A Public Building Maintenance System for Quincy, MA

An Interdisciplinary Qualifying Project
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Submitted by

Edward O'Connell
Erik Schmidtberg
Ian Blizard

Submitted to

Instructors and Advisors (WPI)
Prof. James Hanlan (Projects Advisor)
Prof. Fabio Carrera (Co-advisor & Center Director)
Project Liaisons (DPW, Quincy)
Brion Wynn (Mitigation Manager)

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Quincy-d04@wpi.edu

Attributions

Abstract: Written by Ian, Revised by Erik & Ed

Executive Summary: Written by Ed, Revised by Erik & Ian

Introduction: Written by All, Revised by All

Background: Written by Ian and Ed, Revised by Erik

Methodology: Written by Erik & Ed, Revised by Erik & Ian

Results: Written by All, Revised by All

Analysis: Written by Ed, Revised by Erik

Conclusions: Written by Erik, Revised by Ed & Ian

Recommendations: Written by Erik & Ed, Revised by Ian

Appendix A: Written by Erik, Revised by Ian & Ed

Abstract

The focus of our project was to help The Department of Public Works in Quincy, Massachusetts maximize the effectiveness of their constrained budget. To accomplish this we created tools that allow the city to systematically collect comprehensive assessments of public buildings and then scientifically analyze the gathered information. While on site we tested all facets of these tools by preliminarily evaluating buildings in the city. These tools allow Quincy to use its funds more effectively by identifying areas of concern before they become larger problems.

Executive Summary

Municipal capital asset management programs across the United States are all faced with a limited amount of resources that must be used to maintain public property. One area of asset management that has often been ignored is the maintenance of public buildings. Frequently the maintenance of buildings is deferred in order to save money in any given year's budget. However, when repairs and renovations are delayed, the cost of upkeep for the following year increases and the level of service that facilities are able to provide consequently decreases. The concept of allocating resources for current repairs and renovations in order to prevent higher costs and potential problem in the future is called preventative maintenance. Those in charge of municipal capital assets who do not practice preventative maintenance are not using their already limited resources as effectively as possible.

In the past the Department of Public Works (DPW) of Quincy, Massachusetts had not implemented a formal maintenance management system. Public building conditions were not organized in a systematic fashion and repairs were performed only when components became inoperable. The process by which building conditions were assessed and renovation projects were prioritized was completely informal. These issues stymied the DPW's ability to use their budget efficiently. Having a minimal amount of information regarding public facilities also makes it difficult for the Department to provide substantial evidence in order to justify budget requests.

The driving focus of our project was to address these problems and develop tools that the city of Quincy could use to improve their current maintenance management program. We decided that the best way to achieve this was to develop a single tool which would allow the DPW to collect, organize and analyze condition assessment of public buildings. The results from this tool needed to serve two purposes. First is to provide information to better maintain the buildings in Quincy. And second, to provide information that can be used in a budget request to the City Council. The maintenance management tool developed for Quincy has four distinct components.

The first is a systematic method for data collection. Checklists that objectively examine all aspects of a room were created. These checklists require no prior knowledge of

building assessment and also take almost no time to learn how to use them. They also provide space in order to make comments about a room conditions that might be important to the person in charge of building maintenance.

The second facet of the maintenance management tool that was created is a Microsoft Access database. The database allows the answers of the checklists to be inputted in a very simple and time efficient fashion. Once answers from a checklist have been stored in the database, mathematic and logic operations are performed on the answers to calculate 1-5 (very poor – excellent) ratings for each room, floor and building. These ratings make it easy for DPW officials to quickly identify problem areas and investigate further.

The third component of the management tool is a set of Geographic Information Systems (GIS) map layers which interact with the Access database. These layers display the ratings in a color coded system. This makes it much easier for the DPW to identify which rooms, floors and buildings need improvement, allowing for quick understanding of where money must be spent.

The fourth element of the management tool is a photographic database that interacts with the Access database. The photographs are taken with a digital camera by whoever is also performing the condition surveys of the public buildings. This database allows the DPW to look directly at issues within buildings without having to travel directly to a site. The collection of images can also be used in reports and budget requests to the City Council. Photographs provide a medium for the DPW to explain to those outside the profession key problems with buildings.

After this maintenance management tool was created we used it to preliminarily examine nine buildings in Quincy and performed an in-depth examination of the Department of Public Works Headquarters. Our findings mostly serve as an example for future condition assessment but, some basic conclusions could be drawn from the amount of data we collected. The DPW Headquarters was given a 4 (good). The first floor was in excellent condition, in comparison to the basement in its current status is suitable only for storage.

The maintenance management tool created and the preliminary results were given to the Department of Public Works in Quincy. After completing the surveys and populating the database with the data collected. With this tool and it's different elements, the DPW is better equipped at handling the daunting task of providing quality public facilities to the people of Quincy.

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1 Introduction

For centuries, officials have been managing urban resources and properties. Public assets are often the result of capital investments from previous decades. As with all capital equipment, the city's real estate depreciates over the years and performance degrades. Renovation and proper maintenance of such properties demand that a city must have both the funds and desire to do so. Cities with successful building maintenance programs distribute their limited funds based on a priority system. The priority system is designed using concrete evidence about the city's public property and its specific needs. This requires that cities maintain accurate records on these community properties. Without accurate data on its own buildings and property, it is nearly impossible for a city to effectively allocate and utilize the funds for renovation projects and routine and preventative maintenance. It is a recognized principle that a properly maintained building will give a better service than an improperly maintained building and, in the long run, have overall lower cost to its owner.

Collecting and organizing accurate data on local buildings is a major problem for any city. The information collection process requires man-hours and money. Often, the capital management department in the city cannot spare such resources and the task goes unfulfilled. The city of Quincy, Massachusetts, like other cities, has formal and informal knowledge of the buildings it owns and operates. The Department of Public Works (DPW) oversees the maintenance of all public property in the city; collecting data on existing buildings has been postponed in favor of more important day-to-day functions. By spending its resources on present projects, instead of establishing a solid foundation of information for the future, the DPW is operating without effective future planning regarding the buildings for which it is responsible. In the long run, this will be a very costly decision

The DPW in Quincy does not have a systematic method for recording and storing data on its buildings. Any current information about the city buildings is either scattered amongst many city records or in the memories of the DPW workers. With no formal structure for storing public building data, the DPW is unable to most effectively plan future maintenance renovations. Instead, they are forced to react to problems as they happen. Fixing problems as they arise, the DPW uses many different companies to perform the repairs, even if the renovations are in the same building. The Department contracts out the maintenance tasks to the private sector. Another problem the DPW is experiencing is that there is no schedule for gathering information about the facilities in Quincy. Many records that may exist likely could be outdated and of limited use to the department. Without current and accurate data, the DPW is unable to arrange and implement large-scale systematic renovations to its buildings.

Thus far, we are the first team to commence planning a comprehensive maintenance system for the public buildings in Quincy. The DPW has recently been reorganized and is currently identifying areas that need improvement. One of those areas is constructing a data organization system for the buildings that the DPW manages. The next step is for the initial data to be collected and the foundations of a database created.

The purpose of the project is to take the first steps in solving the DPW's building management problem. We created a schedule for conducting a two-phase walk-through in each of the Quincy buildings. The first phase was to collect all the basic information of the building (address, square footage, use) and inventory all capital equipment within it. The information collected in the first pass was important because it will assist the DPW in performing preventative maintenance. By having access to the age and condition of the major components (roof, exterior, HVAC) in the building, the DPW will be able to predict when they will fail and replace them accordingly. The second pass comprised of analyzing the condition of its components. Conscious maintenance is when a department makes the conscious decision to bring a building up to a predefined condition or level. The DPW will be able to do this because the second pass has provided them with accurate condition assessment of the buildings. They can use this data to make financial estimates based on their maintenance goals. We then created a database that contains all of the pertinent information for each building. At the end of this project, we left the DPW with a rubric for conducting condition assessment in a building and a database that can be easily expanded to include every public building in the city. The database and rubric will provide the DPW with a solid informational base and data management tool. The information can be used to create a schedule for future maintenance and will demonstrate the extent to which the allocation of additional short-term funds, via budget increases, will save the city long-term expenditures that could prove substantially higher.

2 Background

Quincy, located to the immediate southeast side of Boston, wants to develop a more organized way to maintain public facilities. The Department of Public Works is looking to create a maintenance management system for about 20 buildings under public supervision. As the initiators of this project, we are charged with the task of creating this maintenance system. In order for us to achieve this goal, research into the mechanism of governance and budgeting of the city had to be done. A major part of this budget is invested in capital planning. We found past examples of capital planning and studied how they can be applied to our project. Also, information about the components of the physical buildings needed to be gathered in order to determine how to assess condition. After completion of the project, we were able to recommend a course of action regarding possible repairs. The final component to making this all work is the creation of a computer database to store and analyze data. The lessons learned in the different areas of investigation are presented in this chapter and allowed us to make well-informed decisions regarding the establishment of a maintenance system for Quincy.

2.1 The Components of a Building

The individual systems or components must not be ignored. The components inherent in any building are many and varied. The work involved in repairing and installing each component is as different as the function they serve. Since many of the individual systems are complex, there are specialty contractors who work on each system. In every system of the building, there are also sub-systems that make a component function. In order to accurately diagnose a building, we must look at not only the components of a building, but also the sub-systems of the components.

The exterior shell of the building is one of its most important aspects. It houses the building and provides protection from the elements. The exterior elements include systems such as the roof, the skin (or outer wall), drainage systems, and windows and doors. All of these must be kept up if the building is going to be able to stand the test of time. Without one of these items, water damage or extreme cold could damage or even destroy the building and its contents.

The roof is the first, and possibly the easiest, to assess. Put simply, if a roof leaks, it needs to be repaired. Other aspects to look at for the roofing are the framework underneath. If it has rotted away or if there is any sign of water damage or potential damage, it will need to be replaced or repaired. These are the kinds of things that affect not only the stability but also the protective quality of a roof.

The skin of a building is the outer wall. It is the next layer of protection after the roof. Protecting the inhabitants from wind and rain, the walls also provide insulation from the heat and cold. The skin also includes any shutters, paint or masonry on the outer wall. Its condition, both aesthetically and functionally is important to the well being of the building. It will also be important to note the type of wall, whether it is wood, metal siding, brick, or stone. This will aid in determining if there is any damage in terms of both structural stability and water damage.

Windows and doors also serve as both protection and portals to the outside, they must be able to be opened and shut. When shut, there must be a sealant of some kind that prevents water penetration. Windows and doors also serve as draft points for a house or building. Energy loss is becoming more and more important. One of the easiest things that can be done to save on energy costs is to install double or even triple pane glass. A double paned window can save as much as 35% heat loss (Sustainable Energy Authority Victoria, August 2001) when compared to normal single paned glass. This is a large amount of heat and money that can be saved by simply installing better windows.

The drainage system allows for water and waste to flow freely from both the roof and the outer area of the building. We must determine the flow of this system, when it was installed, what type of drainage system it is, and when it was last cleaned or maintained.

The next level system is the interior surfaces. Though a very small system, it is the part that all the inhabitants and workers of the building see the most. It includes all of the ceilings, walls, and floors. The type of interior usually dictates the lifespan of these parts. In the WPI Campus Center, stone tiles were used instead of linoleum because the "high traffic would deteriorate the linoleum in under a year" (McLaughlin, 2004). These parts must meet both aesthetic and structural quality levels. The floors and walls must all be tested for strength, and the beams and studs behind them should be inspected if possible.

The third and final level of systems is the utility systems. The utility systems consist of the components that help a building to actually function. Including everything from the heating, ventilation, and air-conditioning (HVAC), to electrical and plumbing, the utilities systems make the building able to operate on a day-to-day basis. Another utility system is the fire protection system.

These systems are constructed before the inner walls are placed. The wiring and piping that goes into any building is extensive. It must all be planned well. Electricians must anticipate where an outlet will be going as well as where one might go in the future. Much like a water delivery system for a town, there may be additions to the building later on and the ability for change to occur must be taken into account. The plumbing and electrical systems that are put in both must plan for such occasions. Because of this, the inner walls are never put up until the wiring or plumbing for that specific section are complete.

The electrical system in a building has some qualitative as well as some quantitative values. It must be known where the building gets its power from and who the supplier is. Also, it is important to know how many outlets and lighting fixtures there are, where they are, and what the quality of the outlets and fixtures are. It is important to know what the amperage and voltage of the building is. Also, it should be known where all the wires in the building run.

The plumbing in a building is much like the electricity in that there are qualitative and quantitative values. The source of the water and the company that provides it, as well as when service started, is important to note. A list of all spigots, faucets, sinks, and bathrooms and their locations must also be recorded and mapped. The quality of every spigot, faucet, sink, and bathroom must be ascertained and recorded. Because the piping is part of the sanitary system, it is one of the first to be put in, and must be maintained to keep health risks at a minimum.

A component that a person wouldn't normally think of would be the fire protection system. The fire protection system ensures the safety not only of the people in the building, but also of the building itself. In larger buildings the steel and framework is actually coated in a fire retardant material to deter heat and melting of the beams. A list of every fire alarm and sprinkler must be compiled for each building. Also, the nearest fire stations to the buildings and quickest routes must be mapped. All of these parts will determine the level of fire safety of a building.

Most of the parts of a building are fairly standard up to this point. The specialty systems are quite building specific, however. The specialty systems depend upon what the function of the building actually is. It could include special phone lines, service elevators, escalators or even just unique stairs. These items will need to be assessed and noted. A list of what is in each building, how many there are, and what state of repair is important and allows for quick knowledge of what is inside the building.

The components of a building are as varied as the sub-systems and components. A list of quantity and quality of all parts must be determined in order to figure out a weighted rank for the condition of the building as a whole. The building cannot function without its individual systems, and the systems cannot function without their sub-systems. To have a well running building, you must have well running parts, however small they may be.

2.2 Capital Planning

A city's budget can be spent in many different places. When dealing with municipal improvements, cost concerns arise at every corner because of the large expense of doing even the smallest project. Renovations and construction are two of the largest areas for money loss because of the price of these large expenditures on improvement. Buildings that are being looked at for renovation or new construction must be assessed and inventoried because of this.

Building maintenance is a difficult process that consumes much money from a city's budget. Before any building construction or renovation takes place, the owners of the building or land must present a budget for the proposed work and reasons for this work to take place. The usual reason for work is because of an inoperable or inadequate aspect of the building. In the case of a building, the owner will most likely hire out a consulting firm to do a survey of the particular component of the building in question. In the case of the Quincy Fire Station (March 2003), Brion Wynn hired Noblin & Associates, L.C. (Noblin). Per request of Mr. Wynn, the Noblin survey "included, but was not limited to, a close examination of the roof areas along with test cut extractions for analysis of construction methods and materials used".

In the process of a survey, the hired company must do background research into the building's original construction date as well as constructed materials (as best can be found through records). Also included in this research is a list of recent repairs and or construction work performed on the building. This gives the consulting firm an idea of what the problems may be and what has been done in the past to try to resolve these issues. A comprehensive walk through of the building, or in this case just the roof, is then completed, noting all flaws and problems as well as the different parts of the building. When a flaw is noticed, an estimated cost is also submitted for the repair or replacement of this problem. After a comprehensive analysis of the building, a report was submitted to Mr. Wynn, which included recommendations for actions to be taken. This submittal includes an estimate for the entire job and any other areas surveyed in the process. Also in the submittal is any information regarding violations of building code.

Through this process of outside consulting, a building owner can easily determine how much it would cost to replace or repair the section causing problems. Through recommendations, cost estimates, and building code violations, an owner can decide whether it is in the interest of the city to fix this building. In the case of this firehouse, it was necessary to replace the roof because of violations of the Massachusetts State Building Code. Having an outside consultant also provides an unbiased look at the problems of the building. Where a city can have its own people look at the problem, there may be biases inherent in their decisions. With an outside consulting firm, this will not be the case. For this reason, one of the parts of the project that we have is to come up with a checklist that is straightforward and has no semantics to be argued over. Using a method such as this will give owners a complete look at what their building has to offer, or what it lacks.

Capital planning is another important aspect of a city. Capital projects happen all the time in cities large or small. A capital project is defined as "a physical public betterment or improvement involving facilities, land, or equipment, with a substantial useful life and a cost of $10,000 or more" according to the City of Newton (October 2001). In the case of Newton, they also made requirements for the improvements. Any improvement to the city had to fulfill at least one of six criteria set forth by the mayor. These criteria include items such as enhancing public health and safety, reducing or stabilizing the budget, and improving the ability of the city to deliver services. At least this last item applies to the project we are currently undertaking. As it states to the Plant Facilities Handbook (1995), there are different types of work requests that can be filed. Emergency requests are diagnosed as work that needs to be done for the facility to continue to function properly. There are then standard work requests, which include small fixes such as doorknobs and hinges. The Handbook states that "major work requests are projects that involve more than one trade, contractor, and the apparent cost will exceed $500.00". This classification of requests allows the decision maker to be able to prioritize these requests in fashion. By taking care of the emergency requests, the facilities can continue functioning, which brings in money to allow for later requests to be finished.

The City of Quincy Department of Public Works (QDPW) has inadequate methods to deliver maintenance and repair to their buildings. This, in turn, affects the ability of these buildings to provide their services. By grouping these buildings as capital investments, the city can then allocate proper funds into the QPDW to fix and augment these buildings.

When a plan is made for capital renovations and replacement, there is a city budget proposal. This proposal includes past fiscal year budgets, expenses incurred, the new proposed budget, as well as other relevant information about money issues in the city. Looking at the proposed budget, the past year's budget, and debts still to be paid, the city will be able to get an idea of the total amount of money it has to expend and also what money can be apportioned to the building projects. Most cities make a plan for repaying all debts over a certain period of time.

A citywide inventory must be taken to know where all of the city's assets are located. This includes accounting for all vehicles, equipment and materials. Having information on these items gives a total cost of replacement. Also included in this inventory may be the buildings and even the streets. Accounting for every mile of street may be necessary when asking for funds to renovate sections of streets and sidewalks. Again in this case, knowledge of all prior work done to these areas is necessary to show problems that have arisen in the past and how serious problems can be stopped before they happen.

Estimates for all capital projects are given over a projected yearly plan. The City of Newton budget proposal called for a 5-year budget plan. This plan showed all purchases to be made over the next 5 years (starting FY03-FY07). This lets the city board members and public see exactly when and where the money is going. Also, by giving a yearly cost as opposed to a total 5-year cost, the city can allocate funds accordingly. For example, in the case of exterior doors in Newton, the Mayor is asking for $75,000 in FY03. This number includes replacing doors at the DPW and Police Garage, as well as citywide. In following years (FY04-FY07) the proposal only asks for $25,000 per year. Aware of these future lower numbers, the city decision makers may be more inclined to give the relatively high amount of money in the first year knowing that it would not have to spend as much over the following 4 years.

The City of Quincy in the year 2002 had a total budget of approximately $185 million. Of this money, only a portion goes to the Department of Public Works. The DPW has a number of departments underneath it. The one that we have been focusing on, the Building, Construction, and Maintenance (BCM) Department only receives about $1.5 million, which must cover maintenance and repairs of 29 buildings. Unfortunately, this number is small in comparison to the other departments. For example, the Sewer, Water, & Drain Dept. receives approximately $22 million. A third of this money for the BCM goes to what are referred to as just "expenditures" in the budget report. These expenditures include any of the raw materials that are used by the department to keep the city running. This includes energy bills, vehicular and custodial supplies, dues, and insurance to name a few. The personnel section of the budget takes another third of that money. The department cannot run with a large number of workers. In the city of Quincy 2002, there were 2600 employees both municipal and in the schools. The last third of the $1.5 million goes to the contractual projects. This is not much money at all when you realize that this is all of the work that gets contracted out to agencies outside of the DPW.

An average age of Capital equipment may also be taken to determine replacement stratagem. "Underground fuel tanks have a life expectancy of 15 to 20 years, according to E.P.A. and industry standards. All underground fuel tanks over 20 years of age are required to be replaced as of December, 1998, in accordance with a 1988 E.P.A. directive". Recording the dates that tanks and other equipment is installed is important because of laws such as these. By replacing the schools' fuel tanks, the city was able to bring its average age from 24 years down to 11 years of age, thus complying with E.P.A. standards.

The two processes described give an idea of what needs to go into the planning phase of building and repair. The survey of the building or land by an outside firm gives the city a clear estimate of what it would cost to perform the proposed work. The budget proposal will then provide concrete facts as to the feasibility of funding these projects. By looking at past work and/or problems in both cases, the city can see what needs to be done to improve the area and make it a better place for the public to live and better the city

2.3 Maintenance Systems

Making smart and educated decisions in regards to deferred maintenance of city buildings is not a new issue for city administrators nor is it a unique situation for the city of Quincy. According to Governing Magazine (2000), facility maintenance is referred to as, "The weak spot in capital management." The Department of Public Works in Quincy would greatly profit from incorporating computers into the delivery of maintenance systems. The systems possible for use could be as advanced or as simple as what is deemed necessary. Financial and manpower restrictions will also play a factor in determining the type of system that will eventually be used. Despite the wide variety of maintenance systems, their purpose would be to support the administration of Quincy in its need to make informed decisions.

There are two basic ways to view storing the information regarding the twenty buildings in Quincy. One way is to have a constant update of the condition of all aspects of the buildings; another is to have an update of everything that needs to be done to the buildings. Currently Worcester Polytechnic Institute uses the latter. Although effective, it does not accomplish all the goals that the Department of Public Works has for a system.

WPI uses an Access database that lists the repair jobs that need to be accomplished, how much they cost, and project what year renovations should be done. All the information is manually entered into the system with no automation. The database is on shared server space for the Plant Services department to use. This system meets the needs of WPI, but falls short of some of the goals of the DPW of Quincy.

Quincy needs to have current data on all aspects of public property. They also would like the system to perform calculations on the data. Quincy also needs a way to log past repairs. Unlike WPI, the DPW would like to classify their maintenance needs as either short term, long term, or preventative as well as delineate between renovations that will be accomplished by the DPW personnel and those that will be outsourced. An element of environmental consciousness is an issue that Quincy would also like to address.

Not only are there two basic ways to view maintenance systems, there are levels of complexity associated with the capabilities of a system. The technology used could perform rudimentary or elaborate functions, depending on what is deemed necessary.

A computer based maintenance system would increase the organization of day-to-day tasks. Fresno County, CA uses a relatively basic system to streamline and quicken the process of dealing with work-orders (County manages facilities 2002). Databases track assets, problems and the resources needed to solve problems. It also logs all activity about completed projects. Automating some of the communication between departments is another function of the software. This system is basic but is adequate for Fresno.

The ultimate goal of Quincy is to improve the delivery of maintenance services. Optimization of services should also be considered. Information technology systems can provide a wide range of resources for the administration of the Public Works department in Quincy. These systems can do more than just provide a list of problems occurring in public facilities. According to Matusheski (May 2001), the aim of an ideal system should be, "to strike a balance between cost and reliability." The basis of his system is highly evolved "neural networks" that act on enormous amounts of data collected from every possible aspect of whatever is being maintained. The purpose of such a complex system is to reduce the amount of resources used by deciding a monetarily sensible course of action. This type of system could be advantageous for Quincy in regards to routine maintenance and maintenance issues that can be forecast.

Sometimes component failures arise which are completely beyond the scope of prediction software. In situations like this, data collection must be performed on sub-systems, which are not normally reviewed. A computer system would have to be able to facilitate this. An ideal system would also have the ability to evolve from these types of component failures. Another factor, which Matusheski's systems fail to address, is emergency response. If a problem arises the most pertinent feature to the solution may be time, not money. Although the two are related, an in-depth analysis of a problem might restrict the response time to fixing a vital function.

Information technology systems in regards to public facilities can include thousands of different components that are tailored to whatever the needs of the managing body requires. The ability to accept, record, prioritize and distribute information for fixing problems is the minimum requirement for a database. Logging repairs and conditions of facilities can also help towards giving information to an administration so that they can learn from past actions. Having modeling and analysis software to predict component failure and offer prevention actions further increases the effectiveness of a maintenance delivery system. These systems are all based on the consequences of something breaking.

However, measuring success of building performance and value is not as effective as considering the fulfillment of purposes of an organization (Brackertz 2002). A higher level of operation for a computer-aided administration could be the ability to go beyond maintaining a facility. Using all of the information gathered in order to fix components, software could also make suggestions on how to improve components through the use of technology. With the longevity of capital assets such as buildings, technological improvements are bound to come out before component failure. Just because something may not need repair, doesn't mean that labor could not be performed in order to increase its performance. As technology evolves, it should be incorporated into existing facilities regardless of the state of a current system. Such steps could help in efficiency of energy, in addition to increases in service and environmental protection.

Prioritization is a significant aspect to any system. With the enormous amounts of data and courses of action presented to an administration, prioritizing what to do is essential. Pitt offers a suitable method for prioritization for forward maintenance (maintenance as a result of predictive problems). However, this simple method is applicable to all maintenance needs. The three basic parts of the scheme are to assess what needs to be done, organize which is most important, and implement a plan. The consequences of deferred maintenance also needs to be examined in each case as well as the costs associated with each job. By using software that helps in prioritization, the governing body of Quincy can more efficiently use their time and resources.

3 Methodology

From March 15 to April 30, our project teamed worked with the DPW in Quincy, Massachusetts. During that time period, our goal was to aid the DPW in the inventory and condition assessment of the components within the 29 buildings for which it is responsible. Providing the DPW with a systematic approach to building management assures both short-term efficiency and long-term minimization of expenses. The main objectives of our project were to design and implement the following tools for the DPW:

1. A Data Collection Process for Building Inventory and Condition Assessment;
2. A Functional Data Management System;
3. A Prioritization System and Recommendations for Future Courses of Action.

To create the tools listed above, we found that a cyclical process was needed. This process is shown in Figure 1.

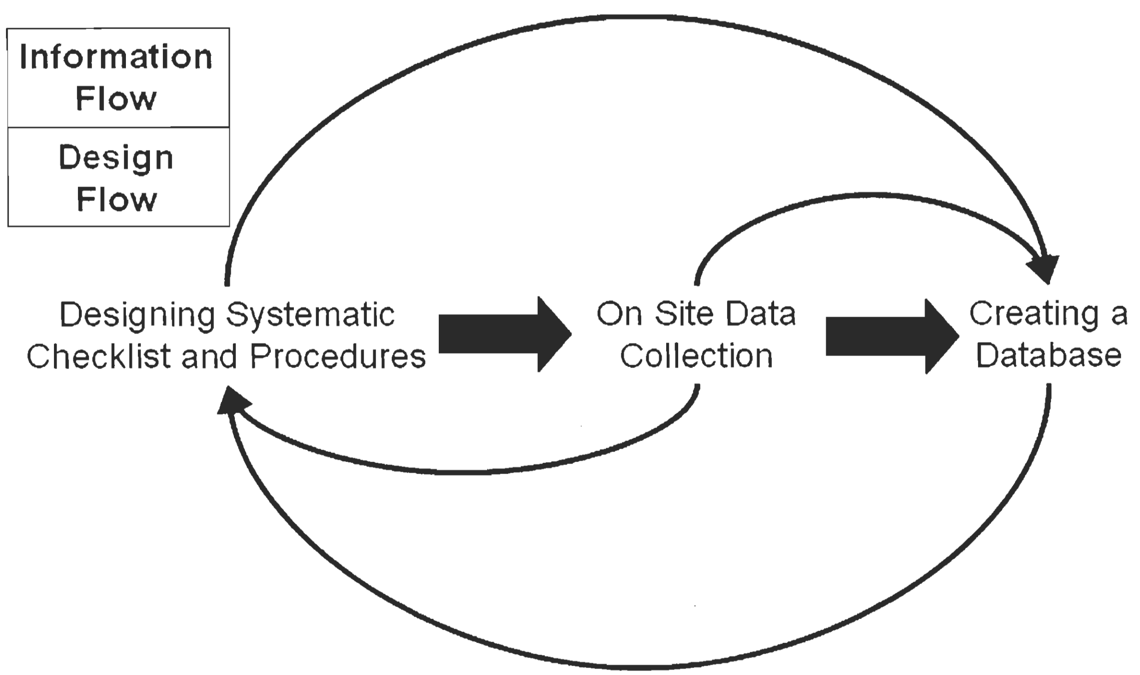

Figure 1: Cyclical Process for Completing Objectives

3.1 The Data Collection Process

Designing a data collection process for the DPW was the first step in our methodology. Like all design projects, this was a multi-step process. We identified the data to be collected, defined the checklists for collection, tested the checklists, and then updated the checklists to reflect any problems we found. This needed to be done for both the basic inventory and detailed condition assessment of the buildings in Quincy.

3.1.1 Basic Inventory

The first step in the data collection process was a basic inventory of the capital equipment in the buildings. This information needed to be collected to track the age of all of the equipment. Additionally, the basic contact information of the building needed to be collected. This information was used to form a basic description of the building and its contribution to the city.

3.1.1.1 Identify the Target Data

When designing the data collection checklist for the basic inventory, we were forced to consider which information was most important to the functionality of the building. We also needed to identify basic information about the building that would be useful for the DPW to have. We designed the process to conduct condition assessment on all of the major capital equipment as well as collect basic information to form a building description.

The purpose of the building description is to provide the DPW with all of the basic contact and building information that it needs. The building description will also be used for prioritizing the building maintenance needs based upon a building's age and contributions to the city. The basic information that was included in the description was the building's name, code to be used in the database, address, main phone number, director name, square footage, and room count. We also included a brief description of the service provided by the building and pictures of the building as it is seen from the street.

The capital equipment in a building is among the most expensive components contained in it. Since these components are so expensive, it is important that an assessment of their condition be performed during the inventory process. To address this assessment, we designed condition assessment checklists that can be used for the utility rooms, roof, and exterior of any building. These checklists were used to perform accurate assessment on all major HVAC (ie: boilers), exterior, and roof components. We also included a datasheet for recording all information on the faceplates of the major HVAC units. By performing an inventory and condition assessment on the major capital components of the buildings during the basic inventory process, we were able to provide a basic description of the condition of the buildings without performing a lengthy assessment.

3.1.1.2 Define the Process

The greatest challenge that we faced when designing the process for condition assessment was that it would be used by an unpredictable number of users. It needed to be designed so that the results would be the same for any person using it. To do this, we designed the process to collect only hard facts and information. By asking the user specific questions about the equipment, instead of asking them to assess the equipment, we were able to create an accurate system for condition assessment. Once we had designed a basic checklist for all systems, we created a specific one for the utility rooms, roof, and exterior of the building.

The capital equipment is the most expensive part of any building and must be both assessed and catalogued. After looking at the floor plans, we made a list of the rooms that appeared to contain mechanical equipment, electrical or telecommunications closets, or pump rooms. This equipment is essential for the building to function. After making a list of the different rooms we needed to look at, we made our walkthrough of the rooms. By using the checklists that we made for the specific utility rooms and closets, we filled out the checklist for each of the rooms, which then were put into the database. For all of the equipment in the rooms we recorded the model numbers and serial numbers and all of the information that we can get off of the serial plates.

For assessing the roof of each building, we had to both study the plans available and get onto the roof. By studying the plans, we were able to determine what the roof was made of and what style of roofing it was. The area of the different types of roofs (if any) was also figured out from the plans. After we looked at the plans for the buildings, it was necessary to go up on the roofs and check out all of the equipment on the roof. We made a checklist for the roof that included an assessment of all the equipment, the electrical components, and the condition of the roof. For the equipment on the roof, we completed the same process as with the utility rooms and recorded all of the serial information and model numbers.

We made a checklist for the exterior of every building to include the electrical components, capital equipment, plumbing, emergency systems, and the shell of the building. The checklist for the exterior was made by talking with Mitigation Manager Wynn and seeing what he thought was important and also by walking around the buildings. By talking with Mr. Wynn we were able to make a preliminary list of items to look for. After forming this list, we walked around the buildings looking for the items on Mr. Wynn's list and for other items that he may have missed.

3.1.1.3 Testing the Process

After designing the initial checklist, it was important that we test the process for accuracy. To do this we performed the data collection process ourselves. We were able to test the checklist for accuracy by conducting the inspections individually and then going over our results. This testing also helped us identify any components or systems that we had overlooked and include them in the checklists.

During the design process, it is not uncommon for a team to test their product numerous times before they view it as satisfactory. We found that our data collection process required testing in numerous buildings. We also discussed the checklists with our advisors and liaison to gain their insight.

3.1.2 Detailed Condition Assessment

The second step in the data collection process was a detailed condition assessment of all components and rooms in the buildings. This information was then used to form an accurate description of the overall condition of the buildings in Quincy.

3.1.2.1 Identify the Target Data

The detailed condition assessment needs be performed in every room of the buildings. This is a time consuming task and is one that our group could not complete during our 7 weeks on site. We did design a process to analyze the numerous types of systems within a room and numerous types of rooms within a building.

We started by identifying the types of rooms within a building. By creating different checklists for different rooms, we were able to make the checklists more concise and accurate. For example, it wouldn't make sense for us to include components such as toilets in the checklists for an office room. We identified the major room types as private office space, open office space, storage, general public, bathroom, and stairwell/elevator.

Next, we identified the different systems and components that can be found in each type of room. Many of the systems can be found in all rooms. These systems include the electrical, interior envelope (walls, ceiling, floor), fire protection, and basic HVAC (vents and heaters). Other systems can only be found in certain rooms. These include the more complex electrical systems (circuit breakers, transformers) and plumbing.

3.1.2.2 Define the Process

Just like with the capital equipment, the greatest challenge that we faced when designing the process for condition assessment was that it would be used by an unpredictable number of users. It needed to be designed so that the results would be the same for any person using it.

The first part of the data collection process was to observe the equipment with the staff of the buildings. These employees are the people who work with the building components on a daily basis. They know what components are most important to the building and how fragile or durable these components are. We also performed many walkthroughs with Brion Wynn. By watching him work with the components, we were able to create a list of visual clues for each component. These clues were helpful in creating a condition assessment process.

After we compiled a list of visual clues and created the checklists for condition assessment, we started to walk through the library and observe its components. During this inspection, we worked on calibrating the group's observation skills and refining our lists. To check the accuracy of our results, we met with our advisors and Brion Wynn numerous times to share our observations and discuss our results. By working with them, we were able to create a data collection process that we feel can be used by anyone to perform accurate condition assessment.

Once we had created a condition assessment process that could be used for any room, we decided to modify it for individual types of rooms. We modified our original checklist to create 6 new ones for the different types of rooms that we found in the library.

This made the checklists more concise and manageable for the person performing the walkthrough. A copy of our original checklist can be found in Appendix B.

For the electrical equipment, it was important that we inventory the different types of lights and outlets in the room. This can be used to calculate the power being supplied to the room. We also needed to include questions on the number and amount of wires exposed or stripped.

The interior envelope consists of the walls, ceiling, and floor of a room. To perform condition analysis on these components, we asked the user to note the location of any major damages. We also included specific questions regarding the percentage of the interior water or physically damaged.

The fire protection equipment in the room was the most difficult to assess. Since testing the equipment would greatly inconvenience the people in the building, we could only perform an inventory of the equipment. For condition assessment, we assessed the availability of the equipment, rather than the functionality of it.

For the basic HVAC units in the rooms, we inventoried the number of vents and heating units. We also included questions in the checklist checking for blockage of vents and a testing procedure for the thermostats.

Lastly, for the plumbing systems, we inventoried the faucets, drains, and toilets in the room. We also included questions regarding the number and severity of any leaks and the condition of the piping.

3.1.2.3 Testing the Process

Much like the inventory, it was important that we test the checklist for accuracy. To do this we performed the data collection process ourselves. We were able to test the process for accuracy by conducting the inspections individually and then going over our results. This testing also helped us identify any components or systems that we had overlooked and include them in the checklists.

We also had to test the checklist numerous times before we viewed it as satisfactory. We found that our process required testing in numerous buildings. We also discussed the process with our advisors and liaison to gain their insight.

3.2 The Data Management System

Once we had collected the data regarding the building conditions, we needed to create a tool to manage the information for the DPW. This database serves four main functions. It stores the basic information of the building, analyzes the hard data, calculates the building ratings, and displays these ratings in a useful way.

3.2.1 Constructing the Database

There are three basic components to the capital maintenance management tool. The first is an Access database, which stores all of the information related to all of the cataloged items and general information about the buildings in Quincy. The second aspect of the tool is GIS layers to display visually some of the information in the Access database. The final part of this administrative tool is a collection of pictures for Brion Wynn to have a better understanding of a specific problem as well as have a collection of images to use in reports and presentations to other people. In Figure 1 these three components are depicted, anything related to Access is outlined in blue; red denotes the graphics database and the GIS system is colored in gray.

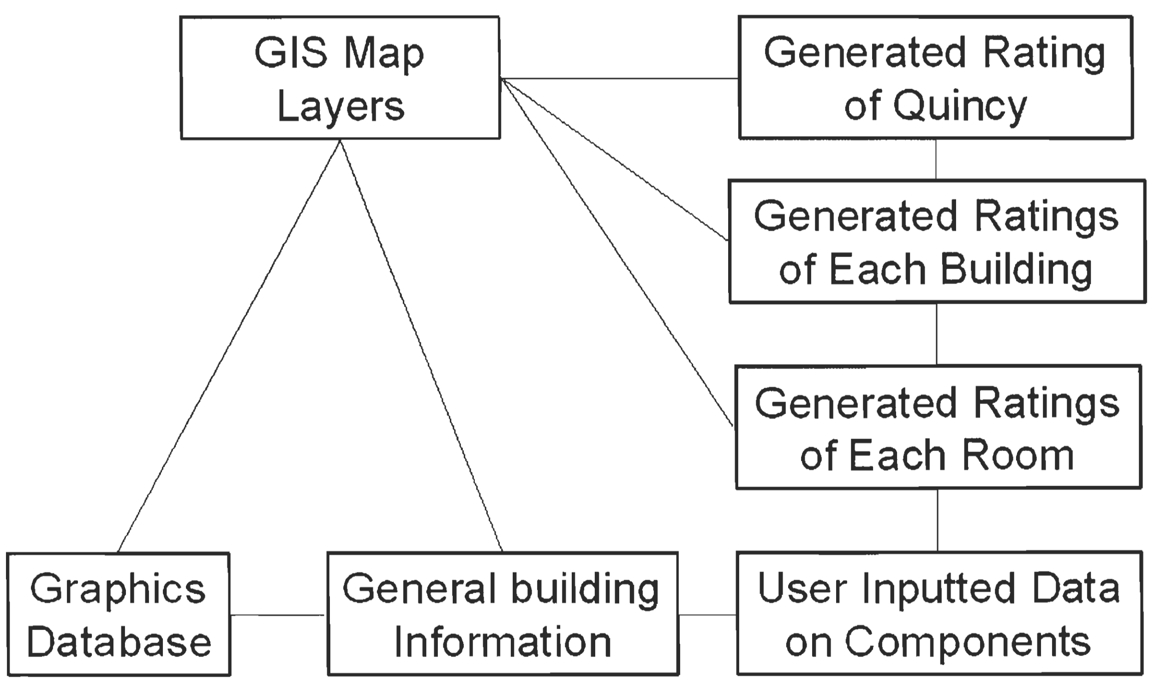

Figure 2: Database Structure

All of the information collected regarding condition assessment to be stored in a highly organized fashion. This was accomplished by using Microsoft Access. An Access database was created because it has a relatively simple and intuitive interface while still having powerful archiving abilities. Another important factor is that Access easily works with MapInfo, the GIS mapping software used on this project. Both of these reasons led us to use Access.

The database has two basic types of information stored in it. The first is user-inputted data and the second is generated data. User imputed-data is information that was collected by the inspectors who are performing condition assessment. For our purposes we used ink and paper checklists while on site, then inputted that into the database by use of a form. A form is a feature of Access which allows someone with almost no computer experience to add information to the database without disturbing other information. It also allows someone who is not specifically knowledgeable of how the database functions to add information. Generated data is the data that is extrapolated from the user-inputted data. This will be discussed later in the analysis section.

The graphics database is a simple collection of images with information about the image attached to it. This would allow the users to search through images and find ones suitable for inclusion in a report to illustrate specific conditions. The information that is attached to the image is the building name, the name of the item in the picture and the year the image was taken. This information is attached to the image by use of a naming convention. All the images are located in a folder and named according to the convention. Using a Windows file search, Brion Wynn can turn up results for whatever he is looking for. There are also links in the Access database to the picture files, which are related to whatever is in the database.

3.2.2 Displaying the Results

Geographic Information Systems (GIS) is a method of mapping information about buildings and cities. The program MapInfo is one such piece of software. MapInfo allows users to create a visual aid for cities and buildings to display information. By using what are called "layers", one can see how some aspects of a city (for example, population density) interact with others (for example, traffic flow). By seeing all of this information mapped out, we can see how they will affect each other.

In our project, we worked with MapInfo (GIS software) to develop a map that contains all of the buildings the DPW is responsible for. Using MapInfo, we were able to display these buildings so that they stand out from the others in the Quincy Area. This was the base for all of the other work that was done in MapInfo. This basic layer gave us an overview of where all the DPW's buildings were. It also gives people who are not familiar with Quincy an idea as to the layout of the city and its infrastructure.

Having already created the Microsoft Access databases, we attached them to the layer. This created a link between our database and the map. In this way, we were able to graphically show how many rooms there are, what size the building is, or even what condition it is in. Since MapInfo reads in exact measurements, information like square footage and distances are easy to ascertain with a few simple commands in the program. Also by linking them, we were able to update the databases with the information from MapInfo.

By clicking on each building, MapInfo displays the information that we entered into the database. We created multiple databases within each other so that the information linked with each building on the map can be shown in different levels of depth. The information retrieved from the databases and from MapInfo is then show in graphs and charts on the map layer.

4 Results

The results of this project fall into two categories. The first is deliverables, these are the tools we created in order to perform condition assessment. The second are the actual condition surveys themselves. These surveys were conducted in the DPW Headquarters and the data collected was entered in the database and used to test it. Without the initial tools, there would have been no way to perform condition assessment. The deliverables consist of the checklists the Access database and the GIS map layers. The condition surveys are the checklists that have been taken to sites and completed.

4.1 Condition Assessment Tools

The main parts of our results were the two condition assessment tools that we designed for the DPW of Quincy. We created a formal process for collecting the building information that is imperative to condition assessment and a data management tool that analyzes and displays the data. After we had designed the process and database, we conducted a survey of the DPW Headquarters. This served two functions; it allowed us to test the functionality of our process and it provided us with a solid example to use when making our recommendations.

4.1.1 The Data Collection Process

As discussed in the Methodology, the data collection consists of two steps. The first pass is to collect the basic contact information for the building, as well as collect data on the roof, exterior, and utility rooms. The second pass is consists of following a detailed data collection survey in every room in the building.

The first pass of a building consisted of collecting the main contact information for the building and completing the data collection checklists for the exterior, roof, and utility rooms of the building. We were able to visit and complete this process in 9 public buildings in Quincy. The first pass checklist for the DPW Headquarters is shown in Figure 3.

First Pass Inspection	
Inspection Date:	4/26/2004
Inspector:	Erik, Ed, Ian
Building Name:	DPW Headquarters
Building Code:	DPWHQ
Address:	55 Sea St.
Phone Number:	(617) 376-1900
Director:	Jay Fink
Square Footage:	
Room Count:	
Building Use:	Department Offices and Public Works Staff
Street View Picture:	C:\My Documents\DPWHQ.jpg
Utility Room Checklist:	completed 4/20/2004
Roof Checklist:	completed 4/20/2004
Exterior Checklist:	completed 4/20/2004

Figure 3: First Pass Checklist from DPW Headquarters

We were also able to complete one second level data collection pass. This consisted of completing a detailed condition assessment data checklist described in the Methodology. A copy of the complete checklist is shown in Appendix B. The results from this detailed assessment will be displayed below.

4.1.2 The Data Management System

As described above, the data management system was designed to store, analyze, and display the data collected using the tool described above. The data management tool is the most important tool that we created because it converts the complex data collected above into a usable numerical rating.

With regards to the first pass in the data collection process, we were able to complete many of the buildings. Through in-depth research in the DPW records, we were able to access the main contact information of all of the public buildings in Quincy.

We were also able to visit the sites of 9 buildings and perform data collection process on the roof, exterior, and utility rooms of these buildings. As discussed in the Methodology, these components are the most expensive in a building and can be used to give a rough estimate of the buildings condition. The data collected during these visits was entered into the database. The results from this data collection can be viewed in GIS. We have included a GIS layer in our database. This layer displays the public buildings that have been analyzed. The buildings have been colored to represent the condition of the building.

Figure 4: 9 Completed Preliminary Pass Buildings

With regards to the second pass of the data collection process, we were able to complete one survey on the DPW Headquarters. We collected detailed data regarding the condition of the building and entered it into the database.

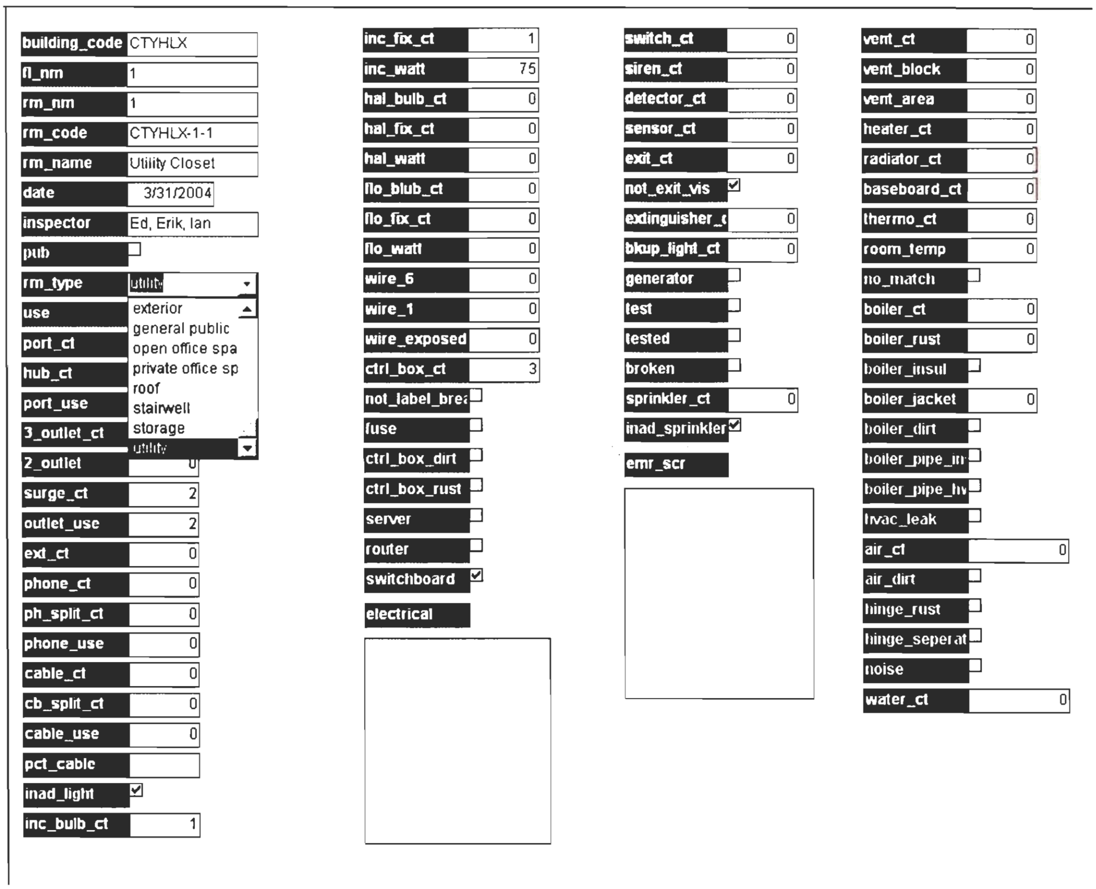

Figure 5: View of Data Entry From

We also imported a digitized copy of the buildings blueprints into GIS. This allowed us to create a layer for every floor of the building. These layers contained every room in the building. By using these layers, we were able to display the condition of every room in the building. Each room was displayed and colored to represent its condition.

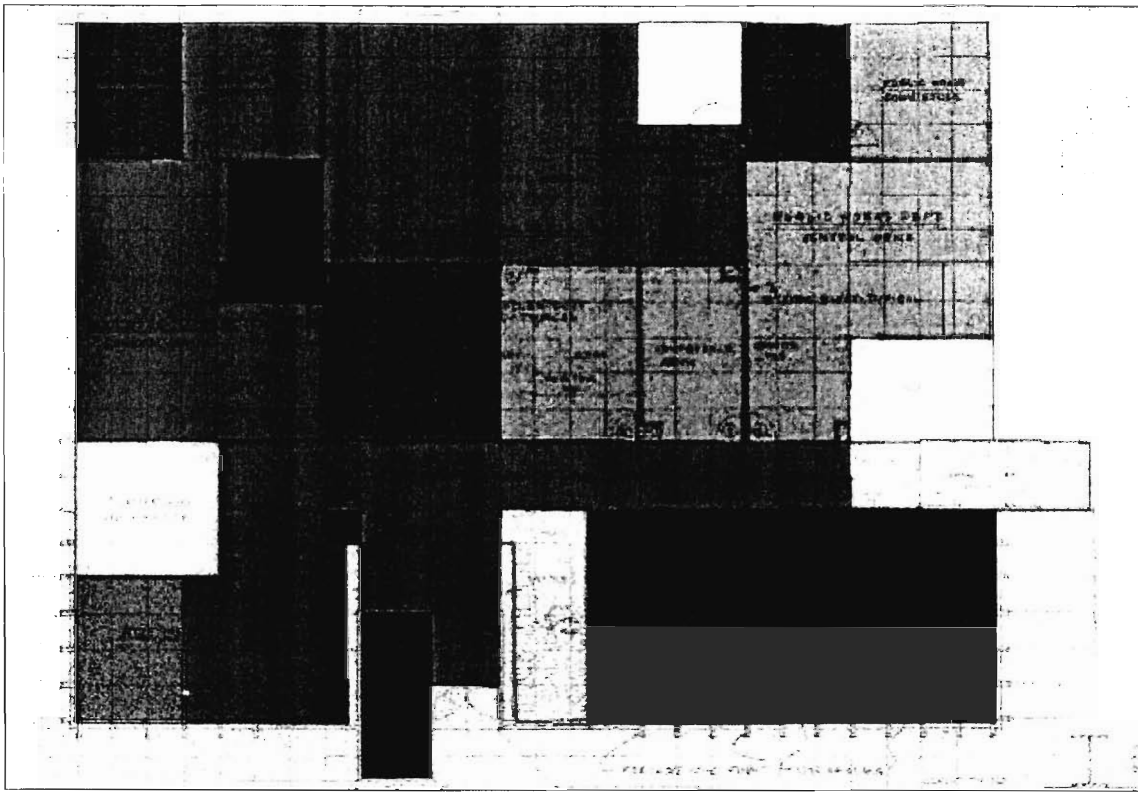

Figure 6: GIS Layer for First Floor of DPW Headquarters

In addition, the display can be changed to represent the condition of systems within the room (ie: Electrical, Interior Envelope). This makes it easier for the user to see which major system is responsible for a low room rating.

4.2 Condition Assessment of DPW Headquarters

As discussed above, we performed a detailed condition assessment of the DPW Headquarters. This provided us with a test case for our system. We were able to input data regarding many rooms of the building into our system and then analyze the results. This building serves as a perfect test of our system because it is the building that Brion Wynn knows best.

The results of our test building consisted of a checklist completed for every room in the building. These results are too detailed to be of any great importance without filtering them. The process used to filter these results is described in the Analysis section.

The result from this analysis is a series of GIS layers that present the data in an easy to read map. These layers display the buildings in Quincy and the floors and rooms of the DPW Headquarters.

The first GIS layer consisted of all of the public buildings in Quincy. It displayed all of the buildings and their conditions ratings. These ratings were shown using various colors.

Figure 7: Building Rating Overview - DPW Complex

There is also a second set of GIS layers that can be used to view the results of our condition assessment of the DPW Headquarters. These layers are used when the user would like to view a more detailed assessment of the building. They consist of a layer for each of the floors in the building and a layer for the roof. This allows the user to view the condition of each room individually. The user also has the option to view the condition of an individual system within the building. This is can be seen in Figure #8.

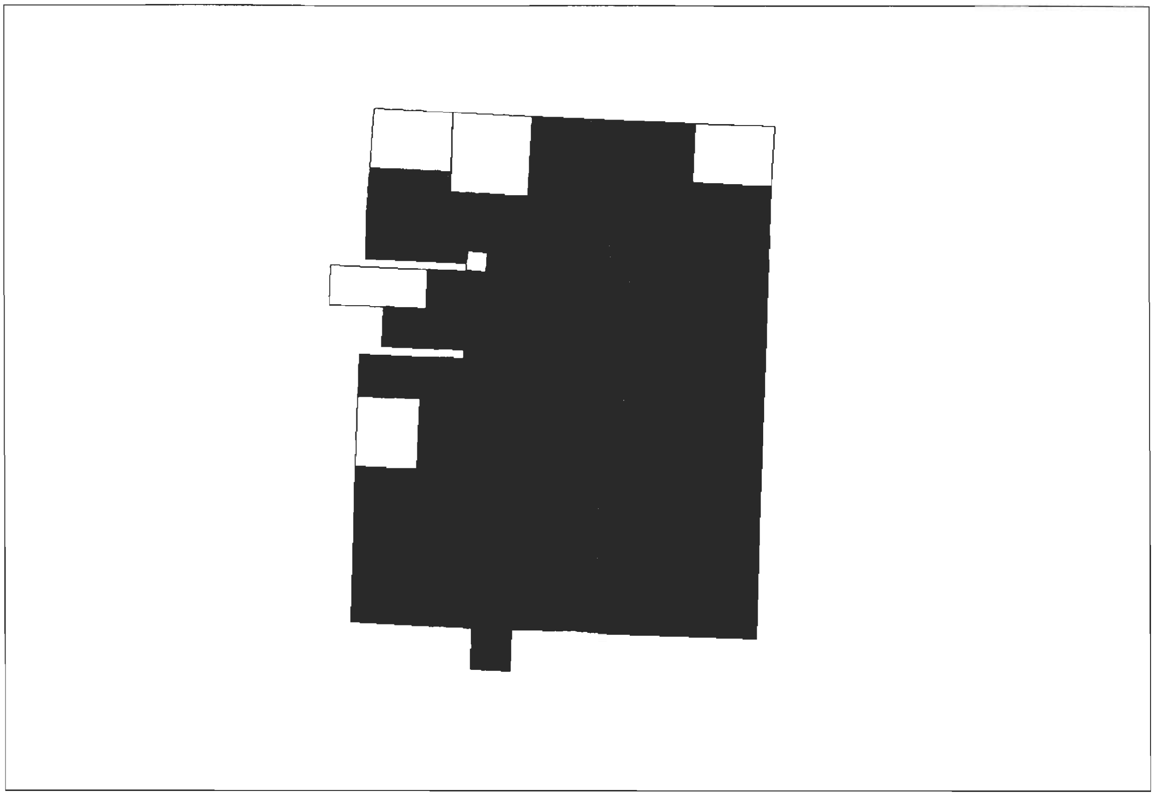

Figure 8: Rating by Room - DPW headquarters

5 Analysis

The information that was collected during the data collection process is too complex to be directly used by the city of Quincy. It is very specific to the buildings and is very in depth. By creating a rating system based off of this information, we were able to provide a functional way for analyzing and presenting the data regarding the condition of the buildings. This approach made it easier to summarize the condition assessment performed on the buildings and displays the results in a user-friendly database.

5.1 The Rating System

All condition analysis was done through a numerical ranking scheme. Using the visual clues described above, we were able to assign a rating to a component. The definitions of the ratings are different for each component and based on the visual clues found in our checklist. The numerical ratings were loosely defined as follows:

1: Very Poor;

2: Poor;

3: Satisfactory;

4: Good;

5: Excellent.

By defining a ranking scheme that can be used for all components, we established some consistency in our project. Designing the scheme using clear yet open-ended definitions provided us with the flexibility that we desired at the start of this project. The ratings are based on facts collected from the surveys that are performed on the public builings.

The rating scheme for the individual components of a building lays a very solid foundation for determining the overall quality of the building. The next step in providing a solid analysis of the building was to implement a weighting system. This process assigned ratings to the subsystems within a room, based upon the ratings and importance of their components. These ratings were then used to determine the overall condition of the room. For example, when we determined the quality of the electrical system within a room, we decided that adequate lighting and outlets were much more important than having a fuse box in each room. A numerical weight was applied to the ratings to indicate this. Since the subsystems are constant throughout each building, we were able to keep these weights constant throughout all buildings. We assigned the weights to each component based upon a percentage of importance that we had determined.

After we had determined a rating for each subsystem, we needed to determine an overall rating for the room and building. This was done using the same approach as the weighting system described above. The only difference is that we could not apply constant weights throughout all buildings. Since the importance of a subsystem to a room varies from room to room, we needed to consult Brion Wynn when deciding the weight for the subsystems. Using the same percentage of importance, we were able to determine the overall condition of the building based upon the rooms within it. A table of the weights used for each type of room can be scene in Appendix C.

5.2 The Data Analysis

Generated data is the data that is extrapolated from the user-inputted data. This corresponds to the rating system developed by the team. This is the data that Brion Wynn is most interested in because it gives him the analysis of a building without having to know the specific details of its particular components. The ratings from the buildings are calculated from the facts collected during condition inspection. The facts are processed through logic components and mathematical functions, which produces a raw rating for each system. The raw ratings for each system are then weighted and combined to produce ratings for each room. This method is then repeated with the room ratings to determine and overall rating for each building, then again to determine a rating for Quincy as a whole. The weightings were derived from a discussion within the group as well as a meeting with Brion Wynn. Having varying levels of resolution for the condition of buildings is beneficial to Brion Wynn because by looking at an overview of the city, if something appears suspicious, he can investigate specific rooms and components.

Brion Wynn can view the ratings of each building or room in two distinct ways. He can view it in an Access report, or in a GIS map. An Access report is a document that is generated by the program using the information in the database and displaying it in a sorted, aesthetic way. This way Brion Wynn can view specific values without having to scan through hundreds of values in which he is most likely is not interested. Figure 5 shows a screen shot of an Access report that indicates room rating and the last time it was inspected.

Room Rate and Inspection Date

Building Code	Room Code	Room Rating	Date	Inspector
CTYHLX	CTYHLX-1-1	4.6494	3/31/2004	Ed, Erik, Ian
CTYHLX	CTYHLX-2-2	4.6494	3/31/2004	Ed, Erik, Ian
CTYHLX	CTYHLX-3-3	4.6494	3/31/2004	Ed, Erik, Ian
CTYHLX	CTYHLX-G-4	4.9135	3/31/2004	Ed, Erik, Ian
CTYHLX	CTYHLX-G-5	4.89715	3/31/2004	Ed, Erik, Ian
CTYHLX	CTYHLX-E-6	4.769	4/8/2004	Ed, Erik, Ian
CTYHL	CTYHL-3-7	4.87645	4/8/2004	Ed, Erik, Ian

Figure 9: Access Report View

6 Conclusions

The main purpose of our project was to create a tool that the city of Quincy can use to improve the condition of their public buildings. Our data management system has been designed to flexible. This makes it very useful to the city of Quincy. It can be used to store contact information and perform the calculations for condition assessment, like we outlined earlier. The condition assessment data is especially useful to the city of Quincy. It can be used to perform conscious maintenance and preventative maintenance. By incorporating these maintenance practices into their current maintenance system, Quincy will be able to greatly upgrade the condition of their public buildings.

6.1 Conscious Maintenance

Conscious maintenance is a building maintenance practice that would be ideal for Quincy. The idea behind conscious maintenance is to provide cost estimates to the better allocate the funds provided to building maintenance. The goal of conscious maintenance is to improve the overall quality of the city by improving the unsatisfactory areas in the buildings. By tracking the condition of their buildings, the city can identify areas that need improvement. The city then makes the *conscious* decision to upgrade these areas and sets realistic goals to do so.

The most important part of conscious maintenance is having accurate and detailed information regarding the buildings in a city. This makes our data management system a perfect tool for integrating conscious maintenance into the Quincy DPW. Our tool will allow the DPW to quickly identify the need areas in Quincy and allocate the funds to those areas. The tool will also allow the DPW to work more closely with the City Council during the budget process. Commissioner Jay Fink will be able to present the City Council with a GIS map (described above) displaying the condition of all public buildings. The City Council can then work with Commissioner Fink to identify areas of need and allocate the funds to improve them.

6.2 Preventative Maintenance

Preventative maintenance is based off of the idea that allocating funds to fix minor problems now will prevent major problems in the future. By upgrading the components of a building before they break, the city will be able to gain more use out of them and save money in the long run.

The data management system will be useful in implementing preventative maintenance in Quincy. The information gathered during the preliminary building inventory will facilitate this process. By gathering the installation dates of all the major components within the building, we have provided valuable to the DPW. By comparing the age of a component to the average lifespan of that component, they can estimate when it is going to fail and allocate the funds to replace it before it fails. They can also use the condition assessment of the utility rooms to perform preventative maintenance. By observing the conditions of the room and the minor components within it, the DPW can spend money to upgrade the conditions and increase the production of the components within it.

7 Recommendations

After completing our 7 week project in Quincy, Massachusetts, we have found that there is more work to be done with regards to building maintenance. This work involves expanding and continually updating the database, as well as increasing its flexibility by adding more tools to it.

7.1 Expanding the Database

During our 7 weeks in Quincy, we were not able to conduct the data collection process in all 28 of the public buildings. 19 buildings need to have the preliminary inventory performed in them and 27 need to have a full assessment performed in them. This work can be done the custodial staff within the buildings our by students hired as summer interns by the DPW.

We also recommend incorporating the public schools into the database. Given the recent changes in the Building, Construction, and Maintenance hierarchy, it will become very important that the information regarding the school be included with the other buildings.

7.2 Updating the Database

The data management system that we have designed is a powerful tool, if used correctly. It will need to be continually updated with new information regarding the condition of the public buildings in Quincy. The condition of these buildings will change with time and it is important that the DPW establish a schedule for collecting data within them. This will ensure that the DPW is always working with accurate information.

7.3 Adding More Tools

Although effective, the maintenance management tool could be more efficient. One aspect that could streamline the process would be if the information could be directly inputted into the database through a PDA used on site as opposed to recording it with pen and paper and then entering that information into a database. Another way streamline the process would be to have it interact with some of the HVAC diagnostic tools that are already in place on some of the buildings.

As well as providing more pathways to make the database more efficient other tools that operate in conjunction with the current database could be created. Using the condition assessment database, a repair log could be created that not only keeps a record of repairs but forecasts repairs that will need to be performed in the future. Coupling this information with maintenance costs, dollars amounts can be given to each possible repair. This information would be useful in preparing yearly budgets as well as determining courses of action regarding renovations and construction projects.

Improving the lines of communication is another way to improve the effectiveness of a capital asset management tool. A database that organizes contractor information as well as tracks there past interactions with Quincy would be a tool that could greatly benefit the city. An online method for transmitting, receiving and organizing work orders would also be of great help to Brion Wynn. This type of system would make it easier for him to have a better understanding of the most current building conditions and would make his response time to certain problems quicker.

Streamlining data collection for the database, adding features that take into account costs and improving lines of communication are all the maintenance management tool could be improved.

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Subject: Computer filing systems in Fresno.
Relevance: Doesn't go into detail and it is not a very modern system but it useful for the county's purposes.

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9 Appendix A: Quincy Department of Public Works

The city of Quincy, Massachusetts was established in 1792 when the northern part of Braintree split off to form its own town. Located south/southeast of Boston, Quincy has been one of the largest cities in Massachusetts since the 1940's. Over the past 60 years, it has seen its population fluctuate between 75, 000 and 88,000, peaking during the 1970's and 2000's. With such a large population, the job of the DPW has become or maintenance oriented. Aged buildings, such as the fire department, police station, and DPW headquarters, require routine maintenance as well as renovation to repair damage caused by aging. With a constraining annual budget, this has proved to be a difficult task for the city of Quincy.

"Measure twice, cut once" (Salters, September 9, 2002). This is the new goal for the Department of Public Works (DPW) in Quincy, Massachusetts. Massive layoffs and reduced town revenue have decimated the budget of the DPW and have forced Commissioner Jay Fink to plot a new course of action. With a major reorganization of the Department underway, disagreements have broken out between the mayor, city council, and DPW as to how the Department can stay within budget and still provide the best service to the people of Quincy. Recently, the DPW has turned to more efficient methods of gathering data and planning services in an effort to garner more resources.

The DPW in Quincy is currently in the middle of a re-organizational period. Many positions within the department hierarchy have been vacated through budget cuts or retirements.

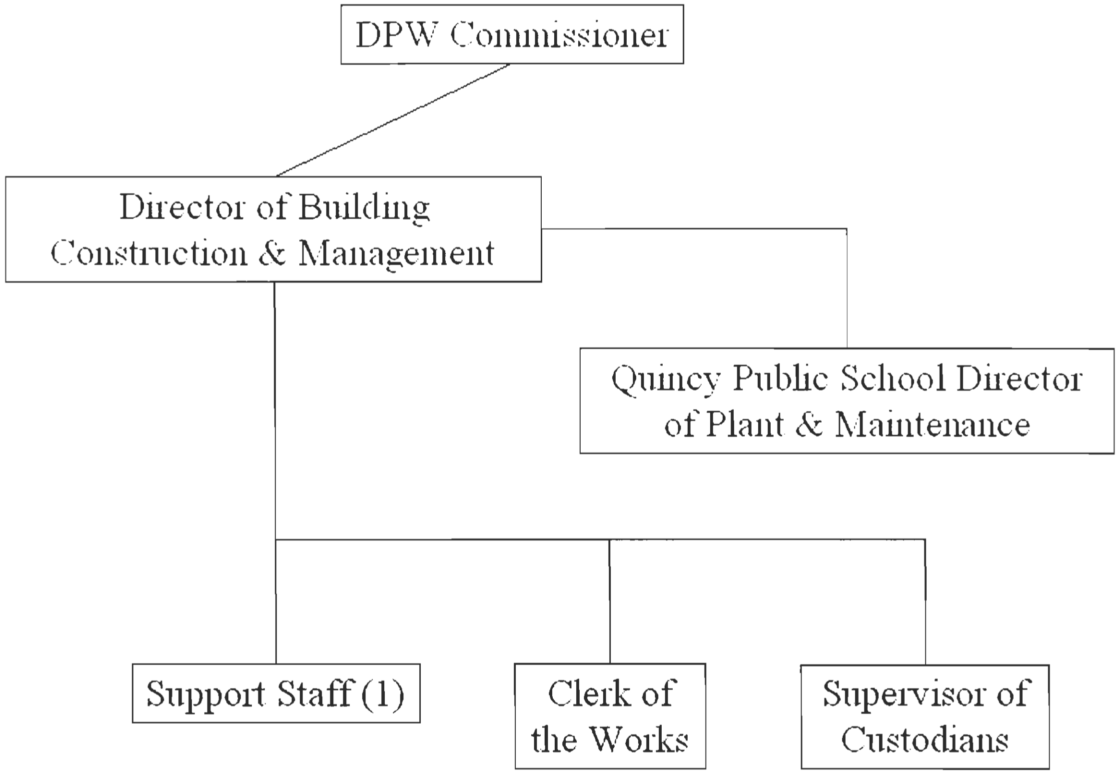

Figure 10: Past DPW Organization Structure

Since the department is forced to operate with many important positions left unfilled, they have had to delegate extra responsibilities to some people. An example of this situation can be found within the Building Construction and Maintenance division. Mitigation Manager Brion Wynn has been given extra responsibilities and is currently acting as Director of Building Contruction and Maintenance. This is an unsatisfactory solution as it forces one man to fill two very important positions and under staffs the Building Construction and Maintenance division. To solve this problem, the DPW Commissioner has proposed a new structure that will reassign some responsibilities and fill many of the vacated positions. His current plan was not accepted by the city council because of salary limitations in the annual budget.

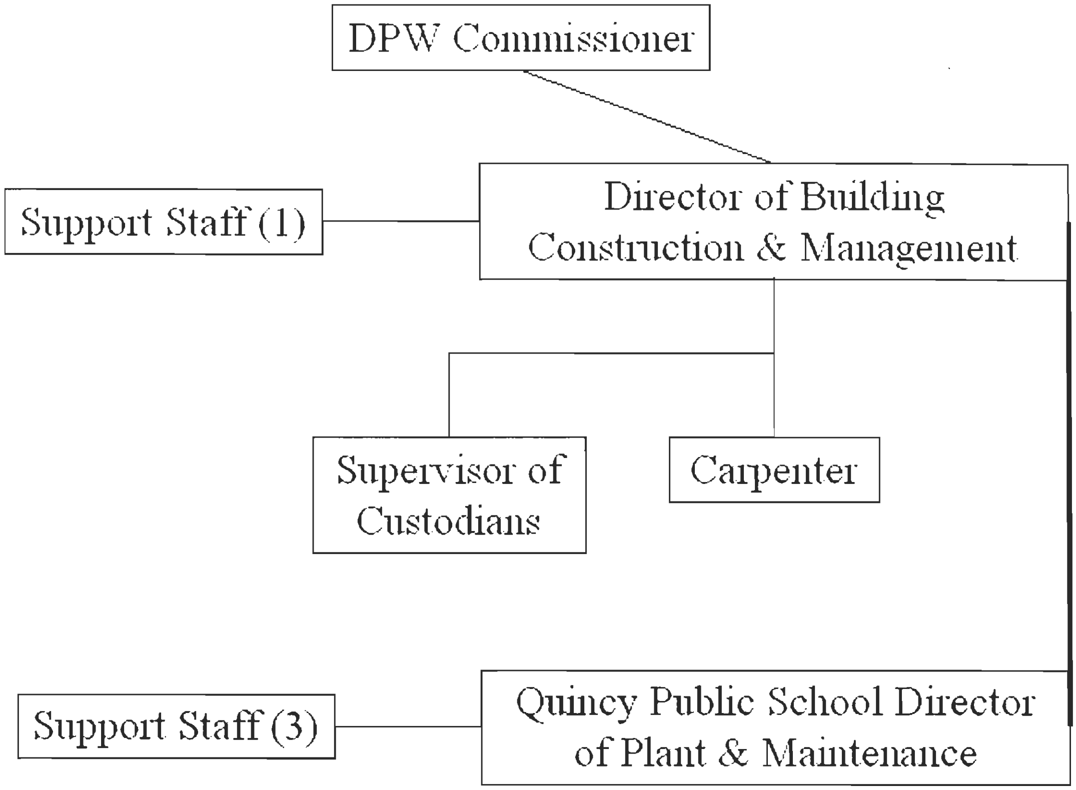

Figure 11: Proposed DPW Organization Structure

Currently this is the organization of the Department of Public Works.

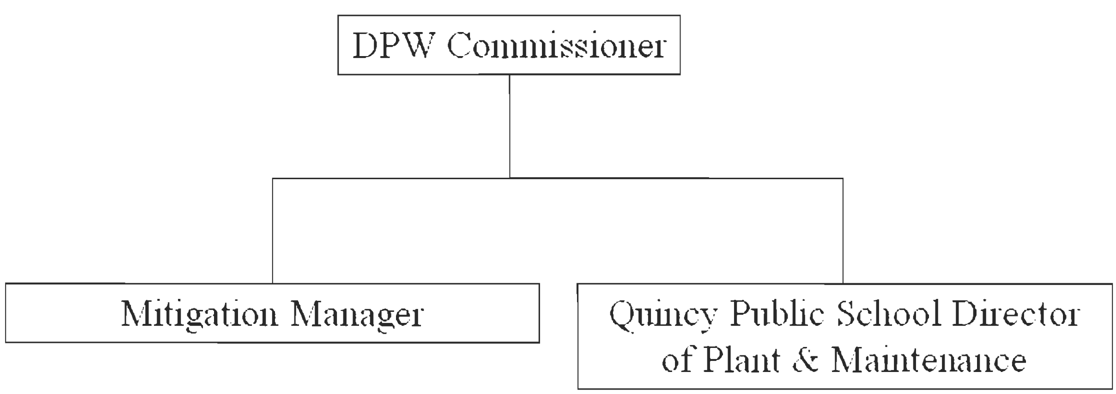

Figure 3: Actual Organization of the DPW

In the city of Quincy, the budget for the coming year is decided upon in May. This is a lengthy process as there is often much disagreement between the City Council and the Mayor over the appropriated funds. Despite similarities in goals, the mayor and councilmen often disagree. The process for deciding the final budget begins with the Mayor proposing a budget to the City Council. The City Council then holds meetings to make alterations to the proposed budget. Once all parties agree on the finalized budget, the funds are divided among the different public services.

Over the past few years, numerous disagreements have arisen between the Mayor and the City Council. With many of the public services operating with inadequate funds, the Mayor has tried to increase the funds to each department. This has been opposed by both the City Council and the public.

"'There needs to be public scrutiny into all that we do,' said City Council President Daniel Raymondi. "That's the purpose of the budget sessions." (Eschbacher December 5, 2002)

Sometimes, allocating extra funds to a department can be a lengthy process. Leaders like Raymondi will always make sure that every detail of the budget has been discussed and agreed upon by the City Council. By thoroughly scrutinizing every inch of the Mayor's proposal, the City Council is doing what they feel is their civic duty. This balance of power makes sure that any decision that is made represents the will of the entire community.

Despite their disagreements over funding, the Mayor, City Council, and Commissioner of the DPW are all working to provide the best service for the city of Quincy. To further improve the service and efficiency of his Department, Commissioner Jay Fink and Mayor William Phelan have organized a long-term approach to the maintenance problems that have long plagued the city.

The first step in this new plan is to develop a more organized system for prioritizing street maintenance. The old method of handling the repaving of streets was disorganized and often produced disastrous results. In 2001, Fenno St. was repaved with no attention paid to the condition of the 100-year-old water main running underneath it (Salters, September 9, 2002). With road conditions being continually worsened by heavy traffic flow, it is inconceivable that the city could plan to repave every street over a thirty year time period. The new plan set forth is both ambitious and well organized; as its goal is to fix all critically damaged streets over a five-year period.

The Commissioner's new plan calls for every street and sidewalk to be analyzed and cataloged according to three criteria: use, condition of surface, and condition of utilities underneath. The Commissioner will then use this data to prioritize repairs according to objective standards of what roads are most in need of repairs. By comparing the conditions of the streets in Quincy, the Commissioner believes that he is taking the politics out of street repair. The system uses objective standards to define which streets receive top priority. This plan shows considerable forethought and has been highly praised by members of the City Council.

It is clear that, over the next few months and maybe years, Quincy DPW's funding will depend on whether our not they can institute well thought out plans such as those for road and sidewalk repair. The city officials may be more willing to find extra funds for the DPW when they see results in the community. With a solution to the road maintenance problem already being implemented, the DPW has turned its attention to creating a similar system to effectively maintain public buildings in Quincy.

Our project's aim is to provide a checklist for assessing the condition of the public buildings in Quincy and conduct an inventory of all of the capital equipment within these buildings. The DPW will be able to use this inventory for preventative maintenance. Brion Wynn can use that model and serial numbers and the date of installation to predict when a component will need to be replaced. This will allow him to plan accordingly and allocate parts of the budget for this task. By creating a rubric for condition assessment of all the buildings, we will be providing the DPW with a method by which they judge the quality of the buildings they are responsible for. This condition assessment will provide the DPW with hard data regarding the condition of their buildings. This data can be used as evidence for a larger budget. With a larger budget, the Quincy DPW will be better able to conduct its business and serve the people of Quincy.

10 Appendix B: Data Collection Checklist

ROOM INFORMATION	
Room Name:	
Use:	Inspection Date:
Building Name:	Inspector:
Public / Private:	
Square Footage:	

CONDITION ASSESSMENT

#	*Yes*	*No*	*Questions*	*Comments*
			Electrical/Telecommunication/Data	
			Outlets	
			How many outlets are there?	
			How many surge protectors are there?	
			How many extension cords are being used?	
			How many outlets are being used?	
			Ethernet	
			How many ethernet ports are there?	
			How many ethernet ports are being used?	
			How many network hubs being used?	
			Phone	
			How many phone lines are there?	
			How many phone lines are being used?	
			How many splitters are being used?	
			Cable	
			How many cable connections are there?	
			How many cable connections are being used?	
			How many splitters are being used?	
			Lights	
			Is there adequate lighting in the room?	
			Incandescent	
			How many incandescent bulbs are there?	
			How many incandescent fixtures are there?	
			Total wattage	
			Halogen	
			How many halogen bulbs are there?	
			How many halogen fixtures are there?	
			Total wattage	
			Fluorescent	
			How many fluorescent bulbs are there?	
			How many fluorescent fixtures are there?	
			Total wattage	
			Wiring	

			How many wires have been stripped more than 6 inches?	
			How many wires have been stripped more than 1 inch?	
			How many feet of wiring is exposed?	
			Circuit Breakers	
			Are the circuit breakers properly labeled?	
			How many control boxes are there?	
			IT Equipment	
			Are there servers in the room?	
			Is there routing equipment in the room?	
			Are there any phone switch boards in the room?	
			Emergency and Security	
			Basic Equipment	
			How many fire alarm switches are there?	
			How many fire alarm sirens are in the building?	
			How many smoke detectors are there?	
			How many motion sensors there?	
			How many exit signs are there?	
			Are the exit signs visible from everywhere in the room?	
			How many fire extinguishers are there?	
			Back-up Equipment	
			How many lights are there?	
			Is there a backup generator?	
			Does it have a test schedule?	
			Has it been tested according to schedule?	
			Is it working properly?	
			Sprinklers	
			How many sprinklers are there?	
			Are there enough sprinklers to cover entire area?	
			HVAC	
			Ventilation	
			How many vents are there?	
			What percentage of total vent area is blocked?	
			What is the area of ventilation?	
			What is the ratio of ventilation area to room area?	
			Heating and Cooling Units	
			How many space heaters are there?	
			How many radiators are there?	
			How many baseboard heaters are there?	
			Thermostats	
			How many thermostats are there?	
			What is the room temperature?	
			Does the room temperature match the thermostat temperature?	
			Capital Equipment	
			How many boilers are there?	
			What percentage of rust is there covering the boiler?	

			Is the insulation of the boiler damaged in any way?	
			What percentage of the outside jacket is separated from the boiler?	
			Is the boiler dirty?	
			Is the insulation of the boiler pipes damaged?	
			Is the support hardware for the boiler pipes damaged?	
			Are there any leaks?	
			How many air handling units are there?	
			Are the hinges or latches rusting?	
			Are the hinges or latches coming away from the casing?	
			is the air handling unit dirty?	
			Is there excessive noise or rattling coming from the fans?	
			How many hot water tanks are there?	
			Is there any rust or leakage?	
			How many units are improperly labeled or documented?	
			How many chillers are there?	
			What percentage of rust is there covering the chillers?	
			Is the insulation of the chillers damaged in any way?	
			What percentage of the outside jacket is separated from the chiller?	
			Is the chillers dirty?	
			Is the insulation of the chiller pipes damaged in any way?	
			Is the support hardware for the chiller pipes damaged?	
			Are any of the coils of the chillers damaged?	
			Are any of the coils of the chillers dirty?	
			Plumbing	
			Is there any leakage?	
			How many water fountains are there?	
			How many toilets are there?	
			How many faucets are there?	
			How many drains are there?	
			Elevators	
			How many elevators are accessible?	
			Interior Envelope	
			Doors	
			How many exterior doors are there?	
			How many interior doors are there?	
			How many closet doors are there?	
			How many doors have locks	
			How many locks are inoperable?	
			How many exterior doors have weather stripping?	
			How many doors are inoperable?	
			What percentage of the exterior door face is damaged?	
			What percentage of the exterior frames are damaged?	
			What percentage of the interior door face is damaged?	
			What percentage of the interior frames are damaged?	
			What percentage of the closet door faces are damaged?	

			What percentage of the closet frames are damaged?	
			Windows	
			How many panes of interior glass are there?	
			How many panes of exterior glass are there?	
			Are the exterior windows multi-pane?	
			What percentage of the interior window panes are broken or cracked?	
			what percentage of the exterior window panes are broken or cracked?	
			Floor	
			What percentage of the floors are worn?	
			What percentage of the floors are water damaged?	
			What percentage of the floors are broken, gouged, or cracked?	
			Ceiling	
			What percentage of the ceiling is deteriorating?	
			What percentage of the ceiling are water damaged?	
			What percentage of the ceiling are physically damaged?	
			Walls	
			What percentage of the walls are worn or deteriorating?	
			What percentage of the walls are water damaged?	
			What percentage of the walls are physically damaged?	

11 Appendix C: Weights Used in the Database

Room Type	Electric	Emergency	HVAC	Plumbing	Envelope
Bathroom	19	9	14	38	20
Exterior	30	6	15	19	30
General public	24	24	15	7	30
Open Office Space	24	24	15	7	30
Private Office Space	24	24	15	7	30
Roof	17	11	28	44	0
Stairwell	21	21	12	42	4
Storage	24	16	20	12	28
Utility	24	7	47	7	15

The titles across the top represent major components of a room that are taken into consideration when calculating a rating for an entire room.