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Enterprise resource planning (ERP)—A brief history

F. Robert Jacobs [a,*], F.C. 'Ted' Weston Jr.[b]

[a] *Kelley School of Business, Indiana University, Bloomington, IN 47405-1701, United States*
[b] *College of Business, Colorado State University, Fort Collins, CO 80523-1277, United States*

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Abstract

This is a brief history of ERP—enterprise resource planning. Major ERP vendors are discussed as well as the major impact of developments in computer hardware and software on the industry. The industry consolidation that has recently occurred is also discussed. Interviews were conducted with Mr. Ed McVaney, founder of J.D. Edwards, Rick Allen, former VP of Finance and Administration, and Rick Snow, former Chief Legal Counsel of J.D. Edwards. Information was also obtained from Bill Robinson who held the position of ''Industry Consultant'' with IBM in the mid-1980s.

Keywords: ERP; Industry; Functional enterprise; Data integration

The move beyond MRP that occurred in the late 1970s and early 1980s was driven by a need for stronger integration between the functional enterprise silos that dominated firms throughout this period. One could argue that software engineers recognized the promise of data integration very early—long before the push towards flatter organizational structures that occurred in the early 1990s.

The Eleventh Edition of the *APICS Dictionary* (Blackstone and Cox, 2005) defines ERP (enterprise resource planning) as a ''framework for organizing, defining, and standardizing the business processes necessary to effectively plan and control an organization so the organization can use its internal knowledge to seek external advantage'' (page 38). This definition highlights the broad scope of applications that fit under the ERP framework. Manufacturing planning and control (MPC) systems are our primary focus but the full system is intended to serve business processes housed within other functional areas—finance and accounting, human resources, payroll, and sales/marketing, etc.

Here we offer a brief history of enterprise resource planning, showing its relationship with its predecessors MRP and MRP II. Our data comes from a number of sources, including our own recall. Major input is from an interview with one of the founding fathers of ERP, Ed McVaney, a founder and former Chairman and CEO of the J.D. Edwards Company. Additional interviews were conducted with Rick Allen, former Executive Vice President of Finance and Administration and Rick Snow, former Chief Legal Counsel, both from J.D. Edwards. Further information was provided by Bill Robinson, a retired IBM executive who held the prestigious position of ''Industry Consultant'' in the mid-1980s.

For completeness, our chronology will begin in the 1960s, an era that is also covered by Mabert in his article in this issue. We move quickly through this period and take the chronology through the important developments up to the present.

* Corresponding author.
E-mail address: jacobs@indiana.edu (F. Robert Jacobs).

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1. The 1960s—early computers, reorder point (ROP) systems and early material requirements planning (MRP)

In the 1960s the primary competitive thrust was cost, which resulted in product-focused manufacturing strategies based on high-volume production, cost minimization, and assuming stable economic conditions. The introduction of newly computerized reorder point (ROP) systems – including economic order quantity and economic reorder point – satisfied basic manufacturing planning and control (MPC) needs of these firms.

MRP – the predecessor to and backbone of MRP II and ERP – was born in the late 1960s through a joint effort between J.I. Case, a manufacturer of tractors and other construction machinery, in partnership with IBM. At the time, this early MRP application software was the state-of-the-art method for planning and scheduling materials for complex manufactured products. Earlier versions of computerized MPC systems (for example, IBM's "PICS" – production and inventory control system) had used the only large-scale storage medium available – magnetic tape. Inventory item master files were kept on tapes, transaction tapes were built during the week, and "passing the tapes" created a new master tape plus lists of orders based on calculated order quantities, safety stocks and on hand balances. (Economic order quantities were calculated by hand using slide rules and entered into the system: first and early second generation computers were not capable of calculating square roots.)

Tape is a one-dimensional medium: manufacturing is (at the least) a two-dimensional business. Projecting requirements of components over future time buckets is a two-dimensional problem; exploding down through a bill of material is a two-dimensional exercise. There were some small shops with very shallow bills of materials, which had schemes for exploding requirements using multiple passes through card sorters. These were rare and, typically, completely dependent on one person who had mastered a technique for this particular data processing art. It was the availability of random access memory that changed the game and made MRP possible.

2. The 1970s—MRP and computer hardware and software developments

Initial MRP solutions were big, clumsy and expensive. They required a large technical staff to support the mainframe computers—at first the IBM7094, for example, and later IBM's 360s and 370s. The development of ever faster and higher capacity disk (random access) storage was a major enabling technology for the development of more integrated business information systems. The word "database" was not in the vocabulary and software tools were highly limited by modern standards.

In the late 1970s the primary competitive thrust was shifting towards marketing, which resulted in the adoption of target-market strategies with an emphasis on greater production integration and planning. MRP systems fit that requirement nicely because of the integration between forecasting, master scheduling, procurement, plus shop floor control. MRP fairly quickly became established as the fundamental parts and materials planning concept used in production management and control.

This era also saw the introduction of IBM's COPICS (communications oriented production information and control system), an eight-volume 1972 series with the objective of providing "... a series of concepts that outline an approach to an integrated computer-based manufacturing control system" (COPICS, 1972). The COPICS software was designed to run on the IBM Model 360 mainframe computer. The movement towards what would be called MRP II – manufacturing resource planning – was underway.

The mid-1970s saw the birth of major software companies that would later become key ERP vendors. In 1972 five engineers in Mannheim, Germany, started up SAP (Systemanalyse und Programmentwicklung). The purpose of the company was to produce and market standard software for integrated business solutions. Lawson Software was founded in 1975 when Richard Lawson, Bill Lawson, and business partner John Cerullo saw the need for pre-packaged enterprise technology solutions as an alternative to customized business software applications. J.D. Edwards (founded by Jack Thompson, Dan Gregory and Ed McVaney) and Oracle Corporation (by Larry Ellison) were established in 1977. Oracle offered the first commercial SQL (Structured Query Language) relational database management system in 1979. In 1978 Jan Baan began The Baan Corporation in the Netherlands to provide financial and administrative consulting services.

Orlicky's (1975) *Material Requirements* text was the first completely detailed description of MRP logic as well as such necessities as low-level coding. It was intended for a wider audience than were the technical manuals which accompanied the purchase of one or another system – hardware or software. Substantial segments of this book were required to explain what

would today be simply referred to as database logic. Miller and Sprague's (1975) article in the *Harvard Business Review* was another attempt to explain the manufacturing and business logic behind MRP systems. It was a layman's description: several hundred thousand reprints were sold.

A critical feature of MRP is the concept of *dependent demand*. Oliver W. (Ollie) Wight's comment on this is quoted as the opening of Orlicky's (1975) book:

> "It is interesting to note that the number of pages written on independent-demand-type inventory systems outnumbers the pages written on material requirements planning by well over 100 to 1. The number of items in inventory that can best be controlled by material requirements planning outnumber those that can be controlled effectively by order point in about the same ratio. It is a sign of the adolescence of our field that the literature available is in inverse proportion to the applicability of the techniques." (Oliver W. Wight from the *Proceedings of the 13th International Conference of APICS*, 1970).

In 1975 IBM offered its Manufacturing Management and Account System (MMAS) which Bill Robinson from IBM considers a true precursor to ERP. It created general ledger postings and job costing plus forecasting updates emanating from both inventory and production transactions and could generate manufacturing orders from customer orders using either a standard bill of material or a bill of material attached to the customer order. Accounts receivable transactions were generated by customer order activity, as well as accounts payable transactions against purchase order activities. At the time, IBM tended to synchronize new software applications with the release of new hardware systems. In 1978 the IBM System 34 – a mini-computer smaller and less expensive than earlier mainframes – was released as was a new integrated suite of applications called manufacturing, accounting and production information and control system (MAPICS) This integrated application took MMAS to another level with general ledger, accounts payable, order entry and invoicing, accounts receivable, sales analysis, payroll, data collection systems support, product and production definitions (the old bill of materials processor), inventory management, material requirements planning (with a scaled-down master scheduling capability), production monitoring and control capabilities. In a second release, IBM added forecasting, capacity requirements planning, purchasing, and full-scale master production schedule planning modules to the application (Robinson, 2006).

Developments in hardware and software made the earliest MRP systems seem obsolete, even crude. With constantly improving hardware available at a reasonable price, and software development keeping pace, it was possible to add functions, which could access a centralized database. The new technologies allowed for system expansion to support increasing numbers of functions while offering the advantage of integration.

Mr. McVaney, a founding partner of J.D. Edwards, explained in our interview that he and his partners believed that the culture in a public accounting firm was not suitable for high quality software development. He and his partners Jack Thompson and Dan Gregory formed J.D. Edwards with the purpose of developing software and offering related consulting services specifically focused on the needs of manufacturing organizations. The new firm was originally constrained by the physical limitations of the computer, but the technology was rapidly changing as hard disk drives quickly replaced the slow and cumbersome tape drives of the earlier era.

In 1978 SAP released a more highly integrated version of its software, called the SAP R/2 system. R/2 took full advantage of the then current mainframe computer technology, allowing for interactivity between modules as well as additional capabilities such as order tracking.

3. The 1980s—MRP II

J.D. Edwards began to focus on writing software for the IBM System/38 in the early 1980s. This system was a much lower cost alternative to the mainframe computers: it offered flexible disk drives with capacities useful for small and medium size businesses. The term MRP began to be applied to the increasingly encompassing functions, leading to the use of the phrase *manufacturing resource planning* rather than material requirements planning. Eventually the term manufacturing resource planning II (MRP-II) was coined to identify the newer systems' capabilities. Parallel with this change in the scope of software applications, the 1980's manufacturing competitive thrust changed to quality with the emergence of the quality "gurus" including Deming, Juran, Crosby, Ishikawa, and others. Manufacturing strategy emphasized greater process control, world class manufacturing, and a focus on reducing overhead costs. The closed-loop scheduling, enhanced shop floor reporting, and linkages to due-date scheduling and procurement, plus detailed cost reporting features of the ever-developing MRP-II systems, were designed to support these new initiatives.

In the early 1980s, Ollie Wight began calling these new systems ''Business Requirements Planning'' only to find that this name had already been registered as a trademark. So he referred to them as ''MRP II'' systems, which by the late 1980s, was ''translated'' as ''Manufacturing Resource Planning'' to distinguish this new capability from the original, simpler, system. But the heart of any MRP II system was the fundamental MRP logic, now typically re-written in modern code.

In our interview with McVaney, he recalled the early decision to integrate the system from the very start of the company. At the time, the firm worked with relatively small firms that had a need for general ledger, payroll and accounts payable as well as manufacturing planning and control. The idea of an integrated software package where sales, inventory and purchasing transactions updated both inventory and accounting information was an innovation: this was designed to replace the several stand-alone systems which many companies used at the time. Because of McVaney's and his associates' strong background in manufacturing, it was natural for them to develop an integrated material requirements planning system for clients that needed the time-phase ordering capabilities of MRP.

J.D. Edwards and IBM identified the IBM System 38 and the later IBM AS400 as the computer system of choice. With these systems, the normal mode of operation was the batch run where periodically jobs would be run and extensive printouts generated documenting the current state of the firm. These smaller IBM computers were programmed in RPG2, a transaction-oriented language developed by IBM and ideally suited to batch processing. As an alternative, digital equipment corporation (DEC) during this time developed mini-computer systems that ran the multi-user UNIX operating system. This offered the possibility of real-time capture of transactions and better decision support since reports could be requested on demand.

In the late 1980s, IBM's MAPICS hit its high water mark: Bill Robinson estimates that as many as 65% of all manufacturing installations were using the software running on IBM System 38 and AS400 computer systems. IBM made the system available to universities for teaching concepts of production: Georgia State University, Auburn University, the University of Illinois, Minnesota, Clemson, and Duke Universities, and others, used the software as part of classes in Production and Operations Management.

In 1981 the then fledgling software company Baan had begun to use UNIX as their main operating system on early DEC computers. Baan delivered their first major software product in 1982 and by 1984 was focused on developing software for manufacturing. In 1983, DEC brought out its VAX computer, a major upgrade over their previous multi-user computers. In addition, the SQL database system written in the portable C programming language and developed by Oracle in the late 1970s was made widely available. This offered the flexibility of being able to write software that could be run on computers from different vendors such as Hewlett-Packard, Honeywell and DEC.

The software company PeopleSoft was founded by Dave Duffield and Ken Morris in 1987. This company offered an innovative Human Resource Management System (HRMS) in 1988. With the addition of PeopleSoft, all of the major ERP software companies were now in place. Although there were many other companies offering business software, SAP, IBM, J.D. Edwards, Baan, PeopleSoft and Oracle would prove to have the most impact on future ERP software developments.

At the end of the 1980s IBM came out with an update to their COPICS software that introduced the new acronym CIM for Computer Integrated Manufacturing. This newer CIM framework offered a ''... comprehensive strategy to help integrate information in a consistent, effective manner across the enterprise''. The framework had three levels of support: the top level supported the functional areas and included Marketing, Engineering and Research, Production Planning, Plant Operations, Physical Distribution, and Business Management. Below this level, the CIM structure had a supporting layer, which included administrative support, application development support and decision support. The bottom layer was a core series of applications including database, communications and presentation tools. With the reference to ''across the enterprise'', the migration path from early MRP to MRP II to CIM to ERP had now been laid (IBM, 1989; Robinson, 2006).

In 1989, Landvater and Gray published *MRP II Standard System: A Handbook for Manufacturing Software Survival*. The work behind this *Handbook* had begun in 1975 when what would become *Oliver Wight Software Research* began reviewing software which was being sold as MRP Systems to provide potential users with information about exactly what was included in which package. This book was an ''... explanation of a complete and comprehensive software package for MRP II and the modifications needed to support Just-In-Time'' (page x). The authors explained that ''Although the Standard System is a complete set of functions, it is not an ideal system with all the possible

functions that could exist. Instead, the Standard System describes the simplest set of tools needed to make MRP II work." (page xiv) Perhaps anticipating additional functions, which would lead to ERP systems, here is their comment on "Limits to the Standard System":

> "Eventually, the question becomes, 'What's not a part of MRP II? Almost every business system is logically part of MRP II or should be interfaced to the system. For the purposes of this explanation, the line had to be drawn somewhere. *Consequently, the explanation of the Standard System is limited to the planning and scheduling functions that form the core around which a complete MRP II system can be built. Without these planning and scheduling functions it is impossible to do MRP II.*" (page xv)

4. The 1990s—MRP II and early ERP systems

The term enterprise resource planning (ERP) was coined in the early 1990s by the Gartner Group (Wylie, 1990). Their definition of *ERP* included criteria for evaluating the extent that software was actually integrated both across and within the various functional silos. For example, IBM's Bill Robinson felt that MAPICS fell short on the criteria because it lacked the automatic interfaces between operational activities and the corresponding accounting transactions. In other words, the accounting implications of inbound and outbound inventory movement, production from raw materials to work-in-process (WIP) to finished goods inventory (FGI), plus shipping and receiving transactions, were not directly reflected in the general ledger in a near real time manner. Instead, transactions were summarized and applied to the general ledger at month-end closing.

Joining the globalization trend, Baan software was rolled out to 35 countries through indirect sales channels. By 1995 Baan had grown to more than 1800 customers worldwide with more than 1000 employees. Continuing with the globalization theme, PeopleSoft set up offices in Canada, Europe, Asia, Africa, Central and South America, and the Pacific Rim in 1991.

The year 1992 marked the release of SAP's R/3 product. The main feature that distinguished R/3 from previous ERP systems was its use of client-server hardware architecture. This setup allowed the system to run on a variety of computer platforms such as UNIX and Windows NT. R/3 was also designed with an open-architecture approach, allowing third-party companies to develop software that would integrate with SAP R/3. This new architecture was a significant departure from the single computer mini-computer (Digital Equipment VAX and IBM AS400) and mainframe (IBM 370) hardware platforms of the past. The ability to distribute the computer load to multiple small computers was particularly attractive due to the relatively low cost of the hardware employed.

By 1999 the dominance of IBM in the 1980s had slipped as J.D. Edwards, Oracle, PeopleSoft, Baan and SAP controlled much of the ERP software market. The following are industry statistics from 1999:

- J.D. Edwards has more than 4700 customers with sites in over 100 countries.
- Oracle has 41,000 customers worldwide, with 16,000 in the United States.
- PeopleSoft software is used by more than 50% of the human resources market.
- SAP is the world's largest inter-enterprise software company and the world's fourth largest independent software supplier overall. SAP employs more than 20,500 people in more than 50 countries.
- More than 2800 of Baan's enterprise systems have been implemented at approximately 4800 sites around the world.

Certainly, a major factor in the dramatic growth of ERP software and systems during this period was the year 2000 (or Y2K) problem that was anticipated as a major turn-of-the-century issue. Fortune 1000 as well as small- to medium-sized enterprises (SMEs) were quick to adopt the new ERP offerings as one way of addressing needed fixes to legacy system software that was not Y2K compliant. In many respects, the successful passage of the Y2K problem, coupled with technology advances, hinted at the industry consolidation that was about to begin.

In 1997, the Decision Sciences Institute (DSI) had its first introduction to ERP: at the Annual Meeting, a flip chart near the registration desk was used to call a meeting of those interested in ERP. Six people showed up. In 1998, an ERP presentation on research issues was given at the DSI's Annual Meeting in Las Vegas. At the 1999 DSI Annual Meeting a track on ERP was offered which included an academic panel discussion of 'trends and directions'; an ERP vendor workshop with representatives from SAP, PeopleSoft, and J.D. Edwards; a panel on curriculum development issues; and a panel on ERP research issues.

The year 1999 also saw ERP presentations at the Asia-Pacific DSI conference in Shanghai, China and the fifth International Conference of the DSI in Athens, Greece. An additional track on ERP was offered at the

2000 DSI Annual Meeting in Orlando with a repeat of topics discussed in 1999. Additional ERP sessions were given at international meetings such as the 6th International DSI Conference in Chihuahua Mexico. Each year following these early introductions to ERP topics, ERP has been a repeat theme in regional and annual meetings, and international conferences. Academic presentations on ERP were also given at ERP user conferences such as the J.D. Edwards Focus 2000 Conference in Denver.

5. The 2000s—software vendor consolidation

Y2K was arguably the single ''event'' that signaled both the maturing of the ERP industry and the consolidation of large and small ERP vendors. It took a few years, but by 2002, and following the crash of technology and 'dot com' stocks beginning in 2000, software companies were looking for ways to improve product offerings and increase market share. Between 2000 and 2002 software companies faced significant pressure to downsize following their amazing growth leading up to 2000. Our interview with Rick Allen, the former Executive Vice President of Finance and Administration and member of the J.D. Edward's Board of Directors during the PeopleSoft acquisition of J.D. Edwards, offered insight into the consolidations that occurred during this period (Allen, 2006).

In 2002 the major players in order of size were SAP, Oracle, PeopleSoft and J.D. Edwards; Baan had fallen out by this time. Allen indicated that, at this time, J.D. Edwards had performed extensive analyses of options for growing the business. These options included acquisitions of competing companies, mergers, or securing additional financing for developing new products. Although there were earlier meetings, a major event occurred on 31 October 2002 when Craig Conway, President and CEO of PeopleSoft, contacted Bob Dukowsky, CEO of J.D. Edwards concerning potentially serious talks about merging the two companies.

Allen reported that the merger looked attractive from a number of points of view. First, the software products were complementary: J.D. Edwards's products were stronger in manufacturing, accounting and finance while PeopleSoft was very strong in human resources products. Second, there was very little overlap in their software offerings. Further, the merged company could offer a much more complete software portfolio to the combined set of customers. Finally, the two companies could see that the merger would result in a company that was larger than Oracle, their major competitor along with SAP.

The PeopleSoft/J.D. Edwards merger was announced on 2 June 2003. On Friday of the same week (6 June 2003), in a great surprise to the industry, Oracle announced a hostile takeover bid for PeopleSoft. Rick Snow, the Chief Legal Counsel J.D. Edwards has vivid recollections of this period—including a 6 a.m. phone call on 6 June 2003 from Rick Allen, then J.D. Edwards' VP of Finance. Snow recalls this period with the following:

> ''Rick [Allen] said, 'Get hold of the lawyers. We've got a problem.' The way that we found out was Bob Dukowsky [J.D. Edwards CEO] was watching CNBC and saw the announcement that Oracle was starting their hostile takeover of the combined companies. So Rick called me, I called the partner of <law firm> and got him out of bed on Friday morning. We all met the following Monday . . . . . We still had not closed with PeopleSoft and now all the talk was about this additional issue. So again, the attorneys and the investment bankers, plus the management of J.D. Edwards, all met and started trying to figure out how we should proceed in light of this addition of Oracle into the picture.'' (Allen, 2006)

The two companies modified their agreement allowing them to close the deal in August 2003, earlier than originally scheduled. This allowed the combined company to focus their attention on Oracle. The Oracle takeover bid raised significant anti-trust questions both in the United States and in Europe. The takeover was finally consummated in January 2005. This merger has left the industry with two major players Oracle and SAP but with the software capabilities of the five original players.

6. The future of ERP

It is our judgment that ERP systems have now reached a level of maturity where both software vendors and users understand the technical, human resource and financial resources required for implementation and ongoing use. ERP systems should now enter an era of relatively ''easy configuration'' that takes days and weeks with implementation completed in weeks, or at most 2–3 months. Major corporations have realized the benefits of short implementation cycles and many are striving to implement a module in 6 months or less. This said project management issues related to large- and medium scale implementations will still be significant issues, possibly led by global implementations where conflicting business and personal cultures exist.

Generic ERP software packages are already increasingly tailored to specific market segments, e.g. refinery, hospital, automotive assembly, law office, etc., such that niche markets create niche products and vendors. Preconfigured software modules incorporating best practices and standard business processes will simplify future implementations.

Hardware and software architectural platforms within and between firms will increasingly become commoditized with data modeling tools and translation software possessing the ability to move any amount of data in any format, and/or language, anywhere in near real-time. Portals to both internal and external business information will become commonplace. ''Push'' information based on user-defined interest areas will be integral to the enterprise system architecture.

Systems will become much more intelligent. Data mining and intelligence tools including expert systems, and advanced planning systems (with optimization) will increasingly be used to make/suggest business decisions. Simulation will become an increasingly important element of an integrated extended enterprise planning and execution system. Examples of major areas to receive the benefits of simulation include cost accounting, forecasting, capacity planning, order rate and response capacity planning, available to promise/capable to match, lead time, and supply network planning.

Consolidation within the ERP industry is an ongoing process that is also ripe for study and research. For example, in September 2005, Oracle acquired Siebel—the firm which invented the Customer Relationship Management (CRM) application. Lawson and Intentia merged in May 2006. Baan is now part of SSA. Consolidation changes within the industry also suggest that those interested in strategic planning may see parallels with other industries that have undergone massive transformation such as autos and steel.

Company cultures have obviously been affected by ERP consolidations. With mergers and acquisitions, many corporate cultures have been turned upside down. This area is ripe for case studies and research addressing questions such as the human costs of consolidation. Consolidation also raises the question of project management in a global marketplace where Western culture may not predominate.

As a final comment, it is our hope that the academic community – in particular Operations Management, Decision Sciences, and Management Science Faculty – will take a much more active role in the development of intelligent software logic that can be used by real companies. As academics we seem to be in an era were there is little concern for engaging in research that can be directly applied to the planning and execution functions within modern manufacturing. We do not mean this as a criticism of the rigor of current academic research. Our point is that current ERP technology provides an information rich environment that is ripe for very intelligent planning and execution logic, yet little has changed since the late 1970s in the logic associated with such applications as forecasting, reorder point logic, MRP, production scheduling, etc. The current systems are now just executing the old logic much faster and in real-time. The area is ripe for innovative new approaches to these old problems. This may include partnering with our business counterparts who live in this dynamic environment on a day-to-day basis.

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