Design of an Emergency Management Information System for the London Borough of Hounslow

An Interactive Qualifying Project to be submitted to the faculty of Worcester Polytechnic Institute in partial fulfilment of the requirements for the Degree of Bachelor of Science

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Abstract

This report, prepared for the London Borough of Hounslow, outlines the rationale for the design decisions implemented in creating Hounslow's Emergency Management Information System (EMIS). Through a review of existing systems, interviewing key stakeholders, and an iterative design process, an EMIS was created to meet Hounslow's current and future needs. Additionally, a user guide and maintenance document are included in this report, which outlines recommendations and general EMIS design guidelines to allow Hounslow to improve this system in the future.

Executive Summary

This project sought to redesign the emergency management information system (EMIS) for the London Borough of Hounslow's Contingency Planning Unit. Having completed the project, a novel EMIS has been developed. This system is a significant improvement over the original system in terms of functionality, structure and overall aesthetic appeal. Additionally, maintenance documentation, which shows system users how to edit all aspects of the system was created and provided to the CPU staff. A system user-manual, which outlines the basics of using the system, was provided as well. Finally, this report, which highlights a number of important considerations regarding EMIS design, was provided to guide future EMIS design, since literature on the subject is noticeably lacking in this area.

Mandated by the Civil Contingencies Act of 2004 (CCA), each borough is responsible for preparing a framework for emergency response in their borough (Secretariat, 2008). One attribute of this framework involves planning for emergencies and developing plans and protocols to outline the most effective response to an emergency situation. EMIS have developed out of a necessity to have rapid access to these plans. Ranging in complexity from a single document containing a list of link to highly complex, server-based systems capable of supporting instant messaging, mapping applications and enhanced security measures, these computer based systems provide rapid and efficient access to stored plans and procedures.

The London Borough of Hounslow has previously utilized an EMIS to aid in their emergency response. This system, composed of a series of links embedded within a Microsoft Word document, was described by the head of the Contingency Planning Unit (CPU) as "unappealing in looks, design and functionality" (Palmer, 2014). Additionally, it was indicated that this system was error-laden and confusing, to the point where using the system was slower than doing a given task by hand. For this reason, the team at the CPU stopped using the system entirely (Davill & Axelsen, 2014). This project focused on building an EMIS to suit their needs, which included a simple and intuitive design, a visually appealing user interface and a platform that was simple to maintain and update.

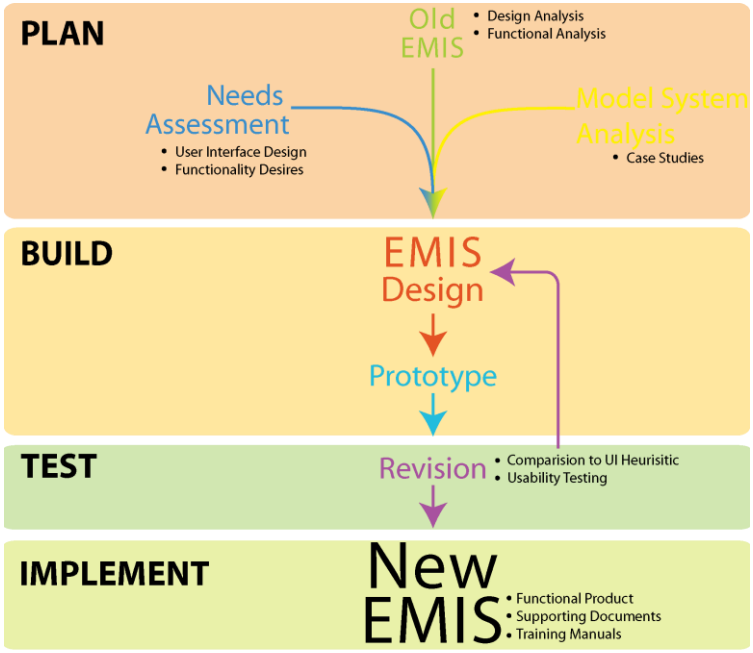

Figure 1- Methodology Overview

In order to develop a new EMIS for Hounslow in the span of seven-week project, a methodology based on rapid application development (RAD) was developed due to its focus on rapid system design and creation (Beynon-Davies, Carne, Mackay, & Tudhope, 1999; Hui, 2011). Using the four-stage RAD framework of Planning, Building, Testing and Implementation, the project methodology was developed. An overview of the methodology can be seen in Figure 1.

Overall, the methodology consisted of an information gathering Planning phase, in which information regarding EMIS functionality and design were gathered by means of:

- A Needs Assessment with the CPU Staff
- An Analysis of the Old EMIS
- An Analysis of other EMIS used elsewhere

The information gathered during this phase was incorporated into the system design and building, which occurred during the Building phase. Following the Building phase, the Testing phase was begun, at which point the system was evaluated for the effectiveness of its user interface. The final phase of the methodology is Implementation, in which the new system in integrated into the Hounslow Emergency Control Centre.

The final EMIS was a fully functional system that addressed the needs of Hounslow's Contingency Planning Unit. This system included a number of functional components which were identified in the needs assessment, including:

- Centralized Task Log
- Contacts list
- GIS Integration

All of these features were able to be incorporated into the system design in a user-friendly interface. An example of this interface, complete with labelled components, can be seen in Figure 2.

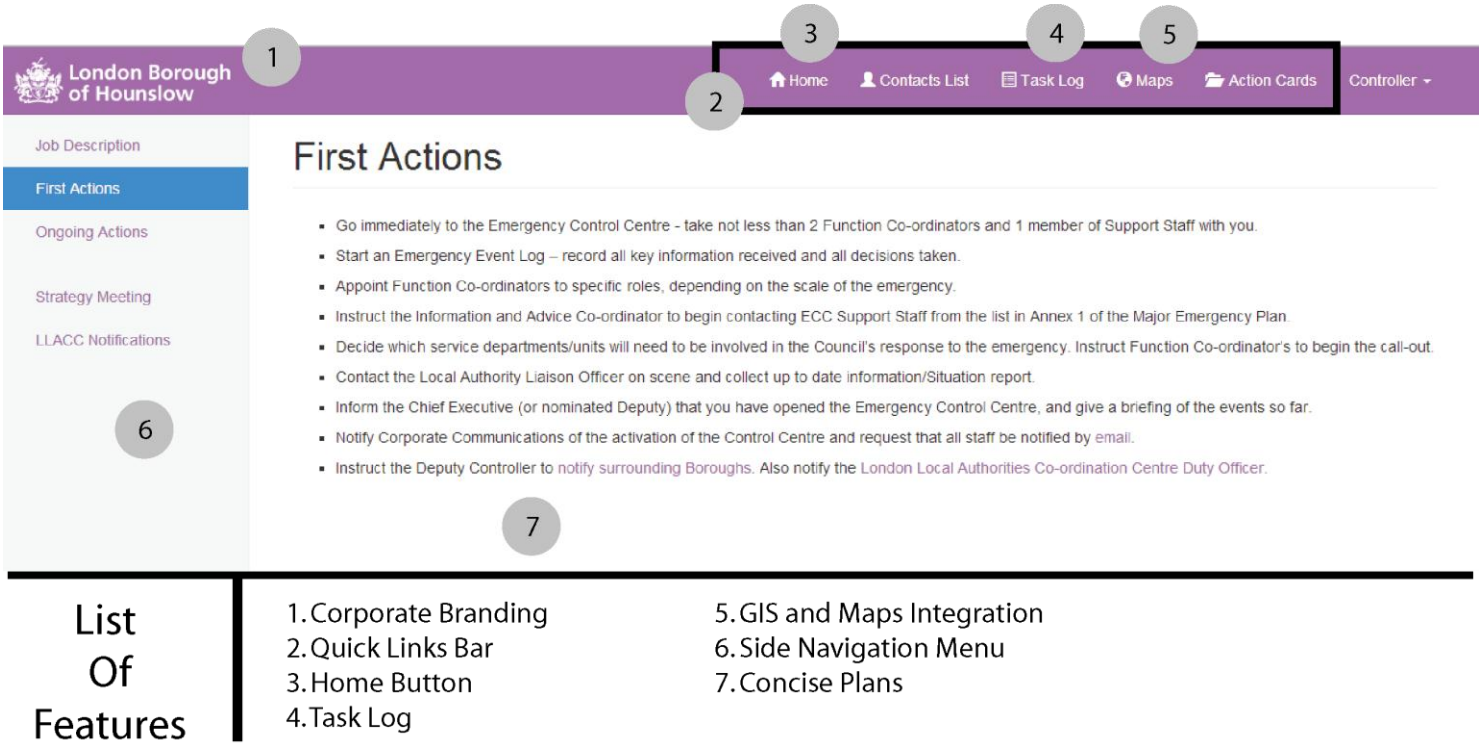

Figure 2- Annotated System Screenshot

Each of these attributes was identified as a critical UI feature to include in the system. In terms of usability features, this system was designed to be user-friendly and a number of techniques were employed to ensure this simplicity:

- Discrete coordinator pages to minimize information overload
- Colour – coded pages to easily differentiate between coordinators
- Icons to quickly identify quick-links
- Minimalistic design

Overall, it was concluded that the user interface was effective in conveying information to responders. In fact, evidence collected in the usability study indicates that:

- System users felt positive about the system design, giving it an average score of at least 4 out of five points in ease of use, visual appeal and intuitive design.
- System users were comfortable enough (after completing the 10 minute test) with the system design that all users agreed or strongly agreed that they would be able to use the system in an emergency situation.

This data supports the validity of the EMIS design principles which were developed during this project, which suggest that an EMIS should:

- At its core, be a data storage system.
- Integrate additional features that enhance command, communication and control.
- Be intuitive and simple to use because users may not be familiar to the system.
- Contain an effective user-interface design using a set of UI heuristics as a guide.
- Be simple and easy to maintain.
- Be tailored to the needs of system users.

This project resulted in a fully functional, intuitive and visually appealing EMIS for the London Borough of Hounslow with a maintenance and user guide. Additionally, this work established a framework, complete with methodology and recommendations for future EMIS design.

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Chapter 1: Introduction

On September 2, 1666, London was engulfed in a great conflagration that eventually destroyed 436 acres of central London and over 13,200 homes (Dolan, Frances 2001). London quickly became a scene of chaos as people tried to escape the walls of the city. Amidst the chaos, a spree of ethnic violence erupted, killing more people than the fire. While the exact cause of the fire is still unknown, its remnants still exist today. This event illustrates the impact that emergencies have on cities. The lack of an efficient, coordinated response led to massive destruction of property and civil unrest. In the centuries that followed, a number of improvements in emergency response have emerged. However, due to the complexity of emergencies, emergency management remains a dynamic task. History has shown that effective emergency management requires preparation, an informed, flexible response and a comprehensive recovery effort.

Disasters are common throughout the world; every city faces a unique set of challenges in emergency planning. London is confronted with a number of possible disasters due to its size, economy and location. The city faces threats from natural, biological, social, and technological disasters. In response this large number of potential disasters, the United Kingdom implemented the Civil Contingencies Act of 2004 to outline a minimum level of emergency planning required of all boroughs and cities, placing the responsibility of preparing for and managing disasters on the local governments. In order to help plan, respond, and recover from possible emergencies, many London boroughs have developed Incident Management Systems (IMS) (Secretariat, 2008). These systems provide the framework for managing emergencies, providing the command, coordination, and communication structures needed during a crisis. Due to the complex nature of incidents and the sheer number of stakeholders involved in the response, each with their own needs and objectives, achieving a high level of organization is challenging. Yet, coordinated response is essential for effective emergency management. This is where the IMS is valuable, as it facilitates multi-agency command, coordination and communication. (Federal Emergency Management Agency, 2008).

Since the advent of the computer, information systems have been making their way into the emergency response effort. Research into emergency management information systems (EMIS), a computer-based framework used to effectively implement control, coordination, and communication during emergencies, has been conducted around the globe (Chumer, Turoff, Walle, & Yao, 2004). Many of these studies, most of which focus on aspects of software engineering and user interface design, establish general design principles that should be incorporated into EMIS design. However, since emergency management varies depending on the local situation, no universal guidelines on EMIS design exist. The London Borough of Hounslow sought to improve their emergency response effort by redesigning their current EMIS, which they deemed inadequate for reasons ranging from its lack of visual appeal to functionality. They required a system that incorporates current design principles and technology to improve their emergency response.

Although there are a number of design principles guiding EMIS design, there was a need to create a unique system tailored to Hounslow. Time had rendered Hounslow's current system unintuitive to use and a hindrance to emergency response. The head of Hounslow's Contingency Planning and Resilience, Mr. Twm Palmer, has described their current system as "unappealing in looks, design and functionality" (2014). To create a new EMIS for Hounslow, a careful study of their needs was merged

with the results of a thorough analysis of their current system and other systems around London. These were invaluable in creating a new EMIS to aid Hounslow in effective emergency management.

The goal of this project was to develop an intuitive, user-friendly EMIS to augment the tactical emergency response in Hounslow. The team performed a comprehensive literature review of good EMIS design practices. Additionally, we conducted a needs assessment to determine the design requirements of the new EMIS as well as a thorough analysis of Hounslow's current system. The team supplemented this information with an analysis of other EMIS systems from Massachusetts and London to determine core design principles. Finally, system prototypes were developed and tested in order to optimize the user experience and refine the user-interface design. All of this information was combined to design and construct a new EMIS in collaboration with the Hounslow Contingency Planning Unit, as well as creating support documentation for the new system.

Chapter 2: Background

Emergencies are chaotic and relatively unpredictable. During large scale incidents, the coordinated response of dozens of emergency personnel in multiple agencies must be achieved. This chapter begins with an overview of the stages of an emergency in order to give the reader a better understanding of the nature of an emergency. Next, an overview of incident management systems (IMS) is presented. These systems provide a communication and command framework in order to optimize emergency response. Following that, the reader will be briefed on emergency management information systems (EMIS). These are the systems used within the IMS in order to achieve a higher level of control, organization and information influx during the emergency. Finally, the reader will be familiarized with the current state of Hounslow's EMIS.

Stages of an Emergency

Emergency planning and response in the United Kingdom is framed by the Civil Contingency Act of 2004, which sought to provide a national framework that would foster efficient, coordinated, and resilient preparation and response to emergencies. Created in the aftermath of the fuel crisis and severe flooding in 2000 and the outbreak of Foot and Mouth Disease in 2001, this act served to establish an effective emergency response system for the UK (Secretariat, 2008). The Act does not create a specified emergency protocol; it serves as a framework that is meant to maintain uniformity and quality among local emergency response plans. It places the responsibility for planning, preparing, and responding to emergencies at the local level, while placing the responsibility for emergency planning, preparation, and response on the Category I and Category II responders, who will be discussed later in this chapter.

Definition of Emergency

When talking about emergency response, it is essential to define what constitutes an emergency. The Civil Contingency Act defines an emergency as:

- An event or situation which threatens serious damage to human welfare in a place in the UK;
- An event or situation which threatens serious damage to the environment of a place in the UK; or
- War, or terrorism, which threatens serious damage to the security of the UK (UK Cabinet Office, 2005).

Thus, the definition of an emergency situation is broad. Such a definition requires local emergency responders to consider a wide scope of possible incidents in their emergency response plans, which is growing exceedingly more difficult to perform.

Typically, an emergency situation has 3 distinct phases: (1) the Preparatory Phase (2) the Operation and Response Phase, and (3) the Recovery and Re-entry Phase. Figure 3 shows an overview of these phases.

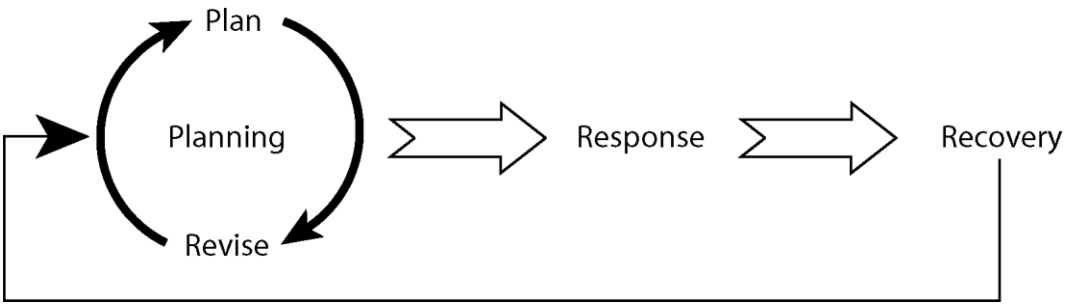


Figure 3 - Stages of an Emergency

While the actual procedure of an emergency is not this linear, this simple schematic helps to break down the complexity of an emergency into a series of more manageable steps. Typically, the recovery phase begins while the response phase is still occurring, and the planning phase carries over into the response phase in order to better plan the recovery operations (Reed, Rogers, & Sorensen, 2008; UK Cabinet Office, 2005). Additionally, actions in each phase play a profound role in the actions that occur in a different phase. For example, actions taken in preparation for an emergency often leads to a much more effective response phase than if the response was undertaken without a plan in place.

Emergency Preparedness

The preparatory phase of an emergency encompasses the identification and analysis of risks, and developing emergency response plans accordingly. At the start of this phase, organizations analyse the risks which they may encounter and categorize the risks based on their potential severity, which is characterized by the likelihood of the risk occurring, as well as its potential impact (Hillingdon, 2013; Hounslow Contingency Planning Centre, 2014). All of the identified risks are compiled into a community risk register, which is a published and publicly available document that provides a brief overview and outlines the potential severity of risks facing the community (Palmer & Axelsen, 2013).

During this phase, a cycle of planning and revision occurs. Concise, step-wise plans are generated in order to mitigate the impact and severity of any of the risks within the risk register. The plans are then routinely tested during responder exercises, where emergency personnel respond to a mock-emergency using these plans. Following this process, responders undergo a debriefing, where they give their opinions as to how effectiveness of the plan. The plan is then revised to include responder's comments (UK Cabinet Office, 2005). This process of risk identification followed by plan formation and evaluation ensures that responders are familiar with the plan, and that it can be effectively carried out during an emergency.

Emergency Response

Once an incident has occurred, if responders feel that the incident is beyond their immediate control, they may declare the incident a "major emergency." If this occurs, the local Borough will dispatch a Local Authority Liaison Officer (LALO) to the scene of the emergency and they will activate their Emergency Control Centre (ECC). At this time, an emergency command structure will be established, formalizing communications and management procedures for the remainder of the emergency (Hillingdon, 2013).

Emergency Command Structure

The UK's emergency command structure used in the emergency response phase is composed of three layers: operational (bronze), tactical (silver), and strategic (gold). The operational level consists of the people directly responding to the emergency; specifically those on-site, such as EMTs, firefighters and police. The tactical level coordinates the actions of the operational level to ensure an efficient emergency response. Members of the tactical response include responders in the Emergency Command Centre. Strategic command considers the emergency in its wider context. They are responsible for creating and prioritizing objectives, and organizing the tactical level accordingly (Secretariat, 2008). Figure 4 shows this command structure.

Figure 4 - Emergency Command Structure (Palmer, 2014)

In essence, the strategic responders set the goals, while the tactical responders figure out how the goal will be achieved, while the operational responders actually affect the changes to meet the goals.

In most cases, the emergency response command works from the "ground up." First, the operational members arrive on scene and make an initial assessment of the emergency. If needed, tactical and strategic command is initiated. Although this is the most common command chain in emergencies, the "top down" approach, where strategic command initiates and implements tactical and operational command, does occur; this is often the case in more predictable events (*Emergency Response and Recovery*, 2010).

An attribute about a command structure such as this is flexibility. When handling a small scale incident, such as a car crash, the medic on site functions as the strategic, tactical and operational responder. They establish goals, plan how to achieve the goals, and go about them. For a larger incident, such as borough-wide flooding where more variables are at play, a delegation of responsibility is warranted, and different people assume the roles of operational, tactical and strategic responders (Federal Emergency Management Agency, 2008).

For this type of command structure, it is essential that the appropriate level of command is initiated for each emergency. Failure to do so can reduce the effectiveness of the emergency response. Effective response also requires familiarity between members of tactical and strategic command. Communication and familiarity between the levels of command can help ensure the most effective emergency response is carried out (Pitt, 2008).

The Civil Contingencies Act designates responders (at all levels) as either Category 1 or Category 2 responders. While the distinction between these two types of responders is subtle, it is also important to make.

Category I Responders

Category I responders are at the heart of emergency planning. They often include the local contingency planning unit, police service, fire service, and health service. The main requirements of Category I responders are to put in place emergency plans, work with other emergency responders to enhance coordination and efficiency of emergency response, and effectively communicate and share information between each other and to the public as necessary to effectively manage an emergency (Secretariat, 2008).

As part of these requirements, Category I responders need to produce a risk register outlining all the potential risks in their jurisdiction. The risk register outlines the likelihood and impact of all potential emergencies and is the first step in planning and preparing for emergencies (UK Cabinet Office, 2005).

Category II Responders

Category II responders are those who may not be at the heart of emergency planning, but are critical to emergency response. Category II responders often include utility companies, transportation authorities, and hospitals. Under the Civil Contingencies Act, Category II responders are required to coordinate with and share necessary information with other Category I and II responders to facilitate emergency response (Secretariat, 2008).

Combined Response

The Civil Contingency Act requires that Category I and II responders come together as Local Resilience Forums (LRF), the organizations who carry out local emergency and strategic planning (Pitt, 2008). Depending on the scope of the emergency, the response can be undertaken by a single agency or coordinated between multiple agencies. Typically, a Category I responder will arrive and determine whether or not an emergency has occurred, and if so, determine what response is needed and whether or not Category II responders should become involved.

When responding to emergencies, there is no fixed protocol; emergency response is a flexible process that uses and adapts established emergency protocols in order to achieve goals set by the organization framework. Communication is critical to an effective emergency response, especially in multi-agency response. In addition to communicating between agencies and command levels, it may be necessary to consult technical experts. A Science and Technical Advice Cell (STAC) should be in place to provide timely advice on scientific and technical issues (UK Cabinet Office, 2005). It is also essential for emergency responders to communicate and inform the public about emergencies; alerting, advising

and informing citizens before, during, and after an emergency is the responsibility of the tactical command.

Factors Affecting the Emergency Response

The response to an incident is influenced by a number of factors, including the scale, kind and predictability of the event (Walle, 2009). The scale of an incident is the extent to which the incident affects the community and the response system. This factor is usually classified into the categories of "Emergency," "Disaster," and "Catastrophe," with each classification being more severe than the preceding classification. In general, the larger the scale of an incident, the larger the response and the larger the proportion of semi-trained/untrained responders (Walle, 2009).

The type of incident influences the response as well. If the community as a whole is equally impacted by the incident, then emergency responders typically respond to the incident. If, however, the incident is a sector-specific incident, meaning that it only affects a small portion of the community, or that a certain group is unequally effected (e.g. viral outbreak, chemical spill in a facility), then sector professionals typically respond to the incident, though they may still call on normal emergency responders for support (Walle, 2009). Predictability and influencability both affect the type of response that an emergency requires. The more predictable an emergency, the better the responders can prepare and coordinate resources. As a result, response volumes typically decrease as the predictability increases. Additionally, as the influencability of an incident decreases, the response volume typically increases, since the ensuing chaos requires more emergency personnel (Walle, 2009).

Emergency Recovery

Emergency recovery is defined as the "process of rebuilding, restoring and rehabilitating the community following an emergency" (Emergency Response & Recovery, 2010). However, recovery is not simply replacing the things that have been destroyed; it involves humanitarian, economic, infrastructure, and environmental aspects that must be rebuilt and repaired. In order to achieve an effective and holistic recovery, the process typically begins with the emergency response and continues as long as necessary; it can continue for hours, days or even months after the end of the response phase. It is important that the recovery plan is established as soon as possible so the response can be carried out in a way that facilitates recovery later (Emergency Response & Recovery, 2010).

The responsibility for recovery falls predominantly on the local authority who is assisted by other Category I and II responders. A Recovery Coordinating Group (RCG) is established as soon as possible in order to coordinate the recovery effort. The RCG should interact with the local community and other stakeholders in order to assess the needs and to establish recovery procedures. The recovery process should be dynamic and respond to the changing needs of the communities affected by an emergency. Targets must be set so progress can be measured. When the recovery has been completed, it is essential that those involved debrief and that the lessons learned can be applied to future planning and recovery efforts (UK Cabinet Office, 2010).

Incident Management Systems

Coordinating the operations of a myriad of responders is a tedious and difficult process. Without any structure, it is easy to see how one could quickly become overwhelmed trying to manage an emergency response. Incident management systems (IMS) are scalable tools used by emergency personnel all over the world that provide a fundamental approach to emergency response. IMS are used by first responders, typically at the tactical and operations level, and serve to delegate decision-making responsibility, as well as to provide a clear and concise framework to aid responders carrying out emergency response.

There are many different platforms for an incident management system. Some smaller-scale systems can be paper-based, while most systems are digital-based to facilitate their wide-spread dissemination. The first practical IMS, known as Firescope, was created in the 1970's to aid firefighters combating wildfires in California. Firescope was created as a cooperative program among local, state, and federal firefighting agencies in order to contain fires, protect citizens, and help effectively coordinate the response of many fire agencies that arrived to fight the fires (Buck, Trainor, & Aguirre, 2006).

Emergencies and disasters of all sizes are accompanied by uncertainty and confusion. The details of every incident cannot be known beforehand, which means quick decisions have to be made with uncertainty. In order to account for the limitations of humans, IMS presents a framework to aid the decision making process such as a procedure for emergency responders to use before, during, and after an incident (*Emergency Preparedness* 2005). Figure 5 presents a generic protocol outline for an IMS developed by the London Resilience Team, the major emergency response organization in London.

Tick [√]	Generic plan[1]
	Aim of the plan, including links with plans of other responders
	Trigger for activation of the plan, including alert and standby procedures
	Activation procedures [2]
	Identification and generic roles of emergency management team
	Identification and generic roles of emergency support staff
	Location of emergency control centre from which emergency will be managed
	Generic roles of all parts of the organisation in relation to responding to emergencies
	Complementary generic arrangements of other responders
	Stand-down procedures
	Annex: contact details of key personnel
	Annex: reference to Community Risk Register and other relevant information
	Plan maintenance procedures
	Plan validation (exercises) schedule [3]
	Training schedule [4]

Figure 5 - Generic Incident Management Plan as specified by the London Resilience Team (UK Cabinet Office, 2005)

In addition to providing an organization framework and communication structure, a good IMS will create step-by-step decision processes to guide and remind responders of actions they should perform in order to expedite response and recovery. Thus, an IMS serves as a means of ensuring that little yet important steps in the emergency response don't get overlooked, while also facilitating command and communications.

Debate on Utility of IMS

Although many proponents claim that a series of orderly plans are a sufficient form of preparation, there have been many critics of existing IMS and their method of operations. One key point often debated is the random nature of an emergency. "Its critics suggest that the emphasis on formal organizations and rationality fails to recognize a series of key factors in disaster response, particularly the presence of unorganized volunteers and emergent groups as well as the transformations of the structure and function of established organizations during the response phase of disasters" (Buck et al., 2006). Critics of incident management cite examples of random events, such as the presence of volunteer workers, which, if unplanned for, can greatly hinder the response operation. Another argument presented by critics is that most emergency response operates under a great deal of uncertainty, for which, they claim, it is not possible to plan.

Proponents of IMS explain that planning for random situations can be attempted, though they concede that it will never be fully completed. This, they claim, is the purpose of a "general plan," which is incorporated into most incident management systems. These generic plans serve as a framework for establishing command, coordination, and communication for any emergency (UK Cabinet Office, 2005). Proponents also argue that a good incident management system will succeed if there has been proper training and familiarity with the system within the multiple organizations that follow it. Responders need to be able to think logically and act quickly, all while working with other organizations in order to provide the best service they can to the community. If the various first responders are familiar with each other, barriers such as miscommunication are reduced and the optimal emergency response can be undertaken (Buck et al., 2006).

Critics tend to argue that the inter-agency response called for in an IMS is confusing. Proponents, however, argue that if organizations are familiar with each other prior to the onset of an emergency, the benefit is far greater than what a single organization could achieve. One such way to achieve familiarity between different organizations is the use of inter-organization training (Buck et al., 2006). Once the IMS plan has been established, responders should train with agencies that they will work with in a real life situation. The training experience will provide a means of trust and confidence between the responders that will make dealing with emergencies less chaotic, while also providing valuable information that can be used for plan revision (UK Cabinet Office, 2005). These training sessions should have an element of randomness built in, in order to simulate a real emergency. This will allow responders to feel comfortable using IMS in new and changing situations, which they will face during actual emergencies.

Proponents argue that an IMS helps clarify the issue of shared authority (Moynihan, 2009). When all emergency organizations arrive at the scene, responders are faced with the question of who is effectively in charge. In certain cases, not everyone agrees to the chain of command. "Case evidence supports the view that shared authority is subject to ambiguity and disagreement. In the majority of cases, the crucial questions of who was in charge and how authority was transferred were a source of contention and negotiation between members" (Moynihan, 2009). During an emergency situation, an argument over the command structure would be detrimental to the response effort. An incident command system quickly and easily makes it clear to all members involved who they report to and

where they fall within the command structure, effectively negating all arguments regarding control. "In the Oklahoma City and Pentagon cases, locally based incident commanders quickly established and maintained a command presence to avoid a federal usurpation of local control" (Moynihan, 2009). While the organizational structure is a "power grab" in the beginning of the incident, it remains relatively constant throughout the incident, in order to minimize confusion and maximize the response potential.

Case Study: National Incident Management System

In order to alleviate miscommunication between agencies on emergency preparedness in the United States, the National Incident Management System (NIMS) was created after the events of 9/11. NIMS provides a "clear, common understanding of operational leadership and responsibilities" which allows for the smooth "integration of different assets to come together in a seamless response package that can save lives, protect property and mitigate additional damage" (Bourne, 2005). NIMS was established on the idea that a structured framework, at the national, state and local level, would deliver a standardized system for all emergency personnel (Federal Emergency Management Agency, 2008). At its conception, NIMS was viewed as a comprehensive model, a collaborative accumulation between all previous government plans and agendas. This system formalizes the process for establishing a command structure and delegates responsibilities into branches, such as the logistics branch or the operations branch (these are only two examples). Each one of these branches has specific objectives that move the response effort as a whole closer to restoring the community to normal (Federal Emergency Management Agency, 2008). NIMS serves to illustrate some of the fundamental characteristics and goals of an IMS.

Difference between IMS and EMIS

As an outsider, there may not be much distinction between an incident management system (IMS) and an emergency management information system (EMIS). Even for an emergency responder, the difference between these two acronyms can be confusing, yet the distinction is important enough to be addressed. An incident management system is a "pre-planned, agreed set of procedures and protocols that are activated when an incident occurs" (Julies, 2004). Essentially, an IMS is the actual framework and backbone of coordinated emergency response.

An emergency management information system is a "computer database… that provides graphical, real-time information to [emergency] responders" (Atteih, Algahtani, & Nazmy, 2010). An EMIS is a computer system, used at the tactical and operational levels, which provides important and relevant information to responders and is a part of the IMS as a whole. This important distinction will help clarify terminology, as we will continue to use the acronym EMIS to define the software aspect of an emergency response framework.

Considering the environment of emergency management, stressful situations force key personnel to make decision based on their instincts or reactions. An EMIS can provide rapid access to the information and protocols needed to ensure that responders can make the most informed decisions possible. Acknowledging the information technology portion of an EMIS, incomplete information, as

well as the other opposite extreme of "information overload", can highlight the need for a computer-based database of materials relating to emergencies (Carver & Turoff, 2007). Instead of not being able to find certain information, an EMIS should be quick and efficient at delivering a user data based on certain circumstances and scenarios.

EMIS Design

Research has stretched beyond the narrow scope of emergency to incorporate important characteristics of many human-computer systems used today. But, what distinguishes an EMIS from any other management information system?

The goal of any EMIS is to deliver information accurately and efficiently. To do this, it is important to understand the key role players in an EMIS; essentially, the human and their computer counterpart. Figure 6 summarizes the areas where people and machines excel.

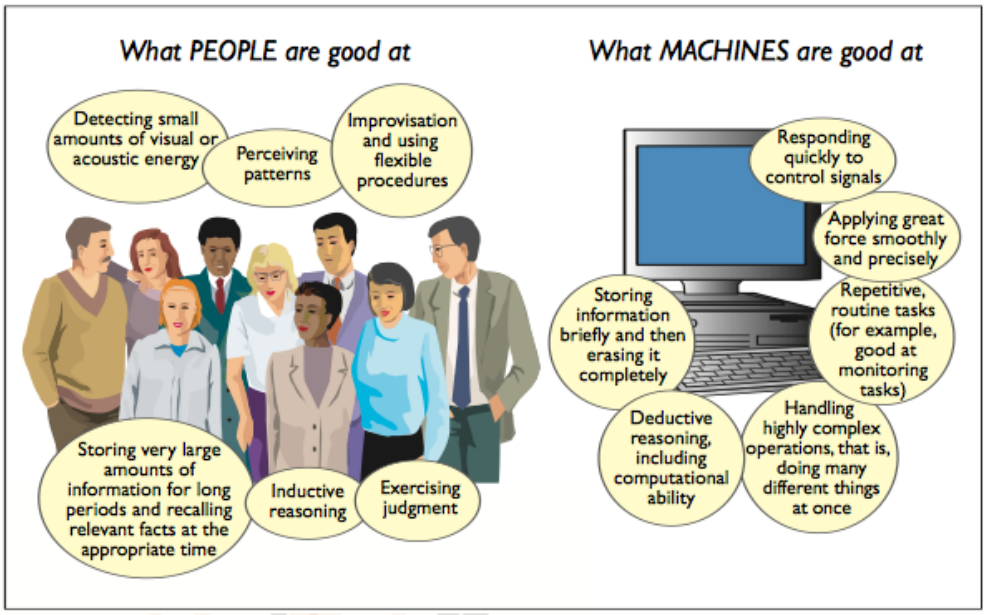


Figure 6 - Human-Computer Interaction Role Players (Carver & Turoff, 2007)

This graphic highlights a number of the attributes where humans and machines excel. Humans are capable of judging a situation as well as inferring aspects of the situation based on its context. Machines are not quite capable of performing high-level cognitive processes, however, they are capable of handling repetitive and complex tasks very quickly. Thus, the design of an EMIS must be such that it assigns humans and machines tasks in the areas where each excels.

Looking upon some requirements for an EMIS, there is a delicate balance between what the user needs and technological innovation (Bram & Vestergren, 2012). From conception, computer systems have been rapidly changing and evolving, venturing forward to capture new frontiers that were previously undiscovered. In order to curtail this rapid expansion, an EMIS needs to continually assess

the needs of the users' it serves. Applying the concept of Extreme Programming to an EMIS, incremental planning and small releases are the most important aspects when developing updates for such a system (Munassar & Govardhan, 2010). In another sense, user needs and requirements absolutely must drive the developments behind technological change in an EMIS (Carver & Turoff, 2007).

Research has been done on what are the key features of an effective EMIS. Chumer, Turoff, Walle, and Yao (2004) specify eight design principles for an effective EMIS. These principles include:

- System Directory
- Information Source and Timeliness
- Open Multi-directional Communication
- Content as Address
- Up to date Information and Data
- Link Relevant Info and Data
- Authority, Responsibility, and Accountability
- Psychological and Social Needs

In addition they outline five criteria for interface design:

- Metaphor
- Human Roles
- Notifications
- Context Visibility
- Hypertext

User Interface

User interface (UI) is the graphical display through which humans are able to communicate with the EMIS. The design of the user interface is fundamental to shaping a person's interactions with a computer. A good UI brings together elements that are easy to understand and enables users to rapidly achieve their desired task (U.S. Department of Health and Human Services, 2014). User interface is fundamental to the success of the system as a whole, as it is necessary for users to be able to quickly and reliably use the system without needing to worry about coding commands for the computer to perform.

When customizing and designing an EMIS, it's important to understand the area and region where it will be used. Ethnography is used in great lengths to ensure an EMIS is properly suited for the area it's serving. Applied to the concept of human-computer interaction, ethnography helps designers and developers to base the system on their own experiences and take in the views of the users in the workspace through methods such as interviews, surveys, and observation (Sears & Jacko, 2007).

Another trait important to interface design, specifically that of an EMIS, is an intuitive positioning of links. It is important that links are located where the user can quickly deduce their location with no prior knowledge (Lewis & Rieman, 1993; Palmer, 2014). Additionally, it is fundamental that the user interface contains minimal excess information and wordiness, such that the user can quickly and easily obtain the information needed (Chumer et al., 2004).

EMIS Drawbacks

While an EMIS has tremendous potential to supply information in order for key personnel to make decisions in an emergency, an ineffective EMIS can be detrimental to an emergency operation, being a source of frustration and confusion. For example, the Defense Research and Development division in Canada (D R&D C) conducted a study on the usability of certain EMIS. Their mission was to analyse the current state of EMIS including the software options available on the market today. In their background research, D R&D C identified multiple issues regarding the usability of current EMIS. These issues ranged from complaints such as "no indication of required fields in a form until after the 'submit' button has been selected and errors are generated" to "inconsistencies within the product", "actual errors or bugs" and "unnecessarily long navigation paths" (Randall, Defence, & Development Atlantic, 2011). Although these issues are not present in all products, they form a brief list of some of the common issues hindering EMIS usability. Some common sources of trouble can be seen in the word cloud presented in Figure 7.

Figure 7 - D R&D EMIS User Comments (Randall et al., 2011)

The study on EMIS conducted by D R&D C also included an experiment with four commercial EMIS, all of which are currently in use in Canadian government offices. Using the feedback from the participants of the study and the "analysis of troublesome features identified through trials," this experiment aimed to gain insight into the style requirements of an EMIS (Randall et al., 2011). The experiment chose four tasks to be completed by the participants using the different emergency management information systems. They then debriefed the participants to understand their thoughts of the system. In an effort to visualize the issues with current EMIS, D R&D C created word clouds based on the participants' concerns with individual systems (Randall et al., 2011). Figure 8 depicts the main themes found in the user's review of the systems.

Figure 8 - Thematically grouped comments from EMIS review (Randall et al., 2011)

Emergency Management in Hounslow

As mandated under the Civil Contingencies Act of 2004, the London Borough of Hounslow has a number of robust emergency plans in place for when disaster strikes (Vallenilla, Pulkowski, Musteata, & Weininger, 2013). These plans allow for a predetermined response to a wide variety of emergencies, ranging from a local to national scope. In order to manage all of these plans and protocols, Hounslow has developed an incident management system. This system provides a framework for data organization and visualization that allows for a higher level of efficiency than could be obtained if all of the documents stored in a paper binder. Hounslow's IMS, used by the tactical responders in the Emergency Control Centre, grants access to emergency plans, business contingency plans, contact lists and action cards, all of which help the tactical responders to coordinate and manage the operational assets and responders at the scene (Palmer, 2014).

Risks Present in Hounslow

The Civil Contingencies Act requires an analysis of all possible emergencies a borough may face, including their scale and severity. In order to fulfil this requirement, the Borough of Hounslow annually conducts a risk assessment, in which they rank the probability and severity of potential incidents and identify responders available for deployment (both Category I and II responders; see Appendix A).

Hounslow contains a number of major thoroughfares and transportation hubs, including Heathrow International Airport, the M4, the A4 Great West Road, and a plethora of underground and national rail stations (Palmer & Axelsen, 2013). All of these major transportation hubs are vital to consider when designing an emergency management incident system, as they could not only be the site of an incident, but could also be a valuable means of getting resources to and evacuating people from an emergency.

The Hounslow Risk Register also accounts for a number of COMAH (Control of Major Accident Hazards) sites in Hounslow. While these sites are required to have their own protocols in place for responding to emergencies (UK Cabinet Office, 2005), Hounslow has decided to incorporate COMAH-related risks into their risk assessment in order to be more prepared for a large scale disaster. Some of the COMAH sites identified by this study can be seen in Box 1. It is important for any IMS to be expandable to the point where it can be used to manage COMAH situations.

Control of Major Accident Hazard (COMAH) Sites

ESSO west London oil terminal
BP Walton
Heathrow Hydrant Operating Co.
Lufthansa Technik Landing Gear Services UK

Box 1 - COMAH Sites in Hounslow

Each risk presented in the risk assessment is evaluated based on its likelihood of occurring and its potential impact if it were to occur. The risk is then given a "Risk Rating." Looking through the chart of all the risk ratings, the two most concerning potential risks include flooding and disease outbreak amongst the population. While it is important for the IMS to have potential to respond to all of the risks identified, it is particularly important for the IMS to have potential to respond efficiently to these two major risks. Box 2 shows the major categories of risks identified in the risk assessment.

Risk Categories
Industrial Accidents
Severe Weather
Human Health
International Events
Industrial/Technical Failure
Transport Accidents
Structural
Animal Health

Box 2 - Risk Categories for Assessment

Hounslow's Emergency Response Structure

The structure of Hounslow's emergency response is based on six different team members, all of whom have unique roles when responding to an emergency. The team members are: Controller, Loggist, Logistics Co-ordinator, Operations Co-ordinator, Welfare Co-ordinator, and Information Co-ordinator. Additionally, a number of support staff are utilized in larger scale emergencies. For the most part, these roles are *not* filled by CPU staff. Instead, the CPU maintains a number of staff from around the building who are "ECC Trained," that is, they have been given a training session about how to use the EMIS during crises and what each coordinator is responsible for. The people come from all disciplines when needed: from social work to IT, from secretaries to education management. The following information come from information presented in the Borough Emergency Control Centre Handbook (Contingency Planning Unit, 2013).

Controller

The Controller is the most important person in the BECC. At the start of an emergency the Controller will start an Emergency Event Log, which is essential for good communication, decision-making, and legal purposes. The Controller will then appoint function co-ordinators to specific roles, the number of roles assigned depending on the scale of the emergency. From there, the Controller will begin communications with the LALO (Local Authority Liaison Officer) on the scene of the emergency, give the Chief Executive a briefing of the current emergency, notify Corporate Communications of the activation of the Control Centre and request that all potential BECC trained staff be notified by email regarding the status of the emergency and that they may be called upon if the emergency is up-scaled. Finally, the controller will instruct the Deputy Controller to notify the surrounding Boroughs who may

be affected, as well as the London Local Authority Coordination Centre (LLACC), which helps coordinate multi-borough responses if the need arises.

After the initial actions are completed, the Controller has a list of on-going actions to complete to ensure that the emergency is being properly handled. These include, monitoring the staff in the BECC and ensuring they aren't overstressed or overtired, regularly reviewing the logs and actions of each emergency management team member, and keeping in contact with the LALO. Overall the Controller manages the aspects of the emergency response from within the BECC, which is completed by assessing need, assigning tasks, and constantly staying updated on the happenings at the scene of the emergency.

Loggist

The Loggist is the person who keeps track of the events that have been completed in the emergency response process, as well as the events that still need to be completed. They record all actions the group takes in a proprietary word document template. Initially, the Loggist will review the current log/situation report that has been created by the Controller. If the Loggist is replacing someone who has already been working on the current emergency, they will be made aware of any outstanding actions that need to be completed. The Loggist then begins to record messages for the Controller, display any relevant maps or information, complete the event log for the Controller, print/save all documents that have been created during the emergency, and all logged information is retained and handed over to the controller after the stand down order is given.

Logistics Coordinator

As the name points out, the Logistics Coordinator handles all the logistics aspects of the emergency response. At their respective computer in the BECC, the Logistics Coordinator controls anything having to do with transportation, ICT support, mapping and GIS, printing any necessary documents, emergency signage that's needed on scene, mutual aid (identifying resources and contacting relevant local authority), and planning ahead for the upcoming hours of the emergency response (pre identifying any potential needs and requirements).

Information Coordinator

During an emergency, the Information Coordinator controls any information that will be helpful to make the emergency response go as smoothly and efficiently as possible. Their respective roles include, offering support to the BECC administration, acting as a liaison to the media (if necessary), liaise with Access Hounslow and corporate Communication to establish public information lines, place information on the public and staff information lines, handle the finances of the emergency response (Emergency Petty Cash, consulting the Emergency Cost Code), contacting legal services if needs be, and monitoring the impacts on business delivery and notify the controller if the Business Recovery team needs to be activated.

Operations Coordinator

The Operations Coordinator deals with any civil operations that need to be completed during an emergency response. The Operations Coordinator's respective tasks include, offering structural advice by contacting Building Control, contacting Hounslow Highways to alert them of the need of clearance of debris, either contacting Hounslow Highways or a special contractor to alert them of the need for cleansing and waste disposal, contacting Pollution Control if the environment will be effected by the

emergency, and contacting the Public Health team if steps need to be taken to protect the health of the community.

Welfare Coordinator

The Welfare Coordinator handles the well-being of everyone involved with the emergency, from the staff in the BECC to the community itself. Their respective roles include, organizing emergency rest centres, providing emergency feeding to the on-scene and BECC staff as well as the citizens affected by the emergency, providing a means for counselling to people in need, organizing short and long term residential care, offering translation services if necessary, identifying vulnerable persons through the Vulnerable Residents pages in the Emergency Guidance Booklet, contacting schools located in the community, and acting as a human resources manager by ensuring the welfare of all responding staff is met.

Support Staff

In addition to these six coordinators, during a full-scale crisis, the BECC fills up will numerous other support staff to help aid in the emergency response. These staff includes people to man the phones and take messages for the coordinators, as well as "runners," who run to and from the BECC carrying messages for the BECC staff. Additional staff includes people to maintain and update the whiteboards, as well as people to print, make copies and archive the papers as needed.

Current EMIS in Hounslow

Currently, responders at the Emergency Control Centre utilize an EMIS that is several years old. This system, based in a Word document displayed in a browser window, consists of a number of textboxes containing links to documents and protocols (Palmer, 2014). While these textboxes are thematically arranged, the display is difficult to read and the flowchart is confusing, due to plethora of lines shown.

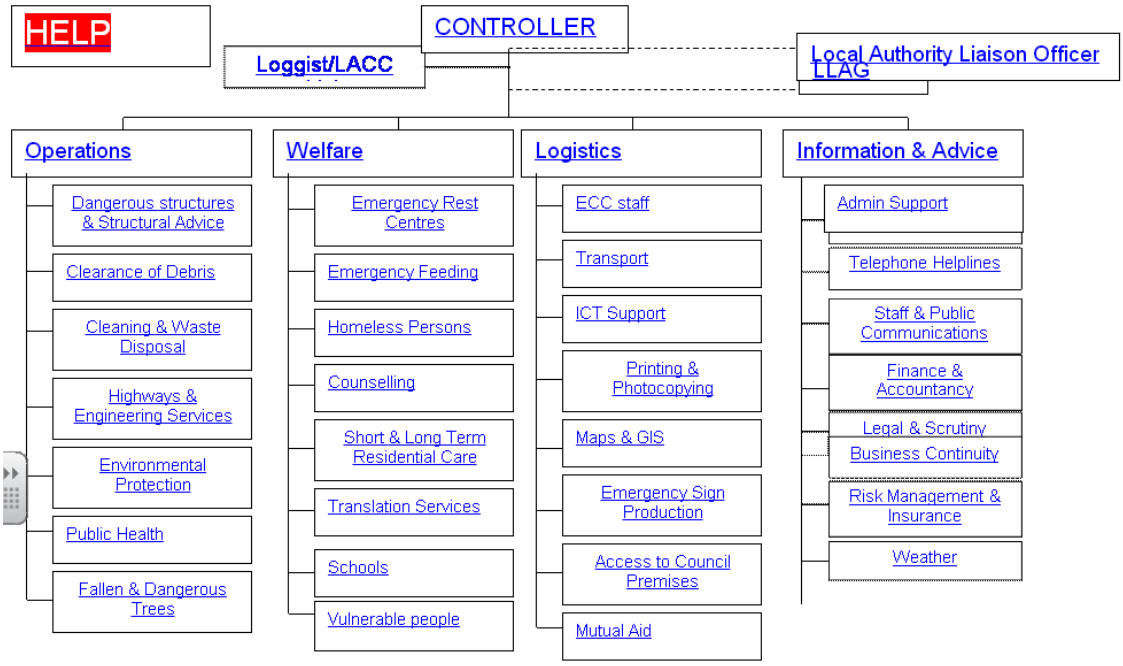


Figure 9 - Screenshot from Hounslow's Current Emergency Management Information System (Palmer, 2014)

The flowchart displays thematically related links in a hierarchical fashion, such that all links pertaining to Logistics are groups under the "Logistics" tab, etc. While this EMIS is arranged logically in that sense, it lacks visual appeal and user-friendliness. Additionally, people who use Hounslow's EMIS often have a number of gripes with the system, some of which can be seen in Box 3. Twm Palmer, the head of Hounslow's Contingency Planning and Resilience Unit, the unit in charge of the Emergency Control Centre, has gone so far as to describe the current system as "reasonably robust in principle, [yet] it is unappealing in looks, design, functionality and neither user-friendly or self-explanatory" (Palmer, 2014). Clearly, the current system is in need of an overhaul.

User Complaints

- System is dated
- Updating the system typically results in error messages
- Errors are common when linking to materials
- Visually unappealing
- Relies on training in order to use the system

Box 3 - User Complains with Current EMIS System

Hounslow's Emergency Response in Action

When an emergency arises the contingency planning officers activate the emergency control centre. Depending on the scale of the emergency they may be able to manage it on their own, or they may need to recruit other people working in Hounslow's Civic Centre to assist in the effort. If the latter is the case, the recruits will take on the emergency response roles defined in the previous sections.

The Contingency Planning Unit typically is notified of an emergency by a first responder such as the police or London Fire Brigade. At this point the borough emergency control centre (BECC) is activated and a Local Authority Liaison Officer (LALO) is briefed and sent to the scene. The LALO is the BECC's main contact at the scene and reports back to the BECC with necessary information. During

the emergency the BECC serves as the response hub. All information is brought in, primarily by phone, recorded by the Loggist, and decisions are made. Information is initially written down on paper and then transferred into the log or the proper digital forms. Some essential information is written on whiteboards located around the room so everyone working on the response has access to the information. Information is constantly gathered from a wide variety of sources and constant updates are provided by the LALO. When the emergency starts to wind down people are let go according to response needs. The LALO is contacted and told when they can return and be debriefed. All logs and manuscripts used during the emergency are compiled, recorded, and filed away.

Currently the IMS has no role in the emergency response. It is opened automatically when a user signs into a computer, however, users are told to close out the system immediately, since they are no longer trained to use the outdated system. Although ineffective, the current IMS structure is designed to augment the emergency response. It breaks down tasks into the different coordinators; however it fails to capitalize on this framework.

Desires for Future EMIS System

In the "WPI London Project Centre Proposal Form," Mr. Palmer outlines a number of traits that the redesigned system should contain. First-off, it is desired that the new system function with some newly obtained technology in the Emergency Response Centre, namely, a SmartBoard and multi-monitor arrangements. Additionally, this system must be robust and resilient in design, while also being simple enough that any member of the response team can log into the system and be capable of using it with no prior training. Some other important traits of the new system include a method for quickly and easily updating/ rearranging content within the system and the ability to be used remotely, either via cloud computing or a secure flash drive. Finally, Mr. Palmer would like for the system to be more visually appealing, something that more closely resembles the Hillingdon EMIS system, which is one of the most state-of-the-art systems in London (Palmer, 2014). A complete list of traits to be included within the EMIS can be found in Appendix B.

Chapter 3: Methodology

This project sought to redesign Hounslow's emergency management information system in order to support their tactical integrated emergency response. We achieved this redesign using information collected by analysing state of the art systems in use around London, while integrating the results with a review of Hounslow's current system, a needs assessment and prototype usability testing.

In order to develop the system, we relied heavily on the software development lifecycle of rapid application development (RAD). RAD, as the name implies, provides an iterative framework for the rapid development of software applications. It drops the formalities employed in traditional software engineering, such as in-depth planning and prototype creation, in favour of a more rapid, iterative, "build-refine-repeat" approach. RAD consists of four primary phases of design, which are summarized in Figure 10 (Beynon-Davies et al., 1999).

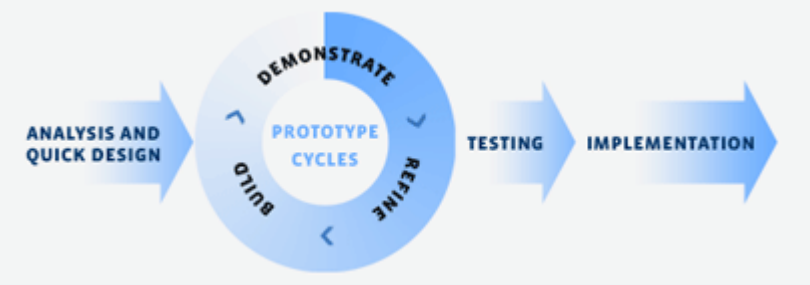


Figure 10 - 4 Stages of RAD (Hui, 2011)

The first stage of RAD, the "planning phase," consists of analysing the needs of the system and performing some quick designs in order to develop a general understanding of the interactions that will be occurring within the system. The next stage, the "building phase," involves the iterative cycle of constructing system elements, reviewing the system elements with the client, and refining the element to meet the client's needs. Following the building phase, the "testing" phase begins, at which time the system undergoes a series of tests in terms of functionality and usability. The final phase of RAD consists of system implementation, where the system is initialized and handed over to the client for use (Berger, Beynon-Davies, & Cleary, 2004; Beynon-Davies et al., 1999; Hui, 2011). This software development lifestyle was chosen as the framework around which Hounslow's EMIS was created due to its focus on rapid system development, a necessity in the seven week idea-to-deployment timeframe of this project.

Objectives

In this section, we outline the methodology that we used to achieve our goal. We identified the following objectives as necessary steps to achieve the redesign of the Hounslow EMIS:

1. Analyse Hounslow's current system to determine the context in which it is used, and determine strengths and flaws of the existing system.
2. Conduct a needs assessment to determine functional requirements to incorporate in the EMIS design.
3. Analyse other EMIS in order to determine the key components for effective EMIS design as well as learn from other's experience with EMIS design.

4. Develop a prototype EMIS.
5. Conduct usability testing to optimize the system.

As seen in Figure 11, the objectives were developed in conjunction with the RAD framework, giving us a clear path to follow for the completion of this project:

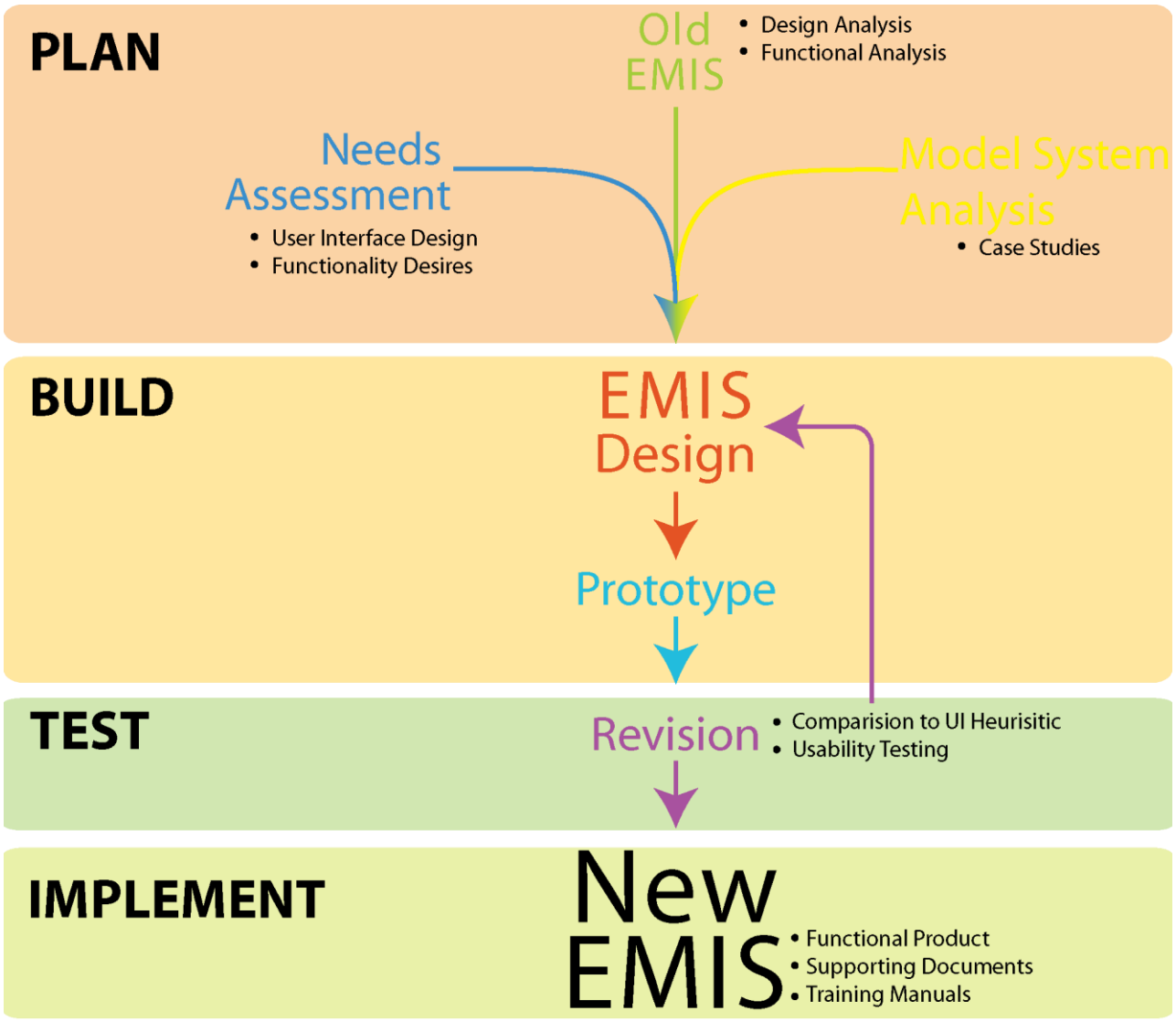


Figure 11 - Methodology Overview

Phase 1: PLAN

The first phase of the construction of Hounslow's EMIS was to gather information regarding EMIS components of EMIS and features to enhance usability. In order to achieve these goals, it was necessary to analyse Hounslow's current EMIS, to conduct a needs assessment which will identify areas of critical improvement, and to examine other EMIS in use.

Analysis of Hounslow's EMIS

An analysis of Hounslow's original EMIS was one of the first things that we performed. The goal of this analysis was to familiarize ourselves with the system, to determine why it no longer met Hounslow's needs and to understand the context in which the system was used. The EMIS analysis consisted of two parts: design analysis and functional analysis. Both of these phases were conducted at the Hounslow Council using Hounslow's original EMIS.

Design Analysis

The design analysis allowed us to understand how Hounslow's EMIS functioned and established the role of technology in EMIS usability. To perform this analysis, we spoke with Mr. Davill, an officer in the Contingency Planning Unit, as well as exploring the system ourselves.

The Design Analysis sought to answer two general types of questions:

- System Specifications
- EMIS Design Process

System specs are descriptions of the original system, detailing technical specifications such as when it was it made, what software platform it runs on and hardware requirements. System specs are important because they helped us understand how the original system functions and provided a context for further analysis. Table 1 summarizes some of the questions that were used to analyse the original system design.

Table 1 - Design Principles Questions

Research Area	**Questions**
System Specs	• What platform is it on? • Security of the system? • Operational Costs? • Remote Access Capabilities? • When was the EMIS designed? • Why was the EMIS implemented?
EMIS Design Process	• Describe the design process? • What resources were used to design the EMIS? • What were the design requirements? • How were the design requirements determined? • What is included in the EMIS?

Functional Analysis

The functional analysis determined how the original system was used. The functional analysis was conducted concurrently with the design analysis through our discussion with Mr. Davill. A summary of sample function analysis questions is given in Box 4.

Functional Analysis Questions

- How often is the EMIS used?
- Who uses it?
- What is it used for?
- How long is it used?
- Where is it used?
- How is it accessed?
- What additional functionality would be useful?
- What functionality is not needed?

Box 4 - Functional Analysis Questions

The design and functional analysis provided guiding information for the design of a new EMIS. After the design and functional data were collected, we brainstormed design guidelines for our EMIS. These design criteria served as an outline (as well as a measure) for guiding our process to develop a new EMIS.

Needs Assessment

In week 3, we were able to sit down with Mr. Palmer and Mr. Davill to conduct a needs assessment for a new EMIS. The needs assessment was a way of gauging what functionality the members of Hounslow's CPU wanted in the new system. The majority of this protocol was adapted from Chalofsky's work How to Conduct a Focus Group (1999), which outlined the specific elements which must be considered and planned for prior to conducting a focus group.

Basis of Needs Assessment

Our entire needs assessment sought to answer the question "What functions do the CPU staff feel that an EMIS must perform?" Since the CPU staff have experience responding to emergencies, they know first-hand how an EMIS could benefit them the most. After collecting this data, we determined a number of key components for the new system. We made a conscious effort to incorporate these features into the system, as well as acknowledging that they should be incorporated in future iterations of the system if we were unable to add them. Overall, the needs assessment provided us with a prioritized list of desires for the new system, from which we were able to combine with elements from existing systems, to build a comprehensive list of design elements.

Question Structure

We determined that a focus group was the best way to solicit information desired. A focus group is an efficient way of extracting important information from a number of people and it gives subjects the opportunity to expand on items that others have mentioned. Additionally, a focus group allowed us to gauge the overall importance of discussed ideas.

In general, there are two main types of focus groups, those that are highly structured and those that are not. Typically, the less structured the interview, the broader the comments will be (Chalofsky, 1999). Since the purpose of the needs assessment was to explore all the areas of need, we decided that a more structured focus group was the best option. In general, these structured focus groups have a series of questions which get asked in order. In order to encourage a bit of freedom in responses, we wrote a number of thematic elements of an EMIS (UI design, functionality, integration with current system, etc.) on a sheet of paper and handed it out to each participant. We then asked subjects what their perfect EMIS would look like in regards to each of those topics (Chalofsky, 1999). This moderately structured

approach allowed us to collect information on all the themes we desired, while still giving the subjects freedom to discuss other topics.

Participants

A good needs assessment focuses on the population in question: the Contingency Planning Unit (Royse, 2009). Hounslow has three people who work in the Emergency Command Centre (ECC): Twm Palmer, Richard Davill, and Fiona Hodge. Since each of these people are major stakeholders, it was important that as many of them as possible were present in the focus group. Due to time constraints, we were only able to meet with Mr. Palmer and Mr. Davill. We believe this to be sufficient since Mr. Palmer and Mr. Davill are most experienced with the original EMIS.

Timing

The needs assessment was conducted early on in our time in London, at the beginning of the third week. We chose this time point, as opposed conducting it in the first week, so we had a chance to better understand the current system as well as build a rapport with members of the staff at the CPU so they will be more comfortable talking with us. Both of these aspects allowed for fluid and dynamic conversation.

Conducting the Needs Assessment

In order to conduct the needs assessment, we used the following equipment:

- SmartBoard
- Computer
- Paper and pen (for notes)

We sat everybody around the SmartBoard in the BECC and explained to them the purpose of the focus group, i.e., to obtain a better understanding of the needs of the users of the EMIS to establish functional requirements for the new system. After explaining the purpose, the moderator informed participants that this was a very informal process and that all of their insights were valuable in the creation of the new system. Then, the moderator passed out a sheet containing all talking points **(**see Appendix C). Some of the questions posed for discussion included:

- What elements of the original system can be conserved?
    - Layout
        - Each coordinator gets their own set of links
        - Link names
        - Menus/submenus
    - Information
    - Contact List
    - Links lead to other documents, which require downloading
- What features of a new EMIS, in regards to these categories, would benefit you the most?
    - UI Design
    - Functionality

The moderator briefly explained what was meant by each of the categories:

UI Design - What do you want the system to look like?

Users were presented with two different system mock-ups, and were asked to explain what they liked about each one. Additionally, they were asked what should be added to either of the designs to improve them.

Functionality - What should the system be able to do (ideally)?

Prior to the focus group, we developed a list of potential system elements. We addressed each one of these topics throughout the focus group. Some sample topics included:

- Digitized Task Log
- Login Screen
- Time-monitoring of users
- Email integration
- e-forms
- Contact List
- GIS integration
- Situation Report exporting (to different formats: LLACC, Hounslow)

A complete list of potential system requirements can be found in Appendix D.

The moderator introduced each one of these topics, giving a brief introduction of how each element would function/ fit into the EMIS as a whole. We then gathered the opinions of the group regarding each element, looking specifically at:

- Would this feature be useful? How would you use this feature?
- Would it benefit you? How might this feature benefit you?
- How important do you feel this to be?

After completing the discussion, participants ranked their top five choices for functionality in the new system. The ranking allowed us to see which features users thought would be most useful.

As the focus group progressed, all group members recorded the participant's responses, with the recorder typing them into a document projected onto the SmartBoard. The recorder summarized what the participant had stated, without adding their own interpretation to the statement. The notes were saved and emailed to all participants for verification.

Deliverable of the Needs Assessment

The information collected during the needs assessment, in conjunction with information collected from other sources, allowed us to generate a series of possible design criteria for the new system, which limited the design space and gave us a framework upon which we were able to start designing the new system (Dym, Little, Orwin, & Spjut, 2009). This was a fundamental step towards the creation of the new EMIS, since it enumerated a number of the functional components that the new system could have benefitted from.

Analysis of Existing Systems

EMIS come in many different forms and each emergency response organization will have a different method of planning and response based on local needs. A major city such as Boston,

Massachusetts, may have a different emergency planning and response framework in place than that of the state-wide Massachusetts Emergency Management Agency, since each agency has a different outlook on emergency management system operation due to their differing population, geographical size, crime rate, and also the possibility of natural disasters and un-natural disasters occurring in their area. For this reason, we conducted research on the different aspects and qualities (both positive and negative) of a number of distinct emergency management agencies and their respective emergency planning and response systems. We took the information acquired from these systems and tried to incorporate the best qualities (while acknowledging and understanding the worst qualities) into the design of a new EMIS that fits Hounslow's needs.

Agencies

The agencies which we contacted and visited can be seen in Table 2:

Table 2 - Emergency Management Agencies of Interest

Agency	Area of Coverage	Population of Area
Massachusetts Emergency Management Agency	State	6,500,000
Hounslow Contingency Planning Unit	Borough	254,000
Hillingdon Civil Protection Service	Borough	273,900
Sutton Civil Protection Service	Borough	191,100
Ealing Civil Protection Service	Borough	339,300
London Resilience Team	City	8,174,100

In total, we attempted to observe and interview 11 agencies in the U.K. Including the 5 U.K. agencies above, we also contacted Harrow, Redbridge, Brent, Hammersmith and Fulham, London Local Authority Coordination Centre, and Westminster. These agencies were identified by the CPU staff as having sophisticated systems that could aid in the creation of our new system.

Research Plan

On-site research was conducted at all of the agencies listed in Table 2. We were able to assess the organization and their respective emergency planning and response systems via a system demonstration and interview and discussion regarding the system and how it fits into their response effort as a whole.

Demonstration

For each system, we were able to participate to a certain level in a demo focusing on system operation and function. During the demo, we collected data pertaining to user interface design and system functionality. Our experience with Hounslow's original EMIS influenced the way in which we evaluated the system. The EMIS was compared with Hounslow's and we drew insights gained from these comparisons to guide the design of the new system.

Informal Interview

The second part of the system analysis was an informal interview with system users. This interview allowed us to extract additional information from each organization regarding their EMIS.

Rather than conduct a structured question-answer interview, an informal interview was chosen because it allowed for open discussion. This provided the opportunity to ask questions as ideas arose and gave us the flexibility to change questions based on information previously acquired during the interview. The list of questions which we used as a guideline for these interviews can be found in Appendix E. These questions served as a thematic guide to the type of information we hoped to obtain from each interview. All of the data obtained in the interviews was analysed in order to understand the elements that can be implemented in Hounslow's new EMIS design.

Phase 2: BUILD

The next phase of the EMIS development involved building the system. During this iterative phase, prototype versions of the system were created, shown to members of the CPU staff, and refined based on their comments.

Develop a prototype EMIS

In order to properly develop a new EMIS, a system had to be designed, prototyped, and revised. Overall, there are two main areas of focus in the EMIS design: hardware development and user interface (UI) design.

Hardware Development

In order to develop a proper prototype for Hounslow, it was essential to understand the facilities and inventory Hounslow maintained in terms of technology. After compiling a list of technological resources, it was determined that the system needed to be compatible the following:

- Laptop and desktop computers running Windows XP/Windows 7
- Microsoft Office Suite 2007/2010
- Interactive SMART board with latest software
- Switch between multiple users and screens on workstations
- Use of projectors

Given the request for this system to not be only limited to computers in the Emergency Control Centre, some type of network framework needed to be established. In order to gather information in regards to "cloud computing," it was essential to ask the following questions:

- How is the current system networked?
- What resources are available to be dedicated to hosting a Web server?
- What resources are available to be dedicated to hosting a database server?
- For a user outside of the ECC, is a constant Internet (whether cellular data or Wi-Fi) connection needed?

These questions were directed to ICT, the Information and Communication Technologies service for Hounslow Civic Centre.

Following our meeting with ICT, it readily became apparent that ICT was not going to be capable of hosting nor supporting this system at the current time. Hounslow's Civic Centre was in the process of moving towards a cloud-based system, known as Box, for all of their computing needs. In order to accomplish this transition, ICT was pushing towards unified, integrated systems developed by their team of app designers. For this reason, they could not ensure support of a disparate system in the ECC. Additionally, their drive towards Box meant that they could not host our system on any servers, as they were attempting to minimize their server space (Akai, Manku, & Tubbs, 2014). This pushed the design away from that of an integrated, cross-talking system to that of individual, discrete systems run on each computer. While this did severely limit functionality, it was decided, with the help of Mr. Palmer, that these individual systems would function fine for what the system needed to do.

User Interface Design

In order to understand the optimal user interface, we collected information from a variety of sources. While information from the case studies shed some light on potential aspects of the user interface, significant design and revision steps were needed before the final UI was created.

User Interface Sketching

Within the first week, we sat down with Mr. Palmer and drew a couple of rough sketches on the SmartBoard of what we anticipated the user interface to look like. Some of the simple sketches that we presented included those depicted in Figure 12 and Figure 13.

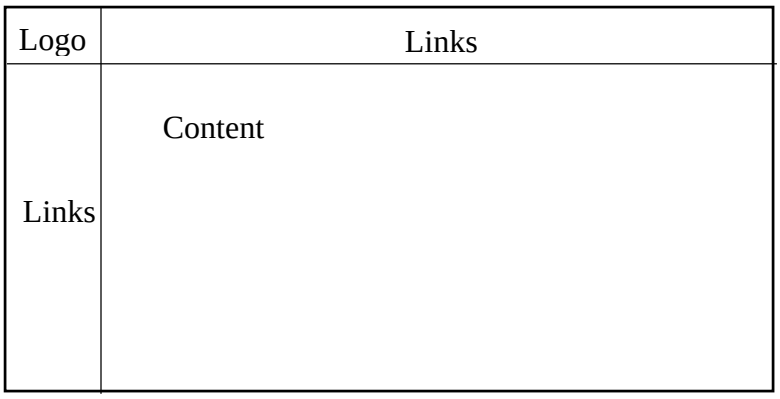


Figure 12- Preliminary UI Sketch 1

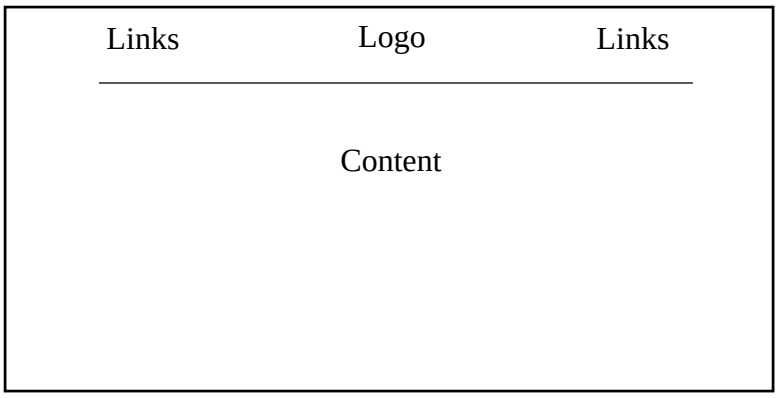


Figure 13-Preliminary UI Sketch 2

After presenting Mr. Palmer and Mr. Davill with the sketches, they identified a number of components that they liked from the two sketches, but indicated that they would like to see a more in-depth rendering of the sketches.

Mock-ups of User Interface

Following a brief analysis of the common items presented in the sketches, mock-up user interfaces were created using Adobe Photoshop and Adobe Illustrator. Using principles from the sketches, case-studies, literature review and needs assessment, a user interface was created to incorporate the most important aspects of the EMIS design into the system. UI mock-ups can be seen in Figure 14 and Figure 15.

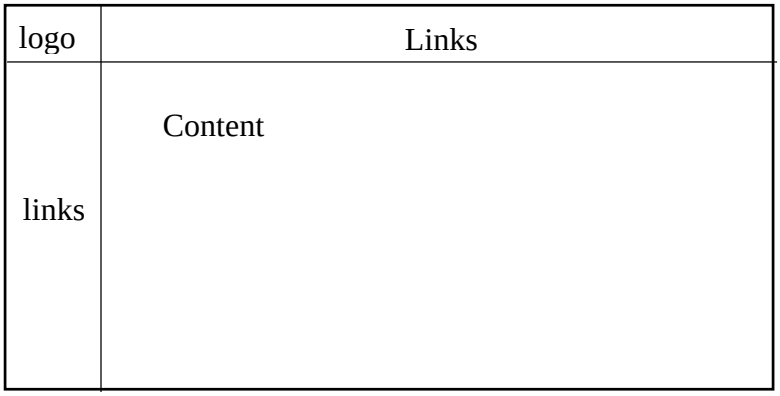


Figure 14-Mock-Up 1

Figure 15- Mock-Up 2

These mock-ups were then presented to Mr. Palmer and Mr. Davill and their comments were recorded.

System Development

It was decided that an HTML 5 framework would be the best platform for system development for Hounslow's BECC. In order to develop the system in the HTML framework, a CSS profile was created for the system such that it very closely resembled a hybrid of the well-received system mock ups shown in Figure 14 and Figure 15. Once the CSS profile has been created, all members of the team were introduced to the basics of HTML 5 and, after a short training session, began converting the elements of the old EMIS to HTML files for integration into the new system. All text-based documents were fully integrated into the system, however, due to the difficulties in both creation and maintenance of HTML tables, it was decided that any spreadsheets in the old system would be linked directly to the system in their native format (i.e. Microsoft Excel), as opposed to recreated in an HTML framework.

Once the framework had been built, providing the core information display functionality intrinsic to an EMIS, addition features were added to the system. Using Google Drive, we were able to embed a task log database into the web site, allowing for each member of staff to update a centrally hosted task log spreadsheet as they complete tasks. Additionally, links to the GIS were embedded within the system, providing rapid access to the GIS.

Phase 3: TEST

The third phase of RAD involves testing the system. In order to test the new Hounslow EMIS, the system was compared to a series of published usability heuristics. Additionally, the system was presented to staff who volunteer in the ECC. These staff members were asked for their feedback and completed a brief system evaluation to assess its usability.

Usability Testing, without Users

Prior to testing the usability of the system with users, the system will be tested using an adapted heuristic metric established in Neilsen's "Ten Usability Heuristics" (2005), which are fully outlined in in

Table 3. Note that only eight heuristics are listed here- the other two did not pertain to a small scale, non-server hosted system.

Table 3- Neilsen Usability Criteria

Usability Heuristics	Definition
Visibility of System Status	System informs users about current status
Match between system and real world	Words and images follow real world conventions
User control and freedom	Allows users to undo their actions
Consistency and standards	Consistency in language and layout throughout system
Error prevention	System designed to prevent errors
Recognition rather than recall	Does not required user memory. Interface prompts action
Aesthetic and minimalist design	Simple, straightforward and functional design
Help documentation	Help documentation is available

These metrics identify key factors in the design of a user interface. For each aspect of this heuristic, system features and attributes were identified to justify how each heuristic was satisfied in the UI design.

Usability Testing, with Users

In order to test the efficacy of the EMIS design, we conducted a user interface (UI) test, in which users were given the new system and were asked to complete a series of task that might be required in an emergency situation, such as looking up a certain response agency's phone number, locating an action card or logging an event. We monitored participants using the system as they attempted to complete the tasks given to them. This experiment gathered data necessary to answer the following questions:

- How intuitive is our new system?
- Where can changes be made to make the system more intuitive?
- What do people think about the EMIS system, comments, suggestions, etc.?

Experimental Preparation

The materials required for this test include:

- Laptop with new EMIS
- Task sheet for participant

The basis for this user-interface evaluation can be found in the work of Lewis and Reiman, who provide an in-depth explanation of how to conduct an efficient UI evaluation with the use of users (Lewis & Rieman, 1993).

First, we needed to determine who the users of the system were. Lewis & Rieman (1993) argue that the best subjects for a UI evaluation are subjects who represent the population of interest, in our case, volunteers trained to work in the borough emergency control centre. We made it our goal to recruit these responders to participate in our test. Additionally, we recruited the members of the CPU staff, as it is important for them to be able to use the system as well, since they don't recruit volunteers for small scale operations. In order to make the event open to all members who have been trained in emergency response and are qualified to work in the ECC, we enlisted Mr. Palmer to invite all of his volunteers in to demo the new system. The assessment was conducted on two separate days, during staff's lunch break (between 12 and 2).

To test the EMIS, participants were given select tasks to complete; reflecting typical tasks that real system user's will likely face. In order to minimize the time necessary to complete each usability test, it was decided that subjects should only complete seven tasks. These tasks were selected with the help of CPU staff as elements a typically coordinator might face. Appendix F outlines the three worksheets created for this study. A number of different task sheets were required so as to discourage communication between people taking the test at the same time, so as to more accurately reflect how intuitive each person feels the system to be.

Once the user population and tasks were selected, it was important to determine what type of data needs to be collected. Typically, the data collection is two-tiered: experimenters collect *process data*, data regarding what and why users are doing as they do it, and *bottom-line data*, which summarizes what the users completed (Lewis & Rieman, 1993). In the case of the Hounslow EMIS, it was important to collect both the process and bottom-line data, since the process data will be important in refining our UI design, while the bottom line data will help us understand how intuitive it is.

In order to fully gauge how intuitive our system is, we felt it best to conduct a "hands-on" approach. Allowing the user to fully interact with our system allows us to monitor and record their actions within the system, which will show us where they intuitively feel that certain information should be located. This "hands-on" approach was needed since it would be difficult to ascertain people's intuition in a simple verbal information exchange, as occurs in a focus group or interview. Note that this usability test, in which the user walks into the room and need to user the EMIS with any training, represents the worst case scenario- the user has no experience with the EMIS. It was determined that if users could understand and effectively use the system in this scenario, the system design would be validated.

Process Data Collection

In order to collect the process data, employed the so-called "Thinking Aloud Method," in which the subject verbalizes what they are thinking, trying to do, and questions that arise as they are using the system (Lewis & Rieman, 1993). In order to preserve these comments, we took notes to capture the participant's experience with the system.

Role of the Experimenter

At the start of the session, the experimenter told the subject something along the lines of "Please tell me what you are thinking, in regards to completing the task, as you try to complete them. Also, please let me know what you are trying to do and any questions or frustrations you have, as they arise."

After stating this, the experimenter opened the EMIS and gave the user the task sheet. During the time the user is attempting to complete the task, the experimenter prompted the user to continue their flow of comments. These prompts were generic and not leading, using probes such as “What are you thinking now?” “What are you trying to do?” and “Keep talking.” During this time, another experimenter recorded what the subject says and does.

Recording

We observed and recorded notes as the user progressed through the system, focusing on qualitative recordings such as suggestions the participant may have and their thoughts about the system as they progress. Since we knew exactly the tasks they were doing, we did not record their path through the system, instead, noting the tasks which gave them difficulty. Additionally, we noted tasks they completed quickly and those that they struggled with.

Rationale

As part of the process of Rapid Application Development for software, it is crucial to receive constructive criticism on the system and refine it based off of those criticisms (Beynon-Davies et al., 1999). In order to get the good, useful feedback, we decided it would be best to let future users of the EMIS test it out through a series of predetermined tasks. We developed three separate tests, each consisting of seven tasks that were designed such that the user would have to navigate through the system using the core functions that were integrated, i.e. the dropdown menu, “quick links”, and accessible action cards. Each person was given only one test.

The overall goal of the usability test was to allow the users of the system inform us of any issues that they have with the system, so that we could take that feedback and further develop and make changes to the EMIS. Here is an example task for one of the tests:

Since you just completed a task, it must be recorded in the task log so that there is a definite record of it. Please navigate to the task log and record the task that you have just completed.

In order to complete this task, the users of the system had to locate the task log from their current screen, access it, and submit a simple test message to the system. This was a relatively simple task due to the constant task log button available at the top of navigation bar, but it helped us to understand how intuitive it was for new users to find and recognize the task log link. A more in-depth task is as follows:

It has been determined that there is no longer a need for the Information Coordinator position. You have been reassigned as the Welfare Coordinator. From your current screen, please navigate to the Welfare Coordinator homepage.

The point of including this task in the usability test was for us to understand whether or not users could locate the drop down menu that is included in the system. Located at the top right corner of the EMIS, the drop down menu allows for users to quickly navigate from coordinator to coordinator.

These two examples serve to illustrate the type of information we were able to gain from each question, and the types of conclusions we were able to make.

We constructed the usability tests to get an outside view of whether or not the system we had designed was useful, clear, and simple to navigate.

Conclusions

Overall, the process portion of the usability study served as a means of verifying whether our system functioned as expected. It allowed us to see where people deviated from the most efficient route to information, which allowed us to make improvements to the system layout. Additionally, this usability study allowed us to gather feedback from members of the staff who most frequently use the system. This feedback was important both in the validation of the design, as well as for making improvements to the system.

Usability Testing Debrief

Following the UI test, the test subjects were debriefed. Subjects were be briefly interviewed and given a quick survey. An interview was chosen since it would allow us to understand their experience as well as probe them more deeply and address unexpected issues that may have arisen during the test. Some of the questions asked include:

- What are your feelings about the new system?
- What suggestions do you have in regards to the system?
- Did you find anything frustrating with the system?

The results of each question were recorded and included with the other notes in order to determine areas of improvement for future iterations of the new system. The user survey was an important mechanism for gathering tangible data regarding the system. It allowed for a qualitative analysis of the system.

Phase 4: IMPLEMENTATION

The final phase of the RAD-driven methodology was the system implementation. This phase focuses on the handover of the system from the system designers to the client. In order to expedite this transition, we held a training session with members of the CPU staff, as well as created a comprehensive user manual and maintenance document.

User Guide

In order to ensure that users would be able to use the system following our departure, we created a user manual for the system. This user manual consists of two main sections. The first section of the guide gives an overview of the layout of the system, highlighting components of the system, such as the quick-links bar, the navigation bar, etc. The next section of the guide consisted of a manual giving step-by-step instructions for using some of the system features, such as the task log, the GIS, etc. A complete copy of the user-manual can be seen in Appendix H.

Maintenance Document

One of the criteria of the system was that it must be easy to maintain. HTML, while not officering a graphic user interface for system maintenance, is still one of the most accessible languages. For this reason, it was deemed that the members of the CPU would be able to maintain the system themselves. In order to facilitate this maintenance, a comprehensive maintenance guide was created. This guide, which can be seen in Appendix I, gives a brief outline of HTML, outlining some of the tags deemed to be the most useful in-terms of what the CPU staff will need to be doing. Additionally, this

manual gives step-by-step instructions on how to update pages, menus, navigation bars and drop downs. Finally, this guide gives a line-by-line breakdown of the code required to generate the overall framework of the system, such that when this system ultimately gets transferred to Box by ICT, the ICT staff will have an understanding of the code such that it can be optimally replicated into an application for Box.

Training Session

In order to introduce the system to members of the CPU staff, we scheduled a three hour window in which we showed members of the CPU staff the system and allowed them to ask any-and-all questions which arose. Additionally, we went through both the user manual and the maintenance manual, showing users features of the system, such as the task log, and how to update pages and menus within the system.

Conclusion

Overall, our methodology encompasses all aspects of EMIS design criteria. The evaluation of the current system identified elements that should be conserved and those that need to be removed in the update. The needs assessment helped to identify traits that must be included in the new system, while the analysis of additional EMIS systems allowed us to discern proven characteristics of EMIS design which benefit or hinder emergency response in their respective communities. Finally, the iterative build and revision process of the EMIS prototype allowed for design optimization to generate a finished product that is highly refined. After verifying this design in the usability testing, the system was able to be readily implemented into the Hounslow emergency response framework. This RAD-based methodology allowed for the development of a high-quality EMIS that satisfies Hounslow's needs in a user-friendly, intuitive and functional system, created within seven weeks.

Chapter 4: Results and Findings

The goal of this project was to create a new Emergency Management Information System for the Borough of Hounslow that would meet their current and future needs. The results and findings gathered throughout this project influenced the design of the new EMIS. Presented in terms of their corresponding RAD phase, this chapter outlines all of the information obtained from each one of our methodological steps towards the design of a new EMIS.

Our results are presented as shown in Figure 16 :

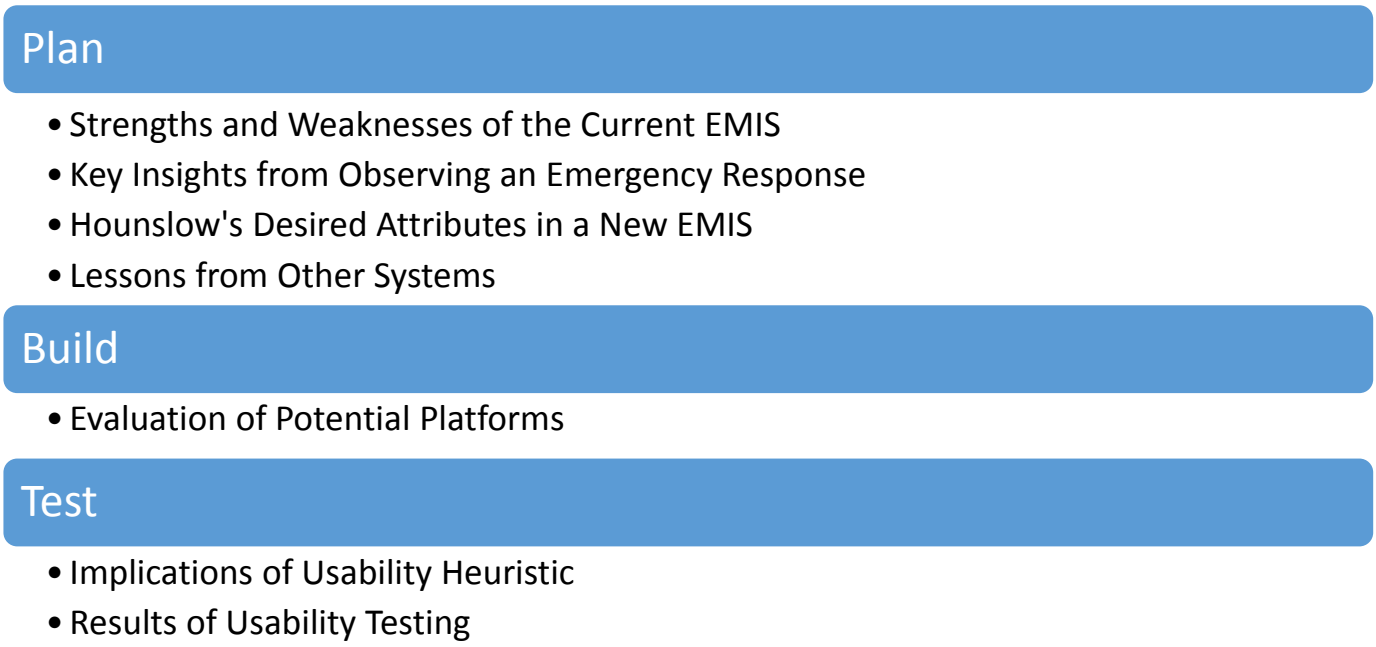


Figure 16- Grouping of Results

Phase 1: PLAN

In this section, we highlight the key findings from each section of the planning methodology. For the complete notes and analysis of each section, please see the appropriate appendix, as outlined in Table 4.

Table 4- Planning Analysis Appendix References

Section	Appendix
Strengths and Weaknesses of the Current EMIS	Appendix J
Key Insights from Observing an Emergency Response	Appendix K
Lessons from Other Systems	Appendix L

Strengths and Weaknesses of the Current EMIS

The analysis of Hounslow's current system revealed several strengths and weaknesses regarding system design. The main strength of the system was its high-level organization of information. It breaks down information into the applicable function coordinator which provided an effective information structure.

However, the system failed to execute and take advantage of the effective structure and had several weaknesses. Although the information was under a specific coordinator, all of the information was displayed at the same time for all coordinators, resulting in disorder and information overload. Giving each coordinator a separate page is a possible remedy to this problem. Additionally, all the documents had to be downloaded which resulted in slowness as well as overcrowding (lots of files open during an emergency). The systems user interface was another weakness. The system failed to take advantage of visual aids; all information was in the same basic colour and style making it difficult to differentiate between information. Last, the system included no "additional features" beyond storing data, limiting its usefulness.

A software overhaul is likely needed to provide additional functionality. As opposed to local hosting, we believe that a server-based system is the best option for this system. This would allow for multiple people to access the information at once and can be coupled with server-side scripting (using a programming language such as PHP) to give increased functionality to the system, such as a digital task log, a message board and a secure login.

Unfortunately, at this time, ICT cannot support such a server-hosted system. In their transition to Box, they are moving away from such systems and could not provide us space for this project. They did, however, allude to the fact that when this EMIS moves to Box in the next few years, their designers would be able to integrate some of the desired functions into the Box App (Akai et al., 2014)

Key Insights from Observing an Emergency Response

During the response, we noticed a number of processes that an EMIS could augment. First, GIS software and Google Maps were used extensively throughout the entire response. This was how the BECC identified the property as belonging to Hounslow Homes as well as informing the LALO where to go. Second, the locations of CCTVs were often requested by the police as well as by the responders in the BECC to gain a visual of what was happening. Third, they searched Twitter feeds, using the terms "Hounslow fire," to collect addition information about the incident. Twitter can provide information faster about a situation than traditional emergency response agencies, as it is populated by people all over the world, some of whom may be tweeting about the events going on at the scene.

These features could all be included in an EMIS. This emergency helped us to identify several other opportunities for our new EMIS. First, the material on the white board could be completed through the EMIS on pre-made forms. This would allow for quicker data input as well as allow the information to be available to anyone on the EMIS. A second opportunity would be to incorporate easy to find contact information. Contact information had to be looked up in the contact book several times during the response, and then was written on a white board. Having digital contact information that is searchable could aid the response process, and cut down the time needed gather these important contacts. Third, the opportunity exists for more effective logging and communication. For example, if

the LALO had access to a tablet with the EMIS they could potentially send photos of the situation back to the BECC, which would aid in their understanding of the emergency. Creating a real time log would allow everyone to contribute to the log and reduce the burden on the loggist.

Hounslow's Desired Attributes in a New EMIS

In order to fully understand what the members of Hounslow's Contingency Planning Unit desired for the final product of our EMIS design, it was necessary for us to conduct a focus group and discuss with them the key elements we could add into the system. What we learned from our discussion was that the only essential thing the members of the CPU wanted was a fully functional platform that easily displayed emergency response information to volunteers working in the CPU. It was necessary for the EMIS to be simple to navigate and understand so that a person with no prior experience with the system could use it in the time of an emergency.

That being said, we also discussed the aspect of including additional features into the system to make it more interactive and well rounded. The features that they suggested would be beneficial to include in the system were mainly a searchable contacts list, a task log to record employees' actions during an emergency response, and links to their mapping and GIS system. Additionally, we found that creating a page specifically for Action Cards that displayed links to Action Cards that didn't fit under a specific coordinator.

The focus group provided a successful discussion and allowed us to better understand the critical aspects of the project as well prioritize all ideas. Though we had trouble keeping the discussion to the outline posted in Appendix C, we did cover all essential talking points.

Current System Design

The first part of the needs assessment focused on the design of the current system. In this step, we asked Mr. Palmer and Mr. Davill what elements from the initial system should be conserved. Initially, they didn't believe anything should be conserved. However, after some probing they agreed that the existing organizational structure, attaching data to specific emergency coordinators, was an effective element. Elaboration on their complaints revealed that they felt that the large number of links made the system overwhelming to inexperienced users. They believed that the user interface could be improved by creating separate pages for each coordinator since they would only confront information pertinent to their responsibilities. Additionally, the team confirmed that we would not need to generate any new information for the system; it could be transferred from existing locations.

The participants brainstormed a number of functionality features that they did not like in the current system and how they could be improved. Some of those traits are shown in Table 5.

Table 5 - Functionality Issues with Current System

Problem	Solution
Documents are downloaded each time a link is selected, creating a cluttered workspace	Embed the information directly within the system
Links don't ways work when clicked	Rebuild system on a more robust platform
Sometimes there are a number of submenus to jump through	More streamlined system

UI Design

Following the discussion of the current system, we transitioned to User Interface design of the new system.

System Mock Ups

To start the user interface design we showed participants a series of mock-ups we created for potential EMIS design. These mock-ups spurred a discussion about the layout of the system. Mr. Palmer and Mr. Davill were both very excited about the layout shown in Figure 17.

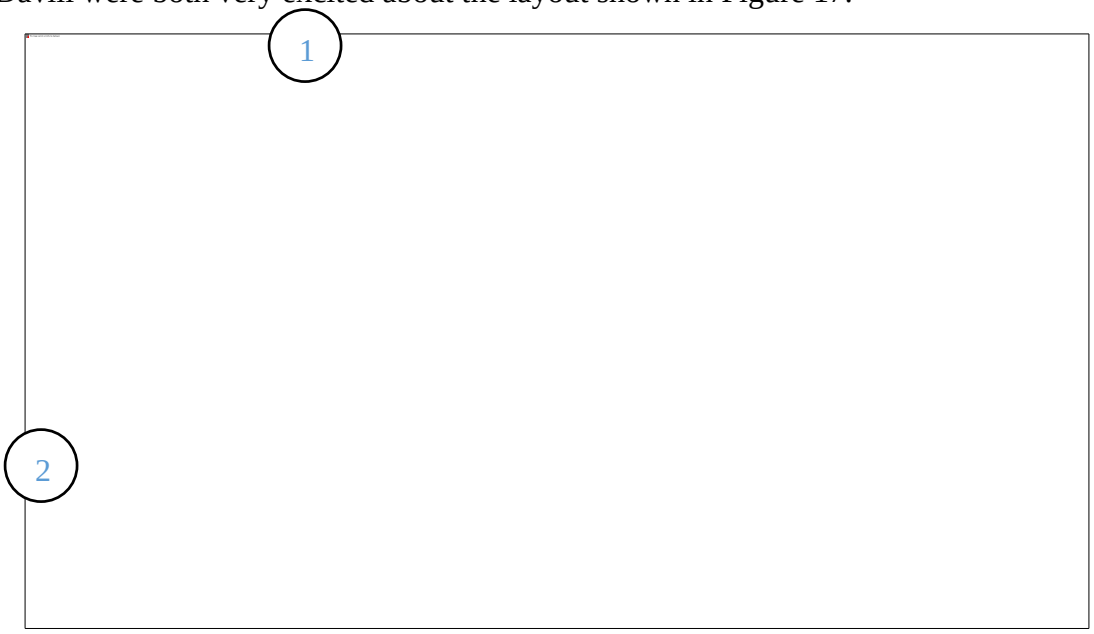


Figure 17-System Design Mock-up 1

Specifically, they liked the quick links located at the top of the screen (number 1) which allowed users continuous access to links that they might use frequently. However, the specific links should be explored to ensure that the most useful information is displayed in the quick links. Additionally, they liked the positioning of the links for each coordinator (to the left, number 2), since they were in a logical position. They also felt that the corporate branding was effective and necessary. The second mock-up, as

seen in Figure 15, provided a different approach to the visual structure of the system and was identified as simpler than the first mock-up. Both users felt that a combination of the two mock-ups would be ideal. The first layout would be effective for navigating and organizing information while the second design would be effective as a home screen that is a simple way for users to enter the system.

Colour Coding

Colour coding was the next UI topic covered. The previous EMIS design did not make use of colour coding; instead it used a basic HTML design. The system left much to be desired aesthetically; it contained little corporate branding and a white background with black outlining and blue hyperlinks.

Following the corporate branding guidelines for Hounslow, we were able to incorporate key colours that are associated with the different coordinators for the Contingency Planning Unit. Colour coding makes the site more visually appealing and organizes functionality for users accessing the system. For instance, someone who is not familiar with the different coordinators would be able to identify that the page has changed colour, thus indicating that the user has changed coordinator roles. Additionally, the colour of each page is identical to the colour of the respective coordinator's computer. For example, the operations coordinator has a blue tag on their computer, so their page is blue. Although colour coding enhances usability, it is not essential for a user to be familiar with the different coordinator colours or even see in colour to use the system. Colour coding creates a secondary link for the user between all related documents to each coordinator.

Additional Recommendations

While both participants were excited about the potential of the preliminary designs, they brought up a number of ideas to incorporate into the new system. For example, they suggested attempting to associate symbols with certain actions, such as a home button for returning to the homepage. This philosophy is very similar to that found in the UI design guidebook, which states that metaphorical imagery should be used wherever possible (Chumer et al., 2004). Additionally, they recommended that additional room for quick links on the page, such as a fixed bottom bar, would be beneficial to the design of the site. The quick links they felt would be most beneficial were:

- Maps (leading to a GIS screen)
- Action Cards (leading to an index of all of the action cards)
- Home (leading back to the home page)
- Contacts List (Leading to a page with all of the contacts listed)

Functionality

Following the UI discussion, we directed the discussion towards functionality. We presented a number of potential features that could be integrated into the new system. All of the features discussed can be found above in the methodology and in Appendix C and Appendix D. Mr. Davill and Mr. Palmer were receptive to all of the ideas we had presented and outlined what features would be particularly useful.

The feature that was seen as most useful was the task log embedded within the system. Currently, the loggist is responsible for compiling the task logs of all responding members. Each person records their own actions on paper, which are later stored and compiled. The current system is inefficient and creates the potential for inaccuracies. Tasks may not get recorded, or written records may

be lost or accidently destroyed. In addition the loggist may transcribe them incorrectly. In particular, time information can get distorted using paper records. Mr. Palmer and Mr. Davill discussed how an electronic task log would allow each person to record their information, have it time stamped, as well as shared with everyone else using the EMIS system. Additionally, it would reduce the demands on the loggist.

Both CPU staff were interested in the development of a message log into the system. Currently, support staff work the phones in the Borough Emergency Control Centre (BECC) and take calls during an incident. These notes are written on forms which are given to the coordinator they pertain to. All these papers must be saved in order to maintain a complete record of the incident. The message log which was discussed with them would entail a digital database in which the communications team could enter messages into the system, which could then be viewed by the coordinators in real time. This would allow for rapid dissemination of information and provide documentation of all communication received during an incident.

Both users also discussed the idea of integrating Geographic Information System (GIS) into the system. In addition the ideas of dashboards, weather information, and contact lists were discussed.

After talking about potential features of the system, Mr. Palmer and Mr. Davill were asked to rank their top five choices. This allowed us to generate a better understanding of what was most important to them.

Table 6- Top Ranked Features from Focus Group

Mr. Davill	Mr. Palmer
1. Task Log	1. Task Log
2. Message Board	2. Maps and GIS Integration
3. Auto Situation-reports formation	3. Weather Information Integration
4. E-forms	4. Message Board
5. Maps and GIS Integration	5. E-Form generation

From this information, the most important features valued by the CPU staff are task log, maps and GIS integration, and message board. Although this list of priorities is useful for understanding what aspects are most desired in the new system, it fails to consider the feasibility of each feature. Integrating maps and GIS could be as simple as adding a single link, while creating a task log could be a lot more complex. In addition to talking about the ideal features to include, we concluded by defining the feasibility of features to create a plan moving forward. It was determined that key functionality needs to get completed. This encompasses organizing data in the EMIS into a simple, intuitive, and easy to maintain way. After this has been completed we can move forward and include some of these features as time allows.

Lessons from Other Systems

As part of our investigation into the process of creating an EMIS, we visited a number of London boroughs, as well as the Massachusetts Emergency Management Agency (MEMA) in order to gain a better understanding of the functions of an EMIS, as well as the pros and cons of using different

platforms for the EMIS. Due to the close collaboration between the borough emergency management organizations we were able to interview the emergency managers and analyse the systems of various boroughs. These visits broadened our understanding of EMIS usage and functionality and informed our design decisions.

Massachusetts Emergency Management Agency

The visit to MEMA, the agency in charge of coordinating multi-agency responses in Massachusetts, USA, yielded a great deal of information in regards to EMIS features and design. MEMA uses two discrete systems: WebEOC, a web-based EMIS and Previstar, a resource allocation manager. During the tour, we were given an overview of both of these systems. While the Previstar system, responsible for resource allocation, offered a great deal of functionality with finding and locating resources, it did not influence our design to a large degree. However, the minimalist UI design and clever use of dropdown menus in Previstar did provide a brief glimpse at an effective user interface.

WebEOC offered a tremendous amount of information about EMIS functionality. This system, located on a server, offered a secure login and provided access only to information and plans that users were cleared for. Additionally, WebEOC contained a comprehensive task log, which appeared after each action was completed, making it convenient for users to enter information into the task log. Other features found in the WebEOC platform included a "significant events board," to which significant events were posted for all to see, embedded weather maps, and an integrated GIS.

Hillingdon System

Hillingdon's EMIS is widely regarded as the best in London. Through analysing the system and interviewing its creator, we uncovered a number of findings about EMIS design and functionality. Hillingdon uses PowerPoint as a platform for the EMIS and are experimenting with Google Docs for a complementary Task Log.

The main finding from Hillingdon was that an EMIS must be simple to maintain and simple to use. Boroughs often do not have time or resources for EMIS maintenance or training. As a result, the main purpose of an EMIS is data organization. Overall, the system needs to be designed in an intuitive way. Examples of this are colour coding, grouping related information together, and incorporating simple navigation features (ex. Point and click, back button ...).

In addition to using a simple EMIS design, it is important for an EMIS to be mobile and robust. In the event that the Borough Emergency Control Centre goes down, the EMIS should be able to be accessed from a different location. Hillingdon does this by using storing their relatively small (6MB) EMIS on USB's. An EMIS needs to be robust.

Sutton System

Sutton's system was composed of a task and messaging database, built using Microsoft Access, which was then coupled to a modified Hillingdon PowerPoint. Examining the Sutton system provided us with useful information to inform our new EMIS design. While the PowerPoint EMIS was similar to Hillingdon's, it was interesting and important to get Mr. Arnold's opinion of the system, primarily that it proved hard to update. The Task Log database was something we had not seen before and presented us with a wealth of new ideas. The opportunity to go "hands on" with this system was fundamental to our understanding of how task logs functions. Not only did using the system allow us to better understand

the fields required in a task log, but it also gave us a better idea of a platform for the task log. A database seems to be an ideal method for internal communication and task logging since it allows for communication without needing to switch windows.

Ealing System

During our conversation with Ealing regarding their current emergency management system, we were able to affirm a few key concepts that had been mentioned by Hillingdon and Sutton. Most importantly, Ealing recommended developing a system that didn't require extra training or use other programs that aren't familiar to users. Other concepts, such as simple to use and easily maintainable were also key points of conversation during our interview.

Ealing's system consisted of an Excel spreadsheet that was used by the loggist to record tasks as they happened. The loggist could then colour code the entries depending on if they were completed, in progress, etc. This will then be supplemented by ResilienceDirect, a web-based platform that was adopted for the use of all boroughs throughout London for emergency management and communication. This system provides a calendar and time management, incident management, document sharing, as well as a contact list directory and instant message functionality.

For collaboration efforts, a standardized system used throughout all boroughs of London makes logical sense—it would expedite the transfer of information through the use of a common situation report that would eliminate the need for converting reports into different formats. Ealing considered this system as the future for borough communication regarding emergency management. Although this system provides many different functions for emergency response, it did not provide the desired goals of our new EMIS.

With their focus on simplicity, it was noted that it'd be best to utilize commonly used applications, such as Microsoft Word, Excel, and PowerPoint, rather than uncommonly used applications that would require constant training and were specific to only emergency management. This approach is consistent with many EMIS design principles, such as the importance of user-centric design over something technological innovative.

Phase 2: BUILD

Before actually building the system, it was decided that a complete analysis of the different system platforms available was needed. The platforms that had been encountered in the planning phase included:

- Microsoft Word
- Microsoft PowerPoint
- Microsoft Excel
- Microsoft Access
- Google Docs
- Web (HTML, PHP, CSS)

Figure 18 summarizes the advantages and drawbacks of each platform.

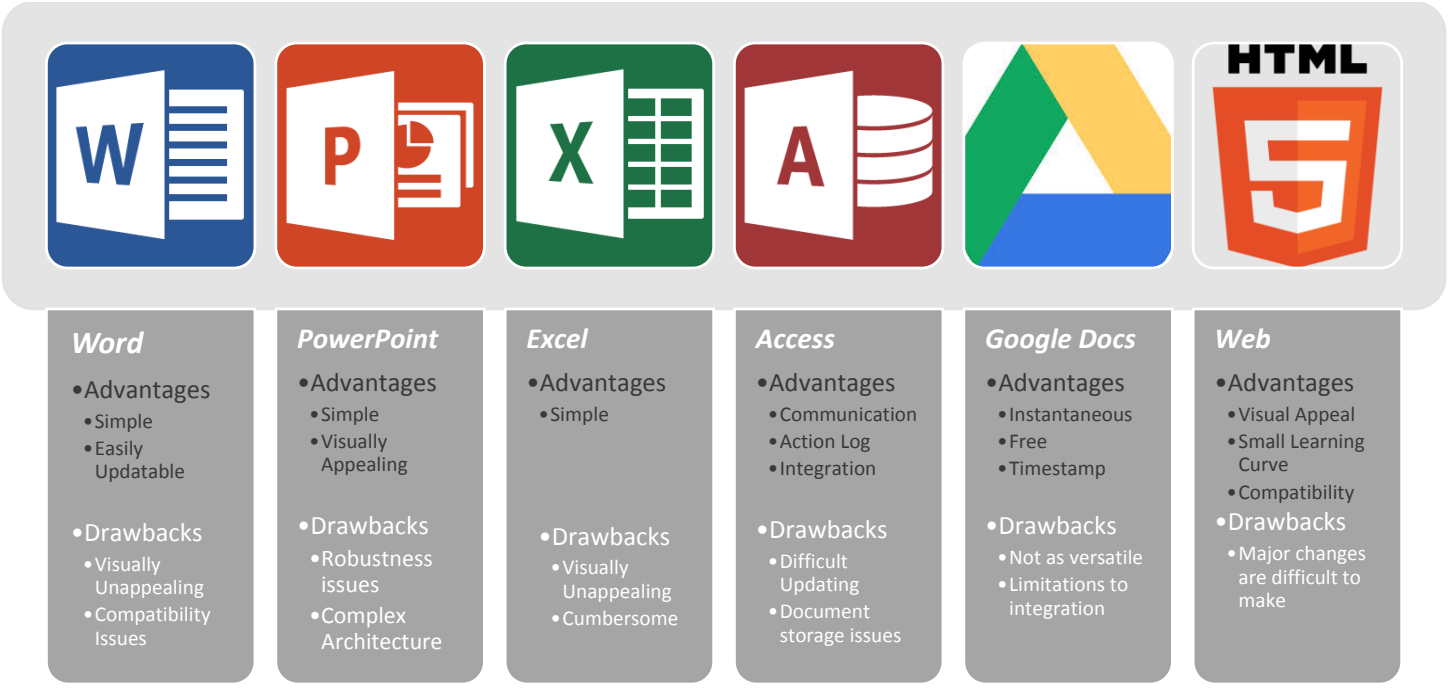


Figure 18 - Platform Advantages and Drawbacks

Microsoft Word

Microsoft Word is an attractive option for creating an EMIS due to its relative simplicity. Word is a product that virtually any person who has used a computer is familiar with. Word allows users to quickly create basic pages with a variety of formatting features. All graphics are "drag-and-drop", meaning that a page can be quickly organized and edited. In terms of an EMIS, creating a web-based system is the best option, since Word makes it easy to export pages to a browser-compatible format. This allows pages to link together and a simple website can be created in a short amount of time. Since each page is created independently, a single corrupt file does not corrupt the entire system, resulting in a relatively robust system.

Developing an EMIS in word also has a number of drawbacks. Since Word is chiefly a text editor, it lacks serious functionality in terms of generation of a visually appealing system. The layout of images, defined relatively to one another, often changes position as text is added. Additionally, the tools available for adding colour and other visual elements are rudimentary and ineffective. Word does not support dynamic elements such as drop down menus or hover buttons. Taken together, this means that, barring large amounts of tedious work, any web system developed in Word would contain the same ineffective visuals and organization of the current system.

Microsoft PowerPoint

PowerPoint is another platform that is used for EMIS. These systems are composed of a slideshow with dashboards that link internally to different slides, each with a different action card. Similar to those based on Word, PowerPoint systems are attractive due to the relative ease of creating them. PowerPoint is commonly used in work environments, meaning most people are familiar with it. Familiarity and relative user-friendliness means that virtually anybody in the CPU could maintain this system. Additionally, PowerPoint improves upon the poor graphics capabilities in Word by providing

users with a more accessible and friendly experience. Finally, as seen in the Hillingdon system, PowerPoint make printing easy, since what is seen on the screen is what is printed and the user can define which slides to print.

There are, however, a number of concerns involved with using PowerPoint as a system platform. First, unlike a web browser, there is no "back" button. Though this can be added, this is high-level PowerPoint option which increases the overall complexity of the system. Additionally, the internal link architecture can be difficult to understand. Since links are to slide numbers, not content, if any major changes are made to the system, *all* links must be updated, since all the slide numbers will have changed. This can be a major setback on the ease of updating the system. Most importantly, the robustness of the PowerPoint system is a concern; since the entire system is contained within a single file, a corrupted file could mean the inability to access the system.

Microsoft Excel

Though we never experienced a system based in Microsoft Excel, we have heard about during a talk we had with Mr. Davill. At some point, Hounslow experimented with an Excel based system, though it was quickly abandoned (Davill & Axelsen, 2014). Due to its nature as a spreadsheet application, information and formatting of information in Excel is cumbersome and development of any intuitive user interface is nearly impossible.

Microsoft Access

Using a database, such as Microsoft Access, has a number of potential advantages. First, a database platform would allow for cross-talk between system users. A database would allow for users to enter information into the system, store it, and disseminate it to other users. Additionally, every action performed within the database, since they come in the form of queries, could be recorded, thus giving a very detailed account of the emergency and the actions taken by each staff member. Most importantly, a database created in Access would be able to be integrated into a large majority of potential platforms.

Access also has a number of serious drawbacks which limit its utility as a platform for an EMIS. One of the largest challenges associated with this platform is the construction of the database. Creating a database is not an easy process, which means that system maintenance will be difficult. Additionally, a database is not an ideal platform for document storage. Overall, this type of system is very difficult to work with and requires a large amount of esoteric knowledge.

Google Drive

Google Drive offers a unique platform for file storage. Although this platform cannot host a website, it provides a means of generating the "communications facet" of the system. It is possible to use Google Forms to allow users to generate content and then submit that content to a Google Spreadsheet. There are a number of advantages to using this technology, one of the most important being its ease of use. The form creation page is straight forward and simple to complete. Additionally, the forms are easy to edit and it is easy to view results. Another important aspect of the Google Drive functionality is automatic time-stamping. Whenever a form is submitted, the drive automatically timestamps the entry, allowing for a complete record of all events that occurred (assuming everybody records all of their actions).

There are a few downsides to the Google Drive platform as well. One concern is security. Although Hillingdon's entire system is stored on a Google Drive, they pay for the enterprise system, which has military grade encryption (Pearkes, 2014), a level of security that cannot be ensured on the free system. While we have talked to Mr. Palmer about this and he has acknowledged the minimal risk, it is a downside of the platform. Another downside to this system is the relative lack of flexibility. While the form fields are flexible, the template is fixed, meaning that we cannot make it fit within the scheme of the rest of the system.

Web-Based (HTML, CSS)

An HTML webpage offers a number of opportunities not available in other platforms. First, this platform allows for a near infinite amount of UI customization, ranging from hover buttons to search bars to dropdown menus. Additionally, the full integration with CSS allows the page to be structured and styled as desired and allows the style format to be conserved between different pages. HTML is one of the simplest programming languages, composed of a number of tags which convert plain text inputted into rich text displayed on the webpage. It is relatively easy to make changes to the content and add new pages with the same structure as existing pages. An HTML platform also allows for near-perfect compatibility with any device, so long as the computer has an Internet browser (Safari, Chrome, Firefox, etc.). With the recent update to HTML, the latest version allows for full scalability and mobile compatibility, meaning that the system would be able to run on a mobile device without any modifications. Another advantage of HTML is its robustness; each page is stored independently, meaning that a single file corruption does not destroy the system.

HTML, while promising, has its shortcomings. One of the major shortcomings is the time of maintenance. While rich text platforms, such as Word or PowerPoint are "drag and drop," HTML is not so simple and requires coding to generate the desired results. While there are a number of programs capable of generating code to from a graphical user interface, such as Adobe Dreamweaver, these programs as typically expensive and don't generate code that is as streamlined as if it were done by hand.

Phase 3: TEST

Implications of Usability Heuristic

Drawing upon the heuristics adapted from Nielsen's "Ten Usability Heuristics" (2005) and outlined in the Methodology, we analysed the new EMIS to ensure the system met original design criteria.

Visibility of system status: The system should provide feedback once a user has completed an action

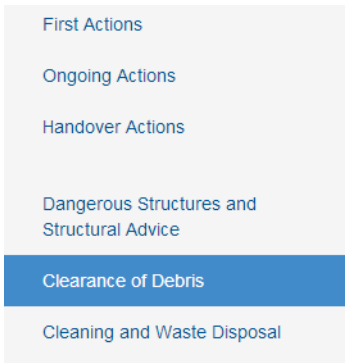


Figure 19-Sidebar of Clearance of Debris page

The new EMIS addresses this criterion in its Task Log. Once a user has submitted a form, they are given a confirmation notice, stating that their information has been successfully recorded. Additionally, the navigation and side bars were designed such that the page a user is currently viewing is highlighted with a different background colour. This allows the user to verify that they are on the correct page, as seen in Figure 19. Since the user is viewing the Clearance of Debris page,

that selection on the sidebar contains a blue background, different from the rest of the links.

Match between system and the real world: Words, phrases and concepts are familiar to the user and follow real-world conventions.

The EMIS addresses this heuristic through the use of visual metaphors in the navigation bar. These "quick link" icons allow the user to quickly and visually identify the button they are looking for, without needed to read through all of the text. Additionally, certain technical terms, such as "GIS," for Geographic Information System, have been reduced to more user-friendly terms, such as "Maps." The language used throughout the system is also aligned with terms common within the Contingency Planning Unit.

User Control and Freedom: System supports undo and redo functionality.

The HTML 5 platform allows for full "undo" and "redo" functionality in the form of the browser's native "Back" and "Forward" buttons. This was determined to be the most effective option, as it is common practice for people to "go back" on websites when they select the incorrect link. Since the system, save for the Task Log, does not actually submit information anywhere, the integrated "Back" and "Forward" buttons are more than adequate.

Consistency and Standards: Consistent conventions are used throughout the platform.

An identical system architecture was utilized throughout the design of the EMIS. The location and display of information was consistent and standard throughout each page of the EMIS. The navigation bar is located at the top of the screen, complete with "quick links," for every page found within the EMIS. If a certain position, such as a Coordinator, has multiple links, a sidebar with those additional links appears, showing the user the extra pages associated with that Coordinator. This layout is nearly identical from page to page.

Although this heuristic does not imply consistency of the content of the system, it should be noted that the content was transcribed directly from the old system to the new system, as directed by Mr. Palmer.

Error prevention: Eliminate error-prone conditions or present users with a confirmation option before they commit to the action.

Through the simple design of the system utilizing HTML 5, thus essentially a web page, this heuristic is met. Since the system negates the need for any complex system input, there is no possible place for errors to occur in the sense of this heuristic. It is completely possible that broken links may occur, which are more concrete than input/output errors. This also provides our system with a robust architecture, as simply linking pages with information is much more stable than a system that constantly uses user input, assuming the pages are maintained correctly.

Recognition rather than recall: Information shouldn't have to be recalled from one dialogue to another. Instructions of the system should be visible or easily retrievable when appropriate.

In order to encourage recognition over recall, the user is presented with only the information that is related to their chosen role. For instance, if the user is in the Information Coordinator page, their

sidebar consists of all links related to the Information Coordinator. This stops the need for the user to search around the index of all action cards, improving time efficiency and response. Looking back at the old EMIS, a user could have experienced information overload by viewing all possible links from start, whereas the new system requires the user to pick a Coordinator view before being able to see any information in the system.

Aesthetic and Minimalist Design

The new system employs the idea of minimalism, coupled with an aesthetically pleasing design, to display the proper amount of information to the user. Text in the navigation and side bars was intentionally kept minimal and the use of colour was confined to that specified within the corporate branding scheme. Information in the system design was kept to a bare minimum, in order to encourage the user to focus on the content of the plans and protocols within the system.

Help and documentation

While it is desired that the system is intuitive to the point where a user can comfortably navigate the system, links to user's guide has been developed and included in the system. A maintenance document specific to updating the system has been developed and given to the CPU staff.

Results of Usability Testing

The usability testing provided insight into the intuitiveness of the system. Since each volunteer gave consistent feedback that the new system was much improved over the old system and simple to learn, we determined that the usability testing was saturated; any additional information would be consistent with what we had already learned. For this reason, no additional volunteers were actively pursued.

Process Data

Two subjects were at first confused about each coordinator having their own page, although once they figured out the system organization, they embraced the design. Additionally, a number of positive comments about the aesthetics of the system were made, such as the user interface was effective and professional. Users also offered recommendations for future improvements. For example, one user commented that the quick links bar was not near where "all the action" was happening and could easily be overlooked. Another user was confused by the organization of the submenus, particularly with some of the expanding ones. User training for the EMIS should touch on these two issues and should be sufficient to remedy these problems. All of the users were able to finish the usability test within the expected 15 minute timeframe, suggesting that this system intuitive and easy to navigate.

System Debrief

The system debrief provided numerical data used to verify the effectiveness of the system; the results are shown in Figure 20.

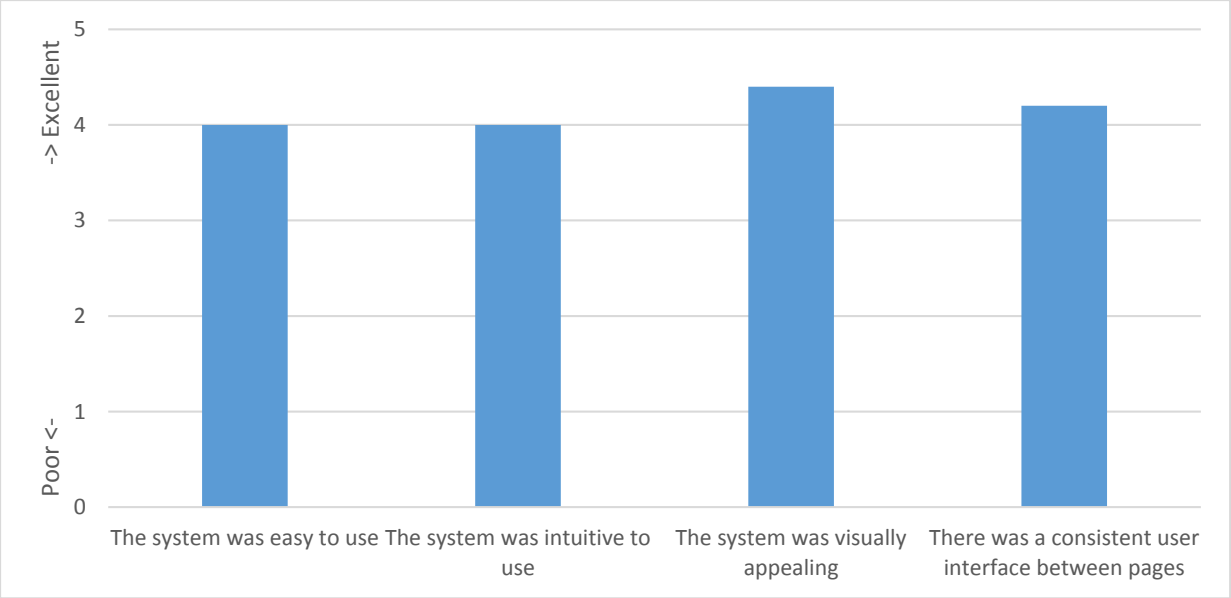


Figure 20- User Debrief UI Evaluation

Overall, the user interface was well received. In each category, the UI received at least a four out of five, with five being the best rating available. This data indicated that the new EMIS performed as well as had been anticipated when it was being designed.

The system debrief also featured questions regarding the general user experience. The data collected in these questions can be seen in Figure 21.

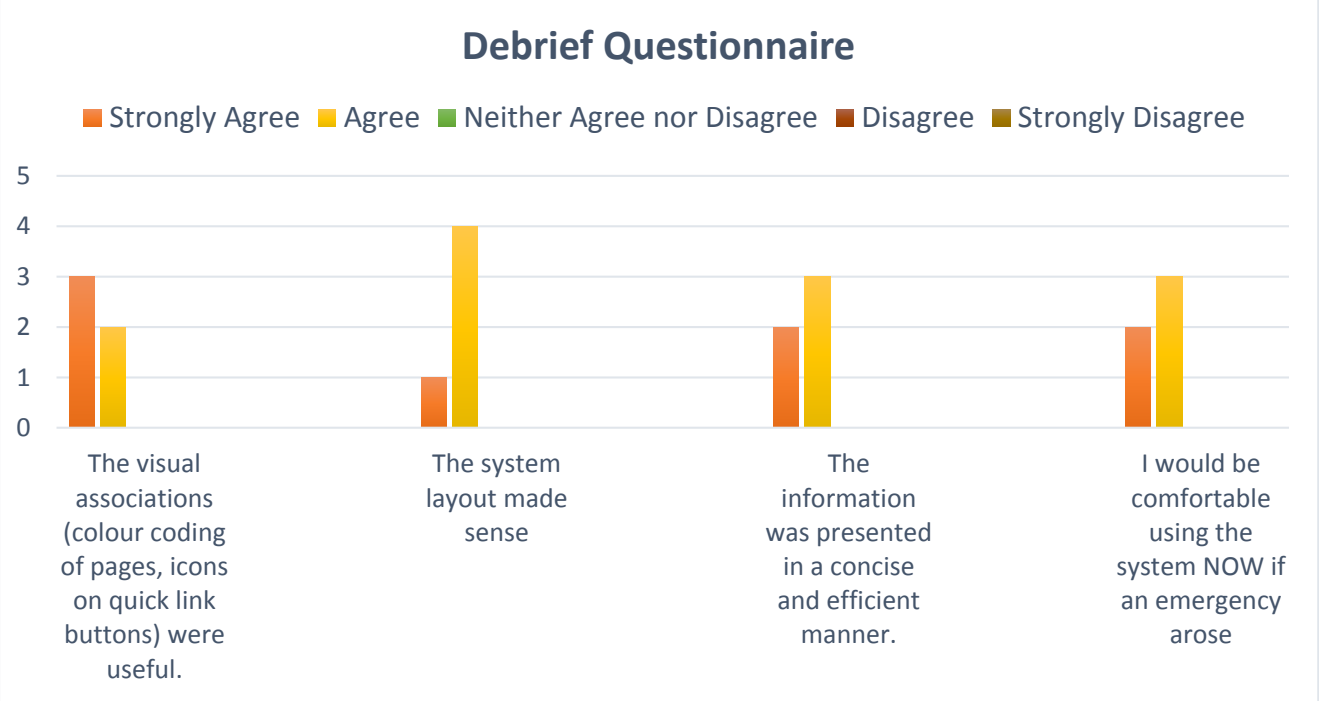


Figure 21- General User Experience Data

One aspect to note about this data is that no users answered anything less than “Agree,” indicating that the participants felt positive about the system layout and design. Most importantly, all participants in the study felt that they would be comfortable using the system at this time, with no prior training. The data collected during the usability study verified that the design of the system was efficient, simple and functioned as anticipated.

Chapter 5: Analysis and Implications

The outcome of this project was a unique EMIS tailored to the specific needs of Hounslow's Contingency Planning Unit. Hounslow's new EMIS was created using HTML, CSS, and Java Script, and functions as a tool for organizing information efficiently so that it can be easily accessed during an emergency. Additionally, we incorporated a contacts list, a link to their GIS system, and a task log into the EMIS. In order to ensure proper use and upkeep of Hounslow's new EMIS, two supplemental documents, a maintenance guide and a user manual, were also created. Overall, this system contains a number of functional and aesthetic features that were identified during the planning stage. Some of these features can be seen in Figure 22.

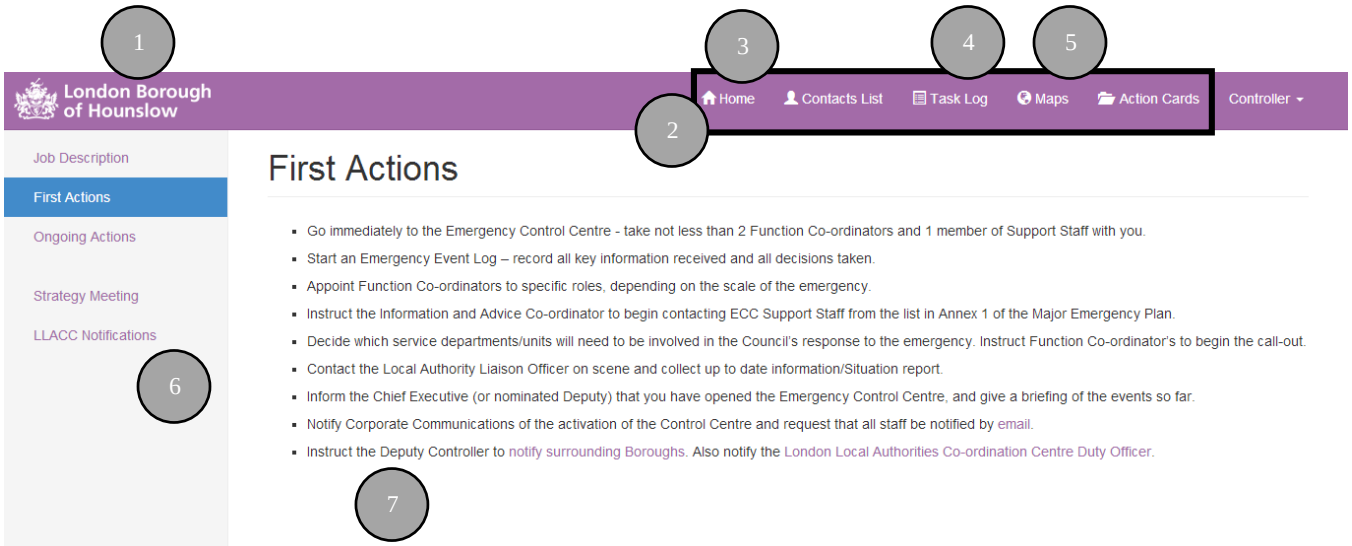


Figure 22- Screenshot of new EMIS

The main features of this new system include:

1. Effective corporate branding. The Hounslow logo is now within corporate guidelines and prominently featured within each page.
2. Quick Links Bar. The bar features a series of links to commonly used information. Each link is bolstered with a visual metaphor to enhance usability.
3. Home Button. The home button provides an "escape" for inexperienced users. If a user is unsure about their current position in the system, they can always click the home button, which returns them to the opening screen.
4. Task Log. We were able to incorporate a task log using a Google Form embedded within the system.
5. Maps. Clicking this link brings the user to a page that allows them to access the GIS or Google Maps.

6. Side Navigation Bar. This bar allows for streamlined navigation within the system, containing pertinent information for each coordinator.
7. Concise Plans. The plans have been broken down into their simplest components and are expressed in a stepwise manner to encourage people to follow them step by step.

After gathering the most pertinent information regarding EMIS design (described in the previous chapter), critical and in depth analysis was performed, which directly led to the construction of Hounslow's EMIS, as well as the maintenance guide and user manual. Not only was Hounslow's system created, but a set of EMIS design guidelines was produced as a consensus of what we believe, through our research, denotes key elements and functions of a successful EMIS. We have determined that an EMIS should:

- At its core, be a data storage system.
- Integrate additional features that enhance command, communication and control.
- Be intuitive and simple to use because users may not be familiar to the system.
- Contain an effective user-interface design using a set of UI heuristics as a guide.
- Be simple and easy to maintain.
- Be tailored to the needs of system users.

An EMIS should at its core, be a data storage system.

After a number of interviews, we determined that at its pith, an EMIS is an information database. Although this seems like an obtuse statement, it is, in fact, the product of weeks of research. Initially, we believed that all EMIS must have a communication functionality integrated within, meaning that each user accessed a common system, which would allow for interconnectedness and real-time data sharing. This belief was the result of our trip to MEMA, where we were shown WebEOC, a sophisticated and comprehensive EMIS (Hengen & Bagdonas, 2014). However, once we began assessing other EMIS from around London, it became clear that EMIS were primarily used as an information database.

Reaching this conclusion, we focused our energy on creating the information system. Additional functionality, such as a task log and messaging system, while still important to include, were no longer driving the project. As a result, the platform used to base the EMIS could be reduced, allowing for greater simplicity in the final system. Ensuring that the system excelled as an information database would increase its longevity and best serve the needs of Hounslow.

An EMIS should integrate additional features that enhance command, communication and control.

Despite the fact that the information viewer is paramount to the success of the EMIS, we discovered a number of additional features that could be incorporated to enhance the functionality of the system. In general, the additional features were aimed at enhancing one of the three C's: command, control and communication. We developed a list of system features, seen in Appendix D, which could be included in the system. Realistically, this discussion will focus only on the three most important features to be included, as determined by the results of the focus group (Davill & Palmer, 2014).

Task Log. A task log is one feature that is complimentary to the core EMIS functionality. It was identified as the most desired feature to compliment the EMIS. A task log allows users to easily record what they have done during an emergency. Additional task log functionality includes sorting tasks based on who had completed them, automatic time stamping, and identifying the status of tasks.

GIS. All of the boroughs we visited commented on the importance of GIS during emergency response. Including a simplified GIS system with the EMIS would allow responders to have dynamic geographic information readily available to complement the information they have stored in the EMIS to improve emergency response.

Contact List. We found that contact lists play an essential role during an emergency. Having a searchable, organized and convenient contact list included in the EMIS would allow for more efficient emergency response.

These features should be included into the EMIS in an appropriate way to increase the utility of the EMIS system. Our design incorporated a Task Log, GIS, and a contacts list. These can be seen in numbers 4 & 5 in Figure 22. They should be integrated in a way that is consistent with the system development findings discussed below.

The features described above should be integrated with the EMIS, not located remotely or in a discrete system. This means that they are used in conjunction and easily accessed from the EMIS. This could either happen through incorporating these features within the EMIS, opening them simultaneously in different windows, or having links to these features.

An EMIS should be intuitive because users may not be familiar with the system.

The main users of this system will be volunteers, who may not be familiar with the EMIS or the Contingency Planning Unit. Regardless of their experience, users play a key part in emergency response. They need to be able to efficiently access necessary information to contribute to an effective emergency response (Arnold, 2014; Davill & Axelsen, 2014; Pearkes, 2014).

Due to the likelihood of users being inexperienced, they system must be intuitive and easy to use. Users need to be able to navigate and locate information quickly in stressful situations. The system needs to be organized in a simple and natural way so information is laid out where the user expects it to be. Additionally, the system needs to be designed in a way that helps the user navigate and locate information essential to their tasks.

What we have gathered from our interviews with other boroughs is that an EMIS is simply a window into information stored in a variety of procedural documents created by local resilience teams. The main focus with these systems is simplicity. Unlike MEMA, which is flanked by a staff of 50+ full-time, trained responders, complete with their own, dedicated IT department, most of the local boroughs have one or two full time responders, and all other members who occupy the ECC during crises are volunteers, trained once or twice a year, who spend the rest of their time doing their “real” jobs (Pearkes, 2014). Constant staff turnover also makes providing adequate training difficult. In order for all people to be able to use the system, it must be kept to its essential elements and be intuitive.

An EMIS should contain an effective user-interface design using a set of UI heuristics as a guide.

The usability heuristic published by Nielson outlines a number of important traits critical for UI design (2005). Having worked with these design criteria, their importance can be verified:

Visual metaphors are important in UI design because they allow for the identification of information without the need to read.

Using visual association can be a powerful method for simplifying the system for users and directing them to essential information. Visual association refers to using colours or images to link common information. This technique was used in many of the systems we saw and was highly recommended as an effective method to increase usability.

Visual association can be used in the EMIS design to link common information, such as that pertaining to a certain coordinator, by using similar coloured pages to display their information. Additionally, metaphors can be used to identify key functionality such as links to maps and the home page. Using visual association throughout the EMIS can greatly increase the usability of the system. Visual association can be seen used in the new system in number 2 in Figure 22.

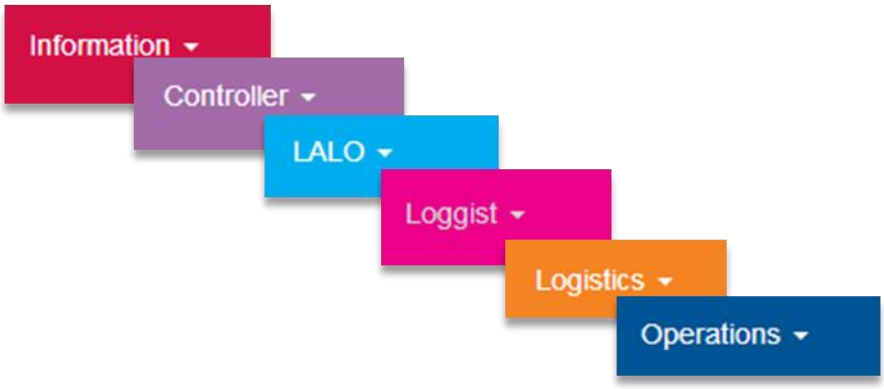


Figure 23 - Colour Coding between Roles

A consistent user interface allows for rapid learning and navigation due to familiarity.

Using a consistent user interface makes it easier for users to learn quickly and navigate through the EMIS. Essentially, the organization and design of the system should be consistent throughout the EMIS so users know what to expect. Additionally, once the user becomes comfortable with the system they can use the rest of the system without further training.

Discrete coordinator pages prevent information overload because users only see the information pertinent to them.

Preventing information overload is a critical aspect of creating an effective EMIS. Information overload occurs when a person is presented with too much information. This results in difficulty finding pertinent information and therefore reduces productivity. From interviewing various boroughs, the conflict between information overload and information availability was a common talking point.

Boroughs want to provide users data on all possible emergency scenarios. However, they have a hard time accomplishing that without information overload.

Solving this conflict of data access and information overload is essential to creating an effective EMIS. We made use of Hounslow's unique emergency management organization structure to solve this conflict. Hounslow has a series of emergency coordinators who all have separate responsibilities during an emergency. Organizing information by coordinators helps prevent information overload while still providing everyone with the all the information pertinent to them.

Quick links enhance efficiency because it provides rapid access to frequently utilized links and information.

A quick link, in this context, refers to the various buttons that are located at the top of each page, as shown in Figure 24. These quick links are constant throughout each page in the EMIS, allowing a user to access them whenever need be. With the distribution of information separated by each coordinator, it was decided that any coordinator would need access to common information, such as maps & GIS. Rather than burying links within pages for each coordinator, they were placed at the top. Again, the consistency allows for a user to be familiar with this information, even if they switch coordinator roles.

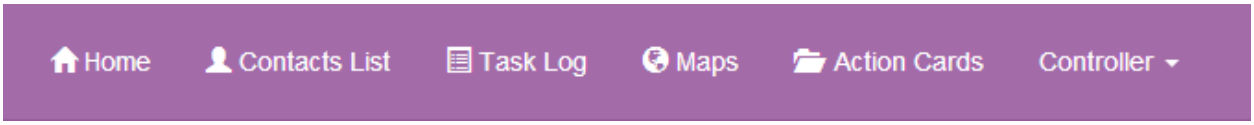


Figure 24 - Quick Links example

An EMIS should be simple and easy to maintain

Due to the non-technical nature of the staff in many of the emergency control centres, it is essential that the system architecture be kept as simple as possible. Keeping the platform to the bare minimum makes understanding the underlying structure simpler, which then enhances the maintainability.

An HTML platform is the best option to address Hounslow needs in that it is robust and easy to use.

Though a number of platforms exist for the information aspect of the EMIS, we have determined that an HTML/CSS based web platform is the best option for Hounslow's EMIS. The combination of HTML with CSS allows for the rapid development of a visually appealing system. Additionally, the ability to integrate JavaScript with the CSS and HTML 5 allows for the creation of dynamic elements, such as dropdown menus and hover buttons. This functionality could not be achieved with Microsoft Word, PowerPoint or Excel. While Access could provide the necessary functionality, it is more complex and would require more time to create and maintain.

Google Drive provides an acceptable service to address the communication side of emergency response due to its form/quasi-database functionality.

Google Drive, while not the ideal system for the main platform, allows for rapid and simple creation of forms, which can easily be embedded within an HTML framework, using a single line of code. This integration can be seen in Figure 25.

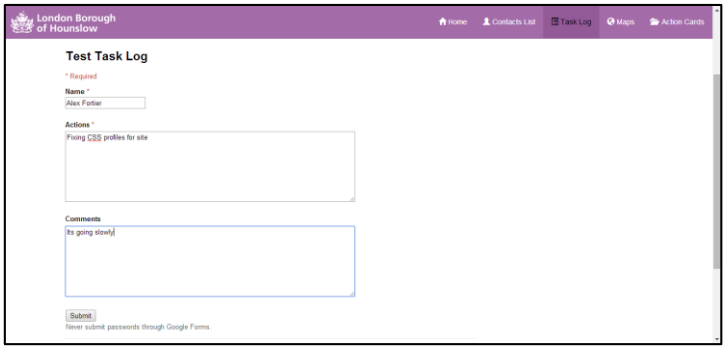


Figure 25- Sample Task Log Form Entry

The data collected from the form is then time stamped and inserted into a Google Spreadsheet, which allows for data filtering and summary. This recording functionality can be seen in Figure 26.

	A	B	C	D	E	F	G	H
1	**Timestamp**	**Name**	**Actions**	**Comments**				
12	4/14/2014 13:35:26	KG	I embedded the form so it would work.	It appears as if the embed was successful				
13	4/14/2014 13:35:55	Joe Kelly	Began proofreading pages	So far, they look good				
14	4/14/2014 13:38:38	Alex Fortier	Fixing CSS profiles for site	Its going slowly				
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								

Form Responses | Form Responses 1 | Form Responses 2 | Form Responses 3 | Form Responses 4 | Test Emergency 5

Figure 26- Sample Task Log Register

This record is locked so only the owner of the document can alter any element of the form. This adds a layer of security to the document that was never previously in place. Due to its ease of use and modification, this system aligns perfectly with Hounslow's needs.

An EMIS should be catered to the needs of the system users

Every system has to make a compromise between functionality and simplicity that depend on the user of the EMIS. The EMIS users encompass all stakeholders in an organization. Hounslow has very specific circumstances that impacted our EMIS design, including a need for system simplicity and easy maintenance due to support and training constraints. HTML and Google Drive were selected as platforms for Hounslow's EMIS because they had the best compromise between simplicity and

functionality. Likewise, the system structure directed users to just the essential information for each function coordinator due to the likely inexperience of the operators of the system.

After an EMIS has been developed, a user guide should be created outlining how to use the system. This should be focused on those users who will be operating the EMIS. It should be able to address any questions users encounter with the system as well as be used for training with the system. Designing the system for the users of the system is essential to the effectiveness of an EMIS.

Chapter 6: Conclusions and Recommendations

Our analysis of Hounslow's old system, coupled with the visits to other boroughs and the needs assessment have given great insight into a number of aspects needed to build an EMIS for boroughs in the greater London area. Using these design principles, we were able to effectively create a new EMIS for Hounslow to provide a user-friendly system which is functional, robust and visually appealing.

This project generated a number of outcomes. First we developed a fully functional, aesthetically pleasing and user-tested system that offers a deployment-ready EMIS to be used in in Hounslow's BECC. In order to support this system, a user guide, outlining system features, and a maintenance document, which encompasses all aspects of system maintenance, were created so the CPU staff could support the system in the future. Finally, this project generated design principles to guide future EMIS design, a document which is largely missing from the professional literature of the topic.

A number of conclusions were drawn from this project. First, simplicity is a key characteristic of an EMIS. The common user is inexperienced so the system needs to be simple enough that users can intuitively use the system. In order to enhance system simplicity, we limited the number of additional features and aimed to build a simple user interface to efficiently organize and display information.

Second, we concluded that user interface design is critical to building an effective EMIS. Effective UI design used in our EMIS design include: visual associations, consistent page organization and utilizing existing colour schemes. Each of these elements enhanced the usability of the system by aiding user navigation.

Third, the EMIS software platform matters and depends on local needs. The platform must be carefully considered to balance desired functionality with ease of creation and maintenance. HTML/CSS were used for Hounslow's system with integrated google drive because they were the best compromise between functionality and maintainability. This platform was also simple enough we handed over a complete system that Hounslow will be able to maintain in the future.

Fourth, Rapid Application Development (RAD) is a critical software-development lifecycle for quick system creation. This design approach involved a condensed planning phase concurrent with the construction of the system. An iterative cycle of building and testing is then used to improve the system design until it is implemented.

Finally, the system we developed was intuitive, visually appealing and functional. The usability study showed that people understood and appreciated the layout of the system; users had minimal complaints and felt it was visually appealing and professional. Additionally, they were comfortable using the system; they rapidly picked up on the discrete coordinator pages and were able to identify information in the quick links section. In all, the data collected in this study suggests that even with no training, the users felt the system was simple enough to use in an actual emergency. This is proof that the system design was effective at creating an intuitive and easy to use interface.

Overall, this project provided a unique window into emergency response. This project emphasized the need to design an EMIS tailored to the user and create an intuitive and simplified system. Without such a system, emergency responders can quickly become overwhelmed by the amount

of information involved in managing an emergency. This system ameliorates this problem by providing a means of imposing order on chaos.

Recommendations

After having thoroughly studied EMIS design, we have uncovered a number of facets about EMIS design. Ideally, all of these concepts would have been incorporated into Hounslow's EMIS; however, due various constraints, we were unable to incorporate a number of system elements. In this section, we outline recommendations for continued system development and improvement.

Don't rely on Web-based plain-text to HTML tools

Although we have provided a comprehensive maintenance document, outlining the basics of HTML and how to change various aspects of the system, there are a number of systems available which can aid users in updating content. Manual coding is preferred to these automated services since they can generate unnecessarily complex HTML tags. A number of websites offer this service for free; simply searching "rich text to HTML" in Google provides a number of sources, however, this option is not recommended due to the large number of tags it generates, greatly increasing system complexity.

If the HTML editing does prove to be troublesome, another option, though considerably more expensive, is Adobe Dreamweaver, which is an industry standard web-development tool. This program allows the user to create or edit the content of the page like they would in Microsoft Word, and generates a streamlined code to match the changes made. This program allows for manipulation of the CSS profiles, which allows the user to customize the way the system looks. If a non-coding solution is required, Dreamweaver is recommended.

Push for ICT integration of this system

The ideal situation for system maintenance would be full ICT support. In our meeting with ICT, it appears that they will attempt to integrate the EMIS into their platform within the next three years (Akai et al., 2014). ICT support of this system would give the CPU staff direct access to a team of skilled developers who could update, refine and expand the site to meet future demands. This team of skilled professionals could bring the system to a new level of functionality, including making a number of changes outlined in this section. Additionally, an ICT compatible system would be supported by their team of developers, meaning that any of the tough editing jobs (i.e. not simple content edits) could be done by ICT.

Upgrade the hardware in use around the BECC

Having spent a considerable amount of time in the BECC, we have become familiar with the capabilities of the current equipment. The entire emergency response is run off of six computers, all of which are identical models and are equally antiquated. These computers take a long time to boot, and once they have booted, take even longer to run through their start-up protocols to open the existing EMIS. We recommend a business case for a series of newer laptops. Based on our system design, these computers do not need to be top of the line. Entry level computers will be sufficient to run our EMIS, which is designed to be run in an Internet browser. Additionally, we recommend a higher resolution projector, which will allow for an increase in pixel density on the SmartBoard. This will make the menu bars take up less space on the screen (due to the fact their width is a fixed pixel value; it is not relative), and free up more space in the content area. Users would not have to scroll as far to read all of the

information contained. Finally, we advocate the purchase of two monitors, which can be wall-mounted on either side of the SmartBoard and function much like the white boards currently do. These monitors could be dedicated displays: one could display the task log, reminding all users what has been done, which actions are pending and those that still need to be completed, while the other monitor could serve as a dynamic display of important contacts for that response in particular (such as LALO's number, external agencies that may need to be frequently contacted, etc.).

Push to develop a custom EMIS application

While we have found HTML to be a robust platform for system development, the ideal would be a custom application that does not require an Internet browser to run. Additionally, this application should have the ability to perform more complex processes, such as keystroke monitoring (for a complete record of the incident) and call logging and monitoring. An application would be able to make better use of the system hardware is a much more permanent, long-term solution.

Add further visual metaphors to enhance the user experience for all

While this system has been develop to a high level of completion, a few aspects of the design were overlooked. For example, the colour coding of each page, while fine for most, would not benefit a person who is colour-blind. In order to remedy this, icons should be developed for each coordinator, and these can then be inserted into each page to remind the user what page they are on. In terms of location, the coordinator icon would likely be most effective on the top of the side navigation bar.

Develop communication tools for integration into the system

While the new system is an excellent portal to information, short of the task log, this system does not aid in user communication. A future iteration of the application should include a wealth of communication tools, including "chat" functionality and the ability for the LALO to take pictures or video on the scene and relay it back to the staff at the BECC. Additionally, a means of directly contacting/integrating with the LLACC would be advantageous in the case of a multiagency response.

Develop a database functionality to support the system

Future iterations of the system should include enhanced database support, allowing for rapid storage and recall of information from the current as well as previous incidents. Additionally, all actions could be recorded on the database, allowing for a complete paper-trail of the entire incident. Post-incident analysis could reveal exactly who did what and when they did it, which could be useful for identifying mistakes and correcting them before future incidents occur.

Develop a secure login screen to enhance functionality and security

While the local storage of this system ensures that only people physically in the BECC can access the information, future iterations should have enhanced security features, such as a login screen. This login screen could allow different users access to different information. For example, the support staff don't necessarily need access to the same level of classified information that the CPU officers do, and as such, the login would allow for information restrictions. Additionally, a login screen would allow for username monitoring, such that staff could monitor the amount of time a person had been logged into the system, to ensure that staff wasn't working too long at a single incident.

Encourage the unification of emergency response framework in London

There is a large amount of room for improvement in the emergency response framework in London. Currently, each borough has its own variant of the Contingency Planning Unit, which is required under the Civil Contingencies Act of 2004 (Secretariat, 2008). However, each borough goes about its emergency planning and response in various ways. Hounslow uses a coordinator-based system, with each coordinator responsible for specific tasks (Davill & Axelsen, 2014), while Sutton uses a directorate based system (Arnold, 2014) and Hillingdon has removed the subdivision of labour entirely, giving all of their responders the ability to perform any task (Pearkes, 2014). This disconnect in structure gives rise to a number of different, disconnected systems that function independently from one another.

While these discrete systems function sufficiently for intra-borough response, there is no ability to scale these systems from the local to the county-wide level. One solution to this problem, similar to the system employed by MEMA, is the standardization of EMIS and emergency response structure throughout the area (i.e. greater London) (Hengen & Bagdonas, 2014). A standardized system would allow for scaling for any emergency. Small scale emergencies could be handled locally, however, if the incident grew, there would be a native transition from the local system to the LLACC, who coordinates multi-agency response, due to the inter-compatibility of a standardized system. Currently, the greater London area is pioneering the EMIS "ResilienceDirect," which is the first attempt at promoting a standardized response information system. However, adoption of this system is entirely voluntary, and, as it does not align well with different emergency response structures, it is not widely used (Freeston & Munnelly, 2014).

In order to reach a truly flexible, multi-agency response system, it is imperative that a standardized response framework be developed in the greater London area, which outlines an organizational framework for both the Emergency Control Centres as well as their EMIS. Another iteration of the Civil Contingency Act might be needed to address these needs and unify the emergency response framework across London.

Bibliography

Akai, D., Manku, K., & Tubbs, S. (2014, April 9). [ICT Interview].

Arnold, T. (2014). [Sutton Interview].

Atteih, A. S., Algahtani, S. A., & Nazmy, A. (2010). Emergency management information system: Case study. *GM, Unicom for Communication Technologies, http://www. unicomg. com/Home*.

Berger, H., Beynon-Davies, P., & Cleary, P. (2004). The utility of a rapid application development (RAD) approach for a large complex information Systems development.

Beynon-Davies, P., Carne, C., Mackay, H., & Tudhope, D. (1999). Rapid application development (RAD): an empirical review. *European Journal of Information Systems, 8*(3), 211-223. doi: 10.1057/palgrave.ejis.3000325

Bourne, M. (2005). NEED FOR NIMS. *Fire Chief, 49*(12), 46-52.

Bram, S., & Vestergren, S. (2012). *Emergency Response Systems: Concepts, features, evaluation and design.* Linköping University, Linköping.

Buck, D. A., Trainor, J. E., & Aguirre, B. E. (2006). A critical evaluation of the incident command system and NIMS. *Journal of Homeland Security and Emergency Management, 3*(3).

Carver, L., & Turoff, M. (2007). Human-computer interaction: the human and computer as a team in emergency management information systems. *Communications of the ACM, 50*(3), 33-38.

Chalofsky, N. (1999). *How to Conduct Focus Groups—Business Skills*: American Society for Training & Development U61.

Chumer, M., Turoff, M., Walle, B. A. v. d., & Yao, X. (2004). The design of a dynamic emergency response management information system. *Journal of Information Technology Theory and Applications, 5*(4), 1.

Contingency Planning Unit. (2013). BECC Manual: Operational Guidance (2 ed., pp. 45).

Davill, R., & Axelsen, B. (2014). Introductory Presentation [Presentation]. Hounslow.

Davill, R., & Palmer, T. (2014, March 31). [[Focus Group]. EMIS Design Criteria].

Dym, C. L., Little, P., Orwin, E. J., & Spjut, R. E. (2009). *Engineering Design: A Project-Based Introduction* (3 ed.). Hoboken: John Wiley & Sons.

ESi. (2014). WebEOC Professional. Retrieved February 23rd, 2014, from http://www.esi911.com/esi/index.php/products-mainmenu-68?id=377

Federal Emergency Management Agency. (2008). *National Incident Management System*. Retrieved from http://www.fema.gov/pdf/emergency/nims/NIMS_core.pdf.

Freeston, S., & Munnelly, K. (2014, April 1). [Ealing Interview].

Hengen, T., & Bagdonas, A. (2014, March 3, 2014). [MEMA Interview].

Hillingdon, L. B. o. (2013). Civil Protection Service. Retrieved January 26th, 2014, 2014, from http://www.hillingdon.gov.uk/article/20466/Civil-Protection-Service

Hounslow Contingency Planning Centre. (2014). Local Risks. 2014, from http://www.hounslow.gov.uk/index/advice_and_benefits/emergency_planning/localrisks.htm

Hui, W. (2011). How well do you know Rapid Application Development (RAD)? *IT Evolution.* from http://it-evolution.blogspot.co.uk/2011/04/how-well-do-you-know-rapid-application.html

Julies, I. (2004). The role of incident management systems. *Civil Engineering : Magazine of the South African Institution of Civil Engineering, 12*(9), 18.

Lewis, C., & Rieman, J. (1993). *Task-Centered User Interface Design*.

Moynihan, D. P. (2009). The network governance of crisis response: Case studies of incident command systems. *Journal of Public Administration Research and Theory, 19*(4), 895-915.

Munassar, N. M. A., & Govardhan, A. (2010). A comparison between five models of software engineering. *IJCSI International Journal of Computer Science Issues, 7*(5), 94-101.

Nielsen, J. (2005). Ten usability heuristics.

Palmer, T. (2014). *WPI London Project Centre Proposal Form*. UK.

Palmer, T., & Axelsen, B. (2013). Hounslow Multi-Agency Community Risk Register (1.1 ed., pp. 36). Hounslow: The Continegency Planning Unit.
Pearkes, B. (2014, March 21, 2014). [Hillingdon IMS Viewer Interview].
Previstar. (2014). CPS - RESOURCE Manager (RM). from http://www.previstar.com/Products/products_RM.asp
Randall, T. E., Defence, R., & Development Atlantic, D. (2011). Incident Management Systems Evaluation and Usability Assessment.
Reed, J. H., Rogers, G. O., & Sorensen, J. H. (2008). Establishing functional requirements for emergency management information systems.
Royse, D. D. (2009). *Needs assessment*. New York: Oxford University Press.
Sears, A., & Jacko, J. A. (2007). *The human-computer interaction handbook: fundamentals, evolving technologies and emerging applications*: CRC press.
Secretariat, C. C. (2008). Civil Contingencies Act 2004: a short guide (revised).
U.S. Department of Health and Human Services. (2014). User Interface Design Basics. 2014, from http://www.usability.gov/what-and-why/user-interface-design.html
UK Cabinet Office. (2005). *Emergency Prepardness* London: HM Government Retrieved from https://www.gov.uk/government/publications/emergency-preparedness.
UK Cabinet Office. (2010). *Emergency Response and Recovery*. London, UK: HM Government Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/253488/Emergency_Response_and_Recovery_5th_edition_October_2013.pdf.
Vallenilla, V. I., Pulkowski, J. L., Musteata, E. S., & Weininger, S. J. (2013). *Methods to Warn and Inform Before, During, and After an Emergency*. Worcester, MA Worcester Polytechnic Institute.
Walle, B. v. d. T., Murray. Hiltz, Starr Roxanne. (2009). *Information systems for emergency management* (Vol. 16). Armonk, NY: M.E. Sharpe.

Category 1 Responders	Category 2 Responders
• The London Borough of Hounslow Contingency Planning Unit (CPU) • Metropolitan Police Service (MPS) • London Fire Brigade (LFB) • London Ambulance Service (LAS) • NHS England • Public Health England (PHE) • West London Mental Health Trust (WLMHT) • West Middlesex University Hospital (WMUH) • Hounslow and Richmond Community Healthcare (HRCH)	• Utility Companies: Electricity; Gas; Water and Sewerage • NHS Clinical Commissioning Groups • BAA Heathrow • Transport for London (TfL) • Network Rail • Train Operating Companies • Highways Agency • Public Communications providers (fixed and mobile) • Port of London Authority (PLA) • Health and Safety Executive (HSE)

Visual Requirements

- Effective in design
- Effective Color Scheme
- Corporate Branding
- Consistent User Interface Throughout the App

Functional Requirements

- Easy to Edit, Modify and Update
- Supports multiple file types
- Intuitive- users should be able to learn without prior instruction
- Resiliently and Robustly Constructed
- Efficient and Streamlined
- Flexible
- Simple
- Cost Effective (free or minimal annual cost)
- Remote Access Compatible (Cloud Computing or USB)

Appendix C Needs Assessment Focus Group Outline Sheet

What elements of the existing system are useful?

- Layout
    - Each coordinator gets their own set of links
    - Link names
    - Menus/submenus
- Information
- Contacts List
- Download each link independently?

UI Design- What do you want the system to look like?

Functionality- What should the system be able to do (ideally)?

- Would this feature be useful? How would you use this feature?
- Would it benefit you? How might this feature benefit you?
- How important do you feel this to be?

Some ideas for functionality:

- Digitized Task Log
- Login Screen
- Time-monitoring of users
- Email integration
- e-forms
- Contact List
- GIS integration
- Situation Report exporting (to different formats: LLACC, Hounslow)

Rank your top 5 choices for integration

Content – What content should be included in the system? What is the most effective way of organizing the content?

- Is there anything in the current system that is missing?

Twitter Integration	Integrate Twitter Feed Into System
Weather Maps	Live Access to Weather Maps
Maps & GIS	Integration of GIS within system
Task Log	Digital Recording of All Task Performed by User
Message Log	Digital Logging and Dissemination of all Messages Recieved
Mobile Compatibility	System can be run of a Mobile Device (Smartphone, Tablet, etc.)
Printable	Information from the system is capable of being printed
Time Monitoring of Users	Monitor the length of time each username has been on the system
E-Form	Digitize forms to great a digital record of all forms completed
Situation Report (SitRep) exproting	User inputs data into textfields, which are formatted into appropriate format for different SitRep formats

Appendix E General "Core" Interview Questions

- How old is your IMS?
- Why did you change from the system you have before?
- What did you use as guidelines for creating your current IMS?
- How often is your system used?
- What are the minimal functional requirements for your IMS to be successful?
- What are the desired requirements that would make an IMS most optimal?
- What updates would you add to your current system that were not created during the initial design?
- What aspect of your IMS actually slows down emergency response?
- Why did you choose the current platform that your IMS operates on?
- How long did it take to create your IMS?
- Are there any training documents or procedures available for your IMS?
- How difficult is it to update your IMS?

IMS Usability Test 1

The purpose of this test is to evaluate the usability and simplicity of our Incident Management System design. We have created specific tasks for you to complete that are oriented so that we better understand if or how easy our system is to use. We would like for you to be vocal about all your thoughts on the system, and in the end provide us with any suggestions you think would be beneficial for us to consider when refining our IMS. You are the user of this program; you are the person who this system is being designed for. Please let us know anything we can do that will make this program simpler and easier to understand/navigate. Also, if you are willing, we will provide you with a short, anonymous survey questioning your experience with our IMS. We would greatly appreciate your answers.

Task 1

Open the Incident Management System. This is an emergency response effort, not business continuity. You have been assigned the position of Information Coordinator for this specific Incident; please navigate to the Information Coordinator's homepage.

Task 2

The BECC Controller has asked you to set up a telephone helpline to warn the public about an emergency situation. Please navigate to the instructions for setting up a telephone helpline.

Task 3

Since you just completed a task, it must be recorded in the task log so that there is a definite record of it. Please navigate to the task log and record the task that you just completed.

Task 4

It has been determined that there is no longer a need for the Information Coordinator position. You have been reassigned as the Welfare Coordinator. From your current screen please navigate to the Welfare Coordinator homepage.

Task 5

The emergency rest centre is asking for any food that can be supplied. Please find the page related to supplying food to an emergency rest centre in a crisis situation.

Task 6

As the Welfare Coordinator, you have actions that need to be completed in the near future. Please go back to the Welfare Coordinator homepage and navigate to the Ongoing Actions.

Task 7

A new Welfare Coordinator is coming in to replace you. In order to understand what situation they are walking into, you need to fill out a Handover Form and provide it to them. Please print a Handover Form.

IMS Usability Test 2

The purpose of this test is to evaluate the usability and simplicity of our Incident Management System design. We have created specific tasks for you to complete that are oriented so that we better understand if or how easy our system is to use. We would like for you to be vocal about all your thoughts on the system, and in the end provide us with any suggestions you think would be beneficial for us to consider when refining our IMS. You are the user of this program; you are the person who this system is being designed for. Please let us know anything we can do that will make this program simpler and easier to understand/navigate. Also, if you are willing, we will provide you with a short, anonymous survey questioning your experience with our IMS. We would greatly appreciate your answers.

Task 1

Open the Incident Management System. This is an emergency response effort, not business continuity. You have been assigned the position of Welfare Coordinator for this specific Incident; please navigate to the Welfare Coordinator's homepage.

Task 2

Due to this emergency being located near schools, the BECC controller has asked you to login to the Schools Asset Management Database. Please navigate to the page where this information is located. (No need to actually log in).

Task 3

As the Welfare coordinator you have now also been assigned as the Emergency Rest Centre Manager. From your current screen, please navigate back to the Welfare Coordinator's homepage, and from there, access the Initial Actions that are to be completed by the Emergency Rest Centre Manager.

Task 4

As the current emergency intensifies, the BECC Controller alerts you that they will need supplies down at the Emergency Rest Centre. This requires that you understand the details of the Crisis Purchasing Scheme. Please navigate to this information.

Task 5

It has been determined that this emergency has become a Business Continuity matter as well. Please navigate to the First Actions of the Welfare Coordinator in the Business Continuity section of the IMS.

Task 6

Each task you complete as the Welfare Coordinator needs to be recorded. Please navigate to the IMS task log.

Task 7

A new Welfare Coordinator is coming in to replace you. In order to understand what situation they are walking into, you need to fill out a Handover Form and provide it to them. Please navigate to the Welfare Coordinator homepage in the Emergency Response section of the IMS and print a Handover Form.

IMS Usability Test 3

The purpose of this test is to evaluate the usability and simplicity of our Incident Management System design. We have created specific tasks for you to complete that are oriented so that we better understand if or how easy our system is to use. We would like for you to be vocal about all your thoughts on the system, and in the end provide us with any suggestions you think would be beneficial for us to consider when refining our IMS. You are the user of this program; you are the person who this system is being designed for. Please let us know anything we can do that will make this program simpler and easier to understand/navigate. Also, if you are willing, we will provide you with a short, anonymous survey questioning your experience with our IMS. We would greatly appreciate your answers.

Task 1

Open the Incident Management System. This is a business continuity effort, not emergency response. You have been assigned the position of BRT Manager for this specific Incident; please navigate to the BRT Manager's homepage.

Task 2

You happen to be the only person working on the business continuity aspect of this emergency, therefore you need to switch from position to position. The BECC Controller asks you to work as the Information Coordinator and set up a staff recorded information line. Please navigate to the page displaying this information.

Task 3

You need to make a record of the fact that you completed this action. From your current screen please access the Task Log.

Task 4

The BECC controller alerts you that you have to switch to the Emergency Response aspect of this emergency effort and act as the Operations Coordinator. Please navigate to the First Actions of the Operations Coordinator.

Task 5

There is a need for a LALO to go down to the scene of the emergency. Because he is in a rush and can't access the IMS, you need to do it for him. Please access the safety guidelines of the LALO Coordinator.

Task 6

Since you were originally working as the BRT Manager of Business Continuity, you have a duty to give a CMT briefing. Please navigate back to the information that needs to be discussed during the meeting.

Task 7

Since you also acted as the Information Coordinator for the Business Continuity, you need to make sure you follow all the actions of that come along with this position. Please access the ongoing actions of the Information Coordinator.

Appendix G Usability Testing Debrief

How many times have you been called to work in the Emergency Control Centre?

Never Once Twice More than twice

Please answer the following questions regarding your experience with the system.

On a scale of 1 to 5, with 1 being not at all and 5 being exceptionally, please rank the following:

The system was simple to use:

1 2 3 4 5

The system was intuitive to use (i.e. it felt natural to navigate, the organization made since):

1 2 3 4 5

The system was visually appealing:

1 2 3 4 5

There was a consistent user interface between pages:

1 2 3 4 5

Please comment on the following statements:

The visual associations (colour coding of pages, icons on quick link buttons) were useful.

Strongly Disagree Disagree Neither Agree or Disagree Agree Strongly Agree

Comments:

The system layout made sense.

Strongly Disagree Disagree Neither Agree or Disagree Agree Strongly Agree

Comments:

The information was presented in a concise and efficient manner.

Strongly Disagree Disagree Neither Agree or Disagree Agree Strongly Agree

Comments:

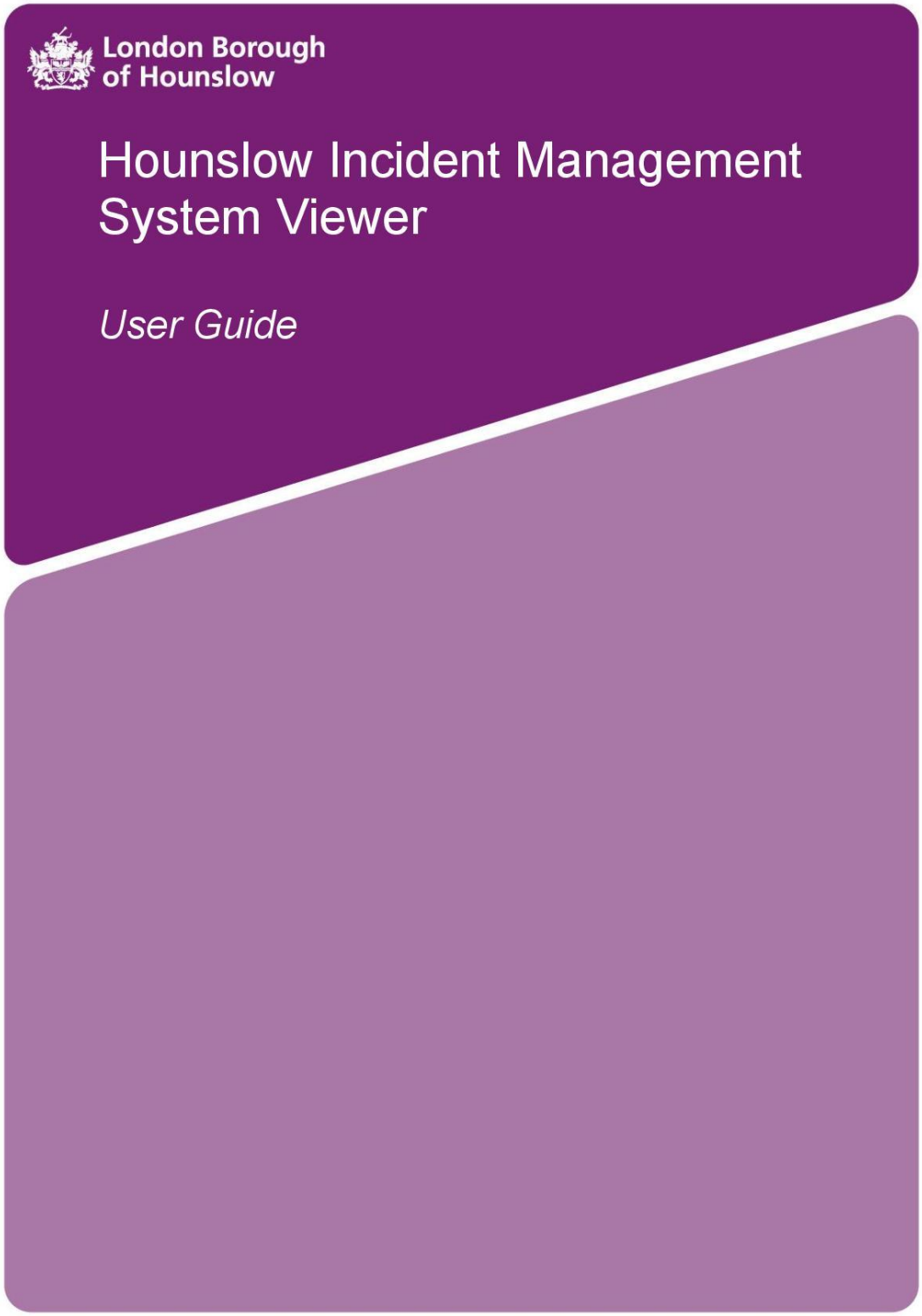
I would you be comfortable using the system <u>now</u> if an emergency arose.

Strongly Disagree Disagree Neither Agree or Disagree Agree Strongly Agree

Please explain your feeling expressed above.

Where could the system be clearer?

Additional comments:


London Borough of Hounslow
Hounslow Incident Management System Viewer
User Guide

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Introduction

This is a guide that provides operation instructions to users of Hounslow's Incident Management System (IMS) Viewer. The goal of this guide is to familiarize users with the basic features and functionality of the IMS Viewer so that the reader will be able to confidently and effectively use the system. The main features covered in this guide are:

1. How to launch the system
2. How to navigate to a function coordinator page
3. How to understand the layout of the coordinator pages, including:
    a. Quick Links
    b. Action Cards
    c. Information window
4. How to set up a Task Log for an incident, as well as record an action in the Task Log

The IMS Viewer contains information useful for dealing with emergencies. The system is designed to allow a user to quickly and easily find the necessary information during an emergency response effort.

Note that this guide does not provide technical information about the system or outline the specific layout, in regards to platform, of the system. Please consult the maintenance guide for this information.

Using the System

Opening the System

After logging in to one of the 6 function coordinator computers (distinguished by their title and colour), the IMS Viewer should automatically open once you are logged in.

If this is not the case, there is a shortcut on the desktop of the computer labelled "Hounslow IMS Viewer." This will open up the system and bring you to the home page.

In order to access the information stored within the IMS Viewer, the system is divided up by the function coordinators. Navigating the system is comprised of two steps:

1. Selecting the type of emergency
2. Selecting the function coordinator you have been assigned for the emergency

The information needed to complete these two steps will be given to you upon your arrival to the Emergency Control Centre (ECC).

Select the Type of Emergency

From the IMS Viewer, select either Business Continuity or Emergency Response (Figure 1) depending on the type of emergency.

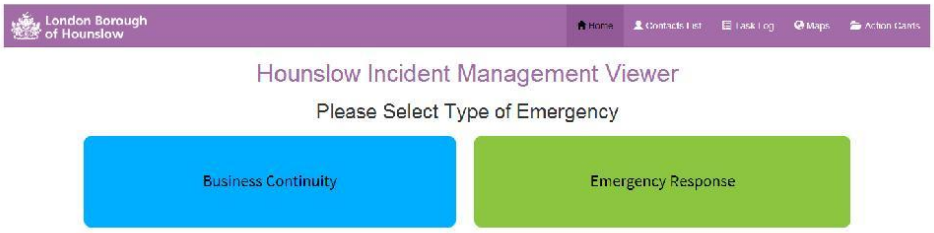


Figure 1 - Hounslow IMS Viewer home page

Selecting an Function Coordinator

The next step is to select a function coordinator. After selecting the type of emergency, you will be brought to a screen similar to Figure 2. This screen will differ depending on the type of emergency. Select the coordinator you have been assigned to.

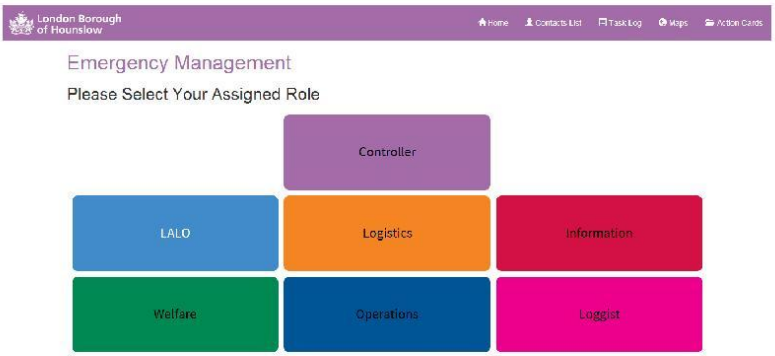


Figure 2 - Function Coordinator page

Layout of the Function Coordinator Page

Once you select a coordinator, you will brought to a page that looks similar to the one shown in Figure 3.

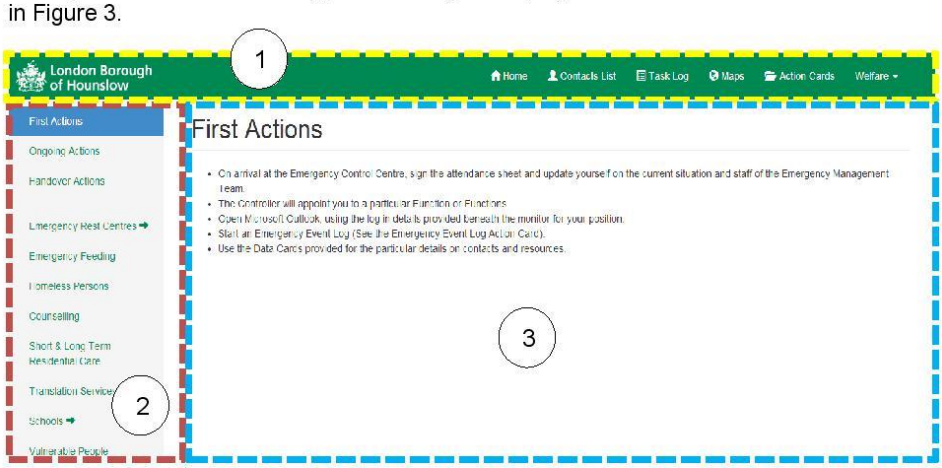


Figure 3 - Sample Function Coordinator page

Each function coordinator page is broken down into three main parts as shown in Figure 3:

1. Navigation bar with quick links
2. Action Cards sidebar
3. Information content window

Navigation bar with quick links

The navigation bar is located at the top of every page of the IMS Viewer. This bar contains quick links, which are commonly-used functions of the IMS Viewer. Additionally, its colour will change depending on the function coordinator you have selected.

Figure 4 - Navigation Bar with quick links

The links provided on this bar are:

1. Home
2. Contact List
3. Task Log
4. Maps
5. Action Cards
6. Function Coordinator toggle

Home

The Home button will bring you back to the home page, as seen in Figure 1. This is useful if the need arises to switch between Emergency Response and Business Continuity, or if you are lost in the system. Additionally, the home page contains links to the Maintenance Guide as well as this User Guide.

Contact List

This is an electronic copy of the Emergency Contact List. You can press **Ctrl+F** to search the document for a specific contact.

Task Log

This links to the task log, an electronic form to keep track of actions taken by the different coordinators. Here you can record your tasks as they happen, and will be stored into a spreadsheet, located on the Google Drive. For additional information, see the Task Log section of this manual.

Maps

The Maps button will link you to information on how to access Hounslow's Geographical Information System (GIS). This will allow you to an assortment of maps with important locations that may be useful during and emergency.

Action Cards

The Action Cards button will open a page that contains a complete index of all information found within the IMS Viewer. This will allow you to search for a specific action card if you know what you're looking for, but you don't know where it is in the system.

Function Coordinator Toggle

Clicking this dropdown menu will display all possible function coordinators for the type of emergency that was originally selected on the Home page. This allows you to quickly and easily switch between different function coordinator pages.

Action Card Sidebar

The action card sidebar displays all action cards that pertain to each coordinator. Each item in the sidebar contains information that may be utilized during an emergency. Selecting an action card will display the information in the information content window.

Figure 5 - Action Card Sidebar

The action card sidebar is broken into two general sections. At the top are items that pertain to general actions that need to be taken throughout the emergency. These are outlined in the yellow box in Figure 5. These items may vary from each function coordinator, but are generally the same.

Below these are the action cards and information that is specific to the function coordinator.

There are two types of arrows you may encounter within the action card sidebar.

➔ Selecting an item with this symbol will bring you to differently structured page in the IMS Viewer. For example, if you click on the "Schools" link in Figure 5, you will be brought to a new Schools page, as seen in Figure 6. You can return to the main coordinator page be selecting the Back To button, located at the top of the page, also in Figure 6.

The "Back To" link is denoted by a similar arrow as above, but facing the opposite direction. Please note the differences between the action card sidebars between Figure 5 and Figure 6. These pages are both contained within the same function coordinator, but not all information is available from the Schools page without going back to the main page of the function coordinator.

Figure 6 - School Action Card Page

▼ You may also encounter this symbol, which will, when clicked, reveal additional pages that are located within the IMS Viewer. For example, if "Pupil Numbers" was clicked from Figure 6, additional items would then become visible, as seen below.

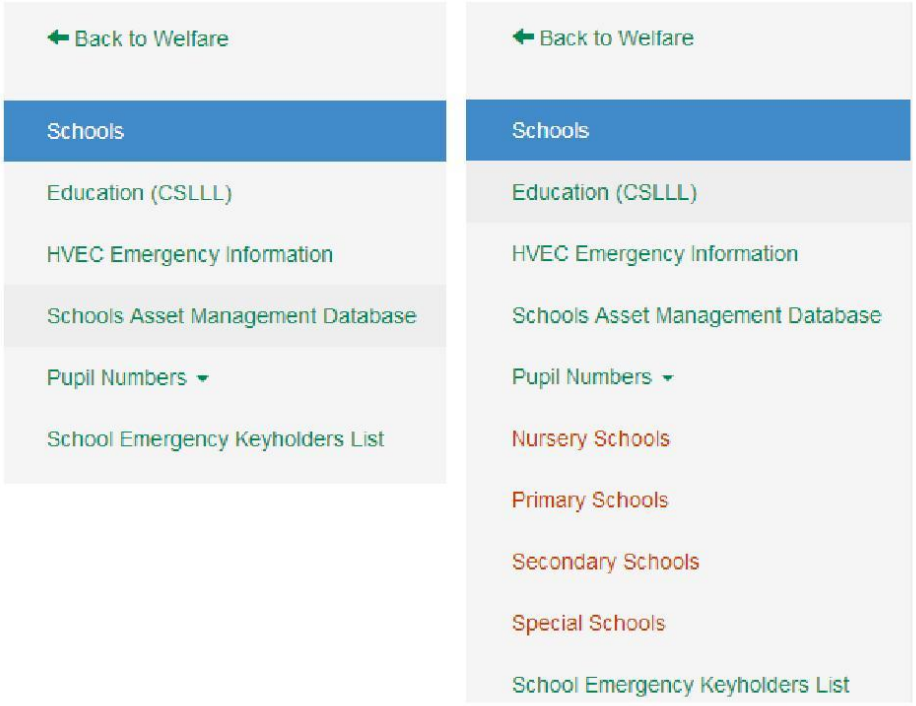


Figure 7 - Dropdown Menu

The dropdown items are displayed in a different colour than the other items in the action card sidebar. You can close the dropdown list by clicking on the action card, in this case "Pupil Numbers," again.

Information Content Window

This is where the information for each action card is displayed. Generally, the "First Actions" information will be displayed in this area when you first select a function coordinator. If the page is long, you will be able to scroll down to view additional information. Scrolling will only affect this main body portion of the page. The navigation bar at the top and the sidebar will remain fixed in place.

In addition, many of the pages contain hyperlinks to other documents, or external websites.

Task Log

The Task Log functionality of the IMS Viewer is used to record all actions taken as they happen. You should be filling out the task log throughout the emergency. This section will cover how to set up the task log for a new emergency and how to use the task log.

How to Setup the Task Log

In order to keep information for incidents separate, a new Task Log must be created for each incident. This must be completed from the Controller Coordinator's Google account.

1. Open Google Chrome and navigate to https://drive.google.com
2. Log in using the following details:
    a. Email: ecc.controller@hounslow.gov.uk
    b. Password: ********
3. Once the page has loaded, click on the **IMS** folder, then the **Task Log**
4. In this folder there should be two documents:
    a. **Incident Task Log** – the Google Form used to record actions
    b. **Task Log Responses** – the Google Spreadsheet that contains all recorded actions
5. Click on the **Incident Task Log** to open the Google Form in a new window
6. At the top of the page in the menu bar, click on **Responses** → **Delete all responses**
    a. **THIS WILL NOT DELETE ANY PREVIOUS ENTRIES IN THE SPREADSHEET**
7. Once completed, click on **Responses** → **Change response destination**
8. Select the "New sheet in an existing spreadsheet…" button and click **Choose**
9. In this window, please select the **Task Log Responses**

This will set up a new sheet within the **Task Log Responses** spreadsheet. You can navigate between different sheets, as well as label the individual sheets.

Using the Task Log

To use the Task Log, simple click on the Task Log button, located in the navigation bar on every page, to open it within a new window or tab.

The Task Log, as displayed below, will ask for specific fields to be completed. As seen in Figure 8, this test task log requires at least the Name and Actions fields to be completed, with the Comments field voluntary.

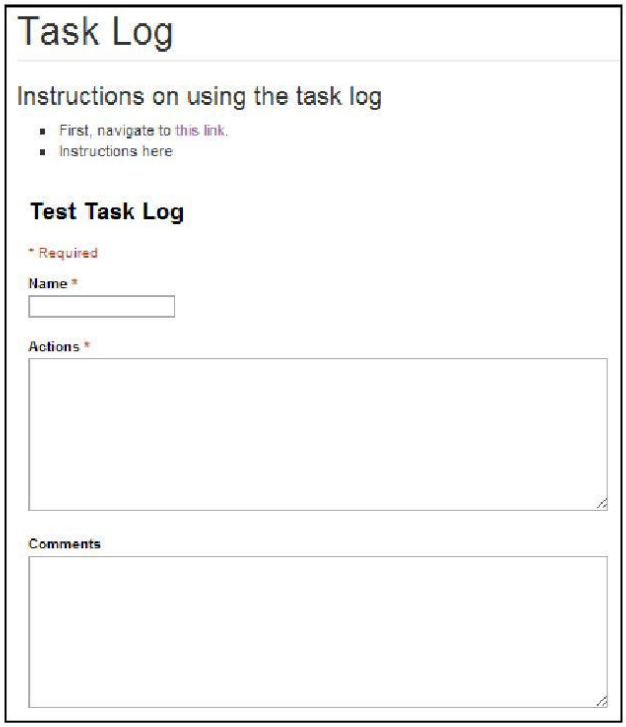


Figure 8 - Test Task Log form

After the Task Log is completed, please click the Submit button to record the action. This will send the information to a spreadsheet located on the Google Drive of the Controller Coordinator's account, along with a timestamp. Figure 9 should be displayed if the Submit button was successful.

Figure 9 - Submitted Task Log page

Select the "Submit another response" link to return to the previous page (Figure 8) and record a new action.

Additional Tips

This section will look at additional tips, tricks, and features that can supplement the IMS Viewer.

User and Maintenance Documents

This User Guide, as well as the Maintenance Guide, can be accessed by links found on the Home page of the IMS Viewer.

Navigation Tips

The IMS Viewer runs in an Internet browser, such as Google Chrome. The "back" and "forward' buttons that are built into the browser will also allow you to switch between pages in the IMS Viewer, similar to any other website.

Selecting certain links in the IMS Viewer, such as the Task Log, will open up a new tab or window. You can easily navigation between tabs by pressing **Ctrl+Tab**, or windows by pressing **Alt+Tab**.

Printing

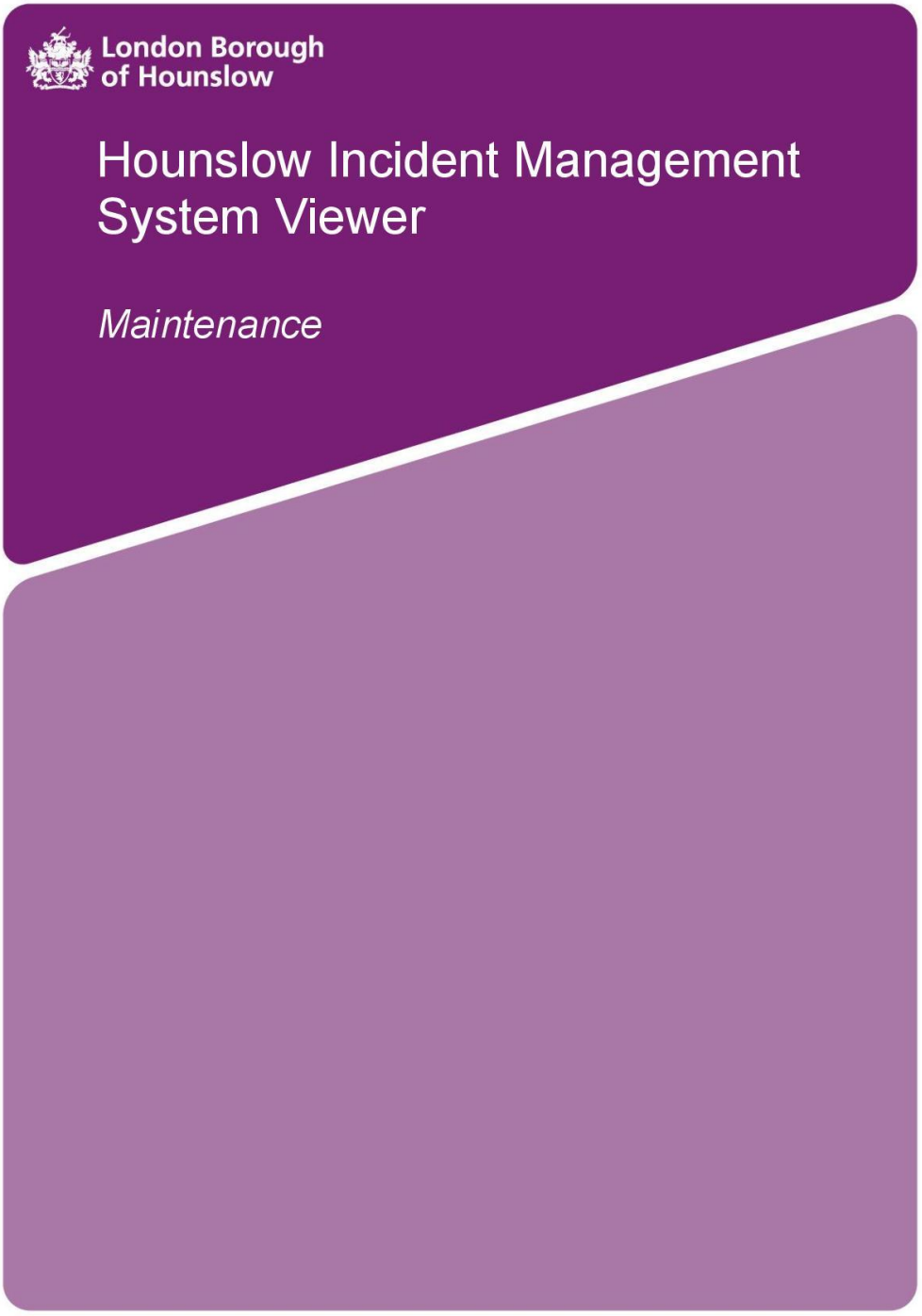
You can print any page found within the IMS Viewer. Simply press **Ctrl+P** to print the page you are on. This will only print the information contained within the main body of the page, and thus the navigation bar nor the action card sidebar will not be printed.

Increasing Text Size

If you have trouble reading anything in the IMS Viewer, you can press **Ctrl-+** to zoom in the page. Likewise, if you want to zoom out, you can press **Ctrl+-**.

Full Screen

If you wish to view the IMS Viewer in full screen mode, you can do this by pressing **F11**. This will hide the top and bottom bars of the computer.


London Borough of Hounslow
Hounslow Incident Management System Viewer
Maintenance

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Introduction

Welcome to the Hounslow Incident Management System (IMS) Viewer maintenance guide. This guide will provide a general background to the platform and technologies used in the IMS Viewer, as well as step-by-step instructions on how to make edits to the IMS Viewer.

This maintenance document is intended for the members of the Contingency Planning Unit, or applicable ICT support. This guide is not intended to teach users the basics of the IMS Viewer; again, it serves as a technical document for maintenance and upkeep of the information contained within the system.

For the best experience, please read through the entire document at least once before attempting changes within the IMS Viewer. The Background section contains useful information in understanding the structure of the system when making edits.

Recommended Tools

In order to provide an adequate development environment, this section will go over a few key tools needed to make edits the IMS Viewer.

Notepad++

An open source text/code editor, Notepad++ provides the same functionality as the Notepad program, but with added support of many languages. Specifically for our use, Notepad++ supports HTML, CSS, and JavaScript. Notepad++ provides colour coding in order to help the user distinguish between certain language structures.

Notepad++ is shown in all figures in this guide displaying the back-end code.

For more information, please visit http://notepad-plus-plus.org/.

Google Chrome

As an alternate web browser, Google Chrome was specifically used during the development of the IMS Viewer and is recommended for everyday use. When referring to a web browser in this guide, Google Chrome will be understood as the default.

For more information, please visit https://www.google.com/intl/en_uk/chrome/browser/.

Google Drive

In order to maintain the task log and other portions of the IMS Viewer that use Google Docs, Google Drive should be installed and logged in to the respective coordinator account associated with that computer.

This will allow users who are taking on certain coordinator roles to be able to have the correct access to view any important files, such as the task log.

Background

The Hounslow Incident Management System (IMS) Viewer is comprised of simple HyperText Markup Language (HTML) web pages, coupled with Cascading Style Sheets (CSS) and JavaScript to provide visually-pleasing aesthetics and core functionality of many common websites today.

This guide will go through a brief introduction on how these three separate entities come together to form the Hounslow IMS Viewer. Additionally, this guide will provide the basics needed for simple modifications to the system, such as content on pages, as well as some more advanced topics for consideration.

HyperText Markup Language

As the de-facto standard to creating webpages since the late 1990s, HyperText Markup Language (HTML) is interpreted by web browsers to bring together text, images, as well as any other media or content, into visual web pages.

HTML pages are formed by using HTML elements, which consist of tags, or keywords, enclosed by brackets. For example, `<p>` is an HTML tag defined for writing paragraphs. Most tags consist of pairs, i.e. `<p>Hello world!</p>`. Figure 1 is a very simple example of a HTML web page.

```
1  <!DOCTYPE html>
2  <html>
3  <body>
4
5  <h1>Hello World!</h1>
6
7  <p>Welcome to my first ever web page!</p>
8
9  </body>
10 </html>
```

Figure 1 - A simple HTML web page

A more comprehensive section regarding important HTML tags used in the construction of the IMS Viewer is located further in the document.

Cascading Style Sheets

Cascading Styles Sheets (CSS) are used to describe the formatting and overall visual look for a document written with a markup language, such as HTML. HTML provides the content for a page (whether it is text, images, audio, etc.), while CSS formats it and places it visually

on the page (such as bolding, italicizing, or apply a colour to text of a paragraph). CSS is responsible for the modern look that many websites have today.

Many frameworks are publicly available on the Internet and allow for users to apply them to their own web sites and modify them as they see fit. In order to cut out unnecessary development, Bootstrap, a widely used CSS framework, was chosen to help expedite the construction of the IMS Viewer.

Although this guide will not go into much depth regarding CSS, a simple example of CSS is included below in Figure 2.

```
1  p {
2      color: red;
3      font-size: 150%;
4  }
5
6  h1 {
7      background-color: orange;
8      font-size: 250%;
9  }
```

Figure 2 - A simple CSS for a web page

Applied to the simple HTML page in Figure 1, the output on a web browser would look like Figure 3:

Figure 3 - Combining HTML and CSS

JavaScript

So far, HTML and CSS describe the visual aspects of a web page. Although both are very powerful tools in the realm of Internet web pages, more dynamic elements that a user may take for granted, such as clicking on an item to reveal more items below it (also known as a dropdown menu), are available through scripting languages. Scripting languages provide a way to interact with the user to dynamically update elements on the page in front of them.

JavaScript is a widely known and frequently used dynamic scripting language. As part of Bootstrap, a library for JavaScript, jQuery, is included and used in many of their possible elements.

As this is a more complicated topic to discuss than HTML or CSS, JavaScript will not be covered in this maintenance guide. JavaScript shouldn't be necessary for the maintenance of the system.

File Structure of a Website

In order to understand how the IMS Viewer works, it's essential to understand the underlying file structure of a website. This section will go over the structure of the IMS Viewer, as well as a brief description of how one page can reference another.

There are no strict rules when developing a website, but there are loose 'best practices' that are generally followed. For example, the root (or base) of the IMS Viewer, shown in Figure 4, is separated into multiple folders. Some of these folders, such as *css*, *fonts*, *img*, and *js*, contain their respective file types. For instance, by grouping all CSS files into one folder at the root directory, it is easy for any developer to use the system and identify that this is the central location for all stylizing.

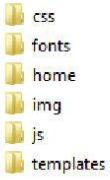


Figure 4 – Root directory for IMS Viewer

This structure is used throughout the entire IMS Viewer. The *home* folder contains the two main components of the IMS Viewer, which are Business Continuity (labelled as *bc*) and Emergency Response (labelled as *er*).

Although this can create very long and deep paths for files, the advantage is a thematically organized system.

File Paths

Now that the general structure has been established, how does one web page reference another? This can be described through the idea of file paths, a unique location within the system.

Any and all files in the IMS Viewer can be referenced by a file path. File paths have two categories:

- **Absolute**: An absolute file path is one that points to the same location on a file system, regardless of where the current file may be.

- **Relative**: A relative path is one that is relative to the current file.

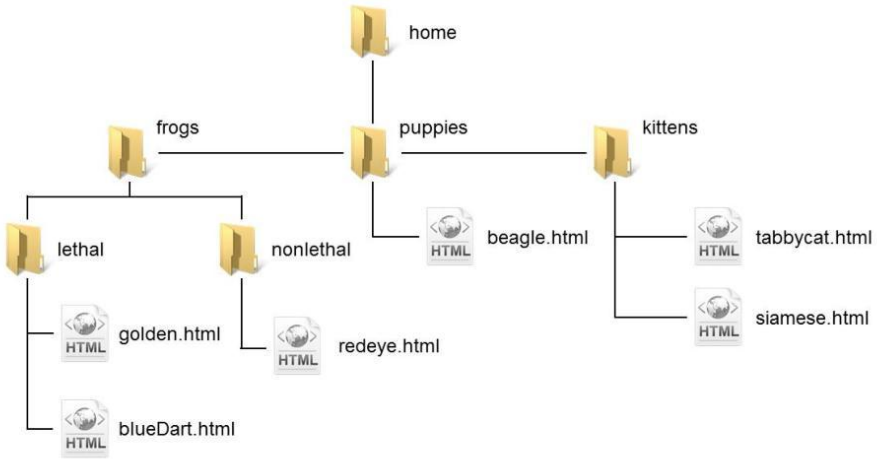


Figure 5 - An example file directory

Although absolute file paths can always be used in any circumstance, but in terms of HTML, absolute paths must contain **http://www**, which refers to an external website. Another issue arises if the hosting for the IMS Viewer changed, for example, from http://www.ims.com to http://www.imsviewer.com. All absolute paths for the IMS Viewer would have to be changed in each and every file.

However, using relative paths allows for such a change without any repercussions. Thus, absolute paths are only used for linking to external web pages.

Using Figure 5, here are some examples of paths to reference files in the system:

1. If viewing `beagle.html`, and wanted to link an element to `siamese.html`, the path would be:

   ```
   ../kittens/siamese.html
   ```

   The `../` that precedes the path is a way to move up one folder. Since `beagle.html` is within the `puppies` folder, the path needs to move up to the `home` folder, then proceed to the `kittens` folder.

2. If viewing `golden.html`, and wanted to link an element to `blueDart.html`, the path would be:

   ```
   blueDart.html
   ```

Since `golden.html` is already in the same folder as `blueDart.html`, there is no need to change folders.

3. If viewing `blueDart.html`, and wanted to link an element to `beagle.html`, the path would be:

```
../../puppies/beagle.html
```

Two `../` are needed since `blueDart.html` is within `frogs/lethal`.

Structure of a HTML page

In this section, we will identify the typical structure of any web page found within the IMS Viewer, and break it down section by section to understand the relation between HTML and what is displayed on the web page.

Header

Below is the first section of an HTML, which contains meta data, or information that is stored and describes the actual document, important links and resources, such as external scripts and CSS.

```
1  <!DOCTYPE html>
2  <html lang="en">
3    <head>
4      <meta charset="utf-8">
5      <meta http-equiv="X-UA-Compatible" content="IE=edge">
6      <meta name="viewport" content="width=device-width, initial-scale=1">
7      <meta name="description" content="">
8      <meta name="author" content="">
9      <link rel="shortcut icon" href="../../assets/ico/favicon.ico">
10
11     <!-- Bootstrap core CSS -->
12     <link href="../../../css/bootstrap.min.css" rel="stylesheet" type="text/css">
13
14     <!-- Custom styles for this template -->
15     <link href="../../../css/main.css" rel="stylesheet" type="text/css">
16
17     <title>Hounslow Incident Management Viewer - Controller First Actions</title>
18
19     <!-- Just for debugging purposes. Don't actually copy this line! -->
20     <!--[if lt IE 9]><script src="../../assets/js/ie8-responsive-file-warning.js"></script><![endif]-->
21
22     <!-- HTML5 shim and Respond.js IE8 support of HTML5 elements and media queries -->
23     <!--[if lt IE 9]>
24       <script src="https://oss.maxcdn.com/libs/html5shiv/3.7.0/html5shiv.js"></script>
25       <script src="https://oss.maxcdn.com/libs/respond.js/1.4.2/respond.min.js"></script>
26     <![endif]-->
27   </head>
```

Figure 6 - Header portion of a HTML page

Using the line numbers as a reference found on the left side of Figure 6, each distinct section will be broken down and explained. The above image is taken from a screen shot of a text editor called Notepad++, which uses colour-coding to distinguish between different parts of HTML.

`<!DOCTYPE html>` (1): Referred to as a doctype declaration, this line supplies information for the web browser regarding the type of markup language the page is written in. For purpose of the IMS Viewer, these lines will be the same.

`<html lang="en">` (2): Following the doctype declaration, the `html` element is the basis of the document, which all other elements must be contained within. A small minus box can be seen above next to the line number, which indicates a type of tree structure.

`<head> ... </head>` (3 & 27): As the header of the page, this is the element that contains all document-related information, but usually doesn't contain any of the content.

`<meta charset=...>` (4 & 8): As described previously, the `meta` contains information for the document, such as author, character encoding, etc.

`<link rel="...">` (9, 12, 15): These `link` elements refer to other resources used within the document, typically for styling purposes. Line 9 links to a favicon, which is a little icon that is displayed in the address bar of the web browser, or next to bookmarks. Lines 12 and 15 refer to CSS that are used to style the page, and specifically, the core Bootstrap CSS as well as a custom style for this page. For some pages, multiple style sheets may be used, and will be placed in a similar fashion.

`<!-- ... -->` (11, 14, 19, 20, 22, 23, 26): These lines are known as comments, which allow developers to provide insight and important information about the code, without actually displaying it in the browser. It is recommended that comments are used to set start and end periods for certain portions of a web page, in order to allow for seamless integration if a new member joins and starts developing the IMS Viewer.

`<title>Hounslow ... </title>` (17): The title of the document, this information can be displayed in the web browser's title bar, as well as when the page is bookmarked. Titles provide meaningful information as to what the actual document pertains to.

These are all typical tags and elements that will be contained within the beginning of a web page found in the IMS Viewer. The structure should be similar as well.

In terms of good practice, it is best to add comments to any changes that may be unclear to the header, as well as proper indenting and spacing between different sections within the header. These will be crucial in the body portion of the web page.

Navigation Bar

Through the Bootstrap framework, the IMS Viewer uses a constant navigation bar at the top of each web page, which may change colour or content depending on the page being viewed. This navigation bar provides essential and frequently used links to other resources, as well as a way to quickly change coordinator roles.

Figure 7 - Navigation Bar for Controller

Figure 7 displays the basic structure of the navigation bar, in the case for the controller coordinator.

Below is the section of HTML responsible for the navigation bar, followed by a description of each section. Again, this may not be constant from page to page, but the structure will be similar for web pages in the IMS Viewer.

```
29  <body>
30
31    <div class="navbar navbar-default navbar-fixed-top" role="navigation">
32      <div class="navbar-header">
33        <button type="button" class="navbar-toggle" data-toggle="collapse" data-target=".navbar-collapse">
34          <span class="sr-only">Toggle navigation</span>
35          <span class="icon-bar"></span>
36          <span class="icon-bar"></span>
37          <span class="icon-bar"></span>
38        </button>
39        <a class="navbar-brand logo" href="#"><img src="../../../img/HOU_Logo_White_AW_V2-transp.png" width="200" height="42" alt="" /></a>
40      </div>
41      <div class="navbar-collapse collapse">
42        <ul class="nav navbar-nav navbar-right">
43          <li><a href="../../index.html"><span class="glyphicon glyphicon-home"></span> Home</a></li>
44          <li><a href="../../contacts/contacts.html"><span class="glyphicon glyphicon-user"></span> Contacts List</a></li>
45          <li><a href="../../tasklog/tasklog.html"><span class="glyphicon glyphicon-list-alt"></span> Task Log</a></li>
46          <li><a href="../../gis/gis.html"><span class="glyphicon glyphicon-globe"></span> Maps</a></li>
47          <li><a href="../../actioncards/actioncards.html"><span class="glyphicon glyphicon-folder-open"></span>  Action Cards</a></li>
48          <li class="dropdown">
49            <a href="#" class="dropdown-toggle" data-toggle="dropdown">Controller <b class="caret"></b></a>
50            <ul class="dropdown-menu">
51            <li><a href="../info/information.html">Information</a></li>
52            <li><a href="../lalo/lalo.html">LALO</a></li>
53            <li><a href="../loggist/loggist.html">Loggist</a></li>
54            <li><a href="../logistics/logistics.html">Logistics</a></li>
55            <li><a href="../operations/operations.html">Operations</a></li>
56            <li><a href="../welfare/welfare.html">Welfare</a></li>
57            </ul>
58          </li>
59        </ul>
60      </div><!  /.nav collapse  >
61    </div>
62
```

Figure 8 - HTML for Navigation Bar

`<body>` (29): The `body` element contains the bulk of the document. All visual items are placed within this element.

`<div class="..."> ... </div>` (31 & 61, 32 & 40, 41 & 60): A `div` element is a generic container. By applying classes, `div` elements can set styles. These containers are important to understand as they help define the certain style of the navigation bar.

Line 31: The container has the class "`navbar navbar-default navbar-fixed-top`", which indicates what styles should be applied from certain CSS files. This `div` is responsible for the entire navigation bar, which is terminated with `</div>` on line 61. If you wish to make edits to the navigation bar, it would be done so inside of this `div`, between lines 31 and 61.

Line 32: This `div` is responsible for the button that would appear if a user were to shrink the page below a certain pixel width. The `button` and `span` elements will be explained further on.

Line 41: The next portion of the navigation bar is the collapsible portion. As described above, if the page is minimized below a certain resolution, the information contained within this `div` would disappear, leaving a button behind to toggle the information to show to the user.

Typically, `div` elements in this section shouldn't be edited. This will avoid potential unwanted visual effects to the navigation bar.

`<button name="..."> ... </button>` (33 – 38): This element is responsible for creating the buttons that are found across many different web pages. Although this button is structurally not conventional, the below image captures the unique button that is displayed when the page is minimized below a certain resolution:

Figure 9 – Minimized Navigation Bar

The button is located on the right, and when pressed, will display the full menu that is found in Figure 7.

`<span class="..."> ... </span>` (34 – 37, 43 – 47): The `span` tag is one of the simplest, yet most useful elements in HTML. This element can be used in any capacity to provide styles, mainly to inline text. Please note that, although similar to the `div` element, it is to only be used as an **inline** container, whereas `div` is used at the **block-level**. These two types of HTML elements are described further.

- **Block**: Block elements naturally expand to fit its parent container, and are used for breaking up larger sections of a web page. Think of block elements as equivalent to chapters in a book.
- **Inline**: Inline elements flow along with the text content that is on the page. In essence, an inline element is similar to a block, but behaves like text. Think of inline elements as equivalent to sentences or words in a book.

The classes applied in the above text provide the simple styles for the button. For instance, the class `icon-bar` from lines (35 – 37) provides the three grey lines in for the button in Figure 9.

The varying classes from lines (43 – 47) specify the images that are used in the navigation bar. These are grouped with Bootstrap, and are known as Glyphicons. For more information please refer to the Bootstrap Components page, as well as the website for Glyphicons.

`<a href/class="..."> ... </a>` (39, 43 – 47, 49, 51 – 56): As described previously, the `a` element is a reference, or hyperlink, to an external or internal web page, or even another section on the same page. From this section, the `a` element is used in two different capacities.

Lines 39 and 49 use this element as a wrapper to provide style. Line 39 contains the Hounslow logo contained at the top left of the page, and line 49 contains the dropdown located at the top right of the page. As you can see, the `href` attribute specifies `"#"`, which indicates that if a user were to click on this, the page would stay exactly where it is.

The remaining lines use this element exactly as intended: as links to other pages. There is an `a` element for each possible button on the navigation. In this case, there is an element for the Home, Contacts List, Task Log, Maps, and Action Cards, as well as elements for each different coordinator found in the dropdown menu. When clicked, these elements point to the new web page to be displayed.

`<img src="..." ... />` (39): Also described earlier, the `img` element provides the user with a way to display images. Again, the `src` attribute is the most important aspect of `img`, providing the reference to the image file that is to be displayed. Other attributes, such as `width` and `height`, are not required, but can be used to resize an image.

The `img` element must contain both `src` and `alt` attributes. The `alt` attribute provides a text description of the image in the case that it cannot be displayed. Although an `alt` can have a blank value (`alt=""`), it cannot be omitted, and if so, could cause problems for the end user of the IMS Viewer.

`<ul class="..."> ... </ul>` (42, 50): Specific to this page, these unordered lists specify the buttons and links located on the right.

The class `"nav navbar-nav navbar-right"` specifies that all items in this list should be right aligned. To add or a delete an item, simply either copy an existing line, edit the appropriate fields, or delete an entire line. Please be aware that due to styling standards, adding or deleting may change the way the navigation bar minimizes.

The class `"dropdown-menu"` specifies the list items found within the dropdown for the coordinators. The same instructions apply above to add or delete an entry in the dropdown.

This completes the overview for the navigation bar and its elements that are in use.

Sidebar and Body

Most web pages within the IMS Viewer contain a sidebar, which stores useful links related to the coordinator of that page. These provide a way to index the various web pages linked to a coordinator. In conjunction with the sidebar, the main content of the web page is also listed

in a similar section in the HTML code. For this reason, both the side bar and body will be discussed.

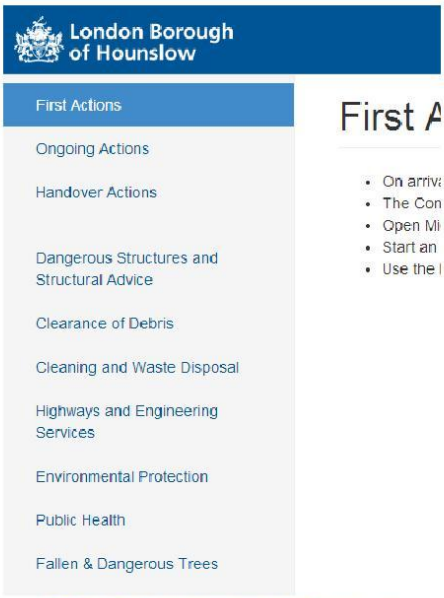
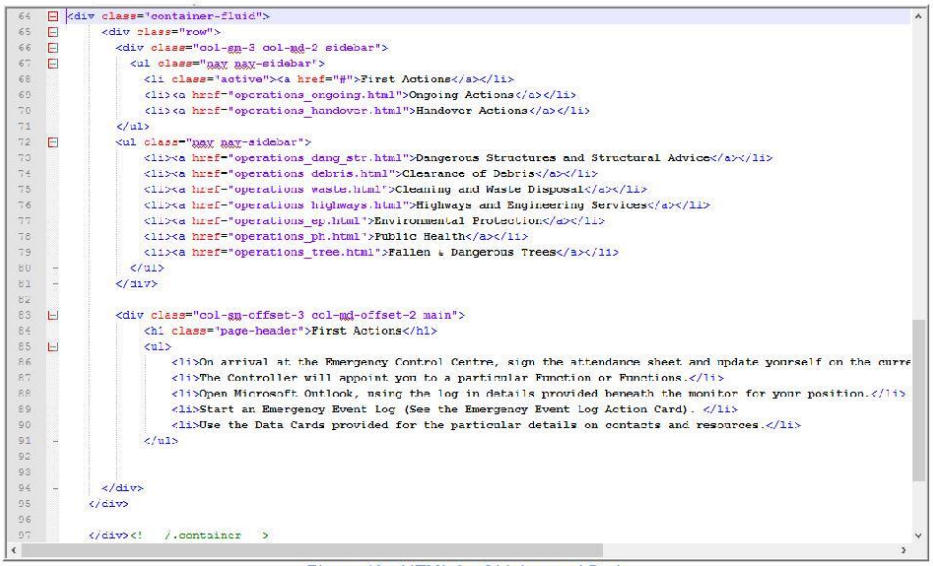


Figure 10 - Sidebar example for Operations

Figure 10 is an example of a sidebar that can be found within the IMS Viewer. The sidebars, if present, are located on the left side of the screen.

Figure 11 - Body example for Operations

Figure 11 is an example of body content that each web page contains. This is essentially where all information gathered from action cards are stored and presented.



```
64  <div class="container-fluid">
65      <div class="row">
66        <div class="col-sm-3 col-md-2 sidebar">
67          <ul class="nav nav-sidebar">
68            <li class="active"><a href="#">First Actions</a></li>
69            <li><a href="operations_ongoing.html">Ongoing Actions</a></li>
70            <li><a href="operations_handover.html">Handover Actions</a></li>
71          </ul>
72          <ul class="nav nav-sidebar">
73              <li><a href="operations_dang_str.html">Dangerous Structures and Structural Advice</a></li>
74              <li><a href="operations_debris.html">Clearance of Debris</a></li>
75              <li><a href="operations_waste.html">Cleaning and Waste Disposal</a></li>
76              <li><a href="operations_highways.html">Highways and Engineering Services</a></li>
77              <li><a href="operations_ep.html">Environmental Protection</a></li>
78              <li><a href="operations_ph.html">Public Health</a></li>
79              <li><a href="operations_tree.html">Fallen & Dangerous Trees</a></li>
80          </ul>
81        </div>
82
83        <div class="col-sm-offset-3 col-md-offset-2 main">
84            <h1 class="page-header">First Actions</h1>
85            <ul>
86                <li>On arrival at the Emergency Control Centre, sign the attendance sheet and update yourself on the curre
87                <li>The Controller will appoint you to a particular Function or Functions.</li>
88                <li>Open Microsoft Ontlook, using the log in details provided beneath the monitor for your position.</li>
89                <li>Start an Emergency Event Log (See the Emergency Event Log Action Card). </li>
90                <li>Use the Data Cards provided for the particular details on contacts and resources.</li>
91            </ul>
92
93
94      </div>
95    </div>
96
97    </div><!   /.container   >
```

Figure 12 - HTML for Sidebar and Body

Above is the code responsible for displaying the sidebar as well as the body content of each page. The structure will be similar for each web page that is associated with a coordinator.

`<div class="container-fluid">` (64): This `div` is responsible for holding the contents of body, as well as applying the proper styling to the sidebar and body content.

`<div class="row">` (65): Bootstrap offers stylizing techniques to create a grid-like structure to a web page. These can be extremely useful when trying to make a dashboard or displaying many different pieces of information on the same page.

`<div class="col-sm-3 col-md-2 sidebar">` (66): The first two classes applied to this `div` element refer to resizing stylizing when the resolution of the page is changed. The final class applies the stylizing for the sidebar to the contents.

`<ul class="nav nav-sidebar">` (67, 72): This line provides the start of the links in the sidebar. As per line 72, a space can be provided to separate and group links within the sidebar. Each list item contains an `a` element that point to another web page in the IMS Viewer.

`<li class="active"><a href="#">` (68): The `active` class, applied to a list item, provides a blue background. This can be seen on the First Actions list item on the sidebar in Figure 10. This will change, along with the `href` attribute, depending on each web page.

`<div class="col-sm-offset-3 col-md-offset-2 main">` (83): This `div` container holds the contents of the body. This will be the main content to be edited from page to page, specifically when updating information.

Maintenance

This chapter will provide an outline and guide for the maintenance of the IMS Viewer. It will identify commonly used tags, and specifically focus on those tags that will be needed to add in items, such as lists.

As described in the Introduction, HTML consists of tags that are typically of the format `<tag> </tag>`. That is, each opening tag is surrounded by brackets, and then terminated with a similar tag, but with a preceding slash. Most commonly used tags, in terms of content for the IMS Viewer, are outlined in Table 1:

Table 1 - Common HTML tags

Name	HTML Tag	Comments
Header	`<h1> </h1>, <h2> </h2>...`	Typical heading styles, from 1 to 6
Paragraph	`<p> </p>`	A paragraph tag automatically formats the text to include spaces before and after a paragraph
Unordered list	`<ul> </ul>`	An unordered list is equivalent to a bulleted list
Ordered list	`<ol> </ol>`	An ordered list is equivalent to a numbered list
List item	`<li> </li>`	A list item is used in conjunction with either unordered or ordered lists. Each bullet is identified through a list item
Hyperlink/anchor	`<a> </a>`	A hyperlink/anchor tag is used to create a link to another page, document, image, etc.
Bold	`<b> </b>`	Bolds text that is contained between the tag
Italics	`<i> </i>`	Italicizes text that is contained between the tag
Underline	`<u> </u>`	Underlines text that is contained between the tag
Line break	` *`	Inserts a line break
Image	`<img>*`	Inserts an image

* These tags do not require a closing tag

Again, this is a limited list that is within the scope of the IMS Viewer. There are many more possible tags, most of which can be found through resources, such as this wiki-based HTML element reference.

Most elements, in conjunction with their tags, also have multiple attributes to allow for further customization. Below is a table of common attributes across most elements, specifically across the elements used in the IMS Viewer.

Table 2 - Common HTML attributes

Name	Comments
`id`	A unique identifier for an element on the web page
`class`	Classifies the element into groups or types
`style`	Defines a CSS style for an element

Although these are important for core web development, the attributes in Table 2 should be used by advanced developers to avoid unwanted changes to the style of the page. When editing pages and elements that have the `class` attribute, please pay careful attention that it is aligned with other elements in that area. For instance, if an unordered list (`<ul>`) has list elements (`<li>`) all with `class="test"`, it would make sense that an added list element should have the `"test"` class.

For some elements, such as `<a>`, attributes are essential for their functionality. Table 3 outlines these important attributes that are used throughout the IMS Viewer.

Table 3 - Frequently used HTML attributes

Name	Use	Comments
`href`	`<a href="...">, <link href="...">`	Defines the external target for the link
`src`	`<img src="...>, <script src="...">`	Sets the source file to be referenced

Again, these are only attributes that are commonly used throughout the IMS Viewer. For a more complete list, please refer to this wiki-based HTML element reference.

Editing a web page

1. Open Google Chrome and navigate to the desired page for editing
2. Note the address link/path, located in the address bar:

3. The IMS Viewer has been structured such that the `home` folder is the root for the individual pages
    a. From the images above, the `controller.html` page is located within `home/er/controller/`
4. Once the path has been acquired, navigate to that location on the computer
5. To open the file for editing, right click on the file, Open With → select the desired text editor, such as Notepad++
6. Once open, locate the text that you wish to edit manually, or through pressing Ctrl + F and searching for it
7. After editing, simply save the file

Editing body content

If editing content on a page that is local to only that page, for instance, anything contained within the body, then the above steps will suffice.

Editing sidebar content

If the sidebar is being edited, these changes must be made throughout each file located in that subfolder. Using the above example, if changes were made to the sidebar for `controller.html`, these changes would have to be made in each file within the `controller` folder.

Editing the navigation bar content

If the navigation bar is being edited, these changes must be made throughout each and every page in the IMS Viewer. Unfortunately, there is no easy and efficient way to do this with the current version of the IMS Viewer.

Creating a new web page

1. Open Google Chrome and navigate to a web page that will contain the similar structure for the new page
    a. For instance, if adding a new page to the Controller Coordinator, it'd be best to copy one of the web pages in the `controller` folder
2. Note the address link/path, located in the address bar:

3. The IMS Viewer has been structured such that the `home` folder is the root for the individual pages
    a. From the images above, the `controller.html` page is located within `home/er/controller/`
4. Once the path has been acquired, navigate to that location on the computer
5. To open the file, right click on the file, Open With → select the desired text editor, such as Notepad++
6. Once open, immediately go to File → Save as… and rename the file relevant to the new content being added
7. After adding in the new body content, the sidebar will most likely need to be edited to reflect this new addition
    a. This will need to be done throughout each of the pages in the subfolder
8. Ensure that the `active` class has been applied to the proper `<li>` after creating a new page.

Example 1

To illustrate the above steps, specifically how to edit the other pages to reference the newly added page, a brief example: assume the page `controller_new.html` will be added to the IMS Viewer under the folder `home/er/controller`.

After copying the base `controller.html` and saving it as `controller_new.html` (step 6) and applying the body content edits (step 7), the sidebar must be edited so the Controller Coordinator will be able to access this new information.

```
63  <div class="container-fluid">
64      <div class="row">
65        <div class="col-sm-3 col-md-2 sidebar">
66          <ul class="nav nav-sidebar">
67            <li><a href="controller_job_description.html">Job Description</a></li>
68            <li class="active"><a href="#">First Actions</a></li>
69            <li><a href="controller_ongoing_actions.html">Ongoing Actions</a></li>
70          </ul>
71          <ul class="nav nav-sidebar">
72            <li><a href="controller_strategy_meeting.html">Strategy Meeting</a></li>
73            <li><a href="controller_llacc_notifications.html">LLACC Notifications</a></li>
74          </ul>
75        </div>
```

Figure 13 - Sidebar code for Controller

Figure 14 - Sidebar displayed for Controller

Now, if the `controller_new.html` is to be added under "LLACC Notifications" with the name "Controller New", the following line of HTML would need to be added after line 73:

```
<li><a href="controller_new.html">Controller New</a></li>
```

This would produce the two following images:

```
63  <div class="container-fluid">
64      <div class="row">
65        <div class="col-sm-3 col-md-2 sidebar">
66          <ul class="nav nav-sidebar">
67            <li><a href="controller_job_description.html">Job Description</a></li>
68            <li class="active"><a href="#">First Actions</a></li>
69            <li><a href="controller_ongoing_actions.html">Ongoing Actions</a></li>
70          </ul>
71          <ul class="nav nav-sidebar">
72            <li><a href="controller_strategy_meeting.html">Strategy Meeting</a></li>
73            <li><a href="controller_llacc_notifications.html">LLACC Notifications</a></li>
74            <li><a href="controller_new.html">Controller New</a></li>
75          </ul>
76        </div>
```

Figure 15 - Sidebar code after addition for controller.html

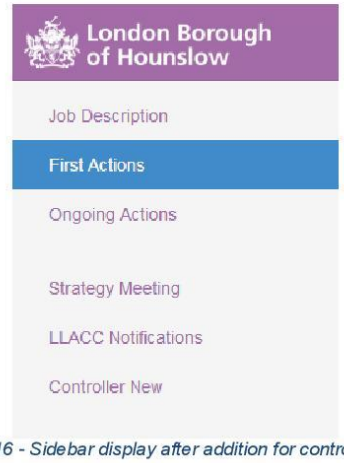


Figure 16 - Sidebar display after addition for controller.html

These changes would need to be made throughout each page within the `controller` folder.

As seen in line 68 of Figure 15, it is important to understand that within the newly added `controller_new.html` page, the class `active` must be applied to the new `<li>`, as well as changing the `href` to equal `#`. This can be seen in Figure 17.

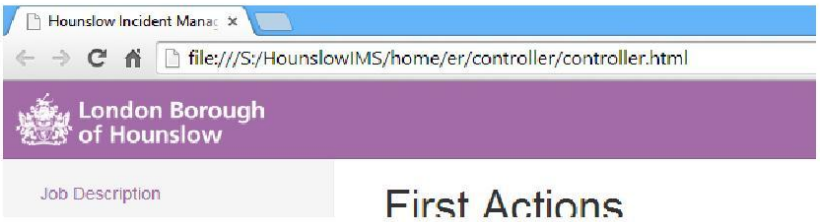
```
63  <div class="container-fluid">
64      <div class="row">
65        <div class="col-sm-3 col-md-2 sidebar">
66          <ul class="nav nav-sidebar">
67            <li><a href="controller_job_description.html">Job Description</a></li>
68            <li><a href="controller.html">First Actions</a></li>
69            <li><a href="controller_ongoing_actions.html">Ongoing Actions</a></li>
70          </ul>
71          <ul class="nav nav-sidebar">
72            <li><a href="controller_strategy_meeting.html">Strategy Meeting</a></li>
73            <li><a href="controller_llacc_notifications.html">LLACC Notifications</a></li>
74            <li class="active"><a href="#">Controller New</a></li>
75          </ul>
76        </div>
```

Figure 17 - Sidebar code for controller_new.html

Note the changes made to lines 68 and 74 in Figure 17. Again, this is specific to the newly added page to the IMS Viewer.

Deleting a page

1. Open Google Chrome and navigate to the web page to be deleted
2. Note the address link/path, located in the address bar:



3. The IMS Viewer has been structured such that the `home` folder is the root for the individual pages
    a. From the images above, the `controller.html` page is located within `home/er/controller/`
4. Once the path has been acquired, navigate to that location on the computer
    a. Keep this file name handy as it will be needed to edit other pages
5. Find the file, then simply right click → Delete, or move to the Recycle Bin
6. Now that the file is deleted, it is essential to delete all references to that file

Example 2

Building off of the Example 1 in Creating a new web page, the page `controller_new.html` is no longer needed in the system. After following the above steps for deleting, it is essential to edit all of the other files contained within the same folder (in this case, `controller`).

Assuming `controller_new.html` has been deleted, the line of code within `controller.html` that references this page must be deleted as well. As seen in Figure 15, line 74 must be deleted. Again, this would have to be applied to all other pages within the `controller` folder.

Leaving extraneous links will cause errors within the system and decrease efficiency.

Updating an external file (Adobe PDF, Microsoft Excel spreadsheet, etc.)

Some links within the IMS Viewer do not reference other web pages, but documents and external files, such as PDFs, Excel spreadsheets, images (such as the logo), etc. If one of these files changes outside of the system, it needs to be uploaded to the system in the same location of the old file.

1. Open Google Chrome and navigate to the web page that contains the referenced file
2. Note the address link/path, located in the address bar:

3. The IMS Viewer has been structured such that the `home` folder is the root for the individual pages
    a. From the images above, the `controller.html` page is located within `home/er/controller/`
4. Once the path has been acquired, navigate to that location on the computer
5. To open the HTML file, right click on the file, Open With → select the desired text editor, such as Notepad++
6. Locate the referenced external file within the opened HTML file
    a. Usually, a referenced document will be enclosed around `<a>` tags
    b. If the external source is an image, look for `<img>` tags
7. Once the `<a>` or `<img>` tag is found, look for the `href` (`<a>`) or `src` (`<img>`) attribute
    a. This will contain the file path to the external file

8. Using the file path, navigate to that location on the computer to find the file
9. Replace the old file with the new one, keeping the same name if possible

Typically, in the case of the Emergency Contacts List, it'd be best to rename the file to match the old version. This will save more edits, as the Emergency Contact List is referenced on nearly every page of the IMS Viewer.

Example 3

To illustrate the above steps, assume that the handover form used by the Loggist Coordinator needs to be updated.

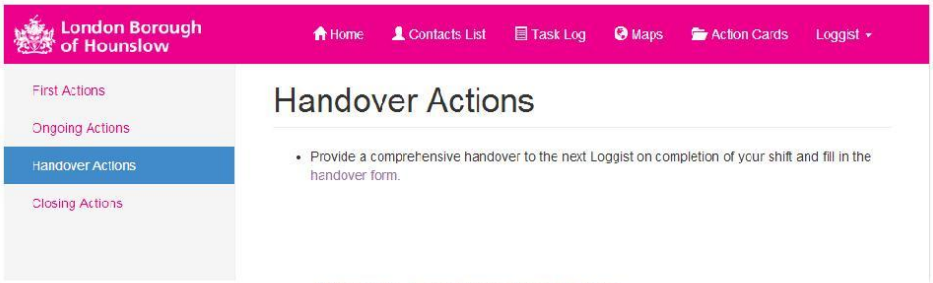


Figure 18 - Loggist Handover Actions

From Figure 18, the text "handover form" is the link to the referenced document. Looking at the code for this page, the `<a>` tag is found, as seen in Figure 19.

Figure 19 - Loggist Handover Actions HTML code

The `href` attribute references `"../handover_form.doc"`. Using this, the handover form is located a folder above where the Loggist Handover Actions page is located.

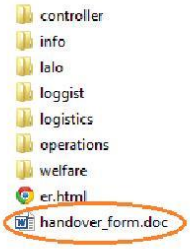


Figure 20 - Location of handover_form.doc

Now, the newer version can be uploaded and the older version deleted. A couple of points when editing external files:

- **Naming**: It's best practice to maintain the same file name when replacing an old file with a new one. For simplicity, keeping the same name as the old file will ensure that all links referenced to that file will maintain active.

  As an example, assume the new handover form had the name `handover_form_v2.doc`. If this version was uploaded to the IMS Viewer, without the name changed, the link on the Loggist Handover Actions page would not work.

  This may seem like a simple fix; changing the `href` attribute on line 83 of Figure 19 to `"../handover_form_v2.doc"`. However, the Loggist Handover Actions page is not the only page that references this handover document. Information, Welfare, Logistics, and Operations also reference this handover file. The same change made the Loggist Handover Actions page would have to be applied to these other pages as well.

  Thus, it'd be easier to simple change the name of `handover_form_v2.doc` to `handover_form.doc`.

- **Naming, continued**: When linking external documents, its best to ensure that the file names are clear, concise, and contain no spaces. Please replace all spaces with underscores, i.e. `handover form.doc` to `handover_form.doc`.

  If the IMS Viewer is ever hosted on a web server, avoiding spaces creates readable URL's.

Editing Task Log Google Form

The IMS Viewer Task Log utilizes a Google Form to record actions taken by coordinators. This is located on the navigation bar of every page in the IMS Viewer, making it accessible to all users.

1. Open Google Chrome and navigate to https://drive.google.com
2. Log in using the following details:

   a. Email: ecc.controller@hounslow.gov.uk
   b. Password: ********

3. Once the page has loaded, click on the **IMS** folder, then the **Task Log**
4. In this folder there should be two documents:
   a. **Incident Task Log** – the Google Form used to record actions
   b. **Task Log Responses** – the Google Spreadsheet that contains all recorded actions
5. Click on **Incident Task Log** to open it in a new tab for editing
6. In this page, you can now edit/add/delete fields as required. For further documentation on Google Forms, please refer to https://support.google.com/drive/topic/1360904?hl=en&ref_topic=2811744
7. All changes are saved automatically, so after completion of editing, simple close the page.

These changes should be propagated immediately to the IMS Viewer. To confirm, simply open up the IMS Viewer and click on the Task Log link at the top.

Please note, that these changes MUST be made using the ecc.controller@hounslow.gov.uk account.

Alternatively, if the Google Drive application is installed on the computer, the Incident Task Log can be accessed that way. Again, this would have to be done from the Controller computer.

Appendix J Current System Analysis-Complete Analysis

The current Hounslow system is approximately 10 years old, though nobody is perfectly sure of its actual age. Created by Joseph McFarland, who hasn't worked in the department for over 3 years, this system is antiquated and in need of an update. Richard Davill, one of the members of the CPU, told us that in the two years he has worked in the department he hasn't used the system once. He claims that trying to use the system actually slows the team down, as they are much more savvy using a pen and paper than clunking through the old system. In fact, when Mr. Davill was attempting to show us the system for the first time, he could not even locate the system on the server (Davill & Axelsen, 2014).

System Platform

Currently, the Hounslow system is a series of web pages stored locally on each computer. Designed in Microsoft Word, these web pages are purely functional and lack aesthetic appeal. Figure 27 shows a screenshot of the current EMIS.

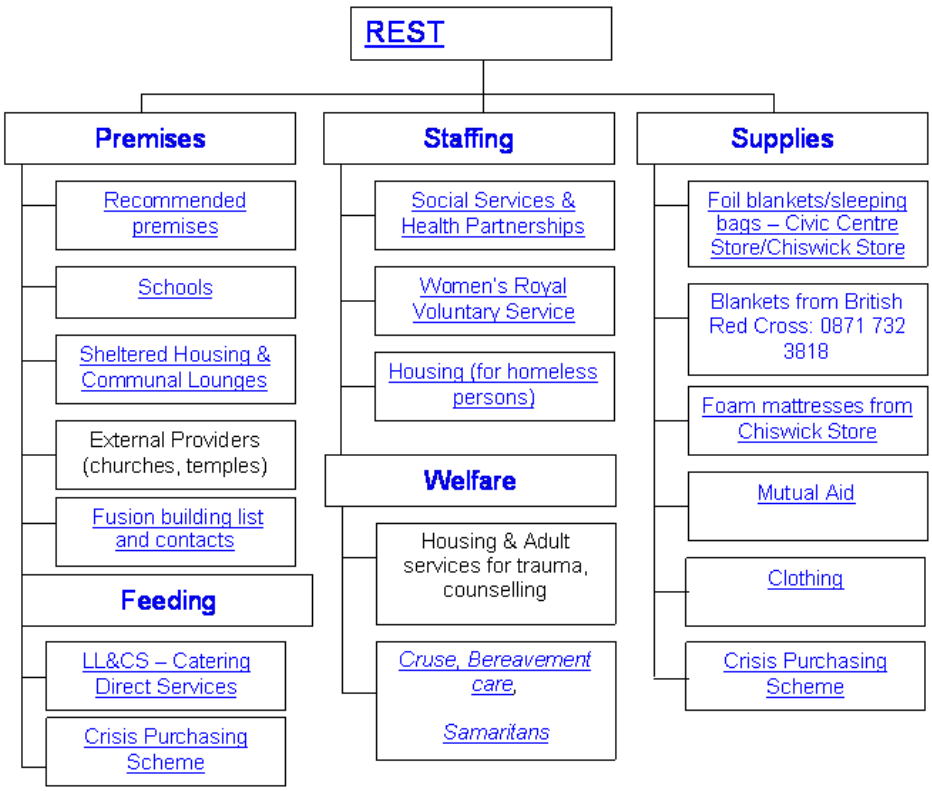


Figure 27-Screenshot of Current EMIS

All of these folders are stored on a local network drive. When a link is selected from the "Incident Management System" (what they call their EMIS), the viewer links to the desired webpage in the folder and opens it up. If the link is to a document, the viewer links to that document, which then opens in its respective viewer (i.e. Microsoft Word, Microsoft PowerPoint, Adobe Acrobat, etc.). This system structure limits the potential of the system to be run on all computers. Since the viewer references local files, if a copy of the system is placed on a different computer, the viewer will not operate effectively unless it is placed into a folder that has exactly the same file structure as the folder

from which it was designed. Additionally, this system is not capable of being run on any computer; any computer it is run on must have the Microsoft Office Suite installed.

The local hosting of this system also offers a number of drawbacks. This means that each system is distinct from all other systems, that is, they are not able of communicating with one another. Currently, the team operates without communication between the systems. All messages get transcribed from people manning the phones and emailed to whoever they are designated for. All completed actions and tasks are manually written down in a paper log. Additionally, the discrete nature of the system makes information security an issue- anybody with access to the common "Environmental Services" drive is capable of opening the viewer and viewing the confidential information within.

Upon using this system, we found that it was cumbersome to use. One of the most prevalent problems was the actual system itself- when using Chrome, the viewer had a tendency to go unresponsive, while the system took a noticeable amount of time to load when run in Internet Explorer. Thus, neither of the browsers were ideal for using the viewer.

Additionally, we found the organization of the menu page to be confusing. From an overall design standpoint, the idea was well thought out- each coordinator has their own series of links to help them achieve their objectives. However, this organization was not well executed, since each coordinator was able to see the links of all of the other coordinators as well. To us, a group of inexperienced system users, all of these links were very distracting and provided far more information and options than were needed. Since the users of this system are most often people with little training in emergency management (like us), it is vital that the system present information in a clear and intuitive manner.

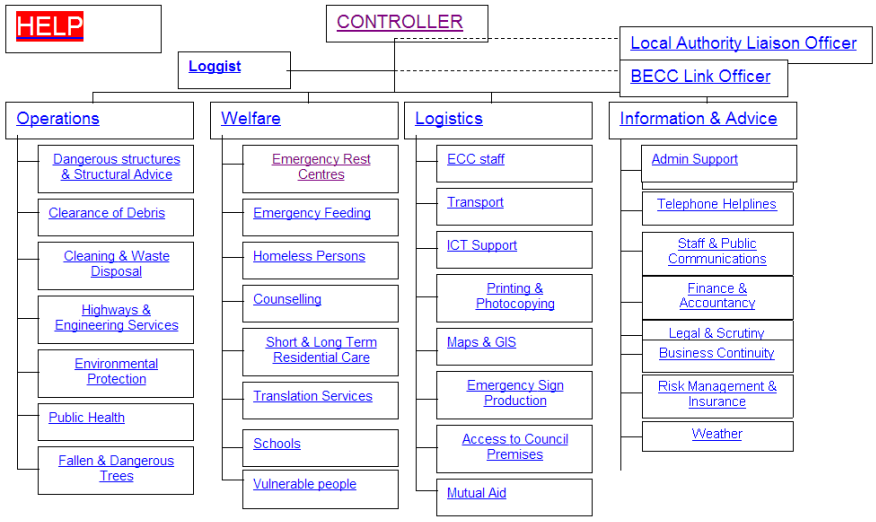


Figure 28- Hounslow EMIS homepage

Despite its drawbacks, Hounslow's current system shows some potential. The functional organization by coordinator is a great idea for users who have minimal experience in emergency management. This framework puts all of the information that they need at their fingertips and prevents them from having to scour a list of links in order to find it.

There are, however, a number of attributes of the Hounslow system that could be improved. If the system were based on a server, cross-talk between the users and the system could occur and users could communicate with one another through the system. Additionally, the current system has no integration of various techniques employed by emergency management agencies, such as mapping applications or the ability to do a twitter search. Improved functionality in these areas, as well as an increase in aesthetic appeal of the system could allow for increased usability and performance.

Appendix K Notes from Observation of Emergency Response

Another critical aspect of the EMIS design involved observing the emergency response effort in action, such that we could identify traits which would be used in a new system. While working in Hounslow's Emergency Control Centre, we were able to observe an actual emergency response. Although the emergency we observed was minor, and the EMIS would probably not have been used, the observation provided useful information regarding EMIS design criteria.

The emergency began on 24/3/2014 at 11:07 a.m.; a call from the London Fire Brigade (LFB) alerted the Borough Emergency Control Centre (BECC) of a flat fire in Northwest Hounslow. Immediately, the CPU officers came into the Emergency Control Centre and took the positions of controller and loggist. In addition, a third officer answered and dialled phone calls and began writing critical information, such as important contacts and addresses, on white boards around the room.

The first major step taken was to recruit a local authority liaison officer (LALO). The potential LALO was notified as soon as the BECC was activated by the LFB. As soon as the borough determined they would be involved in the response, the LALO was brought up to the BECC and briefed. The LALO was given a "jump bag," containing food, water and paperwork that would be needed, and dispatched to the scene. After he left, the BECC decided on a contact schedule with him, in order to maintain a constant stream of information regarding the incident. In addition, the BECC began investigating the property affected by the emergency, which they learned was managed by Hounslow Homes. They then contacted them and gained information and clarified responsibilities. It turns out that Hounslow Homes was responsible for managing the emergency. The BECC wound down by contacting all people involved in their response and notifying them of their last responsibilities before standing down. All logs and writings were collected and filed away.

Communication was central to the entire response. Communication with the LFB, the police, the LALO, others in the Hounslow Civic Centre, as well as Hounslow Homes, who were later identified as a key player, was constant and essential. Communication took place through phone calls. In addition, essential information was written on white boards in the BECC. This information included contacts, people at the scene, a summary of events, and a horizon scan. Notes were often taken on pieces of paper.

The entire event was also recorded by the loggist. The loggist filled out an events log on a Microsoft Word document. In addition, all members filled out their own paper log books. The loggist received information verbally as it happened. A final situation report was compiled at the end of the emergency, outlining each step taken by the BECC and their actors.

Massachusetts Emergency Management Agency

As preliminary research to aid the design of Hounslow's emergency management information system, we contacted the Massachusetts Emergency Management Agency (MEMA) to review their use of EMIS. MEMA is located in Framingham, Massachusetts and oversees emergency response for all 6.6 million residents of Massachusetts. During our site visit, our tour guides, Mr. Hengen & Mr. Bagdonas, were very helpful in showing us the inner workings of the MEMA system (2014). Currently, MEMA uses two systems to help them plan and manage emergencies. WebEOC, a web-based EMIS, allows for emergency responders to upload pictures of the scene, fill out activity logs, as well as provides live information regarding weather. Previstar, the other system used by MEMA, provides resource allocation across the state. Together, these two systems comprise the EMIS employed by MEMA to aid in emergency management and response.

WebEOC

WebEOC, a software provided by Emergency Services Integrators, is described as a "web-enabled, user-friendly, and locally-configurable incident and event management system" (ESi, 2014). As described by Mr. Bagdonas, the Facilities and Technical Services Unit Manager for MEMA, WebEOC provided a simple to use system, with a high-level of customization. A few key components of WebEOC were showcased to us as absolute necessities of an EMIS. These included an electronic task log, message board, and weather radar and forecast integration.

Compared to the traditional pen and paper method of logging emergency actions, WebEOC's electronic task log provides a way to easily share information instantaneously between emergency responders. Once a task log is filled out, the information is then stored in a database that is easily accessible by any other emergency responder accessing the same WebEOC server. This provides real time information throughout the system, and no longer relies on phone calls to the control centre to inform other responders of the incident.

Although the information from the task logs are recorded and saved to a central database, WebEOC provides customization that allows a user to display the task logs in a message-board style page. That way, as task logs are filled and saved, the personnel at the control centre can have this dashboard-style page up on a central screen that will update as new logs are filled out. This tool supports communication throughout the command structure of emergency personnel.

WebEOC also provides integration for weather services and GIS. MEMA customized a module to contain live weather maps and radars, providing instant access to different weather information feeds. These external systems are essential to the overall planning and management of an emergency and with the integration of such systems, emergency responders can relay information fast and efficiently.

These were a few of the components of WebEOC, and are by no means the complete set of possibilities to use this system for.

Previstar

MEMA also uses Previstar's RESOURCE Manager, in order to facilitate the "coordination and oversight of personnel, tools, processes, and systems" to support emergency response (Previstar, 2014). To clarify, if other towns need to request more resources, such as sandbags, Previstar provides an

inventory database to track all available resources for deployment. This provides a structure for smaller towns to follow if they wish to formally request resources to be deployed during an emergency. Resource allocation is certainly an important concept that will need to be applied to Hounslow's EMIS, as per their Emergency Management Team roles, which include (Contingency Planning Unit, 2013):

- Provision of engineering services and emergency signing
- Welfare provisions of staff, resident and evacuees
- Sourcing additional resources through mutual aid

Although Hounslow requires a "home-brewed" solution, Previstar provides a good example of how a resource allocation part of the system should be designed and organized.

WebEOC and Previstar are commercial solutions to creating an EMIS. They provide a large amount of functionality. However, they can be hard to use and expensive and therefore not well suited for Hounslow. Still, several features such as a live events log and resource management tools could potential be incorporated into Hounslow's EMIS.

Hillingdon

We were able to extensively study Hillingdon's EMIS. Hillingdon has a close relation with Hounslow due to their physical proximity and potential to share emergency management responsibilities. As a result, we were able to get a declassified copy of Hillingdon's EMIS as well as interviewing its creator, Ben Pearkes. From prior research, Hillingdon's EMIS was identified as the premier EMIS in London. It has been adopted by a number of other boroughs and therefore the information gained was invaluable. All information presented here is the result of our interview with Pearkes (2014).

Platform

The Hillingdon Emergency Response Procedures (ERP) is a single PowerPoint file consisting of 135 slides, providing essential information and guides for the facilitation of an emergency. The system contains a main navigation slide, which then links to different slides within the presentation when they are selected from the main navigation slide. The main navigation slide consists of a number of elements as seen in Figure 29. The centre of the screen contains links to 7 different thematically grouped "dashboards," which provide further links to other pages. This includes links to dashboards such as ERO Silver, Gold, Capabilities, LALO, Tools and Plans. Additionally, this menu contains links to Contact Lists and "How to" pages. Mr. Pearkes showed us how each slide contains a summarized version of a protocol, which is essentially a list of action items "without the politeness" detailed in the formal protocols (Pearkes, 2014). According to Mr. Pearkes, these lists, which encompass tasks such as printing (listing the locations of the nearest printers, etc.) to accessing the GIS, give system users rapid access to information which might not be obvious under possible working scenarios.

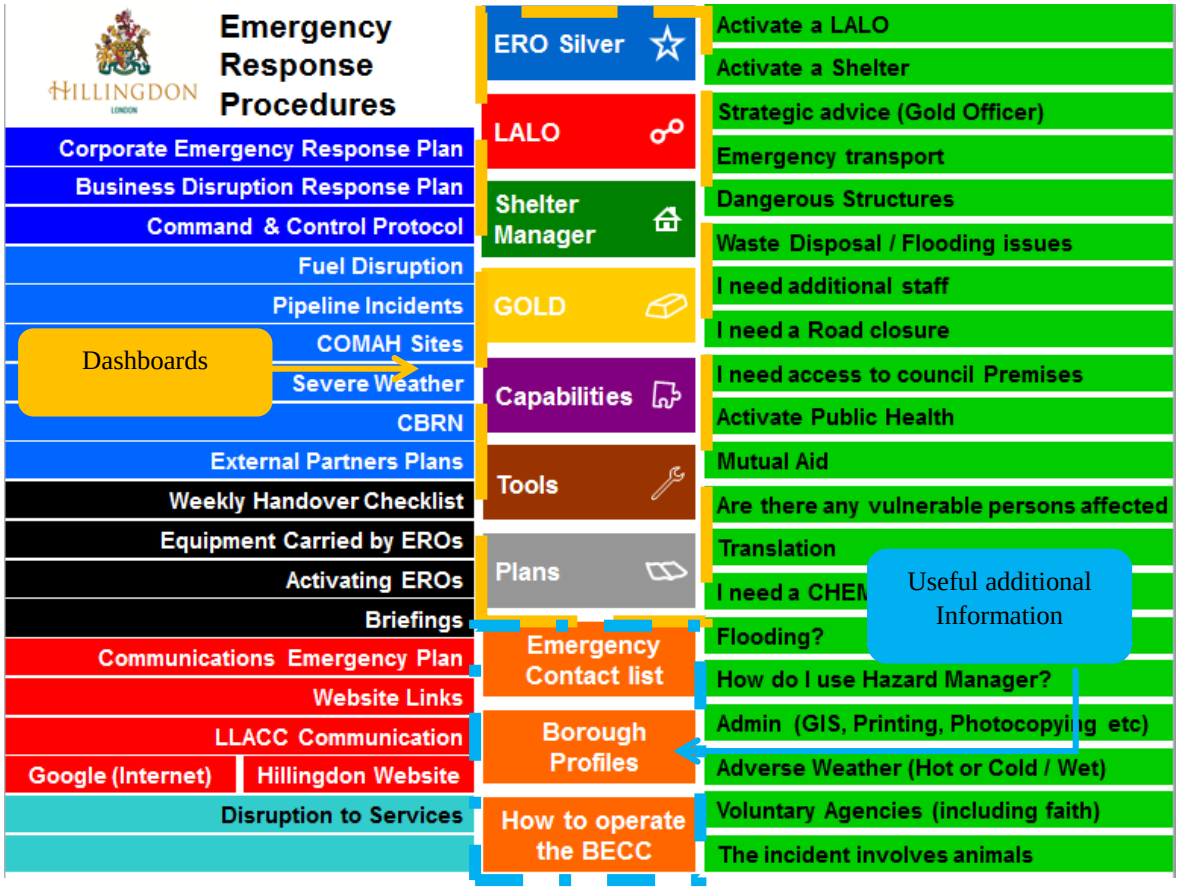


Figure 29- Screenshot of Hillingdon's IMS Homepage (Pearkes, 2014)

In addition to their EMIS, they have a Google Docs setup that can be used as an event log. They still mainly use paper logs because they are easily transportable, cheap to create, and can hold up in court. They possess a cabinet which is solely used to store their event logs. The Google Docs log is still a work in progress; they don't use it for logging but they are exploring the possibilities of it in the future. Google Docs was selected because it is cheap, easy to use, and it records the revision history of the document which makes it more valuable if it had to be taken before court.

The Hillingdon ERP was created three and a half years ago and has been under constant revision ever since. Mr. Pearkes, the creator of the system, has spent 300-400 hours crafting and refining the PowerPoint, and is currently on version 7. He believes PowerPoint is the ideal way to create an EMIS. First, he argues that PowerPoint enables the EMIS to have a small file size (the Hillingdon ERP is only 6MB). This allows for the files to be copied to encrypted USB sticks and moved to any computer that needs to run the file, which is ideal if the Emergency Control Centre (ECC) is compromised. This would allow the Contingency Planning Unit to set up a portable Emergency Control Centre anywhere where there are computers with PowerPoint installed. Additionally, PowerPoint is a relatively simple program; most people who are familiar with basic computer functionality are capable of using the program. This reduces the amount of training needed to use the system; the most advanced technique Hillingdon teaches its users is to use Alt + Tab on the keyboard to switch between windows on the computers.

In addition to ease of use, PowerPoint also offers nice, yet simple, functionality. The files are printable, which allow for users to check-off tasks and note the time as they complete them. Some additional features of the Hillingdon ERP can be seen in Table 7.

Table 7 - Features of Hillingdon's Emergency Response Procedures

Feature	Benefit
Email Integration	Pre-address emails to coordinators and LLACC to save time and ensure email gets to where it needs to be.
Briefing Structure Outlines	Gives the formulaic structure of creating a briefing so that any person can prepare a briefing.
Links to All Manuals and Handbooks	Gives users access to complete information if and when it is needed.

Mr. Pearkes also gave us advice he used when designing the system. Most of his advice focused around the user. He designed the system to be user-friendly, so that system users, non-ECC staff, can navigate easily and effectively. Additionally, he designed the system to be as self-explanatory as possible, such that the people staffing the system can use it with little to no training. Finally, he recommended that we abide by the KIS principle, that is, Keep It Simple. Overall, he argued that a complex, highly integrated and effective system is great; however, if it is too complex, people won't be able to use the system. In essence, he advocated that we design for "the lowest common denominator" (Pearkes, 2014).

Having viewed the Hillingdon system and spoken with Mr. Pearkes, we have identified a number of potential drawbacks to the system. According to Mr. Pearkes, the hyperlinks within the system fail occasionally, especially when moving the file from one computer to another. Additionally, the group has had some issues in the past dealing with compatibility from one version of PowerPoint to another. Finally, and this issue was of largest concern to us, is that all of the data is contained within a single PowerPoint file. If this file gets corrupted, all of the information is gone, unlike in the Hounslow system where all of the web pages are distinct, such that if one gets corrupted, the others are still viewable. While this issue can be remedied by storing the file in a number of places, it doesn't remedy the fact that Hillingdon has put all their eggs in one basket.

Hillingdon's EMIS is easy to use, effective, and provides great functionality. However, there are still aspects of it that can be improved upon such as incorporating an events log and increasing its robustness. As a result, PowerPoint may not be ideal for our system. However, many aspects of the functionality and design can be incorporated into our system.

Sutton

Another local borough we visited was Sutton. Located in the Sutton Police Station, the brand new Sutton Emergency Control Centre (BECC) was being finalized when we visited. Tim Arnold, a

friend of some of the CPU staff, gave us a tour of the facilities and their system. Composed of only two full-time employees, the BECC, much like in Hounslow, will recruit available, trained, members from the police station if they need to scale as a result of a major emergency. The emergency management in Sutton operates similarly to that of Hounslow, however, in place of coordinators, Sutton uses directorates. Each one of these directorates is responsible for a different resource/population. For example, Adult and Social Services will be activated for any emergency that involves adults, while the Children, Young People and Learning directorate will be activated for any incident involving children.

In a crisis situation, Sutton staffs their control centre with staff manning all of the directorates, as well as the BECC Link, which comprises one to three people who staff the phones. These people record messages and generate action items from each of the messages. These action items are then forwarded to their appropriate directorate. What is revolutionary about this system is that this messaging system/task-log is digital. BECC Link members enter messages and tasks directly into the Access-based task log and the system transmits the tasks to each of the directorates, who can then enter their actions directly into the system (Arnold, 2014).

System

Sutton's EMIS is composed of two parts. Their EMIS proper is a modified version of Hillingdon's PowerPoint. Though this system has never been used for a real emergency, Mr. Arnold believed that this system has potential to aid in their response effort, though he does acknowledge that the PowerPoint format has its drawbacks. He states that, although simple to use, the PowerPoint is a pain to update, due to the lack of time and lack of knowledge he and his team possess. Additionally, he argues that PowerPoint is limited by the number of links one slide can show. Unlike a webpage, PowerPoint does not provide a scroll feature which limits the amount of space available on a page.

One unique aspect of the Sutton system is their task/message logging database. This system, which they had custom designed for their unique needs, has been in development for the last year and has cost upwards of £10,000 to develop. When run, the system allows for the creation of unique incidents. At the start of an incident, the ranking officer will initiate a new incident, adding critical information to the profile such as the name of the incident, the incident number, and a brief description of the incident. Once the new incident has been created, members of the BECC Link can begin recording messages and tasks into the incident. This interface allows the user to add in important attributes, such as who the message is from, which organization they are from and information on how to contact them. The user interface is shown in Figure 30.

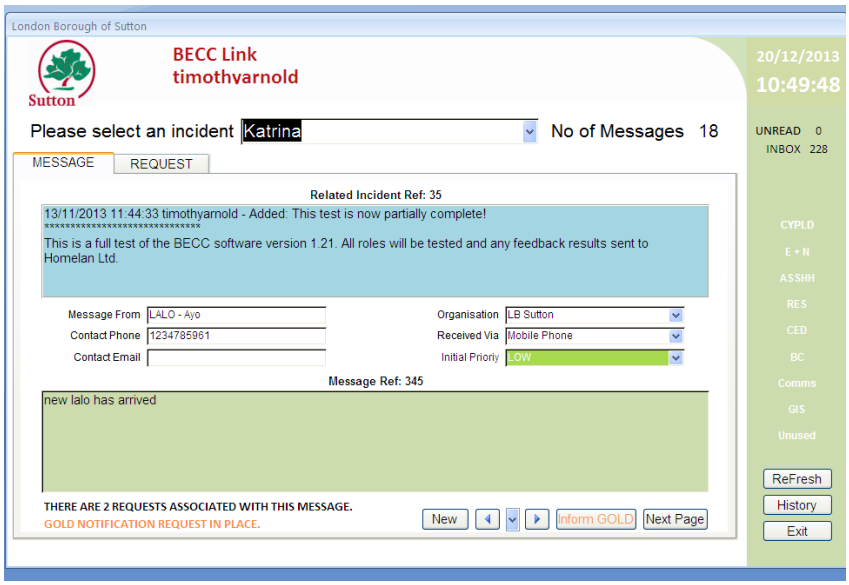


Figure 30- Message Logging Interface (Arnold, 2014)

After entering the message information, the BECC Link staff member moves to the Requests tab to assign action items from the message to the appropriate directorate. A sample UI from the Request tab is shown in Figure 31.

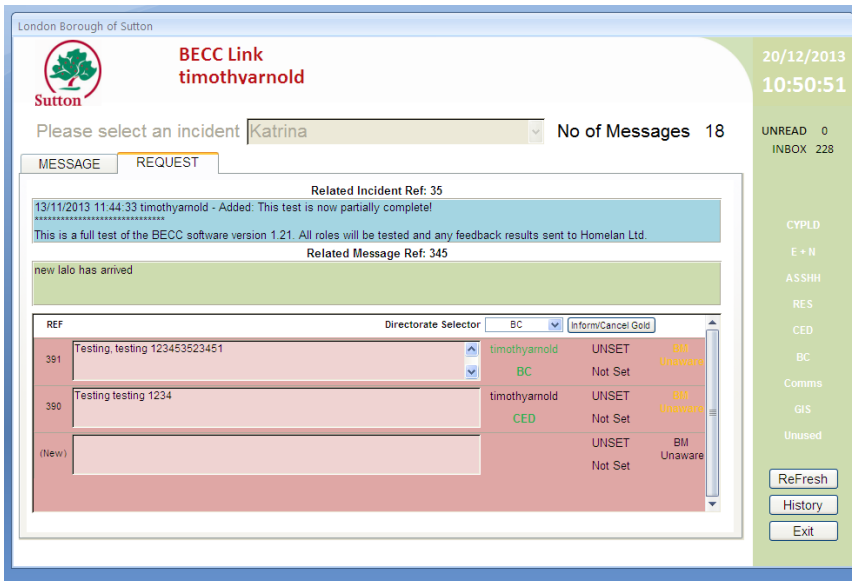


Figure 31- Request Screen (Arnold, 2014)

From within the request screen, the BECC Link staff member can report action items and assign them to different directorates for action.

Directorates view their assigned tasks on a task log screen, shown in Figure 32. From this screen, they can manage all of the tasks assigned to them by any of the BECC Link staff. They can also read the

original message and alter the status of the task, selecting from “Waiting”, “In Progress”, “Completed” or “Unread.” Each directorate task page shows only the tasks assigned to that directorate.

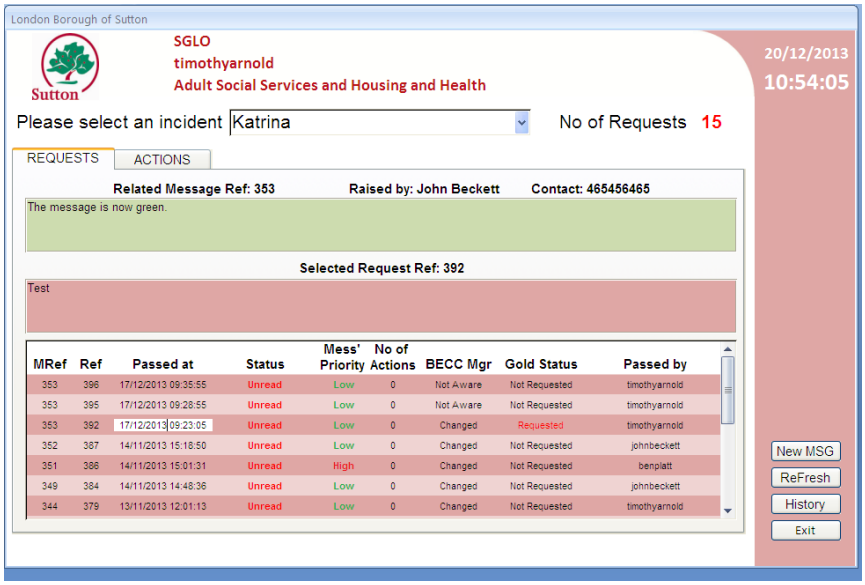


Figure 32- Task Log Screen (Arnold, 2014)

One of the nice attributes about using Access is that the database can be designed so it recognizes the username and automatically stamps every action with the username and time it was performed. Since all of this information is contained within a single database, it localizes the information in a single entity as well, meaning that users don’t have to keep track of dozens of emails. Additionally, the database architecture means that users only see the messages that pertain to them which prevents information overload and increases efficiency.

There are a number of drawbacks associated with using an Access Database. First, this database showed significant lag which makes data entry frustrating. Additionally, the system is relatively complex. As new users, we found it difficult to operate the system and believe that the system was not intuitive. Although we had a 15 minute training session, it was not enough to allow us to navigate the system to a level that would be sufficient. Mr. Arnold also told us that the one downside with their system was its lack of integration with the PowerPoint IMS. For constructing a new IMS, we will look for ways to integrate the functionality of the access database into the IMS system.