Management of individual cows in large herds – a challenge to modern dairy farming

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Summary

A modern dairy farm management system through individual cow management by exceptions is presented. A multi-sensors management system consisting of on-line milk analysis, activity meter, behavioural meter and more, all integrated with a reliable electronic ID, facilitates individual cow management in the modern large herds dairy farm.

The presented system supplies reliable high resolution data which avails maximizing farm performance through individual feeding, health treatment, reproduction and welfare. New sensors emerging from technological breakthroughs and their integration in the management system are demonstrated.

***Key words**: On-line milk analysis, Milk meter, Activity meter, Behaviour meter, Automated data collection system, Multi-sensor integration.*

Introduction

The dominating trend in the dairy industry today is herds getting bigger as small family herds evolve into large dairies with thousands of animals. Traditional 10 to 50 cows family farms built in populated areas disappear and large dairies with hundreds and thousands of milking cows are built in agriculture areas. Intimate familiarity with each individual animal by the owner is no longer an option. Owner operated farms are evolving into big organizations.

Traditional dairying techniques in which the owner is a single man task force that milks, breeds treats and manages the cows changes into teams of professional milkers, health, fertility and feeding people that works different aspects of the farm. The owner becomes a manager of a business.

These new trends requires new management skills and techniques. It is argued that these changes no longer allow caring for individual animals nor do we need to. This article wishes to rebut that argument. The basic production unit in the dairy farm is the individual cow. Herds of 10 cows comprises of the same individual animals as a herd of 10 000 cows. Each one of these cows contributes to the performance of the entire herd. By overlooking individual cows we concede any option of improving performances of these cows. Furthermore, this approach leads to leaving only the survivors in our herd. These survivors are not necessary the best cows economically. The key to success in herds of any size is taking good care of each individual animal.

This comprehension though, is somewhat problematic. How can one manage individual cows in a large scale dairy without getting bankrupt? The answer is idividual management through exceptions.

The industry of today demands advanced management tools. Developing and supplying these tools has become one of the traits of the dairy industry. The future of dairy farming seeks ways to improve the farm performance under the constrains of unfamiliarity with a collection of heterogenous production units(the Cows).

Management systems for managing individual cows in large herds

Managing individual animals requires good familiarity with these individual's performance, analysis of this data and taking necessary actions. The data required for such management include performance data and general information. Maintaining such database in large herds is an expensive task. The only practical way to build a comprehensive database is by collecting data automatically.

This phrase "Management by exceptions" in relation to managing large herds was coined many years ago. This phrase embraces a way of thinking; it is a tool for large dairies.

Management by exceptions means that the farm manager does not have to look at each animal in the herd every day. It brings up only the animals that need attention and by doing this, it enables managing individual cows in large herds. These features can only be enabled by a comprehensive database

The primary demand of a management system is Data accuracy and cow ID accuracy. Assigning wrong data to cows may result many costly wrong decisions.

Considering all of the above, A management system is comprised of a reliable ID system, set of sensors automatically collecting relevant data and the farming know-how to perform analysis of the data to enable productive decision making.

Products and benefits

The value approach for a system is to supply the farmer with benefits and not products.

Hence, the managing system should comprise a set of solutions which are derived as applications from the different sensors.

- Heat detection and improved fertility are derived from activity measurement.
- Production monitoring, health improvement and precision milking is extracted from a Milk Meter and milk electric conductivity measurement.
- Prescise individual nutrition, health improvement, diagnosis of energy balance disorders, selection, follow up of payment from the dairies are availed from milk analysis and body weight.
- Milk separation according to its quality can be performed via real time milk analysis.
- Cow welfare, cow health and calving predictions are performed by a behavior meter.

All these are integrated by management software as a daily operation tool. Performance analysis that point out exceptions allow decision making that promote evolution towards excelence rather than evolution towards mediocrity as is dictated by the non individual management approach.

The future lies in a multifactorial approach able to analyze synchronized data from all sensors.

Heat detection

Heat detection system continuously monitors changes in cow activity which provides an excellent detection of the animal's biological condition. The detection is based on the data collected from a pedometer which measures cow's activity.

Lehrer *et al*., 1992, Pennington (1986) reported efficiency of visual observation at 45% and for pedometers at 78% to 96%. Other studies conducted in the USA compared various breeding methods showing that use of the pedometers resulted in lower cost per pregnancy compared with Presync, Ovsync and visual detection.

An additional new feature is a behavior meter which measures cows lying time and lying bout and can also indicate its restlessness. This new data will enhance performance of heat detection and has the potential of introducing new features to the system.

Monitoring production

Milk meters and milk analyser monitor the production of the individual cow to project out any abnormal behavior, furthermore by comparing any individual's performance to any other segment of cows or to its own past performance abnormalities are highlighted. When several indicators are combined, one can get better certitude of his cows diagnostic.

Milk composition changes during lactation. However, the magnitude of the change is less known. A few field tests were made on this subject and the magnitude of the variance was quite surprising. Figure 1. Displays Fat and Protein concentration of an individual cow during twenty consecutive noon milking sessions. That cow was part of large experiment that tooks place at Tzipori Farm in Israel (Uner, Katz and Maltz, 2003, unpublished data). In this experiment 61 cows was sampled daily during 20 days. The mean standard deviation for fat of all 61 cows was 0.475%

In another research the real time milk analyser was employed to evaluate milk components in comparison to day field test for a period of thirty consecutive milking sessions in ten consecutive days (A.R.O farm Israel 2006, 88 Holstein cows).

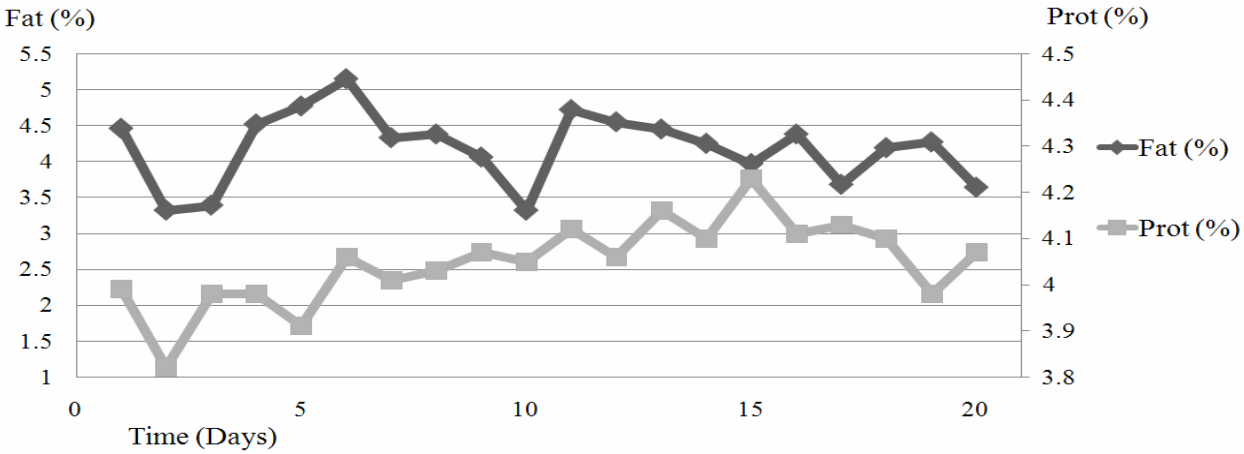

Figure 1. Fat and protein concentrations of cow #609 in Zipory farm for 20 consecutive noon milking sessions.

Figure 2 demonstrates the big fluctuation in fat concentrations during this period of time in the milk of one specific cow.

The mean standard deviation of all 88 cows was 0.57% and mean peak-to-peak of 2.16 % for fat.

These fluctuations hint that there is a great potential for production control in daily analysis of milk components and the necessity of the daily milk components measurement for advanced and modern management.

Individual nutrition

Accurate feeding management can be performed using equations which employ body weight, milk yield and milk components(like the NRC2001 formula).

An example for individual feeding is displayed Figure 3.

The data is part of a feeding research conducted by E. Maltz at A.R.O using the NRC2001 formula employing a walk through body weight, on line milk analyser and a milk meter. Data of two cows from participating in the research is displayed, Cow #302(595kg) and cow #464(713). The left panel shows the allocations and the Net energy from lactation of these cows. The right panel shows their synchronized in time milk fat and milk yield (Maltz, 2007, personal communication).

As it is can be seen performance of one individual went up with allocation while the performance of the second cow was inverse to its allocation.

In the quest for maximizing performance and in the world of rising food prices individual feeding is a major incentive for individual management by exceptions.

Cow health

Early diagnosis of sub acute ruminal acidosis (SARA) and ketosis using fat, protein and body weight change in single-cow/group/herd will enable monitoring nutrition and husbandry management to shorten response for prevention.

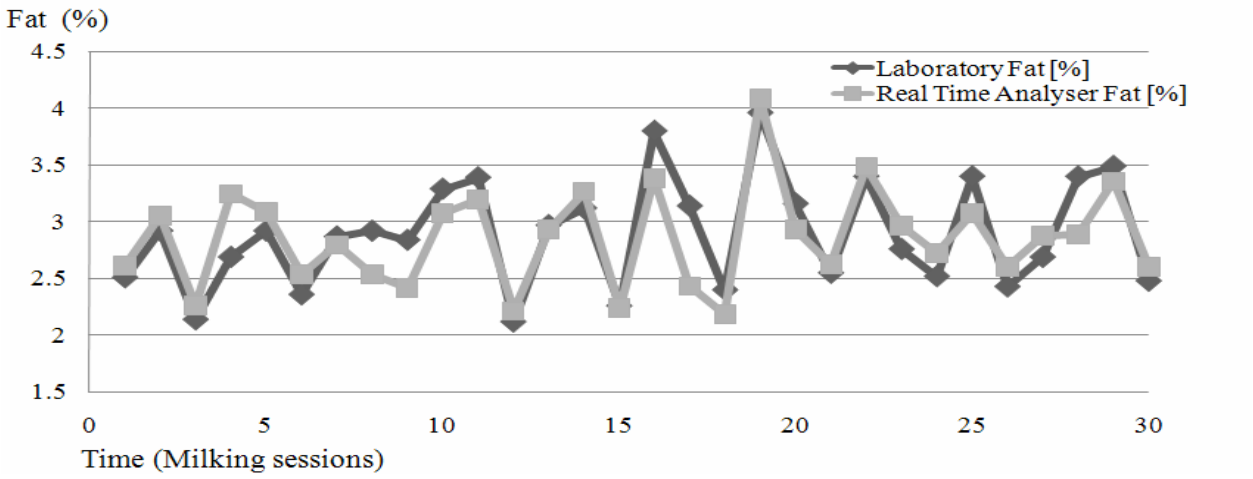

Figure 2. Fat concentrations measured over thirty consecutive milking session (ten days) cow # 2091 at A.R.O. farm a comparison between test day lab results and real time analyser.

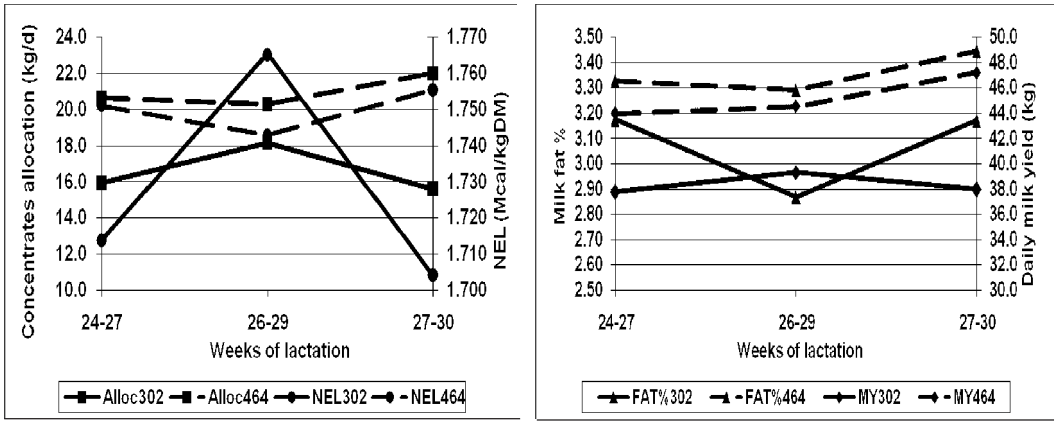

Figure 3. Left – Allocation given (square) and NEL (circle) for cow #464 (dashed) and cow #302 (line). Right – milk yield (diamond) and fat (triangle) for #464 (dashed) and cow #302 (line).

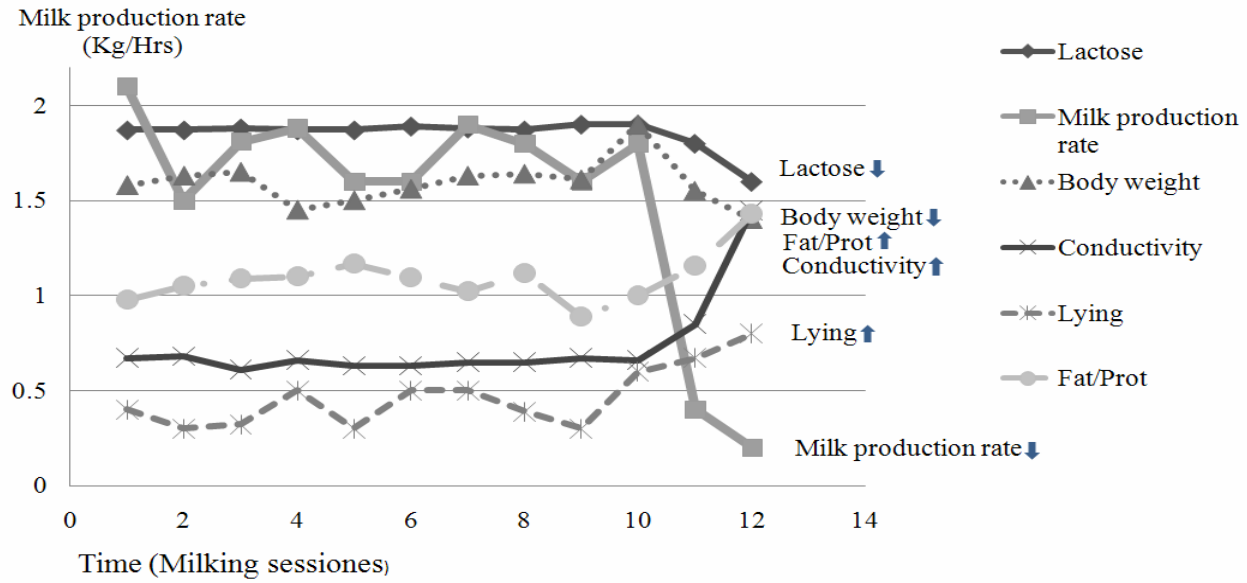

Figure 4. Multifactorial mastitis detection (cow#873 Landau farm). Milk production rate(square), lactose(diamond), body weight (triangle) , fat/protein ratio, milk electric conductivity and lying time as a function of milking sessions.

Mastitis is the most costly disease affecting dairy cattle. Losses occur from decreased milk production, treatment and labor costs, non deliverable milk, veterinary fees, reduced milk quality, reduced milk price, increased risk of subsequent mastitis, culling and death of the cows. Such loss may be caused by sub clinical mastitis, which has no visible apparent symptoms. There is reliable straight forward diagnosis for sub-clinical mastitis, however using a multifactorial approach employing data flow from several sources might in the future avail early detection of mastitis.

This concept is displayed in Figure 4. Showing a case study of the evolution of mastitis following a collection of measurements from different sensors. This case of mastitis is a result of un detected E. Coli case. As it can be seen there is a drop in production rate, body weight and lactose while conductivity, lying time and fat/protein ratio rise.

Discussion

The global changes that the dairy industry is going through demands adaptation of the traditional farm management techniques to accomodate the challenges of the modern dairy buisness.

There are two dominating concepts for the required direction these adaptation should be taken.

The philosophy of the first claims simplification of management by synchronizing large groups towards heterogeneity of the individuals that constitute the herd. The assumption is that this will minimize production cost. However, this attempt, will resolve in evolution towards mediocrity of the individuals assembling these groups.

Such a trend will in time cause for a drop in all production parameters which will not be followed by a drop in production cost.

The second approach, supported by this paper, argues that individual management by exception will not only maximize production but will also lower down cost.

The key for success of the that approach lies in the following terms:

1. Data which is accurate consistent accesible objective and effortles. This dictates automated data collection systems, sensors and reliable ID.
2. Sucsess in attempt to develop multifactorial data exploitation and new approaches to data analysis.

In all aspects of dairy farming displayed above (Milk production, fertility and reproduction, feeding, cow health and welfare) the impact of selections made regarding exceptions would be big on the total perfromance of the group.

The impact of exceptions on all group is allways more then its actual weight. Therefore, by managment through exceptions the selection rules for excellence of the total group are dictated.

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