Using Technology to Facilitate Surplus Inventory Distribution at WPI

An Interactive Qualifying Project Report
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Abstract

This IQP seeks to improve the efficiency of WPI’s asset management. WPI is in a position where much of its inventory could be donated to the community, but the inventory instead is stored, unused, until it is given to waste disposal contractors. In order to address this problem, we created an online interface for a database designed to store details on surplus inventory. The website interface itself is a simple series of CGI-generated HTML documents. The data displayed is determined by a MySQL backend. Clarence Plant, WPI’s Property Manager, is the intended audience to fill the database, while members of the WPI community and associated nonprofit organizations will benefit from the public view of the database. The website will help the community, eliminate waste, and save money.
Executive Summary

The current system of disposal used for the surplus inventory held by WPI leads to wastefulness and could be improved to help the non-profit organizations in the Worcester area. This Interactive Qualifying Project delivers a web page that allows for the better disposal and reallocation of surplus goods to the organizations that request them. This project improves upon the already existing structures of the Community Service Office and the disposal policies that already exist. The web page will allow the various groups associated with WPI to submit what surplus they have and would allow the non-profit organizations of Worcester to submit requests for the items they need. The current system of reallocation for the surplus inventory involves sporadic rather than constant communication and this project is an attempt to allow for constant, consistent conversation between WPI and the non-profit organizations.

All businesses, both for profit and not, have costs in the form of inventory and maintenance. The costs of surplus inventory can lead to failure for businesses large and small. Surplus inventory is inventory that is still usable but is not currently, for whatever reason, being used. In general it is a good practice to have some stock inventory in storage but it must be carefully balanced to keep the costs of storage in line with the usefulness of the items. The best method of handling the problem of surplus inventory is to avoid having any surplus, though doing this is hard for most businesses. The main methods of handling inventory are storage, clearance sales, disposal and donation. WPI has systems both for new acquisitions of material in an attempt to use the existing equipment and for the disposal of equipment that has been replaced. To illustrate this, we have a case study of the disposal of a CRT monitor. The best choice for reallocation of surplus inventory is donation because it supports non-profit organizations and also grants the donating organization tax breaks. The non-profit designation which can grant these tax breaks for donations is known as 501(c)3 and this status is designated by the IRS. The reasons for using a website for this project are that a web page can be accessed from any computer with internet access, doesn’t require the users to download anything and requires the least amount of change to the current systems of inventory management in
place at WPI.

For this project, we created a web site designed off of the “eStore” model. The front end of the web page is built using HTML and the back end is a database written in SQL and maintained on a Linux server. The two sections of the web page are tied together using a bridge written in Python. The HTML itself is kept up to date using CGI scripts to poll the database for changes.

The web site itself has been given to Clarence Plant for use by the Asset Management department, along with a walk through explaining its use and a template for an Excel file for uploading information into the database.

The benefits of this project are threefold. Firstly, it gives WPI a financially beneficial way to dispose of surplus inventory. Second, it gives the non-profit organizations of the Worcester area a way to get some of the non-food items that they need in the way of donations. Lastly, it improves WPI’s civic image and helps reduce WPI’s carbon footprint.

The website referenced in this report can be accessed at http://users.wpi.edu/~surplus/
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1: Introduction

Inventory management is a common problem in large organizations, one that can cause excessive waste if not addressed properly. Worcester Polytechnic Institute (WPI) has developed a system, but improvement is always possible. The project described in the following document was completed as an Interactive Qualifying Project (IQP). The IQP, a graduation requirement for all WPI undergraduate students, challenges them “... to address a problem that lies at the intersection of science or technology with social issues and human needs” (WPI, June 2010). The main deliverable for this project is a web page to facilitate distribution of obsolete inventory to members of the WPI community, and other organizations who work with WPI's Asset Management department. In addition, there is a simple user guide for those who will be accessing the website (see Appendix A). Following the completion of its construction and initial population, the website is to be maintained by the staff of WPI. The problem of surplus inventory is difficult to solve efficiently, and large organizations such as WPI often suffer from significant waste. Technological solutions are a relatively new option for managing surplus inventory, and many opportunities exist for technology to be incorporated into current inventory management systems.

The Community Service Office and policies surrounding asset management already exist in WPI. Our project seeks to address some of their current limitations rather than attempting to create the necessary structures from scratch. The Internet is a great resource for gathering and organizing information and displaying it publicly. Our project will attempt to create as complete as possible a website with two main purposes. It will improve the process by which WPI makes its old technology and utilities available to nonprofit organizations.

The first portion of the web site will address the need for working utilities and materials. Many of the organizations we visited had wish lists for many different items including from more tables and new ovens, as well as others. In addition to WPI itself, groups such as fraternities within WPI often have a variety of potentially useful items that would otherwise be discarded. WPI's official procedures for passing on unneeded resources to nonprofits in the Worcester area are difficult to follow. A website would
allow anyone to register what they have at the moment, and would allow nonprofit organizations to easily browse what is available and may match what they need. In addition, directly requesting items is often legally difficult, due to the regulations surrounding nonprofit organizations, but asking for items off of a list being provided by an organization such as WPI is much more easily acceptable.

During our research phase, our group met with Mr. Clarence Plant. As the Asset Manager at WPI, he is in charge of managing the school’s surplus and outdated materials. According to Mr. Plant, WPI currently has difficulty keeping track of the types and quantities of equipment that are stored on campus. In order to properly dispose of surplus parts, WPI often hires a recycling company to remove equipment that still operates but has been outdated by new purchases. For parts that can still be used as is, WPI is sometimes able to donate the equipment to nonprofit organizations and local schools, but this system relies more on spontaneous communication than a consistently available database. One aim of our project is to provide both a place for the faculty and staff of WPI to record their resources, and for nonprofit organizations to browse and get in contact with employees such as Clarence Plant in order to facilitate the exchange of materials.

The following chapters will elaborate on the need for our project and explain how our project is implemented to address this need. Chapter two will provide detailed background information about the problem including defining surplus inventory, discussing the possible ways to handle surplus inventory, discussing how WPI handles surplus inventory currently, a brief case study we conducted, a discussion of donating, a definition of 501(c)3 designated organizations and a brief discussion of why to use a website compared to other methods of spreading information. Chapter three will contain a methodology discussing our decisions in designing the database and associated webpage. Chapter four will discuss our results. Chapter five will discuss our conclusions.
2: Background

The issue of how to manage surplus inventory is not a new one. Any organization that acquires materials, be it for its own use or to sell, must have a plan for its eventual disposal. When it is deemed that the materials can no longer serve their intended purpose, it is the responsibility of the organization to determine what should happen to the inventory. Below, we address the advantages and disadvantages of the most common options.

2.1: Definition of Surplus Inventory

Efficiency is paramount when it comes to maintaining the financial success of an organization. Be it a full-scale business making profits by providing technical support or a public school receiving government funding, costs manifest themselves through the constant need for materials and services. Required goods must be well managed and maintained, and replaced when necessary. Additionally, inventory and documentation must be kept up to date to ensure that parts are replaced and serviced when needed. Questions involving what should be upgraded, what new items are really necessary, and what the best options are must be answered consistently. The importance of such maintenance is often underestimated, but has far-reaching effects. While it may seem obvious that larger corporations require efficient resource management, the impact that inventory control has on smaller businesses is just as profound. According to the U.S. Small Business Administration, “many small businesses cannot absorb the types of losses arising from poor inventory management. Unless inventories are controlled, they are unreliable, inefficient and costly.” (Hendrick, N.D., p. 2). Without sufficient management, all businesses, regardless of size, are prone to devastating financial loss and corporate failure.

One major hurdle that companies often face regarding resource management is the issue of surplus inventory. This term refers to the excessive stockpiling of goods that are no longer able to help the company make a profit and thus become little more than dust collectors and paperweights. Surplus inventory does not include items that were never usable or have been used to their maximum capacity and are now broken or used
A computer that was received by accident or was used until it no longer functioned is not surplus inventory as there is no potential profit to be made from its use or sale. A computer, however, that was never taken out of its shipping crate when its model was being sold and now is obsolete due to newer technology is considered surplus inventory because it at one point had the potential to make a profit and the only reason it didn’t was because it wasn’t purchased in time.

In general, it is good business sense to have a small amount of extra stock on hand in case of emergencies or unexpected scenarios. The company that just happens to have that unopened computer on hand when a client needs it will be in a much better position for future business than the warehouse that just ran out. In the world of inventory management, however, having too much inventory is detrimental. Surplus inventory can be very difficult to manage, yet is necessary for cost efficiency. Inventory that is obsolete or greatly exceeds the demand is very problematic to a company, as they can potentially result not only in increased spending, but also in reduced profit.

One reason that this has become such an issue is that it is very difficult to judge just how much is too much, as that amount can vary greatly based on many factors. The state of the economy, popular trends, even the time of year can affect the core demographic of an organization. With the business sector constantly in flux, it is far too easy for a business to get caught up in the hype of a high demand product. When a business stocks up on the item only to discover that the demand is temporary, the company is left a severe financial deficit. Additionally, there are multiple types of surplus inventory. In the case of a retail store, for example, a surplus is usually the result of buying more items than the store is able to sell. In the case of companies that earn money through services or support, surplus inventory is likely to consist of parts that were once useful but now are obsolete or items that were purchased with the intent of being used, but were later never needed.

Surplus inventory poses two separate challenges that impact an organization on multiple levels. The first, and most directly influential, is the issue of profit margin. An organization spends money to buy inventory and hopes to either use or resell it. When the product is not sold, that company has lost money because it has spent funds that it can no longer hope to make up with that item. The other challenge, which is less obvious, is one
of physical space. All surplus inventory must be stored until it is sold or disposed of. After a point, extra stock takes up space that could be used to house new inventory. After a point, there is so much extra stock that there may no longer be room for new inventory. This of course is a larger problem for small businesses that don’t have vast warehouses to store their goods, but it becomes an issue for all companies that hope to maintain maximum efficiency.

2.2: Handling Surplus Inventory

The ideal method of handling surplus inventory is to not have any surplus in the first place. This is very challenging to do, though the few companies that have established an effective management system have found themselves at a distinct advantage. For example, Dell Computers has devised a high-efficiency system for managing inventory. Through observation and extrapolation, they determine the minimum number of each computer component needed for any given time period and buy replacement stock in small quantities when they need to. This way, Dell has only a very small amount of surplus inventory and if a computer component is obsolete, it is the supplier and not Dell that must handle it (Magretta, 2002). However, not many companies can financially or logistically prevent excess inventory as effectively as Dell does. For the majority of corporations, there are several options for how to handle the problem of surplus inventory when it does inevitably occur.

The first option is to keep the surplus inventory in storage. This is the easiest choice, since it requires no work on the part of the owner of the inventory. It is, however, not a valid solution because it does not solve the problem. This option only works if there is a large space available for storage that isn't a problem for it to be taken up indefinitely. Additionally, surplus inventory can incur carrying costs. Many companies have to pay for the space they use, through property taxes or leases. Often, maintenance of some kind is required for unused inventory, and it may need to be insured. The costs of retaining inventory may be hard to calculate, but should not be discounted entirely, (Schreibfeder. N. D.).

For retail businesses, the goal of buying inventory is to sell it later. However, to sell inventory has been in stock for a long time, it usually requires reducing the price. An
example of this is the clearance racks in clothing stores. These are often old pieces that have not sold but that the owner still believes he or she can make money on. By reducing the cost of the item, the retailer can potentially still sell their product. Selling inventory can also be done in bulk; there are companies that promise to buy your inventory. Usually, though, the money these companies offer is far below the value of the product and is best for recovering space and making a very small amount of quick money. In all cases of selling inventory, the hard part is finding a buyer who is willing to pay at a price that the owner would be happy to sell at.

The third option is to dispose of the inventory. This option does not require finding a buyer but has its own set of problems. First, the company must pay for waste removal, and the cost is increased if there is a large amount of inventory or if the inventory is hazardous. This is a particularly large issue pertaining to the disposal of chemicals, including household cleaners, paint, and some parts of electrical components. The increased cost associated with disposing of hazardous materials reflects the difficulty of disposing of it. Just as surplus inventory that is stored takes up space, inventory that is disposed of also takes up space in landfills or other disposal facilities. Electronics and chemicals also pose environmental hazards by containing harmful ingredients.

The fourth option is to donate excess inventory to other organizations. The disadvantage of donation is needing to find someone interested in the items, the same issue as with selling it. It is, however, easier to find an interested organization to give products to than to sell them. Almost anything that is free can find a new owner.

Although it may appear to the donating organization that giving away inventory does not help to regain any lost capital from the initial purchase of the products, this is not entirely true. The IRS has implemented tax deductions for donations for registered non-profit organizations. Donations covered under these regulations must have their ownership legally transferred to the new organization, which includes all liability. If the surplus equipment were only rented out, WPI would have to handle any dangers brought about by making use of the equipment. In short, donation excess inventory to non-profit organizations is the most efficient means of disposing of inventory that WPI no longer uses, (IRS, 2009).
2.3: Inventory Management at WPI

WPI employs a full-time Property Manager in the department of Asset Management, Clarence Plant. His duties include managing the three main stages of inventory: purchasing, monitoring, and disposing. WPI has set a number of guidelines and procedures for each task, with parts to be followed both by members of the faculty and by Mr. Plant himself. This allows WPI to be as efficient and cost-effective as possible. It minimizes waste and duplication of expenses. In addition, when materials are to be discarded, proper asset management is necessary both to ensure that the items really are removed and not merely moved around, and also to conform to the federal regulations surrounding the institution.

At WPI, acquiring new equipment is handled by the Procurement system that must be followed to avoid over-paying or duplicating items. A form is turned in to Asset Management, where it is processed. WPI already has existing equipment which has been purchased in the past, but not all of it is always in use. When possible, requests are filled with already-owned property rather than a new purchase. The Property Manager handles all major requests in the system. He has the task of finding the best source of any materials for WPI. When it is custom equipment, he contacts the companies that could produce it to work out a contract. He also often interacts with the Asset Management departments of other large institutions. NASA and other government-sponsored organizations often provide WPI with valuable materials as part of their own asset management programs (Plant, September 2010).

The Asset Management department also spells out disposing of old materials. The main consideration in this case is ensuring that WPI has permission to relocate or dispose of the item in question. Much of WPI’s property is purchased with money which came from government grants. These grants often list the specific purpose their money is to be used for, and so equipment bought through the grant is not legally owned by WPI. Before an item can be disposed of, WPI must either gain permission from the source of the grant, or, more often, request “title” on the equipment bought with the grant money, which legally changes the ownership to WPI. It may then be processed normally. WPI’s Property Management Manual has a section on Equipment Disposition for when equipment is to be disposed of. The Declaration and Disposal of Surplus Equipment
Form includes the amount and type of equipment and the reason it is no longer needed. The form gets sent to Asset Management, where the first steps towards actually disposing of the equipment occur. The form includes an optional field for where the equipment is to go. If it is not filled, it will be sent to the companies employed by WPI to take away. If it is, then a donation may be made, the process we plan to facilitate.

2.4: CRT Monitor Case Study

To illustrate the process of disposing of equipment, discarding a Cathode Ray Tube (CRT) monitor will be considered as a case study. WPI employs subcontractors to dispose of the majority of its waste. The company brings shipments to New Hampshire, where they are processed. For a CRT monitor, a number of legal aspects must be considered, as is the case with any electronic equipment. Cathode Ray Tube monitors contain mercury and because of this are considered hazardous materials. The final rules, set forth by the Environmental Protection Agency, are meant to "encourage increased reuse, recycling, and better management of this growing waste stream [sic], while maintaining necessary environmental protection." This is accomplished by CRTs not being subject to RCRA regulations (EPA 2009). As a result of these laws and regulations, the case of a CRT monitor results in a considerable charge to dispose of the hazardous material, in addition to taking up space in a landfill or requiring the energy of an incinerator.

Our project would consist of redirecting equipment that is destined for disposal to instead be donated, and would have no effect on this step. The equipment would still have to be tracked and be taken away, the only difference being where it will go. There are times when materials, such as a monitor, would be passed on to other, smaller organizations. Our website will facilitate these types of transactions.
2.5: Donations to Non-Profit Organizations

The surplus inventory held by any corporation can be reallocated usefully by donating it to a non-profit organization. Donating surplus inventory has benefits both for the organization that is donating and the organization receiving the donations. These benefits are financial, social and environmental. The financial benefits apply both to the organization receiving donations, which then doesn’t have to allocate part of their limited budget to acquiring those items, and to the organization making the donation, which gets tax breaks for donating and no longer needs to pay disposal fees. The social benefits are from the improvement to the community provided by the existence of non-profit organizations and also the community views of a corporation that helps to better its community. The environment benefits from there being less waste in landfills and the donating corporation gains a reputation for being green.

Donating these useful items such as computers, monitors, tables, beds, etc, makes these items that are normally difficult to get on the low budget a non-profit organization has available to them. Many of these items are things that a non-profit needs to be able to provide their service to the community. For example, a soup kitchen can’t function without a stove to heat food, a refrigerator to keep things cold and things of that nature. Ensuring that these groups can run benefits the community that they are in and, in the case of WPI, the community that the school is a part of. This would have the added benefit of increasing public opinion of the school because then it would be giving back to its community.

There are also financial benefits to donating. Non-profit organizations are allowed to give tax breaks to donating entities or individuals relative to what was donated. While a company cannot donate to a single non-profit for the express purpose of gaining these tax breaks, donating to all or many of the organizations in the area is a viable option.

There is also the matter of the fees for the disposal of many items such as chemicals. Many items must be disposed of by companies who have the facilities for handling hazardous waste. The fees for this can be completely avoided through donation. Then the hazardous material inside the computer, for example, is never exposed and the computer continues to be useful. Looking at the financial benefits of donating such items, one can
see that the disposal fees are no longer in the budget and instead replaced with a profit from tax breaks. Furthermore, because the items are not being disposed of in a landfill, this is diminishing the environmental impact of the corporation, which is something sought by many such groups in this modern era.

The benefits from donating surplus inventory are more than worth the slight change in inventory management required to implement donation rather than disposal. The views of the corporation in the community are improved, the profit margin increases and the environment benefits from the decrease in material disposed in landfills.

2.6: 501(c)(3) Designated Organizations

When considering donating to a non-profit organization, the question of what exactly a non-profit organization is and does come up. Non-profits exist for many different reasons and perform many different useful functions for society. There are also very strict regulations determining what can and cannot receive the actual government tax exempt non-profit status and in turn provide tax breaks for donation. The specific exemption status designation that most of the Worcester region non-profit organizations fall under is known as 501(c)(3).

The Internal Revenue Service (IRS), maintains several tax exemption statuses for organizations that the government has deemed should not be taxed to the same degree that a corporation is. The 501(c)(3) designation refers to any organization that exists for one of the following purposes: “charitable, religious, educational, scientific, literary, testing for public safety, fostering national or international amateur sports competition, and preventing cruelty to children or animals” according to the Exemption Requirements - Section 501(c)(3) Organizations section of the IRS webpage (IRS, 2009) These organizations are also normally referred to as non-profit organizations and none of the earnings from a 501(c)(3) organization can go to an individual or private shareholder. 501(c)(3) organizations are a great benefit to the communities that they’re in, whether they’re a soup kitchen, a church, a battered women’s shelter, or a day care for underprivileged children. These programs ensure the health and welfare of people who could not otherwise provide for themselves or their families.
In order for an organization to gain the 501(c)(3) exemption status, they have to complete a set of forms for the IRS. These forms prove that the organization is currently obeying the standards a 501(c)(3) will be held to as far as purpose and use of income goes. There are also several websites available to help in the process of filing these tax forms. An example of this is www.501c3.org, which has applications to help a 501(c)(3) organization to get started and to help keep their exemption status. The most difficult part of being a 501(c)(3) organization, according to this webpage, is keeping that status after getting it. If any of the rules or regulations listed on the IRS web page are broken by the organization, then they lose the exemption and in most cases they then go bankrupt because a group used to operating as a non-profit that doesn’t have to pay taxes, can’t generally manage to stay in the black financially.

Non-profit organizations, such as those designated 501(c)(3), are a great asset to the communities they exist in. These organizations need the support of the community to be able to run effectively but cannot directly solicit resources from institutions such as businesses. Providing them with the surplus inventory of such as institution is an efficient way to benefit the community while also benefiting the corporation. WPI would benefit most, both financially and ethically, from allowing many of the donations to go to 501(c)(3) organizations.

2.7: Reasons to Use a Website Compared to Other Media

Distributing current and up to date information to the people to whom it is relevant has always been a problem. Methods vary from ads in newspapers, to fliers placed in high-traffic areas. For our project, we determined that a website would be the most effective means to reach the greatest number of people. A website is accessible from anywhere with access to the Internet. At this point, anyone can reach a website, whether from personally owned computers, computers at work, or public kiosks such as most libraries. Our hope is for as many groups who may benefit from the project to be made aware of the website as possible.

Designing the project around a website has three main advantages. First, from our own experiences, it minimizes the amount of work needed to keep the database
updated. Second, it requires the least change in the current methods of asset management, (Plant, October 2010). Lastly, it means that unlike software, the end users don’t have to download or acquire any special program that may or may not run on the operating system they are using and can instead merely use their Internet browser of choice, (Brown, 2009)

One of the most well developed uses of computers is managing databases. Services such as the SQL family of languages, Oracle, and Microsoft Excel can be placed on servers and used to keep track of any large repositories of information. This is an improvement over older, pre-computer methods of maintaining data, which mainly involved large physical filing systems. For the purposes of our project, a database running off of a server can be updated from anywhere in the world, by anyone we give permission, and can report its data in many useful forms. No other method would offer the same amount of versatility.

The current methods of asset management requires that anyone who wants to dispose of an item must complete a form saying that they no longer need the item. These forms all go to one person who processes them. These steps would not change for the faculty members who wish to dispose of surplus inventory if our distribution method was adopted. The only change that takes place is that instead of most items being destined for a landfill, many will instead be put in the database for donation. The fact that these items are being put into a database does nothing to change the fact that the forms must be submitted and that the items must be stored somewhere until they are taken away. For anyone who isn’t directly involved with maintaining the webpage, there is no change to the system that must be followed for item disposal.

Software has the same distribution problem that physical media does and also has the problem that it must be compliant with the hardware and operating system that the end user has available. Also, most public kiosks don’t allow software to be installed. This makes the use of a website the most optimal choice with regards to publicly available information. The Internet also has the added benefits of being platform independent and being backwards compatible, such that websites made at any point since the advent of the Internet will render properly in any modern browser.
When compared to physical methods of compiling and distributing data, the website is still the optimum choice. The website can update frequently and remotely, whereas physical methods such as sending out fliers or going to tell the non-profit organizations what we currently have available can only be updated so often. And to update those more frequently would be a waste of time and resources. For example, if we were donating a set of objects containing a computer, a table and a chair and sent out a flier saying such, and then the next day wanted to update what was in that set, another batch of fliers would have to be sent out. This is a waste of the time of the people making the fliers and a waste of paper because the set of items hasn’t changed.

Thus, the most efficient solution to the problem of distributing information about the resources that WPI has available for donation is through a website. It adds a minimal amount of work for a single person, doesn’t impact anyone who isn’t involved in the maintenance of the webpage and is easily accessible for the end users. Our objectives for this project are as follows: to provide a database with an easy to use interface for keeping track of inventory, a website that allows nonprofit organizations to request surplus inventory, and to produce a walkthrough guide of using this website.
3: Methodology

Our project consisted of three main sections to fulfill its purpose. There was a database backend, which recorded the currently available items. There was a website frontend, which allowed nonprofit organizations to request specific items from the database. Finally, there was Clarence Plant’s interface, which allowed him to enter new items and coordinate with the ones which have been entered in the past.

Both the database and the website are served from ccc.wpi.edu, WPI’s Red Hat Enterprise Linux Server (release 5.5) cluster. The website is accessible at http://users.wpi.edu/~surplus/, and is administered from http://users.wpi.edu/~surplus/admin/. ccc.wpi.edu is a fully configured and publicly routed UNIX server available to all WPI students, making it ideal for a project which is meant to provide a service to anyone in the Worcester area. Another server would likely require maintenance or upkeep fees, which would have been detrimental to our project. The choice of ccc.wpi.edu also dictated a number of software decisions, as the programs and libraries installed on ccc.wpi.edu are kept updated by WPI’s Network Operations. We based our project around these technologies which required minimum additional configuration on our part.

3.1: Website Model

The overall model of our website is that of an online store such as Amazon.com. We want our users to feel comfortable with the interface and have an intuitive knowledge of how to use it to order items that they want. In an “eStore” interface, available items are displayed and the user selects the ones he wants to request or order. He is then taken to a confirmation screen where he inputs information to facilitate the transfer of the items (contact information, payment information where relevant, etc.). While this website will not be collecting payment information, it will gather information about the organization requesting the item and the contact information of the responsible individual.
3.2: Advantages of a Website

While there are many ways to display information and make it easily and freely available, the best of these is through use of a website. A website can be kept up to date easily, unlike fliers or newsletters which are only sent out periodically or through calling the organizations to see if they are interested in any of the current surplus. Once a URL is distributed, as long as the website is maintained, the information present will always be up to date.

3.3: Interface Design

The appearance of a webpage is very important to its usability. The webpage we have made for this project is a centered table with black text on a white background. It was designed this way to be simple way of interfacing with a database and nothing more. During our meeting with Clarence Plant, he requested that the webpage be kept simple because it doesn’t need anything more than a simple, user-friendly interface and adding anything else would needlessly over-complicate it. Moving from one section of the webpage to another is done through links which are formatted to be obvious links rather than part of the text. The majority of the pages are built around a table displaying relevant fields from the database.

The administration portion of the website is similar to the section shown to the world at large. Administration pages also display tables with views of the database, but include fields to make edits to the stored information. At Mr. Plant’s request, we included a field allowing Microsoft Excel files based on an included template to be loaded into the database. Departments in WPI with large amounts of surplus inventory will be able to request the template and use it to insert large numbers of items, rather than requiring Mr. Plant to insert each individually.

3.4: Advantages of CGI

The website we have created accomplishes its goals through the use of Common Gateway Interface (CGI) scripts. CGI scripts allow web pages to display up-to-date data
stored on the server to the user, with minimal intervention from the web site's developers. Through CGI, web pages can be written defining a specific form that should be used to display the data, while leaving the specifics of what data is being returned up to the server when a web browser is navigated to the page's URL. The two other methods which could be used are Asynchronous JavaScript and XML (AJAX), and directly writing the information into the web pages. The first, AJAX, takes much more work to program, and requires more modern computers than we can count on for our viewers. The second requires constant updating of the web site, by someone capable of altering HTML. CGI scripts allow us to automate much of the process (Robinson, 2004).

CGI, or common gateway interface, is a “simple interface for running external programs, software or gateways under an information server in a platform-independent manner” (Robinson, 2004). What this means is that the end user can view data or run programs without having to download them themselves. CGI runs well on older computers, since it serves static HTML as opposed to JavaScript which is dynamically generated. Since JavaScript is dynamic, it doesn’t tend to run well on older browsers or computers or over slower Internet connection.

3.5: Advantages of Python

The CGI scripts themselves are programs written in the Python Programming Language. Python has a number of attributes which make it well-suited to our purposes. It is a standard interpreted scripting language, which means that it has no delay for compiling, and can easily produce text output. When a program is used as a CGI script, the printed text is interpreted as standard HTML and served to the web browser which requested the script's page. Additionally, a standard library has been written to allow Python programs to interface with the database software we chose, MySQL. Python also includes a module containing code to interpret data passed from the web browser to the CGI script. Finally, the standard Python interpreter is already installed on the WPI CCC, where our website is hosted. Python is the language with the best combination of tools, that we are most familiar with, for this project.
3.6: Advantages of HTML

HTML is the major language used for writing webpages and thus any computer that can connect to the Internet can handle basic HTML. The main reason that we chose to use HTML for this project instead of generating a webpage using one of the many webpage generation programs on the market is simply a matter of low level control and neatness and because automatically generated HTML is not up to the same standard that hand coded HTML is.

Security in the website is handled through the “htaccess” system. The Apache Web Server as provided by WPI allows special files which restrict access of directories by WPI username. Through the methods detailed in the website for the CCC, only Clarence Plant and the members of this IQP may currently access the administration areas of the website. This prevents unauthorized users from editing or removing entries in the database. The system uses WPI’s standard login portal, allowing the website to safely assume that user authorization is handled without needing a custom implementation. Only the administration pages are password-protected in this way; the rest of the website is visible to the world. The authorized users may be changed by editing the file ~/public_html/admin/.htaccess, when logged in to the CCC with the username “surplus” (WPI, 2009).

3.7: Advantages of a Database

Databases are the best option for storing data that needs to be written to, read from and kept synchronous across the Internet to multiple users. While information could be stored in files that could be accessed by the code and displayed or edited, this way of handling data is not only complicated to write and maintain but it is also difficult to keep synchronized between multiple instances of reading the data. Databases can be kept on a server and handle their own synchronicity and can recover from crashes on their own, where simple data files might have to be repaired by hand.
3.8: Database Fields

The database has the following fields: id, item, description, quantity, cond, department and requested. The id field is the primary key for the database and is a number that can be used to identify each individual entry on the table. The item field contains the name of the item and is necessary for identifying which item is contained in the particular database entry. The description field contains a brief description of the item. The quantity field contains the number of the item that are available. The cond field contains the condition of the item. The department field contains the department the item is originally from. The requested field contains a Boolean value showing whether the associated item has been requested.

3.9: Advantages of MySQL

There are many languages that can be used to construct and maintain database tables. We chose to use MySQL in particular because WPI’s CCC servers already had it available for use. While the CCC also has the Oracle implementation of SQL available for use, the MySQL implementation is easier to use and maintain.

3.10: Limitations

This project, due to time and resource constraints, had some limitations. The most glaring one is that the database is simply a framework and did reflect actual inventory of WPI. This was because we did not have enough time to design the website and populate it. To have taken time to inventory WPI and add the information to the database would have resulted in a website of much lower quality. It was our belief that populating this database was an IQP in itself that another group could have undertaken.

Another thing that this project did not do was advertise the existence of the website to local non-profit organizations that might be interested in requesting inventory from WPI. From our experience, 501(c)3 organizations are very challenging to get in contact with and, like with populating the database, we were unwilling to sacrifice web

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1A Boolean is a value which is either “true” or “false”, and the computer will not allow to be set to any other value.
design time for it. This could also be a separate IQP for another group. It could also be the responsibility of Clarence Plant or whoever else maintains the website and the database.
4: Results

4.1: Database

The database was chosen as the most effective method to store the information about surplus inventory which could be donated to other organizations. The software behind the database was MySQL version 14.22, running on the WPI RedHat Linux server ccc.wpi.edu. MySQL was chosen because it was the relational database implementation our group is most familiar with. It allowed us to request a database from one of WPI’s administration pages and be assured of a working account with the database server.

4.2: Website

A website provides a clean and easily accessed interface to our project’s database. The website is served from the Apache Web Server on ccc.wpi.edu. It was written in standard HTML, restricted to HTML 4 to avoid incompatibilities with HTML 5. The website needed to be accessible from any computer which may be used to request it, including older computers such as those in many public libraries. Therefore, we avoided any aspects of Internet programming which would require web browsers to be able to recognize the newest standards. The server-side code for the website is written in Python 2.4.3, a clean and powerful scripting language installed on ccc.wpi.edu. PHP is a common language for web programming, but the security holes it allows have caused its use to be banned from ccc.wpi.edu by NetOps. The following (image 4.1) is a screenshot of the main page of the user end of the webpage. The text in blue is click-able links. In the case of the item name, these links lead to brief descriptions of the item (image 4.2) if such a description is available. The ‘Request This Item’ link leads to a request form (image 4.3) where the user can put in their information and the information of the group that is requesting the items.
Image 4.1: Listing Page of Items Available

<table>
<thead>
<tr>
<th>Item Name</th>
<th>Item Quantity</th>
<th>Item Condition</th>
<th>Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chairs</td>
<td>40</td>
<td>Mint Condition</td>
<td>Request This Item</td>
</tr>
<tr>
<td>Laser</td>
<td>1</td>
<td>Good Condition</td>
<td>Request This Item</td>
</tr>
<tr>
<td>Microscopes</td>
<td>20</td>
<td>Decent Condition</td>
<td>Request This Item</td>
</tr>
<tr>
<td>Rat cages</td>
<td>200</td>
<td>Good Condition</td>
<td>Request This Item</td>
</tr>
<tr>
<td>Tables</td>
<td>10</td>
<td>Decent Condition</td>
<td>Request This Item</td>
</tr>
</tbody>
</table>
Item Description

Microscopes

Magnify up to 400x
Requesting Chairs

Please enter your organization’s contact information. A representative of WPI will contact you as soon as possible to arrange collection of the requested item.

Contact Name: 

Mailing address

Organization Name: 
Street address: 
City or town: 
State: [MA] 
ZIP Code: 

Other information

Phone Number: 
Email Address: 

Submit request

Image 4.3: Item Request Form
4.3: Administration Interface

The final section of the project was the interface which was to be used by Clarence Plant, WPI’s Asset Manager. This interface was a second web site, which allowed him direct access to the database without having to know SQL syntax. This second web site was written using the same technologies and methods as the main interface, but with an added identity check system in place to prevent unauthorized access. Once the system knows that it is being accessed by Clarence Plant, it uses HTML and CGI scripts to create a view of the items stored in the MySQL database, and allowing it to be updated. This makes it possible for Mr. Plant to keep the database updated as requests are made on old surplus inventory, and new surplus inventory is added to WPI’s storage. Inserting, deleting and modifying items in the table can all be done from the main admin page (image 4.4), and it also allows for the uploading of Excel files that are made using a template file also supplied with the webpage. Also on the main admin page is a link to where the requests that have been made can be viewed. This view is shown in image 4.5.

The CGI files written for this project were done using the Python language on the CCC servers. This allowed for instantaneous testing of each line of code written and also made it very easy to connect directly to the database. The CGI programs themselves are printing out HTML to generate the webpage but are also referencing the database to fill in the tables that are being presented to the end user. Referencing the database is done in the same way as other operations on the database are done, so the programs also allow for updating the database.
Image 4.4: Administration Main Page

Image 4.5: Requested Item Table
4.4: Administration Tasks

As the Property Manager of WPI, Clarence Plant will have to ensure that the database reflects the current state of WPI's surplus inventory. The interface described above allows for the operations he will need to run on the database. Image 4.4, a screenshot of the page accessed from the web address http://users.wpi.edu/~surplus/admin/, contains the display which allows the main operations.

New items can be added individually or in groups. The first gray bar designates the options which should be specified to append a single new item to the database. Once the name, quantity, condition, and department are set, clicking the Insert button will update the database and make the new item be displayed in the tables on the administration and public inventory pages. The item's description may then be modified by clicking on its name on the administration page, which links to a new page with the description in a modifiable text box. A new description may be entered and saved. The file items.xls, accessible through the link with the text "found here," may also be filled with a list of new item data. It can then be uploaded, and the items will be entered into the database by the program.

There are also operations to allow items to be modified, or deleted entirely from the database. To delete an item, its name can be selected from a dropdown menu, and then deleted with the "Delete" button. To modify a particular property of an item, its name should be selected from the menu, and the field, "Item Name," "Item Quantity," "Item Condition," or "Department" should be chosen. If the property being modified is Condition, the new condition must be one of the seven standard words: Poor, Mediocre, Fair, Decent, Good, Excellent, or Mint. Clicking the "Modify" button will update the item in the table.

Mr. Plant will also have to handle requests for items from the table. When an item is requested, it will cease being displayed on the main web page, and the table in the administration page. Requested items appear only in the page at the web address http://users.wpi.edu/~surplus/admin/admin_request_view.cgi, accessible through the "View Item Requests" link. From there, the contact information of the requesting group are displayed, as well as buttons to note that the item has been collected, and should be
entirely removed from the database, or that the request has been retracted, returning the item to the visible tables.

4.5: Moving Forward

Through this project, we have created a platform for organizing surplus inventory. With the completion of this paper and the programs which run on the server, our involvement is concluded. Use of the program has been handed off to Clarence Plant, WPI’s Property Administrator. Over the course of several meetings, we designed the website to include all of the features he requested, and demonstrated its use. He will now be able to incorporate the website as necessary for WPI’s asset management.

Mr. Plant is currently sent a form documenting any surplus inventory which departments in WPI need to dispose of. He handles the legal and logistical steps necessary to reuse, recycle, or donate the inventory, or have it picked up by an external contractor which deals with waste. With the addition of the website, he will be able to process the submitted form, and create a new entry in the database, which will be publicly visible. Additionally, through the items.xls spreadsheet (Image 4.6), he will be able to send a Microsoft Excel spreadsheet file to other departments in WPI, who can then fill in their own excess inventory, and return the file to him. He will be able to upload the file directly into the database, greatly increasing the efficiency of the process.

Management of the website can now be passed on to any employees or volunteers who work with WPI’s Asset Management department. Clarence Plant has been given the password to the UNIX account and MySQL database, which would allow any future website administrators to alter the programs running the website, if necessary. Through the file ~surplus/public_html/admin/.htaccess on the CCC, the usernames hifo, epw, and rbaron can be removed from the list permitted to alter the administration section of the website, and other usernames could be added.
Image 4.6: Microsoft Excel Spreadsheet for Submitting Inventory
5: Implications

To address the issue that WPI has a large amount of unused inventory in storage, we designed a database to organize the information about what materials WPI has as surplus and a website interface from which non-profit organizations in the greater Worcester area can request that these materials be donated. The social implications of this project have many components. First, it allows 501(c)3 organizations access to useful items that they might not be able to afford. Second, it gives WPI a financially beneficial way of disposing of their unused inventory. Third, it improves WPI’s civic image by giving it a channel through which to become more involved in the community.

Through this project, WPI can make these items available for donation to all local 501(c)3 type organizations, letting them choose which items they get, which does not put their tax exempt status into jeopardy. The income of nonprofit organizations is very limited because they are government funded. These 501(c)3 designated organizations also cannot solicit donations from companies or organizations. Due to this fact, many of them do not have the things they need in order to run.

Keeping surplus inventory is a financial drain for WPI. Not only are there direct costs associated with keeping this inventory, space that is used by unused materials cannot be used for uses that would bring money into the school. WPI does not have an effective way to sell these materials, and it would cost money to throw the inventory away. Donation, however, allows WPI tax deductions, so is financially beneficial.

Not only does donating supply organizations that are seeking to better the community with items that they need, but it can also directly improve the conditions in the local area. For example, schools could be supplied with computers to be able to properly educate their students on the technology that WPI about which seeks to teach. Also, donating keeps the items out of landfills, reducing the carbon footprint of the donating organization and improving the global community.

This project allows for several other projects to grow from our framework. One project would be working with Clarence Plant to populate the database with a complete account of all of the surplus inventory at WPI. Another is reaching out to the local community and the non-profits therein to inform them about the existence of this project so they can use it to better themselves.
Appendix A: Site Walk-Through

The purpose of this website is to display surplus inventory which is being handled by WPI’s Asset Management department. The site may be accessed at http://users.wpi.edu/~surplus/, where the list of available items is shown (Image 1).

Image A1: Index at http://users.wpi.edu/~surplus

This page shows the items currently available to request, as well as the quantity available and condition of those available. Click one of the arrows (▼) to sort the list of items by the column selected.

- Sorting by Item Name sorts the list alphabetically by item.
- Sorting by Item Quantity sorts the list from the item with the fewest available to the item with the most.
- Sorting by Item Condition sorts the list by condition, with the items in the best condition at the top.

The condition descriptions, from best to worst, are:

1) Mint
2) Excellent
3) Good
4) Decent
5) Fair
6) Mediocre
7) Poor

Blue text indicates that clicking on it will lead to a new page. Clicking on the name of the item will lead to a page describing the item in more detail, as shown below in Image 2.

Image A2: Description of “Microscopes”

Clicking on Request This Item next to any item will lead to a requisition form, as shown in Image 3. This is where an organization’s name and contact information may be entered. None of the information is required for the form to be submitted, but enough information must be provided to allow WPI’s Property Manager to contact the requester and negotiate collection of the item selected. Providing insufficient information may result in a request not being processed.
Image A3: Requisition Form For “Chairs”
## Appendix B: Microsoft Excel Spreadsheet for Submitting Inventory

### New Item Document

Fill in one row for each unique item. Department and Description may be left blank if unknown.

When completed, please return to Clarence Plant (cplant@wpi.edu)

<table>
<thead>
<tr>
<th>Item Name</th>
<th>Quantity</th>
<th>Condition</th>
<th>Department</th>
<th>Description</th>
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<tbody>
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</table>

When entering condition, use the following codes:

- Poor: 1
- Mediocre: 2
- Fair: 3
- Decent: 4
- Good: 5
- Excellent: 6
- Mint: 7
References


