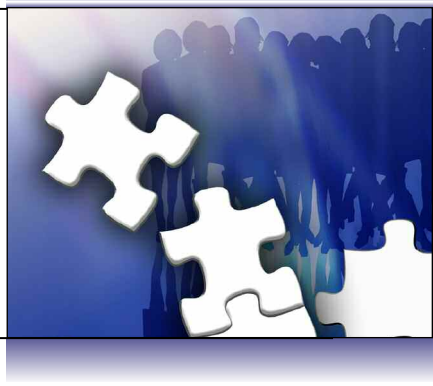
Component Architecture and the Technology Marketplace



By John Macy, Competitive Edge Technology

Component-based software is a relatively new paradigm changing the way business applications are developed and deployed. It is defining a new era of component architecture. As it evolves it enters new territory and there is no roadmap to help navigate through the many issues that will be encountered along the way to universal acceptance by the information technology and business communities. Other industries have encountered similar evolutionary problems and there is a lot to learn from their experiences. The automobile industry is one such industry.

This article will take a look at similarities between the automobile industry and the software industry and the various stages of development, including innovation, production, and the way they are marketed, packaged and sold to the public. The packaging and marketing techniques are of particular interest because they may provide an indication of the future model for component-based human resource information system (HRIS) products and the marketplace operation.

Why the Automobile Industry?

The design and construction of an automobile is often used as an analogy to describe the future model for component-based business applications. Automobiles consist of thousands of component parts, all assembled on a single chassis that acts as the base frame. Similarly, a business system, such as a HRIS, can consist of thousands of component program objects that require an application framework on which to be assembled. The automobile parts can be interchanged according to the buyer's preference when purchasing a new vehicle or replaced later when the original part wears out. Similarly, an HRIS buyer can select a combination of components when purchasing a new system and interchange components as the business changes.

Unlike the automobile, component-based HRIS has not yet achieved market acceptance. A major factor inhibiting the growth of the component-based HRIS software industry is the lack of commercial incentive to vendors to sell subsets of their total HRIS product. The reason is HRIS buying habits have not changed since the 1980s and companies still go shopping for total solutions from a single vendor. Similar commercial challenges were faced by the automobile industry in the era when car makers built and sold the entire product. The way the automobile industry evolved to sell either the whole vehicle or allow interchangeable parts may provide a guide for the software industry.

Industry Similarities

Unlike computers, automobiles have been around for hundreds of years. The automobile industry can be traced back to the 18th Century and is now a mature industry. Computer technology and business applications are relatively new, arriving in the mid- to late-20th century, and the industry is still maturing. Our personal lives changed forever with the invention of the automobile. Our business lives changed forever with the invention of the computer. Both inventions focus on a mass market. Both have people as the target users. Both strive for usability perfection. Both experienced barriers to progression. Both experience constant change and variation to find the right model to suit their customer. The composition of both requires many individual parts. Both represent an improvement on a pre-existing crude version of themselves: Automobiles improved on the horse and carriage and computers improved on the calculating machine and a record card system.

Vertical Integration Techniques

Although the early American automobile industry became concentrated in Michigan, Ohio and Indiana, today motor vehicles are no longer produced in one location with a single manufacturer making all of the parts and using an assembly line to piece together the final product. There is a vertical integration approach to the manufacturing and marketing processes based on pure economic rationale. For example, vehicles from the Ford Motor Company are assembled in all parts of the world and use engine and body components from a host of different suppliers. The automobile industry recognizes the advantages of vertical integration and uses parts from different suppliers and encourages innovation to take place at the supplier level to achieve a higher quality product without shouldering the entire investment in research and development.

On the other hand, entire HRIS are still being developed by single suppliers without regard to the economics of distributing research and innovation to smaller companies with the right expertise in the business area and lower costs structures to build specialty components to integrate into their product suite and enhance the overall product quality.

The advantages of a vertical integration approach to software marketing, and the encouragement of software development communities to expand the functional range of their products, is understood by larger software companies,

such as Oracle and SAP, and they have adopted appropriate strategies.

A Brief History of the Automobile

The period of particular interest to HRIS, for comparison purposes to the automobile industry, is the late 19th and early 20th century when the automobile became of age and evolved into the product we know today. That period has been divided into four "eras" by Langlois and Robertson in an article entitled "Explaining Vertical Integration: Lessons from the American Automobile Industry:"

1. The era of invention (pre-1900),
2. The era of product development (1900 – 1908),
3. The era of rapid expansion (1908 – 1918), and
4. The era of replacement demand (1918 to 1929).[1]

HRIS systems have experienced similar eras:

1. The era of invention (1950s to 1970s): The period when the capability of computers to store large amounts of data and perform mathematical calculations for business applications, such as payroll, was discovered.
2. The era of product development (1970s to 1990s): The period when business applications evolved from monolithic mainframe systems to client/server applications using different network protocols and Windows user interfaces.
3. The era of rapid expansion (1990s to present): The era when HRIS moved from in-house developed solutions to generic off-the-shelf products that could be sold to a mass market.
4. The era of replacement (future): The era we are entering when business and technology changes occur at a rapid rate and the need to constantly replace business applications leads to the need for a new type of interchangeable HRIS component product.

1. *The Era of Invention*

The origin of today's automobile could probably be traced back to 1769 when a French military engineer named Nicolas Cugnot designed a very cumbersome steam-powered road "vehicle." Opposition to the new form of transport was very strong, especially from horse-driven coach owners with a vested interest in the existing method of transport. Resistance to change manifested in the British government's "Locomotives on Highways Act," or the "Red Flag Act," as it became known, in 1865. The Act imposed speed limits of 6.4 km per hour in the country and 3.2 km in towns. Every "vehicle" was required to have three attendants: one to steer, another to stoke the locomotive, and one to walk 50 metres ahead of the vehicle, waving a red flag.

Acceptance of the new transport paradigm was slow and people were not sure if the vehicle was really a horseless carriage or more like a railway locomotive than happened to run on roads instead of railway tracks. It was not until the automobile was seen as a brand new form of transport, rather than an improved form of an existing mode, that advances were made. During the era of invention, the integration of parts from various sources played a role. Often parts from other modes of transport, such as bicycle wheels, were used to construct crude forms of the automobile.

From a software industry parallel perspective, computers were perceived in 1950 as giant calculating machines. As the storage capability became apparent and the use for data input, processing, and retrieval were realised, their suitability as a replacement to a manually maintained record card system emerged. The perception of HRIS was a computerised employee record maintenance system. However, life as a business application offering self-service, workflow, workforce analytics and all the other nice features, accessible from anywhere in the world, took another 40 years. Pioneers, such as Bill Gates with his Microsoft company and the Windows product for personal computers contributed greatly to the look-and-feel of the modern business application. Dave Duffield and his PeopleSoft company that developed one of the first client/server HRIS applications shaped the direction of business applications that followed.

2. *The Era of Product Development*

As the automobile emerged with an identity of its own, rather than the horseless carriage, the commercial opportunities became apparent. The early 1900s market preference was the heavy French version of the automobile with a multi-cylinder engine mounted at the front, multi-gear transmission and differential, all attached to a steel frame, rather than the lighter Curved-Dash Oldsmobile Runabout. However, they were expensive and an opportunity emerged for an automobile that incorporated the solid French design with its steel chassis, but with a price comparable to the Oldsmobile. Ford's Model T emerged to take the market space with all the modern features and low price.

From a software industry parallel perspective, early business applications were built by organisations with large teams of in-house developers. Only big companies that could afford large information technology (IT) units could take advantage of the automation that resulted. In turn that gave large companies an even greater competitive advantage in the marketplace. Most in-house HRIS systems were designed to run on mainframe hardware and software built over many years, taking time to meticulously measure and map each task within a process and identify data and database requirements. The cost of building an in-house system was extremely high and the process slow.

It was not until the late 1980s that a similar union to the steel chassis and low price of the automobile industry took place in the computer industry. The power of the mainframe was combined with the cheaper personal computer (PC) platform to deliver client/server products.

3. *The Era of Rapid Expansion*

From 1908 the demand for motor vehicles expanded rapidly and the focus shifted from product innovation and development to production process. Mass production techniques, such as the assembly line, took centre stage. Much of the early success of the Ford Model T was due to early

adoption of the mass production technique. However, manufacturing plants required considerable investment and because of the relative newness of the industry, investment was considered high risk, obtaining capital was hard, and entry into the industry was difficult. The result was many automobile companies started out as assemblers rather than manufacturers using parts from small suppliers.

As the component parts market developed for smaller suppliers, it became apparent that some of the suppliers could develop superior quality parts at a lower cost structure than the principal automobile manufacturer. An example was one of Ford's part suppliers who developed pressed steel used in axle housing. The process was perfected by engineers at one of the supplier companies and that prompted Ford to introduce a strategy to assist suppliers to improve their parts through innovation rather than take on the task themselves.

As the demand for motor vehicles accelerated, production techniques continued to improve. The technique by manufacturers of keeping inventories low and ordering parts as needed led to just-in-time supply and further reduced costs. Automobile companies were able to keep up with market demand.

From a software industry parallel perspective, it wasn't long before it became obvious that there was a great deal of similarity between all of the in-house HRIS systems and a generic industry model was possible. After all, they were modelling a common business function that had been applied for over 40 years without undergoing major change. For example, the process of hiring, developing, paying, administering and terminating employees is common to almost all types of companies and hasn't changed. That opened up the door for the HRIS off-the-shelf products. The effort then moved from building the initial system to implementing and modifying the off-the-shelf product and tailoring it to suit individual companies. Although expensive, the pricing model and overall economics still favoured the off-the-shelf solution over the in-house development.

By the mid-1980s HRIS had almost moved into an assembly line operation as hundreds of software companies sprung up to build HRIS products. Although building to a generic model in theory, each company developed their product in isolation and designed their own database structures and often used proprietary toolsets to program their products.

As new products came on to the HRIS market and competition grew, it was necessary for vendors to have some form of product differentiation in order to gain market share. For that reason, there was no effort to integrate products with competitors, and vendors tried to provide all things to all people within a single product. The niche market vendors selling standalone human resource specialty products, such as performance management solutions, found it difficult to enter the market, sold limited copies of their software, and had to price them in a high bracket to recover development costs. The issue of data duplication and synchronisation created a market barrier for most niche product sellers.

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Integration of business applications during the early stages of this period was almost non-existent. There were standalone products that operated in parallel to other systems and some had file transfers to avoid re-keying data but no database integration. There were early attempts at integrating the new PC platform with the existing mainframe systems of the day with screen scraping techniques and emulation software, but it was difficult to achieve a robust operation that was sustainable.

4. *The Era of Replacement*

By the 1920s, the replacement market had emerged to supply parts for the aging automobiles purchased in the years before and the used car market arose to compete with the new car market. Many new parts companies that entered the market were small to medium size, had a low cost structure, and could offer alternate parts cheaper than the original manufacturer. The profit margin on spare parts was much higher than the car makers were achieving through new car sales. Spare parts companies were catering to both the new car manufacturers, as component suppliers, and the spare parts market as retailers. For a while, automobile manufacturers could force their dealers to use only authorized replacement parts to retain some control over the parts market, but that strategy was not sustainable and price ended up being the determining factor in the marketplace.

Another feature of the automobile industry market was the new model demand. Customers wanted new models and manufacturers were more than ready to cater to obsolescence in their product planning. However, new and multiple model frequency placed a strain on production capability and the use of external component suppliers became an essential strategy. Spreading the development cost of new components onto the parts suppliers meant models could be turned out at regular intervals. The result was a labour shift, resulting in a decrease in number of employees in automobile plants and increase in employment levels in parts suppliers.

The options available to new car buyers today are numerous. The buyer does not have to take the showroom model. The buyer can select almost any feature they want relating to the body, brakes, interior, suspension, wheels, engine, transmission, etc. and a suitable vehicle can be assembled to match their requirement. The barriers to progress have dissipated over the years and the process associated with supplying millions of alternate and replacement parts has been managed effectively through defining and cataloguing components, computerised inventories and online marketplaces.

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From a software industry parallel perspective, the HRIS market is just starting to feel the impact of the HR business equivalent of the component assembly and replacement demand. The current HRIS production and marketing model is no longer suitable for today's business community. Change is happening constantly as the result of a new business direction, new HR practices, company mergers or acquisitions, increased competition due to global markets, etc. The speed required to respond to change is faster than ever before and technology needs to adapt to be able to keep up with demand. Component architecture's time has now arrived.

LESSONS LEARNED

The HRIS software industry is evolving through similar eras to the automobile industry. The era the industry is about to enter provides an opportunity to re-think the way companies operate in regard to production, distribution and marketing techniques. Some major lessons learned that provide guidance for HRIS include:

- The focus of software development companies should be on how to build a product that satisfies highly specialised needs and is able to respond quickly to change.
- Component innovation is best spread over many suppliers.
- HRIS software companies should re-think the way their company operates if it is to be successful in the new era. Do they want to be a manufacturer of a single HRIS product or do they want to team with suppliers to offer multiple brands of products with a focus on marketing and distribution?
- Just as parts suppliers sprang up during the automobile "era of replacement," suppliers of HRIS specialty component products have an opportunity to gain market share due to their lower cost structure and higher level of expertise in the subject matter.
- The marketplace for HRIS component parts must apply the same cataloguing technique, application of technology, and distribution practices that the automobile industry uses today.

The impact of change has already started. The number of large HRIS software companies has been reduced over the last five years. Some have been acquired by even larger companies, but some have simply failed to adapt to the new market needs. In contrast, every day there are new specialty companies appearing. The trend is starting to emerge, but the production technique of integrating suppliers' parts is yet to be mastered by the HRIS industry.

INTRODUCTION TO COMPONENT-BASED HRIS

At the conceptual level, components are system modules defined according to the human resource management business practice they support, such as recruitment, learning and development, remuneration management, payroll, performance management, and so on. At the physical level, components are a collection of program objects. Objects are parcels of code that perform a function or a series of functions. They can be likened to "subroutines" in earlier programming models. The subroutines are compiled, packed and sold as discrete units. There are three formats in which components and objects may be sold:

- Black Box, where the code is hidden from the purchasers,
- White Box, where the code is exposed to the purchaser and can be modified to suit individual needs, and
- Grey Box, where the component is sold with a combination of both Black Box and White Box.

Unlike the automobile industry that has taken the integration process down to the micro level for engine and body parts, the software industry is still focusing integration efforts at the larger assembly parts. Detailed design standards, covering everything from size and weight down to thread types for nuts and bolts, has allowed automobile manufacturers to select from many parts suppliers offering the same product but compete on price and quality. The result has been cost control and better quality vehicles. The software industry needs to go down a similar path if the HRIS customer is going to be able to buy a higher quality business application at a cheaper price. The inevitable direction for software development is component-based software design based on open standards. The result will be interchangeable components that can be assembled into complete business applications. A further level of development is the micro building blocks of an application that goes down to the program level packaged as objects. Objects must also be interchangeable, similar to brake linings, wheels, tires, etc. in an automobile.

COMPONENT INTEGRATION

Just as an automobile requires a manufacturer's manual to assemble all the parts into one finished product, a business application needs a similar set of guidelines to integrate all of the component pieces. To be truly integrated and interchangeable, all of the components need to conform to a

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design standard. Until the component software industry matures to that point, there will be transitional techniques to integrate components. Transitional integrated architecture allows data to be exchanged between applications but it is a complex and fragile way of connecting software. There is usually replication of data, business rules and look-up, or reference tables, throughout the architecture and multiple databases. There needs to be one common database for all applications to access, based on an industry standard.

One common transitional model that is emerging to allow a basic form of component integration is illustrated in Figure 1. The transition model maps data flowing from one product to another. At the centre of the model is a layer that usually includes staging tables and/or an operational data store that directs data traffic in and out of transactions and feeds a data warehouse repository. Legacy systems can coexist in the architecture, acting as a feed for core HRIS data and payroll processing. The niche products sit on top of the model to provide users with a greater range of functionality.

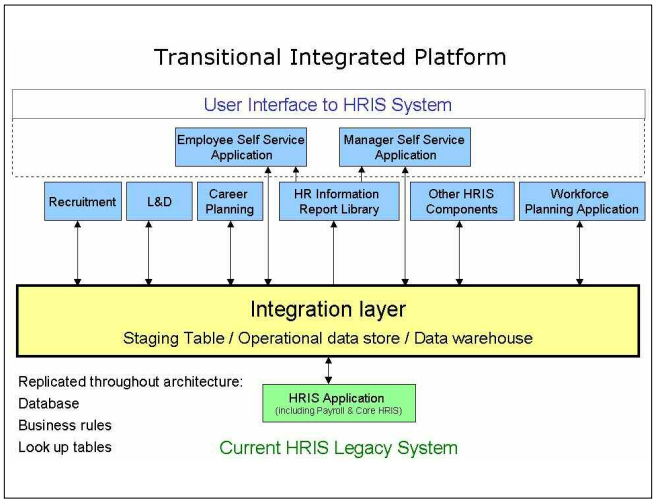

Figure 1. Transitional Integrated Platform.

A high percentage of data validation within an HRIS application is determined by a limited and controlled selection from look-up tables, and business rules often invoke a look-up table as a means of protecting data integrity. In Figure 1, there is a high degree of replication of look-up tables, business rules and databases. The ultimate integration model eliminates all replication in a simple, centralised component architecture. It is logical to keep the business rules and the look-up tables as close to the database as possible. Most modern database management systems (DBMS) allow rules and procedures to be stored with the DBMS which simplifies maintenance and avoids inconsistent copies of the system programs across the network.

The ability to access HRIS applications using a Web browser has simplified the task of managing distributed applications and has helped overcome some of the middleware connectivity problems. The next frontier for integration is the application itself. In Figure 2 totally integrated component applications would be built compliant to the human resource component software application standard (HR-CSAS) and the components could be interchanged to offer system flexibility, higher functional fit against HRIS needs and achieve a higher quality business application.

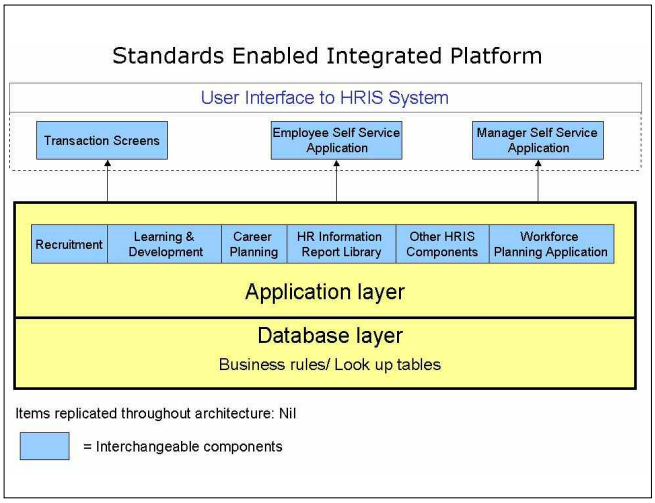

Figure 2. Standards Enabled Integrated Platform.

In the new era, HRIS customers face the reality of selecting and implementing the right mix of components. The component software market must apply a different model to traditional HRIS marketing techniques in order to facilitate the selection process.

Standards for Component Application Design and Deployment

To be truly interchangeable, HRIS components must access the same database. The database is a critical layer in the HRIS architecture and vendors need to agree on a common specification for database design, just as the nuts and bolts in the automobile comply with a standard thread and size type.

As component technology becomes more popular, standards are emerging for almost every facet of application design and deployment. The Internet and web services are becoming the preferred platform for the deployment of components. Technology organisations have made the most prominent contribution so far. Organisations such as the Organization for the Advancement of Structured Information Systems (OASIS) have developed specifications for web services. Specifications include business process execution language (BPEL), service-oriented architecture (SOA), service data objects (SDO), and service component architecture (SCA). The HR-XML group has developed a set of document type definitions (DTS) for the extensible markup language (XML) and schemas to facilitate the exchange of data between applications. Object Management Group (OMG) have developed a set of standards for the middleware and modelling environments. Figure 3 illustrates the role standards play in the design and deployment of HRIS and the exchange of data between the organisation and external entities.

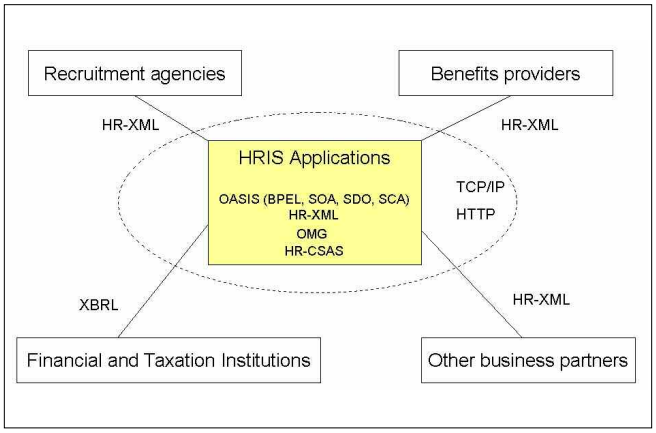

Figure 3. The Role of Standards in Enterprise Applications.

From the business side, Competitive Edge Technology published a draft standard, Human Resource Component Software Application Standard (HR-CSAS) to build HRIS applications for a fully integrated platform, where the database is structured according to an industry model, business rules are categorised into component classes and subclasses. The HR-CSAS document is closely aligned to HR business processes and forms the structure for the component software market of the future by relating software components to the process they support.

The earliest standards in the diagram above are Transmission Control Protocol/ Internet Protocol (TCP/IP) and Hyper Text Transfer Protocol (HTTP) that support the communication protocol for networking all of the components together. The most recent standard initiative is the Extensible Business Reporting Language (XBRL).

THE REALITY OF THE COMPONENT SOFTWARE MARKETPLACE

There are over 2,000 HRIS software companies worldwide selling products in the marketplace today. If each vendor were to enter the HRIS components "spare parts" market there would be millions of component products to choose from. Unless there is a cataloguing method applied, similar to the spare parts catalogue of the automobile industry, then it would be impossible to locate the HRIS component needed – let alone shop for best price. The market needs a structure that business people can relate to and are comfortable with.

The automobile industry managed a more daunting task in the 1930s than HRIS faces today: cataloguing parts for every vehicle manufacturer, every model, and the year it was produced was an enormous challenge. If the scope of the task relating to the documentation of spare parts was understood by the emerging automobile industry in the 18th century, further progress would have been considered too difficult and we would probably be still getting around with horses and buggies.

CHARACTERISTICS OF THE HRIS COMPONENT MARKETPLACE OF THE FUTURE

There are two groups with different needs from an HRIS component marketplace, resulting in two distinct markets: the HR business practitioner group to select business solutions and the HR component vendor and object developer group to assemble HRIS products.

The HR business practitioner group needs to know where to find the component product that supports their HR process or business function. Without a component class structure designed along HR business function lines, finding the right object to integrate into the framework would be like looking for a needle in a haystack. To facilitate the location and selection process of components (and objects), there needs to be an electronic filtering process, as illustrated in Figure 4. Buyers need to focus on a product match based on functional fit, rather than sift through thousands of product brochures to locate the right group of objects, and sellers with smaller specialty components would have to spend a fortune to get their product to market.

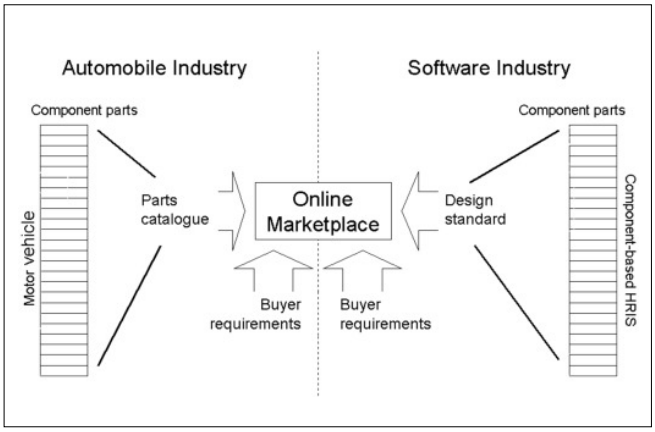

Figure 4. Online Marketplace.

Central to the market operation is a core design standard for naming, defining data and grouping objects into component classes based on business process, in the same way automobile parts are grouped according to physical areas within the automobile such as body, brakes, interior, suspension, transmission, engine, etc.

The buyers will need some assurance that the products they are buying are compliant with the design standard, so a form of product/vendor accreditation is needed.

MARKET ISSUES

There will no doubt be many issues to be resolved around licensing, support and software ownership. The actual ownership of components that have been purpose built for clients as part of a customised implementation will be an issue. The client has paid for the development, but who will own the component and who has the on-selling rights? If components are packaged as Black Box, White Box and Grey Box, it will make the copyright and ownership issues even more difficult.

There will be apprehension about open disclosure of product information: many software vendors are afraid to publish too much functional capability detail about their product for fear of imitation. The generic nature of HRIS software makes it almost impossible to guarantee uniqueness through patent protection. The reluctance makes perfect knowledge of product capability in the marketplace difficult and vendors often prefer to rely on the personal contact to make sales and that limits the scope of their market.

The lesson the automobile industry offers is the emergence of the Japanese car makers in the 1960s. The products sold were imitations of the more expensive European and U.S. models. The fear was loss of market share by the established automobile companies. The result was that a more competitive era evolved, more affordable cars became available, and other Asian countries, such as Korea and Malaysia, entered the market.

There is no doubt new developers will enter the HRIS component software market with low cost structures and varying prices. The result will most likely be more affordable HRIS products.

THE FUTURE

The logical evolution of HRIS software is component assembly and change to the HRIS product marketplace is inevitable. Like every stage of development the automobile industry faced, there will be resistance. The solution is not to introduce "Red Flags" to slow progress, but to recognize the nature of change and impact on the HRIS community, and adjust. The human factor is the only impediment to a speedy progression to the next era of HRIS evolution.

The basic design of the petrol-driven engine has not radically changed since the 1920s. Like the arrested state of development of the petrol driven engine, the software industry is approaching a similar stage where the fundamental design of business software applications may not radically change for many years. The future will focus on HRIS production technique, packaging and presentation to the market.

Change is always difficult, but the trend towards new component-based software design is not an entirely new innovation and should be easy to accept. Component-based software development techniques are used at present; to offer the component products for sale is simply decomposing systems into the micro parts and offering them as assembly objects. The major challenge facing the HRIS software industry is to provide a successful market operation to facilitate the location and purchase of the right software components. Once that operation is put in place, commercial viability and industry acceptance is almost guaranteed.

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ENDNOTE

1 *Journal of Economic History*, Volume 49, Issue 2, Explaining Vertical Integration: Lessons from the American Automobile Industry, The tasks of Economic History, 362-375, June 1989.

ABOUT THE AUTHOR

John Macy is the founder of Competitive Edge Technology, a consulting company formed in 1994 specializing in human capital management software. He has more than 35 years experience as a senior HR manager with an international airline and consultant in HR technology usage. He is an advocate of service-oriented architecture (SOA), web services, component-based applications and business driven standards to achieve greater flexibility and integration. In 2002, he published the HR Component Software Application Standard and set up the first component software brokerage. In 2006, he introduced the first commercial component registry for HR products. He has written several books and published many articles on HR technology. He has worked throughout Asia, the USA and Australia on consulting assignments and is a senior global advisor for the Jeitosa Group International. He can be reached at ***john.macy@cet-hr.com***.