

April 16, 2024

Desktop Computer Procurement Project

BTB Heavy Equipment Inc.



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April 16, 2024

Verna Johnson
CEO
BTB Heavy Equipment, Inc.
PO Box 566, Regina, Saskatchewan, S4P 3A3

Dear Ms. Johnson

Subject: Proposal Submission for Desktop Computer Acquisition Project, RFP 03-2024a

I hereby submit my proposal on behalf of Bagga and Shah Consulting Services for the Desktop Computer Acquisition Project outlined in the Request for Proposal (03-2024a). This report comprises details regarding the tailored approach our company has designed to meet BTB's expectations.

As a result of a thorough review of the requirements, our proposed solution represents the optimal choice through cost-effectiveness balanced with cutting-edge technology. Under our project schedule, the system is anticipated to be operational by June 15, 2024.

Keeping in mind the budget while delivering the best quality, we have decided to utilize advanced products such as the AMD Ryzen 5600X processor, the GIGABYTE B550M K motherboard, an ergonomic keyboard-mouse combo, and a 22" LED display.

I want to emphasize that we have devised a strategy to facilitate BTB throughout this transition. We have meticulously crafted a comprehensive training program to equip BTB personnel with the necessary skills and knowledge post-implementation. Our dedicated field technicians and customer support representatives will remain available around the clock to deliver exceptional client care as required.

Besides the technical side, by leveraging our extensive network of tech vendors and our esteemed reputation within the industry, all the items will be provided at a very affordable price. In addition, we are offering an extra 15% labor cost discount should BTB opt to work with our company. This will serve as the foundation of a long-lasting partnership between our two businesses.

Please do not hesitate to contact me if you have any questions or need any clarification. You may reach me at abc123@saskpolytech.ca.

Bagga and Shah Consulting Services would like to thank BTB for requesting a proposal for an upgrade project of such scale. We are excited to complete this project and contribute to BTB's success.

We kindly request authorization to proceed with the project.

Looking forward to hearing back from you.

Sincerely,

Gracy Bagga
Gracy Bagga

DESKTOP COMPUTER ACQUISITION PROJECT

BTB Heavy Equipment, Inc.

Gracy Bagga
Prabhjeet Kaur Shah
RFP Number : (03-2024a)

April 16, 2024
BAGGA AND SHAH CONSULTING SERVICES
PO Box 115, Regina, Saskatchewan, S4N 1S8

Executive Summary

This summary outlines our findings in response to the Request for Proposal 03-2024a. The market was researched to find parts that would meet the specific requirements of BTB Heavy Equipment Inc. whilst meeting the financial requirements.

Following a deep market analysis of currently available technology and the associated costs, a variety of options for each component of the proposed computers were evaluated. Then the best option is chosen. Our selection criteria focused on meeting the project constraints as outlined in the RFP.

The processor and memory enhancements will improve the speed of the workstations, thereby translating into a significant boost in processing efficiency and increased storage capacity. As a result, this will help to ensure seamless support for heavier software and improve their cloud compatibility. Moreover, the integration of better graphics, elevated network connectivity, ergonomic mice and keyboards, and modern display monitors will tremendously elevate the user experience.

While acknowledging the perpetual scope for improvement, our selection of technologies from AMD, GIGABYTE, and Lenovo ensures that the deployed units meet or exceed industry standards. The calculated cost per unit totals \$892.35, with the total project cost estimated at \$249,751.38.

To ensure a smooth transition, the upgrade project will be executed in stages. The initial deployment of 5 units by May 15, 2024, will allow BTB's tech team to review the product and provide us with feedback. Provisions will be set in case any amendments to the plan are needed, thus ensuring maximum customer satisfaction. Moreover, the BTB team's training will be organized in groups under the guidance of our well-trained staff.

Abstract Summary

In pursuit of maximum computer performance and user experience within the set budget, our analysis concentrated on selecting quality products.

Our primary challenge centered around finding a reliable motherboard and processor combination within the budget that offers ECC memory support. After careful consideration, we have opted for the AMD Ryzen 5 5600x Series processor paired with the GIGABYTE B550M-K motherboard. This combination offers both cost-effectiveness and ECC support, with highlighting features such as the processor's Zen 3 Architecture (8 cores, 32MB shared L3 cache) and Master Utility for personalized performance adjustments (AMD, n.d.). While the motherboard is equipped with an integrated graphics card and a Network Interface Controller, an IEEE port is going to be added externally via an expansion slot.

To ensure ample processing power, storage capacity, and external device compatibility, the system equips 16GB of RAM, a 1TB SATA hard drive, and a multi-card supporting card reader. Additionally, an energy-efficient and low-vibration SATA optical drive has been installed facilitating software installation and configuration. Prioritizing the comfort of employees, we selected an ergonomic and spill-resistant Lenovo keyboard-mouse combination, complemented with a noise-canceling padded headset, featuring a swivel microphone.

For ensuring stable and efficient power distribution, a 450W power supply with 85% efficiency from EVGA has been selected. Finally, a 22" Samsung 1080P display has been installed that is aimed at maximizing user experience.

In conclusion, our research aimed to maximize device capabilities and user experience while adhering to the budget proposed by BTB. We believe these goals have been effectively attained due to our careful decision-making and attention to detail.

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Formal Introduction

BTB Heavy Equipment, Inc. has embarked on a journey to enhance its technical capabilities, recognizing the pivotal role of technology in modern business operations. As a result, we have undertaken a comprehensive analysis to identify solutions that offer the best product-to-price ratio, enabling BTB to implement new desktop computers for approximately 250 new end users. This upgrade strategically positions BTB step ahead of its competitors.

This report serves to discuss each component of the computer needed to construct a whole unit and describe each product that has been selected, along with the rationale behind its selection. Key specifications are summarized in a table for each product for the technical audience, while explanations are provided for the non-technical audience.

In this report, emphasis is placed on the processor and the motherboard, as they are the most crucial components comprising the brain and the heart of the computer.

To sum up, the planned date for the completion of this project is June 15, 2024. The initial deployment of 5 desktops will be completed by May 5, 2024.

Background

The root of BTB's Request for Proposal lies in the pressing challenges arising due to the company's existing infrastructure. Considering the ever-changing landscape of technology, one must stay up to date. As a result, BTB has recognized the urgency to modernize its technical infrastructure.

First, maintenance of the older units has become increasingly difficult. Nowadays, manufacturers frequently discontinue services and repairs for their older models, in a hope to

steer consumers towards newer models. This has left BTB with limited resources to maintain its existing gear. This shortage of components/services not only increases the maintenance costs but also compromises the reliability of the computers.

Secondly, BTB has experienced reduced productivity due to the older technology. This has resulted in prolonged task completion times, increased stress levels in workers, and increased project costs. Improved workflows and an optimized work environment are of the utmost importance for BTB to gain a competitive edge in the industry.

Additionally, with phishing attacks becoming increasingly sophisticated, BTB is experiencing elevated risks of data breaches. By integrating new computers capable of enhanced connectivity with the servers, BTB's cyber security team will be able to better incorporate collective protection measures on the units.

The combination of these challenges resulted in BTB to plan this upgrade project. In response to the said challenges, the utilization of advanced technology from AMD, GIGABYTE, and others aims to improve productivity, streamline workflows, and improve cybersecurity software capabilities.

Project Description

Our business is cognizant of the significance of BTB Heavy Equipment Inc.'s endeavor to modernize its hardware infrastructure. The company aims to experience improved efficiency and capability from this project. Moreover, it opens potential doors in the future to expand the services offered.

The project enables BTB to leverage new and inventive technologies to their benefit. Better processing of engineering drawings and Surface Point Clouds, optimal GIS data

processing for project planning, and quicker processing of drone data are among the benefits of these upgrades. Additionally, the proposed solution enhances the company's cloud capability and streamlines the data management for a large workforce and resource management under a single platform.

The following section provides a detailed description of each component of the proposed desktop and the selected product, along with the rationale behind our decision.

CPU

One way to think of the Central Processing Unit, or CPU, is as an interface between the human and machine world. Simply put, the CPU supplies the set of instructions that are carried out by various computer components when a user clicks on the screen, prompting an action or input. It might be interpreted fundamentally as the computer's brain, as the name implies. CPU does computations and sends out digital signals to prompt computer components to execute tasks. The following table discusses the processor components (Both, 2023):

Arithmetic Logic Unit (ALU)	This handles the computer's mathematical and logical operations.
Instruction Register and Pointer	It guides the processor through task execution, storing and executing instructions one at a time while referencing the next instruction in memory. It is analogous to an individual's timetable/schedule.
Memory Management Unit	This is the bridge between RAM and Processor.
CPU Clock and Control Unit	It coordinates processor components using timing signals based on the clock tower's rate.
Cache	To expedite data processing, the CPU uses cache, storing frequently accessed data across 3 tiers: L1 helps in current task completion, while L2 and L3 manage memory for upcoming tasks.
Random Access Memory (RAM)	It is the processor's data reservoir. It temporarily stores information which is essential for successful task completion.

Table 1: Components of CPU

Considering the projects' requirements, the **AMD Ryzen 5 5600X 6-core, 12-Thread Unlocked Desktop Processor with Wraith Stealth Cooler** is selected. A key factor in choosing this processor is its support for ECC memory, a crucial requirement for the project's needs. The AMD Ryzen 5000 series is known for its compatibility with ECC memory (ASUS, 2023), making it a suitable processor that supports daily tasks, while aligning with the budget constraints.



Figure 1: AMD Ryzen 5 5600X (AMD, n.d.)

Manufacturer	AMD
Slot/Socket Type	AM4
Model	Ryzen 5 5600X
Speed	3.7 GHz
OS Support	Windows 10 Pro is supported, and BTB already has licenses
PCIe Express Version	PCIe 4.0
Memory	DDR4
Special Features	Zen 3 Architecture and Master Utility (See the Glossary at the end of this report.)
Cost (AMDRyzen5600XAmazonElectronics, n.d.)	\$209.00

Table 2: Processor Key Specifications (AMD, n.d.)

Motherboard

The motherboard is the mediator among several computer components. Simply put, the motherboard coordinates and transmits a set of instructions from one area of the computer to another. In technical terms, a motherboard is the main Printed Circuit Board (PCB) that acts as the main communications backbone connectivity point (Karvin, n.d.). The main components include, as illustrated in the Figure below, memory, storage, ROM BIOS, CPU, Northbridge and Southbridge chipset, cooling fans, and backup battery (Karvin, n.d.).

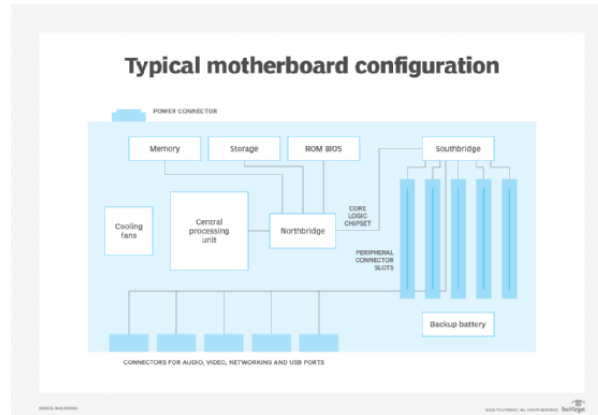


Figure 2: Typical Motherboard Configuration (Karvin, n.d.)

The table below summarizes the specifications to keep in mind when selecting a motherboard.

Form Factor	This correlates to the motherboard's size, a crucial consideration based on the system's space restrictions. Some of the different form factors in motherboards include Standard ATX, Micro-ATX, Mini-ATX, Extended-ATX, and others (Blog, 2021).
Processor Slot/Socket	The processor and motherboard are attached here. Due to design modifications over time, not every motherboard and CPU combination may work together (Bell, n.d.).
Chipset	It, consisting of the Northbridge and Southbridge chips, facilitates communication between the CPU, memory, and I/O devices (Knerl, 2021).
Expansion Slot	It enables the connection of additional components to the computer. The PCI (Peripheral Component Interconnect) slot is the most often used slot to connect peripherals (LenovoExpansionSlot, n.d.).
Other connectors, slots, and ports	The RAM slot is crucial for connecting RAM to the processor, ensuring compatibility with the motherboard and CPU interface (Bell, n.d.).

Table 3: Key points to consider when purchasing Motherboard.

To accommodate the AMD Ryzen 5 5600X processor, we have selected the motherboard from **GIGABYTE – B550M K**. Notably, this motherboard supports ECC memory as confirmed by ASUS (ASUS, 2023). Another highlight of this motherboard is its integrated Network

Interface Controller (NIC). Importantly, all these requirements are being met while being well within the allocated budget.



Figure 3: GIGABYTE B550M K (Gigabyte, n.d.)

Manufacturer	GIGABYTE
Form Factor	Micro ATX
Memory	DDR4 (Supports ECC)
Dual Channel Architecture	Yes
Slot/Socket Type	AM4
Chipset	AMD B550
On-board ports and connectors	1 x 24-pin ATX main power connector, 4 x SATA 6Gb/s connectors, more than 4 USB ports, NIC integrated.
Integrated Components	Integrated Graphics Processor with AMD Radeon™ Graphics support, Realtek® GbE LAN chip (1 Gbps/100 Mbps/10 Mbps)
Cost (B550MKAmazonElectronics, n.d.)	\$124.99

Table 4: Motherboard Specifications (Gigabyte, n.d.)

This motherboard does not have an integrated IEEE port; so, this is being handled with the help of an expansion card. A controller card will be attached to the motherboard.

Manufacturer	AxGear
Model	PCIE PCI-E FIREWIRE IEEE 1394 3 PORT FIRE WIRE CONTROLLER CARD
Cost (AxGearWalmart, n.d.)	\$12.99

Table 5: IEEE port card Specifications (AxGearWalmart, n.d.)

Memory

People frequently mix up storage with memory. To differentiate between storage and memory, understanding volatility is crucial. Primary storage, or memory, is volatile, characterized by its brief lifespan and frequent usage in computer processing, commonly associated with RAM. In contrast, storage is non-volatile, found in devices like USB drives and hard drives, where data can be stored indefinitely. RAM typically comes in two types: DRAM, which utilizes capacitors for data storage and requires regular refreshes, and SRAM, which retains data till power is maintained (Gillis, n.d.). Chip creep, a phenomenon associated with memory, refers to the loosening of the older memory chips from their sockets due to frequent heating and cooling of the system. To address this issue without fixating the memory onto the motherboard, memory modules like SIMM (Single Inline Memory Module), DIMM (Dual Inline Memory Module), and RIMM (Rambus Inline Memory Module) were developed, providing a more reliable solution and simplifying processor complications in case a replacement is required (InformIT, 2010).

The **Kingston Technology 16GB RAM 2133MHz DDR4 ECC Reg CL15 DIMM DR x 4 with TS Server Memory** has been selected primarily due to the combination of its price, ECC capabilities, and 4 times the minimum memory requirement, offering better processing power. In evaluating various options, it became apparent that the ECC market is limited, with available products often pushing computer prices higher. This balance among memory size, affordability, and ECC compatibility made it the optimal choice for meeting project requirements without significantly inflating costs.



Figure 4: Kingston Technology 16GB RAM 2133MHz DDR4 ECC Reg CL15 DIMM DR (Kingston16GBRAMAmazonElectronics, n.d.)

Manufacturer	Kingston
Model	KVR21R15D4/16
Type	DDR4
ECC support	Yes
Size	16GB
Memory Speed	2133 MHz
Form Factor	Registered w/Parity 288-Pin DIMM
Cost (Kingston16GBRAMAmazonElectronics, n.d.)	\$79.26

Table 6: Memory Specifications (Kingston16GBRAMAmazonElectronics, n.d.)

Card Reader

The name alone conveys the meaning—it reads cards. It can read data from cards, such as memory cards, and use that information to execute certain functions or transfer data. The software associated with a card reader processes the data that the magnet heads or sensors read when a card is inserted (LenovoCardReader, n.d.). Prior to the USB drives era, users would use memory cards to transfer data, and computers would utilize card readers to read the data from those cards. Even though USBs are available, card readers are still highly important in the sectors such as GPS and photography.

Beikell SD Card Reader is selected for its versatility and connectivity options. It supports multiple types of memory cards allowing for the simultaneous reading of up to four cards at a time. Moreover, its dual connectivity options via USB-B and USB-C provide

flexibility in connecting to various devices, ensuring compatibility with a wide range of computers and other devices.



Figure 5: Beikell Card Reader (BeikellCardReaderAmazonElectronics, n.d.)

Manufacturer	Beikell
Card Types supported	SD/SDHC/SDXC/Micro SD/MMC/Micro SDXC/MS Duo/MS Pro Duo/CF cards
Connection Type	USB B/C
Cost (BeikellCardReaderAmazonElectronics, n.d.)	\$11.99

Table 7: Card Reader Specifications (BeikellCardReaderAmazonElectronics, n.d.)

Hard Drive

When customers inquire about a computer's storage capacity, they often refer to the amount of storage it has. This is where hard drives come into play. An analogy of "Storage Rooms" can help illustrate the concept of hard drives. For instance, when Mr. John runs out of space in his garage, he rents a storage room to store items he doesn't frequently use. Here, the garage represents RAM (primary storage), while the rented storage room symbolizes the hard drive (secondary storage). In essence, hard drives serve as secondary storage sources for storing data or programs (Dropbox, n.d.). Presently, there are three types of secondary storage available, Hard Disk Drives (HDD), Solid State Drives (SSD), and M2 Drives.

HDD	Hard Disk Drives (HDD) utilize magnets for operation, making them non-volatile and unaffected by power loss (Dropbox, n.d.). Their storage-to-price ratio is the highest. However, their excessive moving parts lead to energy loss and slower data transfer compared to SSDs and M2 Drives.
SSD	They function on the same flash memory concept as USB flash drives. SSDs utilize semiconductors compared to magnets (Dropbox, n.d.). They are generally more expensive than HDDs.
M2 Drives	M2 Drives, a smaller form factor of SSDs, emerged to meet the demand for compact computer components, albeit at a higher cost due to limited competition. M2 Drives were disregarded due to a lack of space restrictions, allowing for the allocation of funds to other components (KingstonTechnology, 2023).

Table 8: Types of Hard Drives

The **Toshiba MQ01ABD Series Hard Disk Drive** has been selected for this project over SSD/M2 Drives primarily due to its suitability for a desktop computer setup and twice the storage capacity than the minimum requirement. While SSDs are known for their durability with fewer moving parts, the lack of mobility in the desktop unit makes this less of a concern. Additionally, the storage-to-price ratio offered by Toshiba is significantly higher than the competitors. This comparison could easily be confirmed at an e-retailer's website such as Amazon.



Figure 6: Toshiba MQ01ABD Hard Drive (ToshibaMQ01ABD, n.d.)

Manufacturer	Toshiba
Size	1TB
Model	MQ01ABD
RPMs	5400 rpm
ATA	ATA-8
Connection	SATA (up to 6Gb/s)
Cost (ToshibaMQ01ABDAmazonElectronics, n.d.)	\$53.70

Table 9: Hard Drive Key Specifications (ToshibaMQ01ABD, n.d.)

Keyboard

The keyboard serves as a vital interface between human language and computer language, translating inputs into electrical impulses. This transformation may involve displaying user-inputted tokens or executing specific actions (LenovoKeyboards, n.d.). Keyboards are typically categorized into two primary types: QWERTY and DVORAK, differing in the arrangement of the keyboard's keys. Each keyboard also features built-in shortcuts, enabling users to do predetermined actions by pressing a combination of keys. The users can select keyboards as per their needs as they vary in size and form. Further, Virtual keyboards are now being researched as a potential replacement for physical keyboards (LenovoKeyboards, n.d.).

Please note the keyboard specs are mentioned in the next section along with the mouse as the product selected is a combination of a mouse and a keyboard.

Mouse

The mouse, a peripheral device essential for screen navigation, requires a solid surface for operation. It tracks its displacement with respect to the surface and displays the resulting change on the computer screen. Several different types of mice are available, including J-Mouse, IntelliMouse, Optical, Joystick, Mechanical, Cordless, Footmouse, Touchpad, Trackball, and TrackPoint (JavatpointMouse, n.d.).

Typically equipped with a scroll wheel and two buttons. The mouse's buttons have pre-programmed functions such as drag-and-drop, task selection, and screen highlighting. The scroll wheel facilitates window or document scrolling. However, modern mice now contain additional programmable buttons to do specific tasks, commonly used for navigating forward and backward within open windows (JavatpointMouse, n.d.).

The **Lenovo 300 Keyboard Mouse combo** has been selected for its ergonomic design, spill defense, and competitive cost. This choice is informed by its widespread use among our office employees, leading us to confidently recommend it for this project.



Figure 7: Lenovo 300 Keyboard Mouse Combo (LenovoCombo, n.d.)

Keyboard	
Manufacturer	Lenovo
Model	300
Special keys or feature	Waterproof exterior (prevents damage from accidental spills)
Ergonomic	Yes (2.5 zone layout)
Connection	Wired through USB
Mouse	
Manufacturer	Lenovo
Model	300
Ergonomic	Yes (ambidextrous design)
Connection	Wired through USB
Optical Wheel	Yes
Additional buttons	No (standard two buttons along with scroll wheel)
Cost (LenovoCombo, n.d.)	\$23.99

Table 10: Keyboard-Mouse Combo Key Specifications (LenovoCombo, n.d.)

Optical Drive

Optical disks, commonly known as **CDs** or **DVDs** (See the Glossary at the end of this report.), are familiar examples of optical storage media. Optical drives are devices utilized to read, write, and store data from such disks, including Blu-ray drives, CDs, and DVDs. However, with the introduction of USBs, external hard drives, and cloud services, optical drives are becoming less prevalent in PCs. Despite this, they have played a significant role in the advancement of IT technology. These drives operate based on binary system principles. The discs contain the data in spirals from the innermost point to the outermost edge. The surface of

these discs contains grooves representing binary "1" and dips, known as pits, representing binary "0." Optical drives use light to interpret this binary system, with a **photodiode** (See the Glossary at the end of this report.) converting light impulses reflected from the disc's surface into electrical signals for the computer (LenovoOpticalDrive, n.d.). Due to their reliance on light for data transmission, the term "Optical" was given to optical drives.

ASUS (DRW-24B1ST/BLK/B) Internal 24x DVD Writer, OEM - Black, SATA is chosen for its large range of disk compatibility. It fits perfectly in the tower chosen (details in the tower section), and connects via SATA, utilizing the SATA ports on the motherboard. It features special functionalities like **E-green technology** and **AVRS** (See the Glossary at the end of this report.), enhancing its efficiency and performance.



Figure 8: ASUS Optical Drive (OpticalDriveCanadaComputers, n.d.)

Manufacturer	Asus
Model	DRW-24B1ST
Read Speed (Maximum)	DVD+R: 16 XDVD-R: 16 XDVD+RW: 12 XDVD-RW: 12 XDVD-ROM: 16 XDVD+R(DL): 12 XDVD-R(DL): 12 XDVD-ROM(DL): 12 XCD-R: 40 XCD-RW: 40 XCD-ROM: 48 XDVD video playback: 6 XVCD playback: 16 XAudio CD Playback: 16 X
Write Speed (Maximum)	DVD+R 24XDVD-R 24XDVD+RW 8XDVD-RW 6XDVD+R(DL) 12XDVD-R (DL) 12XDVD-RAM? 12XCD-R 48XCD-RW 24X
Supported Standards	Audio CD, Video CD, CD-I, CD-Extra, Photo CD, CD-Text, CD-ROM/XA, Multi-session CD, DVD Video
Connection	SATA
Special Features	E-Green technology and AVRS
Cost (OpticalDriveCanadaComputers, n.d.)	\$29.99

Table 11: Optical Drive Key Specifications (OpticalDriveCanadaComputers, n.d.)

Video Card

Video cards, also known as graphic cards, play a crucial role in converting complex machine language into human-readable visuals. Better-quality video cards result in improved graphics quality. Competitive video gamers are often observed paying close attention to the quality of their video cards.

These cards leverage **multi-threading** (See the Glossary at the end of this report.). A computer's processing cores share the workload of performing complicated calculations, to process binary data into images. Therefore, the video card method uses the motherboard's bus data lines to transmit the binary data set into the Graphical Processing Unit (GPU) processing cores, where specialized cores divide the task among themselves. This relieves pressure from CPU cores which can then do other tasks. Furthermore, the architecture of CPU cores allows only sequential data processing or with limited parallelism. Computer thus this way, manifolds its processing performance (LenovoVideoCard, n.d.).

While the chosen motherboard already includes an integrated graphics card suitable for daily tasks, it was deemed necessary to provide additional support for more demanding graphical applications, particularly in response to the increasing use of drones, satellite data, and point cloud processing in the construction industry. Hence, **MSI GT 710 2GD3 LP** is selected, offering 2GB of memory and a low-profile design, making it an ideal choice to meet these requirements effectively.



Figure 9: MSI GT 710 2GD3 LP (GT710MSI, n.d.)

Manufacturer	MSI
Model	GT 710 2GD3 LP
Chipset/GPU	NVIDIA GeForce GT 710
Video memory	2GB – DDR3
Maximum Resolution supported	Up to 2560x1600 (NVIDIA, n.d.)
Connection/Interface	PCI Express 2.0 x16
Video Input	Not present (strictly for outputs)
VGA port	Yes
Special Features	Low Profile Design (saves space)
Cost (GT710AmazonElectronics, n.d.)	\$78.47

Table 12: Video Card Key Specifications (GT710MSI, n.d.)

Sound

A computer's audio components include microphones, speakers, and headphones. Acting as an intermediary, a sound card plays a crucial role in computer audio components by facilitating the conversion between digital impulses processed by computers and analog signals perceived by human ears. It ensures seamless bi-directional conversion and synchronization of sound-related components (Wright, n.d.).

Utilizing analog-to-digital converters, sound cards can efficiently handle both analog-to-digital and digital-to-analog signal conversions. Nowadays, the sound card equivalent chip on motherboards features dedicated processors for audio processing, lowering CPU workloads through multithreading and parallelism. Typically, sound cards offer multiple 3.5mm stereo audio output and input **TRS** connections (See the Glossary at the end of this report.), although contemporary computers often integrate these functions into a single 3.5mm **TRRS** jack (See the Glossary at the end of this report.) for both headphones and microphones (Wright, n.d.).



Figure 10: Sound Conversion (Wright, n.d.)

Lenovo H151 Stereo headset is selected for its highlighting features of the earpiece for both ears, 180° rotating mouthpiece and cushion for the ears providing comfort during extended use. Additionally, it offers convenient inline controls for easy audio controls.

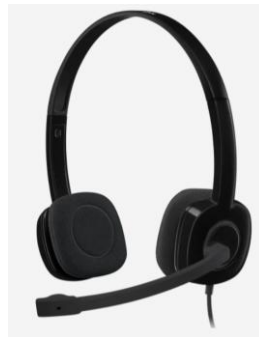


Figure 11: Logitech H151 (LogitechH151, n.d.)

Manufacturer	Lenovo
Model	H151
Special features	Inline Controls, Adjustable Headband, 180° Rotating Microphone, Noise Cancellation
Connection	Standard 3.5mm audio jack connection
Cost (LogitechH151, n.d.)	\$29.99

Table 13: Headset Key Specifications (LogitechH151, n.d.)

NIC or Network Interface Controller

In today's digital landscape, Network Interface Controllers (NICs) play a vital role in connecting computers to networks, assigning them unique digital addresses akin to physical structures. NICs efficiently convert digital signals to network signals and vice versa. Connectivity options include WiFi for open networks like those in homes, Ethernet for secure connections in institutions like banks, USBs (dongles), and Fibre Optics for high-speed connections, such as those used in oil pipeline monitoring. Traditionally, NICs were connected externally to computers via PCI slots, but with Ethernet's popularity, these chips are now integrated into motherboards (Miller, 2023). NIC Components are listed below.

Speed	This is the processing speed at which the controller can handle several connections at once. As more devices connect, the speed may decrease. Typical speed ratings for Ethernet NICs include 10 Mbps, 100 Mbps, 1000 Mbps, and 1 Gbps.
Driver	NIC drivers must be installed alongside the device to mediate communication between the controller and the computer's operating system. Regular driver updates are necessary to ensure proper network connectivity.
MAC Address	It is a unique network identifier assigned to the NIC, facilitating internet communication by specifying where data should be delivered.
Connectivity LED	It is a visual indicator of the connection status. A lit LED indicates a successful connection.
Router	Although optional, they can enhance network connectivity by strengthening connections between computers and nearby devices.

Table 14: NIC Components (SDXCentral, n.d.)

Please note that there is no need to buy a separate Network Interface Controller as the motherboard is equipped with an integrated NIC - **Realtek GbE LAN chip**.

Manufacturer	Realtek
Model	GbE LAN chip
Architecture	Wired connectivity to Motherboard
Integrated or PCI card	Integrated
Speed	1 Gbps/100 Mbps/10 Mbps
Wake on LAN (WOL) support	Yes - Additional free driver installation may be needed to support the available OS
Special Features	Network bandwidth management application - improved network latency and maintained low ping times (See the Glossary at the end of this report.)
Cost	\$0.00

Table 15: NIC Key Specifications (Gigabyte, n.d.)

Enclosure

Enclosures, often mistaken for a computer's CPU by non-technical individuals, are cases designed to house and protect the internal components necessary for computer processing. These cases shield components from spills, dust, and debris, serving as a connection hub for visible computer elements like keyboards, displays, and printers. Enclosures come in various shapes and sizes, dictated by the motherboard they accommodate, and are typically constructed from aluminum or steel. Inside enclosures, one can find peripheral connectors linking devices to processors, dust filters maintaining component cleanliness, PSU mounting ports delivering power, vents regulating processor temperature, and drive bays accommodating optical drives (ICPAmerica, n.d.).

IN WIN EN708 Micro ATX Mini Tower Computer Case has been selected for its optimal compatibility with all components, particularly the motherboard and optical drive. Its design ensures a perfect fit for the hardware, providing ample space and secure housing. Additionally, the case boasts a variety of front panel features, enhancing accessibility and functionality.



Figure 12: In Win Enclosure (InWinAmazonElectronics, n.d.)

Manufacturer	IN WIN
Model	EN708
Motherboard Compatibility	MicroATX, Mini-ITX
Type	Mini Tower Case
Front Panel features	2 x USB 3.0 Ports, HD Audio, optical drive port
Cost (InWinAmazonElectronics, n.d.)	\$69.99

Table 16: Enclosure Key Specifications (InWinAmazonElectronics, n.d.)

Power Supply

Since electricity from the grid is in the form of **AC**, while computers operate on **DC** (See Glossary at the end of this report.), the Power Supply Unit (PSU) plays a critical role. PSUs were designed to convert AC to DC, facilitating computer operation. Whereas laptops have an external converter incorporated into the charger, desktop computers house their PSUs internally, where power enters the machine. The PSU is connected to the motherboard, which then distributes power to the other parts. Therefore, the PSU and motherboard must be compatible. Typically, modern computers require an overall power demand of around 300W to 1000W. Different types of PSUs are available and are listed below (Immotionhosting, 2024).

ATX Standard	Typical for Desktops, compatible with ATX motherboards, Voltage rails: +3V, +5V, +12V, +5V SB(standby).
Entry-Level Power Supply Specification (EPS)	More advanced ATX standard, typical for Server computer.
Small Form Factor	As the name suggests, typical for small form factor computers and hence compatible with Micro ATX processors.
Thin Form Factor	Typical for smaller form factor units, hence compatible with Mini ITX processors.

Table 17: Types of PSU (Immotionhosting, 2024)

EVGA 450 BR is selected for its higher wattage than the minimum required, along with its 80+ Broze rating indicating 85% efficiency. This ensures ample power distribution among all components. Additionally, it offers a 3-year warranty, providing reliability and peace of mind.



Figure 13: PSU (Evga, n.d.)

Manufacturer	EVGA
Model	450 BR
Wattage	450W
Connection	24 Pin ATX (matches motherboard)
Special Features	3-year warranty, 85% efficiency, AVPC Correction (See Glossary at the end of this report.)
Cost (Evga, n.d.)	\$54.99

Table 18: PSU Key Specifications (Evga, n.d.)

Monitor

Monitors, the computer's output devices, translate digital signals into human-readable images, encompassing words, numbers, shapes, symbols, and even movies. As technology has evolved, connection ports have transitioned from VGA to HDMI to USB, among others. Various

types of monitors are available, each employing distinct technologies and they are summarized below.

CRT Monitors	CRTs utilize cathodic ray tubes for RGB color production (See Glossary at the end of this report.).
Flat Panels	Safer alternatives to CRTs, using technologies like LCD and GPD (See Glossary at the end of this report.).
Touch Screens	Common in smartphones and tablets, operates by sound waves or current flow changes.
LED Monitors	Employ LEDs for light emission, consuming less power (See Glossary at the end of this report.).
OLED Monitors	Enhanced LED technology with an organic thin-film layer between two conductors.
DLP Monitors	Essentially advanced projectors with digital micromirror devices (See Glossary at the end of this report.).
TFT Monitors	Utilize Thin Film Transistor Technology (TFT) for pixel management (See Glossary at the end of this report.).
Plasma Screens	High-resolution displays employing GPD principles.

Table 19: Types of Monitors (JavatpointMonitor, n.d.)

SAMSUNG T350 Series 22-inch LED monitor is chosen for its seamless ability to line up the display without view gaps and its provision of tilt adjustments. It meets all other requirements while remaining within budget constraints. Additionally, LED technology saves power, making it an efficient choice for the project.



Figure 14: Samsung T350 (SamsungT350AmazonElectronics, n.d.)

Manufacturer	Samsung CA Monitors
Model	T350
Size	22 Inch
Type	LED
Maximum Resolution	1920 x 1080 Pixels
Special Features	Tilt Adjustment
Refresh Rate	75Hz
Cost (SamsungT350AmazonElectronics, n.d.)	\$109.99

Table 20: Monitor Key specifications (SamsungT350AmazonElectronics, n.d.)

Cost Analysis

The following table depicts the product selected for each component of the desktop. The corresponding cost is mentioned in the table and at the end, the total price of the unit is summed up.

Component	Product	Price
CPU	AMD Ryzen 5 5600X	\$209.00
Motherboard	GIGABYTE – B550M K	\$124.99
IEEE PCI card	axGear PCIE PCI-E FIREWIRE	\$12.99
Memory	Kingston KVR21R15D4	\$79.26
Card Reader	Beikell SD Card Reader	\$11.99
Hard Drive	Toshiba MQ01ABD	\$53.70
Keyboard	Lenovo 300 Keyboard-Mouse Combo	\$23.99
Mouse	"	\$0.00
Optical Drive	ASUS (DRW-24B1ST/BLK/B) Internal	\$29.99
Video Card	MSI GT 710 2GD3 LP	\$78.47
Sound	Lenovo H151 Stereo Headset	\$29.99
NIC	Realtek GbE LAN Chip	\$0.00
Power Supply	EVGA 450 BR	\$54.99
Enclosure	IN WIN EN708 Micro ATX Mini Tower	\$69.99
Monitor	SAMSUNG T350 Series 22-Inch LED	\$109.00
EHF-SK	Environment Handling Fee	\$4.00
Total Price:		\$892.35

Table 21: Computer Component Cost Breakdown

The following table outlines the Environment Handling Fee in the province of Saskatchewan for desktops (TheSource, n.d.):

EHF per unit	Amount
Desktop (General Components)	\$0.80
Monitor	\$3.00
Peripherals	\$0.20

Table 22: Saskatchewan Environment Handling Fee Structure

In the table below, different tasks involved in the successful execution of this project are mentioned, along with the cost involved in completing each task. The bottom row of the table shows the total cost of the project, which turns out to be \$249,751.38.

Breakdown	Price	Description
Research	\$800.00	20 hrs @ \$40/hr
Equipment	\$223,087.50	250 units
Desktop Assembly	\$11,957.50	\$55 @ 250 units
Training	\$7,500.00	\$300 per group (\$30/user) @ 25 groups
Delivery Charges	\$700.00	third party delivery costs
Contingency Budget	\$7,500.00	3% contingency funds
Labor Discount	\$1,793.63	15% Labour discount
Project Cost	\$249,751.38	

Table 23: Overall Project Cost Breakdown

The following pie chart visually represents the distribution of project cost of \$249,751.38 among various categories, including Equipment and Delivery costs, Research costs, Desktop Assembly hours and Training program, Contingency budget, and a 15% Labor Discount.

The majority of the budget is allocated to the procurement of components to assemble 250 desktops. At a unit rate of \$892.35 for 250 units, the hardware amounts to \$223,087.50. Following procurement, the units need to be assembled. Assembly of a unit incurs a cost of \$55, resulting in a total expense of \$11,957.75. Additionally, a third-party delivery partner is contracted to manage the delivery of equipment to BTB, and their fee amounts to \$700.

To ensure a smooth transition, the training program is planned to accommodate 25 groups, each comprising 10 BTB staff members, at an expense of \$300 per group, totaling \$7500. Furthermore, the cost associated with conducting research for this project amounts to \$800.

Finally, Contingency funds have been reserved at 3% to accommodate any alterations to the proposed solution as per reviews after the first deployment of 5 units on May 15, 2024.

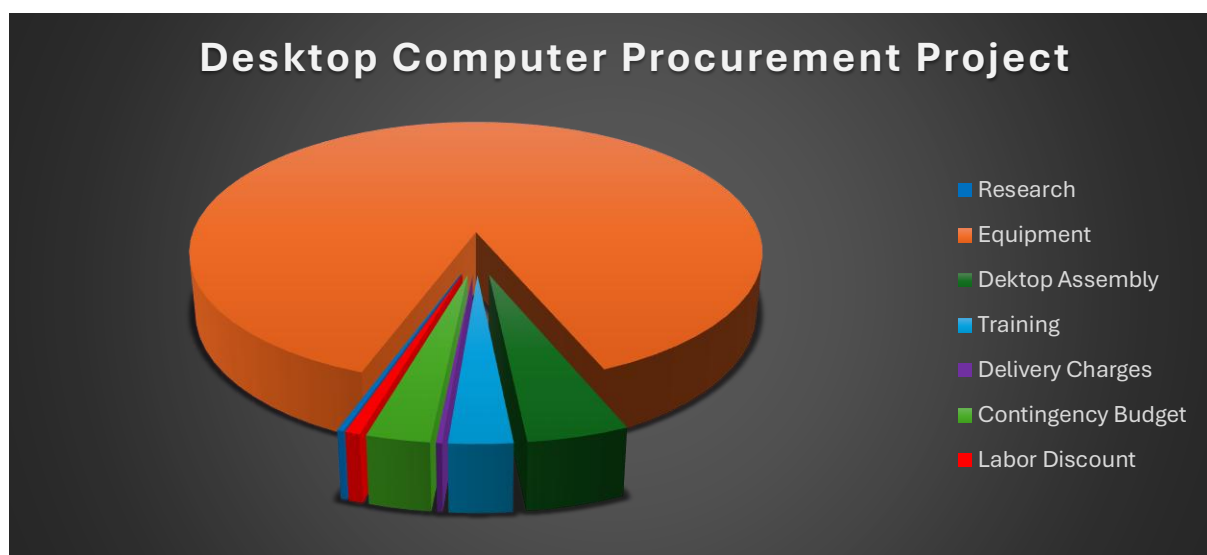


Figure 15: Cost Analysis

Conclusion

The research concludes with finding cutting-edge technology from AMD, GIGABYTE, Kingston, and others. All these new components combined will improve the computers' power to tackle the current technologies being utilized in the construction industry. This investment is indeed an investment in BTB's future. Employees' point of view was kept in mind while selecting the parts, such as selecting an ergonomic spill-resistant keyboard and mouse combo combined with a 22" LED display and a high-quality headset that offers multiple features.

The project's budget constraints were respected. The per unit cost of the computer came out to be \$892.35. Overall, the project cost came out to be \$249,751.38, comprising \$223,087.50 in equipment and the rest of the funds targeted toward the successful execution of the project.

As mentioned earlier, 5 units will be installed first, and the team will be given a chance to review them. However, our thorough market study instills confidence that the products that we have selected will meet or exceed the expectations of the BTB team from the outset. Henceforth, we hope our solution becomes the foundation for BTB's upcoming growth.

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Glossary

<i>Term</i>	Full Form	Short Description
<i>Active Power Factor Correction</i>	-	AC voltage automatic correction
<i>Analog signal</i>	-	smooth real world signals
<i>AVRS</i>		(Auto Vibration Reduction Technology – minimized vibrations and noise)
<i>Blue-ray</i>	-	optical digital data storage format. Upgrade from DVDs
<i>CD</i>	Compact Disk	optical digital data storage format
<i>CRT</i>	Cathodic Ray Tubes	Display technology that uses the principle of recurrent reflection of an electron beam on a screen.
<i>Digital signal</i>	-	binary signals
<i>DVD</i>	Digital Video Disk	optical digital data storage format. Upgrade from CDs
<i>E-Green technology</i>	-	(auto close driver applications when not in use-conserving energy)
<i>GPD</i>	Glass Plasma Display	Display technology that uses a layer of gas between the glass panes. UV light is released when gas is powered by current, generating images

<i>LCD</i>	Liquid Crystal Display	Display technology that uses Liquid Crystal to block backlight to generate pixels
<i>LED</i>	Light Emitting Diodes	a semiconductor that consumes current and produces light
<i>Master Utility</i>	-	(utility to overclock speed to personalize performance)
<i>Micromirror devices</i>	-	Microscopically small mirrors
<i>multi-threading</i>	-	concept of sharing workload concurrently
<i>Network Latency</i>	-	delay in network communication
<i>photodiode</i>	-	a semiconductor that consumes light and produces electricity
<i>Ping</i>	-	related to network lag
<i>RGB</i>	Red-Blue-Green	Short form for the primary color combination
<i>TFT</i>	Thin Film Technology	They use 1-4 transistors to manage pixels on display.
<i>TRRS</i>	Tip, Ring, Ring, and Sleeve	serves both headphone or microphone
<i>TRS</i>	Tip, Ring, and sleeve	serves one connection - either headphone or microphone
<i>UV</i>	Ultraviolet light	A special type of light that is non visible to human eye
<i>Zen 3 Architecture</i>	-	(8 cores and 32MB shared L3 cache)

Appendix – Project Requirements

Component:	Include in your report:	Requirements:
CPU	Manufacturer, slot/socket type, model, speed, cost	Dual core. At least 2.5 GHz. Must match motherboard slot/socket type.
Motherboard	Manufacturer, form factor, bus speed, slot/socket type, chip set, on-board ports and connectors, any integrated components (e.g. video, sound or NIC), cost	Must have correct slot/socket for CPU. Must support memory type (correct slot) and speed (see below) and dual-channel architecture. Must have minimum 4 USB ports, and 1 IEEE 1394 port, and also WOL connector if NIC is not integrated (see NIC).
Memory	Type (SIMM, DIMM, or RIMM), module size(s), speed, manufacturer, other properties (e.g. buffered vs. unbuffered, voltage used, parity/ECC, etc.), cost	Minimum 4 GB, single DIMM preferred. Must have parity/ECC capabilities.
Card reader	Manufacturer, size, and cost	Must support multiple types including CompactFlash™.
Hard drive	Manufacturer, size, model, RPMs, ATA standard (e.g. ATA66, ATA100, ATA133, etc.), cost	Minimum 500 GB, attaches to standard IDE or SATA cable.
Keyboard	Manufacturer, model, special keys or features, cost	Ergonomic, with standard PS/2 or USB connector.
Mouse	Manufacturer, model, connection type, special buttons, cost	Either PS/2 or USB connector, wheel optical mouse preferred.
Optical drive	Manufacturer, model, speed(s), supported standards, cost	Must support installation of software and creation of backups.
Video card	Manufacturer, model, chip set used, video memory, maximum resolution supported, special features, cost	AGP card (at least 4×), PCI Express, or integrated. No video inputs. Must include standard VGA port.
Sound	Manufacturer, model, special features, cost	Jacks for microphone and speakers. Headset must have noise cancellation features. Speakers not included (existing speakers not being replaced).
NIC	Manufacturer, model, architecture, speed, special features, cost	Integrated or PCI card. Gigabit Ethernet with Wake on LAN (WOL) support.
Power supply	Manufacturer, model, Watt rating, cost	350 W minimum. Must match motherboard connector type.
Enclosure	Manufacturer, model, type, front panel features, cost	Mini-tower, able to hold all other components. Enclosure and power supply may be treated as a unit.
Monitor	Manufacturer, model, size, LCD/CRT, dot pitch, maximum resolution, special features, cost	17-inch or better monitor, supports 1024×768 at 75 Hz or better, best if it supports video card's maximum resolution.

MEMORANDUM

TO: Jesse White, System Administrator
CC: Verna Johnson, CEO
FROM: Gracy Bagga
DATE: April 16, 2024
SUBJECT: Regarding Disposal of Old Computers and Data Security at End-of-Life

One of the major challenges that will follow this upgrade is how to dispose of the old computers properly and how to tackle data security. Electronics, like paper and plastic, should be recycled or repurposed.

Before the older systems can be decommissioned, the older data must be saved. Data would need a thorough backup using external hard disks or cloud services. BTB's tech team can perform this task themselves or our company can offer this service, the cost of which could be discussed later. This backup can then be transferred onto the new units. Once the backups are complete, all the old storage devices need to be shredded or degaussed, which is the process of erasing the magnetic fields on a storage device, to prevent data theft and security breaches. If this is not feasible, a final nail in the coffin would be to drive a hard nail such as a concrete nail through the device. This would physically destroy the device. However, this should be done with extreme caution and under the guidance of a professional. Our company can extend this service and send a trained technician who can oversee this whole procedure.

The Saskatchewan government has established the Electronic Product Recycling Association which organizes the proper disposal of electronics. In addition to the proper disposal of the gear by using their services, BTB can get some of the EHF money back that would have been paid at the time of the original purchase. The nearest drop-off location can be found on their website, <https://recyclemyelectronics.ca/sk>.

Another good alternative would be to donate some units to Saskatchewan Polytechnic or the University of Regina. They could use the units as-is in their labs or use parts from them as they see fit. Furthermore, Bagga and Shah Consulting Services is offering to pick out still useable parts from the old units and pay BTB in return. This way, those parts could be utilized in future repairs that come to us.

Please feel free to contact me with any further queries or comments at abc123@saskpolytech.ca or 639-111-1111.