What are the potential benefits?

The benefits of automated heat detection will depend on the current herd reproductive performance, how well the automated heat detection performs on a particular farm and the drug and labour costs associated with the current herd management. The greatest benefits will occur in herds with previously high drug and labour costs and poor reproductive performance. Many manufactures have used their own case study herds to calculate a payback period and return on investment. Reported pay back periods range from 1-3 years and depend on the assumptions and figures used.

The following are a list of potential benefits of a well performing automated heat detection system:

- Improved reproductive performance (if currently less than optimal)
  - Mostly through increased submission rates
  - Possibly also increased conception rates (if current timing of AI and heat detection accuracy are poor)
- Increased revenue from improved reproductive performance
  - Increased milk production
  - Increased replacements available
- Reduced labour costs from less time spent on
  - Observing heat
  - Administering drugs
  - Identifying and drafting cows for AI
  - Pregnancy testing cows (more cows are likely to be pregnant at each pregnancy diagnosis reducing the average number of pregnancy tests per cow)
- Reduced direct costs
  - Reproductive drugs
  - Pregnancy diagnosis
  - More efficient use of semen

What features are important when choosing a system?

- Method of data transfer from cow device to receiver
  - Close contact data transfer may limit the ability to compare cow activity against the herd until milking is complete.
  - Close contact systems may not be suitable for non-lactating animals.
  - Long distance data transfer can allow real time updates of cow activity and may detect calving cows in springer paddocks and help identify lame or sick cows in the lactating herd.
- Battery life and ability to replace batteries
  - The expected battery life of different devices ranges from 2-10 years.
  - If batteries cannot be replaced then device life is limited to the battery life.
  - If batteries can be changed then consider the extra time and labour required.
  - Battery saving features may be available, such as the ability to turn on and off when not in use and the ability to change the data transfer frequency.
- Warranty
  - Full replacement warranty ranges from 1 year to 5 years.
  - Some systems have a full warranty period followed by a pro-rata warranty.
  - Extended warranty can be purchased in some systems.
- Ease of attaching and removing devices from cows
  - Some farmers have given up using or limited their use of this technology solely due to the inconvenience of changing devices.
  - Very important if you plan to move collars from cow to cow to reduce investment in collars.
  - Straps may be difficult to undo after some time.
  - More important if the battery life of the device is limited.
- Neck versus leg attachment of the cow device
  - Facilities and OH&S involved (may differ for cows and heifers).
  - Cow comfort.
  - Durability in wet muddy conditions.
  - May depend on whether cows are housed or paddock grazed.
- Additional features
  - Rumination monitoring may improve heat detection capability and also provide early detection of sick cows and changes in feeding pattern.
  - Tri-axial accelerometer sensors may provide other useful information such as identifying lame cows, downer cows and grazing/eating activity.
- Algorithm optimisation
  - Some systems allow optimisation for the farm.
  - Some systems automatically optimise over time using confirmed heats and pregnancy data.
- User interface, including the location of data storage and the options to access and control the system, affects the practical application of the technology:
  - All data stored, accessed and controlled on a base PC.
  - Data stored and controlled on base PC with data access from smart phone or other internet device.
  - Data stored on base PC with data access and control from smart phone or other internet device.
  - All data stored in internet based cloud application and all access and control available from any internet device.
- Integration with current setup
  - Most systems can operate as a standalone system or in conjunction with their own herd management software, automated drafting and/or milking equipment.
  - Some systems can integrate with herd management software, automated drafting system or milking equipment from the other providers.
- Technical back up and ongoing support
  - Availability of skilled support for technical issues, operating the software, interpreting data and optimising algorithms may vary between providers.

For more information contact **enquiries@dairyaustralia.com.au** or call **03 9694 3700**.

Dairy Australia
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Your Levy at Work

Guide to Automated Heat Detection Technologies

This guide is designed to help you to assess the various automated heat detection technologies currently available in Australia. It outlines when to consider using such technologies, how they work, their key advantages and limitations, their likely performance and the features to consider when choosing a system.

Before purchasing an automated heat detection system you should consult your veterinarian or herd reproduction advisor to ensure that the technology is appropriate for your herd management practices.

Why use automated heat detection technology?

Detecting cows on heat has become increasingly difficult over the past few decades. Herd sizes have increased, the availability of skilled labour has decreased and there is evidence that cows are having shorter heats and their heats are of lower intensity. An InCalf study[1] found that 3-week submission rates had decreased over the past 10 years. As a result, an increasing number of Australian dairy farmers have begun to use automated heat detection technologies to save labour and improve heat detection efficiency.

Automated heat detection systems may benefit herds with poor fertility primarily due to low artificial insemination (AI) submission rates. The technology is designed to help find more animals in heat, which should increase insemination rates. Herds with high submission rates and conception rates are unlikely to see reproductive benefits but there may be savings in drugs and labour costs.

The InCalf guidelines for submission rates are shown in table 1. In year round calving herds the key measures described in the table should be calculated at least every two months in herds of 250 cows and quarterly in smaller herds.

Measure	What this tells you	Performance	
Year round calving herds			
80 day submission rate	% cows inseminated by 80 days after calving	**Seek help if <61%**	Top farmers 73%
Split or seasonal calving herds			
3 week submission rate	% cows inseminated in the first 3 weeks of the mating period	**Seek help if <75%**	Top farmers 86%

An InCalf Fertility Focus Report can also provide estimates of submission rates for your herd. This can be produced by your InCalf accredited Herd Improvement Centre or InCalf advisor or via InCalf accredited herd management software. A list of InCalf Fertility Focus Report providers in your State is available on the Dairy Australia website (www.dairyaustralia.com.au/incalf).

Automated heat detection systems deliver the most value when the herd manager is motivated to make the system succeed. Some investment in time is needed to actively manage the technology and correctly interpret the data. Cows that are flagged as being on heat only by their activity data require further investigation to determine if they are in fact in heat, so it is essential that your stockpeople are properly trained in the use of the system. It will take up to six months for everyone to learn how to use the system to its full extent.

1 Morton J (2011) InCalf Data Fertility Project 2011, Dairy Australia, pp. 60-61.

How do these technologies work?

Automated technologies are an aid to heat detection but they do not directly diagnose cows in heat. When a cow is in heat she becomes increasingly restless and this change in activity can be monitored by a motion sensor attached to the cow. Most automated heat detection systems work by monitoring changes in these patterns of cow movement.

The simplest sensors have a ball or mercury switch inside a chamber that moves from side to side creating a total activity count. More advanced sensors measure both the direction and the intensity of movement in three different planes: side to side, up and down, and front to back.

Cow motion is monitored multiple times per second to help identify different activities such as lying, standing, mounting, walking or grazing. The sensor sits inside a waterproof housing that also includes a battery, a miniature processor for processing the data, a memory device for temporary data storage (usually up to 24 hrs) and a data transmitter.

The monitoring device is attached to the cow by a leg strap or a neck collar (which may be weighted to keep the device in position). Earlier devices downloaded activity counts in 12 hour blocks each time the cow passed through the milking shed, allowing comparison of cow activity only twice daily. More recent devices divide the activity data into 2 hr, 1 hr or 15 min time blocks, allowing for more precise identification of increases in cow activity and an indication of the optimal time for insemination of each cow.

How activity data is transferred back to base

The way the devices transfer their activity data back to the base computer can affect their:

- practicality for use in different dairy systems
- use in non-lactating animals such as heifers and dry cows
- ability to access cow activity data either continuously in real time, just prior to milking, during milking or immediately following milking
- maximum distance from the monitoring device to the receiver.

Close proximity receivers require the cow to walk immediately through or under a receiver often located at the entry or exit to the milking platform. Close proximity data transfer is by infrared or radio frequency.

Medium and long distance data transfer uses radio frequency and can transmit data over distances up to one kilometre. Medium distance receivers are usually located in the milking holding yard and long distance receivers can be located in paddocks. Once the receiver picks up the data it is then transferred to a base computer via a direct cable or wirelessly via Bluetooth, GSM or WiFi. Some systems transmit from the receiver directly to an internet-based cloud application using a cellular data network or via a local WiFi network.

Once the activity data is received by the base computer or a cloud based internet application it can be stored, processed and retrieved. The computer software uses proprietary algorithms (formulas) that establish a baseline of normal activity for each cow and compares each of their activity periods against their own previous activity record and in some cases also against the whole herd's activity. The cow's relative activity is usually displayed in a graph with alerts and warnings indicating that the cow may be on heat. An added bonus with some systems is that extreme reductions in cow activity are also noted, providing alerts of cows with a possible illness or lameness.

Some systems allow the activity thresholds to be optimised for the individual farm. In systems with automated drafting facilities there are normally options to create auto drafting rules for cows identified as at risk of being on heat. The information on the base computer may also be accessible remotely by another computer, smart phone or tablet device connected to the internet. The remote device may only retrieve information or it can also input information and control the program's decision making abilities such auto drafting.

How good are activity meters for detecting cows on heat?

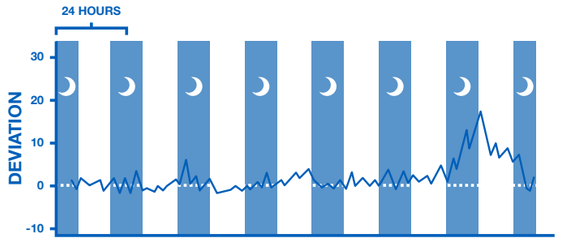
Many of these technologies were developed overseas and so independent evidence of their performance under Australian conditions is limited.

The performance of activity meter systems varies with the dairy management system, the position of the device on the cow and the algorithm used to create an alert. In general heat detection using activity meters is likely to be slightly more accurate in housed cattle compared with grazing cattle and more accurate in cows milked routinely compared to voluntary automated milking systems.

Measures of heat detection performance

In general, activity meter systems can detect a high proportion of cows actually on heat (heat detection rate) but in doing so they sometimes select cows not on heat (false positives). Raising the activity threshold required for an alert will decrease the heat detection rate but improve the accuracy (fewer false positives) and conversely reducing the threshold will increase the heat detection rate but decrease the accuracy (more false positives).

Reported heat detection rates of activity meter systems range between 75-95% with false positive rates of between 5-25%. A typical performance result would be a heat detection rate of around 85-90% with 15-20% of alerts false positives. A system with a heat detection rate of 85% and a 20% false positive rate means that for every 12 cows on heat 10 will be detected and 2 will be missed and for every 10 cows the system alerts, 8 will be on heat and 2 will not.



Combining activity alerts with other information about the cow such as the last time she was recorded on heat and visual observations by an experienced stockperson or AI technician will help improve heat detection accuracy without substantially reducing the detection rate. Combining activity data with rumination monitoring may also improve heat detection performance. Rumination often decreases during heat.

The onset of increased cow activity is a good indicator of when ovulation will occur and so can be useful for determining the optimal time to AI. The average interval from onset of increased activity to ovulation is approximately 30 hours. The reported best time to inseminate cows following the onset of increased cow activity varies between studies with ranges from 6-24 hours, with a 12-16 hour interval as the target.

What reproductive benefits can I expect?

Research trials in year round herds have shown that the using activity meter systems to select cows for AI can achieve in-calf rates as good as or better than the use of routine timed AI programs. Combining timed AI programs with the use of activity monitoring to observe return heats may be even better but this may not be economical.

Manufacturers claim that significant improvements in reproductive performance may be observed within the first few years of installing an activity meter system. Reductions in the average number of days open (calving to conception interval) of approximately 20-30 days have been reported. Palpated pregnancy rates (proportion of cows pregnant at pregnancy test) have been reported to improve from around 70% to 90%.

How much will an automated heat detection system cost?

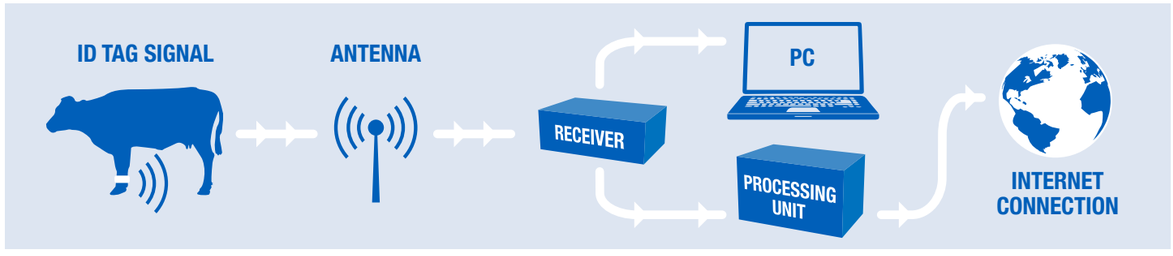
Activity meters:	$110-$180 per device
Receivers:	$4,000-$10,000
Computer:	$1,000-$2,000
Software:	$1,000-$2,500
Installation:	$1,000-$3,000
Total setup costs for a 200 cow dairy:	$30,000-$50,000
Ongoing support/license:	Nil - $750 per year or $2 per sensor per year

What is involved with setting up a new system?

The time needed to install an activity meter system will depend on the size of the herd, the type of system being set up and the number of receivers required. In general most herds can install a system in one full day. Set up will involve:

1. Attaching neck collars or leg bands to cows
2. Installing receivers and connecting to mains power and a data transfer method
3. Installing software on a PC located near the dairy & or connecting the computer with the internet.
   N.B. Some systems operate using a custom terminal avoiding the need for a computer and software.

Consideration will need to be given to the available labour, OH&S risks and facilities required for handling cows to attach sensor devices. If power is not already available at the site of the receivers then this may need to be arranged prior to the day of installation. A suitable computer and office area may need to be set up near the dairy if one does not already exist.
A functional internet connection to the dairy computer may also be required.



1 Morton J (2011) InCalf Data Fertility Project 2011, Dairy Australia, pp. 60-61.