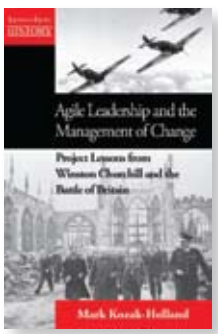
The Bentley Priory Operational Center Map Table gave a real-time view of invading German forces. Decision makers sit in the gantry above the map.

LESSONS FROM HISTORY

HOW THE SENSE-&-RESPOND METHOD HELPED IN THE BATTLE FOR BRITAIN

BY MARK KOZAK-HOLLAND



Today's 9-1-1 emergency call system is typically composed of three technologies: enhanced 9-1-1 (E9-1-1), computer-aided dispatch (CAD) and geographic information systems (GIS). This allows dispatchers receiving 9-1-1 calls to optimally deploy resources to provide the best possible outcome. It tracks the response by modeling it on maps in real time. It also allows for post-incident analysis.

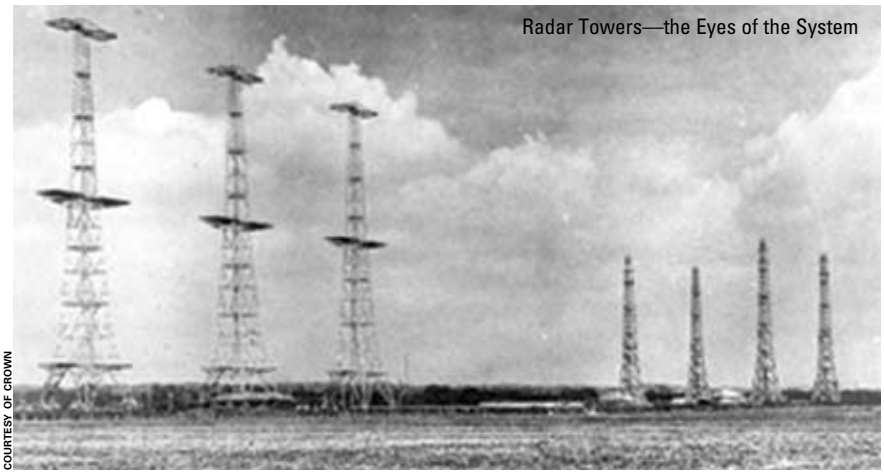
This article discusses how all these concepts were brought together back in 1940, when the first call and dispatch systems became operational for the military, and draws lessons for today's world.

INTRODUCTION

In May 1940, the U.K. faced the greatest crisis in its history. Unprepared for war, the U.K. was facing a potential invasion after the disaster of Dunkirk and the defeat of France. With no land defense and a shattered army that had left most of its equipment on the beaches of Dunkirk, Prime Minister Winston Churchill realized the last hope was an air defense. The Royal Air Force (RAF) Fighter Command had already sustained massive losses of 500 operational fighters in the air battle over Flanders and France. Air Marshal Hugh Dowding knew Fighter Command was grossly understrength, with 620 operational fighters about 50% below its set target (in 1939), the minimum number thought necessary to win an air battle. These fighters were outnumbered by the Luftwaffe, Germany's air force, by a ratio of 2:1, so Dowding had to very carefully deploy these in the forthcoming air battle.

Dowding had established Fighter Command in 1935, with its headquarters at Bentley Priory in Stanmore, Middlesex. He had great determination and foresight in fighting the "old guard" of senior military chiefs and politicians who wanted to equip the new RAF with inexpensive, but well-tried, string-and-canvas biplanes.

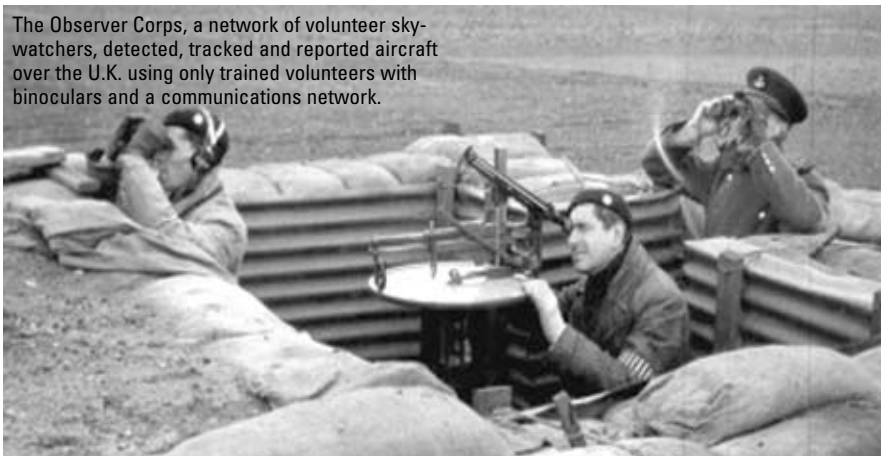
Dowding was aware that the Air Ministry was very slow in scaling up its fighter production schedule and unlikely to reach its minimum targets for many years. So he looked to other means to


Radar Towers—the Eyes of the System

COURTESY OF CROWN

COURTESY RAF UXBRIDGE GROUP II HEADQUARTERS

The Tote Board helped decision makers determine what response was necessary during a battle. The operations room clock tracked the battle in five-minute increments.


The Observer Corps, a network of volunteer sky-watchers, detected, tracked and reported aircraft over the U.K. using only trained volunteers with binoculars and a communications network.

assist his fighters and created a call-and-dispatch system.

Dowding invested in alternative technologies. *Example:* In 1935, he asked Watson-Watt to follow a line of research that led to the world's first operative radar network, Chain Home, which became operational in 1937.

In 1936 the Observer Corps became part of the newly formed Fighter Command under Dowding. This was a defense warning organization that provided a system for detecting, tracking and reporting aircraft over the U.K. using nothing more than trained volunteers with binoculars and a communications network.

One of Dowding's most significant contributions was the physical organization of Fighter Command. He created a geographically distributed hierarchy and network of stations (Group and Sector) and air fields all networked to his headquarters. Each sector had a main fighter air base, with an operations room, maintenance and repair facilities, and a number of other satellite fighter bases attached to it.

In August 1939, despite the lack of funding, Dowding, through his preparation and prudence, had made the right investments to create all of the basic components of a complex but sophisticated sense-and-respond system.

BECOMING OPERATIONAL

By June 1940, an integrated air defense system that followed the basic sense-and-respond concepts (see Figure 1, p. 37) was almost ready. These same concepts are what we would see in today's CAD systems.

It became known as the Dowding System and has three unique mechanisms:

1. *Sensing:* Integrated into Bentley Priory operations room was an early warning system—consisting of radar, Observer Corps, pilot sighting and Ultra-decoded messages (*Ultra* was the code name given to the highly classified code-breaking operation that broke the German Military Enigma code)—notifying them to the Luftwaffe's location in the sky.
2. *Decision making:* This was institutionalized within the operations room through the use of real-time event models to allow personnel to analyze possible actions and decide on the best course of action.
3. *Responding:* A system feeding information to a distributed hierarchy of Group/Sector operations rooms capable of responding to the threat by taking action and measuring progress toward goals.

We see these three mechanisms in today's CAD systems. For example, within an EMS environment:

1. *Sensing:* E9-1-1, provided by the phone company, allows the EMS dispatcher to identify the location of a caller. CAD displays the location of the incident (emergency situation) through GIS.
2. *Decision making:* The dispatcher identifies the requirements for the incident and the type of response necessary. *Example:* Basic or advanced life support ambulance service or a tiered response involving other agencies. The dispatcher uses CAD to identify all available resources, and their locations, and determines the proximity of the closest and most appropriate emergency response vehicle required to respond.
3. *Responding:* The dispatcher assigns the unit to the location of the emergency and dispatches it. The ambulance crews are provided with all pertinent information, including a MPDS response determinant and, where applicable, the legal land description, and a map book page number of the call's location. CAD manages the resource status and displays its availability.

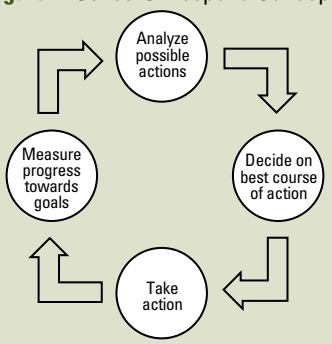
THE 1940 DOWDING SYSTEM

Sensing: At Bentley Priory, the Filter Room was the communications hub that aggregated disparate information collected from multiple sources (radar, observers, pilot sightings and Ultra-decoded messages). The combined information accurately indicated where the Luftwaffe planes were (coordinates, height), the number and size of formations (number of aircraft with mix of fighters and bombers, and their types), the direction they were heading and their speed. This information was integrated in real time and passed directly into the operations room.

Decision making: In the operations room, the information was passed to WAAFs (Women's Auxiliary Air Force), which displayed it on a sophisticated model, the Map Table, depicting the skies over the U.K. Using croupier sticks, they moved colored counters representing aircraft formations. These formations were sequenced to the operations room clock to provide five-minute increments of the evolving air battle overhead.

At every increment, new colors were added to show the progress of a raid in real time. This provided advanced warning so decision makers in the gantry above the map could readily track the incoming raid in real time and analyze possible actions. They could then use the tote model to determine what fighters were available and how they could respond. The tote model reflected what squadrons were in what sectors (locations), in what state. They could then decide on the best course of action.

Figure 1: Sense-&-Respond Concepts



Responding: Bentley Priory fed this information to a distributed hierarchy of Group and Sector operations rooms. They were capable of responding to the threat by taking action at a local level. These operations rooms were smaller but identical, with map tables, and were capable of measuring progress of the ensuing air battle. Fighters were individually vectored to points in the sky, typically above the Luftwaffe formations. Luftwaffe pilots were astounded that RAF pilots were always waiting for them.

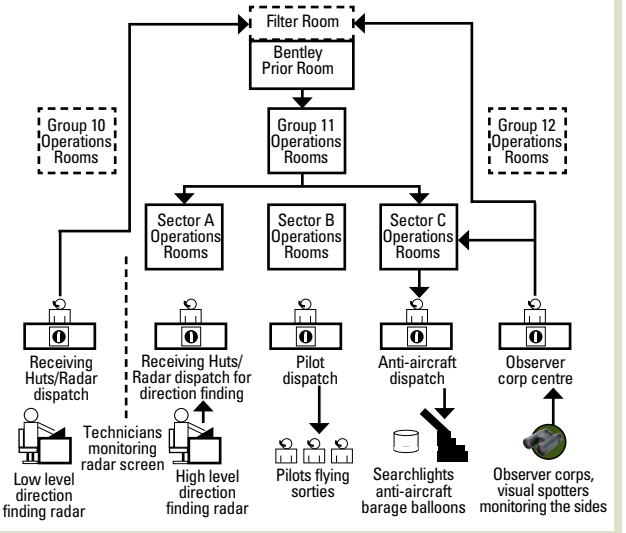
Post-day analysis: Every day, metrics were collected on the battle results. For example, they compiled the number of losses for both the RAF and Luftwaffe, pilot casualties, operational status of aircraft, and fuel and ammunition stocks (see Figure 2, opposite). A detailed analysis was done with these metrics and pilot operational reports. Tactics were then adjusted accordingly for the next day. Through this approach, Dowding was skillfully able to preserve his precious fighters and not get drawn into a battle of attrition.

OUTCOME

The sense-and-respond solution reduced the number of fighters required because they were vectored to specific targets and did not waste time and fuel looking for Luftwaffe formations. This maximized the effectiveness of how fighters were used and magnified the air force size. RAF pilots flew multiple sorties per day (three to four), so the overall number of available fighters started to match the Luftwaffe's strength.

Likewise in today's world, a CAD system can have an enormous impact on the number and disposition of emergency units, to provide the best possible outcome.

Figure 2: RAF Fighter Command hierarchy and the complete picture showing analysis from the sense-and-respond method.



SUMMARY

The completion of real-time event models and institutionalized decision making influenced the course of the Battle of Britain and tipped the scales for the RAF. A sophisticated call-and-dispatch system can do the same today by, seemingly magnifying the number of resources available to a dispatcher and the quality of service. ||PSC||

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Note: All references for historical facts mentioned in this article can be found in *Agile Leadership and the Management of Change: Project Lessons from Winston Churchill and the Battle of Britain* by Mark Kozak-Holland, published by Multi-Media Publications Inc., Oshawa, ON, Canada, in September 2009.