Value Engineering

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Introduction

The objective and scope of our project is to quantify the selection of laptops available in the market according to our needs by using the value engineering techniques. No matter either you are faculty member or a graduate student; our project will help you find the perfect system for your needs.

The simple fact is Notebook PCs can go anywhere and handle almost anything a traditional desktop PC can, including multimedia applications. No wonder notebook sales are gaining on desktop sales. That is not to say that desktops are on the fast track to extinction far from it. The best desktops are blazingly fast, and the cheapest cost under SR2500. Still, notebooks can be just as powerful as desktops, and they offer users the freedom to roam. With increasingly low weights, longer battery life, and the addition of integrated wireless, today's notebooks are taking mobile computing to a new level.

The following are the phases for purchasing a notebook.

a. Information Phase

b. Selecting Alternatives Phase

c. Evaluating Alternatives

d. Recommending Alternatives

a. Information Phase:

There are hundreds of laptops are available in the market by different vendors and price ranged from 3200SR to 10000SR. The main market leaders are shown in the table.

Notebook Market Share Leaders

Company	Market Share
1. Dell	26.5%
2. HP Compaq	20.0%
3. Toshiba	12.3%
4. IBM	9.0%
5. Apple	5.1%
6. Sony	4.8%
7. Gateway	3.4%
8. Fujitsu/Fuji	1.1%
9. Acer	1.1%
10. eMachines	0.8%
Others	16.0%

U.S. Sales in 4Q 2003. Percentages do not add up to 100 because of rounding.
Source: IDC WW Quarterly PC Tracker, 2004.

Here are the most important elements of a laptop.

i. Bay

A cavity in a notebook used primarily for removable drives, but also for accessories. A two-bay notebook has an internal bay for the hard drive and a second bay for a CD-ROM, DVD-ROM, floppy disk drive, or a spare battery. A three-bay notebook also has a floppy disk drive built in. Some manufacturers use the term spindles, referring to the shafts on which the disks spin, so a two-spindle notebook has two drives and two drive bays. Most optical bays are 12.7mm (0.5 inches) thick; smaller notebooks are shifting to 9.5mm.

ii. Bluetooth Technology

For wirelessly transferring data short distances (up to 30 feet) among notebooks, cell phones, Palm or Pocket PC handhelds, and printers. It is available on many notebooks. Bluetooth is not a competitor to wireless Ethernet.

iii. DVD-CD-RW drive

The most popular optical drive for notebooks, it reads DVDs and CDs and writes CDs. There are multiform at DVD writers that write both minus (DVD-RW) and plus (DVD+RW) discs.

iv. Display Type

Notebook computer screens use LCD, so you want to be sure you choose a notebook computer that has an active matrix display (also known as TFT), which gives a brighter display which can be viewed from an angle. The alternative, passive matrix display, gives a dimmer view and has to be viewed head on to be seen.

v. FireWire

A high-speed connector (capable of 400 Mbps) is required such as Universal on Macs, common on media-oriented PCs for transfers from digital video (DV) cameras USB is used for virtually all other high-speed data transfers on PC notebooks.

vi. Kensington Slot

A universal connector for a physical security lock, named after the company that invented the feature. Regardless of the brand, virtually every notebook security lock you can buy fits the Kensington-style slot.

vii. Key Pitch

Distance from the center of one key to the next. Desktop keyboards have a 19mm (0.75 inches) pitch. Some notebook keyboards have a 95 percent (18mm) pitch. To check key pitch, measure across 10 keys (from the left side of the Q key to the left side of the left bracket ([) key) is needed. It should be 7.5 inches across 10 keys, equal to 0.75 inches/19mm per key.

viii. PC Card Slot

A space in a notebook, where you can insert credit card-size accessories such as modems, network adapters, wireless network adapters, security cards, and memory cards, as well as connection points for some external disk drives is required.

ix. PCI Express

Anticipated eventual successor to PC Card; it's smaller and faster.

x. Pointing device

A built-in substitute for the mouse ether a touch pad or a pointing stick that looks like a pencil eraser stuck below the G and H keys. Some notebooks have both types. Many users still prefer plugging in a traditional mouse.

xi. Port Replicator

A hardware device, that attaches to a notebook and connects all the cables (modem, printer, power, and mouse) that you would otherwise attach one by one to your notebook's ports. It is simpler than a docking station and cheaper. Most repllcators include a security locking slot.

xii. Travel Weight

The total weight of a notebook and the package for computing on the road, including the notebook, transformer, battery, and possibly an adapter module for connecting accessories has to be considered. Marketing literature usually quotes system weight (computer, battery, and usually the internal optical drive). Add 0.75 pounds for the transformer and 0.5 pounds for the optical drive if it wasn't quoted by the manufacturer.

xiii. Universal Serial Bus (USB)

An all-purpose input/output connector that lets you attach a digital camera, audio player, memory key, mouse, external drive, or printer. A notebook has one to four USB ports (two are adequate for most users). All notebooks sold today use USB 2.0, capable of 480 Mbps; earlier notebooks used USB 1.1 (12 Mbps).

xiv. Wi-Fi

Short for wireless fidelity is an umbrella term for wireless Ethernet. 802.11b, capable of 11 Mbps theoretical speed (about 5 Mbps actual), is most common. 802.11g, capable of 54 Mbps, is succeeding (and incorporates) 802.11b. Some corporations prefer 802.11a, also 54 Mbps. It is possible for a wireless card to integrate both g (with b) and a. Virtually every notebook incorporates wired Ethernet; many include wireless, too.

xv. XGA (Extended Graphics Array)

One of the two most common screen resolutions for notebooks: 1,024 pixels horizontally by 768 vertically. Other resolutions are SXGA (1,280 by 1,024), SXGA+ (1,400 by 1,050) and UXGA (1,600 by 1,200). The higher resolutions make for crisp graphics and small text. Widescreen displays typically use WXGA (1280 by 768), WSXGA+ (1680 by 1050), and WUXGA (1920 by 1200).

On the basis of following features we have collected the prices and specifications of number of laptops. Which are as follows

Acer 1,2,3,4,5

Dell1,2,3,4,5

xvi. Exception: on the basis on operating system usage (Microsoft windows approx.92% for PCs) we have excluded apple laptops from our study. And apple use his own operating system macOS. So we have just included the laptops which can have any operating system installed.

The Consultation sources:

1. Jarir bookstore
2. J.Al-Jassim Electronics Co.
3. Compu me
4. Dawainet
5. Medar Computers

What is the function of that?

Verb	Noun
process	personal data

Why	←	Function	→	How
To make any job Easier		To Process personal data		Purchase a laptop

b. Selecting Alternatives Phase:

According to the usage of PC we divided the users in three categories:

Beginners who have the little knowledge of computer and they just use it for browsing e-mailing and word processing or for data entry.

Moderate user who have a good knowledge of computer application and used computer applications to facilitate their work (students faculty members business personals).

Advance users who are using the computers for developing 3d games, video auditing, application development.

For our selected segment (Faculty members and graduate students) laptops are used for presentations, preparing a word documents, some scientific application are being used for their projects and games and movies for their fun. As laptops are not so easy to upgrade as a desktop and if we need to do so it incurred a high cost for upgrading. So keeping future needs in mind and their use we divide the laptops into three main categories.

(a) Desktop replacements

These are the heavyweights among notebooks. These are gaining popularity among the advance users (video editors, 3D graphic designers, etc.) and run from 7 to 10 pounds. Battery life is not so important with desktop replacements, which often stay plugged in and unmoved. These notebooks incorporate top-shelf components such as fast processors, which can easily top 3 GHz, and impressive graphics. They also offer substantial 15- to 17-inch displays, many of which are wide-screens and full-size 19-mm key pitch with 3-mm travel. That is great for multimedia creation and viewing, and systems even include TV tuners.

(b) Mainstream notebooks

These laptops are typically owned by college students, faculty members, and marketing personals because of its well-balanced blend of portability and power, as well as these systems' long battery life. Battery life is from 3 to 6 hours, because of power-saving technologies in processors. These weigh 4 to 7 pounds; tend to have 14- to 15-inch screens. Highly regarded as a traveler's salvation, such systems strive to achieve the perfect blend of portability and power. They are almost always outfitted with low-voltage processors that reduce power consumption, like the Pentium M, and yield solid battery life, averaging 5 hours or more, as well as solid performance. Wireless capability is also very important; 802.11b is almost always an option, and 802.11g is becoming increasingly prevalent.

(c) Ultra portables (Mini notebooks and tablet)

These are the sleekest, slimmest full-featured notebooks on the market, weighing from 2.2 to 4 pounds. These notebooks tend to be on the expensive side, and are primarily intended for high-level business executives who travel frequently and only need to check e-mail often, surf the Web, and read documents more than they create content. They typically have 12-inch screens, and though some have smaller-than-standard keyboards.

Mini-notebooks weigh less than 2 pounds, with diminutive 10-inch screens and compressed keyboards. These systems are best if you'll use them only for reading documents and doing light e-mail.

Tablets come in two types: convertibles and slates. Convertibles, which are more popular, look like typical mainstream notebooks, yet a convertible's display swivels around so you can write on it using a digitizer stylus and Microsoft Windows XP Tablet PC Edition. Slates are more popular in vertical markets like hospitals and real estate. A slate is simply a display and an embedded CPU, with a keyboard that attaches separately.

Generated ideas (Different brands and specs):

- Toshiba
- Dell
- HP
- Siemens
- Acer
- Sony

So according to the needs of a moderate user we have selected the mainstream category which has the following basic features.

System Weight: 4 to 7 pounds.
Display: 14 to 15 inches, with XGA or SXGA+ resolution.
Keyboard: Full-size 19-mm key pitch with 3-mm travel.
Processor: A 1.8- to 2.8-GHz Intel or AMD mobile processor or a Pentium M.
Hard Drive: 40GB to 60GB.
Graphics: A standard midlevel ATI or nVidia graphics card.
Battery Life: From 3 to 6 hours, because of power-saving technologies in processors.
Wireless: Integrated 802.11b, 802.11g, or 802.11a/g; "g" and "a/g" have the best throughput.
USB Ports: Two or more.
FireWire Port: Not standard but useful, especially for a digital camcorder.
Media Card Slots: Becoming more popular on notebooks, especially Secure Digital slots.
Optical Drives: An internal combo DVD/CD-RW drive is common fare, but you can also get a DVD-R, DVD+R, or multiform at DVD5RW drive.

Idea	Advantage	Disadvantage
Toshiba	➢ Low maintenance cost ➢ heavy duty	➢ Heavy weight ➢ High initial & accessory cost
Dell	➢ Low initial & accessory cost ➢ Nice looking	➢ Short battery life ➢ High maintenance cost
HP	➢ Low maintenance cost ➢ Nice looking	➢ Heavy weight ➢ Short battery life ➢ High maintenance cost

Siemens	➢ Low initial cost ➢ Light weight	➢ High maintenance cost ➢ Not heavy duty
Acer	➢ Low initial & accessory cost ➢ Nice looking (Slim) ➢ Light weight	
Sony	➢ Light weight ➢ Long battery life	➢ High initial & accessory cost
Criteria	Raw Score	Assigned Wt
A Initial cost	7	10
B Performance	7	10
C Specifications	5	7
D Maintenance (Warranty + Guarantee)	4	6
E Brand	2	3
F Looks	1	1

How Important
3. Major
2. Medium
1. Minor

Scoring Matrix

	B	**C**	**D**	**E**	**F**
A	A/B	A-2	A-1	A-2	A-1
	B	B/C	B/D	B-1	B-3
		C	C-2	C-1	C/F
			D	D-2	D-1
				E	E-2

Brand	Looks	Specifications	Initial Cost	Maintenance	Brand	Performance		
	10	3	6	10	7	1	Total Weight	Ranking
Toshiba	5	5	4	2	3	4	134	3
Dell	3	3	2	4	4	4	134	4
HP	3	3	2	2	3	3	95	6
Siemens	4	2	1	4	2	2	108	5
Acer	5	3	4	4	4	4	155	1
Sony	4	4	4	2	5	4	135	2

c. Evaluating alternatives

As we have selected the mainstream category of laptops according to the best fit for our selected segment (moderate users). We have develop some criteria for choosing a best alternative and give them rank

Initial cost

Specification (processor, Ram, hard disk, display type and size etc.)

Maintenance (warranty)

Battery life

Upgrade

Many vendors, especially those that sell direct online, let you customize your system. Don't like the installed wireless solution? Want a bigger screen? Want better graphics? Upgrade. Just remember that all those upgrades can really add to your bottom line.

- Processor upgrade, $50 for one step up (for example, moving from a 1.4-GHz to a 1.5-GHz Pentium M). Stepping up to the fastest CPU available, $100.
- Larger hard drive, $50 per step (from 30GB to 40GB or from 60GB to 80GB).
- Increasing the display size (for example, from 14 to 15 inches), $100.
- Moving from XGA to SXGA+ resolution, $50; from SXGA+ to UXGA+, $100.
- Upgrading a CD-ROM drive to a DVD-ROM, $25.
- Upgrading a CD-ROM drive to a CD-RW, $25.
- Upgrading a CD-ROM to a combo DVD/CD-RW drive, $100.
- Upgrading a CD-ROM drive to a DVD-RW drive, $150 to $200.
- Adding a spare battery or optical-bay battery, $100 to $200.
- Adding an extra AC adapter, $75.
- Adding a wireless Ethernet adapter (internal or PC Card), $25 to $50.
- Upgrading from Microsoft Windows XP Home to Windows XP Pro, $75 to $100.
- Increasing RAM from 256MB to 512MB, $100 to $200.
- Adding a better graphics adapter with more memory, $100 (not available on all systems).

Desktop

Size and Weight

The purpose of laptop is to carry with you. So it’s important to have consideration for weight and we give high weightings to lighter and compact size laptop.

Notebooks come in many shapes and sizes. System weight—the weight of the notebook alone—ranges from 2.2 pounds to 10 pounds. The travel weight, which includes added components such as an external AC adapter and an external optical drive, usually adds anywhere from half a pound to a pound.

Display. The options here are dizzying. Screens range from 10 to 17 inches diagonally and come in half a dozen resolutions. Wide-screen displays, available in 15- and 17-inch models, are gaining popularity among consumers because they match up with the aspect ratios of many DVDs. And 15-inch screens are quickly becoming the mainstream displays of choice, supplanting 14-inch screens, just as 14-inch displays supplanted 13-inch screens about three years ago.

Screen resolution is another important factor: The higher the resolution the crisper the image. Small displays (12.1 inches) usually employ XGA resolution (1,024-by-768). Larger displays (15 or 16 inches) use SXGA+ (1400-by-1,050), and a few use UXGA (1,600-by-1,200). Wide-screens use WXGA (1,440-by-900) or WUXGA (1,920-by-1,200).

Processor Speed. Notebooks come with various AMD, Intel, or Transmeta processors, but not all of those were designed specifically for notebooks. Intel offers various chips for notebooks, but its most capable mobile processor is the one-year-old Pentium M. The clock speeds may seem low, at 1.4 to 1.7 GHz, but the top-speed Pentium M CPU performs as well as a desktop Pentium 4 does, at 2.6 to 3.0 GHz, because of its optimized design.

The Pentium M comes in low-voltage (LV) and ultra low-voltage (ULV) versions, which save power. When a Pentium M is paired with an Intel chipset and wireless module, the umbrella technology is called Centurions. Not all Pentium M systems are Centurions systems; some manufacturers choose to pair the chip with a wireless chipset from a different manufacturer. An updated version of the Pentium M (code-named Dothan), which doubles the L2 cache to 2MB, is due out in the middle of the year.

Still on the market is the older Mobile Intel Pentium III Processor-M, which, though specifically designed for mobile computing, is roughly equivalent to the Pentium III generation of desktop processors. PIII-M speeds range from 800 MHz to 1.33 GHz, though this type of chip does not perform as well as a Pentium M at a given clock speed.

Intel also sells mobile-adapted versions of its Pentium 4 processor, both with and without Hyper-Threading, that run at speeds of up to 3.2 GHz. These are used primarily in desktop replacements; the mobile Celeron is often used in value-oriented desktop replacements. A trend over the past year or so is that vendors looking for low-cost, powerful CPUs for notebooks have simply dropped in desktop parts and added more cooling vents, giving them a $50 to $100 price advantage over equivalent mobile-adapted CPUs.

Intel's biggest competitor, AMD, has the fastest CPU for notebooks, the Mobile AMD Athlon 64. This processor will show even greater performance gains once the first 64-bit version of Windows and 64-bit applications trickle into the market. You can also find 32-bit AMD CPUs for notebooks, the Mobile AMD Athlon XP-M and the older, discontinued Mobile AMD Athlon 4.

A smaller manufacturer, Transmeta, recently introduced its mobile Efficeon CPU, which is primarily intended to run smaller notebooks at maximum power efficiency. Stay tuned to www.pcmag.com for more on this.

Hard drive. Hard drive capacities range from 20GB to 80GB. Most users find that 40GB is plenty. The majority of mainstream notebooks use 4,200-rpm or 5,400-rpm hard drives, while the largest desktop replacement notebook drives spin at 7,200 rpm and ultra portable drives at 4,200 rpm. The faster a hard drive spins, the better the system's performance.

Optical drive. A basic CD-ROM drive is almost standard in notebooks these days. But for only a few dollars more you can move up to DVD-ROM, which allows you to play DVDs. A DVD/CD-RW combo drive reads DVDs and reads and writes CDs. A DVD-RW drive can add $200 to $300 to the cost of a system but allows you to read and write DVDs. If you get one, try to go for a multiform at model that handles both DVD-R and DVD+R technologies.

In the near future, look for optical bays to shrink from 12.7 mm to 9.5 mm with the arrival of DVD multi-burners to fit the smaller slot.

Keyboard. Your notebook keyboard should be as comfortable as the desktop keyboard you're used to using. Desktop keyboards have a 19-mm key pitch with 3-mm travel. This means there's three-quarters of an inch between the centers of two adjacent keys, and each key recesses 3 mm when pressed. (A row of ten adjacent keys on a full-size keyboard measures 7.5 inches end to end.)

The smallest notebooks—ultra portables—include keyboards with key pitches from 17 mm to the full-size 19 mm. Many users say that an 18.5-mm key pitch is adequate, while 18 mm is harder to negotiate and 17 mm is too small.

Ideally, a keyboard should have eight cursor control keys (four Arrow keys plus PgUp, PgDn, Home, and End) rather than four keys that do double duty. Also, the Spacebar should be centered under the B key. Before purchasing a notebook, try typing on it.

Pointing Device. Your choices are a pointing stick, a touch pad, or both. If you have to choose one, try both of them first. And consider buying a mouse, which you can plug in and use when you're not traveling.

Communications Wireless. An integrated modem and wired Ethernet are now a given in notebooks. Most but not all come with built-in wireless Ethernet antennas.

The fastest wireless option is 802.11g, with a theoretical maximum throughput of 54 Mbps (the actual rate is 22 Mbps). It is also compatible with the older yet still popular 802.11b standard, which has a theoretical maximum throughput of 11 Mbps (actually 6 Mbps). Many wireless hot spots use 802.11b technology. A third wireless standard, 802.11a, offers speeds similar to 802.11g, but it is used mostly in business settings.

Antenna design is something of an art, and the best-engineered antennas get the fastest throughput and longest distances. The difference is noticeable even when you're less than 50 feet from your access point.

Bluetooth. This short-range radio-frequency technology lets your notebook communicate with PDAs, cell phones, the occasional printer, and possibly your next car's dashboard. Bluetooth is more prevalent in Europe, and though it has caught on slowly in North America, many believe it will supplant infrared wireless technology.

Ports. All new notebooks have USB 2.0 adapters for connecting components like memory keys, mice, printers, external drives, and portable music players. A typical notebook has two ports, though three or four is ideal, especially if one port is on the side or near the front of the notebook. In addition, a consumer-oriented system may have a FireWire (IEEE 1394) port, whose value has been diminished somewhat by the equally speedy USB 2.0. But virtually all digital camcorders use FireWire.

Notebooks also include some legacy ports, such as parallel, serial, and PS/2 (mouse/keyboard) ports; these allow you to connect older accessories. Legacy ports are slowly being phased out in favor of USB.

PC Card or Express Card slot. With so much built into notebooks, there's less need for the credit card–size PC Card slots that used to house modems and network cards; many notebooks have cut back from two to one. By year's end, a smaller, higher-speed card system called Express Card will be available; it will be linked to the coming PCI Express bus. Proponents say it has the potential to be used extensively on desktop systems, as PC Card slots never were, and appear later in notebooks. Critics say the acceptance of Express Card will be slow, just as it was for USB. Some mainstream notebook vendors will likely build in both slots rather than moving immediately to Express Card.

Memory card slots. A consumer-oriented notebook may have a slot for reading digital media from a camera or MP3 player. All Sony notebooks have slots for reading the company's proprietary Memory Stick format, while an increasing number of notebooks have turned to Secure Digital card slots, which have supplanted Compact Flash as the most popular flash media.

Battery. Your notebook's battery rundown time is affected by the notebook's efficiency and the battery's size. The most important measurement is watt-hours (whr). This spec now ranges from 20 whr to 100 whr; 50 whr is typical.

Virtually all current batteries are lithium ion models, supplanting nickel hydride batteries. Most battery packs comprise individual cells the size of double-A batteries, but some use molded lithium polymer elements, which are costly but effectively fill odd sizes.

Even rechargeable batteries don't last forever; they're good for 300 to 500 charge/discharge cycles. That's why a two-year-old notebook doesn't run as long as it did when it was new.

Operating system. Budget notebooks (and some aimed at home users) come bundled with Windows XP Home Edition. Most businesses require Windows XP Professional Edition because of its added networking and security features. Even some home users (especially those with network connections to the office) can benefit from Win XP Pro, though it adds about $75 to $100 to a system's cost. Some enterprises still use Windows 2000 because of its long track record and its stability, though Win XP has proved stable as well.

Windows XP Tablet pc Edition is a version of Windows XP Pro with extensions that support screens' tablet-writing ability. Another flavor is Windows XP Media Center Edition, a version of Win XP Pro that focuses on multimedia features. It has a couch-friendly "10-foot interface," meaning that you can hook your system up to a large-screen monitor and control media via remote from 10 feet away. (Currently you can get Windows Media Center only on a Media Center notebook or desktop; you can't buy it as standalone software.)

Bundled software. Consumer-oriented notebooks often include software with varying degrees of value. If Microsoft Works comes bundled, find out whether it's the version with Microsoft Word (useful) or one with the bare-bones Works word processor (less useful).

Sometimes you can get discounts on additional software when you buy a notebook. Check for deals on Microsoft Office. Consumer notebooks may include multimedia software, particularly photo-editing, video-editing, and CD/DVD-burning programs that go beyond the rudimentary features built into Windows.

Port replicator, docking station, and expansion slice. If you're constantly attaching and detaching your notebook at your desk and you have a lot of cables connected (AC power, printer, mouse, monitor, Ethernet, modem, external drive), a port replicator can make your life easier.

A docking station is a port replicator on steroids; it may also have room for bigger speakers, a module to charge a spare battery, and an optical drive bay, and it may have a security lock. But because docking stations cost so much (twice the price of port replicators), they're mostly used by businesses.

An expansion slice is typically used to add an extra battery or optical drive to an ultra portable.

Warranties. One-year warranties on parts and labor are common, but you'll have to get your notebook back to the dealer or manufacturer. For an extra charge (about $50 to $100 a year), you can increase the warranty to two or three years. Some sub-$1,000 notebooks have 90-day warranties; add $50 to bring the term up to one year.

No-fault warranties are also available, meaning that you're covered even if the damage is your fault—if you drop your notebook, for example. If you can't be without your notebook for very long, check into expedited repair services with three-day turnaround: The unit is returned to the vendor on day one, fixed on day two, and back in your hands on day three.

Top Ten Buying Tips

- Be clear about what you expect your desktop system to do now and in the future. For example, if you plan to edit video or audio clips, you'll want a high-capacity hard drive (at least 160 GB), and both a CD-RW and DVD+, - or multiform at drive for back-ups, as these file types usually eat up lots of storage space. And in this day and age, in which a broadband connection is a must for faster downloads, make sure your system comes with integrated Ethernet. For notebooks, high-end desktop replacements are usually your best bet for multimedia tasks.
- Manage your budget. Even though you know how much you can afford, getting carried away with optional features is easy. The costs can add up quickly. Buying a system with 1GB of memory is overkill if you typically run one application at a time, but 256MB is a reasonable amount of memory in a budget system. Note, however, that we recommend at least 512MB of memory in order to ensure that the Microsoft Windows XP operating system will run properly. Also, if you opt for a high-end video card, realize that you'll have to spend more for a display that can accommodate the card's highest resolution modes.
- Look for bundled extras when comparing prices. Free software, printers, and other peripherals can add hundreds of dollars to the value of your desktop package. Check the cost of consumables, though, especially for printers. The cost of ink for some "free" inkjets, for example, can quickly outstrip the total expense for an equivalent printer from another manufacturer. For software one has to check if you are getting a full version, instead of a trial version that expires in 30 days.
- Don't skimp on mass storage. The difference between a 40GB and a 60GB hard drive may be as little as $50 when you order your desktop, so configure your system with as big a drive as your budget allows. Upgrading to a larger drive later on will cost more and can be a difficult task for a novice, particularly if the PC is a notebook.
- Some desktops and notebooks (particularly the lighter ones) don't offer support for legacy devices such as parallel printers, serial modems, and PS/2 pointing devices. If you own one or more legacy peripherals, be sure your desktop includes ports your old equipment can connect to. Otherwise, you'll have to purchase new peripherals that connect via USB or FireWire ports. Some notebook models offer optional docking stations that include all the legacy ports.
- Read the fine print for hidden costs, especially where warranty options or "free" services are concerned. Some offer limited warranties, which last less than a year. You

may want to invest in an extended warranty for your machine. Some system builders limit you to initial tech support only; you may have to pay for additional service calls.

- If you're on a strict budget, make sure your desktop price includes a monitor. For those angling for a value notebook, look for a built-in wireless solution and hot-swappable optical drives.
- Find out if there's an actual cost to those "free" technical support hotlines. Look for a toll-free number; otherwise you'll take a hit on your phone bill, especially since hold times for tech support are notoriously long. And beware of a "limited warranty." This may mean only 90 days of toll-free technical support, after which you may have to pay a premium just to call for help.
- As with any sizable purchase, buy your desktop from an established, reputable company. There are plenty out there. If you're hankering for a more customized desktop or notebook setup, consider some of the better-known boutique vendors. Just be prepared to pay for it.

- Consider the size of your workspace. If you have limited desk space at home, a tower or mid-size desktop could leave you with little or no room to work. Slim desktops and small-form-factor systems can free up some space, as can a flat-panel display. Realize, though, that small systems are often less expandable than larger ones and that flat-panel displays are more expensive than monitors. A desktop replacement notebook might be more ideal space saver, as many come with desktop processors and ample storage and optical drives.

Reality Checker these thoughts in mind when buying and using notebook PCs.

Consider the travel weight. Compare travel weights, not system weights. That's the notebook (system weight) plus transformer (typically 0.75 pounds). For one-drive systems, add an expansion slice for the optical drive (2 to 3 pounds). If the vendor quoted the weight with a weight-saver bezel (translation: a blank plate in place of the optical drive) you may have to add the weight of an internal CD or DVD drive (0.5 pounds).

Don't get hung up on small weight differences. What really counts is the total weight of the bag you sling over your shoulder. On its own, a 5-pound notebook with a nice screen and two drives weighs 25 percent more than a 4-pound system with a smaller screen, smaller keys, and no DVD drive. But notebook bags weigh 2 to 5 pounds and all your other stuff (transformer, cell phone, music player, paper documents, and paperback novel) adds 2 to (gulp) 10 pounds. A heavier notebook might add an additional pound to the bag's overall weight, but when everything weighs 10 pounds is that extra pound really worth worrying about?

Why 3.5-pound sub-notebooks weigh more than 5-pound thin-and-lights. Before you spring for that svelte one-drive sub-notebook with a smaller display and keyboard, consider how you normally travel. If you need the optical drive more than occasionally,

your real walking weight will be 3.5 pounds for the notebook, plus 2.5 pounds for the modular slice that contains the optical drive for a grand total of 6 pounds.

Small notebook, smaller battery. Manufacturers sometimes keep weight down on subnotebooks by shipping with four-cell batteries that are good for just 2 to 3 hours of power. Serious users will need to add a second battery that mounts underneath or a replacement main battery that sticks out the back.

Fitted cases don't always fit. A glove-like case for a subnotebook won't fit if you add the expansion slice or an extended-length battery. If you're moving up to a 15- or 16-inch display notebook, your current case may not hold it.

Bigger equals more rugged. A small system with tightly integrated components is somewhat more likely to break in a fall than a bulkier unit where there's room for extra bracing. Conversely, the smaller the LCD, the less likely it is to break.

Midlife battery crisis. Batteries don't last forever. A frequently used 2- or 3-year-old notebook may be due for a new battery (usually $100 to $150).

Nonstandard connectors. An ultra portable notebook may need an adapter or port expander if you want to connect accessories, such as a printer or scanner. The weight increase is marginal, but there's always the fear factor: Did you remember to pack the adapter for the important business trip?

Think about the extended warranty. An extended warranty is a moneymaker for the seller. For individual buyers, there is the comfort of knowing that if the notebook breaks, especially early in life, the store may just hand you a new one.

Think twice about hi-res. Higher resolution is generally better, except when you try to read the fonts. Users with imperfect eyesight may want to stick with XGA (1024-by-768) resolution rather than SXGA+ (1400-by-1050)–fonts display 33 percent larger.

You'll want two transformers. Then you can have one at home and one at the office. One of the two can be a multi-product charger (from Targus or iGo) that also handles PDAs and cell phones. They cost between $75 and $100.

Upgrade Prices

Many vendors, especially those that sell direct online, let you customize your system. Don't like the installed wireless solution? Want a bigger screen? Want better graphics? Upgrade. Just remember that all those upgrades can really add to your bottom line.

- Processor upgrade, $50 for one step up (for example, moving from a 1.4-GHz to a 1.5-GHz Pentium M). Stepping up to the fastest CPU available, $100.
- Larger hard drive, $50 per step (from 30GB to 40GB or from 60GB to 80GB).
- Increasing the display size (for example, from 14 to 15 inches), $100.

- Moving from XGA to SXGA+ resolution, $50; from SXGA+ to UXGA+, $100.
- Upgrading a CD-ROM drive to a DVD-ROM, $25.
- Upgrading a CD-ROM drive to a CD-RW, $25.
- Upgrading a CD-ROM to a combo DVD/CD-RW drive, $100.
- Upgrading a CD-ROM drive to a DVD-RW drive, $150 to $200.
- Adding a spare battery or optical-bay battery, $100 to $200.
- Adding an extra AC adapter, $75.
- Adding a wireless Ethernet adapter (internal or PC Card), $25 to $50.
- Upgrading from Microsoft Windows XP Home to Windows XP Pro, $75 to $100.
- Increasing RAM from 256MB to 512MB, $100 to $200.
- Adding a better graphics adapter with more memory, $100 (not available on all systems).

- Adding an expansion slice, $150 to $250.

Wireless choices

Virtually all notebooks include wired Ethernet, and many include wireless Ethernet, either standard or as an option. Here's a summary of connectivity options, the most important of which are 802.11a (fast corporate wireless), 802.11b (most common wireless), 802.11g (most widely used, fast wireless). Today, just about every notebook should be ordered with built-in wireless connectivity. If your notebook doesn't come with wireless and you need to add it later, try adding in this order: MiniPCI card (internal), PC Card or PCI Express Card (external), wireless USB adapter (small box outside the notebook), wired Ethernet to wireless bridge (large AC-powered box outside the notebook).

Term	**Details**
AES	Advanced Encryption Standard; a globally supported successor to the 1974 DES (Data Encryption Standard). Part of 802.11i.
Bluetooth	Short-range (30 feet) wireless for communications among notebooks, cell phones, GPS modules, PDAs. Complements rather than competes with wireless Ethernet.
Centrino	Intel terminology for notebook with Intel-branded Pentium M microprocessor, Intel chipset, and Intel-branded Wi-Fi wireless.
802.11a	54-Mbps wireless operating at 5.4-GHz frequency. Endorsed by some businesses; has few home or SOHO users.
802.11b	11-Mbps wireless Ethernet, operating at 2.4 GHz. Most commonly used wireless option today. Sometimes just called "b" wireless.
802.11g	54-Mbps wireless Ethernet, more popular than 802.11a. Works with 802.11b but slows the whole network to 11 Mbps. 802.11b/g is the same as 802.11g (since "g" incorporates "b"). It's possible to buy an adapter with "a," "b," and "g" wireless.

802.11i	An emerging standard for wireless security, slated to be available late in 2004. Incorporates AES, CCX. Succeeds WEP and WPA.
802.11n	An evolving proposal for 100-Mbps wireless Ethernet.
802.16a (WiMax)	A proposed standard for wide-area or metropolitan-area network (MAN) with a potential range of 30 miles and throughput of 70 Mbps. Would compete with 3G cellular communications, not in-building Wi-Fi. Product possible in 2004, more likely 2005.
IrDA	Infrared wireless. Short-range line-of-sight wireless for exchanging data between two notebooks or with a printer. Seldom used. If two adjacent notebooks start beeping at each other, chances are you've left IrDA turned on.
LEAP	Lightweight Extensible Authentication Protocol. A proprietary Cisco security standard but with wide corporate support. (Also called EAP; same meaning.)
MiniPCI	A small internal card socket used for wireless adapters. MiniPCI Ethernet often can be upgraded to meet newer standards.
PC Card	A credit card–size connector in the side of a notebook. Can be used for Wi-Fi adapters.
PCI Express	A potential high-speed successor to the PCI Card. Available as of mid-2004, but the extra speed is unneeded for even the fastest wireless adapter.
3G	An evolving cellular standard in the U.S.; allows data transfer over cell phones. The cell phone connects to a notebook by cable or Bluetooth.
WEP	Wired Equivalency Protocol. A now-aging standard for wireless security, meant to provide the level of security of wired networks over wireless. Can be cracked. WEP and its interim successor, WPA (Wi-Fi Protected Access), will give way to 802.11i.
Wi-Fi	Wireless Fidelity. Generically used as an umbrella term for standards-based wireless Ethernet, but more properly a term of the Wi-Fi Alliance, an international organization that tests and certifies interoperability of IEEE 802.11 standards-based

Before shopping for a notebook, consider how you'll be using it. If your primary goal is to get some word processing or spreadsheet work done while staying on top of e-mail, a $1000 low-end Pentium-M model with a 12.1-inch screen and 20GB hard drive will be plenty fast and save you hundreds of dollars. Sexy lightweight notebooks and models with top-notch processing power and big screens cost much more.

However, keep in mind that most vendors let you custom build and price your own notebook by picking from a mind-boggling array of features, which gives you a lot of control over the final product. You may be able to afford a faster notebook by accepting a smaller, less expensive hard drive or a CD-RW drive instead of a combination DVD-ROM/CD-RW drive.

Unlike PCs, you can later upgrade only some of these components, such as memory and the hard drive; others, such as the graphics board, are permanent once they're installed at the factory. That's slowly changing, as some manufacturers are incorporating upgradeable graphics. However, take your time and pick only what you need. Below is a rough breakout of some configuration options.

Feature	Low End ($1300 and below)	Recommended ($1300 to $2000)	High End ($2000 to $3500 or more)
Installed memory	128MB	256MB to 512MB	512MB to 1GB
	An important consideration. The more installed memory your notebook has, the more applications you can run at once, and the better your notebook will perform. Ease of access aside, upgrading memory in a notebook is a bit trickier than with a desktop, so buy as much memory preinstalled as you can afford.		
Processor	1.4-GHz Pentium-M	1.3- to 1.7-GHz Pentium-M, 2.0-GHz Mobile Pentium 4, or 1.6-GHz Athlon XP-M	1.6- to 1.7-GHz Pentium M, 3.0-GHz Mobile Pentium 4, or 2.0-GHz AMD Mobile Athlon 64
	An important consideration. The CPU determines how quickly a notebook runs applications and performs on-screen tasks.		
Screen size	12.1 inches	14.1 inches	15 to 17 inches
	An important consideration. The size of a notebook's LCD screen is quoted as a diagonal measurement. The larger the screen, the higher the maximum resolution and the more information you can view at once.		
Hard drive size	20GB	20GB to 60GB	60GB to 120GB
	Somewhat important. The larger the hard drive, the more data you can keep on your notebook. Most people don't need more than 20GB. Those who work with databases, spreadsheets, or digital photo or video files should consider a large drive.		
Expansion bays	0 to 1	0 to 1	1 to 2
	Somewhat important. The more expansion bays, the more options you have to switch in new optical drives or other storage drives, but switching drives takes time. Keep in mind that high-end ultraportables typically have no extra bays, but you can purchase external drives for them.		
Optical drives	CD-ROM	8X DVD-ROM or 24X/10X/24X CD-RW	8X DVD-ROM and 24X/10X/24X CD-RW combination drive or rewritable DVD drive
	Somewhat important. CD-RW drives are a cost-effective and flexible		

	removable-storage option, while DVD-ROM drives allow you to watch DVDs on your laptop. A combination drive gives you the best of both worlds. Most manufacturers offer laptops with rewritable DVD drives, but they tend to be pricey.

Are you ready to buy a notebook? Here are PC World's recommendations for specifications that will fit the needs of the average user.

- **A 1.4-GHz Pentium M processor.** For everyday work--word processing, spreadsheets, e-mail--you don't need the latest, greatest (read most expensive) Pentium processor, but thankfully, with the Pentium M, you get smooth performance and long battery life.
- **512MB of memory or more.** Anything less will probably slow your work.
- **Lithium ion batteries.** They usually last longer on one charge than nickel-metal hydride batteries and don't need to be replaced as often. If you want more time away from an outlet, buy a notebook with a modular bay capable of holding a supplementary power pack. Secondary batteries usually cost between $99 and $200.
- **A 14.1-inch screen.** A screen larger than 12.1 inches eases eyestrain. Unless you're really pinching pennies, bigger is better.
- **A 40GB hard drive.** Unless you generate multi megabyte music or database files, or install more than one office suite, 40GB is plenty big.
- **Touchpad pointing device.** Pointing devices are a matter of taste. However, most people find a touchpad easier to use than a pointing stick. For people who can't choose between a touchpad and an eraser head pointing device, some notebooks include both. If you buy one of these, make sure it provides two sets of mouse buttons--one for the touchpad and the other for the eraser head--so you don't have to stretch to reach.
- **Multiple USB ports.** Many notebooks now come with two or more USB 2.0 ports, useful for connecting more of the latest peripherals.
- **All-in-one design.** Unless you need a lightweight notebook, opt for one with internal bays for both the floppy drive and the optical drive. This design eliminates time-consuming swapping of devices.

Laptop Processors

The central processing unit (CPU) is sometimes described as the most important chip in the computer. It contains the arithmetic and logic unit (ALU), so the computer can do calculations, and the control unit that controls the flow of data between the ALU and memory. There's a lot of competition between manufacturers of processors and the speeds they offer, but the plain fact is that while it is heavily featured in the marketing

literature even the slower processors (1.4 to 1.6GHz) are fast enough for most uses, even though 3.0GHz is offered on many laptops. Money saved on processors might more usefully be spent on memory. There are two things that really matter with laptop processors: the balance struck between processor power and battery consumption, and the links to mobile technology that enable you to make the most of the laptop's portability. For the first, simply put, processors with the word mobile in their name are going to be the best choice, as in Mobile Intel Pentium 4 or Athlon XP Mobile. These use less power and run cooler (a definite plus in a laptop). For the second, Intel's combination of processor, chipset and wireless card technologies marketed under the brand name Centrino is hard to beat.

Notebook computer screens use LCD, so you want to be sure you choose a notebook computer that has an active matrix display (also known as TFT), which gives a brighter display which can be viewed from an angle. The alternative, passive matrix display, gives a dimmer view and has to be viewed head on to be seen.

N+Display Size

Many notebook computers, especially ultra portables, have fairly small display screens. Only you can determine how small a notebook computer display screen you like, but for most people, an LCD display needs to be 14" or larger to be viewed comfortably at XGA (1024 x 768) resolution (which is the preferred resolution for Windows).

d. Recommending Alternatives:

(a) Development Phase

ACER:

- Processor type: Intel Centrino
- Processor speed: 1.8 GHz (533 Mhz FSB, 2MB L2 cache)
- System memory: 512 MB DDR2 RAM (support dual-channel)
- Hard drive capacity: 80 GB
- ATI Mobility Radeon X700 with PCI Express 64 MB VRAM
- Drives included: Slot loading DVD-Dual
- Screen: 15.4” WXGA CrystalBrite TFT LCD
- Modem speed: 56 Kbps
- wireless communications: wireless LAN 802.11b/g, Bluetooth
- Operating system: Windows XP Professional
- Warranty: 3 Years

(b) Implementation Phase

The final decision was made to buy the ACER Aspire 1690 laptop.