

**Venture Development Corporation  
Mobile and Wireless Practice**



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***A White Paper On:***

***TOTAL COST OF OWNERSHIP (TCO) MODELS  
FOR MOBILE COMPUTING AND  
COMMUNICATIONS PLATFORMS***

*Second Edition*

*Prepared by:*

*David Krebs*

*Mobile and Wireless Practice  
Venture Development Corporation  
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**VENTURE DEVELOPMENT CORPORATION**

TECHNOLOGY MARKET RESEARCHERS AND STRATEGISTS SINCE 1971

Tel: 508.653.9000 ♦ Web: [www.vdc-corp.com](http://www.vdc-corp.com) ♦ Email: [info@vdc-corp.com](mailto:info@vdc-corp.com)

The following white paper summarizes some of the significant findings from VDC's recently released report, *Total Cost of Ownership Models for Mobile Computing and Communications Platforms, Second Edition*.

## INTRODUCTION

Today's enterprises continue to race forward with productivity, profitability and shareholder value growth agendas. Distributing the enterprise remains atop the list of strategic and information technology initiatives for global leaders from virtually every industry. Their mantra goes something like this: achieving strategic, financial and operational goals is a function of the organization's ability to improve the accuracy, speed, and reliability of decision making, transaction processing and documentation. The critical enabling technology supporting this next wave of business transformation is the mobile computing and communication platform. With so much riding on the performance of these systems and so much capital required to support certain configurations, selecting the right system is becoming a key strategic decision for many end users.

VDC, a leading research authority on enterprise mobility solutions, recently completed an update to its groundbreaking research on mobile computing total cost of ownership (TCO), initially conducted in 2003/2004. The objectives of the research were to develop accurate and defensible TCO models for a variety of mobile computing form factors and levels of ruggedness or durability. In addition, the research set out to compare mobile computer TCO inside a variety of applications or installation environments. The mobile computing markets have changed materially during the past three years. VDC's TCO data collection and analysis models offer greater detail and accuracy. The market needs better data, VDC models can provide that data – thus this updated release. Consider the following:

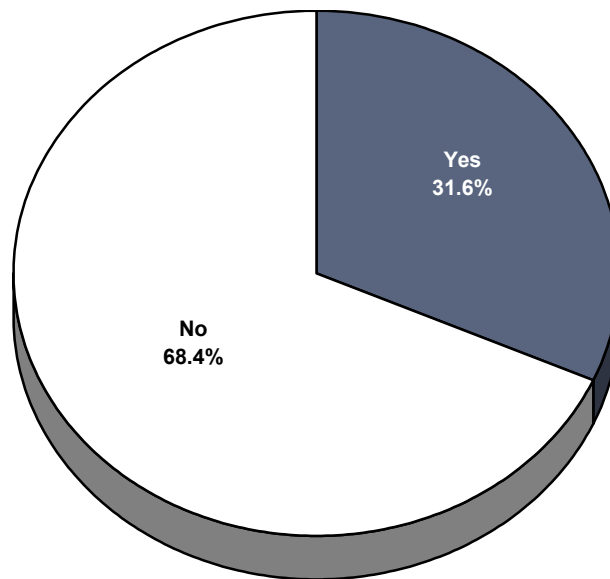
- **Emergence of Durable Mobile Computers.** Non-rugged mobile computer vendors are beginning to acknowledge the limitations of their hardware and are investing to improve their durability. Key developments include shock-mounting hard drives, integrating accelerometers, and spill-proofing keyboards. While these enhancements fall well short of the IP, NEMA or Mil-STD rated rugged hardware, can they significantly reduce the historically high failure rates of commercial-grade mobile computers?
- **Increased Dependency on Mobile Applications/Devices.** As organizations continue to port more line-of-business applications onto mobile devices, the impact of a non-working device in the field may also extend into lost revenue opportunities. According to VDC's 2007 research, mobile device end users lost an average of 75 minutes of productivity each time the device failed. With the average device failing as much as 20 times per year, that can translate into as much as \$4,000 in lost revenues per employee per year.

Understanding mobile device TCO is simply becoming more important, not only for current and potential end users but also for mobile device hardware manufacturers and system integrators. Supported by a rigorous primary research methodology designed to draw comparisons by mobile computer type, OS platform, level of ruggedness, application type and user environment, VDC has developed the definitive unbiased third-party research on mobile computing TCO analysis. This research note provides the summary findings of VDC's six-month research endeavor.

## ENTERPRISE APPROACH TO MOBILITY INVESTMENTS AND TCO ANALYSIS

Enterprise mobility investment decision making, while multi-functional, is being centralized within organizations. Moreover, solutions for Fortune 1000 organizations are increasingly being planned on a global scale. However, organizations frequently do not have the analytical tools or information necessary to make informed decisions. This is perhaps best illustrated in an organization's use of TCO tools to make better mobile computing investments. In fact, according to VDC's most recent mobile computing research, less than one in three organizations currently use TCO analysis when investing in mobile computing solutions (See Exhibit 1).

Exhibit 1  
Use of TCO Analysis During Mobile Decision-Making Process  
(Percent of Respondents)



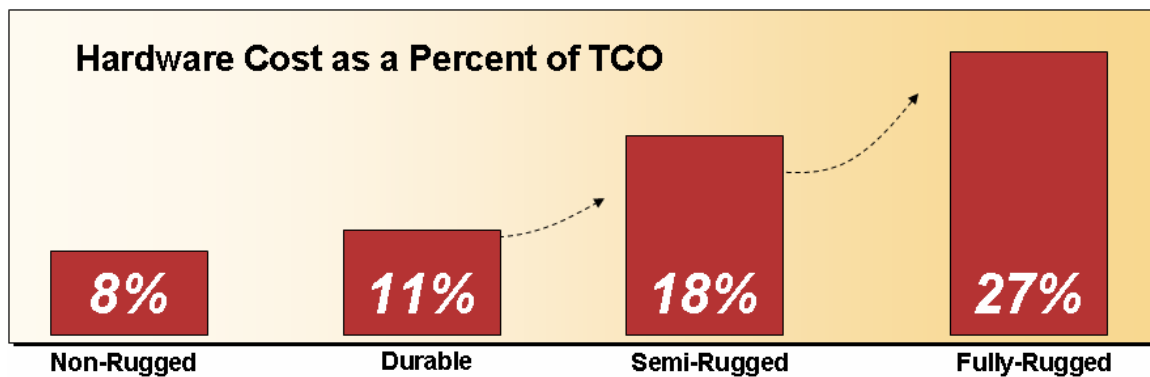
Although this is as much a factor of the overuse – or misuse – of TCO as a savvy marketing and sales tool by mobile computing vendors and the larger IT community, it also relates to the lack of accepted or standard approaches to calculating mobile computer TCO. Most TCO analysis places greatest emphasis on upfront system acquisition, deployment and training costs – in other words, hard costs. However, VDC's research reveals that the soft costs associated with mobile computing solutions – device failure and downtime, productivity loss and maintenance/ support costs – represent the most significant contribution to overall TCO (See Table 1).

**TABLE 1**  
**Hard and Soft Costs of Mobile Computing Deployments**

Hard Costs			Soft Costs		
Hardware Costs	Software Costs	Development Costs	Training Costs	Operational Costs	Downtime Costs
<ul style="list-style-type: none"> <li>• Platforms</li> <li>• Peripherals</li> </ul>	<ul style="list-style-type: none"> <li>• Upfront Fees</li> <li>• License Fees (incl. GUI/ Preso; NW; App.; etc.)</li> <li>• Development/ Customize</li> </ul>	<ul style="list-style-type: none"> <li>• Application Design/ Development (Standard &amp; Customized)</li> <li>• Integration (Internal &amp; Third Party)</li> <li>• Staging</li> </ul>	<ul style="list-style-type: none"> <li>• Initial User Training</li> <li>• On-Going User Training</li> </ul>	<ul style="list-style-type: none"> <li>• System Maintenance (standard; extended; replacement; etc.)</li> <li>• Third Party/ Internal Technical Support</li> <li>• Hardware/ Software Upgrades</li> <li>• Application Management (Third Party/ Internal)</li> </ul>	<ul style="list-style-type: none"> <li>• Hardware Replacement</li> <li>• Lost Manpower/ Wages</li> <li>• Lost Revenues</li> </ul>

Understanding these soft costs and being able to marry the best possible mobile computer with the target user and application is ultimately what will set apart mobility innovators and enable companies to fully leverage mobility investments as a true competitive advantage. However, organizations looking to cut expenditures will frequently opt for lower cost mobile computing hardware. In many cases this means the use of a non-rugged mobile computer for applications that are better served by rugged devices. Given the high current rate of failure of non-rugged mobile computers, this refers to a broad collection of mission-critical enterprise mobility applications and not just deployments in the most extreme environments. While non-rugged mobile solutions typically have lower adoption costs, for many applications, they represent a much smaller percentage of TCO in comparison to rugged solutions (See Exhibit 2).

**Exhibit 2**  
**Mobile Hardware Cost as a Percent of TCO**



**WHERE RUGGED MOBILE COMPUTERS HAVE A TCO ADVANTAGE**

VDC’s research again confirmed that the TCO of rugged mobile computers is in many cases lower when compared to non-rugged mobile computers in similar applications using the same mobile computer form factor. Leading user environments evaluating are summarized in Table 2.

**TABLE 2  
End-User Environments Evaluated**

User Environments	Definition
Public Safety/EMS	<ul style="list-style-type: none"> <li><u>Police</u>. Organizations involved in providing safety and security to serve and protect the property and citizenry of their respective jurisdiction (i.e. local, state, federal etc.). The employees respond to and thwart crimes, disturbances and disputes, investigate crimes, etc.</li> <li><u>Fire/EMS</u>. Organizations involved in responding to emergencies such as fires, accidents, and natural and man-made disasters, among others. Employees are typically trained in providing medical service, from basic levels to complicated care.</li> </ul>
Field Professionals/ Service	<ul style="list-style-type: none"> <li><u>Field Service (MRO)</u>. Field personnel whose primary job function is to maintain and repair all types of equipment. Key service segments include utilities, telecommunications, HVAC, office and building automation, transportation equipment, etc.</li> <li><u>Field Sales</u>. Field personnel whose primary job function is to sell products and/or services to all types of companies. Major sub-segments include pharmaceuticals, insurance, financial services, etc.</li> </ul>
Manufacturing	<ul style="list-style-type: none"> <li><u>Factory Floor</u>. Organizations involved in discrete or process manufacturing operations. Key industries include chemical/petrochemical, electronics, automotive/ transportation equipment, and consumer packaged goods, among others.</li> </ul>
Retail Services	<ul style="list-style-type: none"> <li><u>Shop Floor</u>. Organizations involved in retail service operations. Key segments include mass-merchants, DIY, grocery, specialty, gas/convenience, department stores among others.</li> </ul>
Health Care Service	<ul style="list-style-type: none"> <li><u>Health Services</u>. Organizations that employ personnel whose primary job function is to provide medical care to the surrounding community and others, either on a profit or non-profit basis. Key segments include hospitals, long term care facilities, GP offices, community clinics, etc.</li> </ul>
Transportation/ Distribution	<ul style="list-style-type: none"> <li><u>Mail courier/ Freight</u>. Organizations involved in the physical transporting of goods and/or passengers. Major sub-segments include postal services, courier services, trucking, air, rail, marine etc.</li> <li><u>Distribution center (DC)/ Warehouse</u>. Organizations involved in the operation walled/ enclosed facilities supporting the management of inventory for fixed physical locations.</li> </ul>

Key findings by form factor include:

**Notebook Computers**

- The average annual TCO of notebook computers is \$3,900. TCO varied by approximately \$2,000 per year between rugged and non-rugged notebook computers in select user environments (see Exhibit 3). With notebook computers, the primary factor driving variance in TCO is device failure. The average annual failure rate for non-rugged notebooks was estimated at approximately 30% while annual failure rates for rugged notebooks were less than one-third the non-rugged rate, or approximately 9%. (Device failure is defined as a mobile computer requiring some level of internal or third-party help-desk or technical support. It includes devices that are repaired by an internal service department and those shipped to a third-party service organization.)
- Non-rugged notebook computer vendors are placing increasing emphasis on device durability and have implemented various design innovations to address the high failure rates of their devices. While this has elevated the public’s awareness of device failure, it has not substantially lowered the failure rate of these devices. Failure rates of durable devices are still more than twice as much as for fully and semi-rugged notebooks.

- The leading source of hardware failure for notebooks were cracked displays, damaged hard drives and peripheral/ accessory failure. One noticeable change was cracked displays replacing damaged hard drives as the single highest source of failure. This is perhaps a result of the increased investment most notebook manufacturers are making in providing greater durability to hard drives through shock-mounting and/or integrating accelerometers.
- Another noticeable difference in performance and subsequent TCO between rugged and non-rugged notebooks is wireless transmission. For most enterprise mobility applications, wireless data transmission is a key requirement with the average user processing over 30 wireless data transactions per day. However, while most rugged notebook vendors are providing integrated wireless LAN and WAN options, non-rugged notebooks typically only provide integrated wireless LAN. For the most part, rugged notebook vendors have more experience at integrating multiple radios into their mobile computers and their users consequently achieve superior performance – in terms of range and throughput – and experience fewer dropped or failed transmissions. In fact, wireless transmission failure is almost three times as much for non-rugged notebooks when compared to rugged notebooks. Each failed transmission leads to 5-10 minutes in lost productivity (re-logging onto network through VPN) and as a result can significantly add to TCO not to mention employee frustration. Plug-in peripherals, such as wireless WAN radio cards, also represent a key source of failure for non-rugged devices.
- One key research finding is that the failure rate of non-rugged notebooks increases substantially with time – annual failure rates range from 15-20% during the first year of use to exceeding 40% after the second full year of use – while rugged device failure rate remains fairly consistent over the course of its installed life. As a result, the life cycles of rugged notebooks typically exceed those of non-rugged notebooks by over 18 months, decreasing the overall system deployment and integration costs. However, given the rate of technology advances, many organizations do not want to use notebooks beyond 30-36 months and will mandate faster replacement or upgrade cycles to have access to the most current solutions.

**Exhibit 3**  
**TCO Comparison (Five Year and Annual) for Notebook Computers**

	FULLY RUGGED NOTEBOOK		SEMI-RUGGED NOTEBOOK		DURABLE NOTEBOOK		CONSUMER GRADE NOTEBOOK	
	Five Year <u>Costs</u>	Annualized <u>Costs</u>	Five Year <u>Costs</u>	Annualized <u>Costs</u>	Five Year <u>Costs</u>	Annualized <u>Costs</u>	Five Year <u>Costs</u>	Annualized <u>Costs</u>
<b>Hard Costs - Deployment Costs</b>								
<i>Total Hard Costs</i>	\$6,038.5	\$1,207.7	\$4,891.3	\$978.3	\$4,255.9	\$851.2	\$3,944.1	\$788.8
<b>Soft Costs - Operational Costs</b>								
<i>Total Soft Costs</i>	\$8,691.3	\$1,738.3	\$11,321.1	\$2,264.2	\$18,586.8	\$3,717.4	\$21,722.8	\$4,344.6
<b>Total Cost of Ownership</b>	<b>\$14,729.8</b>	<b>\$2,946.0</b>	<b>\$16,212.4</b>	<b>\$3,242.5</b>	<b>\$22,842.7</b>	<b>\$4,568.5</b>	<b>\$25,666.9</b>	<b>\$5,133.4</b>

\*Assuming a 4-year replacement for fully and semi-rugged notebooks and a 2.5 year replacement for durable and consumer-grade notebooks

\*\*Normalized across all computer platforms

## Handheld/PDA Mobile Computers and Smartphones

- The average annual TCO of handheld/PDA mobile computers is \$3,400. According to VDC's research, rugged handheld/PDA TCO was approximately \$2,700, while the TCO of non-rugged handheld/PDAs exceeded \$4,000. The average annual failure rate for these mobile computers ranged from 11% for rugged devices to 38% for non-rugged devices (see Exhibit 4).
- The primary sources of failure of non-rugged handheld/PDA mobile computers centered much more on environmental issues with exposure to extreme temperature fluctuations, water/moisture/humidity, excessive vibration and in certain cases EMI exposure all contributing.
- In addition, non-rugged mobile computers are frequently equipped with numerous plug-in accessories to provide the same level of integrated functionality provided by a similar rugged computer. These plug-in scanners/imagers and wireless cards represent a significant source of failure when the device is dropped.
- As the use of smartphones proliferates within enterprise environments, organizations are looking to port more line-of-business applications to these devices and expand their functionality from communications-centric devices. Although smartphones are mostly deployed for white-collar professionals they are increasingly being considered for gray/blue-collar worker applications. Some of the major smartphone limitations are similar to PDAs in terms of their lack of integrated input/output functionality. However, mobile phone and smartphone vendors are starting to introduce rugged options that conform to IP/NEMA specifications and may compete for market share for applications such as field service (see Exhibit 5).

**Exhibit 4**  
**TCO Comparison (Five Year and Annual) for PDA/Handheld Computers**

	FULLY RUGGED PDA/HANDHELD		SEMI-RUGGED PDA/HANDHELD		DURABLE PDA/HANDHELD		CONSUMER GRADE PDA/HANDHELD	
	Five Year Costs	Annualized Costs	Five Year Costs	Annualized Costs	Five Year Costs	Annualized Costs	Five Year Costs	Annualized Costs
<b>Hard Costs - Deployment Costs</b>								
<i>Total Hard Costs</i>	\$4,475.0	\$895.0	\$4,317.2	\$863.4	\$3,270.7	\$654.1	\$2,358.8	\$471.8
<b>Soft Costs - Operational Costs</b>								
<i>Total Soft Costs</i>	\$8,482.4	\$1,696.5	\$10,026.4	\$2,005.3	\$16,544.0	\$3,308.8	\$18,789.9	\$3,758.0
<b>Total Cost of Ownership</b>	<b>\$12,957.4</b>	<b>\$2,591.5</b>	<b>\$14,343.6</b>	<b>\$2,868.7</b>	<b>\$19,814.7</b>	<b>\$3,962.9</b>	<b>\$21,148.7</b>	<b>\$4,229.7</b>

\* Assuming a 4-year replacement for fully and semi-rugged notebooks and a 2.5 year replacement for durable and consumer-grade notebooks

\*\* Normalized across all computer platforms

<b>Exhibit 5 Smartphone TCO Model</b>		
	<b>SMARTPHONE</b>	
	<u>Five Year Costs</u>	<u>Annualized Costs</u>
<b>Hard Costs - Deployment Costs</b>		
<i>Total Hard Costs</i>	\$4,717.40	\$943.48
<b>Soft Costs - Operational Costs</b>		
<i>Total Soft Costs</i>	<u>\$12,733.20</u>	<u>\$2,546.64</u>
<b>Total Cost of Ownership</b>	<b>\$17,450.60</b>	<b>\$3,490.12</b>

## CONCLUSION

The use of mobile computing solutions is exploding within enterprises to the point that notebook shipments are about to outpace traditional desktop computer shipments. However, mobile computing represents uncharted territory for many organizations, when considering the complexities of managing and supporting this increasingly distributed computing infrastructure. Critical for organizations will be an unbiased assessment of the total cost of ownership of mobile platforms.

## ABOUT THIS STUDY

Venture Development Corporation (VDC), a leading research authority on enterprise mobility solutions, recently released an update to its groundbreaking research on mobile computing total cost of ownership (TCO), initially conducted in 2003/2004. The objectives of the research were to develop accurate and defensible TCO models for a variety of mobile computing form factors and levels of ruggedness or durability. In addition, the research set out to compare mobile computer TCO by a variety of applications or installation environments. Much has occurred since VDC last conducted this research, thus necessitating a refresh.

### Analysis Coverage

#### *Mobile Computing Form Factors*

- Notebooks and convertible notebooks
- Slate tablets
- Handheld computers and PDAs
- Smartphones

Where relevant, each of these form factors was evaluated across a broad spectrum of levels of ruggedness. These included:

- Fully-Rugged: Mobile computers designed to meet MIL-STD 810-F and AT LEAST IP54 standards
- Semi-Rugged: Mobile computers designed to meet IP54 standards (but not MIL-STD 810-F)

- **Durable:** Mobile computers that are not MIL-STD/IP/NEMA rated but have features such as shock-mounted hard drives; accelerometers; spill-proof keyboards; etc.
- **Non-Rugged/Consumer Grade:** Mobile computers with no enhanced durability or ruggedness designed into device

#### *Vertical Markets Analyzed*

- Retail In-Store
- Transportation/Distribution
- Manufacturing
- Government
- Field Service
- Professional Service
- Health Care Service

#### **Report Statistics**

<i>Date Published:</i>	7/2007	<i>User Survey Sample:</i>	568	<i>Total Exhibits:</i>	479
<i>Total Pages:</i>	310	<i>Price* (per volume):</i>	\$3,450	<i>* Multi-volume discounts are available.</i>	

#### **ABOUT VDC**

Venture Development Corporation (VDC) is an independent technology market research and strategy consulting firm that specializes in a number of retail automation, RFID, AIDC, embedded, component, industrial, and defense markets. VDC has been operating since 1971, when the firm was founded by graduates of the Harvard Business School and Massachusetts Institute of Technology. Today, we employ a talented collection of analysts and consultants who offer a rare combination of expertise in the market research process; experience in technology product and program management; and formal training in engineering and marketing. VDC's clients include thousands of the largest and fastest-growing technology suppliers in the world and the most successful investors participating in the markets we cover.

For further information about *Total Cost of Ownership Models for Mobile Computing and Communications Platforms, Second Edition*, contact:

**David Krebs**, *Director*, Mobile and Wireless Practice, 508.653.9000 ext. 136, [dkrebs@vdc-corp.com](mailto:dkrebs@vdc-corp.com)

For purchasing information, contact:

**Tim Callahan**, *Sales Manager*, 508.653.9000 ext. 113, [timc@vdc-corp.com](mailto:timc@vdc-corp.com)

**Tim Shea**, *Sales Manager*, 508.653.9000 ext. 119, [tims@vdc-corp.com](mailto:tims@vdc-corp.com)

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#### **VENTURE DEVELOPMENT CORPORATION**

679 Worcester Road ♦ Suite 2 ♦ Natick, MA 01760

T: 508.653.9000 ♦ F: 508.653.9836 ♦ E: [info@vdc-corp.com](mailto:info@vdc-corp.com) ♦ W: [www.vdc-corp.com](http://www.vdc-corp.com)

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