During the life cycle of an information technology product, a number of milestones are reached:

Introductory Phase
When a product is first introduced, there is a period of time when it is an unknown entity and needs to be fully tested in production settings to insure that it functions properly and meets the manufacturer's stated goals and objectives. The amount of time, which constitutes the introductory phase, is dependent upon two factors -
• Risk (both perceived and actual);
• What's required to incorporate the product into a production setting.

Products that are evolutionary (e.g. changing the speed of a computer chip) have a short introductory phase because there is little associated risk. However, these items are typically very short lived. Vendors are currently replacing business PC products every 2 to 4 months! Products that are highly innovative have a higher risk factor and a longer introductory phase. It is advisable to take the time to properly assess these products before integrating them into the environment.

Practicality Phase
As a product matures the risks associated with the new technology are greatly reduced. Companies that purchase a product soon after it's introductory phase has ended are at the leading edge of technology. The product is very attractive during this period. By this time it is relatively stable, the product is likely to have its longest life expectancy, and risks associated with the introductory phase have been avoided.

Product Phase-Out
It is typical that as a current front-line product matures, it's vendor will introduce a newer product that is targeted to replace the current one. This new product will generally include some level of innovation.

End-Of-Life
The End-Of-Life phase is bound by two events. This phase *starts* when the vendor no longer manufactures or sells the product and *ends* when the vendor no longer supports the product. Even though the product is "*supported*," this does not mean that the vendor will be able to change or fix any problems. In the case of hardware products, what the vendor will do when a hardware problem occurs is to swap out components with re-manufactured components. The bottom line is this phase is designed to provide customers such as ABC Company with enough time to move into newer technology.

This report will focus on five key areas of ABC Company's information infrastructure-

• Software
• Servers
• Network Equipment
• Workstations (PCs)
• Printers

These five information technology products are essential elements in ABC Company's business success. If any one of them fails, it will profoundly affect the business.

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SOFTWARE

What is software? Is it the life-blood of a computer network. It is the operating system (Windows 98), the business application (Office 97) and any other program written to run on computer hardware. In today's world, software is what drives the market. Look at the success of the World Wide Web. It is driven by software. The same can be said for ABC Company's information technology.

With software, the time periods are often long between major versions. Operating systems are evolving such that a major upgrade occurs every 36 to 48 months. High-end application software will typically have major upgrades every 12 to 24 months. Minor software upgrades and patches will be provided throughout the course of a product's life. These minor upgrades will likely occur more frequently in the early part of the software product's life and less frequently or not at all in the last phase of a product's existence.
Software life expectancy is further complicated since for some classes of software the vendor will actually support multiple versions of the product. This is particularly true of operating systems and high-end application software. It is not uncommon for these types of software to be supported by the vendor for a period of 12 to 24 months after the introduction of a new major release. Vendor support of these older software releases will often include patch releases on reported problems.

For low-end applications, product releases may occur every six months, and the vendor support for older products may terminate with the introduction of the new version of the product. It is common among personal productivity application software vendors to only support the "*current*" version of the software.

In selecting a high-end or core software product such as a database or an operating system, in addition to the product selection the purchaser may also need to choose which version to install. As mentioned earlier, for some critical software packages a vendor may have two or more versions under active support. The most innovative may still be in the introduction phase and may be quite risky to use in production settings. Older versions may be more stable but may also require a conversion task in the future in order to migrate to the newer version. If the more innovative version is consistent with the stated direction of the vendor (e.g. it is clearly the future direction of the product), then the older product will have a finite life expectancy, since it is in its product phase-out period. The real key to the length of time an older product will be supported is driven by the stability of the product and the market acceptance of its customer base.

ABC Company currently uses Windows 98 (Second Edition or SE) on each of its workstations as the desktop operating system. As a general rule, Microsoft produces usable desktop operating systems with long life cycles (Windows 95 is still in use by a vast majority of American businesses). Windows 98 SE will be a front-line operating system for another three years.

For desktop application software, ABC Company currently uses Microsoft's Office 97 Professional (which includes Word 97, Excel 97, Access 97, and Power Point 97), Microsoft's Outlook 98 and the full version of Adobe's Acrobat 4.05. Microsoft has come out with Office 2000 (which includes all of the above Microsoft products in a 2000 version). The cost to upgrade is $179.00 per copy of the upgrade software. At this time, an upgrade is not recommended. The differences between Office 97 and Office 2000 are nominal - Office 2000 focuses more on allowing users to create work product and publish it to the Internet. There is a newer version of Outlook (a 2000 version that comes with Office 2000), but it to focuses on a tighter

integration with the Internet. An upgrade would cost $29.90 per copy of the upgrade software. At this time, an upgrade is not recommended. Adobe's current version of Acrobat is 4.05. Within the next year, Adobe plans to come out with a version 5.01. At that time, the issue of upgrading to the latest version will be revisited. Anti-virus software will be discussed below.

Desktop applications have been covered. Now to discuss the software that resides on ABC Company's three Servers.

ABC Company's Servers all utilize Microsoft's Windows NT 4 Server network operating system. Just as a desktop workstation needs an operating system, so do the servers that are the work horses of ABC Company's network. Each of the three Servers has Service Pack 6 on it. This is a patch that Microsoft puts out to fix minor glitches in Windows NT 4 Server. For the future, Microsoft has recently released Windows 2000 Server, which is the next generation business network operating system. It is this firm's recommendation that a waiting period of between 18 and 24 months pass before considering upgrading to this product. That will give ample time for the product to be fully tested in a fast passed business environment and for most of the software bugs (software glitches that users always discover) to be worked out.

ABC Company utilizes McAfee anti-virus software, engine 4.00. This software resides on the Servers to monitor and protect the network from incoming virus threats. A smaller client version of this software resides on each workstation also. McAfee offers a good product with little need by the end users to configure the software. McAfee comes out with a new engine every 6 to 12 months, with support for earlier engines lasting as long as 24 months. Since the engine version that ABC Company currently utilitzes is the latest, another 24 months can pass without having to invest in new anti-virus software until 2002.

SERVERS
ABC Company currently has three Server and they are Hansel (the primary domain controller), Gretel (the back up domain controller in case the primary fails), and Merlin (the fax server).

Hansel is a Compaq ProSignia 500 and has been serving ABC Company for the past three years. It has a 150 Megahertz (Mhz.) Pentium processor, 96 Megabytes (Mb.) of RAM, and it was purchased in January of 1997. Hansel is currently providing the following services:

- Primary Domain Controller - this machine is the main work horse for the network;
- Backup - back up tape drive resides on this Server;
- Dynamic Hardware Configuration Protocol (DHCP) - leases Internet Protocol (IP) addresses to workstations;
- Domain Naming Service (DNS) - enables workstations resolve IP addresses;
- File and Print services - network users can access files stored on the server and print using network printers;
- Windows Internet Naming Services (WINS) - another componant that enables workstations to resolve IP addresses; and
- Additionally, Hansel hosts the database applications Jedi and Raiser's Edge.

Compaq states that the ProSignia 500 ended its Practicality Phase as of March 1999, and it reached the End-of-Life Phase as of July 1999. ProSignia 500's are still being supported with remanufactured components. Now is the ideal time to replace Hansel.

Gretel, the Backup Domain Controller, is a Compaq ProSignia 200 that has been serving ABC Company since July 1997. It is configured with a 166 Mhz. Pentium processor, and 80 Mb. of RAM. Gretel is currently providing the following services:

- Backup Domain Controller - if the Primary Domain Controller fails, Gretel will take over it's functions;
- McAfee anti-virus protection;
- Exchange 5.0 email services; and
- Univeral Power Supply (UPS) monitoring.

Compaq has not retired the Prosignia 200, but they are not recommending it as a host for Exchange server. The functionality of the 200 is designed for supporting a small workgroup of 10-20 users and providing file and print services.

Merlin, the Fax Server, is a Compaq ProSignia 200 that has been serving ABC Company since July 1997. It is configured with a 166 Mhz. Pentium processor, and 80 Mb. of RAM. Merlin is currently not on the network, but it does have Right Fax v.5.0 loaded. Covenant suggests that this server is brought up on the network, and if faxing is necessary, configure it as ABC Company's desktop fax server. If faxing is not necessary, move services from the other servers to better distribute the network processing load.

The Objectives
There are objectives for the ABC Company server environment that must be addressed prior to discussion on suitable replacement servers. The objectives impact other areas of the network infrastructure, and each of these objectives should be addressed individually. The objectives are as follows:

1. Load balancing the servers to insure that each server is adequate to address present needs, and optimized for future growth.
2. Replacing Hansel in the 1999 fiscal year.
3. Access to the file system through the Internet.
4. Migration of Jedi and Raiser's Edge to a common database.
5. An email system to harness the technology of the new millennium.
6. Staggering the replacement of the servers so that the new machines do not impact the business needs of ABC Company.
7. Implementing remote access for volunteers and staff.
8. Implementing a fax solution for all users

Meeting those objectives
To replace Hansel we recommend the following:
The new Hansel will consist of the following: a Compaq ProLiant 1600 Pentium III 600 MHZ. with 512K of cache. Hansel 2000 would be configured with RAID 5 to provide for redundancy and data integrity.

Additionally, the memory on the server would be optimized to 256 MB for optimum performance of the server as it handles files request and manages server processes. It comes configured with a 10/100-network card, which allows for optimal performance on any CAT5 Ethernet network. Since continuing to provide backup services is a requirement; the server will come with an internal DAT tape drive for speed and efficiency in the backup and restore processes.

The ProLiant 1600 is a reliable machine that has been in production with Compaq since January 1999, and it is seen in the industry as a preferred solution for medium-size businesses.
1. By implementing the above solution Hansel can be replaced before the end of the 2000 fiscal year.
2. Hansel will continue to provide file and print services to the ABC Company network.
3. By loading Internet Information Server Hansel will become the point-of-entry from the Internet for ABC Company users.

By implementing this server solution into the ABC Company network we are addressing multiple performance issues such as: Storage, processing speed, and ability for corporate growth of both its workforce and its critical database.

To replace Gretel we recommend the following:
The new Gretel will consist of the following: a Compaq ProLiant 3000. Gretel 2000 would be ideally a Compaq ProLiant 3000 Pentium III 600 MHZ server with 512 MB RAM. Gretel 2000 would also be configured with RAID 5 to provide for redundancy and data integrity. Additionally, the memory on the server would be configured at 512 MB to optimize file requests and server processes. It comes loaded with a 10/100-network card, which allows for optimal performance on any Ethernet network. This server is robust, and suitable for hosting SQL server. Exchange could be either loaded on Hansel, or ideally an Application Service Provider (ASP) would host Exchange. Using an ASP would reduce the total cost of ownership to ABC Company by.

1.   Diminishing the skill set required supporting the environment.
2.   Place the cost of replacement software on the ASP.
3.   Open up hardware resources for other ABC Company uses.

The ProLiant 3000 is a reliable machine that has been in production with Compaq since July 1998 and it is seen in the industry as a small business preferred solution, and if necessary, it is ideally suited for hosting Exchange Server.

The recommendation for Merlin is:
Merlin can provide a valued service to ABC Company by simply being placed on the network, and properly configured as a fax server. The server currently meets all the hardware requirements of a standard fax server running Right Fax v.5.0. Long term we suggest replacing Merlin with a more robust machine so that ABC Company can utilize some of the newer feature of Right Fax such as Internet faxing. As suitable machine that is currently available to the market is: a Compaq ProLiant 1600 Pentium III 600 MHZ. with 512K of cache. Merlin 2001 would be configured with RAID 5 to provide for redundancy and data integrity. Additionally, the memory on the server would be optimized to 256 MB for optimum performance of the

server as it handles files request and manages server processes. It comes configured with a 10/100-network card, which allows for optimal performance on any CAT5 Ethernet network.

The ProLiant 1600 is a reliable machine that has been in production with Compaq since January 1999, and it is seen in the industry as a preferred solution for medium-size businesses.

Merlin 2001 would be configured to host the most current version of Right Fax, or the software that most readily meets the requirements of ABC Company's faxing needs.

NETWORK EQUIPMENT

As applications and data types used by ABC Company become larger and more demanding, a need for greater network throughput to the desktop has become apparent. For applications that generate large amounts of network traffic, and for networks that have been continually expanded in size and traffic levels without an increase in throughput, a significant performance bottleneck will be removed by upgrading to 100Mbps.   100 megabit-per-second technologies excel primarily in the sustained transfer of large files over the network medium.

Ethernet host adapters that support both 10 and 100 Mbps speeds are becoming commonplace on the market. Computers with such adapters installed can be operated at standard 10 Mbps speed until a hub supporting the new standard is installed. The auto-negotiation feature will then cause the workstation to shift to the higher transmission rate. In this way, workstations can be shifted to 100 Mbps as the users' needs dictate. Virtually every part of the 100BaseT standard is designed around compatibility issues with existing hardware. The current network is a 10 Mb network without a high-speed core switch. It is primarily composed of older network equipment and cabling.

Covenant recommends a 100 Mbps ABC Company network including remote users and the Annex. The new network consists of upgrading all network equipment to the 10/100 varieties. This will allow for ABC Company to run all networked applications at 100 Mbs. Also, a significant amount of re-cabling must be redone to optimize the network and to take advantage of a core 10/100 switch.

Finally, there is not a true life cycle for this aspect of ABC Company's technology environment because the suggestion would be to completely replace all of the network components as well as a significant amount of the cabling. The life cycle consists of replacing all hardware and using this hardware for at least four years. This life-cycle document focus on the next three years of ABC Company's technology operations, and at the end of the three years, ABC Company will want to re-evaluate their network environment and develop a true life cycle.

WORKSTATIONS (PCs)

Properly deployed and managed PCs provide you with a lower cost of ownership and generate efficiencies to help you manage your business even better. But getting the most out of your PC infrastructure requires keeping up-to-date with many technologies and deploying enhancements quickly and efficiently.

The life expectancy of computer hardware varies depending on the nature of the hardware. PC technology is changing the fastest, and therefore, it seems to have the shortest life expectancy, and PC hardware vendors will typically support products for only a short period of time.

Currently, ABC COMPANY has an inventory of three different PC models-

- Compaq Deskpro 4000
- Compaq Deskpro 5100
- Compaq Deskpro 5120
- Compaq Armanda 4130T and 4160T

Each machine is functional as currently configured, but each machine has reached the end of its life cycle according to Compaq. Further, the processors speeds are may be inadequate, and available RAM might be insufficient to allow ABC Company to implement more recent editions of business enhancing software. Below is a diagram showing the life cycle of ABC Company's current PC inventory:

Covenant is suggesting that all PCs be replaced in the next year. We realize that this is a significant investment for ABC Company, but we believe the benefits will be great. As ABC Company moves to Office 2000, advanced versions of Exchange server, and desktop faxing, the more capable workstations will become mandatory.

To minimize the impact on cash flow it is recommended that ABC Company stagger the purchasing of replacement PCs and laptops over a one-year period. By creating a skill/requirements model and categorizing the users into 4-groups which reflect their skill set we can roll in the new machines based on business need, and thus put the power immediately into the hands of the users which have the greatest need.

Covenant recommends the following PC replacements for ABC Company:

1. Power User/High Volume User: Latest High-end Compaq with 128 Mbs of RAM
2. Mid and Low Volume User - Mid-range Compaq with 64 Mbs of RAM
3. Laptop Users - High-end Compaq Armanda with 128 Mbs of RAM

Final Notes
It is suggested that ABC Company, Inc. earmark $1,200 to $1,500 for each replacement PC. The price with vary depending upon individual user requirements such as: software loaded, whether a monitor is included or not, and hardware considerations. Further, ABC Company needs to estimate around $3,000 for each new laptop.

This is the course that ABC COMPANY should pursue as it seeks to get the most from its investment in information technology by purchasing a product while the machine is still early in its practicality phase.

When purchasing hardware products, it is important to realize that purchasing computer hardware also means that there is significant software involved. A core part of a computer is the operating system and other low-level software that runs on the system. This software is often "bundled" with the hardware. The recommendation of Covenant is that each machine be loaded with Windows 98 Second Edition and Office 2000.

These new machines could be used for three to four years without replacement. In order for ABC Company to prevent the current situation in the future where all machines need to be replaced at once, ABC Company should begin to replace these new machines towards the end of the third year of the current life cycle. In other words, the life cycle for these new machines should look something like the following:

1. In the third year of the current cycle, the power user and high-volume machines should be replaced with the latest Compaq desktop
2. The power user and high-volume machines should be rolled down to the mid and low volume users. These machines should be able to go at least two more years.

PRINTERS
Determining a printer's life expectancy encompasses several factors, just one of which is the overall cost of ownership. Other factors include: function, performance, networking, and print speed that are specific to ABC Company.

Ideally, the purchased laser printer should address the above considerations. The decision to purchase a less expensive printer often results in spending significantly more money over the long haul. So when a quality printer has been purchased what steps should ABC Company take to insure it is getting a return on its investment?

Extend the Life: Laser printers are rugged and reliable, but still need special care to provide high quality printing over their rated life cycle.

1. Don't stretch printer service cycles.
2. Before a laser printer is moved, remove its toner cartridge. Spilled toner inside a printer can take hours to clean up.
3. Laser printers should be cleaned regularly. Stray toner and paper dust can accelerate wear and contaminate the photo-conductor drum and developer.

Printers last longer when they are regularly maintained and cleaned. Even the paper path should be cleaned with the appropriate chemical cleansers.

Reduce Hidden Costs: The hidden cost of any printer is the price of consumables over the life of the printer. A single year's worth of toner and paper for a printer could easily cost more than the printer itself. In most cases, ABC Company will spend 2 to 3 times the purchase price in printer consumables. ABC Company may save $200 to $500 on the initial purchase price but end up spending thousands of dollars more for the consumables.

Most laser printers need to have the toner replaced every 3,000 to 8,000 printed pages. The overall printer life for the average laser printer is 240,000 pages. OPC drums have a life of 10,000 to 30,000 printed pages. Developer units wear and need to be replaced after 20,000 to 40,000 pages.

The key component in analyzing the cost of ownership is the total price per quality printed page.

An inexpensive cartridge is no saving if it causes an increase in dollars per page. Cartridge print yield also affects employee productivity, and poor quality prints resulting in re-run that really play havoc with efficiency and economy.

Buying for value rather than price is the first step.   Toner cartridges will range from $59 to $199 for new and from $30 to $129 for recycled; depending upon the printer model.

Some toner cartridges seem not to last as long as others: here are a few ideas to make sure ABC Company gets a fair yield from your toner cartridge:

1. Keep your printer clean: a dirty printer can affect the sensors that activate the "toner low" message.
2. If you get light prints, try removing the cartridge and rocking it gently from side to side for a minute or so.
3. Turn down the density dial on your printer when printing draft copies.

Save paper: There are several simple steps ABC Company can take.
1. Disable test pages and banner pages.
2. Use spell-check and page preview functions to be sure the document is accurate and laid-out correctly prior to printing.
3. Use a network based fax modem to send your pages right through the fax modem to the recipient, instead of printing them and using a fax machine.
4. Make margins smaller to fit more text on a page.

Repair & Maintenance: Repair and on-going maintenance become an issue as the printer ages and wears. Prior to replacing a printer we should ask a few questions:
1. What initial warranty does the manufacturer provide?
2. Does the printer have to be shipped to a service center, and how long will it be gone?
3. What will the cost be for a basic repair (e.g. fuser assembly)?
4. Does the repair technician charge travel time?

First impressions mean a lot in business. Printed material is one of the most important and frequently encountered image-making devices for businesses. ABC Company needs crisp, clean, professional-looking output for contracts, letters, fliers, brochures, forms, applications, and more. That kind of look hinges on the printer you use.

All laser printers are on their final leg starting at the end of 2000. We suggest one or two of the printers are replaced in 2000 and the others are replaced in 2001. This will help with cash flow issues as well will prevent the same situation in the future where all of your printers are out dated at the same time.

Covenant does not suggest that the Okidata 320's are replaced until they are not functional anymore. Okidata states that with good maintenance and repair work, these printers have a very extended life expectancy.

The home printers have been retired by HP. If they are still meeting the needs of the users, we suggest they are not replaced until 2001 or 2002. In terms of color printing at ABC Company, it would be advisable to consider purchasing a Color Laser printer.