

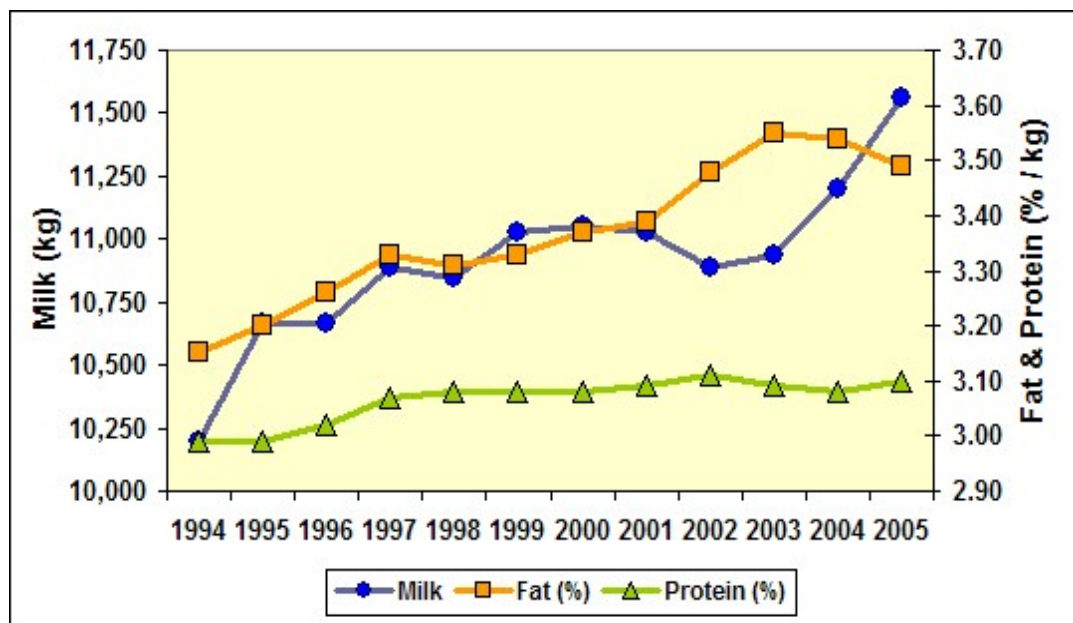
Introduction

The following case study reviews the development of a Management Information System (MIS) for the National Dairy and Beef herds in Israel. The system was developed by the Israeli Cattle Breeders Association (ICBA). It illuminates lessons for developers intending to undertake similar national projects.

The Dairy Industry is one of the main sectors of Israeli agriculture. It fully provides the domestic demand for milk and dairy products. The total annual output is approximately 1,150,000 tons of cow milk; 11,525 tons of sheep milk; and 6,170 tons of goat's milk. Dairy enterprises process the milk into more than 1,000 different dairy products, with an annual sale value of approximately \$1.5 billion. The National Dairy Herd is close to 111,000 head of the Israeli-Holstein breed. This breed has been developed by the Israeli Genetic Improvement System. This breed has been bred to cope with the harsh Israeli climate characterized by a long and hot summer and local diseases. Nearly all the cows are bred by Artificial Insemination (AI).

Milk is produced on over 1,000 farms Kibbutzim (cooperative societies) and Moshavim (private farms). All the Kibbutz dairy herds participate in the Israeli Herd Book (DHI) system and represent 61.7% of the cows with recorded production. Approximately 75% of the Moshav dairy herds participate in the DHI system and represent 39.1% of the cows with recorded production. In 2005, the average annual milk yield per cow was 11,118 kg of milk, 349 kg of protein and 398 kg of fat. Fig. 1. This represents an average yield for the Kibbutz dairies in 2005 of 11,542 kg/cow/year with an average production of protein and fat of 777.6 kg/cow/year. The average Moshav dairies yield in 2005 was 10,430 kg/cow/year with an average production of protein and fat of 698.7 kg/cow/year.

Fig. 1 Production averages of Israeli β Holstein cows by calving year, 305 day adjusted lactations 1994 – 2005 (The “Noa” development period)



The Israeli Dairy Board (I.D.B.) is an organization, which is jointly owned and managed by representatives of the dairy farmers, dairy processing companies, and the Government of Israel. The objectives of the I.D.B. are:

- To generate and organize cooperation between all the entities active in the sector;
- To implement the government policy regarding planning of milk production and marketing;
- To manage the emergency stock of milk powder in Israel;
- To deal with and dispose of surplus milk;
- To improve the professional standards of the dairy industry, to promote research studies and training programs, to assist in breeding programs for dairy cows, sheep and goats, to provide assistance in maintaining animal health standards, to initiate extension services and other activities related to the quality of milk and milk-contents, and in general to improve the overall performance of dairy-farming and the dairy industry;
- To promote the consumption of milk and dairy products;
- To develop and maintain international collaboration.

The DHI receives and processes information from the official Milk Production Control System, which includes 90% of the dairy cattle in the country. In addition to production figures, the Israeli Herd Book incorporates information from the Cattle Breeding System and from “Ha’Chaklait”, the Israeli Society for Veterinary Services. The comprehensive structure of the Israeli Herd Book provides the dairy farmer with useful multi-disciplinary information that is used for up-dated management analysis and decision-making processes resulting in outstanding world-scale achievements. Indeed, the Israeli cow has the highest national milk yield (production/cow/year) in the world in milk volume and milk solids.

The Israel Cattle Breeders Association (ICBA)

The Israel Cattle Breeders Association represents all dairy cattle farmers in Israel. For the past 80 years the Organization has been the sole representative of all milk producers in the country, taking care of all their professional needs and sustaining a vibrant and modern industry. The organization supplies essential assistance to its members and the satellite organizations connected to the industry. As a representative organization the ICBA is involved in national milk pricing and milk production quota policy, milk quality assurance, information dissemination, bull certification and more. The two pivot points of the organization are the National Herd Book (DHI), which is one of the most comprehensive Herd Books in the world and the development and maintenance of NOA.

Developing NOA – The Israeli Dairy Herd Management Program

NOA is the Hebrew acronym for “Managing the National Dairy Herd”. It is an overall Management Information System (MIS) developed by the Israeli Cattle Breeders Association (ICBA) to oversee the professional management of the National Dairy Herd. **NOA** has been designed to give the individual and national herd managers up-dated information regarding all aspects of dairy activity, addressing all aspects of dairy farming. It has been designed to include and input beef cattle variables and serve beef cattle farmers.

Conceptually Noa represents a concept of optimizing each individual cow’s performance as the basis for dairy management rather than using “averages”. This concept in turn is aggregated to practicing dairy herd management at the local,

regional and national levels. Such optimization as compared to e.g. “least cost” herd management has in Israel returned exceptionally good economic results. Realizing this concept dictates establishing an effective and efficient integrated MIS – based on the input of individual cow parameters, aggregated up to an overall national herd data base. Information and Communication Technologies (ICT) are critical success factors enabling implementation of this concept.

Major features of NOA

- **Herd management** – Updating of lactation, production and reproduction events. Cows’ entry, culling and moving between groups within the herd. Veterinary data: input of diagnosis, treatments, medications, etc.
- **Feeding** – Linear programming and ration composition, feed production and TMR planning, stock management and stock reports. Communication with feeding controllers. Complete tracking and monitoring of feed consumption.
- **Milk production** – Milk marketing updating, milk recording and summary reports including lactation summaries. Analysis of lactation variables as milk peak and persistency, and yields by days-in-milk groups of cows. All the Herd Book parameters are available in **NOA**. Communication with different brands and types of commercial milk-meters (on-line milk data).
- **Genetic management** – Graphical presentation of cows’ and bulls’ data. Mating program. Simple tools to implement breeding program according to particular herd goals.
- **Planning of milk production** – Special interactive module for precise managing of the milk quota production along the year. Simulation of the herd milk yield on a monthly level, by using a sophisticated prediction algorithm. The prediction is based on the herd performance in the last 2 years.
- **Additional features** – Shared database (network), powerful report generator, PDA application for pocket pc (IPAQ-HP) that includes all cows’ data. More than 40 pre-programmed reports.

NOA coordinates import and export of files to the national Dairy Herd Book database, dairy processing plants, central milk laboratory, livestock insurance companies, “Udder Health” laboratory, feed mills, and others.

NOA uses a Windows interface and is user-friendly, despite its complexity and sophistication. The program was developed by top Israeli professionals in order to meet the needs of both small and large dairy enterprises.

NOA was introduced in Israel in April, 2000. Today, more than 500 dairy farms use the program, comprising 95% percent of all dairy farms with over 250 dairy cows. Each month new dairy farms install the program and the total number of cows which are managed under NOA software in Israel is nearly 80,000.

NOA interfaces with all aspects of dairy production control, including milking robots and feeding controllers. Ongoing development and program updating currently involve a program manager, three programmers and a technical support engineer. Three animal husbandry professionals provide end user support.

For the first time, comprehensive dairy farm management is possible with a single integrative and user-friendly program. Communication between the dairy farm computer and the national Herd Book database is carried out via an Internet website

maintained by ICBA. Numerous dairy farmers and entities in the dairy industry are connected via this “Dairy Web” which is basically an Internet based industry newsletter, which facilitates two-way interactive exchanges and provides E-mail, a bulletin board, news and other services.

International cooperation

Noa was adapted for and is used exclusively in Israel by about 600 registered users. The program software and know how have recently been sold to De Laval with a commitment to support and upgrade the program as it is being developed in Israel. In the coming years dairy farmers around the world will be able to utilize many of the the NOA system features.

Why did the ICBA develop a MIS?

During the early 1990s dairy farmers had a choice of three MIS for their individual dairy management. Their commercial names were GAVISH, ANAT and PARA. The first two were hosted on personal computers while the last was hosted on Digital mini computers shared by other users on the same and/or other farms. PARA had a declining user base when it was realized that it had to be updated significantly and was eventually discarded. Of the remaining two MIS Gavish serviced about 60% of a total 250 user base. Both MIS had similar capabilities – individual cow data recording and a feed ration linear programming

The main support that the MIS software programmers provided was software updating and refinement – mainly correcting programming issues. There were few if any application updates or improvements. The result was an ever growing gap between what the MIS could do and dairy farmer needs and expectations. When farmers requested updates and/or new applications they were charged for the additional programming and each additional add on. Due to the small user base the cost to each user adopting the change and/or upgrade was relatively high. Regional dairy farmer associations became involved in the updating and developing process which in turn resulted in a process which lead to a new and better MIS which was dynamically updatable.

During this period the ICBA was in the process of establishing a national herd registry. The project was initiated in 1987. The MIS had applications for individual cow monitoring including milk yield details and insemination records. During the development process ICBA professionals established a data and knowledge base acquiring invaluable expertise in the process. The know how was integrated into all ICBA activities and was accessible to all ICBA personnel including administrative staff, programmers, IT technical support teams, laboratory technicians, cattle surveyors, artificial insemination technicians and managerial staff at all levels. The process resulted in newly acquired knowledge while defining needs and specifications for development.

These developments included exposure to new management applications (SQL) and supported the integration of the various animal husbandry systems involved in all aspects of the Israeli dairy industry. The direct derivative of the integrative approach to the various knowledge systems was the establishment of the “Milk Network”. This Intranet was written in DOS and was a world first. It serviced the dairy farm’s communications with the ICBA’s central data bases. It enabled rapid data transfer

between the individual dairy records and the central Herd Book, the inspection results of each dairy's milk yield quality and cattle inventory changes. The success of this specialized framework with the ICBA's comprehensive overview and experience with all aspects of dairy information management led the regional dairy associations to consider the ICBA's expertise as a basis for developing a new general dairy MIS. This would include MIS adaptation capabilities compatible with the expected animal husbandry and market developments over time. With this realization the ICBA was requested to initiate the steps to develop a new overall national dairy herd MIS.

Initially the ICBA hesitated to undertake a complicated project on short notice while on the other hand the association had to comply with the association members (dairy farmers) demands. Following meetings with the regional association's representatives and considering their motivation the ICBA undertook the following steps:

1. Offered GAVISH and ANAT to combine their software into one unified MIS with an offer to fund the ongoing cost of the consolidation. This option did not materialize for possibly the following reasons – both MIS recorded individual cow records and were suitable for individual dairy management without a need for additional investment while integrating one MIS with the other into an MIS with a national dairy herd component would involve considerable cost. This with each harboring the conviction that if put to tender “their” MIS would be awarded the option to develop the new National Herd Management MIS.
2. Requested GAVISH, which had the majority of users, to prepare a cost estimate to upgrade their program. Their proposal was too expensive and was rejected.
3. Adapt some other MIS – possibly from abroad. A survey of options indicated that they were expensive and unresponsive to the dynamism of the Israeli Dairy industry.

The decision was made and development was started

The decision to undertake the MIS project was finally made in 1992. The first stages of the project development were relatively relaxed with a clear definition of goals and a timetable. Adi Raz and I were responsible at the time for the project development. Adi Raz was a dairy farmer, dairy farm manager with an M.Sc, in Agriculture. As a past manager of the National Herd Book with an economist's orientation he was dominant in defining the MIS goals. The first step was to outline the software definitions. A steering committee was elected with members representing all aspects of dairy farming including dairy farm end users. In order to formalize the software outline a veteran system analyst affiliated with the agricultural sector and dairy farming was employed. During this stage we focused on the future outlook of the end product and there was no timetable constraint. The expectations included:

1. A local MIS that will facilitate all the activities in dairy and beef farming – namely herd management, feed management, inventory management, herd genetics, interaction with centralized feed centers, pasture management and fattening. The input would be associated, and an input, for the national aggregate data base. This database would provide the ICBA the data necessary for the national herd management services.
2. Management of each herd as a profit center.
3. Linkage to cost accounting and economic analysis of each dairy in addition to the economic assessment of the animal husbandry aspects;

4. Knowledge mining from the data sets, logical deviations, algorithms,, reports,
5. Knowledge feedback from researchers and scientists;
6. Connectivity to all providers and recipients of services;
7. Automatic report derivation from all data/ reports received and disseminated;
8. Modularity tailored to each end user category – small Moshav dairies, Kibbutz (cooperative) dairy farms with and without feed centers, feed centers, extension services, etc.

After half a year of deliberations the outline was finalized. When presented to ICBA members the response ranged from claims of ICBA megalomania to level headed adequacy.

Development Decision Making

The steering committee that conceived the project characteristics and choose the MIS developer had a wide public representation. Members included ICBA representatives along with representatives from feed centers, economists, nutritionists, extension, regional association directors and the artificial insemination centers. The deliberations held at the ICBA headquarters were long while an attempt was made to reach as wide a consensus as possible. The timetable was lenient largely due to the fact that currently acceptable MIS were available and employed. The new overall integrative approach met several objections. Mainly they were objections to the cost, the high degree of dependence the individual farm would have on the central herd book facilities, redundancy of the existing MIS while eliminating the competition between them which would be to the individual farmer's disadvantage. The overall integrative approach won the day. The project timetable enabled an acceptable cash flow schedule and external financing.

At this point the national Beef Cattle Growers Association (AMABL which is the Hebrew acronym for the "Association of Beef Cattle Breeders") was offered a stake in the new MIS. At that time they were mainly focused on national beef growing policy and had just recently been introduced, as an organization, to organizational information systems. They had minor contact with some MIS local initiatives. They did not have a centralized MIS with centralized backing nor centralized data set input/output facilities. AMBAL viewed the new program as an opportunity to upgrade their data collection proficiency and establish a local breeding program. As a result we are able today, 12 years after initiating collaboration to implement an MIS for breeding beef cattle.

General and detailed specifications

The software and specifications were detailed and presented to the steering committee. A systems analyst was employed to verify that the above mentioned expectations were incorporated. These were then used as a basis for calculating costs and in turn allocating the budget accordingly. In retrospect the specifications and files were very good. All of the software written was programmed without budget overruns.

Technology

During the program initiation deliberations it was decided that the MIS would be programmed with an applications generator. At the time application generators were a combination of object oriented programming and basic programming software which enabled unified and rapid programming throughout the project development. 1994

was a period when the personal computers were just beginning to acquire substantial computing power enabling them to manage fairly large data bases.

Data base calculation performance was made on a PC with acceptable results – with DOS being the operating system with a Win 3 framework. The applications written then compared to applications written today were similar to Window formats. The rulers had operators, a look up icon, tabs with folder icons similar to today's icons. The window operating system on the PC with an Intel processor was WIN95 which was launched in 1995 so it took about a year until experience with all the features was gained. The applications generator chosen for the project was called "Builder Power". It was selected after a comparison to Magic. The development environment was a uniquely dedicated package developed by the Tekem Company titled "Power Pack". In retrospect the human engineering was unfriendly and difficult to operate and the development environment unsatisfactory. The corresponding data base software was Watcom. After Builder Power was bought by a different company Sybase, the data base software was changed according to Sybase. In retrospect the combination between the new software standards which were inefficient in computer resource use, the data base and the hardware available at the time resulted in unacceptable program response time.

Mistakes, technological constraints and implementation problems

Mistakes incurred during the project development delayed the original schedule by about 18 months. The delay was not critical for the dairy farmers who already had earlier MIS software.

The main causes of the delay were software bugs, unsuitable end user interfaces which were incompatible with dairy farmer's routine, poor human engineering and slow program response time. The Power Pack package itself was unsuitable to end user requirements as well – despite multiple attempts to upgrade it. The development delay resulted in a 20% budget overrun. This generated severe distrust between the ICBA and the dairy farmers – which reflected their lack of confidence in the ICBA's ability to provide a quality product.

Project management problems

During the project initiation and defining of specifications, and mainly during the final decision process, the differences between the ICBA's managing secretary and the project manager resulted in the latter's resignation. He was replaced by David Dror who was a programmer, extension specialist and cattle classifier. In retrospect it is hard to evaluate if the change in leadership influenced the final result. Suffice it to say that the first version of the program had several inherent and acceptance problems. This suggests that the change of the program director was not their unique cause. It is now apparent that the problem origins were mainly the result of misunderstanding their source and in turn internalizing the reasons. The initial internal management formulas were completed while the human engineering was problematical. An additional problem was the program's response time. Consequently implementing the necessary changes resulted in about a six months development delay. This extended delay focused attention on the qualifications needed for the project leader. These were a combination of a dairy manager, formal animal husbandry background and familiarity with livestock nutrition. The last qualification was due to the lack of in depth ICBA familiarity with these issues. A suitable candidate was located and

despite the fact that the project was losing popularity and was behind schedule development was kept on hold till he became available. Quality leadership was at a premium and was not to be compromised even at a cost of additional delay in development. This proved to be a wise decision.

Solving implementation problems

Implementing Noa was a long and difficult process. To facilitate adoption the new manager a top programmer as a project facilitator was allocated by the software company. They focused on identifying implementation constraints with me, as the ICBA facilitator, while periodically meeting to update the implementation schedules and timetable. It was imperative to provide the project manager with visual public organizational support all through the project development. This involved dealing with management and animal husbandry issues, daily dairy decisions and human engineering. Boaz, the project manager focused his initial efforts on human engineering – making use of the software as easy and simple as possible. This included a different Graphic User Interface (GUI), different fonts, amenable data fields and their transferability, use of files and folders, sorting of variables and data in the input screens and more. The new interface was incorporated into the main program screen.

The list of cows and offspring and accessing their individual events was easy, immediate and user friendly. Part of that was due to computer upgrading and enhanced computing capability which was an ongoing feature of PCs at the time. This time ICBA decided to adopt and disseminate the program's major human interface renovation.

It took four programmers four months to update all the screens and files. During this period an effort was made to improve program response time and improve the data set models. The program's α and β versions were distributed and were well received. A critical decision at the time involved investment in a newly programmed feed ration program rather than adopting and including a commercially available module. The main problem was a dictate of the need for new program content and a new data set model. It was decided to maintain Noa's comprehensive integrated approach and program in house the necessary changes and additions. By 2000 more and more dairies stated to use the program, despite the ongoing process of improvements, changes and module inclusions. Noa became the unifying overall dairy MIS at the national level. At the dairy level there are several associated MIS all geared to interact with Noa. The main MIS at the dairy level is Afimilk with real time data input. Additional companies include Westphalia, a milking robot, SCR and others. The following lists Noa's modules available respectively at dairy and national levels.

Noa Modules

- Monitoring and managing local dairy herds
- Nutrition management, linear programming and inventory management
- Local dairy herd genetic monitoring
- Nutrition guide
- Cost accounting and monitoring feed center purchases
- Economic evaluation – now being completed
- Beef fattening

- Pasture management
- Milk marketing and quota management
- A hand held data PDA for data queries and health monitoring

The Benefits from Noa

As mentioned Noa is an integrative tool that consolidates information from various sources derived from the individual and national dairy herd activities. Their details and their aggregates are interactively accessible via the program modules. The benefits from Noa can be summarized by way of the following categories:

- **Internal ICBA:** Use of Noa dictated new information management standards, facilitated communication with the organization's members based on them and contributed substantially to the organizations credibility and influence. An additional result was a conflict with a business competitor vying for a share of the Dairy management software market;
- **The dairy farmer** was introduced to new information management models that greatly improved the farmers monitoring, control and decision making ability. This, in the short term, at the individual cow level and in the longer term at the herd management level;
- Interaction with a **Central Feed Center** and monitoring feed quantities and costs – especially for dairies that bought their roughage and feed from feed centers;
- Unifying **professional terminology and standards**;
- Noa became an **animal husbandry focus** - associated with research, extension and services;
- A major improvement in **herd management, nutrition and breeding** via improved extension;
- A significant improvement in the **national beef herd results**.

Summary

The Noa case study is outlined for the benefit of developers of ICT Programs for National Agricultural organizations. The main lessons include the following:

- The main critical success factor is compliance with end user needs and human engineering;
- Evaluate the organizations organizational culture via the following criteria: time taken to make an organizational decision; monitoring and verifying it, adherence to time schedules and budget.
- Following this evaluation decide if the organization can undertake such a project by itself and/or should it be outsourced;
- Estimate the consequences of limited or complete project failure to meet expectations – an extremely difficult task when the program beneficiaries are the organization owners;
- Consider a modular sequence for the software development while comparing its applicability to the existing software;
- Do not compromise your choice of development personnel –carefully match their capabilities to each application being developed;

- Devote sufficient time and effort to the choice of development tools. In non profit organizations a cost saving decision must remain valid for a long period of time;
- Consult and share with relevant professionals, draw on their expertise.

Credits

- Noa traveled a long way over the past 12 years with many partners and contributors. Three ICBA general secretaries – Daniel Peri who made the initial decision to go ahead with the program, Yosi Malul who decided to continue the project despite all the difficulties and Meir Brawn who oversaw the sale of the software know how to De Laval. All three recognized the benefits inherent in the project and saw it to completion;
- Avraham Barav was a hired systems analyst the helped in formalizing a systematic approach to developing the project in its early stages;
- The Noa development directors – Adi Raz who was responsible for conceptualization of the program and the software characteristics; David Dror who oversaw the business logic mainly for the national herd management components and Boaz Chanochi who stabilized the project, brought it to fruition, applied the various planned and additional modules, formalized the work patterns, promoted the project successfully including its sale to De Laval;
- The Noa development team which included the ICBA programmers Elinor Barda, Boaz Tavori, Eti Licht, Anat Sandovsky and Doron Berman; the project technical support personnel Alberto Arditi, Shai Levit, Nadav Chugim and David Shalit, The Noa field staff David Ben Uziel, Gavriela Barak, Shachar Haris and all the ICBA employees, the dairy farmers and extension personnel that contributed and continue to contribute to the effectiveness of the project and the benefits from its implementation.

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