VDC|Research
Insights for the Connected World

Optimizing Mobile Warehouse Solutions

Mapping Mobile Solutions to Meet Warehouse Modernization Initiatives

TABLE OF CONTENTS

LIST OF EXHIBITS

EXECUTIVE SUMMARY

For many organizations, supply chain operations are becoming a growing source of competitive differentiation and increase the focus on investment decisions surrounding disciplines such as logistics and warehouse operations. As organizations look to retool their operations to better meet these rigors, warehouse solution decision makers are citing the need to support faster shipments and improve labor performance as leading warehouse solution investment catalysts, driving the need for smarter warehouse operations. Workflow shifts from pallet fulfillment to item-level support isplacing a greater strain on warehouse performance, further exposing the cost of errors and increasing the need to equip workers with solutions that enable ever higher levels of performance. With labor the single highest cost for these businesses, VDC research indicates that as long as the human element continues to play a central role in warehousing, any technology that optimizes workflows and improves accuracy will add tremendous value.

Mobile solutions are used extensively to support warehouse operations and are fundamental in supporting a wide range of workflows from the receiving to the shipping dock. However, the ubiquitous rugged handheld device is at a crossroads as the primary mobile OS supporting these devices – either Windows CE or Windows Mobile – have already reached their end of meaningful life and are rapidly approaching their end of extended support. What makes this scenario particularly challenging is that there is no clear migration path forward, with each OS option requiring significant rework to legacy applications. For a user base that has been traditionally risk averse – key-centric terminal emulation has remained the primary approach to support mobile warehouse applications for over a decade – addressing this represents a critical decision for organizations focused on minimizing disruption.

Key Research Findings:

> Key pressures driving mobile warehouse solutions modernization investments include customers demanding orders faster, existing systems incapable of keeping up with orders, and mitigating the high cost of labor

> Leading factors influencing mobile solution upgrades include the end of life of the mobile OS on existing devices, desire to upgrade applications to a more visual and intuitive interface, and the overall age of existing mobile solutions

> The greatest perceived barriers or concerns regarding upgrading existing mobile solutions include the cost and time required to recode legacy mobile applications and the potential security threats introduced by next generation mobile platforms

> Windows-based mobile operating systems (primarily Windows 10 IoT Mobile Enterprise) lead other options among warehouse technology decision makers with factors such as security, modern UI, and ability to customize cited as the leading OS selection criteria

METHODOLOGY

To support this research, VDC Research was contracted by Wavelink to survey decision makers with mobile solution purchase or specification responsibility for use in warehouses and distribution centers. The survey was completed by 107 qualified respondents in both North America (41%) and Europe (59%). The survey was fielded in June, 2016.

Mobile Solution Modernization Scope and Methodology

Study Objectives

▸ Research mobile requirements for warehouse applications

▸ Evaluate next-gen mobile OS migration plans

Study Respondents

▸ 107 survey respondents

▸ Mix of respondents in US and Europe

▸ Responsible for selection, purchasing, and /or support of mobile solutions for warehouse applications

▸ Mix of industries represented

Study Methodology

▸ Fielded an online survey among technology decision makers supporting mobile solutions for warehouse operations and voice solutions

▸ Survey fielded in June 2016

Key Study Topics

▸ Current investment in mobile solutions for warehouse operations

▸ Operational challenges faced and addressed

▸ Migration plans for legacy mobile solutions deployed

▸ Next-gen mobile OS migration plans
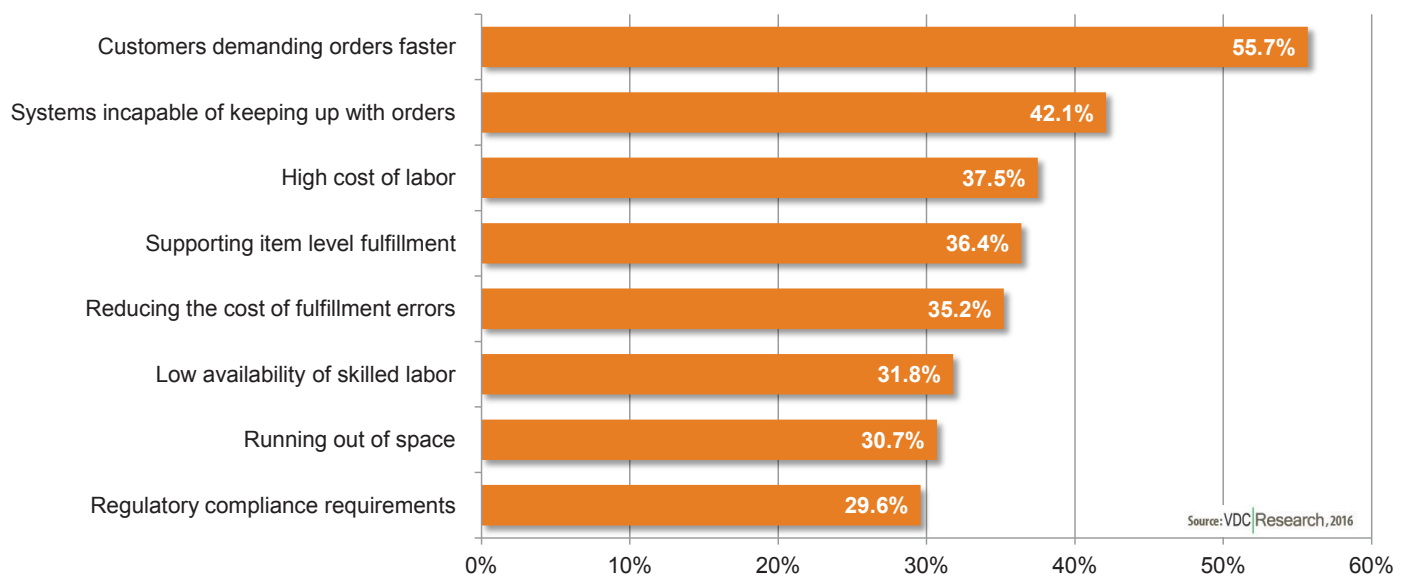
Source: VDC Research, 2016

REDEFINING WAREHOUSE OPERATIONS

The increasingly central role that e-commerce plays in retail has raised customer expectations in product availability, delivery times, and costs. These expectations were taken to new heights last year when Amazon announced the introduction of same-day delivery within certain parts of the United States. Traditional brick-and-mortar companies seek to maintain market share by offering omni-channel shopping to counter purely online competition. These changes have had a profound impact on warehousing.

However, warehouses can be the throttle or bottleneck of an organization's supply chain. Organizations in the warehouse and logistics industry face substantial pressures to improve their warehouse/DC operations. As complexity of processes increases, warehouses and distributors are seeking new ways to optimize their operations with rising labor costs. Today's warehouses are more complex than they were 10 years ago. Our research confirms these trends with decision makers, highlighting the need to reduce cost of errors, perform faster order fulfillment, control high costs of labor, and improve space utilization as the leading pressures to optimize their warehouse performances.

Exhibit 1: Leading Pressures Driving Investment in Mobile Solutions
(Source: VDC Research, 2016)

Moreover, the cost of errors is a major concern to organizations. Incorrect orders sent out to customers can cause businesses thousands, as well as the loss of repeat business and can be a reverse logistics nightmare for organizations as they have to receive and handle returned products from customers. In regards to faster order fulfillment, customers now want their products delivered faster than ever. What once was an industry standard of delivering in four to five days has now changed to next day or even same day. More than 90% of businesses surveyed feel moderate to substantial levels of pressure of customers demanding to see their orders fulfilled faster.

As warehouses and distribution centers continue to take on bigger roles and become vital to the growth strategies of organizations, in the next several years, we will see significant transformations in the warehouse we know today. Dynamics impacting warehouse and supply chain operations has meant that enterprises are looking to a more multi-modal approach in their warehousing solutions. Current solutions revolve around automatic data collection technologies: barcode scanning, RFID, and voice. These technologies are pervasive in most modern warehouses and have contributed significantly to the performance gains experienced over the past decade. Voice-based warehousing in particular provides a tangible benefit to companies looking to optimize warehousing operations and has been proven to provide an exceptionally strong ROI. Research conducted by VDC revealed that organizations employing voice-based technology have consistently cited gains of more than 20% in both picking accuracy and worker productivity.
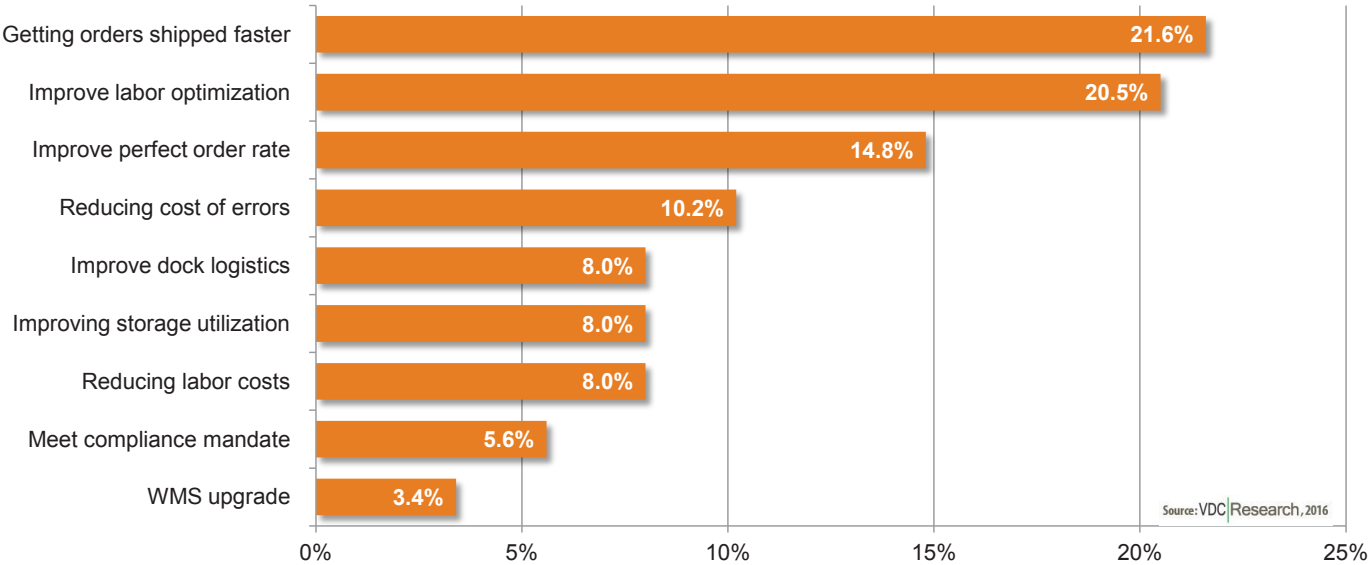
However, there have been limitations to many legacy solutions in the context of high adoption costs and proprietary design. VDC research shows that while firms are generally satisfied with their existing solutions, particularly in regards to accuracy, support, and ease of use, they cite costs of implementation and maintenance, limited compatibility with non-proprietary hardware, and training times as the top weaknesses of the current technology.

VDC research shows trends toward a greater use of e-commerce and omni-channel retail by revealing that nearly all warehousing systems are facing moderate to strong pressure to support more individual piece picking. Existing physical and technological limitations also are major motivating factors to optimize: 56% of those surveyed reported that lack of space exerts moderate pressure on their operations, and 57% noted similar pressures from existing systems being incapable of keeping up with order volumes. However, the pressure to meet customer demands for faster order delivery and associated cost of errors are firmly at the top of the list as a motivating factor. A full 50% of companies surveyed reported that customer demands exerted strong pressure on their operations, while 43% acknowledged similar levels of pressure in reducing the cost of errors. As a result, there is an ever-increasing need for process efficiencies to boost both productivity and accuracy.

The Warehouse Labor Issue

The single largest expense for warehouse operations today is labor. In the US alone, employment in the warehouse and logistics industry has shot to 791,200 in 2015 and average hourly wages have increased 13% since 2005. As a result, ensuring that warehouses employ the "right" labor and solutions to support that workforce is critical, and in a sector where seasonal workers have such a huge impact, training and onboarding has become even more critical. In preparation for the 2016 holiday season, Amazon is planning on hiring 120,000 seasonal workers in the US alone. Considering that it can take three to five days to properly train warehouse workers, training employees and workforce optimization is understandably a big part of overall costs, especially in peak seasons. Having systems and solutions in place to help ease the financial burden on organizations will become more important than ever in the future. This means having mobile solutions that are easy to learn and intuitive to use become only more important to achieving one's performance goals. Modern mobile solutions with more graphical screen-directed inventory picking and replenishment solutions have shown to cut training time by almost 50%. In addition, significant benefits from more dynamic workflows – including the use of task interleaving to improve efficiency – are becoming the norm.

Exhibit 2: Primary Warehouse Improvement Initiative for 2016
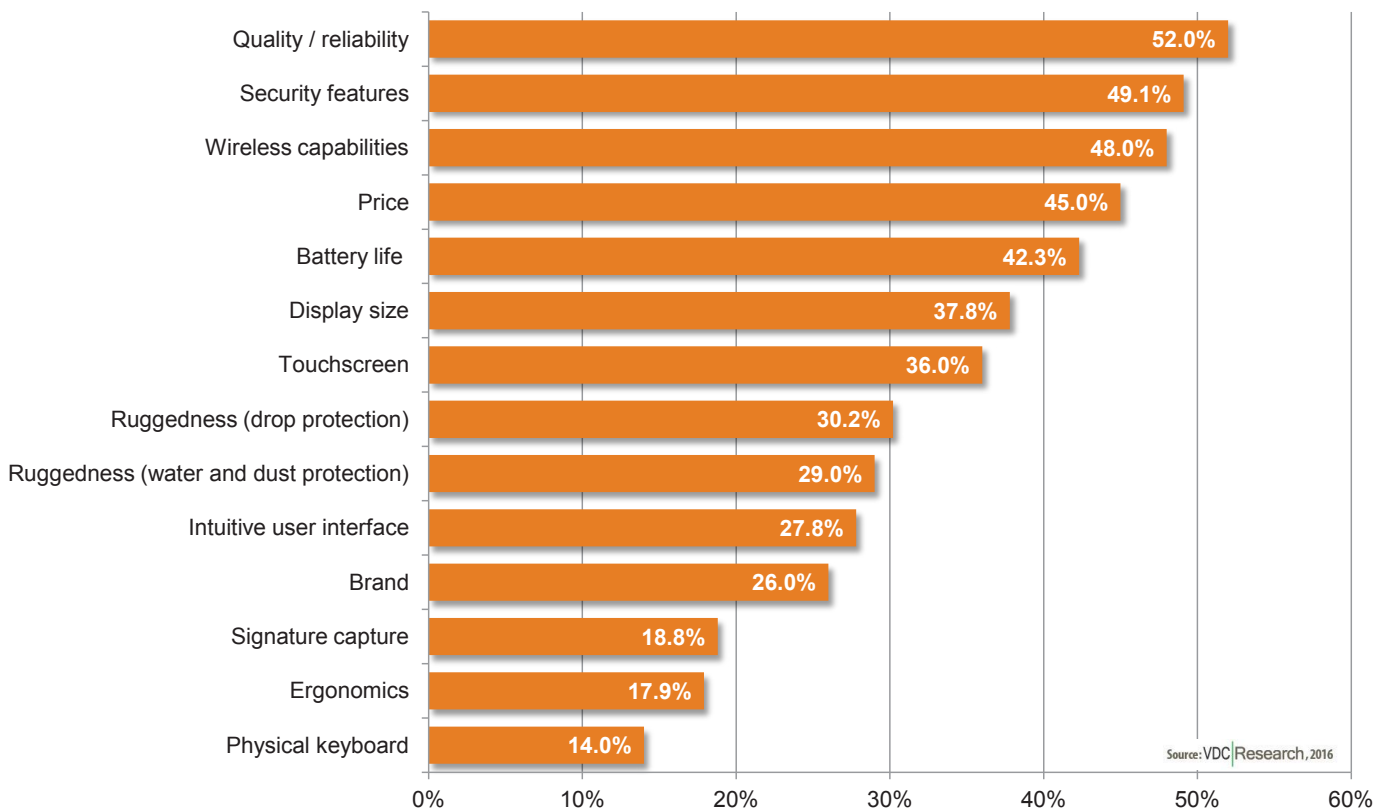*(Source: VDC Research, 2016)*

THE MODERN MOBILE SOLUTION FOR THE WAREHOUSE WORKER

The largest determinant for making appropriate investment decisions is mapping mobile device capabilities and specifications to the application requirements and potential hazards in the deployment environment. A critical element for any successful mobile solution in warehousing environments is to evaluate these requirements in greater detail and use them as guides to select the optimal mobile device. These include length of deployment/replacement cycles, failure rates and causes, opportunity cost of lost productivity, to name a few. In addition, the importance of ease of use and more modern design and interfaces is slowly emerging as a more critical consideration for these solutions.

Mobile device solution requirements for warehousing applications are particularly rigorous, especially when it comes to management, reliability, solution ease of use and uptime, IT integration, and ability to audit and support. Some of the more critical include:

> **Durability and reliability.** Based on their design and portable use cases, the risks of damaging mobile devices by warehouse workers are great, increasing the premium for rugged design. Annual failure rates of non-rugged smartphones/handheld devices and tablets used in the warehouse as recently measured by VDC was 19.8%, substantially higher than the 3.8% failure rate for similar rugged devices. Although most warehouses will have a spare pool of mobile devices in case of failure, the consequences of higher rates of mobile device failure among warehouse workers will directly impact operational efficiencies. On average, warehouse workers can experience 30-40 minutes of downtime as a result of mobile device failure.

> **Battery life and management.** A major requirement for mobile devices supporting warehouse workflows is a strong battery life that lasts AT LEAST one entire shift. Similar to device failure, poor battery performance can lead to disruption of workflows and erosion of operational efficiencies.

> **Ease of use.** Leveraging consumer design styles to deliver greater ease of use and user experience is becoming increasingly critical when considering mobile solutions supporting warehouse workers. To date, most warehouse mobile applications are text-heavy "green-screen" applications that rely primarily on keyboard input. Learning curves for new users are steep, a critical issue especially considering the large value of temporary seasonal workers supporting warehouse workflows. With display size and touch-screen capabilities becoming more critical device-selection criteria, organizations will be looking to migrate to more intuitive "consumer-like" mobile warehouse applications. For example, mobile warehouse solutions with more graphical screen-directed picking solutions can reduce the onboarding time for new employees by up to 50%.

> **Ease of support.** Beyond ease of use, ease of support is of equal importance. Key support requirements include mobile device and application management, help desk services, depot and advanced maintenance and repair services.

Criteria	Percentage
Quality / reliability	52.0%
Security features	49.1%
Wireless capabilities	48.0%
Price	45.0%
Battery life	42.3%
Display size	37.8%
Touchscreen	36.0%
Ruggedness (drop protection)	30.2%
Ruggedness (water and dust protection)	29.0%
Intuitive user interface	27.8%
Brand	26.0%
Signature capture	18.8%
Ergonomics	17.9%
Physical keyboard	14.0%

Source: VDC Research, 2016

The Next-Generation Mobile Platform for Warehouse Applications

Rugged enterprise handheld mobile computers are used as data collection and processing devices across a variety of workflows in virtually every industry. These devices are ubiquitous in warehouses and distribution centers for inventory and material management applications to courier delivery drivers supporting parcel delivery verification and beverage distributors supporting digital exchange. Organizations rely on these devices to conduct business-critical applications and operations in real time. However, the dominant OS supporting the devices is nearing its end of life, leaving current customers with no clear migration path forward. Put another way, no matter which OS platform an enterprise looks to deploy next to support these applications, the application will need to be redeveloped and recoded as it will not be forward-migratable.
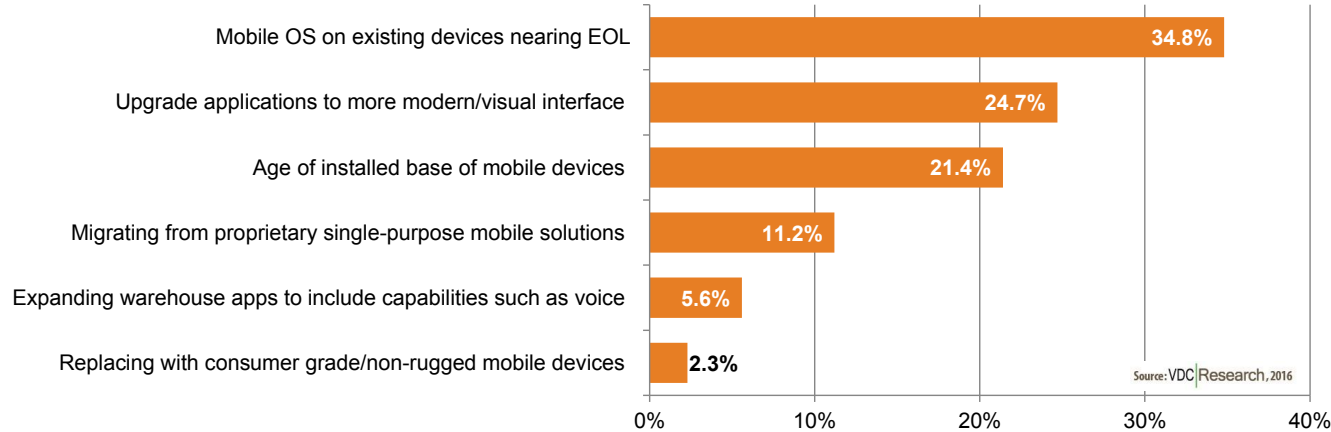
Over the past decade, Windows CE and WEH 6.5 have become the OS platforms of choice for the majority of enterprise mobile devices. The platform has offered its enterprise customers a broad portfolio of devices to select from; as well as strong development tools, a stable developer community, and wide support among enterprise mobility-focused ISVs. In addition, with support from Microsoft for 10 years, enterprise customers received the stability critical to their enterprise mobility investments. However, Microsoft also recognized that their mobility efforts were not resonating with the broader market – especially consumers – and made a critical decision to develop a platform that took better advantage of the significant advances in mobile hardware and conformed to the touch-centric sensibilities of today's leading mobile solutions. Microsoft's initial attempt was Windows Phone 7 (WP7) that was introduced in 2010. WP7 was based on the Windows Embedded Compact 7 version of Windows CE, which was also used in Windows Mobile. The platform was designed with consumers in mind with tight integration of social media and other services and did not offer a viable enterprise-device vision. The market did not take with Microsoft ending service for WP7 in 2014, two years after the release of Windows 8. In addition, and most importantly for the enterprise device community, as of January 2015, WEH 6.5 is completely off Microsoft mainstream support with only security patches provided until 2020.

Thus, the need to equip mobile workers with updated mobile devices and software over the next several years is clear. What is less clear is the direction to take in terms of next-generation platforms. Options available to customers include Android, Windows Embedded Handheld 8.1, iOS, and Windows 10 IoT Mobile Enterprise. Alternatively, customers can elect to remain on legacy platforms knowing that Microsoft will no longer issue security patches and software updates after they have reached EOS, thus increasing risk and potential cost of ownership and support of these specialized devices. Beyond selecting their next-generation platforms, enterprise customers are also weighing the decision of timing. Although the EOS deadline of 2020 is fast approaching, the lack of a viable Windows option to date – beyond Windows Embedded Handheld 8.1, which for most represents a non-starter – has driven many organizations to hold off making a decision, extending the lifecycle of existing devices. With Windows 10 IoT Mobile Enterprise devices becoming available in the second half of 2016, end users will be able to more effectively compare options, which should accelerate decision making and investment plans.
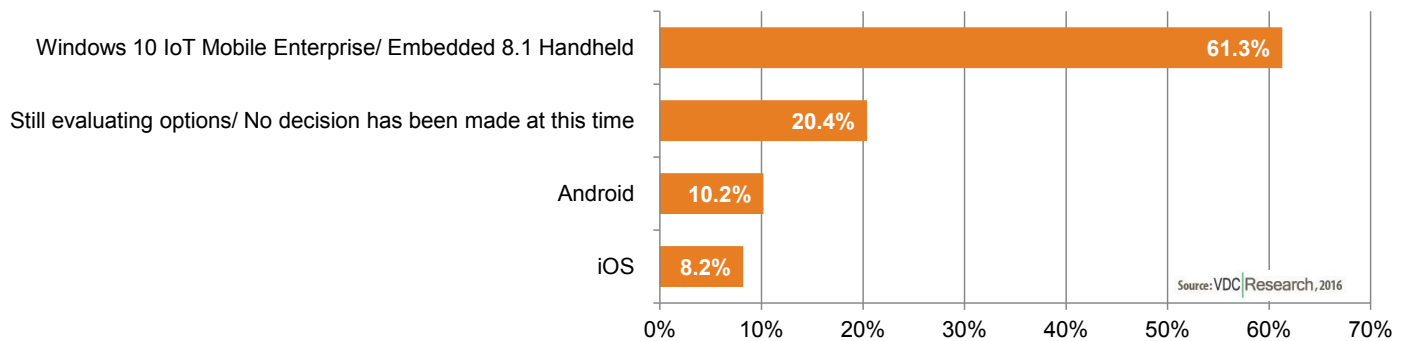
Our research confirms this market reality with over 55% of respondents to a survey indicating that they were planning on upgrading existing mobile devices supporting warehouse applications because existing solutions were nearing their end of life and/or the old age of existing devices. In addition, the motivation to upgrade applications to a more visual or modern user interface was cited by one in four respondents as a critical factor influencing their upgrade decision. This is important as most warehouse mobile solutions have been built using very basic text and keyboard-centric designs. Consequently, training of warehouse workers has represented a critical challenge for organizations as new employees require several days to learn the custom configuration and function-key settings required to seamlessly operate these devices. For a sector that significantly relies on seasonal workers, this represents a growing problem. Moreover, with "improving labor optimization" identified as a Top Two warehouse improvement initiative, the need for more intuitive mobile solutions that more closely resemble consumer mobile applications is becoming increasingly critical among warehouse technology decision makers.

Exhibit 4: Primary Factor Driving Decision to Upgrade Mobile Devices
(Source: VDC Research, 2016)

According to VDC's most recent research, almost one in four rugged handheld computers that shipped over the first half of 2016 were running Android, with the balance primarily supporting legacy Windows CE and WEH 6.5. While this evidences the staying power and commitment towards legacy platforms, it similarly illustrates Android reaching critical mass in this segment. However, much of this Android demand has come from solutions supporting touch-centric "customer facing" applications that most directly benefit from the design and functionality of more modern mobile devices. These include solutions in retail services, postal and courier services, and logistics, for example. However, penetration of Android in the warehouse has been considerably lower, predominantly a function of the nature of mobile applications in the warehouse and, until recently, the lack of warehouse-specific rugged mobile devices running Android.

Exhibit 5: Mobile OS Plan to Migrate Legacy Windows Devices
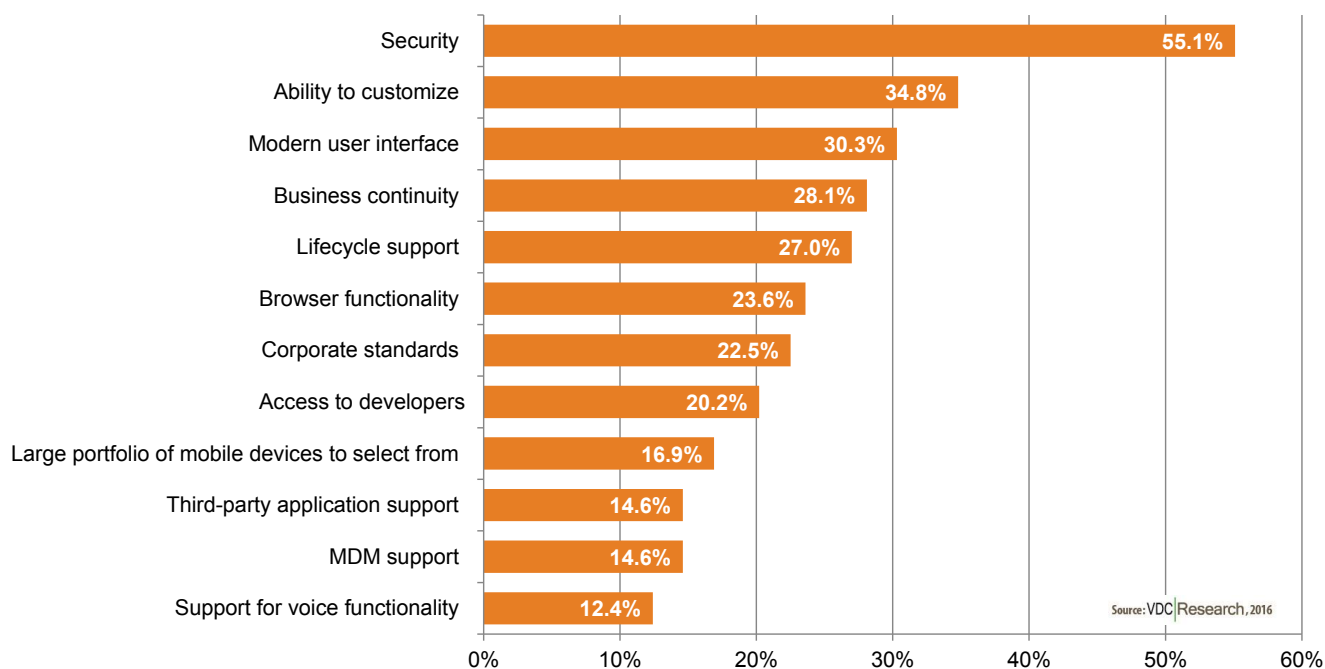*(Source: VDC Research, 2016)*

This Windows-dominant scenario is similarly expressed when warehouse technology decision makers were asked about their mobile OS migration plans. The level of pent-up demand for a Windows solution was expressed in the survey data, with over 61% of respondents indicating plans to migrate legacy devices to Windows 10 IoT Mobile Enterprise or Windows Embedded 8.1 Handheld (the majority favoring W10). In addition, approximately 2 in 10 respondents have yet to make a formal decision while 10.2% favor Android.

The Windows-dominant sentiment is not surprising, given its history in this environment and the continued resilience of Windows CE terminals. While Android is being actively considered by only 10% of respondents, this is also coming from a base of essentially zero with, until 2016, no real Android-powered devices designed significantly for warehouse use cases. However, with the growing availability of Android-powered devices targeting Warehouse applications – in particular wearable solutions – Android adoption is in position to scale. Each platform choice offers distinct capabilities and end users will need to determine which offers the best option to support their requirements. What is clear, however, is that existing platforms will soon reach their end of service (EOS) life and no matter which next-generation platform is selected, recoding of existing applications will be required.

Mobile OS Capabilities for Warehouse Applications

When evaluating mobile operating systems for warehouse applications, critical requirements represent a balance between traditional enterprise-specific capabilities and those that reflect the growing influence on consumer technologies and experiences on enterprise solutions. More specifically, enterprise-specific features such as robust security, lifecycle support, and ensuring business continuity are cited as key requirements. What is perhaps new – especially for warehouse applications – is the need for a modern user interface and the intuitive capabilities inherent with today's consumer mobile applications. Balancing these requirements with others such as access to developers and to a broad portfolio of mobile devices is what warehouse decision makers are considering for their next-generation solutions.

Exhibit 6: Mobile OS Selection Criteria
(Source: VDC 2016 Analysis)

Android is the leading smartphone operating system with approximately 80% market share. With its origins firmly rooted in consumer mobile devices, Android has recently made significant inroads as an enterprise mobile platform suitable for business-critical mobile applications. The Android ecosystem benefits from widespread support from a diverse group of OEMs and a growing community of ISVs and developers. However, the vast success and rapid ascension of Android has also exposed many of its vulnerabilities. As an open platform that provides OEMs with opportunities to customize, the issue of platform fragmentation is a legitimate concern. Moreover, the success of Android devices has made it a popular target for malware attacks. Finally, the rapid development of the platform – following the release of Android 6.0 (Marshmallow) there have been 13 updates or versions since the release of Android 1.0 in 2008 – is a concern for enterprise customers for whom platform stability and lifecycle support come at a premium.

However, various initiatives by prominent Android OEMs, Google, and MDM ISVs have evolved the platform into a more robust option for enterprise applications. Enterprises have the option to prevent access to Google's Play Stores, they can prevent side loading of applications and control access to the Internet on these devices. In addition, through widely available MDM solutions, devices can be managed and supported via a centralized dashboard. In addition, the ISV community that has built businesses around developing solutions for legacy Windows platforms has migrated many

of these applications to Android. The issue of platform fragmentation can actually be of benefit to the enterprise device eco-system as device OEMs can provide extended support for legacy platforms and not force customers to persistently migrate to the latest OS version. Consequently, by the end of 2015, 20% of rugged handheld unit shipments were running on Android.

Microsoft's answer to the next-generation platform for rugged handheld devices has been Windows Embedded Handheld 8.1. The platform has been adopted by a small number of OEMs, however, the devices available supporting this platform today is limited. Other limitations include lack of MDM support and issues relating to VPN integration. While Microsoft is providing support for this platform through 2019, its efforts and focus have shifted towards Windows 10, and more specifically, Windows 10 IoT Mobile Enterprise for special-purpose ruggedized devices. Microsoft's approach with OEMs supporting Windows Embedded Handheld 8.1 and Windows 10 has been to more tightly control specifications, limiting customization options to OEM partners, solution providers, and end users.

The impact of Windows 10 IoT Mobile Enterprise on the rugged handheld market is still largely unknown. Devices are just being made available by OEMs and have yet to be fully vetted by the eco-system of solution providers supporting rugged mobile solutions. From a timing perspective, this puts this platform approximately two years behind where next-generation rugged Android solutions sit in the market today. Consequently, the pent up demand that does exist for a Windows solution among many existing rugged handheld customers has forced some of the market into a prolonged holding pattern, while many are increasingly migrating to alternative platforms. Other unknowns that are contributing to customers' concerns include the pace at which Microsoft will provide updates moving forward and the guarantee or protection against a similar scenario occurring that will force an application re-write in the near future. In addition, lack of customization options for enterprise customers will in several cases also represent a critical concern if not an outright deal breaker.

Unlike Android or legacy Windows embedded OS platforms, Apple's iOS is a tightly controlled environment with Apple the only supplier of mobile devices. Although Apple designs products and applications primarily with the consumer in mind, it is increasingly targeting the enterprise and is actively developing relationships with leading enterprise integrators and solution providers. Apple's share of the smartphone market ranges between 15% and 20%, and, although Android is gaining ground, today has arguably broader enterprise presence and support. Apple, however, is not well positioned to support many of the more specialized applications supported by ruggedized devices. Although iPhones can be accessorized with protective cases and scanner sleds to enable some of the enterprise functionality required for these applications, the final solution often reflects a series of compromises.

HTML5 offers the opportunity or promise to develop cross-platform applications that can be ported seamlessly from one platform to another, and provides some level of protection from the rapidly changing mobile landscape. The HTML5 standard has evolved to address some of the limitations of earlier versions, including offline support and support for certain device-side capabilities such as the camera or scanner. However, for many enterprise mobility applications – especially those with more sophisticated data capture and management requirements – enterprises prefer the performance of native applications and typically relegate lightweight "micro" applications to HTML5. According to recently conducted research by VDC, enterprises supporting or developing line-of-business mobile applications prefer native development over other options.

Mobile OS Platform Capabilities			
	Android	Windows Legacy	Windows 10 IoT ME
User Friendly	★★★	★	★★★
Customizable	★★★	★★★	★
Dev Community Support	★★★	★	★
ISV Support	★★★	★★	★
Device Portfolio	★★	★★★	★
Device Encryption	★★★	★	★★★
OS Fragmentation	★★	★	★★★
Microsoft Infrastructure Compatibility	★★★	★★★	★★★

CONCLUSIONS

Warehouses can be the throttle or bottleneck of an organization's supply chain. With the continued growth of e-commerce and expansion of omni-channel shopping options by all retailers, the pressures for ever faster and more accurate order fulfillment is redefining supply chain operations. Warehouse technology decision makers are faced with a variety of investment options to meet tomorrow's performance requirements. While automation will play an ever increasing role in warehouse operations, the warehouse worker will remain the pulse of these facilities. Equipping these warehouse workers with modern mobile solutions to streamline onboarding and ensure the most efficient use of this critical resource is paramount to any successful operation. This will include upgrading legacy mobile solutions with more modern, intuitive, and ergonomically designed mobile solutions.

ABOUT THE AUTHOR

David Krebs

David Krebs has more than 10 years of experience covering the markets for enterprise and government mobility solutions, wireless data communication technologies, and automatic data-capture research and consulting. David focuses on identifying the key drivers and enablers in the adoption of mobile and wireless solutions among mobile workers in the extended enterprise. David's consulting and strategic advisory experience is far reaching and includes technology and market opportunity assessments, technology penetration and adoption enablers, partner profiling and development, new product development, and M&A due diligence support. David has extensive primary market research management and execution experience to support market sizing and forecasting, total cost of ownership (TCO), comparative product performance evaluation, competitive benchmarking, and end-user requirements analysis. David is a graduate of Boston University (BSBA).

Contact David:
davidk@vdcresearch.com

ABOUT VDC RESEARCH

Founded in 1971, VDC Research provides in-depth insights to technology vendors, end users, and investors across the globe. As a market research and consulting firm, VDC's coverage of AutoID, enterprise mobility, industrial automation, and IoT and embedded technologies is among the most advanced in the industry, helping our clients make critical decisions with confidence.

VDC|Research
Insights for the Connected World

Offering syndicated reports and custom consultation, our methodologies consistently provide accurate forecasts and unmatched thought leadership for deeply technical markets. Located in Natick, Massachusetts, VDC prides itself on its close personal relationships with clients, delivering an attention to detail and a unique perspective that are second to none.

info@vdcresearch.com