How To Build Your Own Computer

by Roedy Green

Introduction

Computers are much like stereo systems. You need not buy a complete package. You can buy individual components to make up your own dream machine. You might assemble and test them yourself, or have someone else do it for you.

Even if the thought of building your own machine leaves you cold, you might still want to read on. Most of what I will tell you will also be useful in selecting a pre-fabricated computer.

Why Build Your Own?

Here are some reasons why you might build your own machine:

1. Long term you will save money. Once you learn to build machines, you can repair or upgrade computers, on your own, just for the cost of the components. In the short term you will not save money. A craftsman can build a machine much faster than he can teach you how to build one.
2. You can be sure that every component in your machine is good quality and tested properly.
3. You will have a deeper understanding of how your machine works.

Selecting the Components

The basic components are: case, power supply, motherboard, RAM, hard disk, video controller, monitor, floppy drives, multi-i/o card and keyboard. Optionally you might have a mag tape backup, modem, mouse and printer.

Manuals

It is crucial that you acquire manuals on all the components in your system. Without manuals, the equipment is useless. Manuals on the floppy drives and the power supply are hard to come by. However, you should be able to twist the vendor's arm to get manuals on all the other components.

Cases

Choose a case with care. You will live with it far longer than any of the innards, since cases do not become instantly obsolete.

There are four basic styles:

1. Full-size tower with six accessible bays.
2. Full-size desktop with three accessible bays and two inaccessible bays.
3. Mini tower with two half-height accessible bays and two third-height accessible bays.
4. Mini desktop with three half-height accessible bays and one third-height accessible bay.

Which one should you choose?

The Case for a Full-size Tower

If you are a hobbyist, and think in future you might add goodies to your machine, such as a mag tape, a CD-ROM, one of those new 2.88 MB floppies, or something not yet invented, get a full-size tower case. It has six bays (holes) in which to put devices such as hard disks, floppy drives and mag tapes.

A tower case has plenty of room for a giant 450-watt power supply or even an internal UPS (uninterruptible power system) if ever you grow that big. Tower cases give you easy access to the components, so assembly and servicing is easier. Tower cases have plenty of room inside for air to flow freely to keep your components cool. Natural convection in the tower also aids cooling.

The tower case sits on the floor, so it takes up no desk space.

There are two main disadvantages to a full-size tower case:

1. It is full size — these puppies are BIG.
2. They are more expensive than the other types of case.

If you plan to build your own machine, then a full-size tower is the best way to go.

The Case For a Full-Size Desktop

A full-size desktop case has one less bay than a tower, and two of its bays are inaccessible. This means you cannot get at them from the front, since they hide inside the case. So you cannot put devices like floppy drives or mag tape units into such bays. However you can put hard disks in.

A full-size desktop case has many advantages of a tower, though it does not cool as well, and is not as easy to service. It takes up a large chunk of desk space. You can mount a desktop case on its side and treat it like a small tower case.

A full-size desktop case is not considered "sexy" and so sells for considerably less than a tower.

The Case for a Mini Tower

A mini tower is best for a low-cost computer that will perform only one function, such as word processing or accounting, and that will never be upgraded. Mini towers are handsome and economical.

A mini tower case cannot sit on the floor. If you were to put it there, you would have to grovel every time you inserted a floppy. Mini towers must sit on your desk.

They have room only for a small power supply and a few components. There will be no room to add half-height devices like a mag tape or CD-ROM. The cramped interiors can limit your choice of motherboards. The cramped placement of the RAM and the bays often prevent you from using all the slots on the motherboard.

If these terms, "motherboard", "slot" and "RAM" are unfamiliar, hang tight. I will explain them later.

Servicing in such cramped quarters is more difficult.

The Case For a Mini Desktop

The mini desktop case sits on your desk. The monitor sits on top of it, so oddly it ends up taking less space than the mini tower case. These cases, too, are handsome and low cost.

The same cautions apply as for the mini tower. However, cooling is even worse than in a mini-tower since cramped cabling interferes with air flow. Further, natural convection is not as efficient.

Cases to Avoid

If you plan to build or service your own computers, beware of non-standard cases. If you buy an unusual case, it may need an oddly shaped or custom-sized power supply. If it fails, you could end up paying five times as much as you would for a one of the standard types.

If you select a smaller case, make sure it uses a standard "slimline" power supply with dimensions 150 x 140 x 86 mm. Other safe, common sizes are "baby" 165 x 150 x 150 mm and "standard" 213 x 150 x 150 mm.

Power Supply

The power supply is a box that converts the 110 volt AC current from the mains to the 12 volt and 5 volt DC battery-style power the computer uses internally.

To work properly it must provide smooth DC power, even when the AC power coming from the utility company is rough with spikes and sags.

The AC power can be noisy even when the utilities company is providing perfect power, even when there are no obvious light dimmings. The trouble usually comes from office copiers, fans, other motors or fluorescent light ballasts on the same circuit with the computer.

Big heavy cans called capacitors in the power supply act like reservoirs to absorb the spikes (overvoltages) and provide power during the sags (undervoltages). Low-quality power supplies scrimp on these and other filtering components.

The best quality "TurboCool" power supplies are made by PC Power and Cooling in the USA. Unfortunately, they cost more than twice as much as an ordinary power supply.

There are several reasonable intermediate brands such as Senstron, Jaba and Maxpower.

Poor-quality power supplies have noisy fans and provide very little protection from AC power glitches. I will not mention any by name to avoid a cross-burning on my lawn. With a poor-quality power supply, your computer will freeze sporadically, reboot for no reason from time to time, and occasionally just give wrong answers. If it appears your computer is haunted, chances are it has a poor-quality power supply. Yet if you take it back to the dealer (who has dedicated clean AC circuits), it will behave perfectly.

The power supply is the engine of your computer. This is not a place to scrimp.

When I build machines, I mostly use TurboCool power supplies, augmented with an ESP surge suppression box that goes between the wall and the computer. The ESP further filters the power, and protects the computer from the really big spikes.

Most of the so-called power protection boxes contain only about $1 worth of MOV's, which are almost useless by themselves since they burn out on the first big hit. You need boxes that have some more robust components such as gas discharge tubes, silicon avalanche diodes, chokes, baluns, capacitors or transformers.

The faster your computer, the more sensitive it is to noise in the power. A slow old 12 MHz 80286 will be happy with any old power supply. A 33 MHz 486 needs the purest, cleanest power money can buy.

UPS

A UPS is an uninterruptible power system. It keeps your computer going even when the AC power has failed. Otherwise, you lose your work in progress if the power fails, even momentarily. UPSes used to be prohibitively expensive, but prices have been tumbling.

Besides the UPS boxes that go between the wall socket and the computer, there are two types that fit right inside the computer. These are simpler and cheaper than a standard UPS since they feed the innards of the computer directly off batteries, rather than using DC from the batteries to generate AC which is then fed to the power supply to convert it back to DC again.

One type incorporates the UPS inside the power supply — such as the Innersource. The other uses a battery that goes between the power supply and the motherboard — such as the Boomerang.

The Motherboard

If you open up a computer and look inside you will see a big board with eight slots (sockets) on it. The various controller cards fit in the sockets. Also on the motherboard are the CPU (e.g., the 80386 DX chip), the ROM BIOS, the RAM, the SRAM cache and the support chip set.

Today's motherboards have far fewer chips and components than those of just a year ago. Ironically, the 486 motherboards are the most expensive, but cost the least to manufacture since they require the fewest chips.

The CPU is the part that does the arithmetic. The ROM BIOS is a burned-in program that handles the details of making the keyboard, floppy and hard disk work. The RAM is the high-speed memory where the results of calculations are stored. The SRAM is super high-speed memory where the most active portions of RAM are duplicated. The support chip set helps the CPU interface with the rest of the computer, handling such tasks as copying data from the hard disk to RAM, tapping the CPU on the shoulder when a character has come in on the modem ,etc.

If you are going to build your own machine, build one 25 MHz or slower. 33 MHz machines are much trickier to get working. A 25 MHz 486 is quite easy to build. If you are successful with that, go ahead and build your second machine at 33 MHz.

How do you judge a motherboard?

1. Look at the soldering and the traces. They should be clean and neat.
2. It should come with a manual that clearly describes the function of all the jumpers (pairs of pegs you short together to configure your board).
3. The BIOS should be a well-known brand. The BIOS most programmers test their code with is called AMI (American Megatrends International). Phoenix is also safe. I would avoid anything else, not because it is necessarily defective, but just because programmers will not have tested their programs with it.
4. The support chip set should be a well-known brand. The chip set most programmers test their code with is called C&T (Chips and Technologies), so it is the safest. The QEMM memory manager has full support only for the C&T brand chipset. Intel and OPTI are also reasonably safe. If you select anything else, you are more likely to run into incompatibility problems, though the degree of trouble is nowhere near as severe as if you select a no-name BIOS. Unfortunately C&T has not yet released a 486 chip set, so there you are on your own.
5. The motherboard should be set up to allow the CMOS to run from a lithium battery. The battery keeps the time and date clock-calendar running, even when the power is off. Once you install a lithium battery, you can forget it for years. Other types of battery require periodic attention and replacement, especially the so-called rechargeable ones. When a battery fails, the computer suffers a fit of amnesia and forgets all its configuration information stored in CMOS. (I wrote a program called CMOSSAVE to restore its memory should this happen. It is available on diskette.)

RAM

RAM is the high-speed memory. RAM can come in the form of chips (DRAM—Dynamic Random Access Memory), miniature cards with edge connectors (SIMMS—Single Inline Memory Module) or miniature cards with pins sticking out one side (SIPPs—Single Inline Pin Package).

SIMMs are the easiest to install yourself. All cost about the same, so go with SIMMs if you have a choice. Most RAM nowadays is 70 or 80 ns. 70 is faster and costs little more.

Check out how much RAM your motherboard can hold. 8 MB sounds like a lot today, but in few years 64 MB will sound as cramped as 640K does today. On some motherboards you need a proprietary 32-bit card to add extra memory. BUY THAT CARD NOW, even if you don't need all the RAM. Guaranteed it will not be available when the time comes to expand your RAM.

2 MB is sufficient for most word processing and accounting. 4 MB is enough for Windows, but 8 MB is better. Microsoft demonstrated their unreleased Windows 3.1 using 14 MB of RAM. Autocad needs 8 to 16 MB. Buy a little more RAM than you think you need since all programs are getting fatter with every release.

Happily, all brands of RAM I have encountered work fine.

SRAM Cache

If you have a 33 MHz CPU, it is so fast the main RAM cannot keep up with it, even if you buy 70 ns RAM. You then need some ultra high-speed 20 ns SRAM that can keep up. This SRAM is so expensive, you can only afford perhaps 32 to 256K of it (about 3% of the size of your big main RAM). A special cache controller makes optimum use of this RAM by dynamically tracking which parts of regular RAM the CPU uses most often and by keeping duplicate copies in the SRAM cache.

You also need a small amount of even faster still 15 ns TAG RAM that tracks which parts of the main RAM are duplicated in the SRAM cache.

The 486 chip has an additional 8K SRAM internal cache built right into the CPU chip.

Happily, all brands of SRAM I have ever encountered work fine.

Hard Disk

There are five kinds of hard disk controllers (electronics). The most commonly sold is IDE because they are fast and inexpensive.

1. MFM: These were the original type of hard disk. They are reliable and inexpensive, but slow. They are becoming rare.
2. RLL: These crammed 50% more data into the same size disk as MFM. They were less reliable than MFM. They too are now rare.
3. IDE: Most disks sold are the IDE type. They are fast and inexpensive. IDE is not a standard like the other types which means you may have software compatibility problems. Usually you cannot test IDE disks properly for surface defects. Usually, if you inadvertently damage the low-level formatting information, there is usually no way to repair it without sending the drive back to the factory.
4. ESDI: These disks are fast, reliable, and expensive. You can rest assured they will work under OS/2, which you cannot say for IDE or SCSI. These are the easiest kind of disks to install. If you are building your own machine, this is the way to go if you can afford it.
5. SCSI: These disks are potentially the fastest, but they are the most expensive and the trickiest to make work. To complicate matters, there are SCSI-I, SCSI-II and MAC SCSI drives. In theory, you can also hang CD-ROMs, mag tape backups, and several hard disks all on the same SCSI controller, but in practice . . .

Buying a Decent IDE

You might have your heart set on an ESDI or SCSI drive till you find out the combined price of drive and controller. That may force you to lower your sights to an IDE. How do you get a decent IDE?

ATA IDE Standard

There is a standard for IDE drives called ATA. To the best of my knowledge, only the Maxtor brand disks comply with the standard. Without standards you have chaos — some drives will work with each other, but others will not. Some drives will work with some controllers but others will not. Some software will work with only some drives. Even without standards, you can usually get things to work, but only after you have pulled out a few handfuls of hair.

IDE Cache Disabling

Conner IDE allows you to disable the cache in the drive itself. (Don't confuse this cache with the SRAM cache. The disk cache keeps the most active parts of the disk in RAM.) With the cache disabled, you can test the drive surfaces. If you cannot disable the cache, all you can test is if the non-mechanical electronic cache is working, not the magnetic surfaces themselves.

I use HDTEST every month on my drive as prophylaxis, to handle any new bad spots before they give trouble. Testing for bad spots in especially important as part of burn-in when you first set up the drive. I run alternately HDTEST and SpinRite for 4 days as part of the initial burn-in. Unfortunately, no other brand but Conner lets you disable the cache to perform this test properly.

IDE LLF

Fujitsu and Maxtor allow you to perform the low-level format in the field. This means if rogue software or a hardware failure inadvertently destroys the housekeeping information on the hard disk, you can recreate it without sending the disk back to the factory. Unfortunately, other drives don't allow you to do this. To get around this problem, I wrote a program called BOOTSAVE, that at least allows you to reconstruct the most commonly damaged sector on the disk.

I know of no IDE drive that simultaneously follows the ATA standard, allows you to disable caching, and allows you to redo the LLF in the field. Meanwhile, I recommend that you just pick one of these three brands and live with its imperfections.

How Big A Disk?

Fortunately, you can create word processing and spreadsheet documents for years without making much of a dent in your disk space. However, you can fill your hard disk very quickly by installing programs. I have built 80 MB systems for people that were ¾ full at the time of delivery —containing just the software they purchased. Further, every upgrade to the software is often double the size of its predecessor.

80 to 150 MB is a reasonable size if you are not sure. Don't buy too far ahead. You are better to put the money in the bank, then buy later when you need the capacity. Then drives will be cheaper, faster and larger. You can also later expand the size of your disk using Stacker, a software data compressor.

Video Controller and Monitor

There are three routes you can go:

1. Economy Plain VGA (such as the ATI Basic) usually with grayscale monitor.
2. Super VGA (such as the ATI Integra) usually with a low-cost color monitor such as the Samsung SyncMaster 3.
3. Deluxe Graphics Coprocessor (such as the ATI Graphics Ultra) with a non-interlace, big-screen monitor such as the Idek.

Without an expensive big screen to make the type big enough, expensive non-interlace monitor to control the jitter, and fast coprocessor to process all the extra dots, the high resolution 1024x768 mode is not practical.

Customers often insist on buying part of such a high-res package, but then end up running it in plain 640x480 VGA mode to get a decent-quality image. They wasted their money. In the musical Oklahoma!, Addo Annie sings "With me, it's all or nothing." She must have been thinking about high-resolution video.

Avoid no-name video cards. These cards lack proper software drivers to make Windows and other programs work. Compatibility problems plague them. Good quality cards are now so inexpensive, it is not worth the hassle.

Floppy Drives

Since most software comes on 5.25" floppies, it is convenient to have a 5.25" floppy drive. Since 3.5" floppies hold more information, and are more durable it is best to use a 3.5" floppy drive for day-to-day use. Since floppy drives are now so inexpensive, there is little reason not to have one of each.

I have had good success with Panasonic and Teac floppies exchanging floppies between XT and AT machines. I have had troubles with some of the other brands.

Unfortunately the quality of floppy drives generally has declined over the years. When you buy a floppy drive, there is a very high probability it will be misaligned. If you are building your own machine, you will need a special tool like the Dysan Interrogator to detect this problem.

Multi-I/O Card

The multi-I/O card provides ports to attach your printers, modems, mice and joystick.

In off-the-shelf machines, the multi-I/O card is usually the weakest link. Sometimes you will find multi-I/O cards worth as little as $5 causing nothing but trouble in a $4000 machine.

I have experimented with many multi-I/O cards. The only one I found completely satisfactory is the Everex. However, it is so complicated to set up, you need to use a computer program to help you.

To set up a multi-I/O card correctly, you must understand IRQs, port addresses, DTE versus DCE and other computer arcana. When people bring me machines to repair, I find very few of the multi-I/O cards were set up correctly. Get experienced help when it comes to that step.

Keyboard

Here are some factors to consider in choosing a keyboard:

1. Touch: a light touch is faster, but if you rest your fingers on the keyboard, you will get spurious keystrokes. Make sure it has tactile feedback — a sudden give when you have pressed the key far enough. Without feedback, your typing will be slower.
2. Layout: function keys on the top, left or both. Is there strange placement of \ ` [ ] keys? Is it similar enough to other keyboards you need to use in a day?
3. Size of keys: large backspace, Enter, Shift, Ctrl.
4. Comfort: how does the lower shelf feel against your wrists?

Before you make your final selection, try typing with your candidate keyboard for at least five minutes. Buy the keyboard you like best. Save money elsewhere on the machine. Do not scrimp on the keyboard.

Mag Tape Backup

Don't kid yourself and say you will do backups to floppy. It takes about 67 diskettes to back up an 80 MB drive. No one has that much patience! If you completely lose the contents of your hard disk, it would cost an average of $35,000 to replace the data.

You might think you will backup only your data to floppy, and "simply" reinstall the software if you crash. Some software takes weeks to get working smoothly. If you hired professional help to install your software, and you have to reinstall it, he will charge you at least as much to clean up the mess and reinstall.

Mag tapes are now becoming so cheap they pay for themselves in months. You just insert a tape the last thing at night, and come back the next morning and the entire disk is backed up. You can keep an extra backup tape offsite in case thieves steal everything.

Modem

2400 baud modems are so inexpensive, you might as well throw one in. I have also written a set of generic modem manuals available on diskette.

With a modem you can get free advice on how to make your computer work from local BBSes (Bulletin Board Systems). You can also "download" free programs. If you tie into commercial BBSes like BIX, you can talk to the magazine and book authors to obtain advanced technical information.

MNP-4 modems automatically correct errors due to static on the phone lines. MNP modems cost a little more, and are only useful if you plan to talk to other MNP modems, e.g., Tymnet.

Mouse

If you use Windows, you must have a mouse. The best 3-button mouse support comes from Logitech. Microsoft makes their own expensive 2-button mouse which is also popular. The problem with using no-name or very cheap mice is the lack of software to make them work.

Also consider using a trackball instead of a mouse. It requires less desk space. You need less manual dexterity to double click, but a little more to move diagonally.

Printer

Before you select a printer, get a list of the printers supported by each software package you plan to use. Then confine yourself to a printer supported by all the packages.

I like printers with very flat paper paths. This means paper does not jam easily. Sticky labels do not peel off inside. S-shaped paths are the worst. Alps and IBM make printers with perfectly flat paper paths where the paper is inside the printer only for a very short time.

Nine-pin printers are cheap, but the print looks ugly. 24-pin printers can produce quite good-looking type. Ink-jet printers produce excellent type, but are limited to single sheets. They are quiet. Laser printers have the best type. PostScript laser printers can do elaborate graphics and shading.

If you select a laser printer, you might also want a small dot matrix printer to handle the sticky labels, or multi-part forms.

Cables

Prefabricated ribbon cables are usually low quality. Overlong cables stuffed into the machines kink easily, giving sporadic trouble. I found that most trouble with hard disks and floppies could be traced to damaged cables or poor connections on the cable ends.

So I suggest you build your own cables using high-quality gold-plated connectors, and 3M flexible ribbon cable. U.S.-made such as Robinson, Nugent or Amphenol connectors have much stronger springs to grip tightly. Further, you can make the cables exactly the right length. This reduces the antenna effect that attracts electrical noise into the cables.

I have written an essay on how to build your own cables available on floppy.

Tools

After you have purchased all the components, you will need a workshop and tools to assemble them. The easiest way to handle this is to use someone else's fully equipped workshop. However, you can do much of the work on the kitchen table, using only a minimal set of tools.

Canadian Tire makes a line of black screwdrivers called Mastercraft that are excellent for this work. They are good quality hard molybdenum steel. Get a 57-3122-8 Phillips and a 57-3101-8 slot head screwdriver.

A Sharpie permanent marker and a Dymo label gun will be useful. A small flashlight is a necessity. A few nut drivers, some needlenose pliers will also be helpful.

For handling your RAM, you need a static mat. You might borrow one just for this crucial step.

For making cables, you need a vice, an Exacto knife, and a righ- angle triangle.

You will also need a collection of diagnostic software such as: Dysan Interrogator for testing floppies, SpinRite and HDTEST for burning in disks, RAMTest and QA Plus for testing the keyboard and ports. You might borrow this for one-shot use since the whole bundle is expensive. Usually diagnostic software comes with your multi-I/O card, video card and mouse.

These are the very same tools you need to repair your computer. You also might find my article in the April 1989 edition on options for speeding up your old XT helpful.

Materials

Get a small bottle each of Cramolin Red, isopropanol and Stabilant. Also buy a half-dozen foam swabs. Foam scrubbies look much like Q-tips except they are lint-free. You use Cramolin to clean electrical contacts. You use isopropanol to rinse them clean. You use Stabilant to treat the contacts. Stabilant is a semiconductor gel that fills in any gap in a contact. Without this treatment, you sometimes find contacts are temperature sensitive. As the machine warms up or cools, strange glitches sometimes occur.

The Stabilant keeps the air away from the contact, which prevents it from tarnishing. This is how NASA treats spacecraft to keep contacts clean.

You need only a small amount to treat every place where current flows where metal contacts metal — e.g., the "teeth" where cards insert into the motherboard, all cable ends, hard and floppy disk connectors, all rear connectors, all connectors on the printer, modem and mouse.

Assembling

When I build a machine, I use a checklist that runs to about 15 pages and with over 400 steps. Different machines have different steps. The major steps are:

- setting the motherboard jumpers.
- installing the RAM
- assembling the case and installing the power supply.
- installing the motherboard.
- installing the floppies, hard disk, and tape.
- setting all the jumpers on all the cards, and installing them.
- constructing the cables and grounding straps.
- setting up the CMOS
- formatting and partitioning the hard disk
- testing everything (this is by far the bulk of the work).
- When it does not work, figure out why, and replace the defective piece. Building a new computer is very much like repairing an old one. Very rarely do all the components work first time.
- burning in the hard disk.
- installing the software.
- getting CSA approval.

CSA Approval

When you have finished assembling and testing your machine, you can take it out to the Canadian Standards Association in Richmond to have them inspect it for safety. They don't care if it works. All they care about is:

1. Will it catch fire?
2. Will it electrocute anyone?

Here are some tips to make sure you pass the first time out.

1. Make sure you case is built of self-extinguishing plastic. They will take a front plate and set it on fire with a match. When they take the match away, the flame must go out by itself.
2. On the power supply is a switch that allows you to set it for 110V or 220V. Set it to 110V then cover it to prevent anyone from tampering with it.
3. Make sure your power cord has a yellow CSA ribbon around it. CSA stamped on it is not enough.
4. Mount your hard disk in the bottommost bay. This way young fingers poking in cannot possibly get at the front power switch and get a shock.
5. Make sure your monitor, power supply and hard disk are already CSA approved as components.

You can ask them to do a special "hospital" leakage current test where 1200 volts pass through your machine. This will flush any shorts or potential shorts. If you pass this test, your machine can then be used in hospitals.

Learning More

I am giving a free course to be held Saturday February 16 from 10 am to 4 pm and possibly repeated February 23. Phone 684-6529 to register. Space is limited. The topic is Building Your Own Computer. The bulk of the course will consist of handling your questions.

Even in that one-day course, there is no way I could tell you everything you needed to know. I teach a $250 course that runs over five consecutive Saturdays where you build and test your own computer. It is quite a full curriculum. Most students need to come in a few extra days during the week to catch up. I am pretty exacting, but the advantage is I personally guarantee your workmanship for two years.

I have written in depth on many of these topics in greater depth in previous editions of *The Computer Paper*. If you cannot find back issues, I have all the articles I mentioned on three diskettes. I will mail you the set anywhere in the world for $18, which includes a hard case, postage, handling, GST and PST. You are free to make all the copies you like and pass them on. I have posted these essays both on BIX and given them to the Vancouver PC User Society Library.

The best book I have found is *Upgrading and Repairing PCs* by Scott Mueller, Que Books ISBN 0-88022-395-2.

Roedy Green, president of Canadian Mind Products in Vancouver (604) 684-6529, builds custom computers. He also writes custom computer software, primarily for non-profit organizations and charities, and offers training and consulting.