SeedQuest / Keywords / Data Management

Enterprise Integrated Data Management, ERP and RRP, in the Seed Business

White Paper Autumn 2009

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This is an age of much knowledge and little wisdom.

(Albert Szent-Györgi, personnal communication to Jack R. Harlan [Crops and Man, 1975, p.251])[2]

Comme les maladies contagieuses, les idées neuves demandent une certaine période d'incubation avant qu'elles soient reconnues.

Like contagious diseases, new ideas demand a certain period of incubation before they become well-known.

(Arthur Koestler, Les somnambules)

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[2] J. R. Harlan, Professor of Plant Genetics, Crop Evolution Laboratory, Agronomy Department, University of Illinois, Urbana-Champaign. *Discovery consists of looking at the same thing as everyone else and thinking something different.* -Albert Szent-Györgi

EXECUTIVE SUMMARY

The integrated management of data became a competitive advantage for companies near the end of the 1980s. Software developed specifically for the largest companies was gradually replaced by standard software suites for managing each business function of the enterprise: manufacturing, sales, human resources and finance. These new software suites often required new hardware platforms and communication protocols that became more complex, unreliable and expensive to maintain. This complexity led to the creation of "integrated" software suites that utilized a shared relational database management system (RDBMS) that remained independent from the underlying hardware architecture.

Relational databases required the unification of information in the enterprise.

The solidification of internal business processes increased the reliability of the execution of tasks and permitted the traceability of operations.

Software constructed using relational databases and managing processes for at least three important functions of the company are called ERP, for *Enterprise Resource Planning.*

The management of information by ERP systems gradually attained a higher level of maturity, with the possibility of working alongside other software, both standardized and specialized. Starting in the late 1990s, companies increasingly needed to easily access and summarize the exploding amount of data in the ERP systems. Software vendors evolved quickly to respond to this need, with solutions originally referred to as data mining and gradually falling under the more general term « Business Intelligence », or BI. Starting in 2005, major ERP vendors such as IBM, Microsoft, Oracle and SAP acquired almost all of the main BI vendors.

ERP systems do not adequately integrate the needs of research departments into their functionality. In general, the number of enterprises having a research department is relatively low. However for agricultural suppliers, notably in the seed and chemicals business, the research department is an essential function of the enterprise, often even managed as a distinct subsidiary in the group.

For research departments, these ecosystems of software are replaced by RRP, or Research Resource Planning, solutions using a shared relational database and able to manage complex business processes.

The LABKEY software suite by Doriane is an example of RRP. The horizontally applicable concepts of LABKEY allow centralized management of the extremely diverse activities within research departments, always guaranteeing the traceability and security required by research. LABKEY is currently used alongside all major cultivated plant species, by both government agencies and research departments in seed companies, some of them dealing with more than 250,000 micro plots per year spread across scores of research stations in numerous countries.

The implementation of an ERP system requires the formalization of the processes used in the primary functions of the enterprise. This deep analysis involves a diverse team made up of business experts, internal IT staff and specialized consultants. Full management support is required, and ERP implementation projects are generally realized in a series of successive steps for each major function of the enterprise. The financing for an ERP project are always decided directly by the highest-level executives with support of the board of directors and/or shareholders.

In conclusion, ERP systems help guarantee the completion of activities in the timeline expected and assure traceability of tasks and IT security. Business Intelligence (BI) tools greatly improve the decision making of management. The ERP system's budget represents an important contribution to the bottom line of the enterprise. The ROI is realized quickly, in the order of 18 to 30 months.

INTRODUCTION

This white paper describes the role of integrated data management in business operations, from administration to research through commercial development and production. It briefly explains the extraordinary development of these technologies between 1970 and 2000 and attempts to show why these tools for information management have become an essential factor of competition for any organization. Finally, it presents the main types of technical tools on the market for data management for enterprises, including those in the seed business.

The audience for this paper includes :

- those responsible for operational activities in sales, production and research
- managers of functional activities in administration, human resources and finance
- IT managers of information systems
- officers and shareholders
- business administration students

In general, this white paper is of interest to all those who wish to better understand why the tools of integrated data management have become vital to businesses and the benefits they bring.

We will tackle the following topics in order :

- The emergence of enterprise data management systems and relational databases
- Trends in the software industry affecting current and future decisions
- The advantages of ERP
- The particular case of the management of data in a research department and the concept of RRP
- Putting in place a project to implement an ERP system

The management of information in the enterprise is by no means a new idea. It is, however, much more recent that the breeding of plants. The automated management of data in the largest enterprises, including the larger companies in agro-business and plant breeding, started in the years 1960-1970. Enterprise software systems were in high demand for supply chain management, customer relationship management, human resources and, of course, finance.

The integrated management of *research* data came much later in the enterprise.

With the emergence of new forms of communication, networks and the internet, and the increasing confidence in the scalability of hardware platforms, the demand for management systems developed even further during the 1980s and 1990s.

ARRIVAL OF RELATIONAL DATABASE MANAGEMENT SYSTEMS (RDBMS)

The arrival of relational database management systems (RDBMS) was a major innovation in the management of information in the enterprise.

The advantage of relational databases is it is only necessary to store a single piece of information one time in the memory of the enterprise, resulting in a "single source of truth."

For example, all of the departments of an enterprise -- sales, production, shipping, billing, accounting access a single version of information about a customer. When this information changes, all of the users will see the update automatically and instantaneously.

In a perfect world the savings and productivity gains are obvious. Unfortunately, each of us knows well that there is a long path from theory to practice.

The improvement of information management in companies unlocked an important source of profitability, and therefore competiveness. This led to the financing of the up-and-coming enterprise software industry.

The information industry is organized into three areas: hardware, software and networking. These three areas have seen their costs decline exponentially in recent decades, much faster than the automobile or even the telephone.

This rapid decline of the acquisition costs of information processing tools allows companies to manage more and more of their activities by these systems. It also allows smaller companies to achieve levels of efficiency and profitability higher than those of large companies..

Enterprise management software is now an essential choice for investment by small and medium enterprises wishing to quickly increase their competitiveness.

This development is tied to the decrease in the Total Cost of Ownership (TCO) of new information systems. The largest companies in a market will of course retain an advantage tied to their sales networks, but there is still plenty of room for increased competitiveness among small-to-medium players.

The specific needs of research departments will be covered later in this paper. The idea that improving competitiveness through research works only for the largest international groups is being debunked by small enterprises using effective new IT systems. Smaller companies realize these tools represent an even more rapid and fundamental change to their own organizations than that of their larger competitors. This change is even stronger in plant breeding research where managing more and more research data is fundamental. In software, "small is beautiful" is often the case.

IT in the enterprise will be an essential completive factor in companies in the coming decades.

CURRENT TRENDS IN THE SOFTWARE INDUSTRY

It is possible to examine trends in the software industry in 3 major areas:

- **Software :**
  - **The history of the software industry is based on the seismic shift from custom[1] to standard[2] software.** Do the largest pharmaceutical, energy or financial companies of today develop their own internal software for word processing, spreadsheets, calculating statistics, drawings, design, account and finance**?**
  - Outside of the research department (undoubtedly the thorn in the side of every IT department that has one), company information usually lives inside a RDBMS. Different software, specialized or not, interacts with this database.
  - **The largest organizing and economic force in the architecture and interface design of recent software is to permit the acquisition of data directly from its source.** This source could be from an external hardware device. In this case, the software can exchange information with the largest number of devices possible. More importantly, the source could be a person, non-specialized in data-entry, who is in fact the original creator of the information. In this case, the user interface must be easy to use, even for a manager who only occasionally uses the function.
  - Organizing the information of an enterprise in one relational database so that the mechanisms of the business function in the most fluid manner is one thing. Extracting meaning from this information that allows management to make better tactical and strategic decisions is another. **Meaningful extraction of information and decision support are the strongest demands of today's enterprise.** Productivity gains permit the financing of this new step in IT systems.
- **Network :**
  - **Sites well-served by fast networks will see their systems return to a centralized architecture, simpler and more economical.**
  - Sites not well-served by fast networks create a technological heterogeneity that penalize the enterprise both technologically and financially.
  - Networking budgets and know-how are once again increasing in importance for companies.
- **Hardware** : except for the research department, capacity often exceeds demand and costs are less of an issue.

These trends also include technological and economic models that do not really affect the cost of ownership for the enterprise :

- **Rapid Application Development (RAD) tools that permit the development (or outsourcing) of custom software at what only *seems* to be an attractive cost.** Except for the large international groups which make up a market segment in and of themselves, the technical and economic advantages are often lost before the project is even started. This lost advantage is due to the fact that developing a complex business application from scratch can take 3 years to realize from a RFP to production. Maintenance and custom enhancements can be even more expensive that the creation.

  The power of standard software is to share the costs between multiple enterprises.

[1] Custom software: software written to be used only by the single owner who possesses the source code and the attached intellectual property.
[2] Standard software: software written for a market segment where each client must acquire a license to use the software.

- **Applications hosted by specialized suppliers**. If the company concerned is growing more than 20% per year, this approach is valid. For slower growth, an IT system under the control by many parties is too expensive and risky from an organizational and financial point of view.
- **Open Source Software.** Like in the seed business, you must always finance your research and development. Thinking that a community of benevolent and unpaid developers is working late nights to improve specialized tools for the seed industry is unrealistic. Each research department also has its own intellectual property that may not be best shared in an open source community. Once maintenance and the entire software lifecycle is taken into account, the cost of ownership does not differ significantly. Free software remains a valuable model for integration tools used by internal development, 3rd party services companies or their subcontractors in wider applications outside of your core business.

Future Trends

- **Specialized, industry standard software** in place of expensive customizations to ERP systems, for activities that require specialized knowledge in a complex domain
- **Organization of information** in a single relational database, department by department, then at the global level for the company, with the research department remaining the most distinct
- **Significant investments in tools that facilitate the extraction of facts and use them to aid tactical and strategic decisions.** These tools are often called Data Mining, or in general, Business Intelligence (BI).
- **Transition to an ERP (Enterprise Resource Planning)** in a phased approach by each process area in the company.
- **Broadband network access** at the largest number of sites possible, including mobile workers

ERP IN SEED COMPANIES

In regards to the natural progression of Relational Databases → ERP → Decision Support, the largest enterprise software companies have largely anticipated this maneuver.

The industry leaders in ERP have rapidly acquired the largest companies specializing in ERP reporting. Microsoft purchased Navision in May 2002, and Oracle acquired Hyperion in March 2007. Oracle had already become a strong player in the ERP space after developing ERP Oracle-Applications and buying PeopleSoft and JD Edwards. SAP, considered by many the global leader in ERP software, bought Business Objects in October 2007. IBM purchased Cognos in November of 2007. After acquiring the ERP software Navision, Microsoft's BI offering continued to be complemented by tools present in version 2005 and specifically 2008 of SQL Server Enterprise Edition.

ERP : The Keys to Success

ERP is an acronym for Enterprise Resource Planning. The success of a company providing ERP solutions, and thus the success of their customers, depends on many factors :

*** Knowledge of relational databases, both in terms of flexibility and scalability**

*** Industry knowledge of at least 3 primary business functions (manufacturing, sales, human resources, finance) and a module for each area**

*** The separation of work between software developer and software consultant, with a network of preferred integrators**

*** The capacity to evolve software offerings and services independent of the underlying platforms**[1]

In the seed industry, the ERP used is usually a function of the size of the enterprise :

Large Enterprise: Oracle Applications or SAP, custom development, others
Medium Enterprise: JD Edwards, PeopleSoft, others
Small Enterprise: Microsoft Dynamics (formerly Navision), others

For the production of seed, which is a very specialized domain, there exists both specialized and standard software.

They often addresses a specific geographic region, with nearby customers, or a particular segment : corn, cereals, vegetables, grains, fruits, etc. Certain software is not adaptable to certain regions or certain market segments.

[1] Underlying platforms include application and database servers, operation systems and database administration tools

SPECIALIZED SOFTWARE FOR RESEARCH

Large enterprises in agronomy that have a research department rarely use their ERP system, no matter which one they use, to manage technical data and R&D. The largest companies such as Monsanto, Syngenta, Pioneer, Vilmorin, and KWS still develop specific solutions for their research software.

A comparison could be made with the pharmaceutical industry, another sector that invests strongly in biological research.[1] For more than 10 years, a large part of the large pharmaceutical companies, which have budgets far superior than the seed industry, have profited from no longer developing or outsourcing internal custom software. This is true both for upstream research with molecular modeling[2], as research with downstream clinical trials. It must be said in defense of seed groups that switching to standard software can be done only if there is an option available that meets real needs. The pharmaceutical market is roughly twenty times higher than seed, so it is natural that standard software has arrived much earlier.

Specialized software exists for different activities in research, often adapted to specific activities :

- In biotechnology, genomics, proteomics, molecular markers
- For LIMS (Laboratory Integrated Management System) qualitative analysis laboratories in medical or pharmaceutical (which can be more or less easily adapted)
- For the management of genetic materials in breeding, experimentation and statistics
- For the management of experimentation with phytosanitary products
- Also general statistics software that can be adapted to plant research (SAS, S+, SPSS, Genstat, etc.)

These offers are still very fragmented, with companies using this more specialized software solely for their research and development departments, almost always in combination Microsoft Office Excel and Access.

[1] Industrial seed companies invest between 10 and 12 percent of revenue in R&D. For pharmaceuticals, the investment is between 12 and 14.

[2] Standard software such as Sybyl® from Tripos® or Clinical Trial Manager® from TranSenda® have been used for many years in industrial pharmaceutical research.

RRP FOR THE INTEGRATED MANAGEMENT OF RESEARCH DATA

Recognizing that ERP often stops at the door of research departments, Doriane has developed the concept of RRP, of Research Resource Planning, with the support of two large Agronomy groups in Germany and France.

Doriane's innovations are oriented around 2 concepts that permit the management of all types of flow and experiments on live material and integrate with a RDBMS (Relational Database Management System) :

- The concept of the experiment cycle with the management of stock of live material, observation of the objects and conditions of the experiment, and automatic production of new generation of individuals following a non-deterministic model. This is still an original approach in 2009.
- The concept of experiments and stock with multi-level variables and unlimited levels of detail of the objects observed

This model was presented at the 2006 Eucarpia Biometrics conference in Zagreb and the topics related to data mining were presented at the 2009 Eucarpia Biometrics conference in Dundee.

The software LABKEY™, based on these concepts, possesses the principal characteristics of an ERP/RRP system :

- Advanced use of an RDBMS system incorporating dynamic SQL
- Adaptability: different team sizes, scaling up to research departments of hundreds of employees
- Flexibility: permits a variety of uses including hybrid species, varietals and populations, all species of vegetables and flowers, trials of phytosantiary products, animal nutrition and animal breeding.
- Performance: used by customers having more than 150,000 or even 280,000 experiment plots per year with centralized management, with up to 14 sites in 8 different countries, with capacity to spare
- Knowledge of the domain : proposal of modular tools, step by step.
- Separation of the business-oriented consulting and development teams.
- Capacity to evolve the software and services along with the evolution of the underlying platforms.

IMPLEMENTING AN ERP/RRP SYSTEM

In a situation where a patchwork of specialized, standard and specific solutions exists, it is up to the IT management to integrate and "connect the dots." Responsibilities include:

- **Development of integration gateways** running on hardware systems that support specialized software for the conversion of data, rendering integration more or less automatic
- **Ensuring that the different software vendors** and their different versions of software follow the same communication standards and are synchronized with the same version of these standards

This enterprise integration work is increasingly complex, depending on the growth of the company, its activities and the number of divisions. The more players the more difficult the integration becomes. As the situation becomes a Tower of Babel, integration becomes increasingly difficult and more and more expensive.

Implementation of an ERP system starts with a description of each targeted business activity. This analysis will often result in the redesign of certain activities and the relationships between these activities. The implementation of an ERP may be just a pretext for larger organizational change. It is often the case that the company has experienced at least 10 years of growth and has opened itself to globalization, and it must now manage a melting pot of processes in a research department doubling its lines of production.

The implementation of an ERP/RRP is an excellent time to evolve the organization and attempt to see things more clearly with a fresh set of eyes.

The ERP/RRP solution must be flexible and adapt to a variety of situations, often unanticipated.

STEPS TO ROLLOUT A ERP/RRP SYSTEM

- Discovery of the initial situation
- Definition of the project mission and writing of the initial project plan
- Choice of tools, consultant team and project management team
- Business analysis by ERP consultants
- Formalization of business processes. This step is indispensible for the effective execution of business tasks and respect of quality norms.
- Configuration, customizations, prototype tests
- Data migration project
- User Acceptance Testing
- Documentation and training of users
- Final data migration and production rollout
- Startup assistance
- Technical support, corrective and evolving maintenance
- Training of new users

This list of steps illustrates the large amount of work necessary to implement an ERP / RRP.

The success of the project as a whole depends heavily on the resources, internal and external, assigned to the project. Having an experienced team which has already seen these types of projects in companies of different sectors and sizes will help guarantee success.

If the project allows, a team approach organized by business area will lessen resistance and help manage the many questions that will be directed at the project management team.

CONCLUSION

Why have ERP systems had such an influence on our world in the last two decades?

Why will they continue to influence our world for the decades to come?

- The growth of ERP has been fed by the competitive gains that have been realized at the heart of companies that have implemented these systems. This feedback loop of investing in the intellectual development of the ERP system permits the company to react faster to market forces.
- ERP has been widely accepted by professionals in a variety of domains who have successfully balanced the often opposing demands of business users and programmers
- ERP has facilitated the growth of the management consulting industry. It has won over both executives and consulting firms by its fundamental organization capacities due to the constraints imposed by the relational database.
- ERP has once again empowered executives and boards of directors to adapt and rapidly make decisions.

Once the management of information in an enterprise is well-organized, the work of using this information and implementing Business Intelligence begins.

All of these important intellectual and financial investments have paid off in the last 10 years in the sectors most advanced in IT, notably the finance sector.

It is clear, however, that many tools developed and their applications on masses of data are still far from bearing fruit. Given that many of these tools are supposed to help predict and even behave like "artificial" intelligence, they did little to help policymakers to foresee the crisis of 2008.

There is still much ground to cover.

Improvement of the product quality and efficiency of companies using ERP - and RRP when they have a research department - shows that we are headed in the right direction.