

# **RUGGED vs. COMMERCIAL**

**Considering the Total Cost of Ownership  
of Handheld Devices**

**Executive Summary**

In order to objectively assess the business case for deploying handheld devices, it is critical that the enterprise understand the ramifications of their choice of device. As with any buying decision, consumers perform a cost benefit analysis, weighing options versus the benefits relative to the cost of the unit. However, even consumers who understand their application and how certain devices will perform under specific operating conditions, few examine costs beyond the purchase price of the device.

An important aspect of evaluating devices is recognizing how the product features will protect the enterprises' investment over the lifespan of the devices' deployment. Cost should be measured over a continuum rather than a point in time, such as the point of purchase. Over time, device performance can seriously affect the overall performance of the business and the return on investment (ROI).

A common reason for deploying handheld devices is to increase productivity. Productivity has measurable value in revenue, customer satisfaction, market share and other desirable business metrics. Accordingly, counter-productivity has associated opportunity costs to the business. Costs incurred through device down-time are important to include when building a business case for deploying handheld hardware. These costs are far reaching affecting not only the direct user, but indirectly the entire organization from those who support the failed devices to those who must manage around the failure.

An acceptable means of aggregating these costs in a useful format is to develop a Total Cost of Ownership (TCO) model. The TCO includes all costs associated to the device over its' lifespan, from acquisition to disposal. The benefit of examining costs in this way is that it provides the enterprise a more realistic view of their purchase decision and how it will affect the business overtime.

In the model created for this paper, rugged devices are found to be significantly less expensive (approximately 32%) from a TCO perspective that encompasses 5 years. This finding is backed up by Venture Development Corporation's (VDC) findings in their 2003 Total Cost of Ownership models that surveyed a broad range of actual deployments. VDC reports total cost of ownership annual savings of up to 17% in Field Profession applications and up to 32% in Supply Chain applications for rugged hardware deployments. Consequently, even though the purchase price of a rugged device is often higher than a commercial device, it is usually money well spent in the long run.

## Rugged vs. Commercial Handheld Devices

Of the numerous decisions and options facing enterprises interested in deploying a mobile solution, a great debate surrounds the question of whether to integrate industrial grade rugged equipment or to use commercially available non-rugged devices. This question has proven to be complex for enterprises to answer as they attempt to balance the cost of projects and mitigate their impact on budgets, while selecting device features most appropriate for their application.

Since budgets are key influencers in the decision making process, price is a major concern. Higher priced components may present barriers that are difficult to overcome. However, this is more likely when components are viewed with prices rather than costs. Price, in relation to cost, is a one-time expenditure in a snap shot of the business lifecycle, whereas costs are ongoing and carry ramifications that can affect the business over time.

This document will examine the TCO of rugged and non-rugged handheld hardware in enterprise applications and dispel the myth that commercial non-rugged handheld hardware is more cost effective with a better ROI. When examining the opportunity cost of hardware failure and resulting downtime to the enterprise, the total cost of ownership becomes clear.

*“VDC’s end user research confirms that more rugged premium priced products are viewed as money well spent.”*

Venture Development Corporation (VDC) Report: THE GLOBAL MARKETS FOR RUGGED MOBILE COMPUTERS, APPLICATIONS SOFTWARE AND SYSTEMS INTEGRATION SERVICES

## Understanding The Key Metrics Used To Measure Handheld Hardware

In order to evaluate handheld hardware, it is important to understand some key metrics used to benchmark them. Much like more memory, faster processor speeds, colour displays, etc, more and robust handheld features contribute to a higher purchase price of goods. Thus, feature rich rugged hardware often carries higher purchase price tags than commercial devices simply due to their increased number of features. This paper will show how the “costly” rugged features of industrial rugged equipment, contributes to an overall lower TCO over the lifespan of the unit.

TCO is defined as all of the possible costs incurred during the lifespan of a handheld, from acquisition to disposal. There is a direct correlation between high scoring rugged metrics and longevity of hardware in industrial applications and the cost of ownership.

It should be noted that for the purpose of making an “apples-to-apples” comparison, the commercial non-rugged units used in this paper are made quasi-rugged using aftermarket ruggedized accessories. Peripheral equipment has been added to the commercial handheld configuration as required in order to mirror the feature set of the rugged units. These additions have the net affect of increasing the price of the commercial unit substantially beyond the base unit price. Without these additions, the commercial device would be considerably more susceptible to damage in industrial applications. In support of this comparison methodology, a TCO report published in December 2003 by VDC cites 100% of respondents having deployed commercial devices

add at least one external or integrated module to enhance the device. The report states that over 59% add one module, 28.1% add two, 9.4% add three and the remaining add four. Modules may include RF radios, barcode scanners, etc.

### Rugged Specifications

In order to measure the ruggedness of handheld hardware, standard tests, performance criteria and rating systems have been developed. These tests are designed to mimic some of the environmental strains to which hardware might be exposed during deployment. In the case of commercial units, many of these test results are not published, if indeed these tests are even performed, as these devices are not designed to be sold for industrial use. VDC estimates testing device ruggedness to be as much as \$100,000.00 per design. It is unlikely that such testing would be done for products that are not required nor expected to support claims of ruggedness. Commercial devices are designed for use in a non-rugged office environment where rugged features are not important considerations for consumers. Interestingly, enterprise consumers, including commercial device users, cite ruggedness and durability as the number one product feature deemed critical to operational efficiency. However, if commercial devices are deployed outside of their intended application, the lack of rugged features can seriously shorten their lifespan, thereby adding to the total cost of ownership.

**Note:** In research done by VDC, the most common reasons cited for choosing rugged handheld devices over commercial handhelds were:

1. Ruggedness/Environment is too harsh for commercial grade
2. Sustainable increase to productivity
3. Lasts longer - Lower TCO.

The following is a summary of the tests used to determine the ruggedness of handheld devices.

#### Drop Rating:

The drop rating is a measure of a devices ability to survive repeated falls from a specified height onto a designated surface in full working function. In rugged device testing, the surface is concrete while the height can vary. The higher the survivable drop height, the more rugged the device. A drop height of 4-5 feet to concrete is considered a reasonable test of ruggedness.

**From the Field** A company that provides residential and commercial water service uses handheld devices for their field service technicians who read, repair and change water meters. Originally, the company deployed a popular commercial device to improve the productivity of their technicians; however, they were unhappy with the ruggedness of the device. The device failures prevented meeting their efficiency goals. Even after deploying ruggedized sleeves the drop rating did not improve sufficiently. Eventually the company upgraded to a rugged handheld and effectively eliminated the device drop issue.

In an enterprise application where the device is an integral and regular part of the workday, device drops are a common occurrence. Since the hardware is a business critical component, any device failures carry numerous costs to the user, the customer and the support infrastructure required to manage and correct it. A high drop rating

protects the enterprise against the inevitable device drop and the resulting downtime and maintenance costs to replace it.

#### IP Rating:

An Ingress Protection Rating (IP rating) is a standard used to identify to what degree a device can withstand exposure to solid particles and liquid ingress. Typically, an IP rating is expressed in 2 numbers - such as IP65. The first number indicates the protection against solid objects or dust, where the maximum rating is "6". A "6" indicates that the device is impervious to any ingress of dust. The second number indicates the protection against liquids, where the maximum rating is "8". An "8" would indicate that the device can withstand continuous immersion in water. A device with a high IP rating would be an important consideration for use in outdoor applications.

The required IP rating will vary by application, however, commercial device manufacturers rarely specify an IP rating. Again, commercial devices are not designed with excessive dust and liquid exposure considerations. Commercial devices rely on after-market accessories to provide limited ingress protection which may or may not provide consistent protection during device operation.

#### Operating Temperature:

Commercial terminals are typically designed to operate in a "normal" environment where the temperature is fairly constant such as an office. Using a terminal outside of its specified operating temperature range may lead to premature failure. Industrial terminals are designed to work over wide temperature ranges that often include conditions well below freezing. This is an important variable to consider if the terminal will be used outdoors.

**From the Field** In order to use a commercial handheld in the cold Canadian winter, users have had to create inventive ways to overcome the limitations of commercial devices to operate in the cold. In one example, to keep the display screen warm enough to read, custom cradles were built with heating pads that warmed the screen when it was docked in the cradle. This "work around" increases the TCO of the solution by adding a second point of failure (the cradle) that could cause the device to fail, not to mention the cost of the cradle itself.

#### The Business Case

In order to develop a business case for purchasing rugged mobile devices versus non-rugged equipment, it is necessary to analyze how these device benchmarks will affect the ability of the business to operate at their desired level of productivity. A common rationale for deploying handheld devices is to increase productivity of the workforce. Thus, any downtime attributed to the device would have the contrary affect on productivity. The cost of downtime can be estimated by extrapolating the numbers compiled to calculate potential productivity gains to predict potential costs from device failures to various areas of the business. Using these figures, decision makers can calculate many values required to develop a TCO model that includes the potential opportunity costs of device failures specific to their operation. The following section details important consideration for developing an accurate TCO using calculation from the ROI.

Building a general business case that is representative of all businesses, even businesses in the same vertical market, is difficult. There are many nuances and parameters that can change the business case and the ROI from one business to the next, therefore TCO studies must be done on a case-by-case basis. However, there are a number of cost silos that are shared across most businesses that can be identified as a place to look when building a custom business specific case.

Opportunity Cost

The biggest single ROI killer is downtime. Downtime is defined as anytime that a device is not functioning at operational capacity thereby affecting the user’s ability to complete their work. Downtime typically stems from device failures caused by incidents or exposure to environmental conditions similar to those used to measure ruggedness. According to VDC, the **expected failure rate** of commercial handhelds compared to rugged devices can be as high as 4 to 1. In their 2003 TCO study, VDC found that downtime for mobile workers using commercial devices can be as much as 48% higher than for rugged users. Beyond the obvious costs such as wages, lost productivity, spare units, parts and service, device failures can have more significant and business specific opportunity costs that will affect the ROI.

This chart details two examples of potential opportunity costs in different scenarios as a result of device failures.

Application	Result of Failure	Potential Opportunity Cost
Delivery of Perishable Goods	Late delivery or missed delivery	Late delivery penalties Customer satisfaction Order cancellation Unproductive wage cost Unproductive asset cost
	Spoilage	Cost of Goods
Technical Service	Unable to work	Loss of revenue Unproductive wage cost Customer satisfaction Unproductive asset cost Work cancellation
	Rescheduling of work	Overtime Employee satisfaction Admin costs

These are merely some examples of the cost of failures. Businesses building a business case around handheld hardware should apply these types of considerations in their model using actual costs.

Direct and Indirect Effect

Device failures may not be restricted to affecting the productivity of the direct user; they have an indirect affect as well. Consider everyone in an organization that might be affected by a device failure: the user, their supervisor, IT resources responsible for managing the devices and software, administration who must ship the device for repair, customer service who receives an increased call volume regarding missed

service, the scheduling department who must reschedule the missed business, operations who must reallocate resource to cover the missed work, etc. These are common examples of how deep device failure can reach into the business. VDC found that IT support requirements can be as much as 44% higher for commercial device deployments than rugged ones. When building the business case, create a flow chart through your organization and follow the thread adding the time and costs required to manage the failure and watch them add to the total cost of the downtime.

#### Rugged Hardware as Peace of Mind

An experienced mountain climber will only buy safety equipment that is designed specifically to protect them in their environment against the hazards of the sport. To risk purchasing anything less carries too great a cost. The same rationale applies in business; to purchase equipment for use in a mobile business critical application that is not designed for industrial use and with a higher expected failure rate (4:1 Commercial to Rugged Devices), carries potential costs to the business; costs that may not be recoverable.

In this regard, implementing rugged hardware is a proactive strategy to protect against the costs of future failures. By implementing a commercial device with "after thought" ruggedness bolted on, the enterprise is adopting a reactive strategy through which they will manage failures and their consequences, when they arise rather than trying to avoid them altogether. This reactive strategy has the net-affect of deferring the costs from the point of purchase over the lifetime of the unit.

An example of deferring costs is ongoing service and support supplied by the equipment maker. Support plans offered for commercial devices are typically less costly than those offered by rugged device manufacturers initially, though they are far less comprehensive. Commercial plans may provide a "loaner" during repair process where parts and labor are charged back to the customer often at rates near replacement costs with variable turnaround times. Since the expected failure rate of commercial devices is higher, yearly support costs across a greater number of devices can exceed the costs of supporting the rugged devices over the lifetime of the device. Support plans for industrial units are typically comprehensive in services offered and offer guaranteed turnaround times to ensure a unit is out of commission for a minimal amount of time. VDC found that, on average, users of rugged mobile computing devices indicated possessing longer warranty periods as well as longer replacement cycles versus commercial-grade respondents.

#### Justifying the Business Case

The proceeding business case illustrates how examining the TCO provides a very different view of handheld devices beyond the initial purchase price. Especially when configuring devices for industrial use, the addition of required features can quickly increase the base purchase price of commercial devices closer to or higher than the price of rugged ones. In the 2003 VDC report, analysis concluded that once commercial hardware is made more rugged, the pricing gap closes quickly.

For the purpose of this study, the commercial model has been upgraded to a comparable level with the rugged device by adding a peripheral barcode scanner and PCMCIA radio to enable wireless connectivity. An expansion pack is required to enable both the radio and the scanner to be attached simultaneously. The entire

configuration has been encased in an after-market rugged sleeve to improve the drop rating and the IP rating to IP54. The rugged device used in this example offers the barcode scanner and wireless radio internally while offering an IP rating of 67 and a drop rating that is 20% higher than the commercial device. These options were chosen as they represent ones most commonly used in enterprise applications.

Support was calculated using published support packages and pricing. Since parts and service pricing is subject to the extent of the required repairs, repair pricing was calculated using 1/3 the cost of device replacement as the standard. Obviously, the cost of repairs could be higher or lower depending on the extent of the damage.

The lifespan of the devices was derived by extrapolating the maximum warranty period offered by the manufacturer to include the support term where an enterprise could reasonably expect parts and service. Mean Time Between Failure (MTBF) was not used to assign a product lifespan. Currently there is no standardized method or parameters for evaluating MTBF; therefore MTBF is subject to the interpretation of the manufacturer and is not a reliable means of comparing devices.

The spare pool was calculated using a value of 10% spares for a rugged device deployment and an increase factor of 2 for the commercial based on the expected failure rate of the commercial device being higher.

The remainder of the required data for a TCO business case is company specific. Information such as wage rates, daily revenue by mobile worker, total down-time in man-hours to manage a failure, the cost of down-time to customer service, sales, brand equity, etc, are all numbers that are unique by company. In this case, assumptions were made to create an example of the beginnings of a TCO.

Even without the inclusion of many of the costs that a company might choose to include in their TCO, the results still point to a much more balanced cost of ownership between rugged and non-rugged devices than might be assumed. In this case, the commercial device is the more costly device to maintain over the 5 year term as illustrated in the business case. The TCO model of the commercial device continues to trend higher when more detail is added to the business case to include more opportunity cost assumptions of device downtime. In VDC's TCO models, IT support costs and mobile user downtime costs are clearly illustrated in the model. In each case the total cost of ownership was higher for commercial device deployments. The end results nets annual savings of up to a 17% cost of ownership in Field Profession applications and up to a 32% lower annual cost of ownership in Supply Chain applications for rugged hardware deployments.

#### The Deciding Factor

This whitepaper is intended to illustrate that there is a higher cost of ownership when using commercial handheld devices rather than rugged devices in industrial applications. In this illustration, the additional cost of adding features and improving the ruggedness of the device eliminates any price advantages of commercial grade handhelds. Add to this a higher expected failure rate and the corresponding costs of managing failures coupled with the opportunity cost of failures to the business and the TCO of rugged hardware is significantly reduced.

As detailed in the 2003 VDC report, often the ROI is built around increased productivity of the workforce from efficiencies gained from using handheld computers. The device that can offer a greater degree of up-time will have a better ROI.

Sources:

The Global Markets for Rugged Mobile Computers, Applications Software And Systems Integration Services Venture Development Corporation (VDC) Report 2001

Total Cost of Ownership Models for Mobile Computing and Communication Platforms: Industrial and Harsh Commercial Environments. Volume II: Supply Chain VDC, November 2003

Total Cost of Ownership Models for Mobile Computing and Communication Platforms: Industrial and Harsh Commercial Environments. Volume III: Field Professions VDC, December 2003

Purchase Price Comparison (US\$)

Features	Commercial	Rugged	Delta \$	% Dif
Pricing	\$552	\$1,865	\$1,313	0.70
Radio Card	465	Incl.		
Barcode Scanner	599	Incl.		
Two Slot Expansion Pack	199	Not Required		
Rugged Case	129	Not Required		
<b>Avrg Selling Price</b>	<b>\$1,944</b>	<b>\$1,865</b>	<b>(\$79)</b>	<b>-0.04</b>
<b>Support</b>				
1st Year/ unit	33.33	\$373.0	\$340	0.91
<b>1st Year Total Cost</b>	<b>\$1,976.98</b>	<b>\$2,238</b>	<b>\$261</b>	<b>0.12</b>

Repair/ Failed Unit

Repair Cost 1st Yr	\$641	0		
Failure Rate (Ratio of deployed)				
	2.0	1		2.0
Sparing (% of Deployed)				
	20%	10%		
Lifespan (years)				
	3	5		

Notes:

~Hardware pricing has an estimated discount applied.  
 ~Discounts were calculated using various industry sources.  
 ~Accessories are not discounted.

~**Support plans** are based on estimates using published pricing.  
 ~**Rugged device support** cost are typically 15-25% of the purchase price. This case uses 20% of the device purchase price to calculate support.  
 ~**Commercial support** plans typically offer device exchange where parts and labour are extra.  
 ~Rugged device support plans typically provide a comprehensive plan that includes exchange, parts and labour in one price.

~Pricing for repairs is calculated conservatively as 1/3 of repurchase price. Repair pricing for the rugged device is 0. It is included in the support package.

~Model failure rate is 2.0 (VDC specifies a failure range of up to 4:1 failures, non-rugged:rugged)

~Average warrantee period is 3 yrs for commercial hardware

Business Case- Cost of Ownership

	Commercial	Rugged	Delta	
Price Per Unit	\$1,976.98	\$2,238		
No. of Units Deployed	100	100		
Initial Cost	\$197,698	\$223,800	\$26,102	
Spare Equipment				
	20	10		
Cost of Spares	\$39,540	\$22,380		
Cost of Repairs	\$12,828			
First Year Equip Cost	\$250,066	\$246,180	(\$3,886)	-0.02
<b>Downtime</b>				
No. of Failures/year	30	15		
Downtime from Failure	45	23		
Unproductive wage cost/year	\$10,800	\$5,400		
Lost Revenue/year	\$36,000	\$18,000		
Cost of Failures	\$46,800.00	\$23,400.00		
<b>First Year TCO</b>	<b>\$296,866.09</b>	<b>\$269,580.00</b>	<b>(\$27,286)</b>	<b>-0.09</b>

User Defined Values

30	Tech wage per hour
100	Tech's billable rate per hour
1.5	Downtime from failure per unit (man-days)

Assumes 1/3 of the replacement cost of the spares.

Assumes that the turn around on a downed handheld is min 1.5 man-days even with spares. (Incls. costs for IT and Operational support)

\$30/hr

Assuming \$100 is the tech's billable rate per hour

(This could easily be much higher depending on the application)

TCO defined in terms of hard numbers. This does not account for Soft or Opportunity costs.

Life Span

	Year 1	Year 2	Year 3	Year 4	Year 5	Cummulative Total	
Rugged	\$269,580	\$60,700	\$60,700	\$60,700	\$60,700	\$512,380	
Commercial	\$296,866	\$50,775	\$50,775	\$296,866	\$50,775	\$746,056	Support of deployment incls service contracts and repairs.

Notes

~According to Gartner Group, TCO of a PDA used in enterprise can cost as much as \$3000/user per year (\$4000 with wireless).

This model calculates the first cost of ownership as:

<b>Rugged</b>	\$2,695.80
<b>Commercial</b>	\$2,968.66

~VDC used the following costs in the 2003 TCO models:

Operator/Technicians wage burden \$27.70/ hour

IT Support wage burden \$26.30/hour

Replacement cycle for rugged devices 4.5 Years

Replacement cycle for commercial devices 3.0 Years

~VDC TCO Results for Field Service Model over 5yrs:

Rugged Cost of Ownership	\$2,994.50	9.7%	Lower TCO
Commercial Cost of Ownership	\$3,316.50		