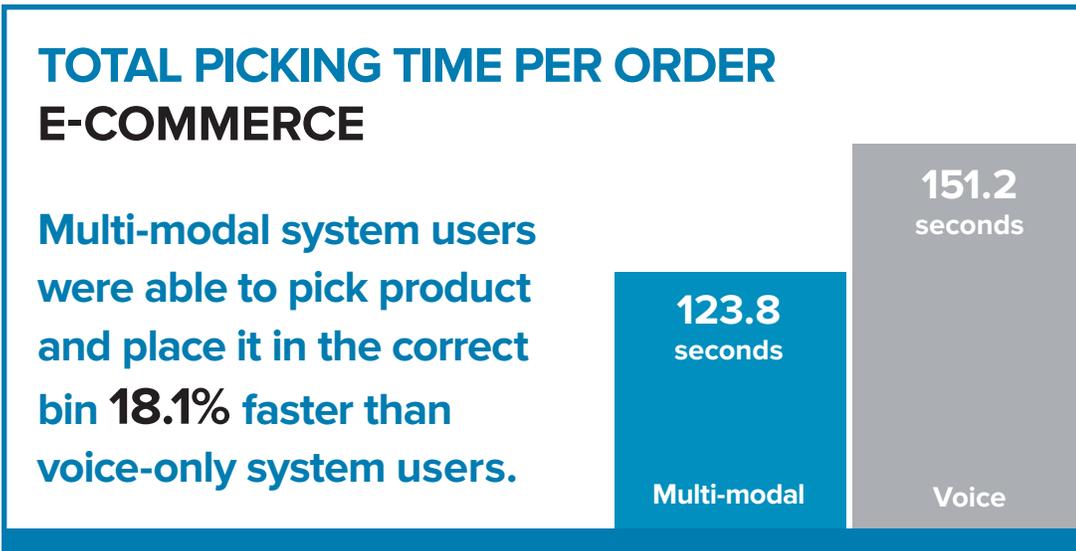


Figure 3

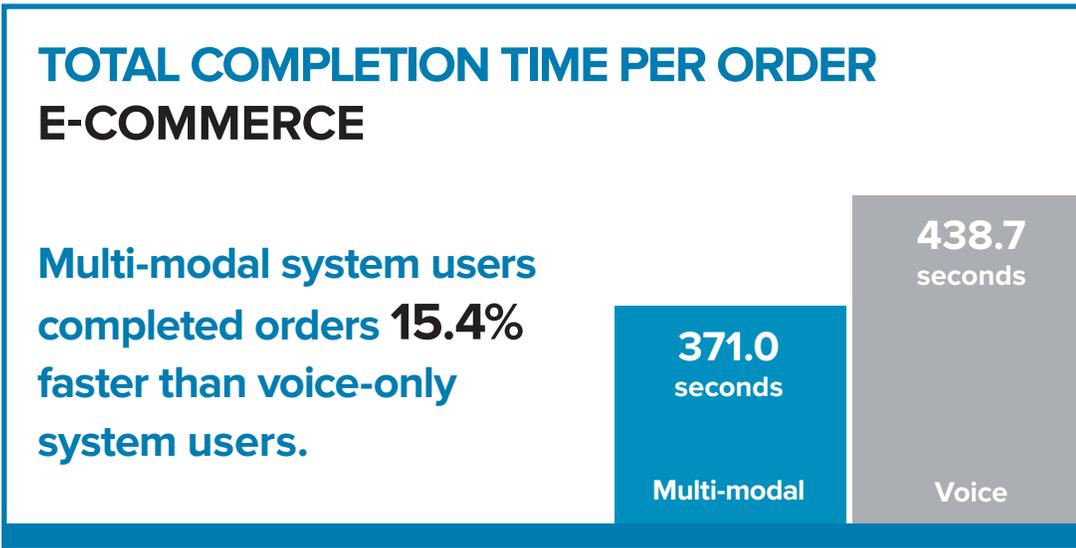


Figure 4

SYSTEM PERFORMANCE: REPEAT REQUESTS

When it comes to system performance, multi-modal is the clear winner — the voice-only system required 381% more repeat requests from users to complete a task.

The striking performance improvement of the multi-modal system is attributed to:

- The ability to scan the item barcode to confirm pick location instead of speaking a 3-digit check-digit location.
- The ability to display a photo and description of the product on the screen allowed users to visually zone in on the item to be picked, eliminating the need for audible confirmation and repeat requests for information.
- Voice recognition system’s occasional failure to understand the user’s spoken information.

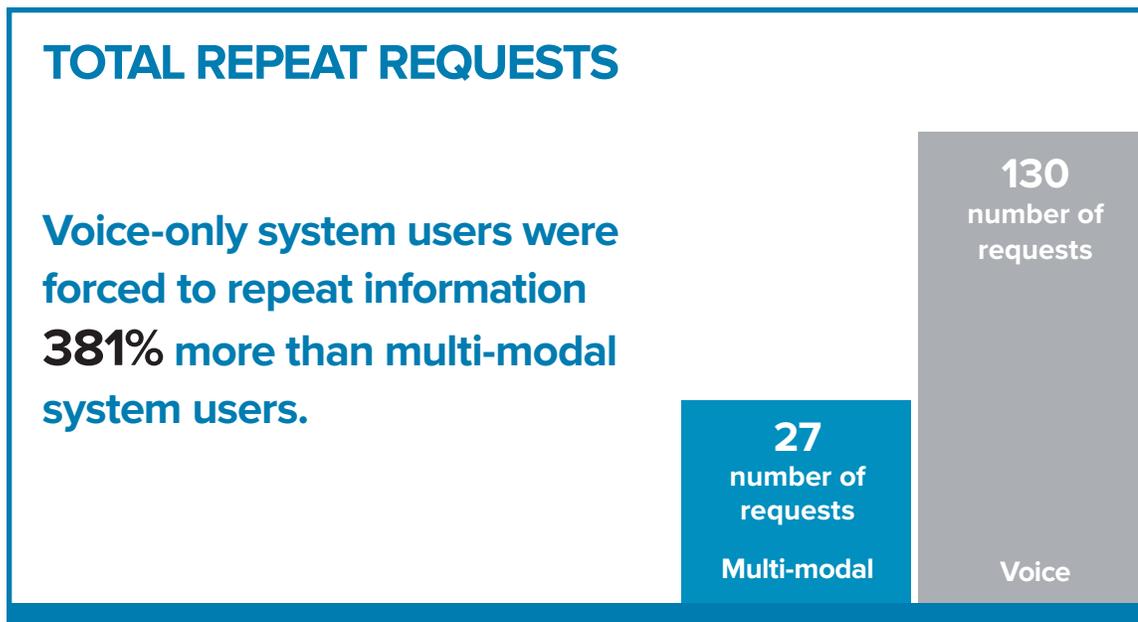


Figure 5

USER ERROR RATES

The errors in the voice-only system were associated with incorrect bin placement and incorrect item quantity, while all of the errors in the multi-modal system were attributed to incorrect bin placement. Neither system generated errors that resulted in the picking of the incorrect item.

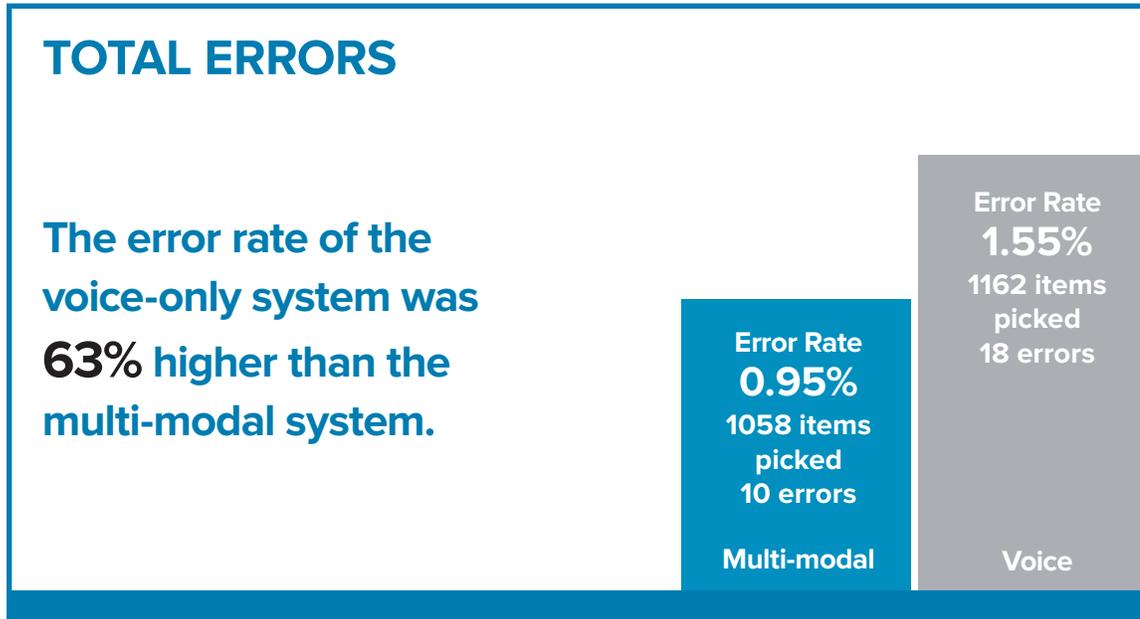


Figure 6

USER'S RATINGS: EFFICIENCY AND OVERALL SYSTEM PERFORMANCE

While users found the effort to complete the order and confidence that the correct items were picked to be the same with both voice-only and multi-modal systems, users rated the multi-modal system for speed and overall system performance.

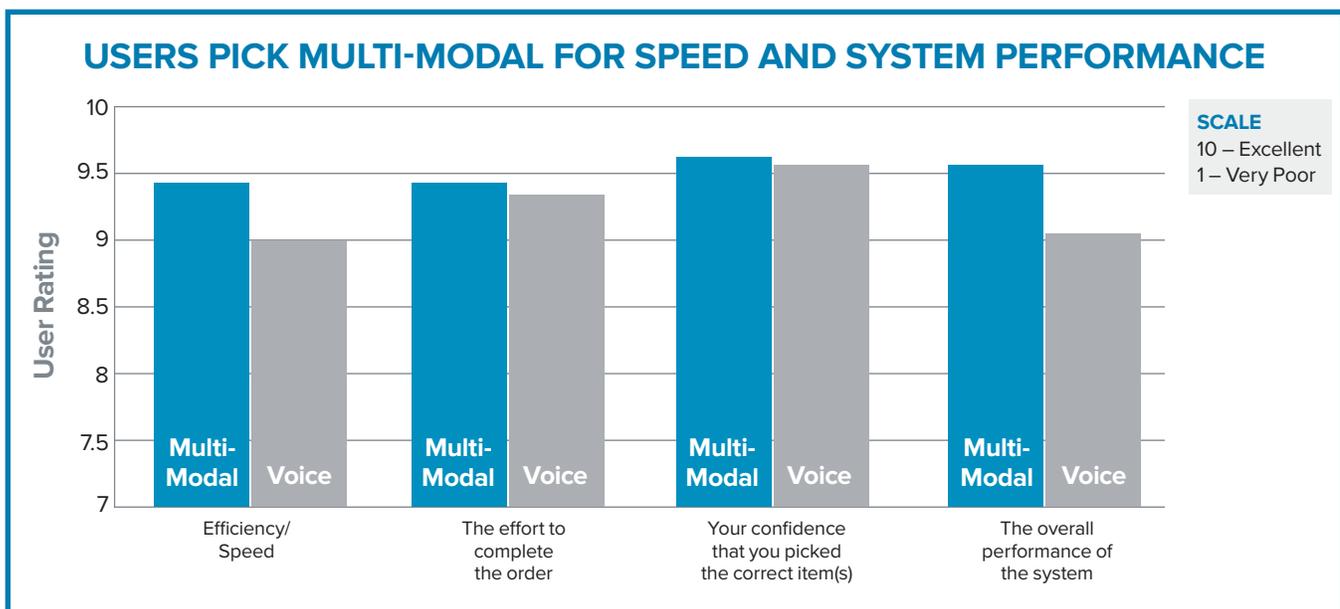


Figure 7

USER’S RATINGS: EASE OF USE AND CLARITY OF INSTRUCTIONS

While users found both systems easy to learn, the multi-modal system ranked higher in the least mental effort, lowest level of frustration and clarity of direction.

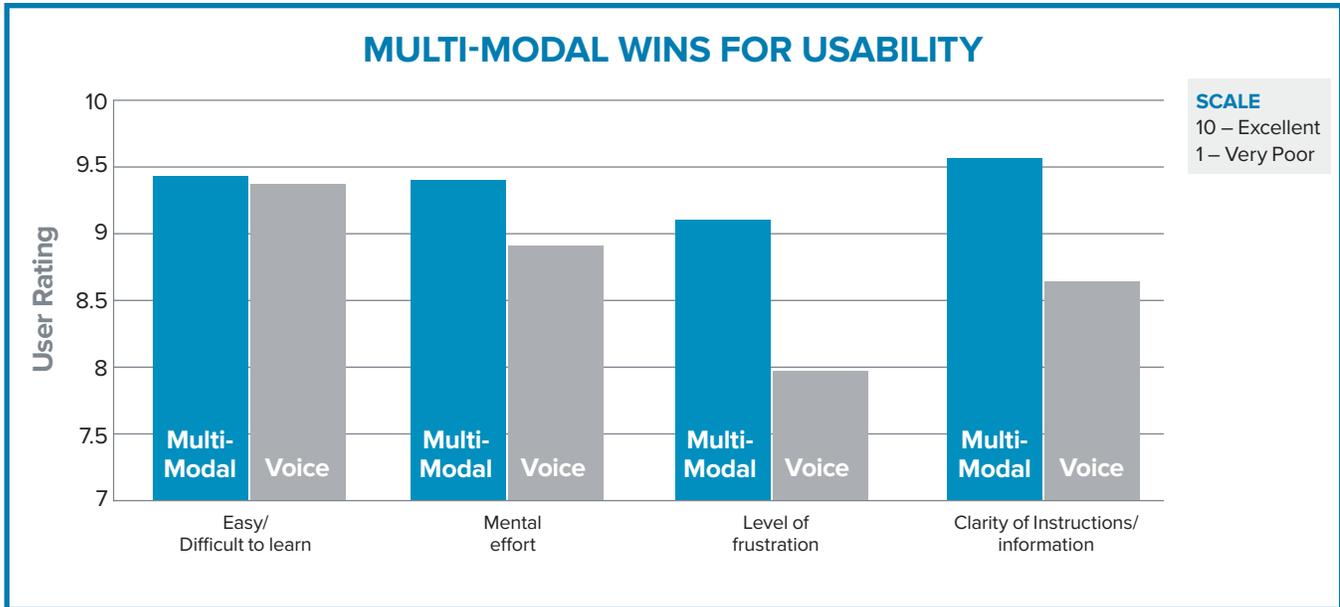


Figure 8

DISPLAY USE

Did users find the display useful? How often did they refer to the visual information to supplement the audible directions? The chart below reveals the answers. All users utilized the display multiple times during the picking of an order — and some referred to the screen with every item pick.

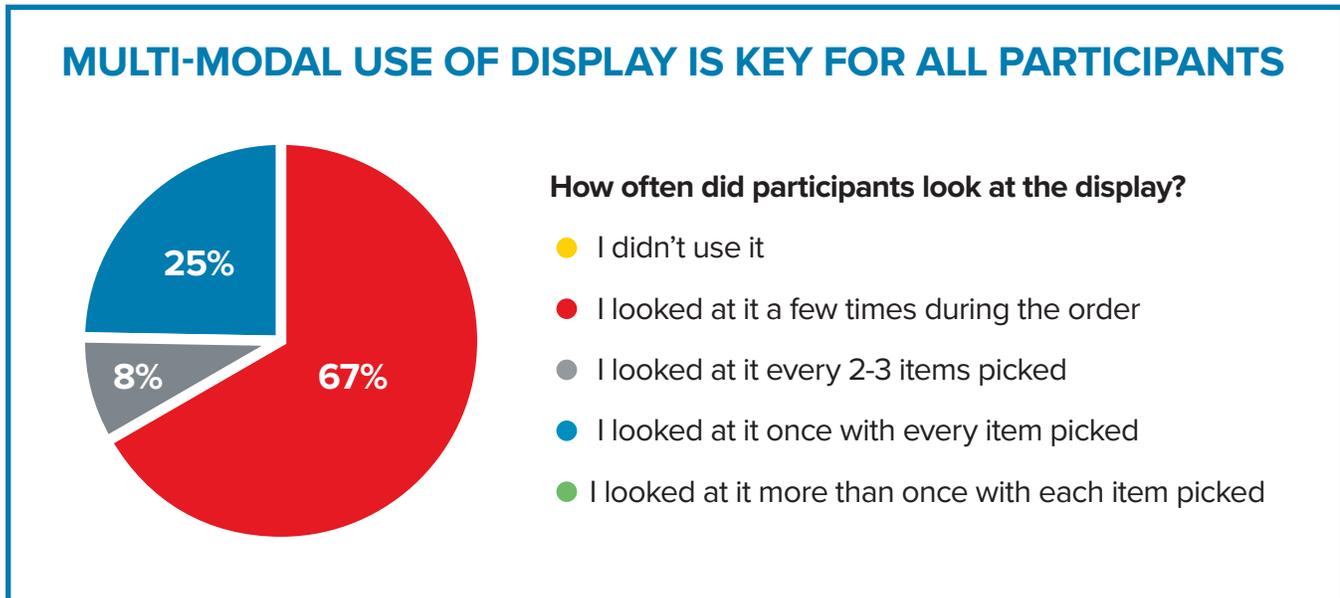


Figure 9

CONCLUSION

In summary, while voice-only speech-directed solutions deliver strong 15% to 30% productivity increases in order picking, multi-modal speech-directed solutions allow enterprises to achieve an additional 15.4% in incremental productivity over voice-only solutions — each worker can now process more orders per day, boosting throughput without hiring additional staff.

When it comes to user preference, participants preferred multi-modal over voice-only speech-directed solutions for five key reasons:

1. Overall system performance
2. Mental effort
3. Frustration level
4. Clarity of instructions
5. Easy to learn

And when presented with the option to view information on the screen as well as hear spoken information, every participant chose to engage with information on screen during every order fulfilled, demonstrating the value of presenting information in multiple formats that allow workers to choose what helps make them the most productive.¹

FOR MORE INFORMATION ON HOW YOU CAN PUT MULTI-MODAL SPEECH-DIRECTED SOLUTIONS TO WORK IN YOUR ORGANIZATION, PLEASE VISIT WWW.ZEBRA.COM/TOTALWEARABLESOLUTIONS OR VISIT OUR LOCAL CONTACTS DIRECTORY TO LOCATE YOUR NEAREST ZEBRA REPRESENTATIVE AT WWW.ZEBRA.COM/CONTACT

The advantages of Zebra's Total Wearable Solutions

When it comes to deploying multi-modal speech-directed solutions, Zebra's Total Wearable Solutions offer everything you need. When it comes to hardware, we have it all, from the wearable computer to ring-style scanners and headsets. And when it comes to applications, Zebra's TekSpeech Pro 4 allows you to quickly and easily create powerful and highly intuitive multi-modal applications that let your users choose the mode that will maximize task simplicity — and productivity. And all the components of our Total Wearable Solutions are packed with innovative features and competitive advantages that provide superior value and a fast return on your investment. Components include:

WT6000™ WEARABLE COMPUTER



The Zebra WT6000 Android wearable computer sets a new standard for enterprise-class wearability. The unique feature set delivers maximum comfort, maximum durability and maximum workforce productivity. Features include:

- A design that is smaller, lighter and more rugged than other wearables on the market
- An incredible new mounting system with micro-adjustability for a perfect fit on any arm
- A larger touchscreen for easy display of Android's highly intuitive graphical applications
- Programmable softkeys that allow workers to complete complex multi-step processes with the press of single softkey
- An innovative all-in one cradle system that can charge both the WT6000 and the RS6000 ring scanner — without removing the batteries

RS6000™ 1D/2D BLUETOOTH RING SCANNER



Add the industry's most advanced and rugged Bluetooth 1D/2D ring scanner to give your users enterprise-class barcode capture. Features include:

- Advanced scanning algorithms to scan virtually any barcode — even if it is dirty, scratched or poorly printed
- The ability to scan faster and nearly four times farther than the competition
- The battery power to scan over 70,000 barcodes per charge — up to five times the battery power of competitive devices
- Simple tap-to-pair, allowing you to add scanning to your WT6000 wearable computers in less than a second
- Rugged and ready for the warehouse — drop proof, spray proof and dust proof
- Direct line-of-sight LEDs that can provide color-coded feedback to direct user actions
- Flexible automatic or manual triggering
- A shared battery with the WT6000, which simplifies back room battery management

RS4000™ 1D CORDED RING SCANNER



Add a rugged 1D corded ring scanner to give your users enterprise-class barcode capture. Features include:

- Advanced scanning algorithms to scan virtually any barcode — even if it is dirty, scratched or poorly printed
- The ability to scan as much as three to 11 times farther than the competition
- Two scanning modes — press the trigger once to capture one barcode, or keep the trigger depressed to continually scan barcodes
- Rugged and ready for the warehouse with a liquid polymer scan element that includes a lifetime warranty, a diecast zinc scan engine chassis and single board construction for superior impact protection and more
- Highly power-efficient — draws very little power from the wearable mobile computer to ensure full-shift operation on a single charge

HS3100™ BLUETOOTH OR HS2100™ CORDED HEADSET



When it comes to enabling speech-directed applications in warehouses, manufacturing plants and outdoor yards, you need a headset that is specially designed for the job. The HS3100 Bluetooth and HS2100 corded headsets are loaded with all the features you need in an industrial headset, including:

- A go-anywhere rugged design is dust proof, spray proof, waterproof and freezer proof
- Feather-weight comfort
- HD Voice and superior noise cancellation for a rich and natural sounding voice that offers unparalleled audio clarity and voice recognition performance
- 15 hours of battery power for Bluetooth models
- Simple tap-to-pair, allowing you to add a Bluetooth headset to your WT6000 wearable computer in less than a second
- Over or behind the head wearing styles in Bluetooth or corded headsets
- All pads are user-replaceable — boom windscreen, ear pads and temple pads



TEKSPEECH® PRO 4



With TekSpeech Pro 4, you can quickly and easily marry speech with all the capabilities of your Zebra mobile computers and their attached peripherals to create flexible next generation multi-modal speech-directed solutions that turbocharge efficiency by providing more ways for workers to collect and access more information. Features include:

- WorkFlow Builder, an integrated development environment that makes it easy to create even your most complex workflows
- The most advanced global voice recognition engine available
- Controllable text-to-speech speeds to shave seconds off of your workflows
- The ability to incorporate multiple languages in a single prompt
- Real-time dynamic vocabulary for lightning-fast response times
- Built-in tools that make it easy to deploy and manage your Zebra Total Wearables Solutions — including the WT6000 wearable computer, ring scanners, headsets, configurations, licenses, sites, users and more
- Integrates easily with your existing Warehouse Management System (WMS) or Enterprise Resource Planning (ERP) applications
- Comprehensive employee usage metrics that provide visibility into the workflows that are working, and which workflows could be improved — viewable for individuals, shifts and sites
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WHITE PAPER

A BENEFITS ANALYSIS: THE ADVANTAGES OF MULTI-MODAL SPEECH-DIRECTED SOLUTIONS

1: Source - 2015 Global Warehouse Vision Study; Business and Market Intelligence; November 6, 2015; Zebra Technologies



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