Hivemind Beehive Monitoring System Field Trial and Management Practice Change Study Report

Yuan Xia, Dr Stuart Charters (Lincoln University), Christian Walsh (Hivemind)

Introduction

The current Hivemind Beehive Monitoring System aims to provide timely information to beekeepers on the current status (weight and temperature) of their hives through a central hub and wireless scales backed by an online portal. This study through survey and field trial gathered data on beekeepers views of the installation and operation of the system and gathered data on hive performances in the field.

System Description

Figure 1a Hivemind Hub
The Hivemind system is depicted in Figure 1a&b and consists of a central hub with satellite communication capability and up to four wireless scales.

Each scale consists of two bars containing load cells, one bar is the master and contains a radio to communicate with the hub, a connection button and a small speaker to allow the scale to provide audio feedback. Data is transmitted to the central hub every six hours. The central hub reports data once a day and the data are shown to the beekeeper via an online portal.

The current version of the system presents an evolution of the system from the first generation product in which the scales were connected to the hub through wires.

Field Trial Setup

To evaluate the system a field trial with Hivemind customers was established. The trial consisted of ten participants, five in the North Island and five in the South Island with 22 sites and therefore systems in total. Sites had between one and four scales attached to their data hub with a total of 87 hives being monitored in total in the trial. Most of the trial participants have not previously used the Hivemind system. Hivemind systems were shipped to customers during December 2014 with customers installing them during December 2014 and January 2015. Each participating customer completed an installation questionnaire online or participated in a face-to-face interview to discuss their installation experiences.

Ten customers participated in the field trial, 70% of these are using the system to monitor hives in manuka honey producing areas. For most customers their equipment was located within three hours travel time across a variety of forested and open pasture locations with honey being harvested twice a year. During the season customers visited hive sites every three to four weeks for monitoring and disease control purposes. The total number of hives per customer varied but over 80% had more
than one thousand hives across multiple sites. During the field trial participants installed and operated the Hivemind equipment and software themselves.

Data collected by the system was made available to the researchers for aggregation and analysis and customers completed a questionnaire on the operation of the system and changes to their hive management routines and practices following installation.

Trial Findings

The trial findings are discussed in three parts, installation, operations and data analysis.

The installation and operations sections report the results of the interviews and questionnaires that customers completed based on their experiences with the system.

The data analysis section reports the results of analysis of aggregated data from all sites in the trial

Installation

The aim of the field trial was to discover any issues with the installation, setup and configuration of the Hivemind system.

All installers of the Hivemind system found the physical installation to be straightforward with the provided instructions being easy to understand and regarded as useful.

The trial revealed a variety of hive installations – including some on pallets, for these configurations of the Hivemind system required modification to correctly measure the weight of palletised hives.

The installation and configuration process revealed issues with the placement of the hub relative to the scales to ensure good wireless connectivity. Specifically metallic components of the lid and strap surrounding the hive could interfere with the signal. This was resolved by moving the hub so that it was suspended at the edge of a hive lid rather than in the centre.

The scales are equipped with a small speaker that reports the connection status between the scales and hub. This approach worked reasonably well when one scale was being configured but participants felt a visual indicator on the hub would also be useful particularly when multiple scales are connected to the one hub. For a couple of participants the connection knob caused issues – either being overly sensitive or stiff. Participants also added extra protection to their systems to prevent damage from rodent, stock or inclement weather.

Operations

To determine the impact of the Hivemind System on beekeeping and honey harvesting operations a questionnaire was distributed monthly after installation of the system. The questionnaire gathered data on the performance of the Hivemind system and the impact of the system on business operation.
Analysis of the results is tempered by the fact that the Hivemind system was installed by most customers after the peak of the honey season, therefore the full impact of the system on their operations could not be assessed.

Participants reported that they believed that the system was reporting accurate weights for hives although accuracy of temperature readings was questioned by a number of participants.

Unexpected impacts reported by participants included at monitored hives sat higher than other hives at their site (due to the scales) and may have made them more vulnerable to honey robbing by bees from other hives, this is still being investigated. This resulted in the data reported for these hives not being an accurate reflection of the performance of the whole site.

Participants reported that the system helped manage timing of visits to their hive sites with half of respondents altering the timing of visits and one cancelling a site visit due to information gathered through the use of the Hivemind system.

Comments below reflect some of the views about the impact of the system on operations now and into the future.

“No visits this year until harvest vs. 2-3 last year.”

“The system helps with the timing of supering”

“More efficient operation”

“no not yet, but would do in the future”

“We haven’t made any changes due to only getting it running late in the summer time but hope to see if it changes what we do in the spring time next season”

Some participants reported that they had made changes to their system after the initial installation to protect from wildlife or to improve the wireless signal between scales and the hub unit. Weather protection for the system was a consideration for some sites.
Participant’s use of the online reporting system, shown in Figure 2, varied from using the system multiple times a day to only occasionally logging in. In some cases infrequent use of the online system was due to the installation of the scales and hub being after the main honey production time. Some sites suffered from intermittent data reporting further investigation is required to fully determine the cause of this.

Data Analysis
The Hivemind system reports weight and temperature data at six hourly intervals. Data is transmitted via satellite data connection each six hours and the data displayed in the online portal.

To aggregate and analyse the data we grouped sites by location into North Island sites and South Island sites. This grouping was to allow any variations due to location or climate to be observed.

Mean, Maximum and Minimum daily weight change and temperature for each group was calculated. The daily weight change for a hive was calculated by using the first reading of the day. This was to reduce issues with detecting super changes, bee movements and other weight fluctuations during the day.

Weight changes due to supers being added or removed were disregarded and adjacent values used to interpolate weight change.

The charts below show the Weight Change per day with, average, maximum and minimum values plotted.
Average temperature for each day was calculated and plotted against the average weight gain for both North and South Island. Data is too limited for the harvest season to be able to draw definitive conclusions between temperature and harvest gains. However a positive correlation between temperature and honey gain in the South Island exists.

Conclusions and Limitations

Complete evaluation of the system is difficult due to the late start of the field trial in relation to the honey harvest season. However the trial did demonstrate that participants could easily install the physical aspects of the system – identifying some issues to be resolved and making suggestions for improvement to the system overall.

Operation of the system has demonstrated the accuracy of weight measurements by the system, although uncertainty remains around temperature data. To better understand the performance of the system it is recommended that the system be run for a full season with a reference hive at each site of a known static weight and a weather station to collect environmental data.

Participants recognised the value of the data provided and in some cases were able to make use of the data to change operational visits to hives to improve productivity. In the majority of cases participants had the system operational late in the season and did not have sufficient opportunity to make operational changes for this season but felt that they would make operational changes in future seasons with the system in use.

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