Integrated Human Resources Information Systems: Involving Extra Data Sources Centered around Groupware

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Abstract

Human resources management systems are having a wide audience at present. However, no truly integrate solution has been proposed yet to improve the systems concerned. Existing approaches classification attempt is made in this paper. Possible approaches to extra data collection for decision-making are considered including psychological testing and fixed assets information as well as product sales data. Concept (or object) modeling is taken as a theoretical background for the systems in question. Current technologies in state-of-the-art HR management software are discussed. Design and implementation aspects for a Web-enabled truly integrate enterprise system with high security and scalability are described. Testing results for an improved enterprise-level HR system are given. Perspectives of the field in question are discussed.

1. Introduction

Human resources information and management systems (HRIMS) involve a collection of technologies that allow us to represent complex processes that center around personnel activities. An advanced HRIMS is based on the following technologies: multimedia data management, workflow control including approval facilities, e-mail, scheduling, conferencing.

As one can conclude, a really versatile HRIMS cannot be separated from World-Wide Web and should include major groupware technologies [9]. From an enterprise point of view, human resources management includes the following activities: recruiting, planning (benefits plans, contribution employee stock options plans, etc.), line management, employees training, employees testing, payrolls, compensations, benefits administration.

HRIMS help to remove layers of bureaucracy by optimizing HR forms storage, retrieval and exchange. With HRIMS, top security of transactions is an important issue since personal data and corporation structure changes should usually be fortified with high security level.

With World Wide Web advent, both recruiting agencies and individuals have become able to publish resumes on the Web. Companies, in their turn, are capable of publishing vacancies on their home pages. This means that new generation HRIMS should feature Web browsing and publishing.

2. Existing Approaches

Current approaches to HRIMS are based on hardware accents and software technologies dominating at present. HRIMS software can be roughly divided into three major categories:

a) transaction-based approach (conservative systems based on mainframe architecture);

b) database server-centered approach (distributed enterprise HR data systems based on a solid foundation of a secure and a scalable database server);

c) groupware approach (recruiters, employees and applicants serf through WWW, schedule interviews, assess personnel performance breaking inter-department and inter-organization barriers).

Let us briefly describe each of the approaches named.

2.1 Conservative Transaction-Based Approach

This approach originated from mainframe architecture, which is transferable to present-day LANs.

Some of the systems built under this approach include such advanced features as payroll data entry, storage and reporting, multimedia personal data handling (including employee photos, etc.), ordinary and sick leave data entry, storage and reporting, flexible form and report generation.
Transaction-based approach means that the system behavior is rather stable since it is easy to either complete (commit) or reject (roll back) the result of current transaction in case of system crash or power failure.

In most cases a high security level is guaranteed by explicitly enabling/disabling rights of every user for each entry form, report or query. Since systems of the kind are non-client/server ones, they lack flexibility of a distributed system and it is hard to develop and deploy applications and perform WWW data publishing. However, high security level together with relative flexibility make them a good choice for conservative companies and even huge enterprises.

A typical and a positive example of systems concerned is *Q Data Dynamique* (Pty) Ltd. *UniQue* HRIMS originally designed for use with AS/400 and later (in 1993) adapted for PC LANs.

*Deloitte & Touche* consulting company estimated the system positively and recommended it for use with companies and even huge corporations. The product is "reliable, and is designed on the whole in accordance with the requirements for functioning mechanism and control possibilities it possesses"[10].

A present-day example of *UniQue* being implemented is Russian subsidiary of *Coca-Cola Refreshments Co*. Human resources and payroll data are stored together in a uniform custom database thus making an integrate solution.

In most cases, however, systems of the kind use rather a primitive set of standard functions and neither possess a front-end programming and development environment nor can easily accept data from foreign sources.

### 2.2 Advanced Approaches: More Integration and Flexibility

More versatile approaches compared to the transaction-based one are existing at present both within proven industrial systems and end-user open solutions.

The two most successful examples include *Oracle* and *Lotus Development Corporation* products.

#### Oracle Human Resources

*Oracle Human Resources* services are based on highly scalable and reliable relational database *Oracle Universal Server*. The HRIMS features compact storage effective retrieval of multimedia data, advanced form generator, advanced report writer, object-oriented visual interface script language, SQL-based procedure-oriented query language, cross-platform support, Web-wired applications development.

Personnel data can be compactly stored in a complex multimedia format including photos of the employees, their signature samples, interviews video records, certificate color copies, etc. Using *Oracle Multimedia Data Server*. Data can be retrieved in a fast way.

Personnel training and skills acquired can be presented either in standard tabular or convenient graph report using *Oracle Reports* report writer. Attractive or formally looking entry forms can be created and edited with *Oracle Forms* form generator.

Multi-platform client/server support is guaranteed for most of the well known operating systems including *Novell NetWare*, *Sun Solaris*, *IBM AIX* and other UNIX dialects etc.

With the help of *Oracle Web Server* developed and deployed database-oriented applications become Web-enabled automatically.

*Oracle Designer/2000* allows to enhance and optimize HR-oriented applications using visual interface and an SQL-based *PLSQL* language as a fundament and a visual object-oriented script language at lower level. Data interchange and database integration is possible with *Oracle Applications* group *Oracle Financials* modules which include *General Ledger*, *Payables*, *Receivables*, *Assets*, *Manufacturing*, *Project Management*, and *Purchasing*.

For example, there are certain points of integration within *Oracle Assets* which can use personal data from *Oracle Human Resources* for depreciation and tax calculations.

However, *Oracle Applications* group products are integrated loosely enough and much is still desired to build a real enterprise level solution out of them.

#### Lotus Notes Solution for HRIMS

Understanding the field importance, *Lotus Corporation* also comes up with a concept of a HR system [17]. Since *Lotus* is the leader in groupware production [9], its choice for any business process control is groupware.

The system is based on *Lotus Domino Server* [16] and includes the following features: multimedia and non-structured data handling, mail services for HR collaborate activities, WWW-ready environment, electronic routing and approvals, streamlined scalable workflow, telephony-based solutions, scheduling for personnel training, cross-platform support, ODBC integration, advanced replication, mobile users support and high security degree (down to field level including electronic encryption).

*Lotus* provides a basis for the entire spectrum of HR activities including recruiting, applicant training, advertising, managers hiring, job offering negotiations and approvals, new hires support, automated inquiry service, personnel activities control, personnel testing and assessment, personnel training, performance management, compensation and benefits administration and HR call support.
Let us overview the HR system activities the way Lotus implements them. Managers can post job openings in a Lotus Notes HR database, providing a quick and easy access to all the openings. Notes HRIMS can also help to match these job openings to internal personnel with the right expertise and experience. And managers can use Notes to publish these job opportunities to the World Wide Web seeking out new talent to meet organizational challenges. As a result, time and money consuming professional recruiting and advertising are accelerated and made cheaper.

For hiring managers Notes HR database can securely and accurately hold thousands of scanned resumes or video clips with applicant interviews ready to be searched. Sorting on various criteria is available thus speeding the search up.

Workflow and e-mail services provide for fast and accurate negotiation approvals and let applicants immediately know the interview results. Appointments are easily scheduled and both sides are informed about possible changes in time.

Telephony-based solutions allow to make essential calls out of the organization and to automatically answer basic questions of the appointments.

Another benefit important to any HR group productivity is questions database including Frequently Asked Questions (FAQ's) and other data indexed for indexed for advanced searching or Web browsing.

Notes HRIMS coordinates the entire organizational training process connecting organizations with training providers, supporting scheduling, organizing and running courses and mailing facilities.

Involving external programs Lotus HR system can be a data source for personnel performance management.

Some personal data like benefits plans, contribution programs and employee stock option plans as well as other financially oriented data can also be stored on Lotus Domino Server.

Though Lotus provides a truly hi-tech groupware-oriented flexible solution for HRIMS, the database is too open (the concept is better for recruiting agencies than for enterprises) and has no specific HRIMS features such as testing and assessing personnel and no connection to financial data except through ODBC.

There are, however, even more versatile approaches existing which are a combination of the above mentioned ones. One of the most successful examples is Oracle InterOffice [15].

### 3. Related works

[1, 2, 3, 4, 5, 8] provide rigorous mathematics foundation and solid theoretical background for the paper.

Lattice of flow diagrams which can be used to represent and to model data flow is discussed in [1].

Object hierarchy as a basic approach to handling objects storage and manipulation is described in [4]. Database structure can also be illustrated in detail using the semantic networks approach introduced in the paper.

Papers [3, 4, 6] deal with various database structure notations, which is necessary to be taken into consideration. Relational DBMS and weak-structured document solutions are cross-examined.

Semantic networks theory is developed in [5]. An intuitively transparent way to adequately illustrate both explicit and obscure object properties has evolved from this paper.

A modern point of view on object-based implementation is presented in [8]. Using a rigorous mathematical fundamentals starting from elementary objects, the paper provides a general overview of object-oriented systems theory suggesting a number of practically applicable solutions as well.
An enterprise solution for groupware-based HRIMS is outlined in [7] and given an even more wide coverage in [9].

Recently developed advanced HRIMS overview (see Section 2) is based on thoroughly studied user and system documentation from respective vendors [11, 13, 14]. World recognized consultants opinion [10] and independent expert advise [6, 15] are also taken into consideration. Current HRIMS status is acquired from World Wide Web [12, 16, 17].

4. Design Assumptions

Designing any HR system and an enterprise HRIMS in particular it is recommended to combine the following technologies: CASE, RAD and advanced database performance tuning and optimization.

The following features are highly recommended to design a state-of-the-art enterprise level human resources information and management system:

- high degree of scalability;
- distributed cross-platform database processing;
- multimedia data handling;
- Internet and Intranet access with advanced mail system;
- WWW data publishing, RSA comparable security level;
- advanced transaction management;
- fast and reliable search and archiving mechanisms;
- query and server performance optimization facilities.

5. HRIMS and Object Theories

Let us specify a set of the following basic operations needed: personnel hire/retirement/movement, personal data structuring/archival, searching and updating, resume publishing, personnel reporting on appraisal, testing and training data maintenance. One can make a conclusion that some of the points mentioned transparently correspond to information flows identifying stage.

Moreover, as soon as one starts moving from an information system to a management system one has to start controlling information flows. For example, in order to control a recruiting agent activities we can count candidates' resumes passed around, number of meetings arranged, number of interviews successfully completed, etc. To further enhance the management, it is necessary to obtain critical approval points and then to start tracking the approvals. Thus we move from just storing information to performance assessment. Of course, the final decision is up to people. Nevertheless, enhancing the information system with the above techniques gives more essential reports on labor productivity and performance, which serves an invaluable raw material for the decision-makers.

The information passed around within a company can bear either personal or strategic enterprise importance that is why it is should be securely coded (RSA level encryption and electronic signatures are recommended), so access limitations of certain kind are to be set.

An intuitively transparent and mathematically rigorous way to implement access limitations is access hierarchy concept discussed in [9]. The approach concerned corresponds even better to HRIMS field since can be based on personnel hierarchy.

5.1 Object Groupware "Centering" Aspect

This is not just a matter of coincidence that author turns to groupware technology while dealing with HRIMS. When it comes to management, various business processes like human resources, sales or tax management, etc. become similar in some aspects. People are generating documents and passing them along the personal hierarchy to view, update or approve. That is why every information system producing reports becomes involved into enterprise document flow. Given below is a typical example based on semantic networks notation [4] used for object modeling [5, 8].

Let us assume an enterprise is using a HRIS and a financial system functioning separately. Let us consider two business process fragments:

i. Mr. John Smith reports to Mrs. Mary Brown (a line manager) on his testing results (see frame F11 in Fig.2);

ii. Mr. Paul Williams sends to Mr. Peter Johnson (a senior accountant) his tax report (see frame F12 in Fig.2).

Since the two information systems are not interconnected, the following drawbacks can be observed:

- Information duplication occurs frequently. For instance, some personal data for each employee (such as name, home address, contact phone number, enrollment date, etc.) has to be duplicated.
- It is really hard to provide corporate data integrity because of multiple duplications and possible contradictory data which results in problems with both taxes and training management;
- Using financial data to improve personnel management is an impossible task;
- Instead of an integrated mail system approach several mail system implementations are required one for each management system.

Let us have a look at Fig.2 once more. It is evident from the illustration that despite the fact that business processes concerned belong to different management systems, these processes have much in common. EMPLOYEES SEND reports, each of which IS A DOCUMENT, to other EMPLOYEES.

This observation provides an idea of an object-based, groupware-centered integrated system for human, financial and
possibly other kinds of resource management. This approach originated from mainframe architecture, which is transferable to present-day LANs.

5.2 Personnel Hierarchy

Let us illustrate the concept of access strategy dependent on personnel which author believes is "the most important asset" [17] for any company.

First of all, let us note that despite the fact that some documents (even in case of HRIMS) make so-called outgoing mail while others are incoming (from beyond the enterprise boundaries), the majority (including HR orders, leave requests, training and testing forms and results, personnel hiring/dismissal and movements) belongs to intro-enterprise documents. Secondly, we definitely need an exception type OTHER to handle hierarchy exceptions. Of course, explicit addressee change by a person with certain access level is also possible.

We also need certain HRIMS-oriented addressee types, namely, PEOPLE, with general subtypes of RECRUTEE and RETIREE for any corporation. Another specific type we need is ADMINISTRATOR with major subtypes of SYSTEM ADMINISTRATOR and SECURITY ADMINISTRATOR. Some of the USER instances can also be of ADMINISTRATOR type as well but we shall assume they belong to LOCAL ADMINISTRATOR type.

Putting it the other way round, an ADDRESSEE is also a SENDER. Naturally, the rules of workflow control are different for a SENDER and an ADDRESSEE instances, still they belong to one and the same domain.

With all the above assumptions made, personnel hierarchy (omitting OTHER type of PERSON) for an enterprise can be generally summarized as shown in Fig.3.

Note that one part of the hierarchy presented is predetermined while the other part is flexible since it is corporation structure dependent.

5.3 Approvals Hierarchy

The structure in Fig.3 handles most of common access level granting cases thus restricting basic document routes and general approval routes as well.

Some routes are predetermined. However, it is a very hard if not a totally impossible task to explicitly define all the possible routes including GUEST PERSON and OTHER DOCUMENT exceptions handling. That is why hybrid approvals routing is suggested. The candidates approval is based on personnel hierarchy while at certain points exceptions are traced.

Approval exceptions tracing can be implemented as a single object with rather complex properties though it could also be represented with a relation shown in Fig.4. Semantic networks notation is also perfectly suitable for this case. Author just considers it to be a bit bulky for this particular illustration. Moreover, this is a practically approved industry solution since it is used in highly secure and scalable Oracle Financials product [13].

6. Implementation Suggestions and Interface Discussion

The above mentioned system examples reveal that in order to construct a really versatile system of the kind an integrate solution is needed. The following alternatives are possible: either a multi-component specific task oriented (e.g. personal data, sales, taxes, testing, leaves, recruiting, personnel movement, etc.) modules "glued" together or an integral all-embracing HR information and management system.

To implement a solution more effectively, it is necessary to decompose the general task down to subtasks and professionally implement the latter ones.
To perform such a decomposition in a rapidly changing enterprise human resources environment involving a fairly large amount of objects it is necessary to use advanced object modeling technologies. Semantic networks technology demonstrated in this paper in respect to HRIMS structure understanding and modeling suggests a CASE tool to be an adequate solution to represent an object-based system model in all its versatility.

Possible tools to solve this task practically approved by author are LogicWorks ER-Win [9] and Oracle Designer/2000 [12]. Both of them are capable of automatic RDBMS schema generation; the operation steps can be traced and approved using semantic networks notation [4].

Figure 2 HRIMS and Financials System Report Flows as an Integrated Document Flow
The task of maintaining personnel structure integrity is really a tremendously important one. Some huge enterprises have subsidiary variations in structure. Several personnel structures may coexist and the task of personnel movements tracking together with maintaining of all the data mappings correctly becomes a really hard one.

Along with advanced CASE tool for modeling we need a means to create applications in a fast way and to make "on the fly" code corrections. In other words, we need a RAD tool. Again, the possible alternatives are either creating the whole system here and now module by module or adding the enterprise-specific code "cement" to huge industry-level professionally developed subsystems.

For a fairly large enterprise with an experienced but a limited in number of people and time IT (and/or consulting) team the second approach seems to be more practically applicable.

The first approach is applicable only for prototyping purposes and *Lotus Notes* is a really great tool for it (perhaps, for enterprises not very large in size it works well for real systems as well since it has a 4Gb limitation on database capacity). Another *Notes* drawback is that it is rather weak at highly structured data manipulation.

*PowerSoft PowerBuilder* and *Oracle Developer/2000* are high-end examples of RAD tools.

With an enterprise HRIMS consisting of a single data center, local servers and clients (the latter ones including mobile clients as well) server reliability, scalability and advanced server performance management is required.

Preferable solution at the moment is *Oracle Universal Server* enjoying world leadership as the most scalable and reliable enterprise level server suitable for TPC-2 [13] transactions intensity level and equipped with a versatile set of fine performance tuning mechanisms [15].

Additional information sources to enhance the system quality and performance were intensively searched for. In an advanced HRIMS the accent should be shifted from *information* collecting, storage and processing towards personnel performance management.

Personnel assessment could give food for decision-makers' thought. List of discovered additional information sources for performance management includes psychology testing (e.g. position correspondence and "computer literacy" tests): as well as financials management system data (i.e., payables, receivables, fixed assets and purchasing modules).
Thus, a rigorous, computer science based approach leads us to an advanced type of a highly integrated HRIMS with an emphasis on management (see Fig.5).

7. Interface Discussion

As we can conclude from the previous section, an advanced HRIMS shares a large amount of personal data with financial and psychology testing systems. That is why the HRIMS should have a user-transparent, uniform, friendly interface with high export/import capabilities.

Forms and reports should be user-customizable since the environment (and user requests as well) is changing rapidly. Operating system independence and Web-publishing capabilities are part and parcel of a state-of-the-art enterprise system. These features are of even greater demand for a present-day HRIMS with a lot of users (including mobile ones) publishing resumes and searching for vacancies.

Since it had already been decided on the Oracle Server, the Financials, a management system from Oracle, has been chosen as a suitable set of financial applications. Actually, the modules listed in the above section are basic Oracle Financials modules.

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8. System Examples

This section describes various implementation classes instances.

8.1 Enhancing a Conservative HRIMS

The system implementation process started from a transaction-oriented DataDinamique UniQue HRIS. After involving some of the information sources mentioned in the above two sections (see Fig.5) the following benefits were achieved:

- fixed assets module implemented creating an additional data source for performance management;
- psychology testing results assessment modules implemented providing more personal-specific information for positions management;
- leaves module improved according to specific enterprise needs;
- database structure optimized resulting in at least twofold acceleration of information entry and report generation;
- user-transparent meta language for queries and reports reduced entry time essentially;
- query and report interface became more user friendly;
- multimedia data handling (e.g., employee pictures, signatures etc.) implemented;
- higher security level achieved;
- wide access levels range added.

A possible data entry and collection client is WRQ Reflection. It can be used in any environment from a terminal or a network PC to a regular notebook or a workstation.

However, a more user-friendly alternative is desired for a mass user instead of this terminal-like data entry program. Possible advanced solutions are Oracle Forms and Oracle Reports.

They both have an attractive, visual user-friendly interface and, according to FORS company, one of the leaders in the field of Oracle-based solutions in Russia, it has a user-transparent interface extension that allows to visually customize queries, forms and reports using a semantically user-transparent language. Instead of database fields users operate with native words with certain meanings.

Oracle Reports has lately become integrated with Oracle Designer and it also has also a procedural SQL-compatible PL/SQL query language equipped with powerful server tuning and query optimization facilities including direct instructions to server, explicit data source pointing and other advanced features.

Oracle Web Server provides a quick-and-easy World Wide Web data publishing. Data becomes accessible from any Web browser (like Microsoft Internet Explorer and Netscape Navigator) which is an invaluable interface advantage for both recruiting agencies and applicants to be used for vacancies and resumes publishing.
The system is implemented at one of the branch offices. End users have been satisfied with its functions set, interface features and performance.

8.2. Groupware-Based Solution

An alternative HRIMS version has been implemented according to the above guidelines by a colleague of mine using Lotus Approach DBMS [16].

In addition to the system described in the previous section, it has the following benefits: WWW publishing ability, more efficient reaction time for semi-structured data queries and RSA-compatible security level.

The system now is in the stage of pilot testing. It is theoretically possible to improve it adding psychological and financial data sources. However, this particular feature has not been implemented yet.

Advanced approval strategy is implemented in a corporate contract approving system by another developer at my department. Lotus Notes has been chosen as a tool. The system could give a source of additional information for contract and sales managers activities assessment. Similar to the Lotus it is also in accordance with the author's groupware-oriented solution concept.

Groupware-oriented and transaction-based systems described previously are good enough to be implemented as a prototype of a truly industrial integrated system. They also serve a good illustration of major theoretical assumptions being in accordance with reality. The only drawback now is the lack of state-of-the-art specific-oriented set of tools for creating a mission-critical system.

The only toolkit the author is convinced to be reliable and scalable enough for a real enterprise system is Oracle set of products. However, even Oracle Human Resources system lacks the "glue" of information sources integration.

The resulting industry-level system has not been implemented on the whole yet though its hardware and software components are identified. Some of local HR solutions and financial data sources are functioning already. The "heart" of the system is its data center installed on an IBM RS/6000 server. Software components of the data center are Oracle InterOffice [18], Oracle Financials, Oracle Human Resources, Oracle Web Server, Oracle Universal Server, Oracle Parallel Server and IBM AIX.

Each of the subsidiaries has a local branch office with local and/or mobile clients communicating by Oracle Web Agent through IBM Global Network provided channel. It is also possible to use any Web browser (like Netscape Communi-
The additional benefits the industrial level integrated system approach provides are:

- OS independence;
- industrial level scalability and reliability;
- user-transparent interface for custom forms creation and report writing;
- a tightly integrated set of industry leading specific task-oriented tools;
- server extension for multimedia data handling;
- server enhancements for instant Web access, development, deployment and publishing;
- fine-tuning server performance tools;
- advanced visual interface procedure-oriented SQL-based data manipulation PL/SQL language including "on the fly" server performance adjustment facilities;
- uniform (all from one vendor) and intuitively transparent interface;
- advanced database management and administration facilities;
- RSA-comparable security level;
- application reports naturally transformable into groupware documents;
- multiple currency and various tax collection standards support;
- multi-language support.

9. Results

This paper presents existing approaches to HRIMS overview. Products currently competing in the market are compared. ISA-hierarchy enabled semantic networks and flow diagrams lattices are chosen to provide a rigorous computer science basis for object and information flow modeling respectively. Putting into service additional information sources such as psychology testing data and financial system reports is suggested to enable a HRIS (as an information acquire/storage/processing system) with certain features of a truly personnel performance management system of an enterprise level.

A conservative transaction-oriented HRIS improved by enabling additional information sources is now at personnel management decision makers’ disposal.

Thus, the groupware-centering approach introduced has been proved to be an effective way to enterprise system components integration.

Several components of such a system have already been implemented (as pilot versions mostly) using world leading groupware technologies from Lotus.

However, to produce a really scalable and reliable industry-level systems oriented on mission-critical tasks it is advised to choose a uniform set of specific task-oriented tools from Oracle. Industry leading technologies are applied in every part of this integrate solution ranging from precision server performance tuning to advanced Web publishing. Industry trends and perspectives are given below.

10. Conclusion, Perspectives and Future Work

Human resource information systems industry is facing new challenges on many fronts: from SQL database vendors with query optimization and advanced server performance facilities, from rapidly evolving Internet era with world-wide resume publishing and recruiting facilities, from emerging object modeling technologies like CORBA Object Request Brokers, recently adopted by Oracle. Possible trends in human resources information systems industry in author's opinion can see can be summarized as follows:

- Human resources systems vendors are embracing the Web. The Web, with its open document standards - including document browsers, firewalls, the pervasive HTML/HTTP publishing standards, and the SMTP/MIME e-mail backbone - is the most formidable competitor HRIMS vendors are currently facing. Human resources system vendors are in the best position to provide industrial strength technology for the Web-wired scalable resume databases, mission-critical mail backbones, security, support for mobile users and system management. HRIMS solutions for WWW will probably be based on currently debated groupware Internet standards [6, 9].

- Human resource systems are getting mission-critical ready. Both Lotus and Oracle provide solutions for a truly robust, scalable, and OS-independent system infrastructure. Advanced features are fine system performance tuning, replication, query optimization, RSA-level security and global systems management.

- WWW, computer telephony, mail systems for HRIMS (as well as for other enterprise level systems) are using groupware-oriented technologies thus making groupware a cementing link for enterprise-wide business processes information management facilities.

- Major HRIMS solution vendors are producing tools that allow end-users to create applications incorporating data from various enterprise systems (both information stores and SQL databases). Uniform tools have been produced to customize forms, reports and even server performance. These tools are equally applicable for almost any type of enterprise-level systems including human resources, financials, goods and documents management.
Human resources information systems have come a long way. Some solutions, like relational databases, work well even up to the present day, of course incorporating a number of recent technological enhancements. Others, like conservative transaction-based HRIS, are becoming outdated. The author's opinion is that the industry on the whole is moving from information processing towards business process management. Since various business processes are interrelated in an enterprise, such an integrate HRIMS should acquire additional information from its neighbors: financials, goods, documents and other resource management systems.

The author is going to continue efforts towards implementing a WWW-wired, mission-critical industrial level personnel management system as an integral part of a uniform groupware-centered business process management system

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