



Feasibility of Mobility Tools within the City of Melbourne's Building Team

An Interactive Qualifying Project submitted to the faculty of
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Abstract

This project assisted the City of Melbourne Building Team, within the city's Building and Planning Branch, increase efficiency and effectiveness of its services by improving data transfer procedures used to convey information from the field to the office. We identified suitable field communication and data transfer technologies to replace the present system and considered the desirability of introducing a mobility tool within the organization. The primary methods used to gather information while in Australia were interviews, surveys, shadowing, and online research. The final deliverable of the project is a summary establishing the need for mobility tools that satisfy the requirements of the Building Team.

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Executive Summary

The Mobility Project was designed to assist the City of Melbourne Building Team, within the city's Building and Planning Branch, to improve the efficiency and effectiveness of their services by reducing resources spent on redundant work. Efficiency is the ability to complete a job with minimal expenditure of the organization's resources and effectiveness is the ability of an organization to produce its final product. Unnecessary reworking of information has led to the loss of employee time and degradation of employees' efforts and motivation. Our research team's role was to investigate the need for mobility tools within the Building Team. We also studied potential benefits and obstacles of introducing new technologies into the workplace.

The City of Melbourne Building Team had previously conducted a pilot study in 2007 with the latest tablet PC technology available at that time. The sampled group for the study included six members of the Building Team as well as members of three other branches of the City of Melbourne Council. This investigation concluded that the costs incurred through implementation and maintenance outweighed the benefits of the increased field mobility. Business Information Services (BIS) is the information technology department responsible for approval of implementation of new technologies within the City of Melbourne Council. After the study conducted in 2007, BIS concluded that another pilot study with mobility tools would most likely see greater success in 2010.

Our research team conducted background research during a seven-week period from January 2010 to March 2010. We carried out our methodologies and analyzed data collected from March 2010 to May 2010. To gather information, our team shadowed, interviewed, and surveyed the twenty-five Building Team members currently employed. We also researched organizations currently using or seeking to use mobility tools and gathered background data on suitable mobility tools. The surveys developed by our research team were distributed to the Building Team and further data were gathered via a second similar survey given to City of Melbourne Planning Enforcement and the Metropolitan Fire Brigade. The survey was meant to assess the officers' attitudes towards technological advancements in the workplace as well as to collect data regarding time spent performing redundant tasks.

Through our investigation, our research team concluded that the Building Team's employees are very willing to change from the current paper-based system to a more digitized and mobile system. Our survey has shown that a majority of the Building Control Officers, twenty-one of the twenty-three who participated, support changes from the current system and the remaining two employees expressed indifference to change. The survey also established that most employees are satisfied with the current programs they use to perform administrative work at the office, thereby placing less emphasis on the software portion of our research team's final recommendation.

With the implementation of mobility tools, Building Control Officers will have access to office-based programs containing site information and reference material such as the Building Codes of Australia (BCA). This information would allow the officer to provide more informed decisions in emergency situations and prosecute offenders for infractions of BCA codes on site. The use of these devices would also reduce reworking of information in the field and office as well as potential opportunities for mistakes by providing pertinent data on site. Access to all necessary documents in a mobility device would reduce time spent on site and increase customer service capabilities. The officer would no longer consult large paper files while on site and can better engage the client and create keener observations of the site. The officer would pay more attention to details of the attended site instead of searching for paperwork in the site file.

Our research team has formed a recommendation of suitable hardware solutions for the Building Team. Survey data from Building Team employees provided information about mobility tool functions that field officers would find most beneficial in their daily responsibilities. The technologies we have found to be most appropriate are tablet PCs, rugged devices, and smartphones. For further action to take place with implementation of these mobility systems, the Building Team requires the approval of Business Information Systems for changes to their current format and funding. This report presents the benefits versus the costs of implementing a mobility tool for the Building Team. A structure similar to this project could be adapted to benefit other branches of the City of Melbourne Council and conceivably other organizations around the world.

Chapter 1: INTRODUCTION

Communication technologies are rapidly becoming an ever more integral part of our everyday lives. These technologies improve our collaboration with one another, the accessibility of information, and the flexibility of connectivity in various field locations. These improvements in communication technologies are necessary for certain organizations to expand and execute their responsibilities effectively. Many organizations have an interest in continually increasing productivity and profitability, while minimizing costs and inefficiencies. A frequent culprit for inefficiencies within a business is poor communication, leading to redundancies such as double handling of work.

The building and planning industry is a large and important sector in national economies around the world, and efficiency in communication and data processing is key to the successful completion of their responsibilities. In the building and planning industry, communication and networking of pertinent information is required for field tasks. However, most companies struggle in this respect. This sector within the United States and India has experienced growths of 7.5% and 7-8% in 2005 respectively (Economy Watch, 2010). Current limitations in data transfer coupled with the growth of this industry establish the need for reducing gaps in communication.

The City of Melbourne Building Team has become concerned that its employees' time is currently not used as effectively as possible, thereby hindering the delivery of their services. On average, the Building Control Officers of the Building Team perform forty percent of their work outside the office (Knight, Personal Communication, 2010). Services offered by the Building Team include issuing building permits, performing site inspections, and enforcing building codes and regulations. According to Warren Knight, the Executive Officer of the Building Team, the agency seeks to "increase the efficiency and the effectiveness of the services delivered" (Warren Knight, Personal Communication, 2010). Two examples of inefficiencies include double handling of paperwork on site and in the field and misplacement of documents, leading to frustrated staff members and customers. This lack of organization ultimately leads to: Building Control Officers (BCOs) reluctantly performing administrative work, negative perceptions of the agency, degradation of public safety in Melbourne, and the agency losing business to competitors. The Building Team is currently seeking an alternative to their current paper-based system through the implementation of newer communication technologies.

The Building Team, currently employing twenty-five BCOs, has attempted to increase efficiency and effectiveness in its flow of data between the work accomplished in the field and in the office. The Building Team would like workers capable of processing data in the field that currently requires completion in the office. In 2007, the Building Team researched and tested tablet PCs as part of a new protocol, but these systems failed to satisfy the Building Team's requirements (Warren Knight, Personal Communication, 2010). Technology has advanced considerably since then and innovations in mobility technology allow the

implementation of these tools within the Building Team to be more feasible. The new system is likely to present challenges with training of employees for efficient usage, employee acclimation, and digitizing existing data.

Although many forms of mobile technology are available, the Building Team has not established which specific products support the programs in place as well as comply with the principles of Lean Thinking, a method seeking to limit aspects of production that detract value from the final product, adopted throughout the City of Melbourne Council in 2009. A list of available mobility tools meeting the requirements of the agency needed to be developed. Moreover, our research team gauged interest of employees as well as management for the implementation of mobility tools.

The goal of this project was to aid the Building Team increase the efficiency and effectiveness of its employees in the field as well as in the office by providing recommendations for mobility technologies. Our research team studied the current system and the services offered by the agency. Our primary methods used to gather the required information were shadowing and interviews of staff. Research of similar organizations around the world, especially those that have already implemented mobility tools, provided insight into potential benefits and concerns. Our research team investigated mobile technologies currently available in Australia to compile feasible solutions for the Building Team. We assessed the potential concerns of implementing a new system by administering surveys to staff members. The final deliverables of this research project are information about viable mobility tools and a summary establishing the need for these devices within the Building Team. We also identified aspects of the Building Team's current system that cause inefficiencies as part of our recommendation.

Chapter 2: BACKGROUND

Data communication and networking are two key areas businesses must invest considerable amounts of resources to run efficiently. Because of the individuality of their needs, agencies employ distinct ways to boost their productivity. A method being utilized by many companies to enhance data communication and networking is the so-called “paperless office”. These companies are implementing systems using computers and the Internet to replace their paper counterparts. This shift in methods used by organizations impacts workers both socially and professionally. The key aspect in successfully shifting systems is considering the desire of the workers for a replacement and the benefits the new systems present. Some agencies have already applied these types of protocols and are now looking to expand on this use of newer technologies for more tasks within their organization. Chapter 2 details the current mobility systems of building and planning teams throughout the world, as well as alternate methods of performing tasks in the field. Our research team investigated different mobility systems to achieve the goals sought by the City of Melbourne Building Team.

2.1 Communication Technologies

Present-day communication is becoming easier thanks to technological advancements (Mohrmann, 2009). Innovations in technologies from cell phones to laptop computers makes connecting to other people simple, quick, and relatively inexpensive. These traits of communication technologies have made them widespread allowing a significant portion of the population to use these devices.

Implementing a mobility system can improve the productivity of many organizations relying on field and office work in their operations. However, investing in one of these systems and installing certain programs onto their databases in order to access these data remotely can be costly and requires backing up of all prior data. Smaller businesses are often unable to invest enough resources to apply such systems because they usually do not employ Information Technology professionals to handle setting up and maintaining of such systems.

2.1.1 Communication in Business

Field workers are the “face” of a business because these workers are responsible for face-to-face interactions with customers and for sufficiently satisfying their needs (Woodlands Design, 2010). Providing field workers with accurate information to convey to the customer will maintain a respectable impression of the company in the customer’s perspective.

Recent surveys indicate that about twenty five percent of the U.S. performs all their job responsibilities someplace other than the office and mobile technologies are predicted to gain similar popularity (Kanaracus, 2007). Examples of organizations benefiting from implementation of mobile forms of technology include delivery companies, hospitals, and law enforcement agencies (Chou, 2009). Forms of

mobile technology are currently available for the use of many applications, but the technology is relatively new and companies do not want to invest in unproven systems.

The Internet and organization's database access rates for mobile technologies vary with the location of the field workers, so consideration must be taken of this variance. The first generation wireless communication systems reached the United States in the 1980s and was strictly used for communication services (Chou, 2009). Cell phone reception in those days was unreliable. The second and third generation of wireless communication systems allow users to access the Internet and transmit data with relative ease. Since 3G cell phone technology is still quite new, companies are not certain of the benefit of implementing such systems.

Many agencies question the ability of this technology to meet the requirements of their daily tasks. The benefits of these mobile technologies for many companies can only be speculated since the systems are very new, and have not been implemented across many fields. Each specific company has distinctive requests to be satisfied, and the lack of concrete evidence that such a system will benefit them hinders their motivation to research the capabilities of the technologies.

An increase in availability and application of mobile technological hardware has been seen over recent years (Mohrmann, 2009). The increase in the implementation of these mobile systems in the workplace will most likely be seen in the near future (Chou, 2009). The use of a mobile system to perform out of office work will benefit the company, its employees, and its clientele. Redundant work could be reduced drastically, saving companies and clientele money and time.

2.1.2 Mobility Tools

Wireless broadband technologies utilizing third generation (3G) wireless networks have evolved tremendously, and are becoming a way to improve the efficiency of organizations worldwide. Mobile devices have been developed to support many widely used programs such as word processing and spreadsheet applications used by many businesses and agencies in the U.S. (Chou, 2009). These devices rely on broadband technologies to acquire and/or transmit data. As handheld devices and laptops become smaller, faster, and more powerful, it has become easier for companies to adopt the use of these mobile technologies (Motorola & O'Neil, 2009). Two of the major forms of mobility technology available are laptops and handheld devices. Mobile wireless and Wi-Fi access are both available on most new mobile handhelds and laptops, which allows for the devices to exploit available wireless connections. Currently, service providers still need to set up widespread, reliable coverage (Chou, 2009).

Security issues and applications of mobile technologies have been the most common concern of companies and organizations looking to integrate such technology with their services (Chou, 2009). Security issues arise when dealing with wireless communications and file sharing. An established Virtual Private

Network (VPN) is a possible option to permit only company workers with the correct authority to access databases and confidential company information.

Another consideration for most companies is how easily they can upgrade their mobile systems once implemented. In the past, mobile systems would have to receive updates in the office, which could take days to complete. Now with newer technologies, updates can take place away from the office with a connection to wireless or Wi-Fi services. The time it takes to upgrade the systems has been reduced to a couple of hours, or even minutes in some cases (Chou, 2009). The technological advances that have occurred within the mobility field have made it possible for companies to benefit from the implementation of portable devices.

2.2 City of Melbourne Building Team

In an attempt to develop an appropriate solution for the Building Team, our research team must understand how the organization operates and what services each team seeks to improve with the implementation of mobility tools. An illustration of the structure of the Building Team is found in Figure 11 of Appendix A. The Building Team is a nonprofit agency of the City of Melbourne Council responsible for issuing and managing permits as well as enforcing proper building practices. If infractions of codes occur, the Building Team is capable of issuing building notices and orders and if needed, issuing fines to noncompliant parties. The Building Team consists of three separate teams: the Building Control Group (BCG), Melbourne Certification Group (MCG), and Construction Management Group (CMG), performing specialized responsibilities within the building and planning industry. Although these groups have different tasks to complete, they must abide by the Building Team's adoption of Lean Thinking principles according to Warren Knight, Executive Officer of the Building Team.

2.2.1 Building Control Group (BCG)

One team in the Building Team is the Building Control Group (BCG) consisting of twelve Building Control Officers (BCOs). The Building Control Group is responsible for ensuring inhabitants' safety. Officers of the BCG must thereby perform both proactive and reactive inspections, where proactive are mandatory inspections and reactive are inspections provoked by complaints and suspicion of the BCO.

Some of the responsibilities of the BCOs include squats management, issuing building permits/notices/orders, emergency orders, inspection and approval of events as well as engaging in proper legal activities if building orders are neglected or ignored.

2.2.2 Construction Management Group (CMG)

Another group in the Building Team is the Construction Management Group (CMG), also known as the Site Services Group. This department is responsible for providing a service that offers protection to the health and quality of life to the people in the City of Melbourne. The CMG is responsible for offering advice

to developers as they create a construction management plan, which details how construction will take place. Designs and drawings only show the finished project that can be used to determine if the building is structurally sound assuming it is built to the specifications. The steps taken to reach the final product are described in the construction management plan.

Any event or activity that has an effect on the environment around the construction site must be established in the construction management plan. The steps that are taken must be justified and explicit detail is required to ensure that the public and surroundings are affected as minimally as possible. Construction laws needing to be followed by builders within Australia govern: daily construction start and finish times, the erection of hoardings (barriers) as well as gantries (scaffolding) to ensure public safety, and any operation that affects the flow of foot or vehicular traffic.

Any violation of the standards may be accompanied by an AU\$2000 fine for non-compliance, which is issued by the CMG in the office. The CMG works along with the MCG during construction to ensure that buildings are built in a safe and legal manner, as well as being built to the correct specifications.

2.2.3 Melbourne Certification Group (MCG)

The Melbourne Certification Group (MCG) is a team of the City of Melbourne Building Team primarily dealing with permits issued for future construction and sites currently under construction. The MCG views plans for proposed construction and provide insight and recommendations for alterations to plans to comply with the Building Codes of Australia (BCA). MCG field workers also visit sites to ensure the actual construction is following the proposed plans the builder(s) submitted to the MCG initially.

Citizens of Melbourne seeking to renovate or perform a fit-out (remove existing interior of a building and rebuilding to satisfy their needs) will consult the MCG for information about the BCA and how to install various components to comply.

In 1994, the Victorian State Government deregulated the building and planning industry allowing certified private builders to issue permits for construction identical to those issued by the MCG. With this competition, the MCG must maintain efficiency and effectiveness in providing their services to continue operations. However, despite allowing private builders to issue permits, all permits must in turn be filed with the MCG.

2.2.4 Business Information Services (BIS)

The Business Information Services (BIS) group of the City of Melbourne Council delivers all technological decisions and handles all problems related to office electronics i.e. computers, printers, and networks. BIS was an integral party alongside the management of the Building Team during the first mobility tool pilot study conducted in 2007 and BIS would be responsible for approving further implementation plans if deemed necessary. Due to financial restrictions from the City of Melbourne Council, BIS must be presented with satisfactory evidence to approve replacing the Building Team's current systems.

2.2.5 Lean Thinking in the Building Team

The principles that make up Lean Thinking have been adopted by many companies and, despite a few instances as described in Appendix B, most have been successful. More specifically, studies have shown that companies within the building and planning sector have reduced construction and project costs by adopting those principles (Lean Enterprise Institute, 2009). However, for them to be successful, the principles must be customized to the needs of the specific organization.

A basic principle of Lean Thinking is the removal of waste. For the Building Team, this comes in the form of time, number of steps involved in a process and number of individuals required to complete a given task. The Building Team, in addition to the general goals of zero defects and zero waste of time and resources, has identified another key element of Lean philosophy regarding staff members as well as customers: “respect for people” (Aldridge, 2010). According to the Building Team, respect for people is about “providing an environment that embraces change, encourages continuous learning, supports working together as a team whilst fostering individual development, and promotes making problems visible within a no blame culture“ (City of Melbourne, 2010). It is clear that despite trying to maximize efficiency, the Building Team focuses on the importance of its employees.

2.2.6 Triple Bottom Line in the Building Team

The Building Team, as part of the City of Melbourne Council, has applied the ideology of the Triple Bottom Line within their organization. The Triple Bottom Line provides the groundwork to measure the performance of the company with respect to its economic, social, and environmental impacts. An agency implementing this ideology must minimize harm caused by their actions and seek to create economic, social, and environmental value. The City of Melbourne Council invests in maintaining Triple Bottom Line within their organization by pursuing more eco-friendly means of conducting business, encouraging recycling, constructing “green” buildings that utilize natural energy sources, and using public transport frequently to lower fuel consumption in government vehicles.

The City of Melbourne Council has a strong focus on environmental sustainability. Council House 2, home office of the Building Team, has been constructed with emphasis placed on minimizing expenditure of electricity while maximizing capture of natural energy sources. Examples include wind turbines on the roof level, conduction climate control systems, and motion sensor lights in most rooms in the office.

Mobility tools could reduce paper used to print site information and minimize fuel consumption from redundant site visits. These tools will enable building officers to make better use of their time thereby providing a better service to clients with less expenditure of City of Melbourne Council resources. Implementation of mobility tools will contribute to the Building Team’s dedication to the ideas of Triple Bottom Line.

While Lean Thinking is a way of doing business, the Triple Bottom Line is “a way of thinking about the business we do” (City of Melbourne, 2010). The goals sought by enacting the Triple Bottom Line within the City of Melbourne Council are to decrease the cost of service delivery, to drive innovation and efficiency in contracting, and to promote better business practices in sustainability, configuring practices to meet client needs and express the worker’s greatest potential while planning and acting with consideration to the long term effects.

2.3 Mobility Project Background

The City of Melbourne Building Team presented the Mobility Project to Worcester Polytechnic Institute as an Interactive Qualifying Project (IQP) for undergraduate students. Students participating in an IQP gain experience tackling problems that lie at the interface of science, technology, social issues, and human needs (IGSD - WPI, 2008). Our research team investigated the feasibility of implementing mobility tools within their organization, while accounting for employee attitudes and benefits of technology usage. In the following sections, we provide background information of the problem addressed by this research project and the objectives the management of the Building Team are seeking to accomplish with implementation of a mobility tool.

2.3.1 Building Team’s Problem

The term “redundant work” refers to a process that causes the same task to be performed multiple times, while little to no value is added to the services. In Lean Thinking terminology, it is referred to as “waste”. The problem of inefficient and redundant work plagues agencies and companies across many sectors. Although some redundant work allows workers to review their paperwork and note any discrepancies or faults, an excess of redundant work leads to poor performance and unnecessary resource usage of the organization. When a BCO reworks field data in the office, typing errors may occur while reading hand written notes or a photo taken on site can be attached to the wrong file.

In a case study for the Santa Cruz, California Planning Department, it is common for a report to be hand written out in the field only to be brought back to the office to be re-typed into word processing software and uploaded into a database. The “waste” is very evident in the Santa Cruz Department in that the same information is written multiple times to be entered into the database (Santa Cruz Building Dept., 2010). This step violates Lean Thinking principles by adding no value to the “product”. A study carried out by the National Conference of States on Building Codes and Standards (NCSBCS) surveyed over five thousand companies in the U.S. and has shown that the losses due to redundant work can cost an organization a considerable amount of resources (NCSCBS, 2005). The value of these losses is naturally influenced by the size of the organization. The City of Melbourne Building Team suffers from the same problems in dealing with redundant paperwork.

Building and planning agencies are inherently affected by this problem due to the nature of their work. BCOs at the Building Team are required to go on site to perform inspections, offer advice, and to grant the building permits among others. Building permits are usually issued from the office; however building inspections must take place at the site. The inspections typically consist of the officer recording observations at the site and taking notes of any violations of the building codes. To process the field notes taken, the inspector travels to the home office to input the information gathered into a central database.

In many of these offices, the employees work both in the field and in the office. For example, inspectors from the town of Grafton, Massachusetts in the U.S. spend about forty percent of their time in the field, and the rest of their time in the office (Cesarone, Stein, & Frost, 2009). In order for a building to be habitable by law in Grafton, as well as in many other municipalities worldwide, an occupancy permit is mandatory. Electrical, plumbing, gas, and general construction inspections are also required for a home to be eligible for occupancy. Operations of building regulating agencies, such as the Building Team, must be performed in the field.

While on site, BCOs of the City of Melbourne Building Team are required to fill out forms and applications. Afterwards, the same paperwork needs to be processed in the office before any further action can be carried out. Delivering the paperwork back to the office to enter the data into a computer database is not an effective use of resources. The time spent to process this data can amount to anywhere between three to six hours per inspection (NCSBCS, 2005). Inspectors from the town of Grafton have reported that in many cases the amount of time spent performing redundant paperwork can account for more than half of the whole processing time of a given task (Cesarone, Stein, & Frost, 2009).

Another common problem is the misplacement and potential loss of paperwork in transition, which can result in all records of the inspections being lost. These and other issues remain common problems and the source of many wasted resources in businesses and other agencies. These problematic areas have caused an impending need for remote sources of data processing.

The Building Team is aware that a mobility tool could be beneficial to provide customers a better service, while saving the organization time and money. A major problem for the Building Team is that funding for such projects comes from BIS upon their approval of a business case that is presented by the Building Team. The business case is required by BIS as a way to determine if the proposed solution will benefit the organization. The Building Team must provide sufficient rationale to BIS that a mobility tool will benefit the company in ways such as saving the company time or improving its service. If the case is presented successfully and funding is available, BIS will permit a pilot study to be conducted. If not, the Building Team must wait until funding becomes available, or perform more research to better justify their proposal to BIS.

2.3.2 Building Team's Objectives

The Building Team Mobility Project is based on the implementation of new technologies that could increase the efficiency and effectiveness of the overall agency, therefore reducing the time and labor required to perform daily activities. The successful completion of this project will not only benefit managers in terms of saving time and money, but also employees who feel unmotivated performing repetitive or redundant tasks. Moreover, delays in processing data result in setbacks to clientele of the agency, which eventually renders the Building Team less competitive compared to private building and planning companies in the city of Melbourne.

To improve its productivity, the Building Team must be more compliant with Lean Thinking principles. Managers seek to eliminate steps adding no value to the services offered and one such service is redundant work. According to Warren Knight, the City of Melbourne Council has recently expanded their jurisdiction to include the Docklands area, which is predicted to grow by twenty thousand inhabitants over the next 5 years. Joseph Genco, head of the BCG, also mentioned that permits are not only growing in number but also in complexity. To increase efficiency and effectiveness, the Building Team management is in search of progression of their current software systems to make them more transparent and consistent in terms of the data included within them. Managers would like all data entered into these systems to be uniform, allowing them to be found via searches by other BCOs with minimal effort and any BCO can perform further actions for sites without consulting prior officers working with a specific site.

To ensure services are delivered in a professional, cost-effective and customer-focused manner as well as competing with other building and planning companies, the Building Team regularly reviews work practices and processes, including both general system designs and specific tools. As new technologies are introduced, the Building Team considers the potential improvements that could be made to service delivery on site.

2.3.3 Summary of 2007 Pilot Study

A trial was performed in 2007 with tablet PCs in an effort to increase the field mobility of workers of several departments of the City of Melbourne Council. Prior to full implementation of a new technology, the benefits from the use of these new devices must be established to Business Information Services. To determine these benefits, a pilot study was performed with six tools given to the Building Team.

The tablet PC used in 2007 was an IBM Lenovo X41 with a hard drive speed of 4200 rpm and an Intel M758 processor running at 1.5 GHz coupled with 512 MB of RAM. The battery life of the X41 was approximately 2.6 hours. The X41 that was used measured 274 mm W x 241 mm D x 330 mm H, and weighed 1.6 kg. The full technical specifications of the Lenovo X41 can be seen in Appendix J.

The benefits experienced with the usage of the IBM Lenovo X41 were ready access to reference documentation on site, such as Building Codes of Australia. While attending a site, an officer could attach

photographs taken to the correct record without office support. These tools were especially useful for on call officers (employees handling situations outside business hours) because they could acquire site information in the field.

Although these mobility tools aided the organization, the officers of the Building Team expressed a lack of desire to further usage. The tablet PCs tested experienced difficulties in connecting to the 3G wireless networks while the BCOs performed field activities. The time required to start the machine and log onto the office network was averaged at fifteen minutes. The mobility tool experienced compatibility issues with certain programs, such as EView and Outlook. The touch screen of the X41 was a new technology in 2007 and was unresponsive and difficult to view in bright environments.

BIS concluded that pursuing mobility tools for the Building Team was not ideal in 2007 and recommended another study be performed in a few years when technology has evolved more. Although BIS felt that waiting was the best option, Joseph Genco, manager of the BCG whom actively participated in the pilot study in 2007, has said at the conclusion of the pilot study “With regards to the mobility project, it is still felt that there is still a case for mobile electronic equipment that is more portable could be utilized to reduce administration time by technical staff” (Genco, Personal Communication, Appendix C).

2.3.4 City of Melbourne Council Plan

The City of Melbourne Council adopted a plan for years 2009 to 2013 where they sought to accomplish eight goals to improve the city for future generations. Being a branch of Council, the Building Team must strive to satisfy these goals as well. Our research team has identified particular objectives of these goals relating to our Mobility Project, shown in Figure 1.



Figure 1: Mobility Project Objectives of the Melbourne Council Plan (City of Melbourne, 2009)

A description of the relation of each objective to the Mobility Project can be seen below:

- Objective 1.3.1 - Enforcement of building codes and regulations will be improved from accessibility of BCAs and site information in the field. Enhancing these areas of field mobility will improve public safety in the city of Melbourne.
- Objective 1.8.1 - Digitizing the office and creating electronic copies of important documents will preserve historical plans. Converting paper-based material to electronic formats will reduce paper usage within the department and eliminate fear of losing historical building plan currently degrading on microfiche documents.
- Objective 3.1.1 - As the demand for the Building Team's services increase, they are capable of handling the increased workload. Managing their work effectively allows BCOs to provide better customer service to citizens of Melbourne.
- Objective 5.1.3 - Mobility tools will allow officers to use their time and efforts towards progress as opposed to performing redundant tasks. Usage of paper and fuel for government vehicles will decrease with the usage of mobility tools.
- Objective 7.1.1 - The Building Team will set a precedent for future implementation for other branches of the City of Melbourne Council and city councils within Australia. Setting an example for other organizations will establish the City of Melbourne Council as a leader in the field of mobility tools.
- Objective 7.1.2 - Providing our research project to other branches of the City of Melbourne Council could provide motivation for improvement within their agencies. As well as creating an example, the City of Melbourne Council will maintain their ideologies of Lean Thinking and Triple Bottom Line.
- Objective 7.3.1 - Pioneering mobility tool usage in the Building and Planning Branch within Australia will provide an example for other councils and organizations to implement mobility tools for their field workers.
- Objective 8.1.1 - Increased enforcement capabilities will increase fines issues and increase public safety by reducing illegal, unpermitted construction.
- Objective 8.3.1 - Increasing information accessible by field workers and reducing Lean Thinking "waste" in the form of redundant work will improve workflow of the data from the field to the office. Better workflow can lead to less worker frustration from performing administrative and redundant work and better customer service provided by BCOs.
- Objective 8.3.2 - Implementing mobility tools to satisfy the above objectives is a usage of technology to improve the services provided by the Building Team.

2.4 Potential Concerns with Technological Solutions

To reduce the amount of redundant work, the Building Team wishes to introduce a more efficient workflow. To make the most efficient use of mobility devices, BCOs will need access to the Internet when they are on site. Blending a large-scale communication technology and social goals is a sizeable challenge but the payoffs are potentially enormous.

While managers easily see the compelling opportunities presented by new communications technologies, employees' resistance to change is a significant hindrance to the implementation of such a system. That is why our research team must consider social as well as technical concerns for all stakeholders. Experiences from previous systems must be gathered to help establish the starting point for interface design. A clear presentation of choices to the building officers and managers of the Building Team will allow them to choose with confidence, learn shortcuts for their most frequent actions, and explore safely when considering a new process. Moreover, socio-technical systems have to be built for easy revision, upgrade and integration with other services.

2.4.1 Flow of Information

To increase its effectiveness, an organization must seek to improve current procedures used to generate the final product and decrease areas likely to adversely affect these products. Within the Building Team, these liability areas occur when transferring and reentering data gathered in the field when the BCO travels to the office. This redundancy of work causes both worker and client frustration because the worker must reprocess gathered data and the client might receive multiple visits from BCOs to obtain data not acquired during prior site visits. The Building Team management and BIS have found reasonable evidence to pursue another mobility tool study because of the technological advancements experience over recent years. In 2007, a mobility tool implementation plan was not researched further because technology had not developed to a point where the costs would outweigh the benefits experienced by the Building Team. The Building Team and BIS view mobility tools as a means of improving efficiency and effectiveness of field workers by increasing the amount of available data accessible to BCOs in the field.

2.4.2 Connectivity Concerns

Beyond potential social problems, the implementation of mobility tools will most likely encompass several technical issues that need to be addressed. For example, the reliability of 3G wireless networks is a concern that may greatly affect the effectiveness of mobility tools. If the 3G wireless network does not cover a majority of the municipal area, the products proposed will not be adequate as they will most likely require 3G internet access. It is important to consider the reliability of the networks from the different providers to determine if a 3G connection will be feasible on site.

To ensure our research team's recommendation is feasible, the technical specifications of the programs used by Building Team must be acquired. However, some recommendations may be formed

allowing the execution of only few programs, provided these programs are more useful to field workers than others. Once the key programs used by field workers were established, we identified technologies capable of running these programs.

2.4.3 Information Security

The Building Team is an authorizing organization allowing builders to perform various tasks within the city of Melbourne. The data collected by BCOs is sensitive and must be kept confidential. Allowing outside parties to access this information could present great safety hazards within the city as false permits may be issued or current permit information may be altered. With this concern, wireless network data transfer must be protected and encrypted to prevent unapproved access to the Building Team's internal database.

2.4.4 Technological Demands

With the introduction of new technologies in the workplace, an alteration to the routine most or all employees of the agency are accustomed to occur. Addressing the desirability of employees to implement such changes is very important to upkeep workplace morale and employee motivation. Also, the demands on the workers by these new systems must also be considered when assessing the desirability.

Less technically savvy and senior members of the office may find it difficult to adjust to newer technologies and some employees may even refuse to learn the new system protocol. For example, currently some officers of the Building Team still use E-View, a program replaced by CoMPASS. Business Information Services, the information technology group of the City of Melbourne Council, perform training sessions to new employees for proper usage of programs utilized daily. If mobility tools are implemented within the Building Team, BIS will be responsible for acclimation of current employees to the new system so our research team worked closely with this branch of City of Melbourne Council.

Such tasks as training and acclimatization to the new systems are likely to initially slow productions of final products within an organization. However, when these two processes are completed, outputs are most likely to increase notably and responsibilities of employees will be performed with greater ease.

Presently, the out-of-office procedures used by the Building Team are mostly paper-based. In order to successfully implement a mobility system, the current paper documentation must be converted to electronic formats. Some plans for buildings are presently being stored as electronic files; however the BCOs must print these plans for any on-site responsibility. The time for employees to complete the task of digitizing all past data is likely to be extensive.

2.4.5 Social Considerations

Technology-based human interaction has created problems among employees and clients, such as losses of trust, empathy, responsibility and privacy, which can potentially be serious impediments to

implementing a web-based system in any agency. Consideration for the lack of desire of employees to implement newer technologies must be taken to allow these tools to work harmoniously with employees and business practices. However, large-scale collaboration has potential for enormous benefits in a range of sectors, including healthcare delivery, disaster response, as well as building and planning. Open access to information, participation of all active member in development, and freedom of information flow can raise such awareness and eliminate negative views towards adopting new technologies (Whitworth and Moor, 2008).

2.4.6 Wall-less Office

After an eight-hour workday, field workers go home where they can escape work and relax. Implementing a mobility tool may allow work to “follow” them home and allow managers to contact BCOs out of hours. Currently, out-of-hours work is limited to on-call officers but this may increase with widespread usage of mobility tools. Employees view home as a sanctuary from the business world, and this could change with the implementation of mobility tools. Consideration of this social concern must be accounted for during our research team’s analyses.

2.4.7 Job Security

A social concern that is raised with the introduction of mobility tools is job security. The use of mobility devices is meant to increase the efficiency and effectiveness of the agency. In other words, the Building Team will be able to do the same amount of work in less time and requiring fewer employees. With increased productivity, an organization can either take on more work or decide to lay off employees. However, according to Warren Knight, the City of Melbourne Council has recently acquired the Docklands area, which is predicted to increase by twenty thousand inhabitants over the next five years. The Building Team, which is a government-run agency, is more likely to respond to increases in efficiency by taking on more work instead of laying off employees.

The Docklands is predicted to grow rapidly, creating the need for the Building Team to provide more services. A mobility tool may help to increase the organization’s efficiency, which will be useful to keep up with the predicted additional work. This expansion of Melbourne, however, does not promise that a significant amount of work will be created for the Building Team. It is possible that for the employees of the Building Team an increase in efficiency and effectiveness could potentially render some types of work obsolete or unnecessary. The Building Team expects an increase in work, seen in Figure 2, but no guarantee can be made that the increased efficiency in the office that could be achieved by the implementation of mobility tools will be perfectly offset by the increase of work. New technology has been a major source of job loss throughout the world due to the ability of each individual to deliver his or her services better or faster. This allows more work to be done, or the same amount of work to be done with fewer employees

(Economy Watch, 2010). Layoffs are a potential concern that will be addressed in the methodologies conducted by our research team.

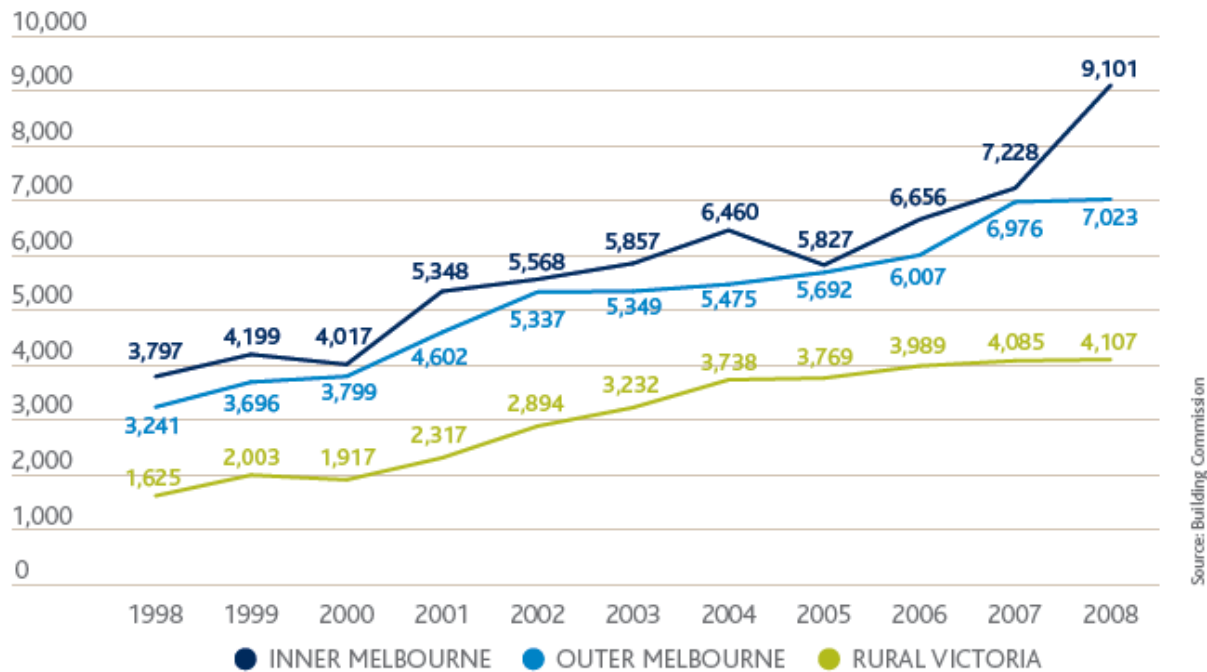


Figure 2: Building permits by year by region (Building Commission, 2008)

2.5 Case Studies

The City of Melbourne Building Team is attempting to solve the problems it is having with redundancy of work in the office. Other companies and organizations have sought to deal with similar situations and have experimented with different approaches to the problem. Although knowledge of these organizations implementing the ideology of Lean Thinking is unknown, the goal sought through the usage of mobility tools is similar to the Building Team's. These methods include ways to increase office efficiency by implementing informational and mobile technologies to process forms in the field. This section reviews studies of similar projects, which reveal successes and challenges involved in implementing mobile technologies.

2.5.1 TBS Mobility

TBS Mobility, a company specializing in mobile communication solutions, now offers new systems with more ease of installation taking significantly less time. In a study involving TBS Mobility's technologies (Hawkins, 2010), a company, not specified in the case study, based in the United Kingdom implemented a TBS system and experienced large increases in production in a short time. According to the reports, the

company enjoyed a 22% reduction in resources required to deliver the same output, but also reported 40% reduced call centre contact from the field.

TBS Mobility has recently expanded its clientele base by offering options for systems allowing smaller organizations to consider implementing a viable solution to their mobility problems. TBS Mobility claims that agencies employing their systems will experience nearly no difficulties accessing off site data storage, which takes away the burden of problematic outages or failures by offering in-house hosting. Since TBS hosts from their facility, they are capable of backing up data from organizations, so if these agencies suffer from catastrophic data loss, they are able to recover the data with no major difficulties.

2.5.2 IT @ Intel

In November 2003, *Intel IT* studied the efficiency and work habits of over 100 Intel employees who were upgraded to wireless notebook computers (IT@Intel, 2003). This case study details technical and societal benefits of implementing mobility tools within a large organization. Intel does not perform the same responsibilities as the Building Team, however the requirement of field workers to perform redundant work is similar to the Building Team's BCOs. To understand and explore the impact of wireless mobility on user behavior and productivity during a two-month evaluation period, five data collection techniques were used:

1. Surveys before and after participants received their new notebooks
2. Participant interviews
3. Self-report activity logs
4. System-generated logs
5. Lab-based user performance tests

Participants were asked to keep activity logs recording how often activities were performed and their duration. The system-generated logs were useful in determining when an activity occurred. The lab-based user performance test consisted of seven core tasks that participants were asked to perform in a carefully controlled and monitored environment.

With a sample size of 106 employees, the results obtained were very consistent. The lab study participants performed office work at a 37.3% average rate faster than before. The surveys showed employees reporting a positive impact on their productivity. Using this data and the fact that employees perform more than those seven core tasks, it is safe to assume that potential exists for even greater gains.

On a behavioral level, participants felt a greater sense of freedom and had more control over where they worked. Another benefit of the notebook was that employees were making more efficient use of small "slices" of time that were previously wasted due to the slow nature of their computer. The wireless capability of the notebook also allowed participants to reorganize their working time around professional and personal engagements. Finally, it was observed that the new laptops became continuous companions to the workers.

A cost-benefit analysis was conducted and the following basic equation was used: *Productivity Value = Time saved × Employee cost*. It was concluded that for a 25,000-employee company, upgrading to the new configuration would realize an annual saving of 2.5 million work hours. For a typical 40-hour workweek, that is the equivalent of adding 1,250 skilled employees to the workforce.

The original goal of this study was to assess the change in productivity after the implementation of the new laptops. However, on top of an increase in productivity, a change in employees' behavior was also noted. The general feeling was very positive and soon after, the new laptops were introduced on a more widespread scale. Once again, this case study had positive results and boosts our research team's expectation of finding a suitable mobility system for the City of Melbourne Building Team.

The report did not present any negative outcomes of implementing laptops within Intel but it being an information technology company, one could question its attempt to uncover such adverse effects.

2.5.3 Conservation Services Group

Conservation Services Group is a non-profit organization located in Westborough, Massachusetts in the United States. Its primary function is to work with building contractors, construction workers and property owners to help rate and enhance energy efficiency of residential and commercial buildings. Our interviewee, Gabe Baldwin, was selected because the processes he uses to accomplish his daily tasks are very similar to that employed by the building officers in the Building Team. Gabe Baldwin is a home energy and green rating professional and as such, inspects and rates residential buildings exclusively.

Conservation Services Group has already implemented mobility tools to facilitate its employees' daily tasks. The company decided to acquire Panasonic Toughbooks for its employees in 2007. At the time of purchase, the Toughbooks cost roughly US\$3,000 (Baldwin, Personal Communication, Appendix D) but they can be bought today for about US\$800 (Bob Johnson's Computer Stuff, 2010). A second component of the mobility system utilized by the Conservation Services Group is known as "hot syncing". The Toughbook runs background software that automatically synchronizes the database of an employee's mobile device as soon as he comes back from site inspections and logs on to the company's Internet. This eliminates the need for employees to manually update the company's website.

According to Baldwin, such a mobility tool is vital to the efficient execution of his daily responsibilities. For example, having to tell an employee "we have to go back to the office, plug in the numbers and get back to you on the actual efficiency of this component" (Baldwin, 2010) sounds very unprofessional as well as causes frustration to the customer and slows down the whole rating process. However, with a mobile computer, those numbers can be handled on site, and the process is much faster and easier on everyone. Moreover, for an environmental services group, reducing transportation wastes is very important. Without a mobility tool that enables on-site data entry and processing, much more travel is involved. For the Building Team, which has adopted Lean Thinking, such travel is considered "waste". It is

also much more convenient to be able to directly enter the make, model and part number of a component into the mobility device as opposed to having to scribble it on a piece of paper, go back to the office, and enter it in the computer to look up its specifications.

While having a mobility device is very convenient, it has some drawbacks. For Baldwin's inspection and rating services, Conservation Services Group charges US \$125 per hour. If at the end of an eight-hour workday, Baldwin damages his laptop and loses all the data collected that day, the company incurs a loss of approximately US\$1,000. Other times, having a mobility device does not help. For instance, on some inspections that Baldwin has performed, the component being inspected did not have a label, meaning no make, model and part number. He had to postpone the rating of that particular piece of equipment despite having a mobility tool.

In general, Baldwin listed a number of capabilities that his "perfect" mobility tool have. Some of his suggestions included:

- Portability
- Long battery life and car charger
- 3G wireless capability
- Processing capabilities comparable to a 1.5 GHz Intel Core 2 Duo processor
- Ruggedness

2.5.4 Sri Lanka Case Study

The social implications of technology change in the workplace are a main concern when considering the implementation of newer technologies and can often affect the feasibility of technological usage within these organizations. Kodikara and McCaffer (1993) used information gathered from ten case studies about the organization of Sri Lankan building contractors to establish the flow of data within and between management functions. These flows of data highlighted a significant burden of re-working of data. The Building Team has identified a similar redundancy of work within its company and wants to implement a new system. Most of the professionals interviewed agreed that the presentation and current method of estimating data in Sri Lanka were the main causes for redundancy of work. However, it was also found that "any revolutionary change to the conventional format would not be welcomed by the industry" (Kodikara & McCaffer, 1993).

To identify reasons for inefficiency in the contractors' data management, the people conducting the research used structured questionnaires. It was observed that the use and exchange of processed data throughout management functions was unnecessarily complex and was one of the causes of repetition of work. By examining the data flow between management functions (e.g. estimating, purchasing, planning, site management, and quantity surveying/financial control), the current re-work of estimating data was better recognized. Professionals in ten organizations were asked to comment on the flow of data that had been

established and most agreed that the current format and presentation of data was one of the major reasons for inefficient site control, site monitoring and cost control. However, due to the Asian culture of remaining faithful to tradition, employees were opposed to any new system proposed.

During discussion, the social scientists proposed other formats for the Bill of Quantities (client's document for client's purposes) but those were rejected. The Building Team has embraced the principles of Lean Thinking and as such is open to continuous improvement. However, this case study illustrates a cultural resistance to change. Our research team will have to gather feedback from employees and managers of the Building Team before proposing a solution that will most likely change the way they perform their daily activities.

Chapter 3: METHODOLOGY

The Building Team is currently struggling with an inefficient flow of information, which occurs because data is handled in the field and again in the office. This process can sometimes be performed several times per site, leading to a significant waste of time and resources. This project assisted the Building Team in improving data collection and processing by investigating the capabilities and appropriateness of incorporating newer mobility tools in their daily tasks, such as issuing permits and performing building inspections. Our research team evaluated the current methods used by the Building Team and identified functions and services that could benefit from the introduction of mobility tools. We ultimately suggested an implementation plan, which considers the appropriateness and effectiveness of specific mobility systems as they relate to employees and clients of the agency. Our research team has summarized the progression of the project carried out in Melbourne, Australia as seen in Appendix E. The specific objectives that guided this research project are:

- 1) To identify essential service types delivered by employees in the field that could be enhanced and supported by mobility tools.
- 2) To investigate what other service organizations are presently doing in relation to mobility data collection and processing.
- 3) To identify suitable hardware/software solutions to improve services offered by the agency.
- 4) To examine the social and technical issues of implementing mobility tools in the Building Team.
- 5) To evaluate the cost/time benefits gained through implementation of mobility tools.

3.1 Identifying Field Services

To identify essential service types delivered by employees in the field that could be enhanced and supported by mobility tools, our research team obtained information about the services the Building Team provides. In order to acquire this information, we became familiar with the operations of the field crew. The following sub-sections and Figure 3 introduce and define the methods that the team used to gather information about the services provided by the Building Team, and of those services, which could be enhanced by mobility tools.

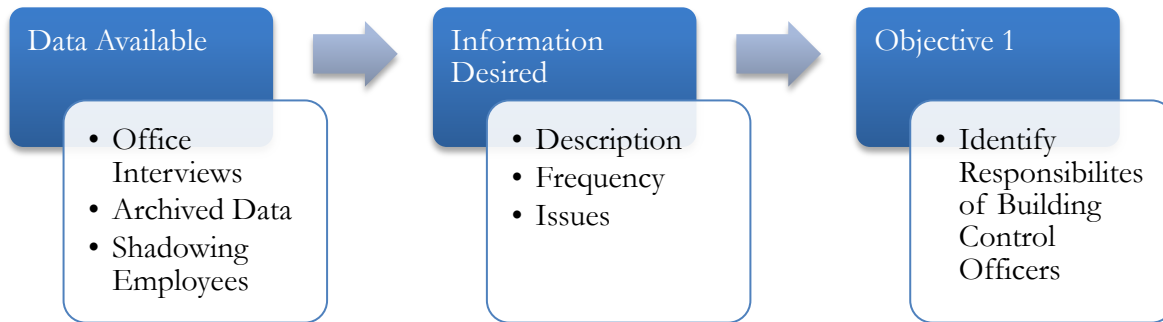


Figure 3: Responsibilities of Building Officers

3.1.1 Interviews

In order to increase the efficiency of field workers through the implementation of mobility tools, our research team first identified the services that are delivered by the Building Team. Interviewing a member of the agency provided a direct way to identify the services that are offered. The sampling frame for the interviews was any member of the Building Team, but the selection process ensured that both employees who work in the office and in the field as well as managers are interviewed. This frame provided representative sample data because the interviews were held with people who gave the team direct answers regarding what services the company provides.

The interviewer used a questionnaire to ensure that all of the necessary questions were asked, and the form was used to take notes about the responses of the interviewed field crewmember. The data gathered were then transcribed and summarized using word processing software. The data acquired by our team through interviews were used as a source of information that established the services provided by the Building Team, and analyzed to determine which services mobility tools may enhanced.

With regard to performing interviews, our team was aware that employees' time is valuable and attempted to condense the questions being asked in the interview to save time.

3.1.2 Shadowing

Our research team observed the Building Team field workers on the job through a method called shadowing. This method was useful to identify services performed by the Building Team and to categorize the services that could potentially be completed without the re-handling of data in the office. Shadowing fieldworkers gave us important insight about what programs the Building Team needs to run in the field to increase efficiency within the agency and introduced us to how they currently perform their daily tasks. Our

sponsor, Warren Knight, identified our research team's sample and the field crewmembers that we shadowed were determined upon arrival to Melbourne. The field crews at the Building Team were very informative about which services cause inefficiencies in the organization attributable to the lack of mobility tools. Attending sites with BCOs also allowed our research team to develop an opinion of their present system and identify areas of improvement as a third party perspective.

Note taking was the most useful way to document the observations, but some questions were asked while the team shadowed the field crew. The data collected in the field were archived using word processing software. We then depicted the data in tables and lists showing the major services that could be supported and enhanced. The data acquired by our research team through shadowing was used as a source of information to establish the services provided by the Building Team, and analyzed to determine which services mobility tools may enhance.

Our research team acquired permission from the Building Team manager and individual crewmembers for shadowing. The format of the shadowing exercise was determined prior to going out in the field with the field inspectors. Our research team is aware that the field crews' time is valuable and attempted to remain as unobtrusive as possible.

3.1.3 Training

To develop an understanding of the daily tasks of BCOs, our research team underwent novice training for the usage of the Building Team programs. The Building Team's Information Technology staff provided training for our team during two one-hour sessions. The programs included in these training sessions were Hummingbird Document Management, Pathway, CoMPASS, EView, and Outlook. With the exception of CoMPASS, all these programs are available for commercial purchase for any organization. CoMPASS is a City of Melbourne Council program developed uniquely to meet the needs of the city. Hummingbird DM is used to handle all documents sent to clients or notes made by BCOs about worksites and organize documents according to labels prescribed by the author. Pathway is the program used to store permit information for all properties in Melbourne. CoMPASS, which is replacing EView, is similar to GIS mapping and allows the user to view all properties of Melbourne and provides links to Pathway documents relating to the sites. Outlook is used for emailing, scheduling, and storing contact information by some BCOs; however most use it for emailing purposes only.

To form an educated recommendation for the Building Team, understanding how BCOs use these programs and which functions of each program would be useful in the field is required. This training allowed our research team to narrow potential candidates for their recommendation due to processing abilities and connectivity requirements.

3.1.4 Meetings

Group meetings with several members of the Building Team were beneficial to our research team. BCOs seek input from other BCOs and information may be drawn from the conversation that would otherwise have not been uncovered. Differing opinions of BCOs allows for new opinions to form similar to what is sought during a focus group. Data were gathered relating to areas of improvement within the present system and features officers would like in a mobility device to assist them in their responsibilities.

3.2 Researching Similar Organizations

To investigate what other service organizations are presently doing in relation to mobility data processing, our research team conducted interviews with members of such organizations. In addition to interviews, we utilized the Internet to gather more data about similar companies based in Australia.

3.2.1 Researching Organizations with Mobility Tool Experience

Once our research team established these services and duties, internet-based resources were used to locate companies/agencies around the world that have faced similar issues as the Building Team. Other agencies within the City of Melbourne Council were also investigated. The Internet was a primary resource because access from virtually any computer was available and no time constraints were imposed as to when we could carry out our research.

To obtain a complete understanding of services that could be enhanced by the introduction of mobility tools as well as potential pitfalls, our research team investigated the use of mobility tools in other organizations that have already implemented them. Valuable data was also obtained when any of these organizations recognized the need for mobility tools and conducted research. Analyzing case studies allowed us to identify the different aspects that need to be taken into account when proposing a radical change in the way employees will perform their daily activities.

From interviews and email exchanges with mobility tool users, our research team hoped to better understand what the daily responsibilities of the company entail. Establishing how the use of mobility tools has improved other companies and the adversities created provided general insight on capabilities of mobility tools. Our research team first identified organizations in Australia performing tasks in the field as well as in the office, then researched further information about how these organizations process and handle data.

The format of the personal interviews was very similar to that discussed in section 3.1.1. However, phone interviews and email exchanges were the preferred method of correspondence. We used a standardized interview format to ensure uniformity of our data, which was then transcribed using word processing software.

3.3 Investigating Concerns of Implementing Mobility Tools

Our research team considered the social and technical issues associated with implementing a mobility system for members of the Building Team. Technical problems encountered through implementation of mobility tools include software compatibility, wireless network connectivity, and instruction required for successful usage and training.

In addition to these social concerns, identifying the technical difficulties that could be encountered during implementation of the new system was an important part of our research goal. Some of the issues to be addressed were:

- Contractual agreements
- Network security
- Reliability of 3G networks
- Compatibility of existing software with mobile system
- Insufficient data available electronically

3.3.1 Surveys

Our research team created surveys that we distributed to the staff of Building Team. The questions asked in the survey were aimed at determining the employees' level of use of technology in their personal lives and their capabilities with such technologies. This data were compiled from the survey sheets, as seen in Appendix F, which were filled out by employees. Graphs, charts, or tables were used to compare the responses of the employees. The data were analyzed to determine any common potential social problems such as the fear of employees being fired, acclimatizing to a new system, and customer interactions with new computer based system.

The surveys were formed in a manner that ensured they are easy to follow. The questions were phrased in a way that does not significantly influence or provoke a response from the employee. Surveys were short enough to get a fast response, but required enough detail to obtain essential information for our project. We were aware of the fact that the employee's time was valuable and attempted to keep the surveys brief, to the point, and easy to answer. This ensured quality data collection, with minimal wasted employee time.

3.3.2 Casual Discussions

During the casual discussions, occurring over lunch or other social gatherings, a member of our research team would ask a question about their concerns regarding our project. Since the staff of the Building Team is very enthusiastic about our final deliverable, a lively discussion followed. With the approval of the participants, we recorded relevant information useful for our project.

Note taking was the major data collection technique for this method. For maximum efficiency during the group sessions, two or three members of our research team were present during these discussions. The data collected were entered into word processing software as transcripts. Our research team developed a more sophisticated understanding of the numerous issues and implications that the new change may cause in the agency. This information allowed our research team to present a recommendation that considers the social concerns and needs of employees to the managers of the Building Team.

3.3.3 Research of Mobility Tool Users

Research of organizations having already implemented various mobility technologies provided insight about the difficulties they faced as well as the benefits obtained and their implementation plan. Our research team was concerned with the technical and social implications that were experienced by the other agencies that are similar to the Building Team. The organizations for this method were also used for information for determining what similar organizations are using to improve mobility of field workers seen in Section 3.2.

3.3.4 Interview with BIS agents

To gain information about the technical specifications of the programs used by the Building Team as well as any limitations present that may narrow our research team's recommendation, an interview with the Business Information Systems (BIS) group of the Building Team was necessary. The BIS team is the approving authority when considering implementation of new technologies. Also, BIS provided information about past research done pertaining to mobility tools and what future actions may have been taken to pursue a new mobility system. This information provided direction for the project and influenced potential recommendations.

3.4 Identifying Available Hardware and Software Solutions

The methods described in section 3.2 provide information about the solutions employed by companies throughout the world. However, some of the products discussed may not be available in Australia. Some solutions have been tailored for a company in a specific location and are not available in Australia. In this section, our research team describes methods used to investigate and identify technologies available in Australia.

3.4.1 Researching Available Mobile Devices

As mentioned in section 3.2.1, the Internet is an effective resource to locate contacts with knowledge of the introduction of mobility tools. Our research team investigated the availability of relevant products and their costs. Conducting research to find less costly systems that offer the required services will benefit the Building Team should they decide to implement our recommendations.

We attempted to develop a comprehensive sample of possible technologies, if the products/services identified are relevant to the Building Team. Our research team identified possible technologies to provide the Building Team with suitable options and detailed the costs and benefits concerning characteristics of particular interest of the Building Team so the best system may be selected. The pricing of the devices and other initial implementations costs were obtained from advertised rates, but further discounts will be available because the Building Team is a large, government organization. Presenting a variety of products to choose allows the evaluation process to be easier and increases the chance of finding a superior solution.

3.4.2 Research Broadband Service and 3G Wireless Service Providers

Based on our research team's accumulated background information, proposed solutions will require internet access through broadband services, 3G wireless systems or both. We analyzed the different data gathering methods such as internet research, phone calls and personal visits for this method. Since the service providers were local, visits to each were reasonable. Upon our third visit we realized that the information being provided to us was the same information we could obtain online ourselves. The Internet was used to obtain quotations from phone providers, which were then used as costs for our cost-benefit analysis. Prices may vary depending on which plan is chosen and bundling of certain packages, but our research is performed to establish an estimated cost for broadband service used with the mobility devices recommended.

3.4.3 Investigate Companies Offering Mobility Solutions

When conducting background research, we found private companies such as TBS Mobility, which implement and maintain mobility tools suited to an organization's needs. Australia, being at the forefront of technological advancements, has similar companies. From online research, technology fairs and personal communication, our team identified companies offering such solutions within the Australian state of Victoria. City of Melbourne Council has strict financial limitations and has an IT group, which reduces the likelihood of such companies being contracted to provide mobility solutions to the Building Team. The costs for hiring the services of a company similar to TBS Mobility for the Building Team is estimated to be in excess of AU\$100,000 for initial costs. However, our research team concluded that learning the processes those companies use to create a mobile workforce would provide valuable information to aid us in providing the correct information to BIS so that a trial is considered.

3.5 Cost-Benefit Analysis

An important factor in establishing the desirability for the Building Team to implement a mobility system is cost-benefit analysis. Our research team determined the potential benefits by comparing their current system to the proposed alternatives. Some aspects considered were:

- Time spent performing field tasks
- Commute time and travel costs to and from the office
- Implementation costs of new systems
- Time performing tasks with new systems

3.5.1 Surveys

The survey tool described in section 3.4.3 included questions addressing the amount of time spent re-handling work by each employee that could have potentially been completed in the field if mobility systems were implemented. The data pertaining to inefficient time usage was collected to facilitate a cost-time analysis for each task. To minimize biases, emphasis was placed on question types chosen (multiple choice, rating, short essay answer, etc.) and word selection.

3.5.2 Data Acquisition

To gather essential data necessary to form an educated recommendation, our research team acquired archived information about the organization through previous methods and research. This data will include permits issued, expenditures of the Building Team, and income produced per year. This information was available through previous analyses by Building Team officers and tables provided by Human Resources department of the City of Melbourne Council. For us to construct a viable cost-benefit analysis, we needed to establish the resources expended and the output produced using the present system.

3.5.3 Data Processing

Once all of the data were obtained, our research team created a template for a future cost-benefit analysis. Simple accounting was used for the analysis by subtracting the costs of the implementation tools from the benefits and wages saved by not performing redundant work. The results were tabulated for easy readability.

3.6 Summary and Recommendations

Our research team collected all data within the first six weeks in Australia. The methods presented in this chapter were not necessarily performed in the order presented. Also, similar methods with different objectives were combined. For example, our team did not intend to administer multiple surveys; instead, one survey with distinct sections was administered to meet multiple objectives.

All of the methods described were employed to meet our five principal objectives. These objectives deal with acquiring data used to fulfill our research team's ultimate goal: to provide the Building Team with a recommendation concerning mobility tools and an implementation plan that will help reduce the agency's redundant work. The quantitative data gathered by the cost-benefit analysis provided financial information.

Qualitative data from interviews, surveys, and casual discussions enabled us to assess the societal desirability of a replacement mobility system. Our research team used this data to establish the need for mobility tools within the Building Team and provide a recommendation for suitable mobility systems.

Chapter 4: RESULTS AND ANALYSIS

The following sections include a cultural uniqueness section discussing the distinct relation of the Mobility Project to Australia, as well as sections that contains the results for each of our research team's five objectives.

4.1 Cultural Uniqueness of the Mobility Project

While in the United States, our research team had not understood the reasoning for the selection of the Melbourne, Australia Project Center for the Mobility Project. It seemed that the project, from the description given by the site advisor, could be completed entirely in the United States with little to no interaction with the sponsor because substantial research could be carried out online. Upon arrival in Australia, we realized that this is not the case.

During the first weeks of on-site project work, we learned that the MCG team of the Building Team has competition. In 1994, the Victorian State Government deregulated the tasks performed by the MCG, allowing certified private builders to perform the same tasks (Aldridge, Personal Communication). Our team has identified the Netherlands as another country that has enacted similar legislation nationwide (Meijer, Visscher, 1997). The Building Team, as a nonprofit government agency in a competitive industry, must continuously review the performance of its officers and alter its existing systems to improve workflow.

To our knowledge, the only other city council within Australia that has implemented mobility tools for their Building and Planning Branch is Brisbane. Councils have used mobility tools in various other branches, or research was ongoing for future implementation. Business Information Services grants approval for trial studies for new technologies within the City of Melbourne Council. They must be provided with sufficient information about the need for a new technology and the technology must be proven to positively affect an organization. Given that mobility tools have been used in few Building and Planning applications within Australia, our team has provided more information about difficulties Building Control Officers within the Building Team cope with daily.

4.2 Identify Field Services

To identify the services delivered by employees of the Building Team, our team used three major methods. The methods used were interviews, shadows, and casual discussions. The transcripts for the interviews and shadows can be found in Appendix D and Appendix G respectively of this report. In an attempt to better understand the services to be enhanced by the implementation of mobility tools, we have developed the following list of all responsibilities offered by the Building Team based on interviews with

Building Team management. The work of each team of the Building Team is closely related and the processes they use to deliver their different services are similar.

1) Building Inspections

Major responsibilities of the City of Melbourne Building Team are to perform safety inspections and ensure construction companies are obeying building codes both during construction and while the building is occupied. The process for completing an inspection begins with researching information pertaining to the work site and the construction company from their internal systems Pathway and Compass, after which the officer obtains printed copies of any documentation he or she believes will be required on site. Finally, the officer inspects the site by completing a pre-existing checklist. Mobility tools could potentially alleviate the research process required in the office and allow the officer to access Pathway and CoMPASS records in the field and have access to the inspection checklist on the tool as well.

2) Issuing Permits

In order for citizens in Melbourne to perform construction, hold events in public areas, or redirect traffic, a permit may be issued by the Building Team or certified private builders to allow this to take place. The applicants for the permit present the Building Team with proposed plans for their event/construction and a permit will be issued if the Building Control Officers find all items are up to code. If any items are not up to code, the officer will notify the applicant of any changes to be made. Mobility tools could provide officers with code information while on site since most event permits are issued within a day, if not hours, before the event begins. Mobile printing could also be used to issue permits in the field instead of printing in the office and mailing to the applicant.

3) Providing advice

During construction, an owner may seek the advice of the Building Team to ensure construction is up to code and any changes to their design are required to obey codes. Officers travel on site to observe the work site and recommend any changes needing to be made. Access to codes of Australia would be highly beneficial to officers in the field because they rely heavily on memory when recalling building codes. A hard copy of codes is not always readily available to field officers so electronic copies of these codes on a mobility tool would be more convenient.

4) Responding to complaints

Outside business hours of the Building Team, two building officers remain on call for emergency situations. One officer (On Call 1) responds to concerned-neighbor complaints of noise,

out-of-hours work (building regulations require construction to be performed during specific hours of the day, any work performed outside these hours requires a permit or is punishable by a fine), traffic blockage, etc. and the other (On Call 2) is used for emergency building failures such as floor or roof collapses. On Call 1 is called into the field approximately three to five times a weekend and On Call 2 is typically called out two to three times a month. The complaints to the Building Team range from squatters (persons occupying vacant buildings) to shoddy construction and dust/noise. When the Building Team receives a complaint, the on-call officer must research current Pathway information for the site and determine which documentation is necessary to bring on site with them. The on call officer must then travel to the site in question with the office documentation and gauge the situation. However if the officer does not have the correct documents, he/she cannot make an informed decision of the situation. If the building officer had access to Pathway records in the field when responding to a complaint, then the situation could be handled with more confidence knowing the officer has all relevant documentation required. Also, when travelling around the city, officers often notice peculiar practices on other building sites and will conduct "surprise" inspections. Mobility tools offering the officer access to current permits and building site information could provide greater enforcement of building codes.

5) Undertaking programmed audits

The Building Team performs proactive audits every two to three years for high occupancy buildings in the city of Melbourne. These inspections are scheduled and mandatory for buildings such as hostels, hotels, and other places of high "tourist type" occupancy where residents are not well informed about their living environment. The building officers perform this type of inspection using a checklist. These checklists could be adapted to a mobility tool that could potentially update the Pathway file of the building while in the field.

6) Inspection and approval of events

The city of Melbourne is constantly bustling with events and activities being held on public grounds, known as Places of Public Entertainment (POPEs) for tourists and residents alike. To ensure the safety of the patrons of such events, the Building Team is responsible for issuing permits for these POPEs. The sponsor must present a plan for the event beforehand for the Building Team to approve construction. A final inspection is completed by the Building Team to ensure compliance to safety codes after construction of the site is complete. If any areas fail to meet these codes, they are quarantined so the patrons of the event remain safe. Approval of these sites is often completed on site on the day of the event, even hours before the event is set to start. Given this time

constraint, mobility tools could be used to approve and process a permit on site so the event may begin as scheduled.

7) Emergency Call outs

Emergency callouts are different from regular complaints as building officers have at most 48 hours to conduct all background research and perform site inspection before issuing an emergency order. Examples of such situations are: squatters spotted breaking and entering in an abandoned property, and a collapsing floor.

Having only 48 hours to issue an emergency order, it would help to have to enter data into Pathway only once instead of taking notes and photographs on site, and then coming back to the office to create a file and add in all the data.

8) Development of guidelines

This is a task performed by managers and more experienced building officers. They discuss how current practices may be improved or how they can enhance the overall running of the agency. Aside from the origination of this research project, this Building Team responsibility would receive little, if any, benefits from the implementation of mobility tools.

9) Financial management

Every time a request for a permit is lodged, the owner/contractor incurs a fee, and owners of construction sites are fined when they do not comply with building regulations. For instances where the owner does not take the actions that the Building Team ordered, the Building Team hires a contractor to perform said actions. For example, if an owner does not comply with an order to build a fence around an abandoned property, the Building Team will hire and pay a private contractor to build the fence. However, the Building Team will not incur that charge and will send a bill to the owner on top of all fines to be paid.

A mobility device that would help a building officer issue a permit would be a mobile printer installed in the officer's vehicle. The ability of a BCO to issue fines for noncompliant construction or building occurring without proper permitting could raise revenue earned by the Building Team and will improve public safety within the city.

10) Corporate initiatives

The Building Commission of Melbourne sometimes creates new procedures that building officers need to follow. They inform the building officers of the new procedures via email or flyers. Corporate initiative is not a task performed by the Building Team, but a requirement the team must

comply with and be knowledgeable of. Mobility tools would have little influence on this responsibility aside from automatic updating of the codes and standards of the Building Team in a digital format on the device.

11) Effecting legislative changed

The City of Melbourne Council regularly updates its legislation and must update building codes and other related regulatory documents. Building officers refer to these documents when performing inspections and providing advice among others. Inspections are performed on site and providing advice may be conducted out of office. Having access to the latest edition of such documents, the Building Code of Australia, for instance, would prove extremely useful. It would also reduce the need to print new copies of such documents and reduce paper usage.

12) Responding to service requests

The Building Team compiles all information pertaining to a particular site on file in the office. This information includes permits issued in the past, complaints received from neighbors, and other various building- and planning-related materials. When a citizen or builder seeks the services of the Building Team, a BCO will gather the site file containing all relevant data and travel on site to provide a quotation for services or recommendation for alterations required to comply with BCAs. Access to all these documents on site is vital to provide a well-informed decision to the client; a mobility tool could provide the Pathway file containing all site information in the field.

13) Liaising With Key Stake Holders

The BCOs at the Building Team provide a service to its clients by communicating with key stakeholders of companies. The agents typically correspond with engineers, owners, and contractors to assess matters related to construction and public safety. The communication between key stakeholders and the building officers is usually intended to help ensure that the Building Team officers will address the building and construction issues and the questions pertaining to them.

14) Issuing Building Notices/Building Orders/Emergency Orders

A building notice is a recommendation made by the BCO to a property owner/builder/contractor to remedy building practices so that they are up to code. A notice is only a suggestion and the customer is allowed to provide arguments against the recommendation. When a building order is issued, the customer cannot argue against the BCOs directives and has to comply within the specified deadline. An emergency order is only different from a building order in the time allocated to the customer for compliance. Typically, a customer will have 48 hours to undertake the

recommended actions. Should the required actions not be started within the time limit, BCOs will contact a contractor to perform the necessary works at the owner's expense.

Currently, any notice/order can only be issued once signed by a senior officer (Municipal Building Officer and Senior Building Officer). The use of mobility tools would allow BCOs to send the site record to the senior officer for approval via email. The mobility device would, in theory, grant the senior officer internet access and online signatures could be used to approve the decision of the BCO. The BCO would then receive the approved paperwork and email it to the owner. However, approving a notice/order is a big decision that BCOs are reluctant to take before consulting colleagues.

15) Commencing Prosecution

When an owner/developer does not comply with an order within the set deadlines the Building Team is forced to take legal action. This can result in a formal court hearing if a negotiation or settlement cannot be agreed upon beforehand. Prosecution is typically a last resort for the Building Team and occurs only when the owner does not remedy a public safety issue within a predetermined amount of time.

Mobility tools could prove very useful as a source of providing evidence for commencing prosecution. If detailed notes are taken in the field and Pathway is kept up to date, this information could be used as evidence to prove that the client/perpetrator has acted in a manner against the laws, codes, or regulations of Melbourne. Photos of construction not following rules, regulations, or laws may be uploaded to the mobility tool and then to the office database to ensure proof of non-compliance in order to provide evidence against the perpetrator.

16) Squats Management

To ensure the safety of people, BCOs participate in controlling the human occupancy of uninhabitable properties. If squats (known as squatters in the United States) are present at a site they are given information about places they can go that are safe such as shelters, or cheap hostels. The owner of the property is notified that squats are present on his/her property and is usually issues a Building Order to erect hoardings, and to replace or board up doors and windows to prevent squats from entering the building again.

Mobility tools could be advantageous for squats management. The BCOs could use the tool to ensure that the correct information is given to the squats about where to go for shelter. Also a message to the owner or at least a checklist of what the owner needs to fix could be drafted or input via checklist right on site instead of going back to the office and drafting a message based on memory.

4.3 Research Similar Organizations

To accomplish this objective, our research team contacted other organizations either currently using mobility tools or seeking to implement mobility tools. We sought information about employee acclimations and acceptance of these newer technologies, and agencies researching mobility tools could provide their prior background information to our team.

4.3.1 Worldwide Agencies

Our research team attempted to contact city councils in the following cities: London, Great Britain; Auckland, New Zealand; Vancouver, Canada; Boston, Massachusetts; Miami, Florida; Los Angeles, California; and Tokyo, Japan.

Vancouver, Canada has implemented mobility tools in their Fire and Rescue Services Division. They have used Panasonic Toughbooks for their field tasks to allow their workers to remain in the field for longer periods of time without returning to the office for missing documentation. Vancouver's Fire and Rescue Services Division has experienced success with this system, however the implementation of this system within their organization is relatively new and some employees have presently remained with their previous paper-based system.

Our research team had not received responses from any of the other worldwide organizations. Direct contact information of individuals with knowledge of mobility tool implementation within their respective councils was difficult to obtain and often led us to dead ends.

4.3.2 Councils and Companies within Australia

To minimize cultural differences, our research team also contacted city councils within Australia including Melbourne, City of Greater Geelong, Port Phillip, Sydney, Brisbane, Adelaide, and Cairns. Although the Building Team has not implemented mobility tools, other branches of the City of Melbourne Council have begun using these tools to perform field tasks. The Health Services department of the City of Melbourne Council has been testing various mobility tools to satisfy their requirements, however they have not identified a device for long-term use and implementation. Parking and Traffic of the City of Melbourne Council has implemented a system using PDA type devices to gather data in the field and sync to their desktop computers when they travel to the office.

Originally, our research team anticipated performing interviews of other building and planning organizations to gather data on their mobility tool systems. However, Australia is unique in the sense that the Building Commission of Melbourne deregulated part of the permit issuing services of the building and planning industry. In other areas, the Building Team is the sole body offering particular services and enforcement abilities. To avoid an awkward situation with a competitor unwilling to describe the work protocols of the company, we focused our research to other councils and companies that are not in direct competition with the Building Team.

A former employee of the Building Team now working for a private surveying firm agreed to hold an interview with our research team. Their company trial tested palm pilots about six years ago, however they offered no extensive information as to the exact details of the reports that were developed. Our contact in the firm told us the trial of the palm pilots was a failure because the units did not have enough processing ability for them to be useful. The company is now in the preliminary stages of hiring an outside firm to develop a mobile solution with a focus on tablet PC solutions capable of replacing the office computers. This contact confirmed our inference that technical specifications are a major component in determining a proper mobile solution. To ensure implementation does not end in failure, a pilot study with a variety of devices must be conducted to assess benefits attained and employee desirability.

In response to our emails to the various city councils throughout Australia, Europe and the United States, the City of Brisbane Council informed us that they have implemented tablet PCs. However, due to the weight and size of the devices currently being utilized, officers leave them in their dispatch vehicle. In addition, the devices do not have 3G wireless capabilities or the programs required to enter data. The officers resort to taking notes using pen and paper. As a result, those devices only serve for scheduling and route optimization purposes and do not seek to address the issues related to performing redundant work.

The societal concerns faced by the City of Brisbane Council have offered some insight to our research team. The major concern Brisbane experienced was the health and well being of their council members when carrying the tablet PCs. While the weight might not seem excessive for a fit person, holding the device with one arm for extended periods of time does pose an occupational health and safety concern. Unfortunately, correspondence with the City of Brisbane Council was limited and only few responses were obtained through our emails and phone calls. The responses we received were not related to our sponsor's goals. The data we collected were useful to develop ideas of potential social concerns and other problems.

It was more difficult to contact other organizations than our research team had anticipated. We emailed and called over forty councils worldwide and in Australia; we also contacted about fifteen departments within the City of Melbourne Council. We had only a limited number of responses, but no other building or planning agency that we communicated with had implemented a mobile solution. Many council agencies plan to implement a mobility solution, but they are only in primary stages of considering mobility tools as a way to increase efficiency and effectiveness, as is the case with Melbourne's Building Team. Our research team evaluated the potential services that can be successfully enhanced by mobility tools by using the information they provided. This data can be valuable for our research because the information we obtained will allow our team to form important conclusions and recommendations. The City of Melbourne Building Team is a pioneer in establishing the use of mobility tools to increase the efficiency and effectiveness of their employees, especially among Australian government councils.

4.3.3 CityWide Service Solutions

CityWide is a private company working closely with the City of Melbourne Council. Whenever a building owner does not comply with an order, the Building Team employs CityWide to perform the required works at the expense of the owner. They are also in charge of maintaining street furniture (e.g. street names signs, other street signs, drains, etc). Starting in 2007, employees were given Panasonic Toughbooks to aid them in their daily responsibilities. Previously, CityWide used another mobility device that was deemed outdated in 2007. We shadowed a CityWide officer to receive a field demonstration of their mobility tool and its capabilities.

Surveillance officers at CityWide are responsible for inspecting street furniture. They perform their tasks by downloading the full database of all street furniture onto the hard drive of their tablet PC and a schedule of the roads to inspect. Since all the information is contained in the tablet PC, the officer updates the database as they conduct inspections through electronic checklists.

The main benefit of this system is the officer goes to the home office once a day to synchronize the tablet to the main database with the remainder of their day spent in the field. The officer saves the company valuable time and money and reduces carbon emission by decreasing the amount of driving. The checklists are also very useful as they ensure that all required data are recorded consistently for similar inspected items.

The downside of using a CF-19 Panasonic Toughbook is the device is relatively heavy (2.3 kg), causes employee inconvenience, viewing of the screen was difficult under direct sunlight. However, these problems are associated with the particular product, not problems with all mobility tools. The surveillance officer expressed their dependence on the mobility tool in their daily responsibilities and believed they could not satisfactorily complete their jobs without a mobility tool. Having been an employee of CityWide for the past five years only, the surveillance officer has always used a mobility device. They were unable to provide our research team with information about how surveillance officers performed their daily responsibilities with their previous system.

The interviewed officer was not knowledgeable in the technology behind the tablet PC that they were using and referred us to an employee of the IT group of CityWide. However, we could not obtain documentation about the research that was done prior to the implementation of the Panasonic Toughbooks or results collected after CityWide adopted the new mobility device. Valuable information gathered from speaking to the IT representative was the Toughbook was running a full version of Microsoft Windows, which is what the desktop computers run at CityWide's home office, eliminating any compatibility issues for the programs to run on the mobility device. They also mentioned that the surveillance officers' tasks do not require real time access to the main database, which limits risks of their tablet PCs "crashing" and reduces security issues over 3G wireless networks.

4.4 Investigating Concerns with Implementing Mobility Tools

Our research team gathered information regarding the potential social and technical issues that may arise with the implementation of a new work pattern in the office. This section provides data gathered by our team through research and surveys completed by officers of the Building Team.

4.4.1 Research Team Survey Data

The survey that was distributed April 8th, 2010 has addressed many of the social concerns regarding the possible implementation of mobility tools. The questions addressed employees' concerns in terms of change in work habits, any concerns they have, and whether they want a new device to replace their existing workstation. Charts depicting the responses of each separate team of the Building Team can be seen in Appendix F.

Our research team first sought to measure the degree of support of current BCOs within the CBMT to implement a mobility tools for their everyday job responsibilities. The chart shown in Figure 4 displays the responses of twenty-three BCOs when asked about their support for the replacement of their current paper-based system. Twenty-two of these twenty-three (92% of the Building Team's total employees) answered they supported change while none preferred to continue with their current system.

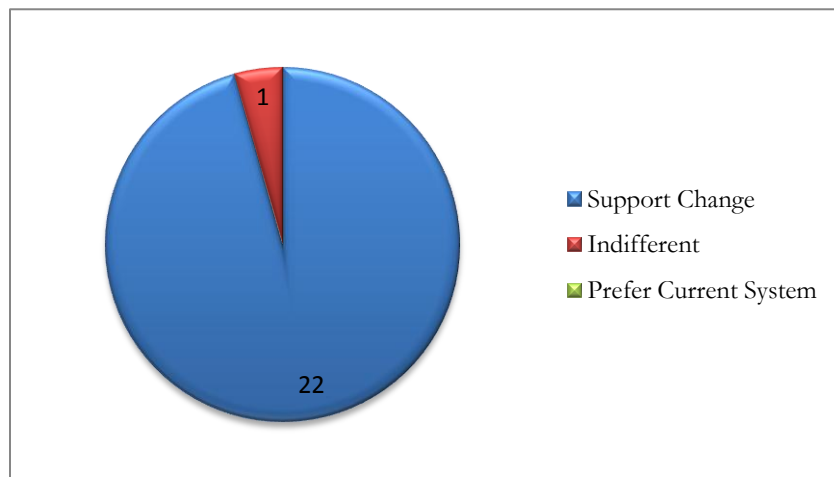


Figure 4: BCOs Support For Implementation of Mobility Tools (23 respondents)

Next, we asked how beneficial mobility tools could be to their daily tasks if implemented within the Building Team and the future state they would like the office to evolve to through the usage of mobility tools (Figure 5).

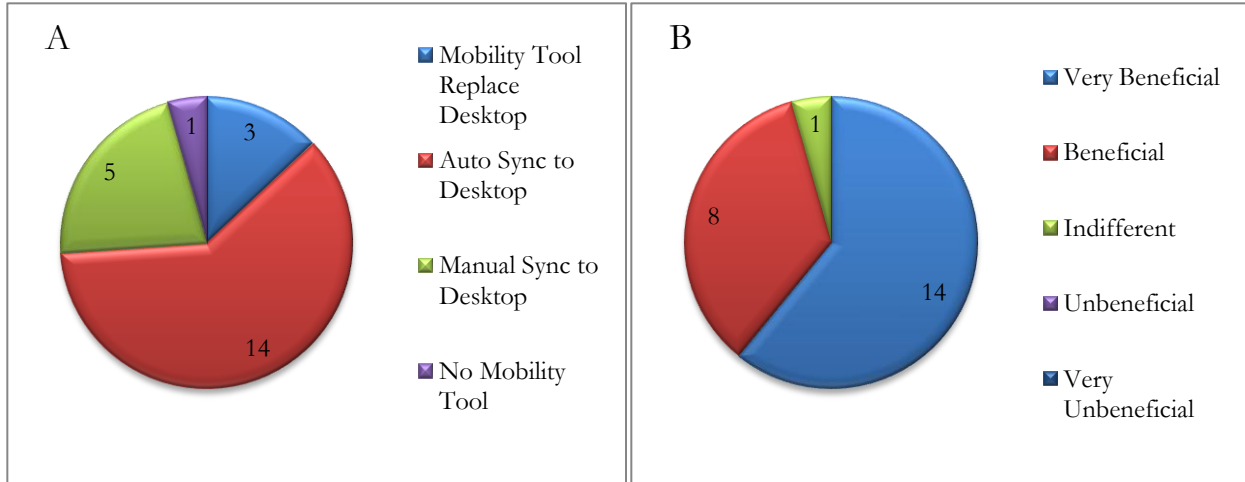


Figure 5: Panel A: As a future state, which would you prefer? (23 respondents); Panel B: How Beneficial Would a Mobility Tool Be? (23 respondents)

As shown in Figure 5, the employees of the Building Team are very inclined to adopt the use of mobility tools in their daily activities. However, we obtained additional information showing that the services provided by the Building Team could be improved by the implementation of mobility tools. Our research team acquired a customer satisfaction survey that we analyzed to obtain data about what areas customers felt unsatisfied with. This data was used to determine which areas mobility tools to increase customer satisfaction could improve.

We distributed our surveys to the Metropolitan Fire Brigade to gather information about the desirability of mobility tools within their organization as well as what features the employees would find most beneficial in the field. Although we received only five responses from MFB, the trends present in the information gathered was identical to that from the Building Team. Both organizations highly support change in their current systems to integrate newer technologies to improve their job responsibilities.

4.4.2 Customer Service Survey

Nexus Research conducted a survey of 281 of the City of Melbourne Building Team's customers in June 2009 to determine the agencies level of customer satisfaction. The summary and conclusions section of the survey can be found in Appendix H. The results of the report are based on 281 phone calls to customers including contractors, building professionals, planners, and any other clients of the Building Team. The data collected and the charts shown were not helpful, but we analyzed the data collected from general comments customers made at the end of the interview. No questions were asked of the customers for this section of the interview, the data obtained was strictly the uninfluenced opinion of the customer. We organized the data into 15 types of unsatisfied response columns and a single satisfied response column. The chart in Figure 6 demonstrates that out of 127 responses received; only 18 of them are positive. The divisions of the negative responses were chosen to organize the unsatisfied responses into sub groups. These smaller groups allowed

our research team to show the areas in which customers find the Building Team unsatisfactory. The three answer choices for improvements are the following customer responses: the system is outdated, the agency needs more staff, and the staff performs too slowly. These three sets of data received 35 out of the 127. Those 35 responses related to the lack of efficiency and effectiveness by the Building Team and made up approximately 28 percent of the responses from the general customer comments section of the survey.

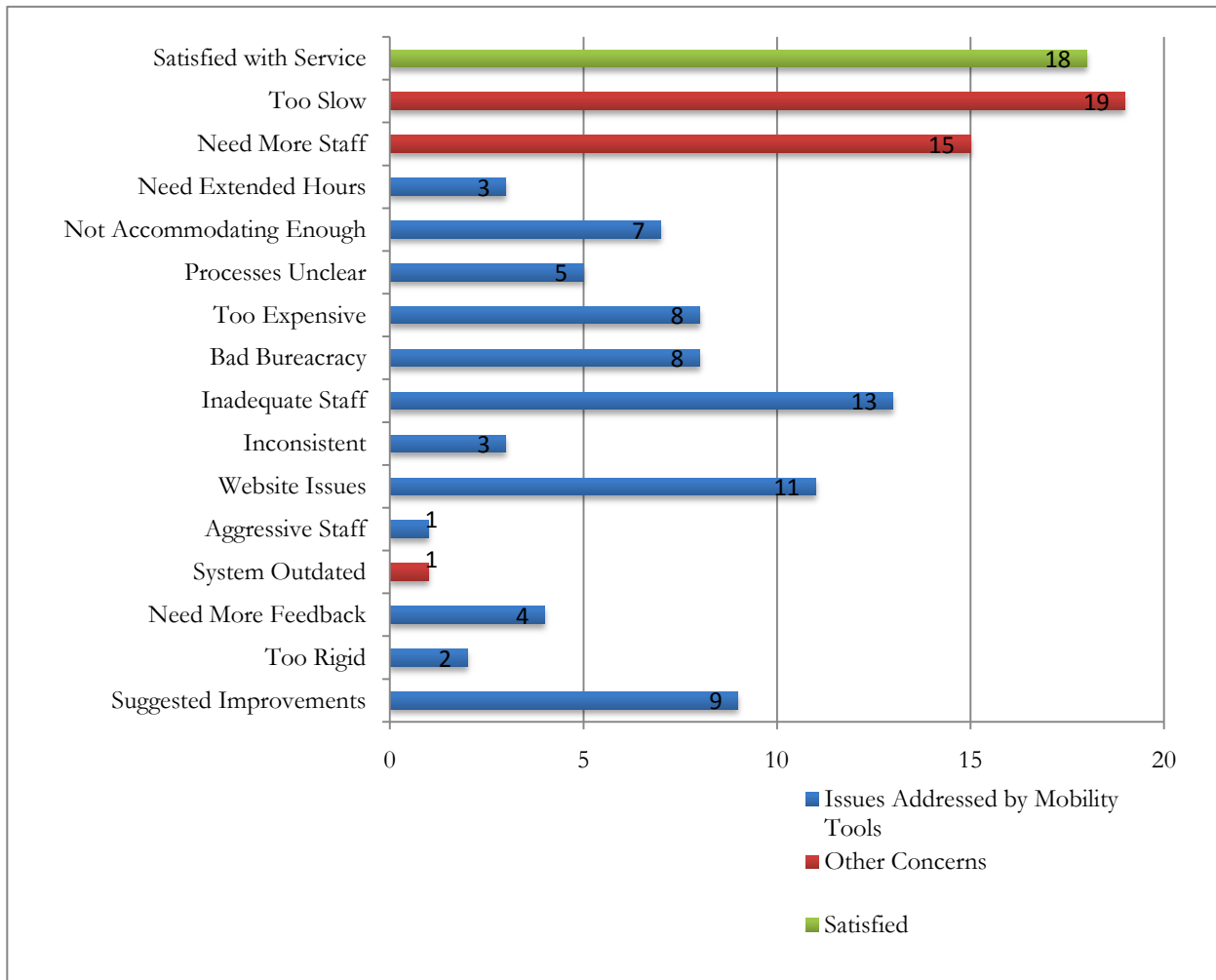


Figure 6: Customer Satisfaction Survey Data (Appendix H)

4.4.3 Technical Concerns

Our research team interviewed representatives of the Business Information Services group of the City of Melbourne Council to gather specific details required for our recommendation. For implementation of a mobility tool to be approved, the need for the tool must be established and it must be clear that the benefits will outweigh the costs. They also expressed concerns with Occupational Health and Safety (OHS) requirements while using these new tools in the field. Upon contact with a Human Resources representative in charge of enforcing OHS regulations, we learned that BIS first proposes a particular device to be trialed. The device is then inspected for OHS compliance by comparing size to weight to overall performance of the

device. Since our research team is only recommending what types of devices to be trialed and not specific products, we were informed that we do not need to worry about OHS regulations.

Our interview supplied information about the current systems used by the City of Melbourne Council. This information included data about Citrix, a program allowing any device with internet access secure admission to the office databases, thus eliminating our security concerns over wireless networks. The Information Technology manager also informed us that BIS have software for most devices to allow them access to the City of Melbourne Council network.

Through our interview, we learned that we do not need to recommend specific products in our business case to BIS but rather broad categories of devices to be considered for implementation within the Building Team. BIS will ultimately choose the manufacturer and model for any future pilot studies or implementation of mobility tools. To increase the success rate for a future pilot study, multiple devices may be chosen and trialed within the Building Team to evaluate actual costs and benefits of each.

We were informed that City of Melbourne Council has no contractual agreements with any potential suppliers but has found products from Dell, HP, IBM, Fujitsu, Toshiba and Apple to be very satisfactory. While we did not limit our search to those brands, we considered the most relevant products each of those brands offers.

In the pilot study conducted in 2007, BCOs complained about the slow booting time, size, weight and unreliability of wireless connection. From talking to the different cell phone providers, they all agree that 3G wireless coverage has much improved over the past three years. For the new devices to be trialed, they have to be smaller and lighter than the previously trialed Lenovo X41.

New devices have more efficient processors in terms of heat dissipation, energy consumption and processing speeds. Some of them have two central processing units, enabling faster data processing capabilities. We also looked for devices with higher bus speeds than the Lenovo X41, which allows for faster processing speeds. While the cache memory does affect processing capabilities, it is not as significant as CPU and bus speed. The screen resolution determines the amount of information that can be displayed on the screen. A higher resolution implies that smaller items (e.g. small items on a map) will be displayed clearly. The 1024 x 768 resolution that the Lenovo X41 offered is sufficient, but a higher resolution will enable BCOs to view more information, especially when using CoMPASS, for the same screen size. More storage space in the hard drive would also be beneficial but not essential. Considering only hardware specifications, the slow booting time of the X41 is caused by the 4200 rpm speed of the hard drive and we will be looking for devices with higher spindle speeds. Finally, while 0.5GB of RAM is enough to run the programs (BIS representatives, Personal Communication), more memory would make the system faster and thus would be preferable.

4.4.4 Business Information Services Data Requirements

To address the Business Information Services' requirement of providing sufficient information that these mobility tools will benefit the organization, we asked BCOs to provide some information about how their time is spent during an average workweek. The first of these questions was how often a BCO travels to a site and discovers he or she has not brought the proper documentation required to provide the service to the client. The survey data can be seen in Figure 7.

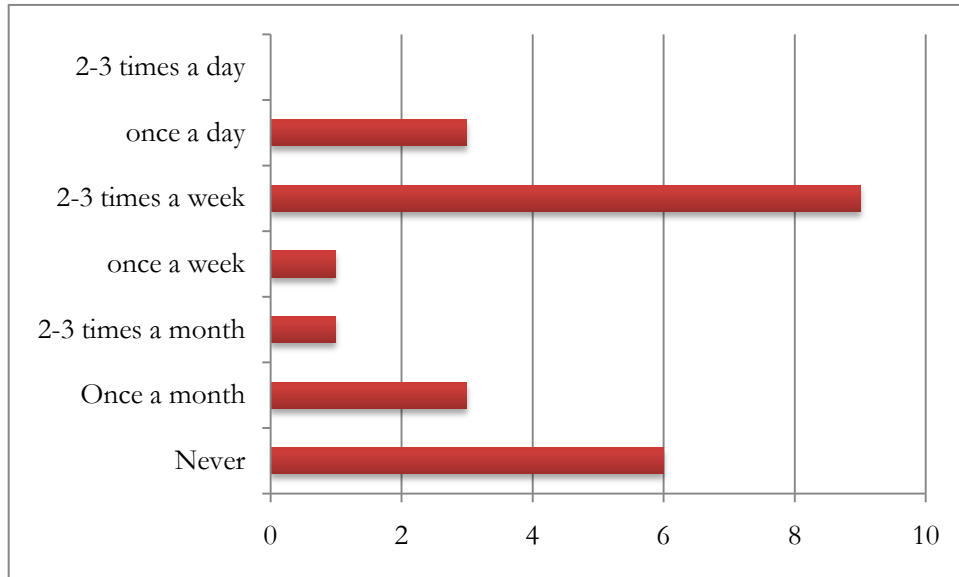


Figure 7: Frequency of Unprepared Site Visits (23 respondents)

Next, we asked surveyed BCOs to approximate the amount of time spent per average workweek gathering relevant site information prior to attending a site. The relevant site information is the prior history of the site pertaining to permits and inspections or the proposed plan submitted by a contractor for the construction. The survey data for this question can be seen in Figure 8.

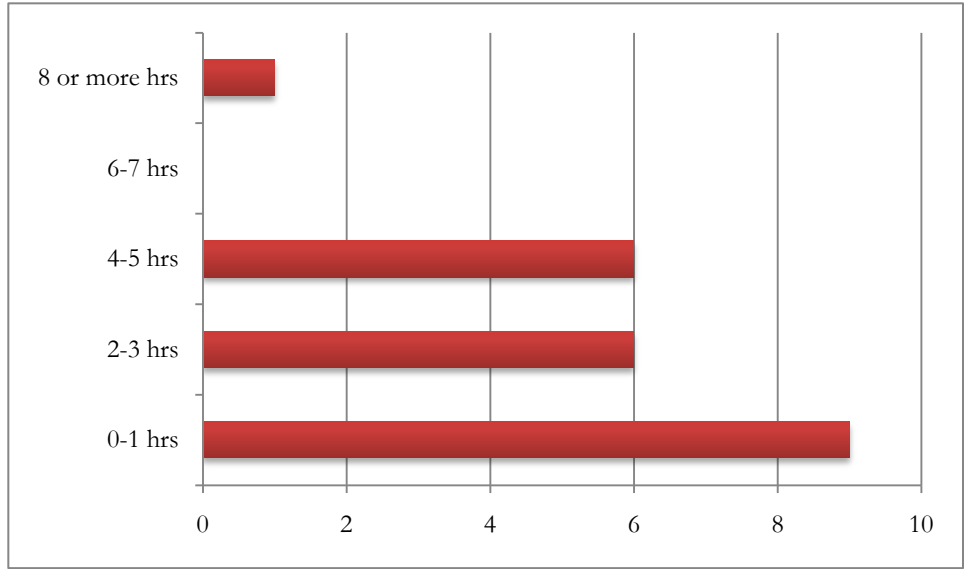


Figure 8: Time Spent Gathering Relevant Site Information (22 respondents)

To estimate potential time savings from the usage of mobility tools, we asked BCOs to approximate the amount of time spent performing redundant work. Redundant work refers to reworking of data including re-entry of field data, multiple site visits to obtain missing information, and searching for missing documents. The data from this survey question can be seen in Figure 9.

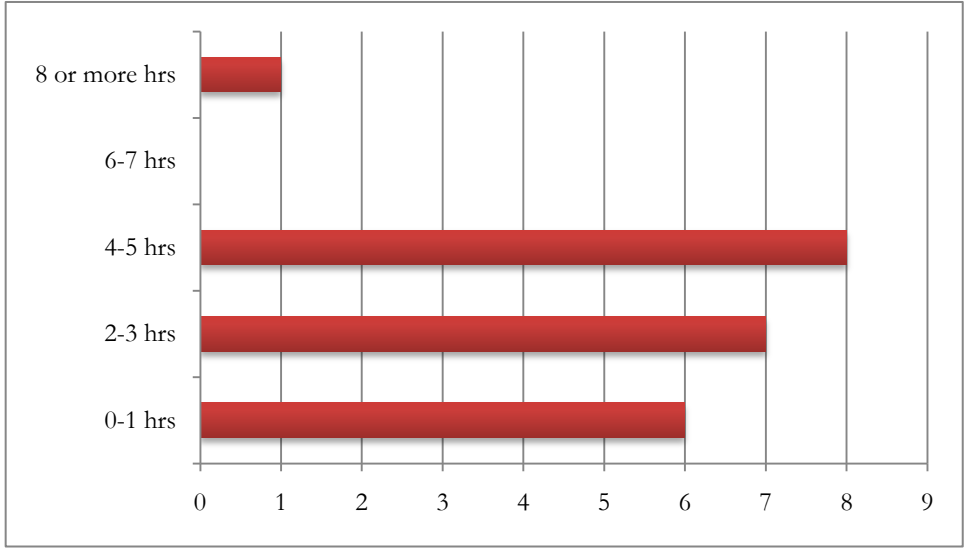


Figure 9: Time Spent Performing Redundant Work (22 respondents)

4.5 Identify Available Hardware and Software Solutions

To identify suitable mobility tools for the Building Team, our research team investigated a wide variety of potential options, capable of providing the necessary services performed by Building Control Officers. We gathered necessary information via online research on manufacturers' web pages as well as extensive reviews of these devices.

Our research team planned to research alternative software allowing the Building Team to perform the same responsibilities with greater efficiency and effectiveness. Through further discussion with Warren Knight, Executive Officer of the Building Team, and a BIS business analyst, we have concluded that the Building Team does not seek to replace their current software. They are continuously upgrading and replacing specific portions of their systems and our mobility tool recommendations must be compatible with these current programs.

4.5.1 Investigating Third Party Options – Pervidi

Our research team visited a technology fair, held at the Melbourne Exhibition Centre, in an attempt to find private companies offering mobility solutions. After examining many companies exhibiting there, we came across Pervidi. The company is a provider of software and hardware products for managing field activities. Pervidi is based in Toronto, Canadian with outlets in New York, USA and Hawthorn, Australia.

Talking to the sales representatives at the technology fair proved little background material and the information they provided was very biased. They were very knowledgeable in terms of how their programs worked and spoke in a very technical manner, which our interviewers had difficulties understanding at times. The transcript of our conversation with the salesmen can be found in Appendix D.

Pervidi identifies the information the customer needs access to on site and creates an intermediate database containing those fields only. As a result, the intermediate database is smaller in size and accessing and modifying particular files takes less time. The mobile devices have access to the intermediate database and update it whenever 3G connectivity is present. The intermediate database then updates the City of Melbourne Council's main database at set time intervals depending on the customer's preference. The benefits of their system include:

- No need to carry reference documentation.
- The use of electronic checklists ensures that items being inspected and information being stored is consistent.
- Grant access to relevant fields of any permits within Pathway while out on-site.
- Eliminate duplication of work inherent to paper based systems.

We asked for a rough estimate of the cost of implementation and maintenance for a five-year period and it amounted to AU\$150,000. When we introduced the idea to an employee of BIS and the IT group

within City of Melbourne Council, they explained an expensive service such as this was unreasonable for the City of Melbourne Council and they would prefer not to involve a third party in their data management. We also learned the City of Melbourne Council currently possesses the staff and tools required to implement and maintain mobility tools and that a private company would be redundant.

4.5.2 Investigating Third Party Options – Destiny Australia

The City of Greater Geelong, Australia is currently looking at the possible implementation of digital pens to create a more mobile workforce. Our team presented the scope of our project at a Victorian Municipal Building Surveyors Group meeting (VMSBG), at the end of which a building surveyor from the City of Greater Geelong mentioned his council was currently working with Destiny Australia to reduce the problems associated with a paper-based office. Destiny Australia is a company offering a digital pen capable of transferring digital copies of forms from the field to the office. The pen is a functional ballpoint pen, however the writing completed with it is converted to an electronic copy. This copy is sent via wireless service providers to the office database or to an email address.

The usage of digital pens is plausible as forms being developed for BCOs of the Building Team are very uniform. The ability for the user to send a completed form to the office or to an email address from the field could prove very beneficial to BCOs and improve customer satisfaction and credibility. Officers could provide a hard copy of forms to the client and email a copy to themselves and the client.

The major drawback of this product is the lack of access to pre-existing data. A BCO would be capable of completing forms, however no access to site information or building codes is available. From survey data gathered by our research team, BCOs answered that access to Pathway site information and to BCA standards would be very beneficial in their field responsibilities. The devices offered by Destiny Australia cannot provide access to office-based programs and databases thereby lessening the desirability of these tools within the Building Team.

4.5.3 Device Selection

Due to BIS's reluctance to involve third party companies with their data management systems, our research team investigated specific devices that would meet the requirements of the BCOs of the Building Team. Selection criteria for the devices included the concerns expressed by BIS and Occupational Health and Safety regulations that can be found in Section 4.4.3 of this report. More importantly, we ensured that the new devices would overcome the weight, size, and slow booting time limitations of the Lenovo X41, used in the 2007 pilot study.

New devices have more efficient processors in terms of heat dissipation, energy consumption and processing speeds. Some of them have two central processing units, enabling faster data processing capabilities. We also looked for devices with higher bus speeds than the Lenovo X41, which allows for faster

processing speeds. Although the cache memory is not as significant as CPU and bus speed in terms of affecting processing capabilities, it was nonetheless considered in our study.

More storage space in the hard drive would also be beneficial but not essential. Considering only hardware specifications, the slow booting time of the X41 was caused partly by the 4200 rpm speed of the hard drive and we will be looking for devices with higher spindle speeds. Finally, while 0.5GB of RAM is enough to run the programs (BIS representatives, Personal Communication, Appendix D), more memory would make the system faster and thus would be preferable.

The screen resolution determines the amount of information that can be displayed on the screen. A higher resolution implies that smaller items (e.g. small features on a map) will be displayed clearly. The 1024 x 768 resolution that the Lenovo X41 offered is sufficient, but a higher resolution will enable BCOs to view more information, especially when using CoMPASS, for the same screen size.

4.5.4 Personal Digital Assistants (PDA) and Smartphones

Smartphones and PDAs are lightweight mobile devices that support many applications, which perform a wide variety of tasks. These devices were considered because of their portability, processing power, and versatility. As compared to 2007 when the previous pilot study was performed, better central processing units and increases in the reliability of 3G wireless coverage have improved the feasibility of implementing smartphones as a mobility solution for the Building Team. Many smartphone and PDA devices are available, however through our team's research, we have found smartphones offer the same abilities as most PDAs with the added ability to make phone calls.

The following smartphone devices were researched, as potential solutions to the Building Team's Mobility Project, but other solutions that provide similar functions exist. The iPhone and the HTC Snap have been previously implemented within City of Melbourne Council. Blackberry smartphones are an alternative with similar characteristic, but have not been widely used within Council. These three devices are the highest performing and most proven smartphones we have researched, however other models with similar specifications may be considered for future implementation. Table 1 shows the technical specifications of the three smartphones researched.

Product Name	Blackberry 9700	iPhone	HTC Snap
Screen Size (inches)	2.4	3.5	2.4
Screen Resolution	480 x 360	480 x 320	320 x 240
Dimensions (mm)	109 x 66 x 14	116 x 62.1 x 12	117 x 62 x 12
Weight (kg)	0.122	0.135	0.12
Processor Speed (GHz)	0.624	0.6	0.528
Hard Drive Speed (GB)	16	32	16
RAM Size (GB)	0.256	0.256	0.192
Battery Life	5.5hrs talk/15 days standby	5hrs talk/12.5 days standby	5hrs talk/16 days standby

Table 1: Technical Comparison of Blackberry 9700, iPhone, and HTC Snap

The major problems with handheld devices are small screen size and difficulty inputting data. Viewing documents and plans of buildings is inconvenient on the small screen of a smartphone and note taking would consume more time due to the small keyboard and thumbing (typing limitation using only thumbs). In our research team’s personal communication with BIS, we learned the HTC Snap and iPhone have been successfully implemented in other council organizations when checklists were used. The Building Team requires a more elaborate note-taking process and has yet to establish standard forms for officers to complete while in the field. Due to the lack of electronic checklists, implementation of smartphones is more difficult and less likely to succeed.

A major advantage of a smartphone is access to the Internet. According to BIS, an internet connection is all that is required to gain access to the office database through Citrix. Citrix on a smartphone has many abilities useful to the Building Team such as remote access to Pathway, CoMPASS, and Hummingbird. They also offer the ability to run Microsoft Office (Excel, Word, and PowerPoint). At a cost ranging from \$200-300, a smartphone could offer a partial solution to the BCOs’ need for mobility tools with a smaller expense to the organization.

4.5.5 Laptops and Netbooks

Newer laptops include better hardware than the devices available in 2007. Even smaller, less powerful netbooks are comparable to the Lenovo X41 tablet PC trialed in 2007 due to newer technologies. However, laptops and netbooks require the user to input data via the keyboard and mouse/trackpad. Holding the laptop in one hand and typing/navigating with the other renders the laptop less practical than the current paper-based system BCOs currently use while performing inspections. Due to the drawbacks of inconvenience and impracticality, laptops and netbooks were not considered further.

4.5.6 Tablet PC

A tablet PC is similar to a laptop with the exception that the screen can swivel and a stylus is used to navigate and enter data on the touchscreen, instead of a keyboard and mouse. Tablet PCs currently are available in a wide array of sizes ranging from 5.6 inches to 17 inches in diagonal screen size.

We considered specific criteria when researching viable products to be implemented. Those criteria were based on the results of the pilot study conducted in 2007. The main issues with the Lenovo X41 trialed were its weight, size, speed, poor battery life, and compatibility issues with the Building Team software.

The trialed Lenovo X41 had a 12.1” screen size, so we limited our research to devices with screen sizes of 12.1” or smaller. Tablet PCs with a 12.1” screen size are considered as desktop replacements rather than its smaller size counterparts. While the technical specifications of the 12.1” devices are satisfactory, their size and weight made them less desirable options to BCOs. The devices that were researched and found less suitable to the needs of the Building Team are listed in Table 2.

Product Name	W x D x H (mm)	Weight (kg)	Battery Life (hrs)
IBM Lenovo X41	274 x 241 x 33	1.8	2.6
HP Touchsmart TM2T	302 x 223 x 40	2	9.75
Fujitsu Stylistic ST6012	325 x 220 x 32	1.6	5.4
Fujitsu LifeBook T2020 (3.5G)	297 x 219 x 34	1.6	5.6
Fujitsu LifeBook T4410	297 x 233 x 36.4	2	5.13
IBM Lenovo ThinkPad X200T	297 x 230 x 33	2.27	7

Table 2: 12.1” Tablet PC Comparison

We have included a more comprehensive list of technical specifications of the 12.1” devices in Appendix J to give the reader an idea of how powerful those devices are. Since those tablet PCs were heavier and larger than the Lenovo X41, we considered devices with smaller screen sizes. The most-suited devices researched and their relevant technical specifications were obtained from manufacturers’ and professional reviews websites.

The devices below were chosen as they fall in the 5.6” to 10.1” screen size category and include the hardware required to run the programs the BCOs currently use.

- Apple iPad
- Archos 9
- Eee PC T91MT
- Entourage Edge

- Fujitsu LifeBook U2010/U2020
- Fujitsu LifeBook P1620/P1630
- Fujitsu Stylistic ST5111
- IBM IdeaPad S10-3t
- iLet Extreme
- Samsung Q1U-XP

Taking processing abilities, size, weight, and hard drive space into consideration, the most promising tablet PCs from each screen size class ranging from 5.6 to 10.1 inches were determined. A comparison of these devices is shown in Table 3. The research, although not exhaustive, was very extensive and our research team found that these devices would meet the needs of building officers when they are out on site.

Product Name	Fujitsu LifeBook U2020	Samsung Q1U-XP	Fujitsu LifeBook P1630	IBM IdeaPad S10-3T
Screen Size (inches)	5.6	7	8.9	10.1
Cost (AU\$)	1,500	975	2,600	600
Screen Resolution	1280 x 800	1024 x 600	1280 x 800	1024 x 600
Dimensions (mm)	171 x 135 x 30	230 x 128 x 25	235 x 169 x 35	282 x 176 x 28
Weight (kg)	0.61	0.68	1	1.27
Battery Life (hrs)	3.5	4.5	3	4
Processor Type	Intel Atom Z550	Intel Ultra Mobile	Intel Core 2 Duo SU9300	Intel Atom N470
Processor Speed (GHz)	2	0.8	1.2	1.83
Bus Speed (MHz)	533	200	800	667
Cache Memory (MB)	0.512	0.512	3	0.512
Hard Drive Size (GB)	120	60	120	250
Hard Drive Speed (rpm)	4,200	4,200	5,400	5,400
RAM size (GB)	1	1	2	2

Table 3: Technical Comparison of 5.6, 7.0, 8.9, and 10.1 inch Tablet PCs

Below are devices deemed less suitable than the devices illustrated in Table 3 for the Building Team's daily responsibilities with reasons for this decision.

- Apple iPad

The iPad has not yet been released in Australia, but is due for the end of May. While Apple products are very popular and user-friendly, they are relatively new and unproven category of products. We have been informed that BIS tends to trial products that have a substantial consumer record, which is not the case for the Apple iPad.

- Archos 7/Archos 9

The screen size of the Archos 7 and the Archos 9 are 7" and 9" respectively. These sizes are optimal for BCOs when they are out on site performing inspections. The Archos offers satisfactory performance, but compatibility issues with current Windows-based Building Team software could arise as it runs a Linux Operating System.

- Eee PC T91MT

The Eee PC T91MT falls under the 8.9" screen size category. It boasts a weight of only 0.96 kg with dimensions of 225 mm x 164 mm x 26 mm. However, the lighter and slightly smaller tablet PC has a much slower CPU and has a more robust hard drive of 32 GB. For a price of AU\$700, the implementation costs will be lower than its competitors at the expense of performance and storage space of the device.

- Entourage Edge

The Entourage Edge is not intended as a mobile computer. At first sight, it appeared to suit that purpose but after more in depth research, we found out that it is an e-book reader designed for text notations and scholastic research. Its screen does not account for glare and would prove very inconvenient for BCOs to use them in direct sunlight.

- Fujitsu LifeBook P1620/P2010

We considered these devices but they are older models and compared to the Fujitsu LifeBook P1630 and the Fujitsu LifeBook P2020, provide lower performance for the same size and weight. Due to the ongoing evolution of technology, we reported devices that exceed current hardware requirements so that BCOs will not require upgrades in the near future. More importantly, having a mobility device that has faster processing abilities will reduce the time the BCO spends waiting for the computer to execute a command.

- Fujitsu Stylistic ST5111

The ST5111 has a screen size of 10.4” with dimensions of 325 mm x 220 mm x 26 mm, which is bigger than the Lenovo X41 (274 mm x 241 mm x 33 mm). BCOs already found the Lenovo X41 to be cumbersome in 2007; as a result ST5111 does not meet the criteria as a potential solution.

- iLet Extreme

Haleron, a rather unknown computer company, designed the iLet Extreme as a competitor to Apple’s iPad. With a 10.2” screen and dimensions of 266 mm x 180 mm x 22 mm, it is comparable to the IBM IdeaPad S10-3t in size. Compared to the IdeaPad S10-3t, the iLet Extreme boasts very similar technical characteristics and for a price of roughly AU\$900.00, it is a serious contender for the 10.1” screen size category. The reason why the IdeaPad S10-3t was chosen over the iLet Extreme was due to the lower price and the more renowned name of the company, IBM.

For full technical specifications of the devices mentioned in this section, please refer to the Technical Specification Bibliography in Works Cited where links to manufacturers’ websites are listed.

4.5.7 Rugged Computers

Tablet PCs have the processing capability to meet the demands of the BCOs when they are out on site. They are fast, have appropriate size and weight, can have internet access and since the majority of the devices considered used a full version of Microsoft Windows, software compatibility issues are not a major concern. However, BCOs will be using those devices in the harsh conditions of direct sunlight, heat and dust with the constant risk of them dropping the mobility tool. Tablet PCs are not built to resist falls and one typical outcome is the loss of data. As mentioned by Gabe Baldwin from Conservation Group Services, the data collected in one particular day can be valued at thousands of dollars. As a result, our research team has considered rugged tablet PCs in addition to regular tablet PCs.

Once again, we have grouped them by screen size ranging from 5.6” to 12.1”. The devices considered were drawn mainly from Panasonic Corporation and Opentec Rugged Portable Computer Solutions. We also considered the company, Armor Rugged Mobile Solutions, as a potential supplier of rugged mobility devices but they have no retailer in Australia. BIS has made it clear that they would rather order from a local company so that the warranties offered by the company are not void.

The devices that were researched and their cost, size and weight are shown in Table 4. A more comprehensive list of technical specifications, including screen resolution, processor, hard drive and amount of memory can be found in Appendix J.

Product Name	Screen Size (inches)	Dimensions (mm)	Weight (kg)	Processor	Processor Speed (GHz)	Cost (AU\$)
Panasonic CF-U1 Rugged	5.6	184 x 151 x 57	1.1	Intel Atom Z520	1.33	2,800
Opentec RPT 8-1	8.4	250 x 190 x 42	1.7	Intel Core 2 Duo	1.06	6,125
Panasonic Toughbook CF-08	10.4	267 x 208 x 38	1.2	Intel PXA270	0.312	2,700
Opentec Drover	10.4	264 x 213 x 49	1.4	Intel Atom	1.6	2,949
Panasonic Toughbook CF-19 MK3	10.4	271 x 216 x 49	2.3	Intel Core 2 Duo SU9300	1.2	6,440
Motion J3400	12.1	323 x 231 x 23	1.6	Intel Core 2 Duo SU9400	1.4	3,000

Table 4: Comparison of Rugged Devices

The Panasonic CF-U1 RUGGED is a viable option due to its smaller size and weight. With a similar resolution of 1024 x 768 as the Lenovo X41, the 5.6” screen size should be appropriate for the Building Team’s needs. The robust, lightweight design of the product coupled with an optional hand strap makes this tablet PC very manageable and a possible solution for the Building Team.

The Opentec RPT 8-1 offers better performance than the Panasonic CF-U1 RUGGED but its weight and price do not outweigh the additional processing ability. The Lenovo X41 weighed 1.8kg and was deemed too heavy as a conclusion of the 2007 pilot study. At weight of 1.7kg, the Opentec RPT 8-1 approaches the unsatisfactory weight of the Lenovo X41.

Compared to the dimensions of the Lenovo X41 (274 mm x 241 mm x 33 mm), the Panasonic Toughbook CF-08 is slightly smaller and lighter by 0.6kg. The lighter weight and smaller size coupled with a hand strap facilitate handling of the device. We were however, unable to get information about the processing capability of the Intel PXA270 processor and are unaware of how it compares to the processors used in the other mobility devices. The CF-08 has only one USB 1.1 port and does not have an integrated SIM card, enabling it to get 3G wireless access. Therefore, BCOs would use the one USB port available for an air card and would have no other ports to upload photographs onto the device.

The Opentec Drover is very similar to the Toughbook CF-08 in size and includes a processor likely to be faster than the CF-08. It also has two USB 2.0 ports and has an integrated SIM card, enabling access to 3G Internet. However, the added weight and the absence of a hand strap bring the Drover very close to the Lenovo X41 in terms of portability.

The Panasonic Toughbook CF-19 MK3 and the Motion J3400 did not meet Building Team requirements due to their weight and size respectively. Despite offering significantly better performances than their smaller counterparts, BCOs will most certainly leave them in the car and continue using a pen and paper to conduct their inspections similar to the outcomes of the 2007 pilot study.

4.5.8 Mobile Printers

With the implementation of mobility tools, BCOs will be able to complete inspections without having to come back to the office. Mobile printers, while uncommon, are available on the Australian market. Having those printers in their cars would allow BCOs to produce building notices, emergency orders and so on without having to come back to the office. However, since an order or a notice can only be issued once a senior or a municipal building surveyor has approved it, having mobile printers in the car would not be useful. Thus, the team eliminated printers as a consideration of this project.

4.5.9 3G Service Providers

Our team researched prices for 3G wireless services in Melbourne. The prices obtained came from each of the five major mobile broadband provider's internet sites. These were SingTel Optus Pty Limited, Telstra Corporation, Virgin Mobile PLC, Vodafone Group PLC, and Hutchinson 3G, commonly known as 3. These prices establish an initial cost estimate allowing us to perform a cost-benefit analysis. Our team determined that an 8 GB per unit per month plan would satisfy the needs of the BCO. Actual data use will have to be established upon the implementation of a mobile tool.

The Building Team currently holds a service contract with Telstra, but it is only a two-year contract. However, once the contract expires, a bid for the new contract for the Building Team is available to any service provider. The main point of finding these costs is to offer an estimate for the costs of mobile broadband for the proposed devices.

The 8 GB data package monthly prices per unit for each provider can be seen below (accurate as of April 2010):

- SingTel Optus Pty Limited - \$69.99 per month
- Telstra Corporation (9 GB) - \$89.00 per month
- Virgin Mobile PLC - \$49.00 per month
- Vodafone Group PLC- \$49.00 per month
- Hutchinson 3G - \$49.00 per month

All of the plans that were researched come with a USB connection modem granting wireless access to any device with a USB slot. Start up costs for the modems need to be considered. From the service providers we have researched these costs are included with the purchase of the data plan. . We investigated air cards as they allow the mobile device to have the fastest internet connection speed as possible. If 3G is

brought into the device through a built-in wireless modem, the speed of the internet access will be hindered in most cases (Telstra sales representative, Personal communication). However, this information was received through communications with a sales representative of Telstra and one may question the validity of the statement. The external modems can be an inconvenience while they are plugged in, and they are small enough to be easily lost while not in use. The speed of the internet connection is the major concern of the Building Team, therefore the extension of the modem outside of the mobile device may be overlooked.

It is important to realize that these prices have been compiled for an estimate for the costs and benefits of the implementation of a mobility tool. The cost of mobile broadband could vary depending on the provider chosen, the data plan required, and over time plans typically tend to increase in cost.

4.6 Cost-Benefit Analysis

For the cost-benefit analysis, we realized that we can only create a layout of the study that will be carried out once the product has been tested for a couple of months.

4.6.1 Costs of Mobility Systems

Our research team has developed a list of anticipated costs for implementation of mobility tools shown below.

- Initial cost of devices: The cost of the mobility units must be considered.
- Maintenance and upgrade costs: Any technology system needs maintenance and maintenance costs money. Moreover, technology evolves at a fast pace and the Building Team, in its attempt to be more efficient and effective, will have to invest in upgrades for the devices. Those costs can only be speculated at this point and will have to be evaluated at the time of upgrade.
- Service costs: To access the office database from the field, 3G wireless services will be required.
- Training and learning period: To be familiar with the new system, BCOs need to undergo training resulting in less time to devote to performing inspections. Also, a learning period is associated with any new system during which officers will not be performing as efficiently as possible.

4.6.2 Benefits of Mobility Systems

Through the use of mobility tools, many benefits are expected. The three main types of benefits are separated into economic, social, and environmental benefits to coincide with the Triple Bottom Line way of thinking. The benefits portion of implementation is of most importance to BIS because they are interested the return of investment into mobility tools.

To establish the need for increased field mobility for Building Control Officers within the Building Team, we have compiled potential benefits achieved through usage of mobility tools. Attaching photos to the right report immediately reduces the risk adding a photo to the wrong report when completing a report in

the office at a later time. Access to the Building Code of Australia would increase credibility of the officer and less reliance is placed on the officer's memory. Mobility tools will also improve accuracy of information entered into office databases because any observations are recorded on site. Retrieving site information from Pathway for construction unrelated to the prior site attended will increase enforcement capabilities. Access to relevant site information such as ownership details and building permits in the field would be especially useful to on call officers responding to situations outside business hours. A reduction in the duplication of work will cause less frustration to BCOs, increase level of customer service, and increase number of inspections carried out per day. Greater consistency within the office between Building Team members will facilitate the search of documents and increase efficiency of the office.

To calculate an approximate dollar value for the amount of redundant work and gathering relevant site information (retrieving paperwork related to the site attended) per workweek performed by Building Team officers, we used survey data and salary information available from Human Resources. An average BCO salary was determined using salary information for each member of the department, and then assuming a forty-hour workweek, an hourly wage was calculated. Using the hourly wage and survey data, a value for redundant work and gathering relevant site information per workweek was found. The values obtained can be seen in Figure 10 and a more detailed outline of calculation can be seen in Appendix I.

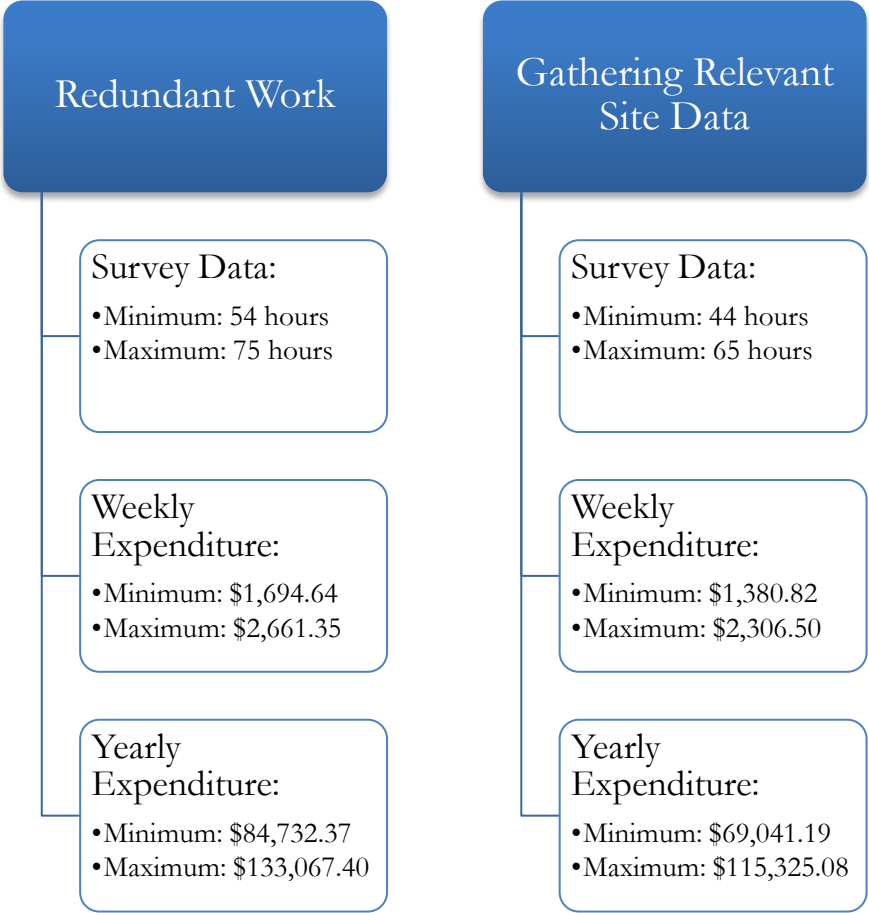


Figure 10: Benefit Analysis for the Building Team

Chapter 5: CONCLUSIONS AND RECOMMENDATIONS

Through the research conducted in Australia, our team has concluded that the implementation of mobility tools within the City of Melbourne Building Team will increase the efficiency and effectiveness of its Building Control Officers. The use of such tools will also benefit customers seeking the Building Team's services.

5.1 Project Conclusions

Our research team identified redundant work as a source of inefficiencies within the Building Team. Through our cost-benefit analysis, we found that the amount of resources expended performing redundant work is significant to the organization. Mobility tools address this issue for the Building Team as well as lack of accessibility of data in the field, increase consistency of officers, and transparency of their work. This project report provides the basis for Building Team management to pursue funding for a pilot study similar to the study done in 2007.

The main obstacle for the first pilot study in 2007 was the impracticality of the technology at the time. In the project report released by Business Information Services, Mark Bransby of BIS observed the trends of technological advancements in the mobility tool market and recommended to delay implementation of these tools for two to three years because these tools would most likely evolve into more functional platforms. The feasibility of the implementation of these tools has greatly increased because of technological advancements as well as the need for BCOs to provide more complex services to a continuously increasing client base.

The groups of the Building Team perform specialized tasks with minimal overlapping of responsibilities, however the recommendations formed by our research team applies to the Building Team collectively. Our team has analyzed each team separately and recommendations could vary for each group. Given the time constraint for our research team, we could not provide a recommendation specific to each group, but we have generated a list of devices with their positive and negative attributes. This project gives the Building Team a starting point in developing a business case for BIS to acquire funding to perform a pilot study. A preliminary cost-benefit analysis was provided to the Building Team that will provide information about the costs and benefits of implementing mobility tools. This analysis is only an estimate, and if they choose to pursue a solution that our research team recommended, the Building Team will present a more specific cost-benefit analysis to BIS. If the Building Team decides to wait, or to choose a different solution, they will still benefit from our research into the amount of redundant work performed.

Another concern we faced when looking for a viable device was that the City of Melbourne Council has limited funds (Peter Doyle, personal communication). As a result, BIS is more inclined to test products

on the market for an extended time and have a higher likelihood of providing a net benefit to the Building Team. For example, BIS is considering upgrading to MS Office 2007 next year, four years after its release.

We also identified the issue of assessing is the lack of acceptance by customers. Some clients may be weary of providing information via electronic format or may not accept the field officer sending information through 3G wireless networks. We are concerned that some people would prefer more traditional ways of doing business. Our research team is aware of this concern for the client, however due to the time constraint of the project, we cannot evaluate the social desirability of the client's of the Building Team. However, a similar customer satisfaction survey to the Nexus study performed in 2009 could be performed prior to and immediately following a pilot study. The data gathered would provide details of the changes in customer satisfaction with the implementation of mobility tools.

Other branches of the City of Melbourne Council showed interest when we presented our research project during personal communications. We expect that many other departments within and outside City of Melbourne Council could benefit from the findings of this report. These organizations include, but are not limited to, City of Melbourne Health Services, Metropolitan Fire Brigade and City of Melbourne Tourist Information. Each of these organizations requires field data to be entered into the office database. Their data transfer methods are similar to those currently used by the Building Team so our research of mobility tools and potential concerns with implementation should benefit our sponsor and these agencies. These departments may use the information from our methods, results, or recommendations to create their own projects to implement mobility tools.

Councils within Australia have researched the usage of mobility tools for departments performing fieldwork requiring re-entry into an office database. However, few have implemented these tools because data of prior research conducted is not readily accessible. The City of Melbourne Building Team would provide an example of the benefits achieve through integration of newer technologies in the workplace. Leading by example is also Goal 7 of the City of Melbourne Council Plan 2009-2013 and Objective 7.1.1 is to “enhance and protect City of Melbourne’s reputation as a leading Council and progressive organization through key campaigns and projects” (City of Melbourne, 2009). Pioneering mobility tool usage in their workplace would further relate the Building Team’s goals to the City of Melbourne Council’s initiatives.

5.2 Project Recommendations

Based on analyses performed on gathered data, we recommend a new pilot study to be conducted to assess full implementation of mobility devices within the City of Melbourne Building Team. In order to proceed with the implementation of mobility tools, BIS requires a business to be submitted. As a result, we have provided the information needed for a business case, a possible layout of the pilot study to be conducted and a description of the devices that meet the requirements of the City of Melbourne Council best.

5.2.1 Business Case Requirements

This section illustrates the data that Business Information Services requires to approve a pilot study. The business case template is shown in Appendix K of this report. Only with the approval of BIS can the Building Team further pursue the implementation of mobility tools.

The first requirement expected by BIS is to describe the driving force behind the need for the project. Third generation (3G) wireless networks have evolved significantly and present a means to improve the efficiency and effectiveness of organizations worldwide. Simultaneously, mobile devices have been developed to support many widely used programs such as word processing and spreadsheet applications, among many other applications used by businesses and agencies. As handheld devices and laptops become smaller, faster, and more powerful, companies can adopt the use of these mobile technologies more easily. As a conclusion from the previous Mobile Tablet Trial in 2007, “there is still a case for mobile electronic equipment that is more portable and powerful that could be utilized to reduce administration time.” Now, three years later, technology has progressed and mobility tools must be piloted again to allow the officers of the Building Team to provide more efficient and effective services.

A brief overview of the intended project and the objectives sought to be achieved upon completion is a second requirement of the business case. A main objective is to provide inspectors with technical and property information on site. The two on-call officers will greatly benefit from mobile access to the office database during emergency callouts. The objectives of this project are to provide a more effective means to ensure the provision of safe buildings, reduce the amount of redundant and administrative work performed by building officers, achieve higher quality inspections with increased level of transparency and consistency, facilitate the ability to perform multiple inspections per outing, and reduce a potential OHS risk when officers carry the BCA and stacks of files and plans on-site.

BIS expects a defined scope of the project and a list of what tasks and objectives are essential to be met and which ones would be beneficial but not crucial. Within the scope of this project is the implementation of a device that allows inspectors to access and use Pathway, CoMPASS, Hummingbird DM, Microsoft Office suite, and the Internet from the field. Those applications will grant inspectors access and the ability to record data in the field using the mobile device. Another feature that is essential is an online/offline application. This software will enable the mobility device to synchronize to the office database real time through a 3G wireless connection. When the device loses connection, the program will save the data on the hard drive and will auto-sync to the main database as soon as the device reconnects to the 3G service. An air card or an internal modem will be required to obtain access to 3G wireless Internet. The ideal mobility tool should have the following specifications: three or more hours of battery life, meet OHS specifications, integrated camera or ability to upload photographs taken with camera/phone, and two minute or less boot time.

An out of scope objective of our project is the development of electronic checklists to increase consistency between officers and facilitate inspection. Creating a uniform format of naming files in Hummingbird DM will also allow officers to search through the database with greater ease. Customer acceptance of the mobility devices may be a concern. After the implementation of mobility tools, a customer satisfaction survey similar to the Nexus study performed in 2009 could be conducted. The data gathered would provide details of the changes in customer satisfaction with the implementation of mobility tools.

The anticipated benefits of the implementation of mobility tools must also be provided. For our project, the potential benefits are:

- Increased customer satisfaction due to reduced response and processing times
- Economic savings as a result of less time spent on redundant tasks amounting to a potential savings of AU\$12,000-19,000 annually (assuming a 10% decrease in redundant work due to the implementation of mobility devices)
- Environmental benefits obtained from reduced usage of paper associated with current inspections.
- Encourage officers to complete documentation in Pathway at the time of visit.
- Ensures correct legal documentation of client information is made at the time of the visit, thus reducing the risk of inaccurate documentation in cases of litigation.
- Ability to display site plans and correspondence, e.g. permit conditions, agreements, etc during a site visit, especially relevant for after hours visits, thereby increasing the ability to make more informed decisions.
- Photographs can be uploaded on site, reducing the risk of attaching it to the wrong file at a later time.
- Provide OHS benefits by not carrying heavy stacks of paper and cumbersome maps.

To increase likelihood of approval of this project by BIS, we have provided the risks present associated with preference to remain with the current format. The major financial risk is spending money on redundant work completed by inspectors every time they return from inspections. If the project is not implemented social and environmental risks are also a concern. Inspectors feel frustrated when completing redundant administrative work that could be eliminated by mobility tools. There is also a great potential for paper saving, especially by on-call officers who currently rely on bulky printouts. Additionally, OHS concerns arise because of the heavy files that have to be carried on site.

Finally, means of measuring the achieved benefits from the previous systems must be defined. Through customer surveys implemented yearly, a measure of the benefits could be determined. An increase in the number of daily site visits could be measured through a controlled test with one group using the new mobility tool and another control group that utilizes the current format. Issuing a survey asking the officers the amount of time spent performing redundant tasks could also be issued in the controlled test to assess the

time that officers save with the use of mobility tools. Paper savings are foreseen and can be measured from the amount of paper that the Building Team purchases monthly. OHS benefits can also be evaluated through surveys inquiring about an officers' attitude towards handling a mobility tool and their physical health after a six-month period. OHS could also perform periodic physical to officers to observe any health risks related to mobility tools.

5.2.2 Future Pilot Study

Our recommended pilot study would consist of multiple devices. A multi-device study would allow greater chance of success as some factors cannot be evaluated before an actual trial is conducted. Also, the cost of a pilot study is far less than organization-wide implementation of mobility tools and reduces the risks associated with a failure of the new format.

The pilot plan that our team has developed involves the implementation of multiple devices to a small groups of BCOs. A control group, consisting of the same number of officers as the “mobility groups” would be studied along with the groups that will be trialing the mobility devices. The study of the different groups should last about two months to obtain enough data to average daily fluctuations and enable valid conclusions to be drawn. During the study period, bi-weekly surveys should be issued to the different groups. The participants will be asked to report the amount of time they feel was wasted completing redundant work over the previous two weeks. The following formulae can be used to determine the amount of money saved with the implementation of each type of mobility tool. If the amount of money saved per employee is greater than the cost of the device, we can conclude that money is being saved with the implementation of mobility devices.

$$\text{Time Saved} = (\text{Time Wasted by Control Group}) - (\text{Time Wasted by each Mobility Group})$$

$$\text{Money Saved} = (\text{Time Saved}) \times (\text{Average Hourly Wage of Participants})$$

A final survey, issued at the end of the study period, should seek to assess the validity of the potential benefits described in the Business Case Requirements section. Should the potential benefits achieved and money saved exceed the implementation and maintenance costs, BIS will have to consider a full implementation of mobility devices within the Building Team.

5.2.3 8.9” Tablet PC

Taking weight, size, performance and price into account, tablet PCs with an 8.9” screen size meet the requirements of the Building Team best. After in depth research, we concluded that the Fujitsu LifeBook P1630 is currently a very appropriate candidate for a trial study. The full specifications of the Fujitsu LifeBook P1630 can be found in Appendix J.

With a size of 235 mm x 169 mm x 35 mm and a weight of 1.00 kg compared to the 274 mm x 241 mm x 35 mm and weight of 1.80 kg for the Lenovo X41, the LifeBook P1630 overcomes most issues of portability faced by the Lenovo X41. Moreover, with a much faster processor, higher spindle speed hard drive, more RAM, the booting time of the LifeBook should be significantly shorter than the fifteen minutes taken by the Lenovo X41.

The LifeBook runs a Microsoft Windows operating system, thereby reducing compatibility issues when running programs currently being used by the Building Team and during synchronization of databases. Since the operating system is the same as the present system on desktop workstations, the training period for proper usage of these tools should be minimal. The LifeBook P1630 currently costs around AU\$2,600.00 and with the option of an integrated SIM card, 3G Internet access would be possible without an air card.

5.2.4 10.4" Rugged Device

From our results section, the most viable rugged devices were the 5.6" Panasonic CF-U1 RUGGED, 10.4" Panasonic Toughbook CF-08, and 10.4" Opentec Drover. Although the CF-U1 has a screen resolution comparable to the Lenovo X41, the small screen size would make it hard to use CoMPASS requiring a larger viewing area.

From Table 4 in Section 4.5.7, the Opentec Drover and the CF-08 are very similar in size but the Drover is heavier by 0.2kg. The Drover, while slightly heavier, offers two USB ports, has an integrated SIM card and is faster overall. Should the BCOs be comfortable with carrying a 1.4kg device instead of a stack of paper, the Drover provides a robust solution that will meet the demands of the Building Team.

5.2.5 Smartphone

Smartphones address only part of the issues that the Building Team currently faces. The major benefit of using a smartphone is their small size and weight. However, the small screen size would make consulting plans difficult for BCOs. With the introduction of electronic standardized checklists, smartphones would be a more viable option.

The iPhone and HTC Snap have been proven to work with the current Virtual Private Network software (Citrix) used by the City of Melbourne Council. We recommend the iPhone and the HTC Snap as possible recommendations provided standardized checklists are implemented.

5.2.6 Device Comparison

To determine the best-suited devices to recommend to the Building Team, our team chose the devices from the broad categories of tablet PCs, rugged devices, and smartphones. For our final recommendation, a comparison of these devices, seen in Table 5, was conducted by ranking characteristics most desirable to BCOs. The traits considered were cost, hard drive size, processing speed, durability, portability, and usefulness of the tool to BCOs. The ranking scale used one as the lowest and ten as the

highest ranking. A weighting was used for each trait, where one was the least beneficial and ten was the most beneficial to the organization. This weighting was generated in collaboration with Warren Knight, Executive Officer of the Building Team. Cost, hard drive, and processing power specifications were compared and ranked among the four devices. We generated rankings for durability, portability, and usefulness to BCO by the judgment of our team on behalf of building control officers. Usefulness to BCOs was determined with survey data regarding functions in a device that a BCO would find most beneficial in the field and with conclusions drawn from the 2007 pilot study.

The following criteria descriptions were used to determine the rankings:

- Cost – The unit cost for each device
- Hard Drive – The hard drive speed and capacity
- Processing Power – The processor type and speed
- Durability – The device’s robustness and toughness to physical abuse
- Portability – Physical dimensions and weight of the device and available accessories that facilitate handling
- Usefulness to BCOs – Ability to perform office tasks in the field

Recommendations	Weight Factor	8.9" Tablet - LifeBook P1630	10.4" Rugged - Drover	Smartphone - iPhone	Smartphone - HTC Snap
Cost	5	2	1	4	3
Hard Drive	5	4	3	2	1
Processing Power	5	4	3	2	1
Versatility	5	3	4	2	1
Portability	10	3	4	1	2
Usefulness to BCOs	10	4	3	2	1
Total		135	125	69	60
Maximum Value		160	160	160	160
Ranking		0.84375	0.78125	0.43125	0.375

Table 5: Ranking of Recommended Devices

The comparison of our four recommended devices has shown the most appropriate tool for the Building Team to be the Fujitsu LifeBook P1630 tablet PC. This device provides sufficient technical requirements to run current programs and has the physical characteristics desired by field officers.

Although the LifeBook P1630 scored the highest in our ranking scale, we recommend a multiple device pilot study trialing the LifeBook P1630, Opentec Drover, and Apple iPhone. Each of these devices has distinct strengths desirable to BCOs and allows the pilot study to cover a wider range of mobility solutions.

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APPENDIX A

Structure of the City of Melbourne Building Team

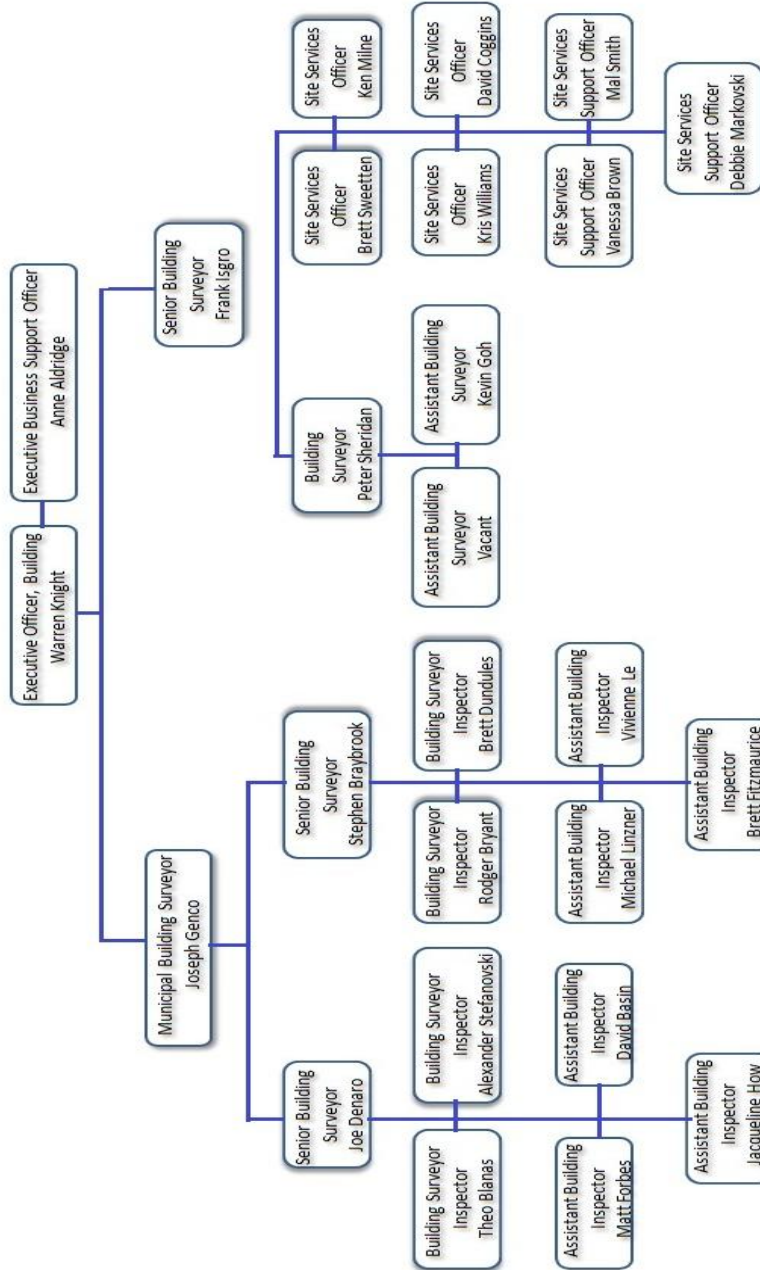


Figure 11: Structure of the City of Melbourne Building Team

APPENDIX B

Lean Thinking

The City of Melbourne Building Team, the city's building inspection and permitting agency, has adopted a Lean Thinking philosophy, which seeks to reduce the amount of time and resources spent in performing repetitive tasks. As a result, they have performed trials of communication technologies to establish the feasibility of future implementation of these mobility tools to reduce unnecessary expenditure of resources. The first trial performed in 2007 was with tablet PCs, but they found that this equipment was too cumbersome and required the officers to log into the network in the office before they could access the database in the field. The Building Team considered implementation of palm pilots, but they felt it was unnecessary to trial this technology because the device was too small and did not possess the processing capabilities to run programs used by the team.

Definition of Lean Thinking

Lean Thinking is an organizational management concept based on the idea of reducing waste. The first company to implement the concept of Lean Thinking was Toyota in the 1970s. According to the Toyota Production System, two basic concepts make the backbone of the philosophy: "Jidoka" and "Just-in-Time" (Toyota, 2010). "Jidoka" is a process by which the equipment stops immediately should a problem be identified, thereby preventing more defective products from being manufactured. "Just-in-Time" ensures each process waits for the next downstream process to require a product before manufacturing it rapidly.

The goals of Lean Thinking, as described by the City of Melbourne Council, are the opposite of mass production, where no overproduction, no wasted time, no wasted effort, and no wasted energy is present within the organization. The objectives of these goals are to provide the right service, in the right place, at the right time, provided by the right person, and done right the first time (City of Melbourne, 2009). Craig Rapp, Director of ICMA Consulting, described Lean Thinking with the following quote "One of the truly great things about Lean Thinking is that it links the purpose and mission of the organization with the processes that drive performance and serve the customer(s). The objective is to help an organization "see" waste and non-value activities, and facilitate a process of continuous change that will reorient activities into better alignment with customer desired outcome." (2006).

Positive Outcomes of Lean Thinking

In a case study conducted by Womack and Jones (2008), they analyzed the Lean revolution within Lantech. Previously, all departments of the company generated long transition times from manufacturing to shipment to customers and inventory overwhelmed the factory. To "lean" the factory, a workstation for each department was created and standard work was defined: on time, on spec, every time. Takt time (maximum time per unit allowed to produce a product in order to meet demand) was also introduced. Lantech cut 30%

excess space, doubled product output, cut defects from 8 per product to 0.8 per product, and reduced lead-time from sixteen weeks to fourteen hours.

In 1991, Wiremold hired Art Bryne, a Lean agent to change their current working practices. Bryne's first step was to introduce a scoreboard for each product team. To track productivity, sales per employee were monitored. To determine quality of service, the percent of products being delivered on time was used. After being "leaned", Wiremold freed 50% of factory floor space, eliminated a warehouse, converted \$11M of inventory to \$24M of sales and reduced lead times from four weeks to two days.

Since the start, Porsche always favored unique solutions that were difficult to manufacture and required re-assembling elements, repainting and re-fitting. Those were thought to add value to the product. Such practices do add value but only from the engineer's definition of value and not the customer's. When Porsche was "leaned" in 1997, managers started to prioritize on customers' definition of value and production doubled, manufacturing space was cut in half, lead time for a finished vehicle was reduced from six weeks to three days and supplier defects were cut by 90%.

The validity of Lean Thinking has been proven in many manufacturing industries. However, those principles are not limited to such companies and the City of Melbourne decided to make its agencies Lean in 2009 to increase productivity and offer a higher level of customer service. However, the implementation of Lean Thinking must be carried out carefully. The following section depicts instances where Lean Thinking was wrongly adopted, leading to failures and adverse effects.

Negative Outcomes of Lean Thinking

In a Wall Street Journal article entitled "How Lean Manufacturing Can Backfire" (2010), David Meier, co-author of "The Toyota Way Field book" and founder of a consulting company on lean manufacturing, speaks of a "trade-off" inherent in lean manufacturing principles. He mentioned that the production cost may be decreased in the short term, but the risk is increased. To decrease cost, lean manufacturing suggests the standardization of parts across different methods and the manufacture of parts only when needed by the next process in the chain. Assuming that an efficient quality control is in place, such a recommendation is rational. However, as Toyota has experienced with a faulty gas pedal and Ford with a fire hazard due to faulty cruise control, efficient quality control is not always attained. Since the similar parts are being manufactured only when needed, employees do not have the chance to inspect parts before it is processed by the next step. In the rare instance that quality control is subpar; the company ends up producing thousands of faulty units.

The construction industry is one of the least integrated of all the major industrial sectors, characterized by adversarial practices, disjointed supply relationships and a lack of trust between clients, main contractors and sub-contractors. In 2006, a case study involving two major construction projects and their application of Lean Thinking was undertaken in the UK. In between the transportation, stockholding and

on-site labor, instances where the application of Lean Thinking created difficulties with regard to project delivery. For example, creating a streamline and producing goods only when needed is not viable in the construction industry due to the large number of suppliers involved and the uncertainty of each of them delivering their services on time. At other occasions, practices that conflict with Lean Thinking principles (e.g. keeping stocks) made more practical sense and enabled the projects to move more efficiently. Contractors focused on efficiency to reduce costs and increase profit but that hindered the effectiveness of project delivery, that is, within time, budget and specification.

There are major areas in which industries can work to improve both its effectiveness and efficiency. To achieve this, a more integrated and customized approach to the implementation of Lean principles is essential. For the building and planning sector, it also requires fundamental changes in relationships and the management of clients, contractors and sub-contractors.

APPENDIX C

Mobile Tablet Trial

MEMORANDUM

Date Wednesday, 17 July 2007

To Mark Bransby

Copy

From Joseph Genco

Subject MOBILE TABLET TRIAL - BUILDING CERT. & INSPECTION

1.0 Introduction

A mobile tablet was provided to the Building Certification & Inspection branch during the May – June period of 2007 to trial its suitability for use in the field with a view of reducing administrative time and improving efficiencies of inspectors and on call staff.

The aim of this report is to provide a brief summary of the pros and cons for the tablet itself and the resulting conclusion for its suitability a mobile solution.

2.0 Users

The mobile tablet was utilized by a broad range of people including; on call site services, building staff, building inspectors, team leaders and managers. The programs utilized included GEAC Pathway, DM, Eview, and Outlook. The main use of the tablet was on site or within the vehicles at the relevant sites.

3.0 FINDING

3.1 FOR:

Positive points with respect to the tablet were as follows:

- Good for on call officers where photos taken with regards to a project to then immediately attach to a report carried out on site.
- Good ready access to site services permits for referral, building permit
- Handy to access EView where an officer if called out can call up information about a property, including the owners details
- Good for obtaining ownership details.

3.2 AGAINST:

Negative points for the tablet were as follow:

- Takes a long time to start up, and in the initial stages had a level of difficult of obtaining access
- Battery life was insufficient for time spent on site
- Touch screen was very difficult to use as difficulty was had with the stylus.
- Charge life was not long in time
- Not able to print of notices and order
- Size and weight made the tablet unsuitable for on site. It was OK as long as stayed in the cars.
- Too heavy for inspections and was not carried on
- Unable to connect to certain programs e.g. outlook, DM

4.0 CONCLUSION

For the team of Inspectors it was found not to be suitable for inspection purposes, as it was too heavy to physically take on site. To carry the tablet on site was too cumbersome and the potential for it being dropped was increased. In most cases the Inspectors used it within the vehicle. If the tablet is to be left in the vehicle then security issues may arise.

The start up time to log in and the battery life also were of a major detriment to effective use. It was found frustrating that it took close to 15 minutes to log on. Effectively the inspectors resorted to logging in and then placing it in rest mode, which then depleted the battery.

For ongoing cost of approx. \$1200 p.a. plus the cost of the unit the added benefits was felt not to exceed the expenses. Although the tablet was handy in certain circumstances it was felt that due to portability issue that it would not justify the expense and ongoing expense.

It is suggested that for the occasions where the tablet could be used it would be best be resolved with BIS having one available for loan whereby the officer could obtain it for a short period of time.

With regards to the mobility project it is still felt that there is still a case for mobile electronic equipment that is more portable could be utilized to reduce administration time by technical staff, with checklists and automatic document generation able to be produced on site or to be hot synced when the officer is back at his/her desk.

Regards

Joseph Genco

Municipal Building Surveyor

City of Melbourne

APPENDIX D

Interview Template for Mobility Tool Users

This Section of the questionnaire sheet will seek to obtain information about the use of mobility tools in other organizations. This information will be used to provide insight into an educated recommendation for the City of Melbourne Building Team.

- Date:
- Interviewer:
- Recorder:
- Interviewee:
 - Employing Organization:
 - Industry of Organization:
 - Job Title:
- What issue(s) led to your decision to replace your prior mobility system?
- What mobility tool was chosen to replace the prior?
- What research had your organization performed to lead to their decision of this particular system?
- How have the employees using this new system reacted to its implementation?
 - Positive:
 - Neutral:
 - Negative:
- Has your organization seen improvements in productivity over the prior system? Detriments?
- Did you offer training for employees who were to use this new system?

Interview Transcripts

Local Contact Interview 1

Date: 25-2-2010

Interviewer: Hamresh Lutchmun, Brandon Stuczko, Michael Votruba

Recorder: Hamresh Lutchmun

Interviewed: Gabe Baldwin

Employing Organization: Conservation Services Group

- Industry of Organization: Environmental Services
- Job Title: Home Energy and Green Rating Professional
- Experience: 18 months
- Why was he interviewed?
 - He is a current mobility tool user and his job requires in office and on site data handling.
- What mobility tool do you use right now and can you mention some of its useful properties?
 - Panasonic Toughbook model CF-18
 - It is virtually unbreakable. It is certified for a six feet drop and I know I dropped it from a ladder and it is still working fine
 - It has a battery life of about four and a half hours.
 - Toughbooks can function properly in extreme environmental conditions.
 - When they were purchased some three years ago, they could only be bought in bulk and cost about US \$4,500 each.
 - They have a long booting time. (We tested it during the interview and it takes 2 minutes and 30 seconds to be fully operational) they can be left on stand-by but still.
 - Being somewhat old laptops, they have slow processing capabilities but I am sure that Panasonic has already launched new, more powerful models.
 - It does not have 3G wireless capabilities but once again, I am sure that newer models do.
- Describe us the processes involved in rating a building?
 - Before construction, we get blueprints of buildings and the components that will be installed to improve energy efficiency. We look at those parts and calculate a theoretical efficiency based on manufacturer's specification.
 - During construction, I perform several site visits to make sure that the components installed are the ones that were given to us in the blueprint. I run tests on those components and feed data to my Toughbook to calculate the actual efficiency compared to the specified one.

- After construction, I need to determine if the building passes or fails the Leadership in Energy and Environmental Design (LEED). Using the Toughbook, I fill a 16 page long questionnaire and the computer determines if the building passes or fails. If it passes, we issue them with a certificate right there and then.
- How would you perform the same process without a mobility device?
 - It would be very inconvenient.
 - I would have to perform all calculations before going to the construction site and if I forget a vital calculation, I may have wasted hours of my time driving and gas.
 - On site, I would have to write down everything and go back to the office to perform calculations and then go back to the construction site again to provide the property owner and building contractor with results and recommendations.
 - Having to carry around a 16-page questionnaire on top of my other notes would be very cumbersome. Also, it would be time consuming to fill in the questionnaire by hand and it wouldn't be financially responsible to rate the building on site as the final calculations take a lot of time. I would go back to the office, give the paperwork to the Administration Department and they would get back to me with results no sooner than a week later.
 - It would also be very inconvenient to manually enter data on my desktop computer in the office to update the main library.
- Do you mean to say that right now, you do not have to manually update the main database when you come back from a site inspection?
 - No, as soon as I log in to the company's Internet on my laptop, a background program is run that automatically syncs both libraries. Not only do I not have to update the main library but mine gets updated with relevant data as well.
 - Our IT department developed that software and if you need it, I can ask them more about it.
- Are there other situations that you can think of where having a mobility device came in really handy for you to perform your daily tasks?
 - Sometimes it is hard to convince property owners to modify the insulation properties they are using as better ones cost more. However, by performing calculations that show the owner how much money they would save in the long run, they will be more inclined to incur the extra initial cost.
 - If I don't know what exact components are being installed, it is easier to access the database on my computer and look up properties, such as efficiency, of that particular component and continue my rating of the building. Otherwise, I would have had to write down the

make, model and part number and go back to the office to have access to the data that I need.

- Have there been situations where the mobility device ever impacted you in an adverse manner and can you foresee any problems with a prevalent use of mobility tools?
 - Sometimes, if you are not careful enough, you may not have enough battery to power the Toughbook for a full inspection and it is really embarrassing.
 - The only thing really bad that I can think of is if you damage your hard drive somehow and lose all the data that you have collected that day, it might represent a loss in the couple of thousands of US dollars for the company.
 - If I were able to get internet access on a construction, it would really help me. Especially, in situations where I could look up manufacturer's specifications of a component to compare it with the results I calculated.

NOTE: Our interviewee could not answer the following questions as the company had already implemented mobility tools years before he was employee.

- What issue(s) led to your decision to replace your prior mobility system?
 - N/a
- What research had your organization performed to lead to their decision of this particular system?
 - N/a
- How have the employees using this new system reacted to its implementation?
 - N/a
- Has your organization seen improvements in productivity over the prior system? Detriments?
 - N/a
- Did you offer training for employees who were to use this new system?
 - N/a

Interview 2

Date: 15-3-2010

Interviewed: MCG member

Interviewer: Hamresh Lutchmun, Michael Votruba

Recorder: Brandon Stuczko

- Construction Management Group (CMG)
 - How a builder gets to a finished product
 - Law enforcement agency of Building Team
 - Any construction between the site and roadways
 - Deals with noise, impeding walkways, etc.
 - Minimize loss of trade for surrounding businesses because of obstructions to walkways and diversion of traffic
 - Out in the field the most
 - Confine work to certain hours of the day
 - Control of public nuisance of construction work
- Melbourne Certification Group (MCG)
 - Issue building approvals
 - Final products
 - State government legislation must be followed
 - Structural construction – are the builders following the plans they intended/submitted to the Building Team
- Field worker must decide which plans to take on site with them and if they do not take the correct ones, they must ask to borrow the builders' copy or travel back to the office to get the Building Team's version
- Determination of inspections
 - Travelling around, inspectors notice peculiar things in construction
 - If going out on site, they will take a few sheets for construction in the area and conduct inspections based on the area they are going to
- On Call 1
 - Officer is at home with a Council car
 - Complaint on after hours hotline to the town hall
 - Officer will print a spreadsheet with all permits for property in question

- They will attempt to contact the builder then possibly travel to the site to conduct further analyses
- On Call 2
 - A different building inspector than On Call 1
 - Typically a licensed building surveyor
 - Used for building emergencies
 - Has a builder on call
 - Technical resources needed for site to determine safety and the course of actions suitable for the situation
 - Stadium roof collapse
- Social Impact
 - Women shopkeeper suffered lack of business because a construction site ended up occupying the entire street her business was located on

Interview 3

Date: 15-3-2010

Interviewed: BCG member

Interviewer: Hamresh Lutchmun, Michael Votruba

Recorder: Brandon Stuczko

Past programs

- Looked into 2 or 3 years ago
- Tablet PCs
 - Toshiba
 - Notebook size
 - Heavy
 - Good screen
 - 10 to 15 minute startup
 - Cumbersome
 - Toughbook type screen
 - Implemented for 2 to 3 months
 - Small sample
 - Air card used to connect to phone provider
- Palm Pilot
 - Not implemented
 - Checklist sheet
 - Form list in office
 - Update in the field
 - Sync back in the office
- Building Team's need for system
 - Cost benefit of the system
 - Field access to data
 - Record electronically
 - Produce on site
- BIS – Business Information System
 - Group maintaining information about previous study with tablet
 - Field workers would not use it
 - Information not available
 - No wireless in office

- Access to database and Internet
 - Need information about existing permits and building information
 - Travel to and from the office
- Fair amount of travel time
- Note details in office – if something does not look right, the officer must return to the field for further analysis
- CMG – Construction Management Group – Site Services
- BCG – Building Control Group
 - Statutory side and enforcement
 - Safety of existing building
 - Public events – concerts
 - Combination of building officials and fire marshals
 - Handle fire complaints, problems on site, warrant proactive process for rating fire safety
- Buildings are typically inspected every 2 or 3 years
- Nightclubs, backpackers (hostels), hotels, multistoried buildings
- No apartments or condominiums
 - Intense occupancy with limited knowledge of environment
 - Limited resources cannot handle apartments or condominiums
 - Reactive than proactive
 - Complaints to landlord or do it yourself
 - Proactive Audits – research building
- Checklist – “memory jotter”
- Occupancy building – Code 3 in Australia on p. 39 BCA Volume 1
- Nightclubs – 9b or 6 classification depending on size and usage
- No entertainment and small bar would be 6
- Purpose of building is used in classification, not capacity
- Audit every 2 to 3 years
- 550 buildings under proactive
- Team of BCG is 12 or 13 member
- Complaints – reactive process
- Public Events
 - Temporary structures and public events
 - Melbourne has a large number of events
 - Events must obtain permits if exceeding a certain size

- Fire and public safety
- Structures are typically made in Germany or Italy so they comply with their building standards and possibly do not satisfy Australian codes
- Events must comply with Australian codes and provide satisfactory emergency evacuation exits for size
- Event size for permit is 500 square meters enclosed
- Barriers around events
- Spring Carnival
 - 100 to 120 thousand people
 - 4 days
 - National race
 - Paperwork and application – 3 month beforehand
 - 1.5 to 2 weeks of processing
 - Inspection – 3 to 4 days
 - Deliver permits that day
 - Quarantine unsafe portions
- Issue 150 to 200 permits per year for just events
- Events Team upstairs from Building Team
 - Building Team provides insight and information to the Events Team on permitting and need for inspection
- Look at documents/inspection sheets the Building Team receives
- MCG and BCG workers are able to help each other
- Site Services
 - Construction Site to street
 - Traffic management
 - Public protection
- Inspections performed in pairs
 - Safety of the inspectors
 - Record of conversation
- Electronic complaints database
 - Adopted Council wide
 - Complaint forwarded to BCG from centre if it should be forwarded
- Ten to twenty conditions on some events
- Pathway

- Database of permits and order for each for each property
 - Commercial usage
 - Ill suited
 - Stable
- No IT division
 - No software development
 - Tweak current system to keep up to date
- BIS
 - “Guardians” of the system
- Profile
 - Snapshot of building
 - Research and notes on building of interest
 - Layers of permits for each building
 - Make research sheet attached to property containing layers
- In Pathway/drafts only
 - Proactive Audit confirms data on Research Sheet
 - Audit sheet recognizes missing areas
- Building Laws
 - Building Act of 1993 → Building Regulations 2006 → Building Code of Australia

Interview 4

Date: 15-3-2010

Interviewed: MCG Building Control Officer

Interviewer: Hamresh Lutchmun, Michael Votruba

Recorder: Brandon Stuczko

- Melbourne Certification Group
 - Building work requires building permits
 - Inside Melbourne, except multimillion dollar projects outside of Melbourne may require MCG support
 - Builders do not have to go through MCG
 - 1994 – industry deregulated opening private industries to issue permits
 - Part 4 and 5 of Building Regulations
 - Siting – where you can put a building and the site the building can be placed on
 - Must apply for report and consent to go outside boundaries (limiting height, size, etc.)
 - Inspect foundations, frames, concrete reinforcement, completion
 - Issue permits before construction
 - During construction, complies with what they said they would do
 - After, certification of completion or occupancy permit
- Building Certification Group
 - Events and temporary structures
 - Building notice
 - Owner can explain why they do not have to do something
 - Building order
 - Funded, no bottom line
- Building Commission
 - Above all surveyors and construction contractors
- Process
 - Private company
 - Greater efficiency by separating technical and administration responsibilities
 - Outdated systems and computers within the Building Team
 - Better software used in private companies
 - Mobility is in need of improvement

- Field workers use two mobiles – personal and business

Interview 5

Date: 20-4-2010

Interviewed: Surveillance Officer, CityWide

Interviewer: Hamresh Lutchmun

Recorder: Hamresh Lutchmun

- The mobility device in place is a Panasonic Toughbook CF-19 and CityWide has been using it for the past three years.
 - It is a very robust device. It has been dropped and although screen was cracked and it was more cost effective to replace the unit, data was safe.
 - The glare on the screen is terrible, almost unreadable. Officers need to be smart about it. Moves back a couple of steps into the shade or sit in the car to enter data.
 - The battery life is about 4 – 5 hours but with a car charger available, this is perfectly acceptable.
 - The tablet is heavy and the officer had to put it down during interview.
 - The touchscreen is very reliable and the preferred method of inputting data.
- Digital camera is connected to tablet PC via a USB cable. As soon as a picture is taken, it is uploaded to the database.
- Software that surveillance officers use is Asset Master and TRAX. Both are GIS mapping programs that contain information about the different assets of the City of Melbourne (e.g. – drains, street furniture...). Both are updated once a day when the officer goes back to the office plugs his Toughbook to his desktop computer and syncs his database to the main database.
- With the use of mobility devices, works get completed within 48 hours. Officer will input what assets need work in the database, go back to office and sync to main database. A report including the works that need to be done and their urgency is generated and sent to the team responsible of fixing defects.
- We try to keep the disc usage to a minimum. That is, there are almost no other programs installed on the computer besides the essential ones. Installing more programs increases the risk the computer experiencing compatibility issues and failing.
- Surveillance officers did not want a device that was too small as it would be harder to look at the GIS maps, which is the interface they use most of the time.
- The officer goes to the home office only once a day to sync his tablet to his desktop PC and as a result, the main database.

- The surveillance team performs three types of inspections: maintenance, construction works and complaints. Maintenance is inspections that occur at set time intervals. Construction works inspections are carried out when a construction site needed to move street furniture. When they get notice of such action, they go out and inspect the new position of the asset. When they get a complaint, employees are sent to fix it. It is the surveillance officer's responsibility to check if the work done is up to code. For the construction site and complaints, surveillance officers will grab a pile of files at the beginning of each month and complete them parallel to the maintenance work, which represents the majority of their workload.
- The software that the surveillance officer uses consists of a very user-friendly interface. For instance, when inspecting a "Stop" sign at the corner or street X and lane Y, that particular asset is selected in the program. A window then opens which asks the officer about the condition of the sign, are there any works required, where should the budget of this work come from and so on. When the checklist is complete, a photo may be attached and the file is saved to the computer database.
- There is literally no text fed to the computer during inspection.
- Verbatim:
 - "It would not be feasible to have a paper-based system at CityWide"
 - "Make sure you are in league with your IT department"

Interview 6

Date: 21-4-2010

Interviewed: IT Personnel, CityWide

Interviewer: Hamresh Lutchmun

- Do not have any documentation about research that was conducted prior to the implementation of mobility tools.
- Do not have any documentation about results of implementing Panasonic Toughbooks
- Mobility devices were implemented in 2007
- So far, the devices have been very good and very stable
- Since they are running a full-blown version of Windows instead of Windows Mobile, which is what smaller devices such as PDAs and smartphones use, there was no compatibility issue. Programs ran the same way they did on the desktop computers
- We have found that updating the main database once a day is sufficient. There is no reason to grant officers real time access to the database. Eliminates the risk for potential crashes of system as well as security issues.
- CityWide uses a program called Express to sync to main database.
- The Toughbooks currently in operation are the CF 18 and CF 19. The more RAM the tablet possesses, the better it runs.

Interview 7

Date: 15-4-2010

Time: 9:00 AM- 9:30 AM

Interviewed: Member of Private Company

Interviewer: Michael J. Votruba

- A company that provides a similar service as the MCG was interviewed because they had trialed a type of palm pilot 6-7 years ago
 - Because the company is private they were able to trial palm pilots without providing a major case to a department like BIS.
 - The trial of the palm pilots was a failure, there was not enough data processing ability and according to the interviewee they ended up becoming diaries and have not been used since the initial test.
 - The company is now considering hiring outside company to come up with a mobile solution for them through the use of a tablet PC that will also act as a home computer.
 - From this interview, our team learned we needed to be sure that the tool chosen is able to handle the data processing, and other tasks that the BUILDING TEAM requires. That is the advice that was given to us by this contact.

Interview 8

Date: 22-4-2010

Interviewed: IT Personnel from the City of Brisbane

Interviewer: Michael Votruba

Interviewer: Michael J. Votruba

- City of Brisbane Building and Planning Department
 - The building and planning department use the Mobile Office software using a 3G network and a secure tunnel into the councils network
 - Mobile tools used include PDA's for parking and traffic, but tablets have been introduced to the building and planning team. The tablet is primarily used in the car for schedule and dispatch purposes, as well as for job and route optimization.
 - The mobile devices have increased service responses and staff productivity; it allows field workers to stay in the field to perform multiple jobs before coming back to the office. Administration overheads have been reduced.
 - Social concerns involved the lack of privacy due to vehicle tracking (not related to mobility tools), and also some health concerns have become an issue dealing with the weight of mobile devices
 - Organizational change management is an essential component of implementing new mobility tools. With an ageing workforce, BCC has had put in significant effort in demonstrating the efficiencies from the use of mobile tools in business processes. The Org change management practitioners usually complete employee profiling, skills analysis and gap analysis to the desired future capability. Mobility projects are responsible for the change of management and training of staff.
 - Security issues were a problem and had to be addressed by IT, integration was successful but required extensive hours from IT, screen size, and capacity of the devices
 - Business cases are considered for all ICT projects, (including mobility projects by ICT Governance Board). The business case includes a clear definition of cost and benefit. Similarly at project closure and post implementation review benefits are reviewed and presented to the Board.

Interview 9

Date: 20-4-2010

Interviewed: Pervidi representative

Interviewer: Hamresh Lutchmun, Michael Votruba

Recorder: Michael J. Votruba

- This company offers mobile solutions to businesses that cater specifically to their needs.
- The hardware is provided by Pervidi, but is bought from an outside distributor.
 - The customer only has to specify his needs for the hardware and Pervidi will take care of finding the product that will match their requirements best.
- The Pervidi system originated from before mobile broadband was available and its design allows for work to be completed successfully online, and offline.
- Using Pervidi would require a lot of work from the IT department initially, but once implemented Pervidi would be responsible for the training for staff (IT and building officers) to fix problems, and answer questions dealing with the systems operations.
- Pervidi creates electronic checklists based on the ones currently being used and embeds them to the database so that once the checklist is filled and the device synchronized, the appropriate fields in the main database are updated.
- Pervidi would have to develop a new database to work with Pathway.
- It was unclear as to whether they would be able to view data from Pathway
- A trial for safety inspections with results still kept private showed that the time taken to perform safety inspections reduced from 2 hours to 70 minutes since the implementation of Pervidi's system. Other results included:
 - Increased accuracy of the inspections
 - Increased consistency in the data recorded
- Initial costs may be expensive, but a trial can be done with a smaller risk and could help to determine how valuable the system could be.
 - A rough estimate to implement and maintain mobility tools for a company the size of the Building Team for five years came out to be around AUD 150,000.

Interview 10

Date: 22-4-2010

Interviewed: Three representatives of Business Information Services

Interviewer: Hamresh Lutchmun, Brandon Stuczko, Mike Votruba

Recorder: Hamresh Lutchmun, Brandon Stuczko, Mike Votruba

- The purpose of our research project
 - Boost effectiveness, efficiency
 - Increase consistency of data
 - Decrease frustration of officers
 - Better level of customer satisfaction
 - Mobility devices being considered: Tablets, smartphones, PDAs
- What your position entails
 - Business Analyst
 - Considers business needs and solutions from an economics side of things
 - Desktop Team Leader
 - Supervises technical projects
 - Technical Architect
 - Takes care of technical devices
 - IT Program Manager
 - Manages Pathway and other software such as Assetmaster
 - Responsible to oversee improvement projects for different programs
- Nokia phones have compatibility issues with Desktop computers. Any recommendations for possible smartphones.
 - It is irresponsible to cater for all different phone brands. Nokia has historically had issues because each new model came with different software. Nokia is supported for phone services only, not to synchronize calendar and contacts to system.
 - We support only a few phone brands. The main phones that are supported are HTC (mainly HTC SNAP) and iPhones.
- Does BIS have any concerns regarding the possible trial of mobility devices?
 - We would be happy to trial new devices should there be enough grounds for it.
 - Make sure you check with HR for OHS specifications. There have been instances where the product to be tested met all requirements and pleased everybody but was too heavy according to OHS specifications and testing was not implemented. Contact Celia Paine for more information.

- The companies that we deal with mostly are: Dell, Apple, HP, IBM, Fujitsu, Toshiba
- We are preparing a business case to present to BIS for the trial of a mobility device within the Building Team. What are the requirements of a business case?
 - Be sure to rank items as must have, would be nice to have...
 - The scope of the case: what you are trying to achieve
 - The potential benefits of the case, that is, “return of investment”
 - Providing recommendations for multiple types of devices is ok as long as you make it clear why each should be trialed.
 - Keep the case as generic as possible, do not limit options. That is, we do not need specific products to test but more what you want to product to offer and how important those are.
 - Based on our recommendations of hardware requirements, IT has access to further information and they will make a more informed decision about the particular device to be trialed.
- Describe solution Pervidi offers. Does this sound like something you would consider? Or do you have the staff to create/maintain an interface that would act like a bridge between Pathway and the mobility device. Is such a bridge needed?
 - No, Citrix is already available and takes care of bridging the gap between our database and the mobility device
 - Citrix can be accessed from anywhere as long as there is an internet connection. An officer doesn't even need to be back at the office to access/sync with database
 - It provides a secure way to access the main database.
 - We would prefer not to have a third party involved due to the instable nature of computer programs.
 - Over the next 12 months, we are trying to make all the applications available via Citrix.
- Are you aware of other software companies that offer similar solutions as Pervidi?
 - No
- Data transfer options
 - Real time access to database
 - Sometimes lose internet connection especially when inspecting basements.
 - Would cater for unanticipated inspections
 - Downloading relevant modules of Pathway onto hard drive
 - Even if lost connection, would still be able to access relevant permits.
 - Modules are too big to be downloaded on a hard drive
 - Solution

- Create an automated real time offline/online application. Has been designed for another department and it has been proven to work. Need to tailor the software for the building team's purposes.
 - Downloading only relevant fields to hard drive. Represents a lot of work
- What hardware is required to run the Pathway, Citrix, DM, MS office suite? What processor speed? How much RAM, etc.?
 - Very minimum to run our programs. Our programs are designed to run on very little "firepower".
- What are the licensing requirements/cost of having the programs available on mobile devices?
 - None, this will be BIS's responsibility.
- Do we have authorization to publish the trial study that was conducted in 2007 in our report?
 - Yes, as long as you cite it properly
- Further works
 - Currently, paper checklists are being used during inspections. Once officers are accustomed to the use of mobility devices, creating a computerized checklist within Pathway would allow council to reach the full potential of a mobile workforce.

Interview 11

Date: 22-4-2010

Interviewee: HR Consultant Safety Systems

Interviewer: Hamresh Lutchmun

- Interviewee was out of office but got in touch with another HR consultant
- What are the specifications in terms of weight and size that I need to respect for a mobility device to be considered acceptable by OHS policies
 - At this stage, there is nothing extremely rigid to abide by. Since you are only providing a recommendation to BIS, HR will look at the product selected by BIS.
- OHS addresses size and weight issues of new technologies as they arise
- At this point, no specific size and weight limits are imposed

APPENDIX E

Mobility Project Timeline

Project Objectives	Start Date	End Date
Total Project Time	3/12/10	5/4/10
Background Research and Project Proposal	1/14/10	3/5/10
First Sponsor Meeting	3/12/10	3/12/10
Objective 1 - Identify Services to be Enhanced		
3.1.1 Interviews	3/15/10	4/9/10
3.1.2 Staff Shadowing	3/15/10	4/22/10
3.1.3 Training	3/15/10	3/29/10
3.1.4 Meetings	3/29/10	4/30/10
Objective 2 - Investigate Similar Organizations		
3.2.1 Research Organizations with Mobility Tool Experience	3/15/10	4/16/10
Objective 3 - Identify Suitable Solutions		
3.3.1 Research Available Mobility Tools	4/6/10	4/23/10
3.3.2 Research Broadband Service Providers	4/19/10	4/21/10
Objective 4 - Identify Potential Concerns		
3.4.1 Survey	4/2/10	4/9/10
3.4.2 Casual Discussions	3/15/10	4/30/10
3.4.3 Research of Mobility Tool Users	3/15/10	4/16/10
3.4.4 Interview with BIS Agents	4/13/10	4/22/10
Objective 5 - Cost-Benefit Analysis		
3.5.1 Surveys	4/2/10	4/9/10
3.5.2 Data Acquisition	4/9/10	4/13/10
3.5.3 Data Processing	4/13/10	4/16/10
Report Submission	4/30/10	4/30/10
Final Presentation	5/4/10	5/4/10

Table 6: Mobility Project Timeline

APPENDIX F

Survey Questionnaire Sheet for City of Melbourne Building Team

This Section of the questionnaire sheet will seek to obtain information that will be useful for the team to complete a cost/time benefit analysis of the possible implementation of Mobility tools in the office.

1. Which part of the City of Melbourne Building Team do you work in?
 - a. BCG
 - b. MCG
 - c. CMG
 - d. Other (Please Specify)
2. On average, how many times a week do you perform on site work away from the office?
 - a. Never
 - b. 1-2
 - c. 3-4
 - d. 5-6
 - e. 7-8
 - f. 8 or more
3. How often do you attend sites without the complete documentation or information required to make a decision in relation to a project?
 - a. Never
 - b. Once a month
 - c. 2-3 times a month
 - d. Once a week
 - e. 2-3 times a week
 - f. Once a day
 - g. 2-3 times a day
4. Please rate your level of satisfaction with the following systems. Rating scale: Excellent, Above Average, Average, Below Average, and Poor.
 - a. CoMPASS
 - b. EView
 - c. Pathway
 - d. Hummingbird DM
 - e. Outlook (Email, Calendar, Tasks, Contacts)

- f. MS Office (Word, Excel, PowerPoint)
 - g. Internet (access to BCA regulations and City of Melbourne website)
5. Please rate the following capabilities that would assist you most in your daily responsibilities. Rating Scale: Very Useful, Useful, Not Useful, And Unsure.
- a. Bluetooth (transfer files i.e. pictures from mobile to computer)
 - b. Email
 - c. Touch screen and Stylus Writing
 - d. Internet Access
 - e. Access to Office Database/Programs
 - f. Full Keyboard
 - g. GPS Capabilities
6. Taking size and weight into consideration, which of the following devices would benefit you most with your fieldwork? Rating Scale: Extremely Helpful, Very Helpful, Helpful, And Not Helpful.
- a. Mobiles (call and text/picture messaging)
 - b. Smart phones (call, text/picture messaging, email/Internet)
 - c. Net book (smaller, less powerful laptop)
 - d. Laptop
 - e. Tablet PCs (touch screen, smaller size laptop)
 - f. Other (Please Specify)
7. How helpful would the following programs be in assisting you in performing on site responsibilities? Rating Scale: Very Helpful, Helpful, Somewhat Helpful, And Not Helpful.
- a. Pathway
 - b. CoMPASS
 - c. Hummingbird DM
 - d. Outlook (Calendar, Email, Tasks, Contacts)
 - e. MS Office (Excel, Word, PowerPoint)
 - f. Internet (access to BCA regulations)
 - g. Please List Additional Programs that could assist you.
8. Within your daily responsibilities, how beneficial do you feel mobility tools in the workplace will be?
- a. Very Beneficial
 - b. Beneficial
 - c. Indifferent
 - d. Unbeneficial
 - e. Very Unbeneficial
9. How comfortable are you with the potential implementation of newer technologies in the workplace?

- a. Support Change
 - b. Indifferent
 - c. Prefer Current System
10. As a future state, which would you prefer?
- a. Mobility Device that can replace your Desktop Workstation
 - b. Mobility Device that automatically syncs with your Desktop Workstation
 - c. Mobility Device with manual sync to your Desktop Workstation
 - d. No Mobility Device (continue current work practices)
11. On average, how much time do you spend gathering the relevant information relating to a specific work site per work week prior to attending the site?
- a. 0-1 hrs
 - b. 2-3 hrs
 - c. 4-5 hrs
 - d. 6-7 hrs
 - e. 8 or more hrs
12. Please estimate the amount of time you spend performing “redundant work” during an average workweek. (“Redundant work” refers to repeated tasks in the field/office, mishandling of paperwork, etc.)
- a. 0-1 hrs
 - b. 2-3 hrs
 - c. 4-5 hrs
 - d. 6-7 hrs
 - e. 8 or more hrs
13. Do you have any final comments in relation to how mobility devices may (or may not) support current fieldwork responsibilities?

Survey Data Analysis

BCG Survey Data

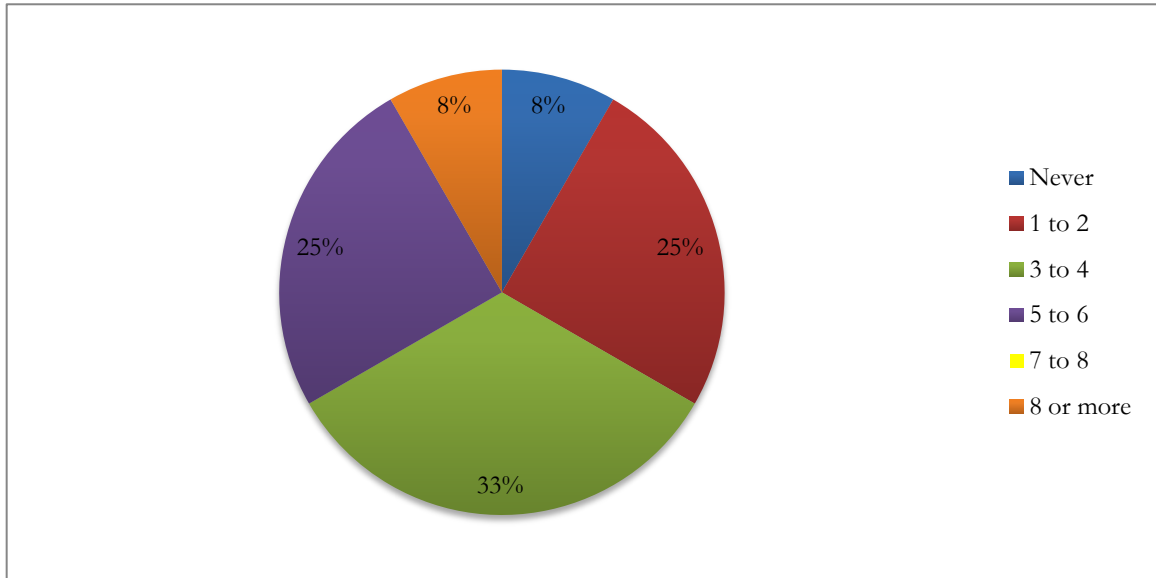


Figure 12: BCG Frequency of Attending Sites per Workweek (12 respondents)

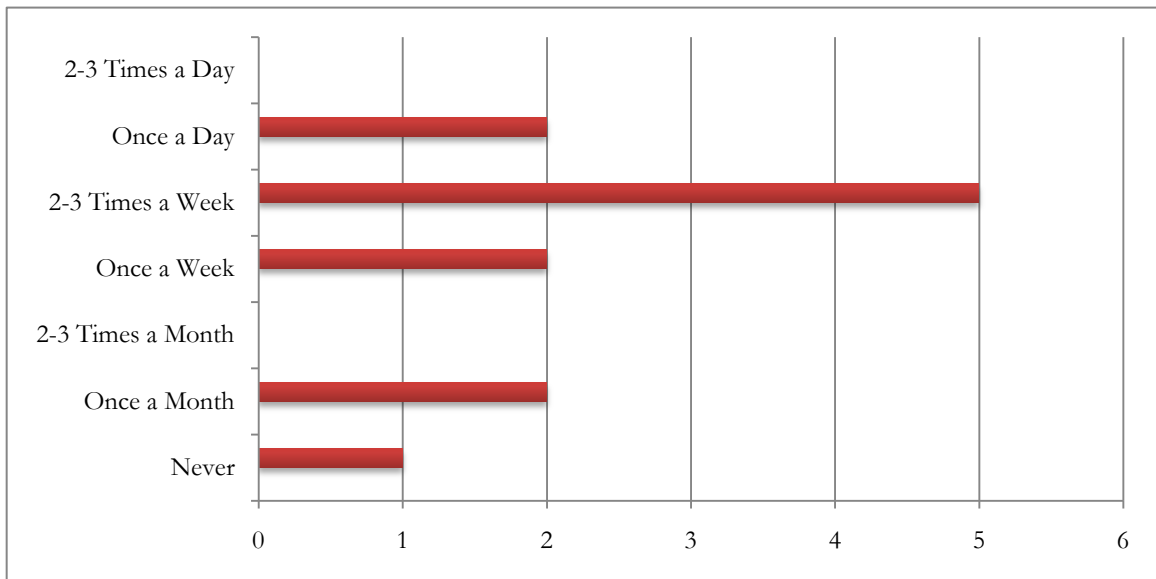


Figure 13: BCG Frequency of Attending Sites without Proper Documents (12 respondents)

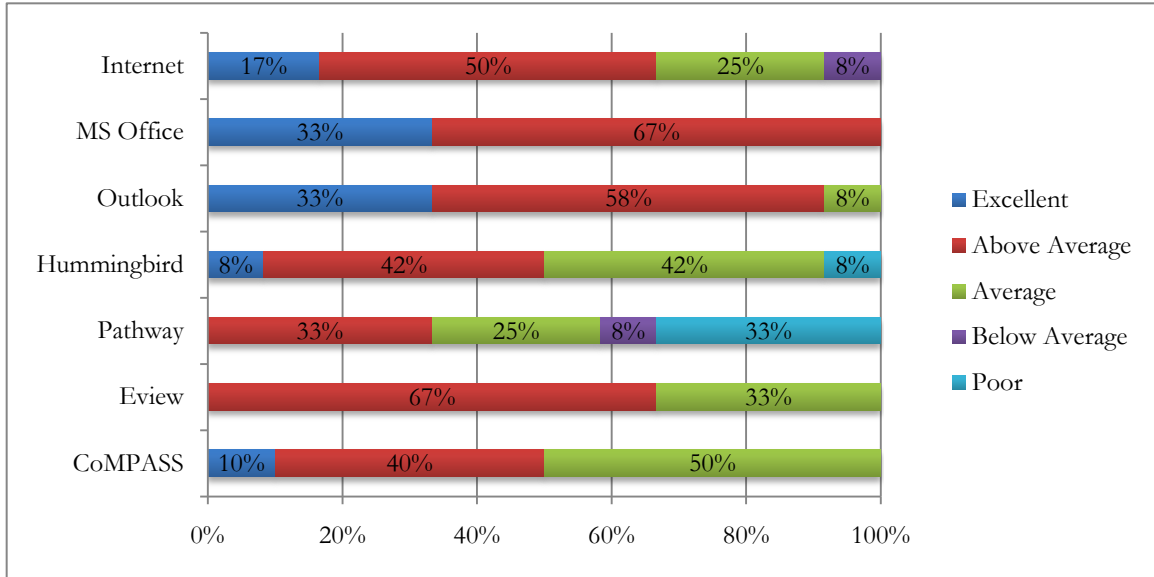


Figure 14: BCG Employee Satisfaction with Current Software (12 respondents)

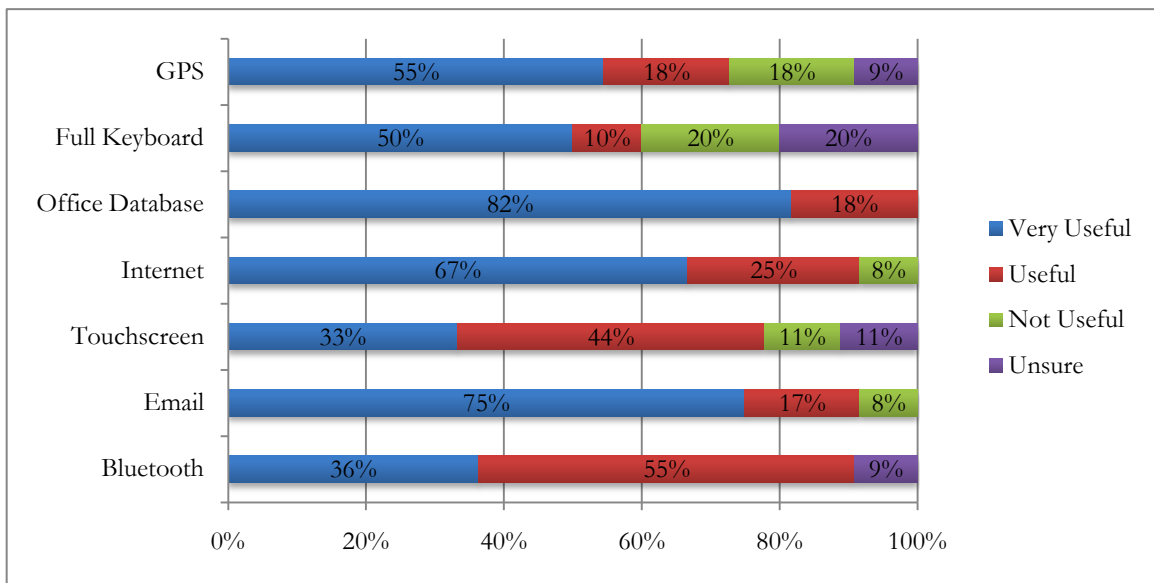


Figure 15: Mobility Tool Features for BCG Officers (12 respondents)

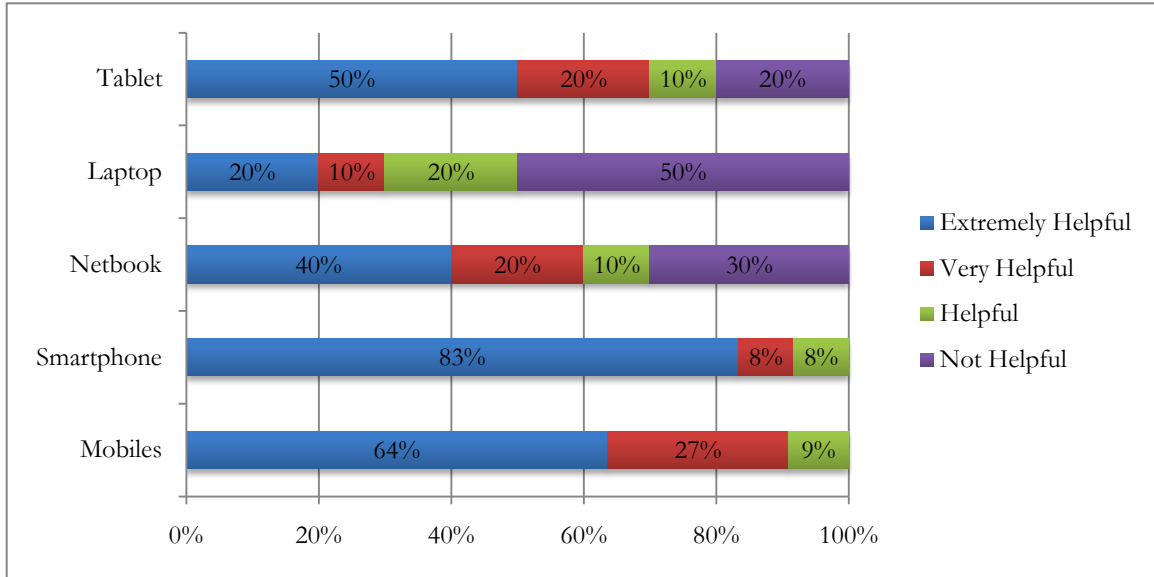


Figure 16: Usefulness of Specific Devices for BCG Officers (12 respondents)

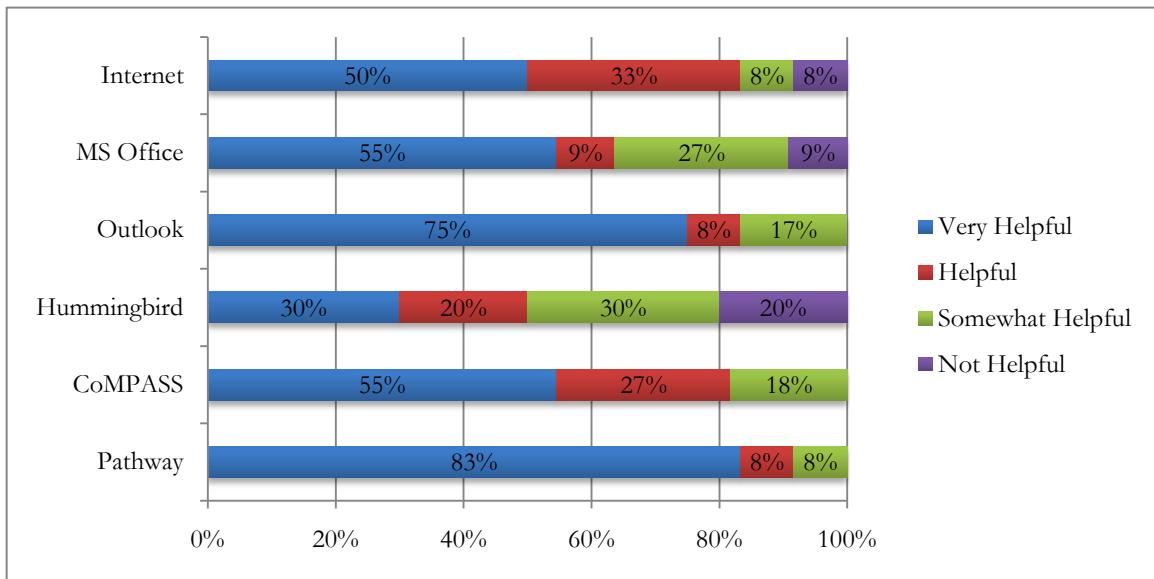


Figure 17: On Site Benefit of Specific Software for BCG Officers (12 respondents)

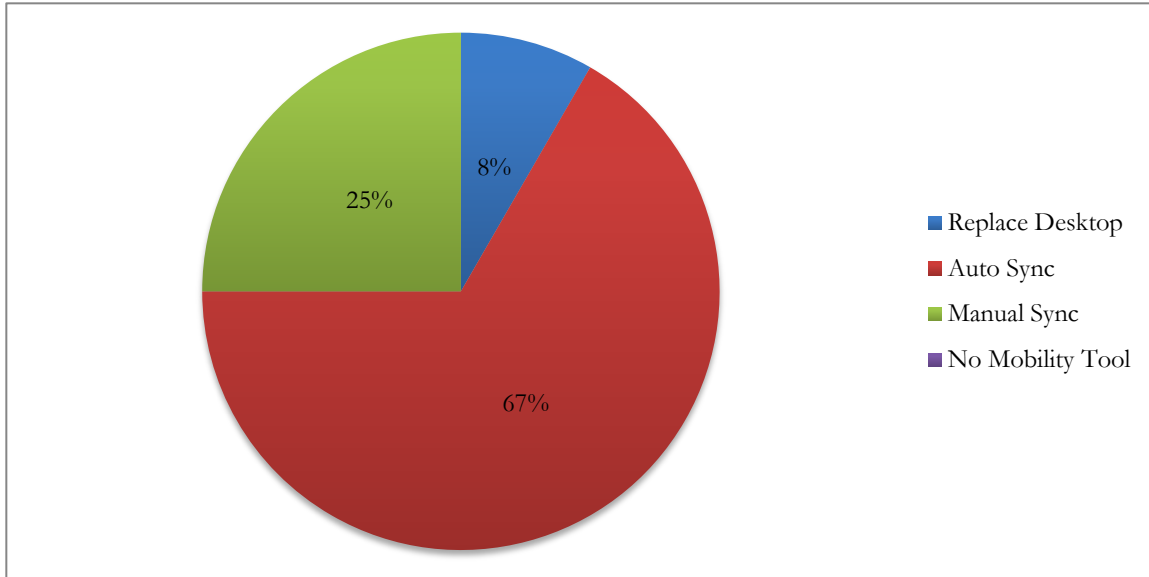


Figure 18: Future Technological State of the Office for BCG Officers (12 respondents)

MCG Survey Data

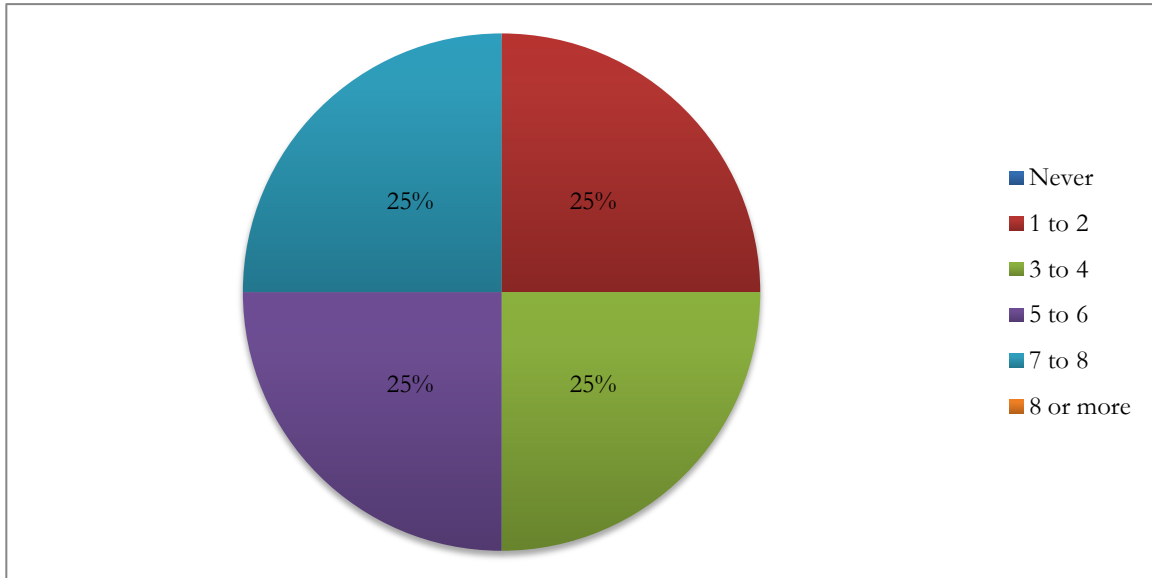


Figure 19: MCG Frequency of Attending Sites per Workweek (4 respondents)

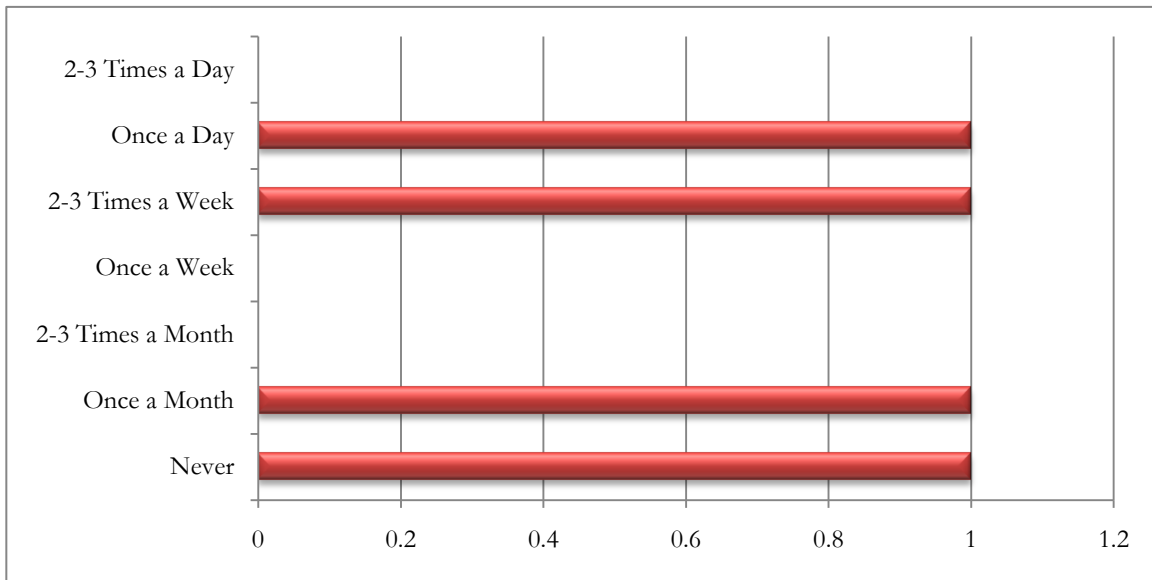


Figure 20: MCG Frequency of Attending Sites without Proper Documents (4 respondents)

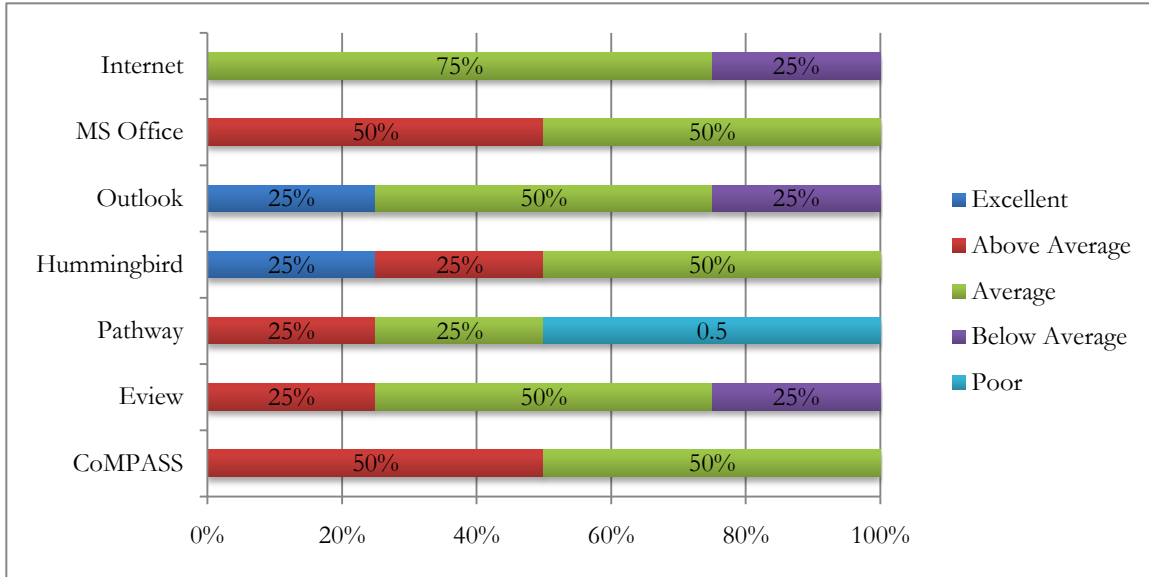


Figure 21: MCG Employee Satisfaction with Current Software (4 respondents)

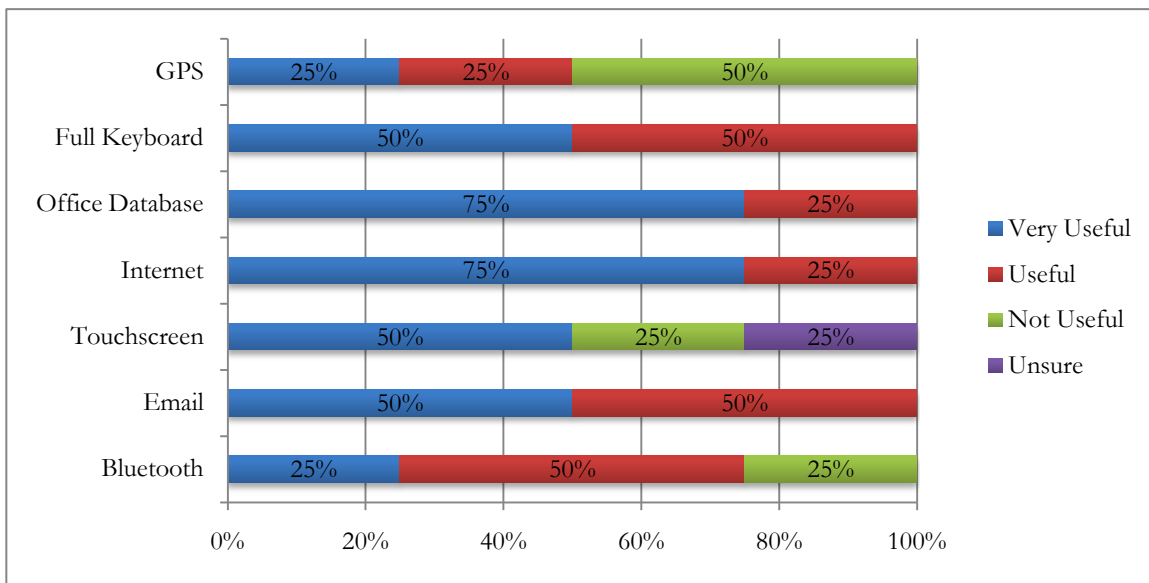


Figure 22: Mobility Tool Features for MCG Officers (4 respondents)

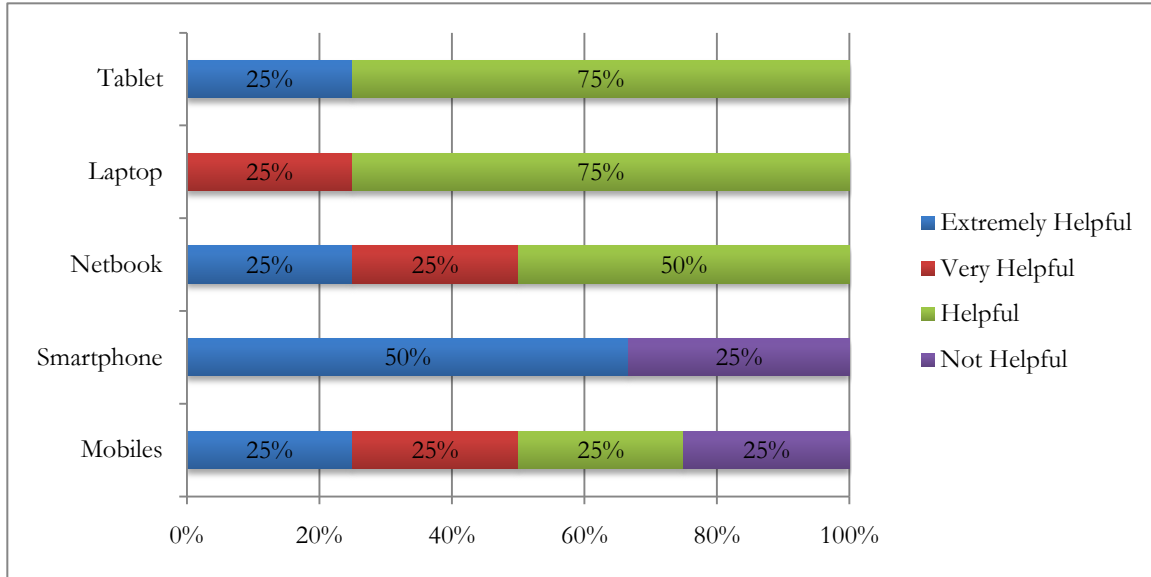


Figure 23: Usefulness of Specific Devices for MCG Officers (4 respondents)

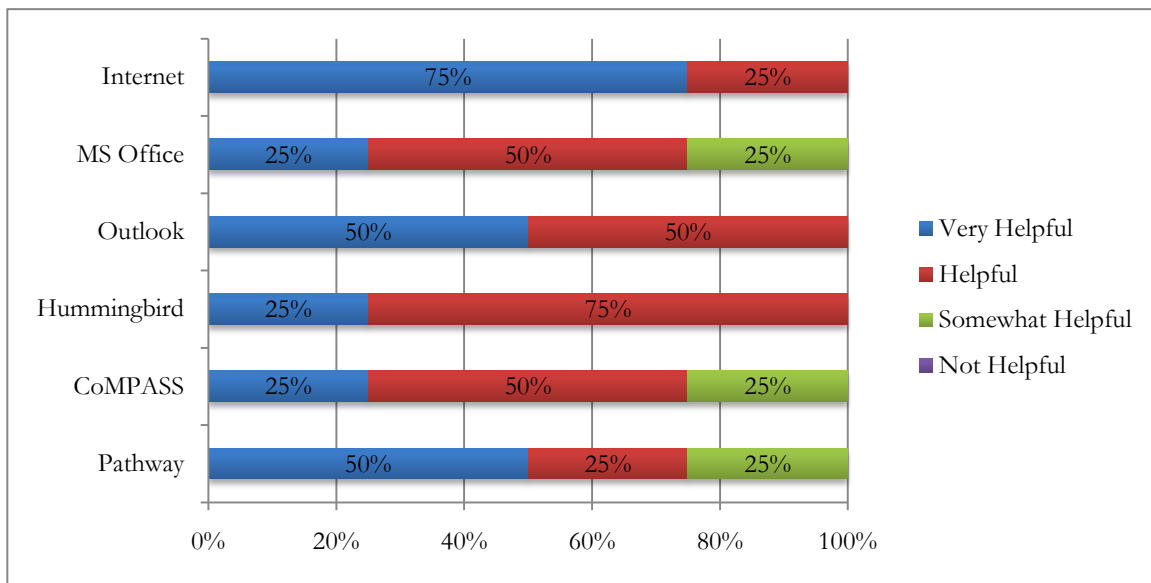


Figure 24: On Site Benefit of Specific Software for MCG Officers (4 respondents)

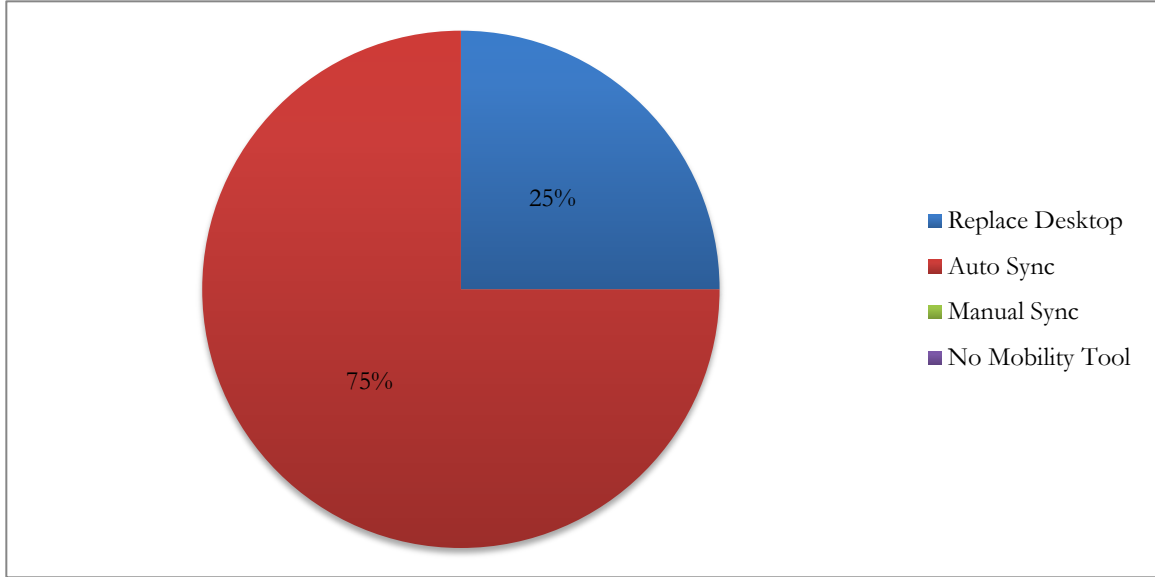


Figure 25: Future Technological State of the Office for MCG Officers (4 respondents)

CMG Survey Data

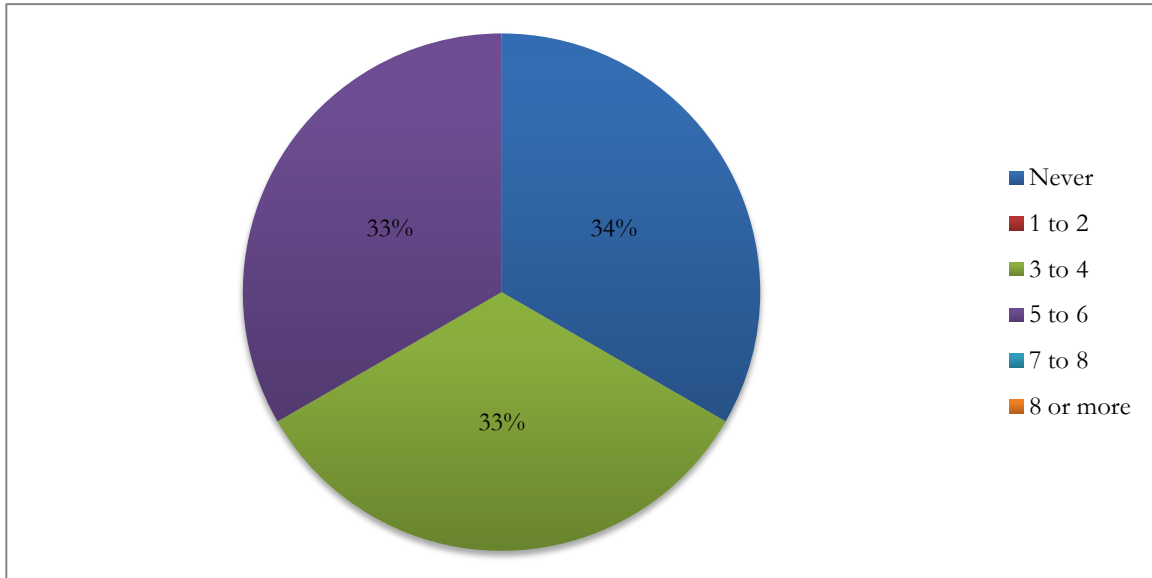


Figure 26: CMG Frequency of Attending Sites per Workweek (3 respondents)

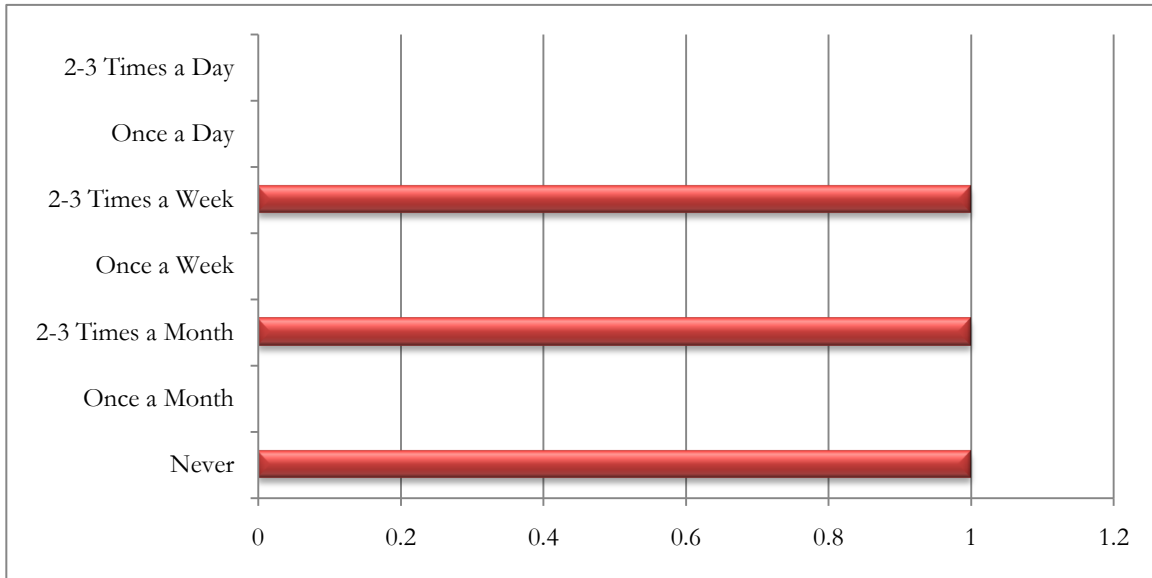


Figure 27: CMG Frequency of Attending Sites with Proper Documents (3 respondents)

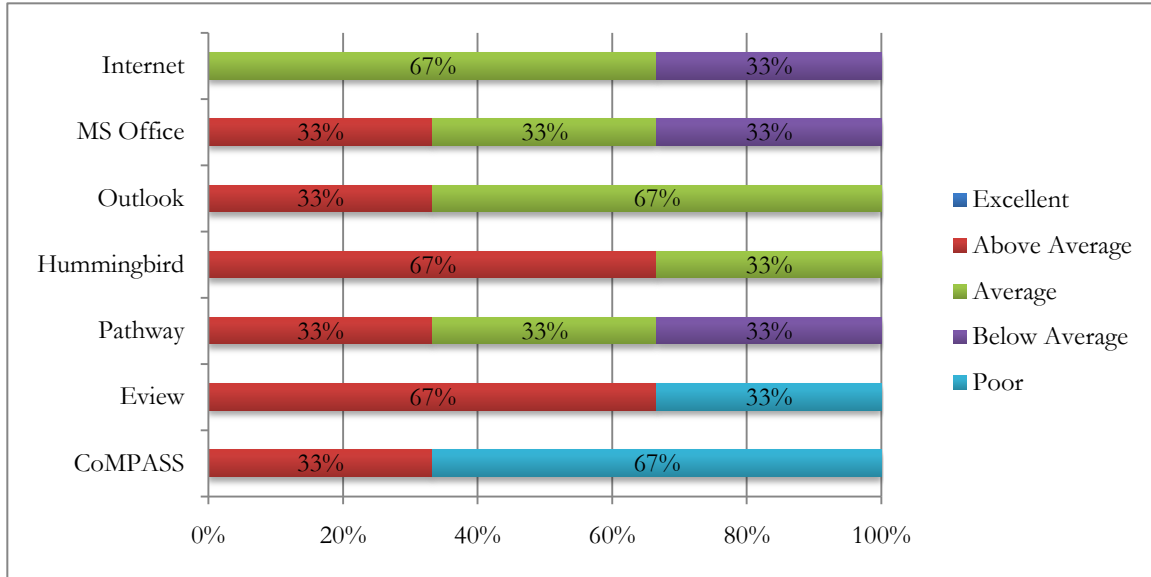


Figure 28: CMG Employee Satisfaction with Current Software (3 respondents)

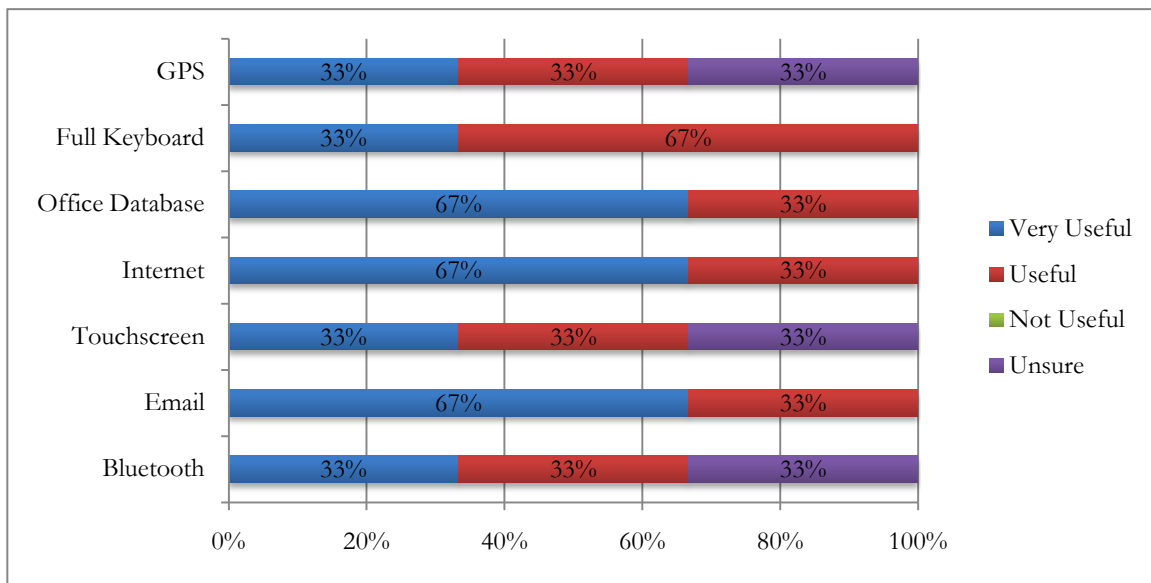


Figure 29: Mobility Tool Features for CMG Officers (3 respondents)

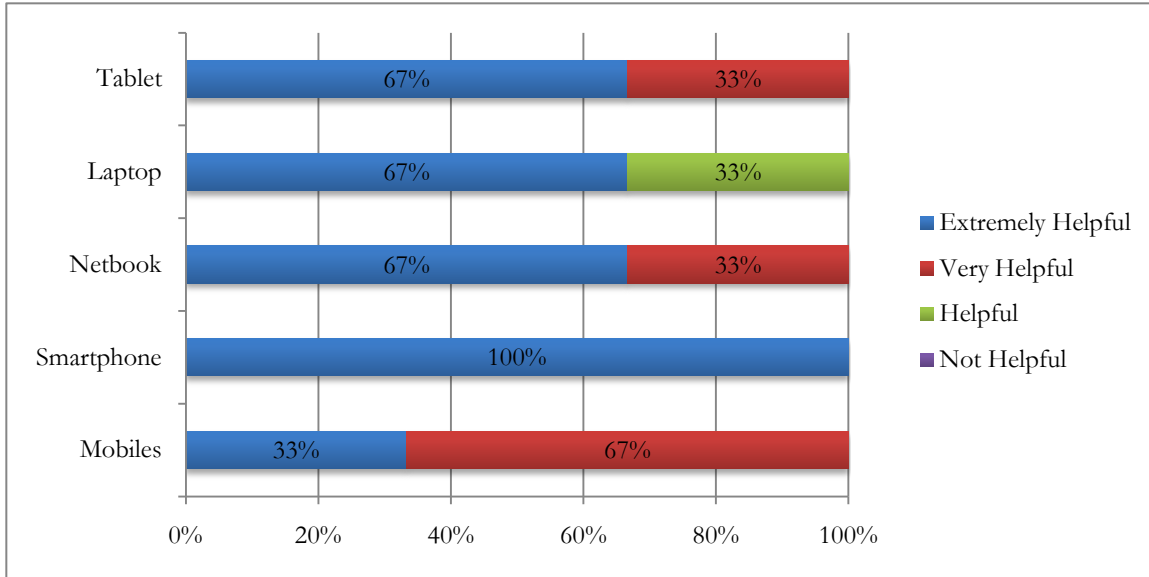


Figure 30: Usefulness of Specific Devices for CMG Officers (3 respondents)

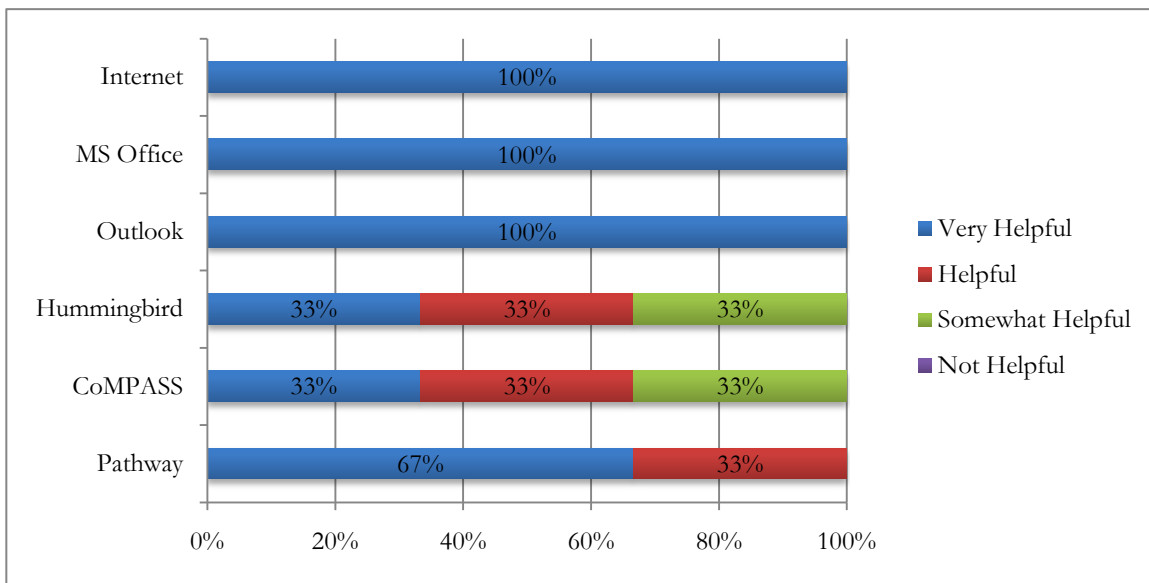


Figure 31: On Site Benefit of Specific Software for CMG Officers (3 respondents)

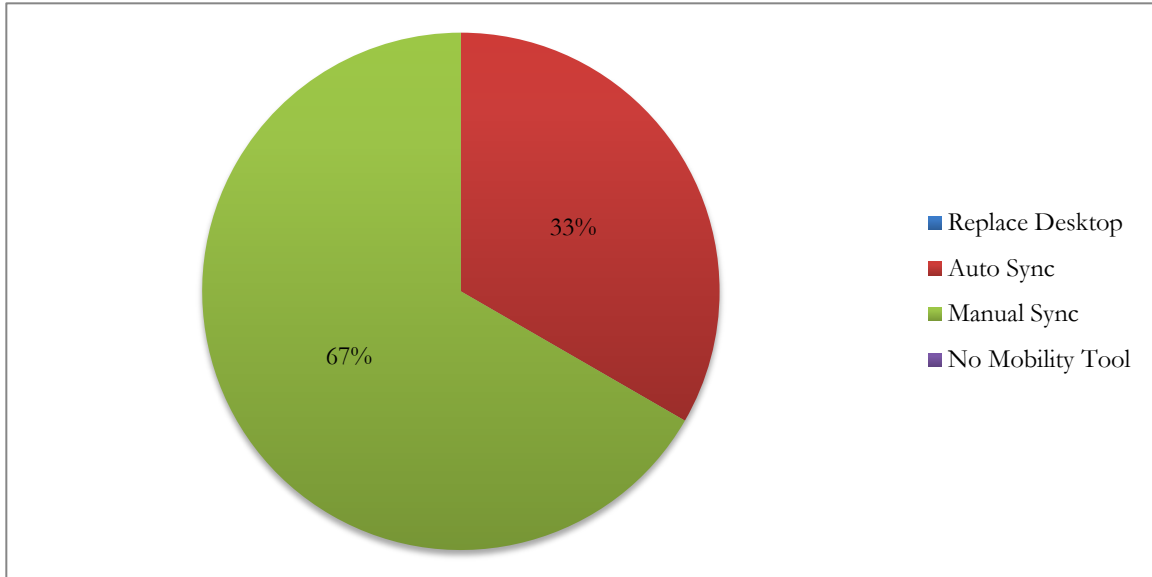


Figure 32: Future Technological State of the Office for CMG Officers (3 respondents)

APPENDIX G

Shadowing Transcripts

Shadow 1

Date: 16-3-2010

Shadowed: MCG Building Control Officer

Shadier: Brandon Stuczko

FIRST SHADOW – Zen Apartments

- Average commute time is one to two hours
- 50 story residential building – Zen Apartments
- Design and construct
 - Plan exterior of building and design the interior on the fly
- Surveyor consults builder about what they are designing and how they are designing it
- Vodafone – service provider for Building Team
- Builders continuously consult with MCG for insight on changes to building design
- FER – Fire Engineering Report
- Can provide permits for one floor to continue work or for multiple floors at a time
- Builders had drawn 13 repeats of the same sketch
- Surveyor requires updated drawings as the building progresses

SECOND SHADOW – Othello Restaurant

- Forgot file required for inspection
- Causes frustration to inspector and inconvenience to the client
- Worked for Phillip and Chung, a company offering the exact same services as MCG
 - Used a paper based system, same as MCG
- Forgetting a file happens frequently
- Currently, work phone is a Sony Ericsson
 - Phone is very outdated (Pete had one five years ago)
- Take notes in the field on relevant observations
- Come back to the office and enter notes into Pathway
- Use template saved on the computer to send email about permit to the client

- Creating a program to automatically generate these templates and send them to clients would increase efficiency and redundancy
- Took 20 minutes to complete Pathway and scanning of field data
- Had to scan documents, save to Hummingbird, place a copy in the site file, and make note of further action to be taken on this site with Post-It note
- Further action for the site (i.e. Occupancy Permit) requires office support

Shadow 2

Date: 16-3-2010

Time: 11:00AM- 1:00 PM

Shadowed: Member of BCG

Shadier: Michael J. Votruba

- Building Certification Group BCG
 - Situation: The BCG provides a service to the City of Melbourne in which it takes preemptive action to prevent fires or other hazards
 - An audit or inspection is performed every two years on establishments that have visitors that stay for only short periods of time such as bars, hostels, amongst others
 - This inspection was of a bar/hostel that was up for its two year audit
 - A checklist is followed and filled out that determines the systems that are in the particular dwelling, and a yes/no is marked for whether each system is maintained or not
 - Notes are also taken on any information that need more specific details such as obstructions, minor details found while inspecting maintenance records, and any other relevant notes.
 - Examples of the systems that are on the checklist are as follows:
Exit lights, emergency lights, door lock mechanisms, fire equipment- hoses, extinguishers, and smoke alarms
 - The first issue that was presented was that there was confusion to the tenant because the City of Melbourne can only contact the landowner not the tenants to do these inspections. The landowner did not let the tenant know that an inspection was going to occur so we had to explain ourselves in order to inspect the bar/hostel.
 - Throughout the inspection the building officer I was shadowing talked me through the steps of what he was doing and made a few comments as seen below:
 - The building officer said that the checklist was experimental and prior to the checklist the officer would have to remember everything to check, and even now the incomplete checklist makes it hard to remember specific parameters that are required by certain regulations
 - The law books BCA 2009 Vol. 1-2 could be very useful, but are too cumbersome to bring along with other paperwork; standardized wording, housing classes, and other specific laws would be essential to making onsite decisions, and there is no way to access this info from the field to ensure that the agent gives the right comments, and includes pertinent information about safety deficiencies

- Access to the city of Melbourne's records in the field could be helpful because sometimes an agent may have been to the same site recently, in order to make sure that the defects found previously were fixed... amongst other situations it would be very useful to have access to the city's records
- More research and interviews will be required by our team because the building officer hinted at there being IT issues due to the contracts the City of Melbourne has with service providers, and some issues that concerns the city council dealing with data transfer within the office, and out in the field.

Shadow 3

Date: 16-3-2010

Time: 9:30-10:30 AM

Shadowed: Member of BCG

Shadier: Michael J. Votruba

- Building Certification Group BCG
 - Situation: Building Order for a smoke alarm
 - Had to meet with a surveyor to talk about the Enforcement Order on the building in question, the surveyor was hired by the building owner as an agent
 - During the meetings several plans were exchanged, these plans were cumbersome and consisted of five folders full of plans, details, and site info....
 - There was some wonder about some of the exact details that could be found in the BCA 2009 Vol. 1-2
 - Definitions, laws, and types of building classes of certain types of structures such as the difference between bars and clubs would be useful to have in the field, but the amount of paper work that would be needed would be extremely cumbersome.
 - The BCG offers the private surveyor advice that requires that the building meet certain standards. There was somewhat of a negotiation that occurred once I left, but I left to ensure that I did not get in the way of the operations of the BCG during its more intense negotiations
 - The advice given/ or checklist that needs to be completed for the building to meet compliance could be developed on the spot and sent by e-mail immediately following the meeting
 - By typing out the negotiations on the spot there will be proof of the meeting that has taken place, and the advice/requirement will have more credibility if there are arguments about what needs to be done in the future

Shadow 4

Date: 16-3-2010

Time: 1:30 PM- 3:30 PM

Shadowed: Two Members of BCG

Shadier: Michael J. Votruba

- Building Certification Group BCG
 - Situation: The BCG provides a service to the City of Melbourne in which it provides permitting and inspects events
 - An audit or inspection is performed for each event
 - This inspection was of a truck exposition and was in the city of Melbourne fairgrounds being set up in 3 to 4 major tents.
 - The systems that are in the city of Melbourne fairgrounds are assessed, and all temporary structures are evaluated as well, all temporary structures require a signature of a structural engineer
 - Notes are also taken on any information that need more specific details such as obstructions, minor details found while inspecting maintenance records, and any other relevant notes.
 - Examples of the systems that are on the checklist are as follows:
Exit lights, emergency lights, door lock mechanisms, fire equipment- hoses, extinguishers, smoke alarms, stair railings, and ramp steepness
 - The building officers inspected and wrote down all of the deficiencies found at the fairgrounds and would later bring them back to the office to review. Once a list of revisions was established the list is sent to the truck exposition site manager

Shadow 5

Date: 17-3-2010

Time: 9:00 AM- 9:40 AM

Shadowed: Member of BCG

Shadier: Michael J. Votruba

- Building Certification Group BCG
 - Situation: The BCG provides a service to the City of Melbourne in which it provides inspections to restaurants that have had complaints or accidents
 - An audit or inspection was performed at a Hungry Jack's (Burger King)
 - A fire that took place in the Hungry Jack's led to its inspection in which the BCG found a few problems
 - The inspection today was done to check that all of the problems had been fixed
 - It was a simple checklist that then had to be entered into the office database later on.
 - Notes are also taken on any information that need more specific details such as obstructions, minor details found while inspecting maintenance records, and any other relevant notes.
 - Examples of the systems needed to be verified:
 - Exit lights, emergency lights, door lock mechanisms, fire equipment- hoses, extinguishers, smoke alarms, stair railings, and ramp steepness
 - The building officer made sure that Hungry Jacks complied with all building codes.
 - We then were on the way back to the office and we saw people building a hoarding the officer asked for a permit and the contractor said he had one but could only produce a report of consent.
 - We then had to go back to the office to check that a permit was actually file, which it had been

Shadow 6

Date: 17-3-2010

Shadowed: MCG Building Control Officer

Shadier: Brandon Stuczko

- Start Time: 10:30 AM
- Pete expressed difficulty finding site specific paperwork
- Difficulty finding site spreadsheet and site file
- Spreadsheet was generic excel file
- Getting access to site specific file on site would be highly beneficial
- Measure rail heights and rung heights to ensure problem found before were addressed
- Look into caulking heights under door jam
 - Benefit from mobility being able to look up the codes on site
 - Simple internet access would have sufficed in this instance
- Proof of alteration of problematic area can be sent via email with picture of area or picture message to mobile
- End Time: 11:30 AM (back at the office)

Shadow 7

Date: 17-3-10

Shadowed: MCG Building Control Officer

Shadier: Brandon Stuczko

- POPE
 - Place of Public Entertainment
- Greater than 500 square meter enclosed area must obtain permit
- Forgot a few documents required for the job
- Checked:
 - Sufficient toilets
 - Sufficient emergency exits
 - Adequate fire extinguishers
- Food provider had inadequate fire extinguisher
 - Officer did not have the proper documentation for the provider

Shadow 8

Date: 17-3-2010

Time: 3:30 PM- 4:30 PM

Shadowed: Member of Building Team and Member of CMG

Shadier: Michael J. Votruba

- Construction Management Group CMG
 - Situation: The CMG provides a service to the City of Melbourne in which it provides advice to project owners as to how to go about creating a construction management plan, and then during construction the CMG enforces the construction management plan in which each evaluation incurs a \$2000 (Australian) fine.
 - The meeting I shadowed today dealt with a site that is in the pre-permit phase for construction, this means that builder wants to develop the site and plans/designs have already been started.
 - The client was taking preliminary steps to create a suitable construction management plan, he met with the CMG early on to acquire an understanding of what is required by the CMG for a Construction Management Plan
 - The meeting dealt with an intro to the clients site as well as a more in depth discussion about what has to be done by the land owner to satisfy the City of Melbourne's rules and regulations
 - A construction management plan is created to ensure the safety, health, and well being of the public
 - The plan is created then signed off by the CMG and after a 15-day period in which the abutters may appeal the plan if they have legitimate reason.
 - This plan dealt with construction challenges such as putting up hoardings and gantries, as well as dealing with limited access and traffic flow.
 - Throughout the meeting a previously completed construction management plan was referenced on multiple occasions to show the client what is needed in a construction management plan.
 - The plan goes into great depth to the extent that each piece of equipment on-site has to be identified as well as the frequency of each piece of equipments use.
 - The referenced plan was large and bulky, and if it were in electronic form on a mobile computer it could be much easier to lug around and more easily accessible. The meeting I shadowed was in our home office, however this is not always the case and even in the office meeting the referenced plan was forgotten at one members desk, if the meeting had been

somewhere else there would have been no plan to reference and it would be likely that a new meeting would have to be rescheduled.

- There may be some room for mobility tools to help here.

Shadow 9

Date: 18-3-2010

Time: 9:15 AM- 10:30 AM

Shadowed: Member of CMG

Shadier: Michael J. Votruba

- Construction Management Group CMG (site services)
 - Situation: The CMG provides a service to the City of Melbourne in which it provides advice to project owners as to how to go about creating a construction management plan, and then during construction the CMG enforces the construction management plan in which each evaluation incurs a \$2000 (Australian) fine.
 - The meeting I shadowed today dealt with a site that is going to be developed from a 4 story building into a 20-story building.
 - The client was taking preliminary steps to create a suitable construction management plan, he met with the CMG to acquire an understanding of what is required by the CMG for the Construction Management Plan mainly dealing with traffic and pedestrian issues
 - The meeting dealt with an intro to the clients site as well as a more in depth discussion about what has to be done by the land owner to satisfy the City of Melbourne's traffic and pedestrian rules and regulations
 - This plan dealt with construction challenges such as putting up hoardings and gantries, as well as dealing with limited access and traffic flow, at the same time the effects of construction need to have as little impact on the businesses around it as possible.
 - Throughout the meeting a previously completed construction management practices were referenced on multiple occasions to give the client an understanding what is needed in a to satisfy safety and impact regulations
 - The references were vague and required traveling a couple of miles to go see the actual site being referenced, and if pictures or plans/specs were in electronic form on a mobile computer it could be much easier to show the client exactly what was meant.
 - The meeting I shadowed was in the field about 4-5 blocks away from the office.
 - Ken went on to explain some more of the processes of the CMG dealing more so with the enforcement tasks of the branch
 - The CMG deals mostly with part 6, 9, and 14 of the "Melbourne City Council Activities Local Law 2009"

- In most cases if a violation is minor the Construction team is allowed to fix the problem and continue work, however if safety is an issue, there is no permit on file, or it is a company that commonly commits offenses then it is likely that the construction will be shut down
- A permit is required for out of hours works, occupying space on a footpath/roadway owned by the City of Melbourne
- It is sometimes hard to determine whether or not a permit is on file without having to go back to the office, or call the office if another Member of the Building Team is in. The major issue here is that most people get into the office at 8:30 AM to 9:00 AM, but the CMG tends to do inspections at 7:00 AM to 9:00 AM
- Also if the CMG agent has to go back to the office the builder committing the offense may be able to pack up and run away before the agent finds out about whether there is a permit or not. Even if the agent asks for the offenders' information there is no way to ensure that the offender is not giving out a fake name.
- There may be some room for mobility tools to help here.

Shadow 10

Date: 24-3-2010

Shadowed: Members of the Building Team

Shadier: Hamresh Lutchmun

- BCG Weekly team meeting
 - There is currently an issue with flexible leave arrangements, most officers decide to work more during the week and try to get Monday and Friday partially off. This results in not many officers being present at the office, which hinders the performance of the whole group. The managers want officers to take the leave in a more staggered fashion. With the use of mobility tools, officers would potentially be able to work from home.
 - Event spreadsheet
 - Workload matrix. Management wants to be able to better assess the workload of building officers. However, this is not as simple as comparing the number of permits issued today to the number of permits issued over the past 10 years. This is because not only has the amount of work been increasing, but its complexity has been rising as well. Monitoring workload has multiple applications: investigating the need for mobility tools, the need for an extra building officer...
 - Management is also looking at innovative ways to reward employees for their good work. This idea falls within Lean Thinking principles.
 - The city has been growing
 - There will be training sessions on how to use the different software. Not all officers are using the software the same way. This creates much difficulty when other officers are trying to look for a document but since they are looking in the wrong directory, it cannot be found despite being present in the database.
 - Customer service and the way people contact the Building Team is very important to management. When customers talk to a building officer and will not take no for an answer, this sucks up the building officer's time who could be doing some more productive work.

Shadow 11

Date: 22-3-2010

Time: 9:00 AM- 9:30 AM

Shadowed: Member of CMG

Shadier: Michael J. Votruba

- Construction Management Group CMG (site services)
 - Situation: The CMG provides a service to the City of Melbourne in which it provides advice to project owners as to how to go about creating a construction management plan, and then during construction the CMG enforces the construction management plan in which each evaluation incurs a \$2000 (Australian) fine.
 - The meeting I shadowed today was a weekly meeting between the engineering team and the CMG to make sure both organizations are aware of the major projects that are being dealt with in the city.
 - A mobility tool could have been useful to the agent just because the agent only had a printout to use to run the meeting at the building next door.
 - The agent did mention to me a program called Citrix that may be used to access the office database from out of the office.

Shadow 12

Date: 25-3-2010

Time: 9:30 AM- 11:00 AM

Shadowed: Two Members of the CMG

Shadier: Michael J. Votruba

- Construction Management Group CMG
 - Situation: The CMG provides a service to the City of Melbourne in which it provides advice to project owners as to how to go about creating a construction management plan, and then during construction the CMG enforces the construction management plan in which each evaluation incurs a \$2000 (Australian) fine.
 - The meeting I shadowed today dealt with a site that is in the pre-permit phase for construction, this means that builder wants to develop the site and plans/designs have already been started.
 - The client was taking preliminary steps to create a suitable construction management plan, he met with the CMG early on to acquire an understanding of what is required by the CMG for a Construction Management Plan
 - The referenced plan was large and bulky, and if it were in electronic form on a mobile computer it could be much easier to lug around and more easily accessible. There was a TV screen available that could have been used to display large plans, but no electronic copies were available.
 - Very similar to previous meeting with Warren and Frank on the 17th.

Shadow 13

Date: 25-3-2010

Time: 2:00 AM- 3:30 AM

Shadowed: Member of Building Team

Shadier: Michael J. Votruba

- Went to a meeting upstairs that dealt with what the City of Melbourne Departments want to be included in the City website.
- It is specifically made to notify businesses of happening and requirements of the City of Melbourne.
- It seems as though the Building Team does not use this resource, mainly because they have little to inform business about, but it seems to me that the company may under utilize this resource
- The census team and information center team expressed an interest in our project

Shadow 14

Date: 16-4-2010

Time: 10:00 AM- 2:30 PM

Shadowed: Two Members of BCG

Shadier: Michael J. Votruba

- Building Certification Group BCG
 - Situation: The BCG provides a service to the City of Melbourne in which it inspects buildings that have been complained about concerning safety issues. This reactive inspection took place at a cinema that the Building Team had received complaints about. The complaints were that the exit signs were not posted properly, missing, or were confusing to follow.
 - This inspection was a joint inspection with the MFB, Metropolitan Fire Brigade, who look for discrepancies with fire codes, as do the BCG, but the MFB is brought along to ensure a thorough inspection of the site.
 - Note were taken as well as pictures for proof on any specific details such as obstructions, minor details found while inspecting maintenance records, and any misplaced, or missing exit signs.
 - Examples of the systems that are inspected are as follows:
Exit lights, emergency lights, door lock mechanisms, fire equipment- hoses, extinguishers, smoke alarms, stairs
 - The building officers inspected and wrote down all of the deficiencies found at the cinema and would later bring them back to the office to review. Once a list of revisions was established the list is sent to the building owner.
 - Many of the notes taken, would need to be re written in the office, this creates the possibility of forgetting some details, and also produces some more redundant work for the BCO. Also the pictures that were taken would need to be sorted to go along with the BCO's comments. If the pictures could be directly linked to a caption in the field that could be very useful to the BCOs.

APPENDIX H

City Of Melbourne Permit Applications Customer Satisfaction Survey

Summary and Conclusions, and Verbatim sections

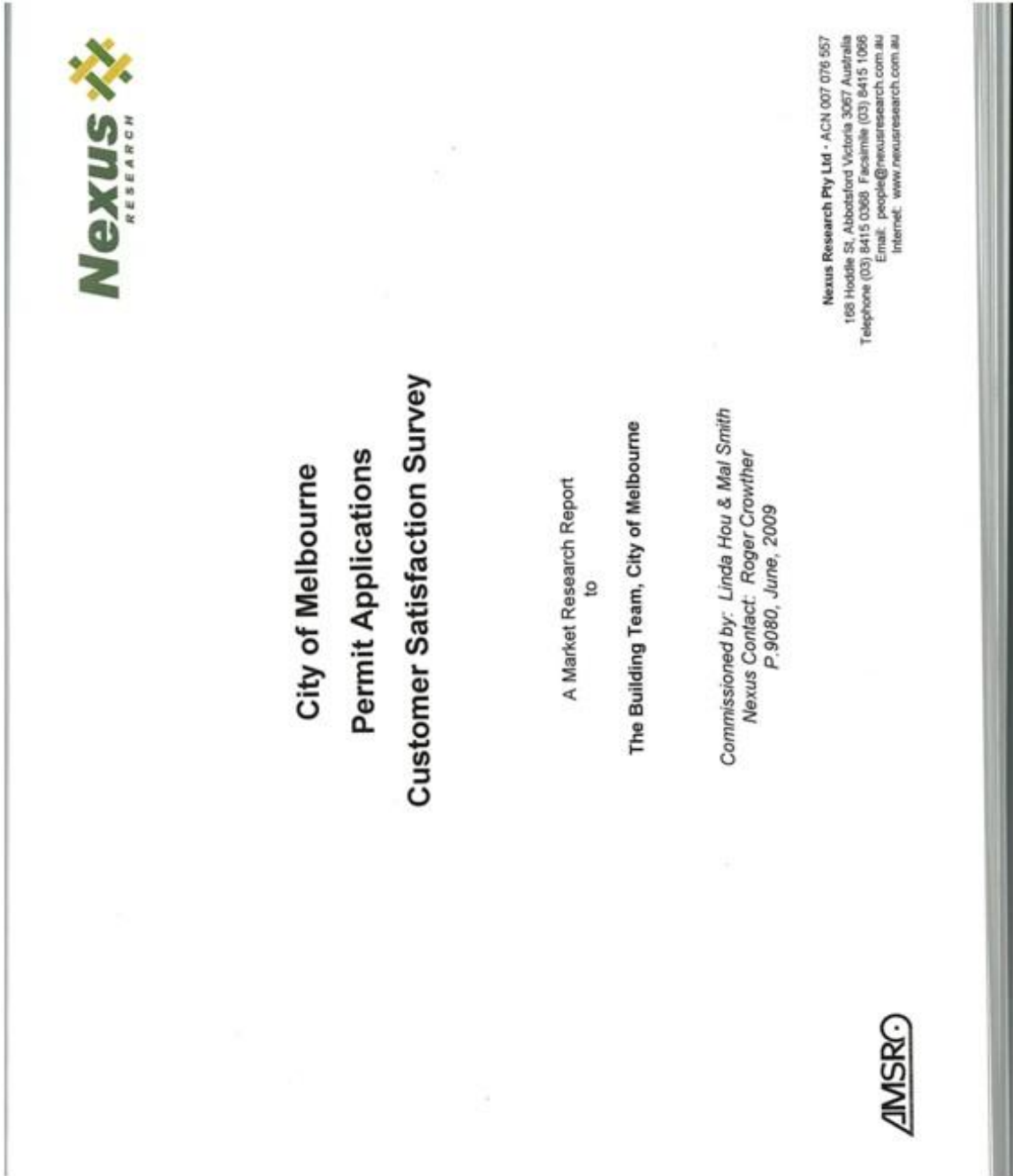


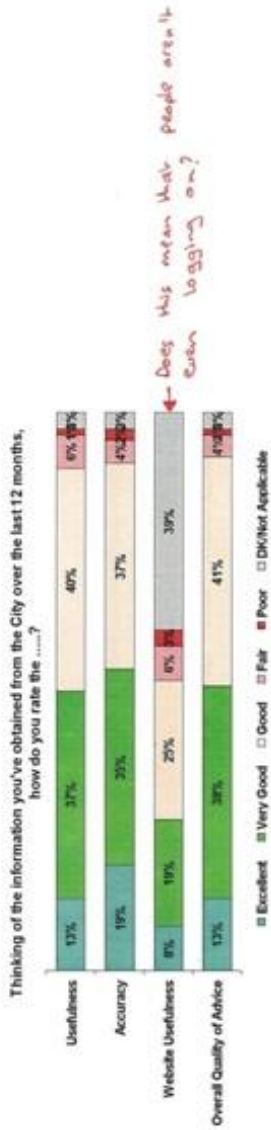
Figure 33: Cover Page of Customer Satisfaction Survey

1. Summary & Conclusions

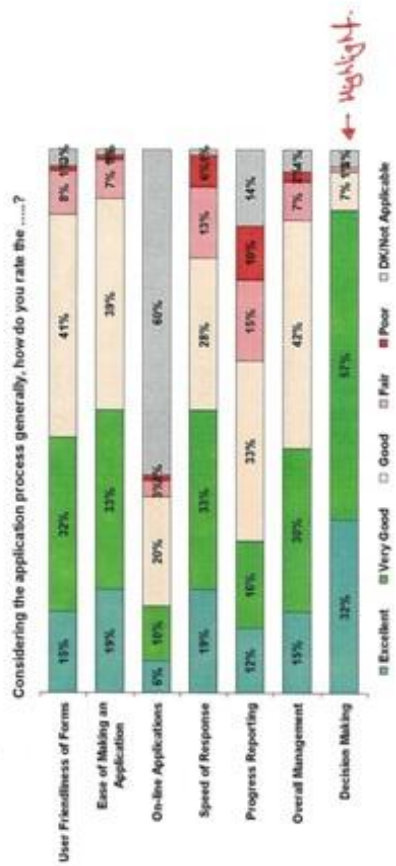
Context	<p>This Report is based on the results of 281 telephone interviews with people drawn from a list of clients of the City of Melbourne's Building Team in recent months. The research was undertaken to define the degree of client satisfaction achieved in relation to applications for permits, etc.</p>
Customer Composition & Behaviour	<p>About 50% of clients may be defined as Contractors/Subs. Building Professionals & Planners account for a further 16% and those involved in Skips, Signs & Cranes a similar amount.</p> <p>In the last 12 months, about 40% of clients have applied for a Road Opening permit and around 30% have variously applied for a Crane permit, an Out of Hours permit, and/or a Skips/Bins permit. Around 95% of applications were reported as successful.</p> <p>Some 43% of applicants seek advice first before applying. Of these, 72% received it by phone, 34% face-to-face and 33% by e-mail.</p> <p>Given the choice, 60% of respondents generally would prefer to receive information by email. Just over half of clients have visited the city of Melbourne's website within the last 12 months. Amongst Building Professionals & Planners, the proportion rises to three-quarters.</p>
Satisfaction	<p>Of the respondents who had sought pre-application advice, over 50% were Very Satisfied with the advice received, rising to over 90% on a Satisfied + Very Satisfied basis.</p> <p>↑ high light</p>

Figure 34: Page 1 of Summary and Conclusions from Customer Satisfaction Survey

On a more general basis, using the full sample, the following chart summarises respondents' satisfaction with the information they'd obtained from the city over the last 12 months.



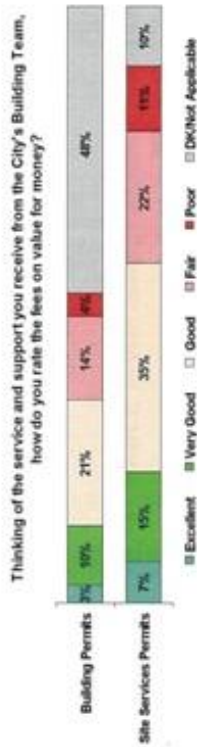
Satisfaction with the application process generally was of a similar level as the following chart, based on the full sample, shows.



The preceding chart suggests that a little more feedback may help reduce the small proportion (10%) of clients who are dissatisfied to some extent with Progress Reporting.

Figure 35: Page 2 of Summary and Conclusions from Customer Satisfaction Survey

Fewer respondents were able to speak from experience on value for money. The following chart breaks out answers including these Don't Knows for perspective.



In summary, when asked to think generally about the performance of the Council and its Staff, 12% of respondents considered this Excellent, rising to 43% on a Very Good + Excellent basis – and 85% on a Good + Very Good + Excellent basis.

There was no particular focus of complaint from the 1-2% overall who rated performance as Poor. If anything, clients sought more access to the Building Team, either by an increase in Staff numbers or in opening hours. It was also suggested by just a few respondents that allocating applications to particular, identifiable staff could ease communication and ensure consistency.

Complaints

Amongst the 281 respondents, just 9% claimed that they had ever felt cause to make a complaint. This was more so on the application process (3%) and outcome (2%) rather than customer service per se (2%). Only a quarter of those feeling cause actually progressed a complaint. Of these 6 people, 4 rated the process of making a complaint as Good or Very Good.

The following pages provide a more extensive analysis, after which the Detailed Tables and a copy of the questionnaire are provided for reference.

Figure 36: Page 3 of Summary and Conclusions from Customer Satisfaction Survey

Table 24: Thank you very much for your help. Finally, do you have any other suggestions for any actions that could be taken by the City's Building Team to enhance their service? (verbatim)

<p>I put my applications in and sometimes they respond and sometimes they don't respond and sometimes I don't even get the permit but I still get the invoice and no other contact from them.</p>	<p>They need more industry based people that understand the practicalities in building. They have 'head knowledge', but no practical experience.</p>
<p>They have been great</p>	<p>Customer advised that access to the building where he applies for permits is difficult. The street is often not accessible and parking is difficult.</p>
<p>Quicker response to applications</p>	<p>Keep it simple. Problem with a response. The client would like an immediate response - same day or night response to her inquiry. Situation - they are slow in making a response.</p>
<p>The only issue I had was with some of the invoicing that was not very clear and I was not too sure what I was paying for.</p>	<p>When we apply for parking permits in the city they require 3 or 4 days notice, and the nature of our work is such that most of it is emergency jobs and so we can only give 24 hours or less notice. <i>Part-time</i></p>
<p>Website is good, easy to search and find what look for - self-explanatory</p>	<p>The cost of the permit for a bin skip is too high and different councils have different prices and there should be one price for all, needs to be standardised where there is a set price for all council</p>
<p>It would help if when I try to make phone contact somebody would answer or/and return the call.</p>	<p>Customer would like emails and messages to be replied to when applying for permits. A lot of the time staff do not follow up customer queries</p>
<p>Everything is pretty straightforward on the website and we are very happy.</p>	<p>Customer believes more staff are needed for responding to telephone inquiries</p>
<p>Getting a person on the other end of the phone as opposed to a voice message or machine or being redirected can be a bit tricky. The main number is fine but being redirected is when it can get difficult</p>	<p>They are very good at the moment and there is nothing I could complain about.</p>
<p>I would like to receive email addresses from other areas or departments within the council</p>	<p>They could return the deposit bond more promptly when requested</p>
<p>They are doing a very good job.</p>	<p>Extend their opening hours especially be available on weekends.</p>
<p>Do away with amount of red tape we have to deal with. Reduce the fees, in some areas the rate fees are too high and unreasonable. The council should not use us for unreasonable revenue raising.</p>	<p>I understand that occasionally some staff need time to obtain the required knowledge to fulfil our needs. Even though I had a problem with a new staff member it does not require complaining about.</p>
<p>When he calls the planning department he never gets the same person. They do not want to give out direct lines so he has to keep repeating his story. Staff are friendly.</p>	<p>Slow in getting permit responses - could this be speeded up within 2 days</p>
<p>I would like the staff to come and see me on the rare occasion that I have a problem that needs solving rather than trying to work it out over the phone or email.</p>	<p>More inspections in their laneways to check bins and keep areas clean and tidy. Make their standard drawings accessible through their website.</p>















Figure 37: Page 1 of Verbatim Section of Customer Satisfaction Survey

Permit Application - Customer Satisfaction Survey

They are not too good at answering the phone. Quite often no response at all.	We found dealing with them terrific and very prompt.
Is there any way of finding the application forms for a permit on the website ie a link searching for them can take time?	Staff assessing permits should have meetings on site to discuss applications before making decisions. They need a better understanding of nature of jobs and the way contractors work.
The parking permit fees are unreasonable given that they are more or less the same as a parking fine and also lack of options for contractors working in the city with loading zones or one hour parks. <i>parking</i>	Before we can get a road opening permit we have to get a permit from Powercor and they are useless and that is what slows us down. There needs to be liaison between City of Melbourne and Powercor.
Look more in depth for quality when they award tenders, not always the lowest price. Lowest price does not always mean the best quality of the contractor that do the work.	Very good overall
There are some groups around the city that are anti-development or anti-construction and the Council needs to be more forceful in deterring these groups as it wastes a lot of time.	Website has too many headings and from our point of view not correctly listed. Simplify it, in alphabetical order or categories of permits is far better- time wasted in searching present site
They could be more open to the working out of hours - 7am- 7 pm current time but overtime is needed. They are terrified of upsetting residents.	Make the response time for gaining a permit quicker.
The council looks after street parking and they are not sympathetic to our needs for parking without charging us a large amount of money or providing adequate room to park anywhere. More flexibility.	Website- not user friendly. Easier links to find permits could be an advantage.
More staff are needed to enhance services provided	There has been a double up in invoicing at times and it is inconvenient as we then have to check, follow-up and investigate further.
Never had a problem, they have always been very timely etc.	We need staff parking and cannot get parking permits because of our location being so close to Queen Vic Market.
The complete process of obtaining a consent approval does not comply with the RMA 2004.	More communication between permit signage and people in office so that duplication does not occur and staff know what is going on ie being informed
More online information about what is available.	Be clearer in finding the sites and specify that is a cherry picker or crane
Permits should be more reasonably priced, customer states that she is charged for two days for bin hire instead of one day, terms on application form are not very clear	They need more experienced staff in the office as some of them aren't very knowledgeable.
Make more space on the forms so details can be filled out	When applications get referred to a certain other department there can be a long delay and there is then a big unknown as to whether approval will be granted or not.
Advise how to contact them better, ie. a direct line rather than the long wait to speak to the right person	A little feedback would be nice after making an application as sometimes I don't know what is happening.
Customer would prefer more updates on the progress of applications	When I called up to apply for permit I was given to different opposing procedures and because of the timeframe I wasted a week before I realised the first information was incorrect and I had to go again
They are doing a great job as it is.	

Figure 38: Page 2 of Verbatim Section of Customer Satisfaction Survey

Permit Application - Customer Satisfaction Survey

-  Tone down the arrogance and abuse of power and authority just because you are the one to make the decision. This is the treatment I received from one person at C of M that I had to deal with.
-  A follow-up phone call to notify progress of application would be good.
-  Too much passing off of the issue onto someone else. Can go through several people before you actually reach the right one.
-  Simplify the website and make it easier to understand the path to the permit system and building in general.
-  The payment I did not receive an invoice and send a overdue notice but I did not receive an invoice out promptly and I did not pay as I did not receive the invoice as it was sent too late.
-  The only issues that are in place are set up to deal with the run of the mill eg footpaths closures, they need to acknowledge more variety of normal use permits, more open minded.
-  They need to be more flexible in administering requirements that are not of an non emergency nature. They are too rigid and not prepared to accommodate our short term requirements. (Q5 Road Closure)
-  More communication required concerning site services and the traffic department, to enable ease of permit approval in a reasonable period of time.
-  I find if you know someone they help you out very well and keep the correspondence to one person they help you very well.
-  I have very distinct memory of a representative on the team. Chris Williams, he was very helpful in there. Really happy with the service I have received from Chris.
-  To deal with things by email rather than fax, the more easier to track things and better print outs. The fax puts a line through the information. If it came in PDF form would be great.
-  Broadening the terms in temporary and public exhibition areas.
-  Make the website more user friendly, eg have to go through to a building permit and then click to others, then it comes to skip bins and we use it for footpath occupancy permit make it easy to use
-  Clients have said there is a lot of red tape, waiting for replies to permits and price fees wise

















-  The Dial before you Dig service is good and the Building Team is good but the rest of C. of M. is not so good.
-  Some of the areas mainly overall is OK. In particular, one person needs to improve in the building permits area.
-  They are doing a good job
-  The application process to answer the phone and then make a call back to me, most of the time I got transferred and then no one there to answer the phone and have to wait on a call back.
-  They need additional staff.
-  More staff would be good as it can be difficult to get through sometimes.
-  Allow more time for the payment processing time to take place before sending out reminder notices. Make a central person in charge of enquiries for road opening permits instead of having numerous people
-  Compared to other organisations, C of M Building team is miles in front
-  They perhaps need more staff. Generally there are only 2 contacts that we deal with and they are not always available.
-  Finding information on website was difficult.....a guide to information on the website could prove handy to those using it
-  Consistency of information for their out of hours permits as I got conflicting information from different people.
-  Follow through with procedure of customer application before the due date. They have let me down, I should not have to chase them up for my permit.
-  All councils around Melbourne charge too much for their permit fees and we can't see the justification for charging so much. The action would be to reduce permit fees.
-  Full contact details on standard footer on all -mail correspondence
-  The permit prices are too expensive for a piece of paper that I have I sign.
-  Get rid of the parking fines

Figure 39: Page 3 of Verbatim Section of Customer Satisfaction Survey

Permit Application - Customer Satisfaction Survey

Our application should have been approved a lot quicker. We deal with big surveyors every week and generally it is a 48 hr process but with C. of. M it took 8-10 wks and we almost lost the job

Simplify applications and forms.

Downsize the council, and stop this money making sham, job creation sheltered work shop.

On the web site it is not always clear which permit is required for a job and it would be a good idea to give example of the type of work a permit applies too.

Be a bit more available to meet on site to discuss some tricky areas to gain more of an understanding of what is required.

Extended office hours service would be good.

Employ more planners, the process of planning is very slow.

it is busy..... improvement needed to review it and make it more user friendly

We generally have to make follow up phone calls to see the status of our permit applications and it would be nice if they contacted us to give us feedback.

Increase or stagger the contact hours so that we could have longer access periods.

What is there is there is sufficient.

They maybe need to give their inspectors more authority to make decisions.

Nothing really, I've been more than happy with the city of Melbourne, they've been very responsive. I received one application the other day, within 15 minutes.

The city parking signs need to be simplified as they tend to be ambiguous and difficult to comprehend at fast notice.

I have been dealing with them 35 years and I find that these days they are overworked and need to employ more staff.

Sometime the accents are very strong and are hard to understand.

Quicker responses to permit applications.

Speed in response time. There are a number of people the applications have to go through before you can get approval, it should be more streamlined to make the process quicker.

They could work with the arts and culture depts to prepare fax sheets for organisations to work with their departments.

The service I have received has been great.

Planning Department is very slow in response time.

If legitimate mistakes are made in getting permits then the team should show leniency if it was to occur and not be unfair with fines like a lot of other councils are.

The applications could be simplified and the records of past information should be readily kept on hand.

Now that the web has arrived it has allowed the council to get out of doing things and when someone who is not computer literate like me needs service the building team does it in their own time.

As a tradesman it would be helpful if they actually made tradespeople aware of the permits that are required for certain jobs.

For parking permits they require considerably longer notice whereas it used to be 24 hours. They need to shorten this time because it is too difficult to manage.

A coffee machine in the waiting room.

Figure 40: Page 4 of Verbatim Section of Customer Satisfaction Survey

APPENDIX I

Cost Analysis

Data	Minimum Value	Maximum Value
Survey Data Used:	Minimum Survey Value – See Note 1	Maximum Survey Value – See Note 1
Redundant Work Performed per work week	54	75
Gathering Relevant Site Documents per work week	22	33
Median Salary of BCOs	\$62,764.72	\$70,969.28
Assume:		
Building Team employees	25, as of April 2010	
40 hour workweek and 50 weeks per year	2000 hours per year	
Calculated:		
Hourly Wage	\$31.38	\$35.48
Redundant Work Costs per Week	\$1,694.65	\$2,661.35
Gathering Documents Costs per Week	\$690.41	\$1,170.99
Using Calculated Data:		
Weekly Expenditure	\$2,385.06	\$3,832.34
Yearly Expenditure	\$119,253.00	\$191,617.00
Saving from Reductions in Redundant Work and Gather Documents per Year:		
10% Reduction in both Fields	\$11,925.30	\$19,161.70
20% Reduction	\$23,850.60	\$38,323.40
25% Reduction	\$47,904.25	\$47,904.25
50% Reduction	\$59,626.50	\$95,808.50

Table 7: Cost Analysis

*** Note 1 – Participants of our research team’s survey were provided a range of values for estimating time spent performing redundant work and gathering relevant site information. Shown values are minimum and maximum averages for all responses to the survey.

APPENDIX J

Technical Specifications of Mobility Tools

Technical Specification of Tried Lenovo X41

Processor	Intel Pentium M 778 1.6 GHz LV, 400 MHz bus
RAM	512 MB
Display	12.1", 1024x768, Super-Wide Viewing Angle technology (IPS panel), antiglare coating
Graphics	Built-in video controller based on Intel® 900
HDD	40 GB, 4200 rpm ThinkVantage ActiveProtection
<u>Optical</u> drives	no built-in drives
Expansion slots	PC Card Type II x 1 SD card reader x1
I/O ports	<ul style="list-style-type: none"> • 10/100 Ethernet RJ-45 • 56K Modem/Fax RJ-11 • IrDA • Mini Dock Box Replicator 50 pin • USB 2.0 4 pin x 2 • Special powered USB • D-sub 15 pin • Mini-jack mike • Mini-jack Stereo • Connector for a dock replicator
Input devices	Trackpoint with the "Press-to-Select" function, stylus, full-size keyboard
Audio	One speaker, 0.5 W, Soundmax support
Communications:	<ul style="list-style-type: none"> • Ethernet 10Base-T/100Base-TX • Fax/modem 56K • Intel® PRO/Wireless 2915ABG, 802.11b/g • Bluetooth • IrDA
Power supply	<ul style="list-style-type: none"> • 56 W adapter (old connector) • Battery time - 2.5 hours • 4-cell battery.
Extra	Thinkvantage security subsystem 2.0, other Thinkvantage technologies.
Warranty	3 years, in a service center
Bundled software	<ul style="list-style-type: none"> • Preinstalled Windows XP Tablet edition 2005 • Special utilities
Dimensions and weight	<ul style="list-style-type: none"> • 274x266x29 mm • 1.61 kg

Figure 41: IBM Lenovo X41 Technical Specifications

Technical Specifications of 12.1" devices

- HP Touchsmart tm2t
 - Cost of unit (AU\$): 1,500.00
 - Screen size (inches): 12.1
 - Screen resolution: 1280 x 800
 - W x D x H (mm): 302 x 223 x 40
 - Weight (kg): 2.0
 - Battery Life (hours): 9.75
 - Processor type: Intel Core 2 Duo SU9600
 - Processor speed (GHz): 1.60
 - Hard drive size (GB): 500
 - Hard drive speed (rpm): 7200
 - RAM (GB): 6.00
- Fujitsu Stylistic ST6012
 - Cost of unit (AU\$): 2,600.00
 - Screen size (inches): 12.1
 - Screen resolution: 1280 x 800
 - W x D x H (mm): 325 x 220 x 32
 - Weight (kg): 1.6
 - Battery Life (hours): 5.4
 - Processor type: Intel Core 2 Duo SU9400
 - Processor speed (GHz): 1.40
 - Hard drive size (GB): 250
 - Hard drive speed (rpm): 5400
 - RAM (GB): 2
- Fujitsu LifeBook T2020 (3.5G)
 - Cost of unit (AU\$): 2,000.00
 - Screen size (inches): 12.1
 - Screen resolution: 1280 x 800
 - W x D x H (mm): 297 x 219 x 34
 - Weight (kg): 1.6
 - Battery Life (hours): 5.6
 - Processor type: Intel Core 2 Duo SU9400
 - Processor speed (GHz): 1.40

- Hard drive size (GB): 320
- Hard drive speed (rpm): 5400
- RAM (GB): 4
- Fujitsu LifeBook T4410
 - Cost of unit (AU\$): 1,800.00
 - Screen size (inches): 12.1
 - Screen resolution: 1280 x 800
 - W x D x H (mm): 297 x 233 x 36.4
 - Weight (kg): 2.0
 - Battery Life (hours): 5.13
 - Processor type: Intel Core 2 Duo T9600
 - Processor speed (GHz): 2.80
 - Hard drive size (GB): 500
 - Hard drive speed (rpm): 5400
 - RAM (GB): 8
- IBM Lenovo ThinkPad X200 Tablet
 - Cost of unit (AU\$): 3,915.00
 - Screen size (inches): 12.1
 - Screen resolution: 1280 x 800
 - W x D x H (mm): 297 x 230 x 33
 - Weight (kg): 2.27
 - Battery Life (hours): 7.0
 - Processor type: Intel Core 2 Duo SL9600
 - Processor speed (GHz): 2.13
 - Hard drive size (GB): 250
 - Hard drive speed (rpm): 7200
 - RAM (GB): 2
- IBM Lenovo ThinkPad X201 Tablet
 - Cost of unit (AU\$): 4,085.00
 - Screen size (inches): 12.1
 - Screen resolution: 1280 x 800
 - W x D x H (mm): 297 x 230 x 33
 - Weight (kg): 2.27
 - Battery Life (hours): 6.7

- Processor type: Intel Core i7-620LM
- Processor speed (GHz): 2.66
- Hard drive size (GB): 320
- Hard drive speed (rpm): 7200
- RAM (GB): 2

Rugged Devices

- Panasonic CF-U1 RUGGED
 - Cost of unit (AU\$): 2,800.00
 - Screen size (inches): 5.6
 - Screen resolution: 1024 x 600
 - W x D x H (mm): 184 mm x 151 mm x 57 mm
 - Weight (kg): 1.1
 - Battery Life (hours): 9
 - Processor: 1.33 GHz Intel Atom Z520
 - Hard drive: 16 GB flash memory
 - RAM (GB): 1
- Opentec RPT 8-1
 - Cost of unit (AU\$): 6,125.00
 - Screen size (inches): 8.4
 - Screen resolution: 1024 x 768
 - W x D x H (mm): 250 x 190 x 42
 - Weight (kg): 1.7
 - Battery Life (hours): 12 - 15
 - Processor: 1.06 GHz Intel Core 2 Duo
 - Hard drive: 350 GB @ 5,400 rpm
 - RAM (GB): 2
- Toughbook CF-08
 - Cost of unit (AU\$): 2,700.00
 - Screen size (inches): 10.4
 - Screen resolution: 1024 x 768
 - W x D x H (mm): 267 x 208 x 38
 - Weight (kg): 1.2
 - Battery Life (hours): 14
 - Processor: 0.312 GHz Intel PXA270

- Hard drive: 16 GB flash memory
- RAM (GB): information not available
- Opentec Drover
 - Cost of unit (AU\$): 2,949.00
 - Screen size (inches): 10.4
 - Screen resolution: 1024 x 768
 - W x D x H (mm): 264 x 213 x 18
 - Weight (kg): 1.4
 - Battery Life (hours): 5
 - Processor: 1.6 GHz Intel Atom
 - Hard drive: information not available
 - RAM (GB): 2
- Panasonic CF-19MK3
 - Cost of unit (AU\$): 6,440.00
 - Screen size (inches): 10.4
 - Screen resolution: 1024 x 768
 - W x D x H (mm): 271 x 216 x 49
 - Weight (kg): 2.3
 - Battery Life (hours): 10
 - Processor: 1.2 GHz Intel Core 2 Duo SU9300
 - Hard drive: 160 GB @ 5400rpm
 - RAM (GB): 2
- Motion J3400
 - Cost of unit (AU\$): 3,000.00
 - Screen size (inches): 12.1
 - Screen resolution: 1280 x 800
 - W x D x H (mm): 323 x 231 x 23
 - Weight (kg): 1.6
 - Battery Life (hours): 3.5
 - Processor: 1.4 GHz Intel Core 2 Duo SU9400
 - Hard drive: 80 GB @ 5400 rpm
 - RAM (GB): 4

Technical Specifications of Recommended Devices

Specifications	
Platform	Intel® Centrino® 2 processor Technology - Intel® Core™2 Duo Processor SU9300 (1.20GHz, 3MB L2 Cache, 800MHz) - Mobile Intel® GS45 Express Chip with ICH9M - Intel® WiFi Link 5300AGN (3x3) network connection
Operating System	Genuine Windows® 7 Professional (or Genuine Windows® 7 Home Premium)
Display	8.9-inch WXGA Transmissive Anti-glare screen ¹⁵ with back-light LED, 1280 x 768 pixels (300nits Brightness, 178° Wide Viewing Angles, 500:1 Contrast Ratio), Passive Digitiser
Memory	2GB DDR2 667MHz ¹³ / 1GB DDR2 667MHz ¹³ Max. Memory Supported - 2GB DDR2 667MHz
Hard Disk	120GB ¹³ / 100GB ¹³
Bluetooth	v2.1 + EDR (Enhanced Data Rate)
Battery	Up to 3hrs ¹ (3-cell Li-Ion 2600mAh)
Weight	Approx. 1kg (w/ 3-cell battery & standard hard disk drive)
Detailed Specifications	
Hard Disk Drive	SATA-150, 5400rpm, S.M.A.R.T support, Two Partitions - 50/50 ⁸ , protected by Fujitsu 3D Shock Sensor ⁷
Graphics	Integrated Intel® Graphics Media Accelerator 4500MHD with Intel® Clear Video Technology ¹² and DVMT ⁴ 5.0 delivers low-power, high-performance 2D/3D graphics with Shader Model 4.0, video and display capabilities at a maximum shared memory ¹⁴ of 783MB/ 271MB
High Definition (HD) Audio	RealTek ALC269 HD audio codec dual built-in speakers HD Audio-in: External Mic-in, Built-in Microphone HD Audio-out: Headphone-out
Communication	Bluetooth® v2.1+EDR, 56K V.92 ² Global Modem MDV1.5, 1000/100/10Mbps ³ Gigabit Ethernet PCI Express® x 1 and Intel® WiFi Link 5300AGN (3x3) network connection with three Antenna. Separate ON/OFF switch for wireless network connection. Built-in 1.3 Mega Pixel camera
User Interface	Spill-resistant Keyboard ¹¹ with Quick Point: 82-key, 16mm key pitch, 2mm key stroke
Card Slot	PC Type II, Secured Digital
Connector Interface	USB 2.0 x 2, VGA (external display), RJ45 (LAN), RJ11 (modem), Headphone-out, Microphone-in, Port Replicator Interface, Power Adapter DC-in
Easy Access Panel	Five Security/ Application Buttons (Including Two Programmable Applications Launch Buttons) and one add-on Button
Security ⁴	BIOS Lock, LifeBook Lock, Hard Disk Lock, Anti-theft Lock Slot, Fingerprint Sensor, Trusted Platform Module Option
Dimensions	232mm (W) x 167mm (D) x 34.5~37mm (H)
Bundled Accessories	
AC Adapter	Input AC 100~240V, Output DC 16V 40W/ 60W
Bundled Software	Softex Omnipass, Adobe Acrobat Reader, Fujitsu UpdateNavi ⁹ , Fujitsu Power Saving Utility, Fujitsu Hardware Diagnostic Tool, Fujitsu Display Manager, Sun Microsystems Java Runtime, Fujitsu 3D Shock Sensor Utility, Arcsoft Webcam Software, Microsoft Office Professional 2007 60-day Convertible Trial ¹⁰
Other Software	1 year Full Licensed Norman Virus Control with Sandbox Technology and Norman Personal Firewall
Optional Accessories	
Port Replicator	Connector Interface: USB 2.0 x 2, VGA (external display), RJ45 (LAN), Power Adapter DC-in
Extra Battery	Up to 6hrs ¹ battery life (6-cell Li-Ion 5200mAh)
Mouse	Optical USB Black Mouse (Retractable)
Optical Disk Drive	External Slimline USB DVD Super Multi Driver

Figure 42: Fujitsu LifeBook P1630 Technical Specifications

Standard Model Specifications	
CPU	Intel 1.6GHz ATOM
LCD Size/Type	10.4" XGA (1024x768 pixel) 250NIT LED backlit LCD with 5-wire resistive touchscreen
Max RAM / HDD	1Gb SO-DIMM DDRII RAM 80Gb 1.8" PATA HDD; or 8Gb CF (Compact Flash) Card
Size	213mm x 264mm x 18mm (HxWxD)
Weight	1.4kg
Colours	Black (all models)
OS	Windows XP Pro Embedded
Battery life (primary, nominal)	up to 3 hours (LCD always on, full CPU load)
Ports	1x RS232 (DB9), 2x USB 2.0, 1x VGA output, 1x power in (12-32VDC), 1x stereo headphone jack, 1x microphone jack, 1x internal mono microphone, 2x internal stereo speaker
Chassis	Semi-Rugged grade; plastic case over metal sub-frame
Operating Temp	0C to +40C
External Power	240VAC
IP Ratings	IP54
Compliance	CE, FCC, ACA, MIL-STD 810F
Connectivity	WiFi (802.11 a/b/g) with integrated antenna; V.90 56kbps modem; Bluetooth (v2) with integrated antenna
Included Accessories	240VAC power adapter and stylus
Options/Upgrades	
Sunlight readable 10.4" SXGA (1400x1050 pixel) 400NIT LED backlit LCD with 5-wire resistive touchscreen	
GPS	
3.5G/3.75G (UMTS/HSDPA) phone/data	
2D Barcode reader	
RFID (proximity type) reader	
2 Megapixel digital camera	
Accessories & Spares	
Rear-mounted (secondary) Li-Ion battery - up to 3 hrs additional power	
Desktop docking cradle/charger	
Protective plastic buffers (side mount)	
Rear-mounted fold-out desktop stand	
Rear-mounted hand grip with integral shoulder carry strap	
VESA panel mounting system	
RAM Mount vehicle mounting systems (various)	
Pelican rugged transport case	

Figure 43: Opentec Drover Technical Specifications

Technical Specifications

Size and weight¹

Height: **4.5 inches** (115.5 mm)
 Width: **2.4 inches** (62.1 mm)
 Depth: **0.48 inch** (12.3 mm)
 Weight: **4.8 ounces** (135 grams)



Cellular and wireless

- UMTS/HSDPA (850, 1900, 2100 MHz)
- GSM/EDGE (850, 900, 1800, 1900 MHz)
- Wi-Fi (802.11b/g)
- Bluetooth 2.1 + EDR wireless technology

Capacity⁴

- 16GB or 32GB flash drive



Color

- Black or white



Display

- 3.5-inch (diagonal) widescreen Multi-Touch display
- 480-by-320-pixel resolution at 163 ppi
- Fingerprint-resistant oleophobic coating
- Support for display of multiple languages and characters simultaneously

Camera, photos, and video

- 3 megapixels
- Autofocus
- Tap to focus
- Video recording, VGA up to 30 fps with audio
- Photo and video geotagging
- iPhone and third-party application integration



External buttons and controls



Connectors and input/output



Figure 44: iPhone Technical Specifications Part 1

Location

- Assisted GPS
- Digital compass²
- Wi-Fi
- Cellular

Power and battery²

- Built-in rechargeable lithium-ion battery
- Charging via USB to computer system or power adapter
- Talk time:
 - Up to 12 hours on 2G
 - Up to 5 hours on 3G
- Standby time: Up to 300 hours
- Internet use:
 - Up to 5 hours on 3G
 - Up to 9 hours on Wi-Fi
- Video playback: Up to 10 hours
- Audio playback: Up to 30 hours



Mac system requirements

- Mac computer with USB 2.0 port
- Mac OS X v10.4.11 or later
- iTunes 8.2 or later (free download from www.itunes.com/download)
- iTunes Store account
- Internet access

Windows system requirements

- PC with USB 2.0 port
- Windows Vista; or Windows XP Home or Professional with Service Pack 2 or later
- iTunes 8.2 or later (free download from www.itunes.com/download)
- iTunes Store account
- Internet access

Environmental requirements

- Operating temperature: 32° to 95° F (0° to 35° C)
- Nonoperating temperature: -4° to 113° F (-20° to 45° C)
- Relative humidity: 5% to 95% noncondensing
- Maximum operating altitude: 10,000 feet (3000 m)



Audio playback

- Frequency response: 20Hz to 20,000Hz
- Audio formats supported: AAC (8 to 320 Kbps), Protected AAC (from iTunes Store), HE-AAC, MP3 (8 to 320 Kbps), MP3 VBR, Audible (formats 2, 3, 4, Audible Enhanced Audio, AAX, and AAX+), Apple Lossless, AIFF, and WAV
- User-configurable maximum **volume limit**

Video playback

Video formats supported: H.264 video, up to 1.5 Mbps, 640 by 480 pixels, 30 frames per second, Low-Complexity version of the H.264 Baseline Profile with AAC-LC audio up to 160 Kbps, 48kHz, stereo audio in .m4v, .mp4, and .mov file formats; H.264 video, up to 2.5 Mbps, 640 by 480 pixels, 30 frames per second, Baseline Profile up to Level 3.0 with AAC-LC audio up to 160 Kbps, 48kHz, stereo audio in .m4v, .mp4, and .mov file formats; MPEG-4 video, up to 2.5 Mbps, 640 by 480 pixels, 30 frames per second, Simple Profile with AAC-LC audio up to 160 Kbps, 48kHz, stereo audio in .m4v, .mp4, and .mov file formats



Languages

- Language support for English (U.S), English (UK), French (France), German, Traditional Chinese, Simplified Chinese, Dutch, Italian, Spanish, Portuguese (Brazil), Portuguese (Portugal), Danish, Swedish, Finnish, Norwegian, Korean, Japanese, Russian, Polish, Turkish, Ukrainian, Arabic, Thai, Czech, Greek, Hebrew, Indonesian, Malay, Romanian, Slovak, and Croatian
- Keyboard support for English (U.S.), English (UK), French (France), French (Canadian), French (Switzerland), German, Traditional Chinese (Handwriting, Pinyin, Zhuyin), Simplified Chinese (Handwriting, Pinyin), Dutch, Italian, Spanish, Portuguese (Brazil), Portuguese (Portugal), Danish, Swedish, Finnish, Norwegian, Korean, Japanese (QWERTY), Japanese (Kana), Russian, Polish, Turkish, Ukrainian, Estonian, Hungarian, Icelandic, Lithuanian, Latvian, Flemish, Arabic,



Sensors

- Accelerometer
- Proximity sensor
- Ambient light sensor

Headphones

- Apple Earphones with Remote and Mic
- Volume control
- Frequency response: 20Hz to 20,000Hz
- Impedance: 32 ohms



In the box

- iPhone 3GS
- Apple Earphones with Remote and Mic
- Dock Connector to USB Cable
- USB Power Adapter
- Documentation
- SIM eject tool



Environmental Status Report



iPhone 3GS embodies Apple's continuing environmental progress. It is designed with the following features to reduce environmental impact:

- PVC-free handset
- PVC-free headphones
- PVC-free USB cable
- Bromine-free printed circuit boards
- Mercury-free LCD display
- Arsenic-free display glass
- Majority of packaging made from post-consumer recycled fiberboard and biobased materials
- Power adapter outperforms strictest global energy efficiency standards

Figure 45: Apple iPhone Technical Specifications Part 2

APPENDIX K

Business Information Services Mobility Project Proposal

IT PROJECT PROPOSAL

This form is to be completed by the customer requiring work to be undertaken by BIS. The details required are on this page, and only the necessary fields are able to be completed. All remaining fields and worksheets are to be completed by BIS.

Project Title <small>Insert a one-line meaningful 'stand-alone' title of the project</small>		Number <small>(BIS Use Only)</small>
Mobility Project		
Business Owner <small>A Director or Branch Manager.</small>	Position	Telephone
Shiran Wickramasinghe	Manager Planning & Building	8400
Customer Contact <small>The person completing this form or the business representative who will be the main point of contact for BIS</small>	Position	Telephone
WPI Research Team	Contractor	N/A
Division and Branch	Planning & Building	
Community & Culture		
Is this request for a new system?	Yes	Expenditure Type <small>(BIS only)</small>
Background <small>What are the drivers for this request? Legislation? New Business Processes? Business Plan? What is the context?</small>		
<p>Wireless broadband technologies utilizing third generation (3G) wireless networks have evolved tremendously, and are becoming a way to improve the efficiency of organizations worldwide. Mobile devices have been developed to support many widely used programs such as word processing and spreadsheet applications, amongst many other applications used by many businesses and agencies. As handheld devices and laptops become smaller, faster, and more powerful, it has become easier for companies to adopt the use of these mobile technologies. It was stated as a conclusion from the previous Mobile Tablet Trial in 2007 "there is still a case for mobile electronic equipment that is more portable and powerful that could be utilized to reduce administration time." Now three years later technology has evolved tremendously and mobility tools need to be looked at again to help to allow Planning and Building Branch to provide more efficient and effective services through their inspectors.</p>		
Description <small>Provide a brief overview of the project. Consider how the project supports / complements your business plan and the corporate strategy.</small>		
<p>The implementation of mobility devices would be very beneficial to the City of Melbourne Building Team divisions CMG, MCG, and BCG. Providing inspectors with pertinent information for every site in the City of Melbourne while in the field will increase the efficiency and effectiveness of inspectors in and out of the office. CMG in particular has two on call officers at all times that could greatly benefit from mobile access to the office database during emergency callouts.</p>		
Objectives <small>Provide a clear statement of what are you trying to achieve. What will change as a result of this project?</small>		
<p>*Increase the efficiency and effectiveness of inspectors between the field and the office. *Reduce or eliminate the amount of redundant work that is done by inspectors when they get back to the office. *Achieve higher quality inspections and allow inspectors to stay out in the field to perform multiple inspections. *Remove a potential OH&S risk to staff due to the need for officers to carry the BCA codes, and stacks of files and plans on-site.</p>		
Scope		
In Scope <small>List functions of the project that should be included and therefore should be delivered.</small>	Out of Scope <small>List functions that should be excluded by the project and therefore not delivered, but that might be misunderstood to be included.</small>	
<p>*Implement a device that allows the inspectors to access and use Pathway, Compass, Hummingbird, Outlook, MS Office, and the Internet from the field that would allow the inspectors to perform the site inspections in the field and record the information to the mobile device. *Implement a device that can be synced to the office real time through a 3G wireless connection, but allow the device to go offline if service is lost and auto-sync data once the device reconnects to its 3G service. An air card or an internal modem could be used to access mobile access.</p>	<p>*Development of checklist software to perform more consistent inspections</p>	

Figure 46: BIS Mobility Tool Project Proposal Part 1

Business Benefits Develop a justification for the project to be funded. All benefits should be measurable. Outline each benefit and how it will be measured.

Benefits What are the benefits of meeting the objectives?

**Customer satisfaction increase due to reduced response and processing times.
 *Economic savings due to less time being spent performing redundant tasks potential savings of \$12,000-19,000 annually assuming only a 10% reduction in redundant work due to the implementation of mobility devices.
 *Environmental benefits occur from saving paper because many documents, or note sheets that required paper will become electronic
 OH & S benefits will be presented because inspectors will no longer have to carry the BCA Code books, or other bulky files with them into the field. Instead a lighter mobile device can be carried.

Measures How will you know you have achieved the benefits?

**Through customer surveys that are implemented yearly a measure of the benefits can be made.
 *Economic savings can be measured through a controlled test in which surveys, and records of time saving are recorded through two groups of inspectors, one group that uses the new tool, and the other that does not.
 *Paper savings are assumed and will be difficult to measure, but surveys could provide relevant data
 OH & S benefits can also be assessed through surveys dealing with tough it is to carry paper in the old system compared to the new system.

Impacted Applications Indicate if you are aware of any applications that will be affected by this request.

Pathway Yes No Technology One (Financials, HR, etc) No Yes
 Assetmaster No Yes Internet/Intranet Yes No
 Other - please list

CoM Strategic Selection Criteria Refer to Weighting Criteria tab for criteria definitions and rate each measure as either High, Medium, Low or n/a.

**Note that requestors will be required to justify the scores assigned to each project both during the selection process and after project completion*

Cost Saving / Return on Investment	L	By providing inspection services more efficiently and effectively inspectors will be able to perform more inspections rather than performing redundant work.
Customer Resolution	M	Faster processing of data due to the elimination of redundant work will result in reduced response time to customer requests and questions.
Regulatory Compliance	N/A	
Council Plan (inc A&I's)	H	Objective 1.3.1 - Work towards a safer city through partnerships with other agencies Objective 1.8.1 - Establish a robust planning scheme that facilitates sustainable growth and development and protects heritage Objective 3.1.1 - Implement strategies to support a thriving and diverse economy Objective 5.1.3 - Influence the municipality to use resources efficiently Objective 7.1.1 - Become recognized for leadership excellence in local government Objective 7.1.2 - Communicate our achievements Objective 7.3.1 - Unify internal relationships through regular information exchange and dialogue between councilors, management, and staff Objective 8.1.1 Explore new revenue sources and seek to increase existing ones. Objective 8.3.1 Continuously improve our products and services. Objective 8.3.2 use technology to improve services.
Council Resolution or KSA Enabler	N/A	
TOTAL	45	

Figure 47: BIS Mobility Tool Project Proposal Part 2

Contribution to Council Plan Please indicate Yes or No, if yes, please justify

Essential to keep CoM business and systems running	No	
Council resolution or KSA, including anything integral to delivery of a Council resolution or KSA (a required project deliverable)	No	
A financial or economic benefit is lost in excess of \$2.0 Million if the project is not delivered	No	
Contributes directly or indirectly to Council Plan	Yes	<p>Objective 1.3.1 - Work towards a safer city through partnerships with other agencies</p> <p>Objective 1.8.1 - Establish a robust planning scheme that facilitates sustainable growth and development and protects heritage</p> <p>Objective 3.1.1 - Implement strategies to support a thriving and diverse economy</p> <p>Objective 5.1.3 - Influence the municipality to use resources efficiently</p> <p>Objective 7.1.1 - Become recognized for leadership excellence in local government</p> <p>Objective 7.1.2 - Communicate our achievements</p> <p>Objective 7.3.1 - Unify internal relationships through regular information exchange and dialogue between councilors, management, and staff</p> <p>Objective 8.1.1 Explore new revenue sources and seek to increase existing ones.</p> <p>Objective 8.3.1 Continuously improve our products and services.</p> <p>Objective 8.3.2 use technology to improve services.</p>

Type of Project Please select one option

Single Year Project Year

Multi Year Project Start Year End Year

Single Year Project, but part of a series of projects Year

Please list related projects proposal DMW

Key Stakeholders/Clients Provide a list of the major stakeholders of the proposed project

Planning and Building Branch
Other branches could be affected if they perform similar services that could also be enhanced by mobility tools.

Business Risks Provide an assessment of the risk to City of Melbourne if the project does not proceed. This risk can be financial, political, social, environmental

The major financial risk is spending money on redundant work that is completed by inspectors every time they get back to the office from inspections. If the project is not implemented social and environmental risks are also a concern. Inspectors may feel frustrated when completing the redundant work that could be eliminated by mobility tools. There is also a great potential for paper saving, especially by on call officers who currently rely on bulky print outs instead of a mobile tool. This also brings up OH & S concerns because the heavy files that have to be carried on site weigh much more than a mobile device.

Critical Deadlines Advise any critical dates for completion and the reasons for the criticality. These may include legislative, legal, OHS or political influences that may affect the project.

Project Cost Estimates Provide any indicative costs that may already be known or further information that will assist in estimating the cost of this project. If you do not know the cost please enter a question mark.

Approximate Procurement costs (Hardware / Software / Services):

Approximate Customer effort:

Total indicative cost: **\$80,000**

Signature of Business Owner: Shiran Wickram Date:

Figure 48: BIS Mobility Tool Project Proposal Part 3