Information Systems Frontiers 2:2, 141–162, 2000

What is ERP?

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Abstract. **Though enterprise resource planning (ERP) has gained some prominence in the information systems (IS) literature over the past few years and is a significant phenomenon in practice, through (a) historical analysis, (b) meta-analysis of representative IS literature, and (c) a survey of academic experts, we reveal dissenting views on the phenomenon. Given this diversity of perspectives, it is unlikely that at this stage a broadly agreed definition of ERP can be achieved. We thus seek to increase awareness of the issues and stimulate further discussion, with the ultimate aim being to: (1) aid communication amongst researchers and between researchers and practitioners; (2) inform development of teaching materials on ERP and related concepts in university curricula and in commercial education and training; and (3) aid communication amongst clients, consultants and vendors. Increased transparency of the ERP-concept within IS may also benefit other aligned fields of knowledge.**

Key Words. **transaction processing systems, management information systems, management support systems, production planning information systems, information system evolution, enterprise resource planning, literature review**

1. Introduction

1.1. Background

A new class of packaged application software has emerged over the past decade, ostensibly consolidating under a single banner, a multi-billion dollar industry that includes the world's fourth largest software vendor, several other of the largest software firms and the world's largest management consulting organisations. Usually called enterprise resource planning systems (ERP), these comprehensive, packaged software solutions seek to integrate the complete range of a business's processes and functions in order to present a holistic view of the business from a single information and IT architecture. Most very large organisations world-wide have already adopted ERP, and increasingly small- and medium-sized enterprises (SMEs) too are finding it cost effective and a competitive necessity to follow suit. Though the breadth and tight integration of ERP has only become available in recent years, ERP have a pedigree in large, packaged application software that has been in widespread use since the 1970s.

Nonetheless, until recently, ERP and packaged software generally, though pervasive, have been under-researched in information management and information systems and have been under-represented in curricula (Gable, 1998). While ERP have gained some prominence in the IS literature over the past few years, we observe some dissent among academics on the nature and definition of ERP. Some authors (Davenport, 2000; Laudon and Laudon, 2000) advise against the use of the term ERP and suggest alternatives; others (e.g., Pawlowski, Boudreau et al., 1999) posit that ERP is not a term referring to a distinct object but rather a category (''umbrella term'') signifying a range of similar products. There are further suggestions that explicate ERP as the outcome of the development of IT support for manufacturing (Chung and Synder, 1999) or as supply chain management (O'Brien, 1999). Yet others believe that what ERP stands for, is determined by the product offerings of developers (Holsapple and Sena, 1999, referring to APICS). It is anticipated that MIS scholarly activities would advance through increased consensus on the phenomenon of ERP.

1.2. The problem and motivation for this study

Given the diversity of opinion illustrated above, it is unlikely that a broadly agreed upon definition of ERP can be achieved. What we seek to achieve, is firstly to increase awareness of the matter, and secondly to share observations on the problem at hand. We aim to depict the state-of-the art of scholarly ERP-related activity in information systems, with the objective of

progressing the discussion on what ERP is for IS academics. Clarification here is believed important to: (1) aid communication amongst researchers and between researchers and practitioners; (2) inform development of teaching materials on ERP and related concepts in university curricula and in commercial education and training; (3) aid communication amongst clients, consultants and vendors. Eventually, increased transparency of the ERP-concept within IS may also benefit other aligned fields of knowledge, such as accounting or software engineering.

To delineate the phenomenon of ERP in information systems, we rely on three ''sources of evidence''. In Section 2, we portray the prevalent view on ERP. This mainstream perspective sees ERP as a software product that represents the final stage of an evolution towards integration, originating from IT supported manufacturing. As mentioned earlier and as detailed following, this view has now been subject to scrutiny for never being completely correct, and now has become outdated due to the further extension of ERP products. In Section 3, we reflect on ERP-related activities in the IS field, based on a meta-level appreciation of IS-publications in the area. This summary literature review is concerned with showing levels of activity and general trends and pointing to emerging research topics; it has, however not been the objective to discuss research results per se. In Section 4, we sought the opinion of twelve notable academics having ERP-related expertise in relation to the following issues: important technical, managerial and marketplace determinants of the evolution of ERP; definitions of ERP; and the appropriateness of IS attention to ERP to date, both in research and curriculum. Section 5 includes a discussion on the appropriateness of the ERP term based on the findings from the three preceding sections: the characteristics and history of ERP, the information systems literature, and the expert survey. Finally, Section 6 lists limitations of the study, as well as possibly useful future research activities to increase and extend consensus on ERP-related concepts.

2. ERP—the Product and its Underlying Concept

The ERP concept can be viewed from a variety of perspectives. First, and most obviously, ERP is a commodity, a product in the form of computer software. Second, and fundamentally, ERP can be seen as a development objective of mapping all processes and data of an enterprise into a comprehensive integrative structure. Third, ERP can be seen as the key element of an infrastructure that delivers a solution to business. The latter is the perspective taken by information systems, and the perspective we take throughout the remainder of this essay. What ERP software is and how the underlying concept evolved has been addressed by many authors and below we synthesise these definitions and accounts of concept evolution as the ''mainstream'' view on ERP.

2.1. Characteristics of ERP software

As a commercial product, ERP software is offered by a range of vendors that specialise in this segment of the software market. As of this writing, the main ERP vendors are SAP, Baan, J. D. Edwards, Oracle and PeopleSoft. This ERP market is significant. Gartner Group (Gartner Group, 1999) forecasts that it will grow to more than $20 billion by 2002; approximately half service revenue and half license revenue.

ERP software is highly configurable to accommodate the diverse needs of users across most sectors of the economy. Because of this, currently ERP-software exists in three different forms: generic, pre-configured, and installed:

(a) In its most comprehensive form, the software is generic, targets a range of industries, and must be configured before it can be used.
(b) Packaged, pre-configured templates have been derived from the comprehensive software. These templates are tailored towards specific industry sectors (e.g., automotive, retail) or companies of a certain size (SME).
(c) For most users, ERP-software presents itself as the operational installation after the generic or pre-configured package has been individualized according to the particular firm's requirements on site.

Only in its generic state can ERP software be purposefully characterized, since any configuration, by either adding or reducing detail, creates distinct instances of the product, rendering a generic description impossible. Criteria used below for characterizing the software have been derived from

an analysis of currently available generic ERP solutions.

ERP software is a standard software package. All standard packages targeting an anonymous market must, during the process of system deployment, be tailored to the specific requirements of the individual enterprise. This process of software individualisation is called customizing. More or less sophisticated tools for project management, step by step guidelines, further implementation tools, remote checks, and various other useful materials (e.g., generic presentation files) support the ERP implementation. However, it is not the mere fact that the software can be customized that differentiates ERP software; it is rather the rich potential for customizing that distinguishes ERP from other packages. Some might regard the need to customize as a negative, yet this allows an individual configuration, and unique ERP implementations. The rich configuration potential of ERP software derives from the range of preconfigured alternatives (e.g., number and variety of chart of accounts) and the number of alternative processes and transactions.

ERP-software is obviously application software. Thus, it can be differentiated from software like database management software, middleware or operating systems. The application modules of ERP are integrated across the functions supported and the data involved. ERP software is based on an underlying integrated database that stores master and transactional data in a consistent way and with controlled redundancy. The main features of ERP-software are the provided business solutions, which support the core processes of the business and administrative functionality. High functionality is one of the main differentiators of ERP. ERP purports to support all business functions of an enterprise, especially procurement, material management, production, logistics, maintenance, sales, distribution, financial accounting, asset management, cash management, controlling, strategic planning, and quality management. In addition to these general business functions, ERP often supports industry specific functions like patient management in hospitals, student administration at universities and high volume warehousing transactions for retailers.

The high functionality of ERP software also distinguishes it qualitatively. Although components of the main ERP solutions are at the highest level organized in different functional modules like financial accounting or sales, they all follow a process-oriented view of enterprises. Typical business processes are supported in a seamless way across functions, so that the user often does not realize in what functional module he or she actually works.

The comprehensive functionality of ERP requires corresponding documentation. In addition to the usual software documentation, the supported processes and organizational structures as well as the structure of the data and objects are usually depicted in reference models. These models enable rapid access to the functionality and allow navigation through different abstraction levels and between different views. Furthermore, there exist hot-links to the ERP documentation and related screens.

ERP targets multiple industries with very different characteristics. Consequently, it is difficult to characterise ERP by simply listing functions. ERP supports multiple industries in two ways. ERP can have either the ability to support different industries within one solution (e.g., coexistence of manufacturing and retailing functionality) or offer preconfigured enterprise-individual solutions. For example, PeopleSoft provides industry-specific solutions for the following sectors: communication, federal government, financial services, healthcare, higher education, manufacturing, public sector, retail, service industries, transportation, and utilities.

ERP is designed for companies that act (purchase, produce, sell, administer) in various countries. Thus, it is a prerequisite that ERP can handle the specific requirements of different regions. This includes preconfigured country-specific chart-of-accounts, preformatted document types like quotes, delivery notes or invoices, or HR-related rules (e.g., payroll). The ability to handle multiple currencies in all transactions is also a mandatory feature.

Finally, frequency and repetition of its use could also be seen as an important and distinguishing feature. ERP supports recurring business processes like procurement, sales order processing or payment processes and is not focused on less structured, irregular processes like marketing, product development or project management.

ERP software can also be characterized from a technical viewpoint. Although technical features do not distinguish ERP from other currently available applications, they are useful in differentiating ERP from previous similar software packages such as integrated, but centralized software packages with

strict platform requirements. Furthermore, technical features significantly determine the functionality and potential of this type of software.

In addition to integrated applications and data, a further technical characteristic of ERP software is the consistent graphical user interface (GUI) across all application areas. Thus, a user perceives the ERP solution as a single application regardless of the module he or she is working with. Current ERP solutions are based on a three-tier client-server architecture, in which the database, the applications and the presentation, form three logically independent levels. As ERP software targets all types and sizes of companies and industries, it must handle large volumes of transactions. This is a crucial technical criterion as it is often more complicated to evaluate the performance (efficiency) of ERP than its effectiveness (does it support the required functionality?). Current ERP is typically ''open'' regarding the possible software and hardware platforms. Most solutions run under Windows NT, various UNIX operating systems or Linux. This is another argument, which highlights that ERP is characterized more by its functionality than its technical design or requirements. Finally, the complexity of ERP calls for adequate administration of the system. ERP software includes various solutions for user administration, database configuration, system monitoring, or performance measurement. These solutions are either part of the software or available as add-ons.

2.2. The Evolution of ERP

A common perspective on Enterprise Resource Planning is one that concentrates on the historical development of business integration concepts. It can be assumed that the name ERP was derived from the terms material requirements planning (MRP) and manufacturing resource planning (MRPII) (see also Chung and Synder, 1999; Gunmaer, 1996; Holland, Light et al., 1999; Yusuf and Little, 1998). MRP was developed to calculate more efficiently the materials needed. It evolved into MRPII which encompassed new functionality like sales planning, capacity management and scheduling. Though MRPII was initially seen as the next logical step in efficient manufacturing planning, companies quickly realized that profitability and customer satisfaction are objectives that apply to the entire enterprise—extending beyond manufacturing, and encompassing finance, sales and distribution, and human resources. Computer integrated manufacturing (CIM) is regarded as the next step, embedding at least the technical functions of the product development and production process in a comprehensive integration framework. The concept of a totally integrated enterprise solution is now called ERP (enterprise resource planning).

Besides General Ledger, MRP were the first off-the-shelf business applications designed in the 1950s (Orlicky, 1975). MRP software supported the creation and maintenance of material master data and bill-of-materials across all products and parts in one or more plants. Furthermore, bill-of-materials processors (demand-based planning) and forecasting algorithms (consumption-based planning) were typically parts of MRP. These early packages were able to process mass data, but had only a limited processing depth.

During the 1970s, MRP packages were extended with further applications in order to offer complete support for the entire production planning and control cycle. MRPII starts with the long-term sales forecast from which the master production schedule (MPS) can be derived. The gross primary requirements are, as an output of the MPS, input for MRP, which followed. The materials management module calculates the secondary and net requirements using demand-based and consumption-based planning methods and taking the stocks into account. After these tasks, which are focused on the materials, a capacity management module integrates the available machines in the planning process. The rough production schedule, which only includes a lead-time shift as time-based data, is translated into capacity demand, which has to be compared with the available resources. Via backward and forward scheduling, a possible, not optimal production schedule can be derived. Various approaches to adjust the capacities can be applied next. The most current production orders are selected through an order release module. Together with related documentation they are forwarded to the production process. Finally, scheduling algorithms support the detailed assignment of work tasks to specific machines.

Though the theoretical MRPII stresses the importance of various loops in the planning process, the practical implementations of MRPII were in most cases purely linear. Thus, the existing interdependencies between the functions were not taken into account. Consequently, it was accepted that MRPII

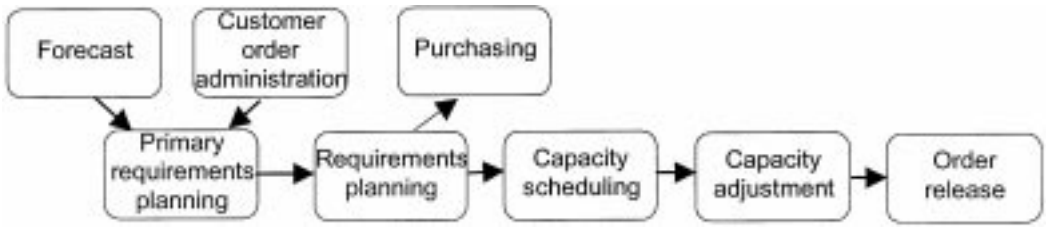

Fig. 1. *Production planning within MRPII.*

supports an integrated and manageable, but far from optimal planning process. Fig. 1 (Scheer, 1994) shows the main functions of the production planning process as a part of MRPII, which is followed by scheduling (production control).

The MRPII approach was extended in the 1980s towards the more technical areas that cover the product development and production processes. These functions were named with various CA-acronyms and included: computer aided engineering, computer aided design, computer aided planning, computer aided manufacturing, and computer aided quality assurance. The entire conceptual framework for the integration of all business-administrative and technical functions of a company was named computer integrated manufacturing (CIM) (Scheer, 1994).

Generic integration frameworks were based on the MRPII functions and the technical CA-functions. They discussed the interrelations between these functions (Becker, 1991). Though this approach was focused on manufacturers, it can be easily generalised. An example is the integration model for retailers, which depicts information flows between the main functions of a retail company. Furthermore, some approaches exist in which these types of integration models were extended towards business partners (Fig. 2) (Becker, Rosemann et al., 1997).

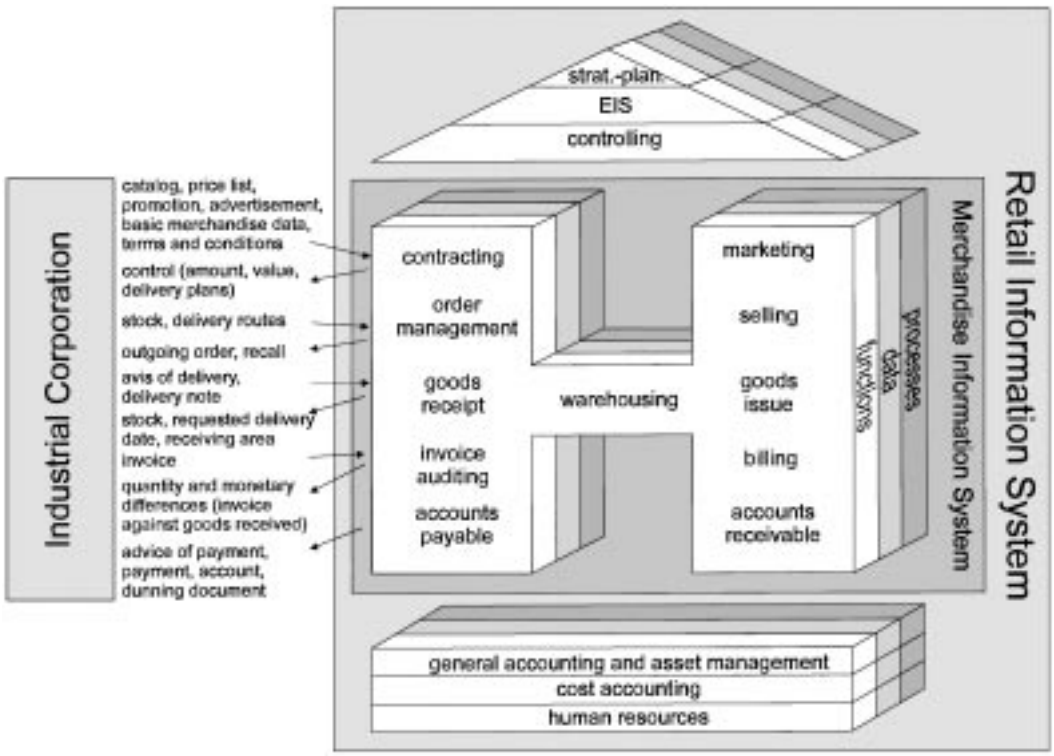

Fig. 2. *An integration framework for retailers and external interfaces.*

The other aspect that was advanced significantly by the CIM discussion was the integration issue, and important contributions were especially made to data and process modeling techniques. The design of integrated and enterprise-wide data models was a major focus of CIM projects in the 1980s. These projects were based on the assumption that an integrated database is the core element of an information systems infrastructure. Process modeling became the focus of attention when reference integration architectures were developed that cover more than the information flow between two functions. Entire process chains were designed in order to explain typical business processes. These models existed initially only as such, since applications to implement the design was not available yet. (''Process Management was possible prior to Enterprise Systems,'' Davenport, 2000). Thus, data and integration (function) models were extended with a fast growing number of process models. Besides the functions involved, these models depicted organizational roles, applications and data. One of the most popular methodological frameworks evolving from this research is the architecture of integration information systems (ARIS) consisting of data, function, organization, output and process views (Scheer, 1999). Today, data and process models referred to as reference models are applied to document ERP-software and software supporting enterprise modeling of data and processes (like the ARIS-Toolset) are widely used in ERP implementation projects.

3. ERP in the Information Systems Literature—a Meta-Analysis

New fields of knowledge and practice become visible through publication activity. In the field of information systems (management), new concepts spread through a range of outlets including the trade press, books for practitioners, periodicals directed at both practitioners and academics, academic journals, university textbooks, and conference proceedings. Since our aim has been to describe how ERP are dealt with in the academic context, we decided to exclude the first two categories from the following elaborations, thus to take into account only sources that had been authored by academics and for the academic environment. The following presents an overview of ERP literature in conference proceedings, in core IS journals and in MIS textbooks.

Despite growing prominence and pervasiveness of ERP in practice, related publications within the academic information systems community, as reflected by contributions to international conferences and journals, is only emerging. We are aware of several recent, or about to appear, journal special issues on ERP (*Journal of Information Technology, Journal of Decision Systems, Database, Journal of Management Information Systems, Business Process Management Journal, and Australian Accounting Review*). This sudden spurt of activity in the area may be seen as an indication that the topic has been neglected for too long and that the IS academic community is now playing catch-up.

3.1. The sample

In order to develop an overview of academic activity relating to ERP systems, key IS conferences and journals were scanned for the period 1997 to mid 2000. Conferences surveyed are those supported in the past by the Association for Information Systems (AIS), and held during the years 1997 through to August 2000: International Conference on Information Systems (ICIS), Americas Conference on Information Systems (AMCIS), European Conference on Information Systems (ECIS), Australasian Conference on Information Systems (ACIS), and Pacific-Asia Conference on Information Systems (PACIS). Our intention was merely to account for ERP-related publication activity in mainstream IS outlets, which of course does not reflect the total output of ERP-related presentations and articles. Thus, other events like conferences in the area of accounting or software engineering, events associated with user-conferences held by vendors, or the special event ''1st International Workshop on Enterprise Management and Resource Planning: Methods, Tools and Architectures, EMRPS'99, Venice'', have not been included. Table 1 lists the conferences, and Table 2 lists journals surveyed.

Articles were located by visually scanning contents pages of the target publications (hardcopy, online) or program announcements where no other details were available at the time of writing (ECIS '00; AMCIS '00). Relevance to ERP was established by searching for terms like ERP and enterprise-wide systems

Table 1. *ERP papers presented at selected international information systems conferences 1997–2000 (August)*

Conference	1997	1998	1999	2000	
ICIS	1	3	5	n/a	9
AMCIS	1	1	29	24	55
ECIS	0	2	3	3	8
ACIS	0	1	1	n/a	2
PACIS	1	n/a	n/a	3	4
Totals	3	7	38	30	78

(EWS) in the title of documents or the keywords, as well as by searching for key ERP vendor names (e.g., SAP, Baan, Oracle). References retrieved were then used to access the original documents. Full text, abstracts, and in a small proportion titles only, were used to subject index the references in a small database in order to establish a systematic overview of current themes.

ERP are highly applied, multi-faceted and multi-disciplinary and there are undoubtedly publications to be found in other than the IS discipline. Furthermore, conference proceedings, which account for the bulk of sources identified, somehow exist outside firmly established publication channels: most proceedings are not distributed by commercial publishing houses, and only a selection of conferences achieves wider publicity by being indexed and abstracted for publicly accessible services. This creates a technical limit to producing a comprehensive, up-to-date overview of ERP literature. Thus, partly due to the selective approach detailed above, the study sample is small and two conferences (AMCIS '99 and '00) account for the majority of papers identified. Nonetheless, we observe steady increase in the number of ERP papers (ignoring AMCIS '99 and '00, total papers rise from 3 to 7 to 9 in 1997, 1998 and 1999 respectively). Steady growth is also observed at ICIS (1 to 3 to 5), the most academically rigorous and selective of all major IS conferences. In 1998/99 nearly all the IS conferences mentioned in Table 1 (AMCIS (Philippakis and Hardaway, 1999), ECIS (Rosemann, 1999), ACIS (Gable, 1998) as well as the ICIS (Veth, 1998) included panel discussions about teaching ERP. In 2000, ECIS will again host a panel on ERP at universities, while the number of ERP-related papers at AMCIS 2000 is similar to the previous year.

3.2. The beginning

The term ERP made the press probably for the first time in 1992 (Lopes, 1992; Ricciuti, 1992; Lindholm, 1992). The article by Lopes, ironically of Dun & Bradstreet Software, a company soon after out-of

Table 2. *Selected academic information systems journals canvassed 1997–June 2000*

Journal	Period	Articles
Communications of the ACM	January97—Jun00	8*
European Journal of Information Systems	March97—March99	1*
Information & Management	January97—June00	1*
Information Systems Research	March97—March00	0
Journal of Management Information Systems	Winter97/98—Fall99	0
Journal of Information Technology	March97—June00	2**
Journal of Strategic Information Systems	March97—September99	0
Management Information Systems Quarterly	March97—June99	0
Management Science	January97—August99	0

*Published in 2000.
** Published in 1999.

business, shows how ERP had been conceived of at the time the term was coined. Under the heading ''CIMII'' [sic!] the features of these new systems are laid out in full: a qualitative leap beyond MRPII, integration across suppliers, departments and customers, relational database, and on client-server architecture. Moreover, Lopes praises ERP systems as ''better, faster and more economical business solutions'' (1992:45) and ascribes to Gartner Group to have defined ERP, and proclaimed it as the new information systems ''paradigm''. More than three years later, Thomas Davenport introduced the IS community to ERP systems at AMCIS '96 (Davenport, 1996). Thomas Davenport avoided the ERP label and called these systems ''megapackages'', highlighting the challenges they allegedly posed for companies both in technical and organizational terms. One year later, ERP papers were presented at three international information systems conferences; this marks the beginning of the period of literature reported following.

3.3. Conferences

Conference publications during the years 1997–August 2000 are mainly about: (1) ERP implementation issues, (2) Teaching with and about ERP, and (3) further ERP research in progress.

3.3.1. Implementation issues. Implementation related publications account for about one third of the articles reviewed. This corresponds with the focus taken on ERP systems by the trade press, which also deals predominantly with implementation and associated problems. Several publications (Holland, Light et al., 1999; Stefanou, 1999; Sumner, 1999) attempt to identify critical success factors of implementations. Shanks et al., strongly recommend consideration of national cultural issues, since critical success factors may vary significantly, depending on the country in which an implementation is carried out (Shanks, Parr et al., 2000). Implementations have also been investigated through case studies with varying intent: to describe the impact of ERP on job characteristics (Pawlowski, Boudreau et al., 1999); to explore strategic options open to firms beyond the implementation of common business systems (Holland, Light et al., 1999); to make recommendations on how to maximize the benefits from ERP (Niehus, Knobel et al., 1998) or how to avoid ERP project failures (Scott, 1999); to identify issues of alignment (Smethurst and Kawalek, 1999; Volkoff, 1999), Business Process Reengineering (Slooten and Yap, 1999), and change management (Pérez, Rojas et al., 1999); to assess the ambiguous role of large systems as both catalysts and inhibitors of change (Mahrer, 1999); to analyze the special challenges of ERP implementations outside the business world (Sieber and Nah, 1999); and to describe global supply chain management (Chatfield and Andersen, 1998). Implementing ERP with or without BPR has been surveyed and analyzed (Bernroider and Koch, 1999). Theoretical considerations have focussed on global business processes (Basu and Palvia, 1999) and IT architecture options (Chan, 1999), as well as on enhancement of process engineering and development methodologies (Sato, 2000). The complex question of how to assess the organizational benefits derived from an ERP system has been addressed by Rosemann and Wiese (1999). This requires looking beyond the implementation phase to consider the operational performance of the system. Rosemann and Wiese suggest a variant of the balanced scorecard approach to grasp the main impact of an installed system. Spanning multiple phases of the ERP life cycle is also the suggestion of an ERP knowledge management framework, to aid companies in optimally handling information and expertise in relation to implementation, operation and enhancement of a system (Rosemann and Chan, 2000).

3.3.2. Teaching. A further significant number of articles reviewed relate to ERP subject matter in tertiary education. Access to ERP software systems and collaboration with their vendors provide tertiary educational institutions with effective and novel means for exposing students to valuable business and business systems concepts (Gable, Heever et al., 1997; Watson, Rosemann et al., 1999). The partnership between an ERP vendor and universities may be beneficial for both parties involved, but requires careful management to overcome the challenges (Scott and Gable, 1997). The university ERP-vendor link has already spawned new curricula at the postgraduate level, either under the banner of a new breed of MBA program (Winter, 1999), or within the Information Systems area as a Master of Science program (Holmes and Hayen, 1999).

The impact of reorganizing ERP subject matter into existing curricula and the special challenges posed to faculty has been reported by Stewart et al.

(Stewart, Gable et al., 1999). An example of a syllabus for remote delivery of an introductory subject via the Internet is given by Holmes et al. (Holmes and Hayen, 1999). The benefits and pitfalls of teaching conceptual knowledge with ERP systems as a learning vehicle have been critically evaluated in terms of learning outcomes and effort by Noguera and Watson (1999) and Scott (1999). Case studies of implementations proved also to be a common method of teaching about ERP (Hirt, 1998; Avital, 1999; Ross, 1998).

3.3.3. Research in progress. Initially, Heever, Erlank et al., (1997) identified the potential and challenges for information systems education and research in tertiary education posed by this new category of manufacturing and business packaged software. A historical perspective has been taken by Chung and Synder, (1999) and Kelly, Holland et al., (1999), who, from different contexts, emphasise the maturing of IS towards an unambiguous business focus, as attributed to ERP systems. This is seconded by Holland and Light, who argue that other, traditional approaches in systems development have proven to be less beneficial in the long-term than ERP systems (Holland and Light, 1999). A historical view, albeit from a business perspective is suggested by Sor (1999), expecting a better understanding of issues surrounding ERP systems to be achieved by moving the discourse towards management theory and dealing with ERP as a special case of theoretical premises that were developed already in the sixties.

Problems of managing the systems themselves have been thematised by Gable, Scott et al. (1998), who argue the value of cooperative knowledge management links between all business partners in implementation projects in order to better cope with the scale and expertise requirements of such projects. In a similar vein it has been proposed that the potential advantages of competence centers to support and maintain these large-scale systems be explored (Eriksen, Axline et al., 1999).

The benefit of ERP systems is seen as improving organizational decision-making by Holsapple and Sena (1999); consequently they claim that ERP and decision support systems should be further integrated and that further research and development effort directed in this area. ERP solutions have recently become increasingly accessible to small and medium enterprises (SMEs). Gable and Stewart have therefore proposed to study adoption and application of ERP in SMEs as an objective of research (Gable and Stewart, 1999). An explicit social science approach to ERP has been suggested by Southwick and Sayer (1999), who argue the importance of analyzing managerial and social issues surrounding ERP implementation by applying critical social theory. Strong theoretical foundations have already been applied in investigating ERP implementations. Using structuration (Volkoff, 1999) and actor network theory (Hanseth and Braa, 1998), the organizational changes brought about by the new system are critically highlighted; these changes are unintended and can affect the social environment (Volkoff) as well as reshape the whole information infrastructure (Hanseth).

3.4. Journal articles

Tertiary education in ERP systems has also been thematized in some of the few journal articles relating to ERP. As cases reported on by Winter (1999) and Holmes and Hayen (1999) (see above) show, engagement in the area of ERP in teaching has resulted in a complete redesign of curricula at both under- and postgraduate levels, in order to respond to the new competence requirements created in the labour market (Becerra-Fernandez, Murphy et al. 2000). Creating and implementing these new curricula can only be achieved through interdisciplinary collaboration across university department, a phenomenon reported on elsewhere as well (Victor, May et al., 1999). Extensive teaching cases have been provided by Ross (1999) and Hirt (1999).

Process engineering is a crucial step in ERP systems implementation. This will be even more true in future, when manifold relations between businesses have to be set up to conduct e-business. Scheer (Scheer and Habermann, 2000) emphasises the significance of business process models to manage the ever-increasing complexity arsing from these solutions; process models are supposedly also a useful medium to communicate about business processes across various cultures. However, evidence from practice (Soh, Kien et al., 2000) suggests, that the best practices built into ERP software might not always be transferable on a global scale due to very country specific requirements relating to very fundamental processes. Closer cooperation between vendors and users and comprehensive knowledge on the part of the user appear to the only remedy to these misfits (Soh, Kien et al., 2000). How this cooperation can be successfully achieved, has been demonstrated

by Scott and Kaindl (2000); they have shown that collaborative efforts between vendors and customers can lead to the mutually beneficial result of rapidly added systems functionality. Yet, new functionality may not always be what companies are particularly keen on, especially when this requires moving to a new version of the installed software; this is one of the conclusions drawn by Kremers and Dissel (2000) who discusses vendors' and clients' attitudes towards migration of software. These attitudes appear to be adverse: while vendors prefer not to support too many versions simultaneously, due to the high personnel costs involved, client companies do not acknowledge that new versions always have the potential to enhance the business, and sometimes change versions only out of technical considerations. Technical problems relating to updates and new versions are anticipated to be overcome in the future with the introduction of component based software according to Sprott (2000) and Fan, Stallaert et al. (2000). Software components are supposed to overcome the ''monolithic'' character of ERP systems, and increase the adaptability to business requirements considerably.

A new aspect of ERP systems, implementation for global companies across many sites has been investigated by Markus, Tanis et al., (2000). They have identified that issues of large scale tend to evolve with regards to business strategy, software configuration, platform and management execution; the combination of these issues must be addressed by the implementing company very carefully and a generic approach cannot be applied. Achieving the best fit between software and business is the main criterion for selecting a package for SMEs in Europe, as reported by Everdingen, Hillegersberg et al. (2000); they point to the fact that the diversity between countries and industries sets up a new challenge for vendors in the new emerging markets, if they want to respond to the demands of clients in a comprehensive way.

For Willcocks and Sykes (2000), old managerial issues relating to the management of IT are perpetuated into the era of ERP systems. They maintain that lessons from the past still need to be learned for successfully implementing and operating an ERP system, and argue that the IT department needs to have established itself as the strategic partner of the business, and that systems should be viewed as a ''business investment in R&D'' rather than on a cost efficiency basis.

Given the low degree of stabilization of research activities indicated by the number of journal articles, it appears to be rather early to point out articulated areas of investigation. Considering both conference papers and articles, however, some observations can be made with regards to themes and methods in current ERP research. A new, ERP-specific issue appears to arise out of the scale of some ERP implementations and the internationalization of the software market. This ''globalization'' issue has the facets of implementing international business processes on one side and the adaptation to local environments on the other. Though the dominant concern appears to have so far been to study implementations through multiple case studies, issues regarding the further evolution of the installed ERP have already attracted some interest. These can be characterized as pertaining to knowledge management, small and medium enterprises, supply chain management, maintenance and enhancements regarding new functions and application areas, such as e-business. The research method most commonly applied is the case study which underlines the rather descriptive type of research currently undertaken, aiming at immediate applicability for practice or teaching. Theory-driven approaches are still rare, but are likely to emerge in the future.

3.5. Textbooks

Textbooks are fundamental elements for introducing novices in the university education system into a field of knowledge. They are commonly perceived to contain a consensually established set of problems and solutions that characterize the field of knowledge: textbooks rely on an accepted research tradition, or simply research precedes instruction. MIS textbooks, however, may need to deviate more or less from this principle, since the whole area is subject to frequent changes. One of the most recent of these changes that has had to be taken into account, was the rapid adoption of ERP packages by corporations all over the world. The following discussion of a sample of MIS textbooks shows that the synchronization of research with production of learning material may be a matter of concern.

Steven Alter (1999) tackles the complexity of today's information systems by following the traditional typology of systems that takes into account their abstract tasks as the distinguishing feature; thus there are e.g., transaction processing, decision support,

management and executive information and execution systems to name but a few. It is obvious that ERP systems cannot be easily accommodated in such a categorization that does not consider the application areas of information systems in terms of business functions. Consequently, ERP systems are seen as hybrids, meaning that they contain a range of features from diverse categories of the systems typology. The development of ERP is depicted as a succession of extensions originating from MRP and leading into the current software offerings. However, ERP systems supposedly have an unexplained ''focus elsewhere''. The author characterizes ERP systems as being controversial, mainly due to their ''integrated database'' which ''structures [...] incorporate many process variations'' making them ''enormously complicated''. Installations of single modules ''may be called ERP'' too, due to their provenance, even though they do not ''accomplish the integration'' aimed at.

In contrast, James O'Brien (O'Brien, 1999) maintains that ''information systems in the real world are typically integrated combinations of functional information systems [...] that support business processes.'' Furthermore, ''cross-functional information systems'' enable re-engineering of business processes and may be used in a ''strategic way'' to ''improve the efficiency and effectiveness of business processes''. He fails to distinguish between ERP and SCM, claiming that these systems run with ''enterprise resource'' planning (ERP) or supply chain management (SCM) software. This suggests that ''ERP software focuses on supporting the supply chain processes [...] of a business''.

Crossing functional boundaries within a company and integration of business processes is also the main emphasis of ERP according to Turban, McLean and Wetherbe (1999). They contrast the promises of ''benefits from increased efficiency to improved quality, productivity, and profitability'' with the difficulties of implementing such a system, usually associated with changes of existing business processes.

One of the core principles of ERP, the interdependence of business functions has also been stressed by Effy Oz (1998: 80). He discusses ''strategic information systems'' and links re-engineering efforts to this concept. Furthermore, a detailed account of what is commonly seen as one of the origins of ERP, production management systems like MRP and MRPII as well as manufacturing execution systems (MES), is given, yet, ERP is not mentioned at all.

For Laudon and Laudon (2000), ERP systems, or as they call them—enterprise systems—need to be viewed from a contextual and comprehensive perspective, which they call ''enterprise computing''. This is composed of the concepts of ''IT investment portfolio'', ''IT infrastructure'', ''business logic'', and ''information architecture''. External factors that have driven the deployment of enterprise systems are identified as resulting from changed market dynamics, industry structures, and an orientation of managerial thinking towards business processes and entrepreneurial strategy. On the technology side, networks, relational databases, client/server architecture and enterprise software applications, paralleled the shift in the business world. Enterprise systems are then discussed by contrasting the ''promise to integrate the diverse business processes of a firm into a single information architecture'' and the resulting business benefits with the five ''issues'' that have to be tackled to make these promises real: implementation, cost/benefit analysis, robustness, interoperability and the realization of strategic value.

This random selection of textbooks shows that ERP systems are often simply presented as being problematic, if they are not ignored. Except for Laudon and Laudon (2000), ERP is dealt with more in a cursory fashion, i.e., a few paragraphs or pages. Nearly all of the authors point to severe issues related to ERP. The criticism of Alter (1999) is mostly from a software perspective, suggesting that ERP systems are poorly implemented databases. Also software focussed, albeit without critical remarks, is the definition of ERP given by James O'Brien (1999), which strongly implies that ERP is very similar to supply chain management. For Turban, McLean and Wetherbe (1999) the problems of ERP systems appear to be more related to the change that the business must undergo. Problems of ERP systems are not reducible to software or a business issue for Laudon and Laudon (2000), who rather holistically see ERP as a complicated product within a complicated business and market environment.

3.6. The emerging focus on ERP in the IS field

Apparently, ERP attracted attention from the IS field once it became obvious that large, and especially U.S based corporations had begun to install these systems;

in other words, only when their significance had been firmly established in the marketplace.

The time-line below (Fig. 3) relates the advent of SAP R/3 (the most prevalent of the ERP products), with evolving IS and trade-press attention to the concept. The ERP marketplace gained considerable momentum after 1995 when the main vendor introduced its client-server software into the U.S. Given that it often takes many months to install an ERP system, Thomas Davenport's 1996 announcement of the arrival of megapackages does not appear to be delayed. 1997 saw the first papers on ERP presented at international IS conferences. On the other hand, although there was a significant increase in articles from the trade press in the same year, the so-called ERP-hype is a more recent phenomenon: e.g., in ABI/INFORM references to ERP articles exceed 1,000 during the years 1998 and 1999.

In summary, we present the following broad observations from our meta-review of the IS literature. Conference activity has grown rather suddenly and dramatically, but appears to have leveled off (this is difficult to predict). As a result of the sudden spate of activity in the area, a consequential burst of journal activity is expected to follow (e.g., this special issue). Numerous case studies have already laid the groundwork for further research, and to inform related teaching that is occurring within redesigned curricula. It can be anticipated that following the first wave of exploration into ERP implementation issues, a range of more focused research topics will emerge, addressing their complexity and far reaching organizational impingements. The review of textbooks suggests that authors not directly involved with ERP have tended to offer superficial and often distorted treatment of the subject area. This situation will improve as research on ERP accumulates, and awareness across the IS academic community grows.

4. Perceptions of ERP: an Expert Opinion Survey

With the objective of gaining further insight into perceptions of ERP, we contacted and received e-mail responses from twelve notable researchers working in the area. Whether a requirement or not, all experts surveyed were assured in the original e-mail that ''Respondent names will not be recorded in our survey database [. . .]. No data reported will be related to individual respondents.'' The twelve senior researchers whom graciously responded are:

Jörg *Becker*, Institut für Wirtschaftsinformatik, Westfälische Wilhelms-Universität Münster, Germany.

Peter *Best* and Glenn *Stewart*, Queensland University of Technology, Australia.

M. Lynne Markus, The Peter F Drucker Graduate School of Management, Claremont Graduate University, USA and Faculty of Business, City University of Hong Kong.

Jeanne *Ross*, Center for Information Systems Research, Massachusetts Institute of Technology, USA.

August-Wilhelm *Scheer*, Institut für Wirtschaftsinformatik der Universität des Saarlandes, Germany.

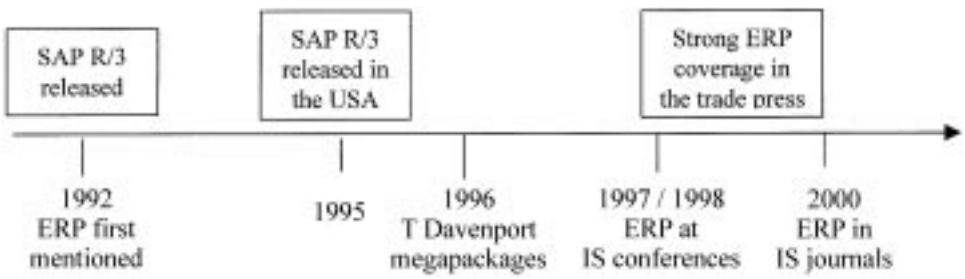

Fig. 3. *Adoption of the ERP concept in IS academe.*

Judy *Scott*, Graduate School of Business Administration, University of Colorado at Denver, USA.
Graeme *Shanks*, Department of Information Systems, The University of Melbourne, Australia.
Christina *Soh* and Kenny (Kwai Fong) *Lee*, Information Management Research Center, Nanyang Technological University, Singapore.
Iris *Vessey*, Kelley School of Business, Indiana University, USA.
Michael *Vitale*, Melbourne Graduate Business School, Australia.

Following is a synthesis of responses in relation to each of four questions posed (note that respondent codes used below e.g., E1, E2, etc., reflect the sequence in which responses were received and have no relationship with the list sequence above).

4.1. Question 1—It is believed by many that IS academics have been slow to recognize the importance of packaged application software. Discussion on ERP has only begun to emerge in recent years. Please comment.

The literature review suggests that academic interest in ERP and packaged software began to emerge only in the second half of the 1990s. Yet the common view (Section 2) suggests that large, packaged application software has been an important phenomenon since the 1970s and that the concept of complete integration has also been pursued for more than two decades (see also Markus and Tanis, 1999). Here, respondents were asked whether academics have been slow to appreciate the importance of ERP software, and if so, why.

4.1.1. Why a lag?—The lag is understandable. Several respondents suggest that the lag has not been very long, the lag is natural, or that some researchers were in early, perhaps even on time. Several respondents imply that ERP was the ''big bang'' (in an evolutionary sense). A major question this raises, is whether ERP represent a quantum leap in packaged application software, or the next stage in an evolution? Gable and Rosemann's (1999) survey data supports the contention that the lag has not been as long in Germany. Anecdotal evidence also supports the view that computer science have mostly paid little attention to this area, but are now like IS, increasingly interested.

4.1.2. Why a lag?—Today's packages and package implementation are different. Several of the experts suggest that today's ERP are different from earlier packages, thereby justifying the lag. We fully agree that package implementation is quite different from implementing custom software. Also, ERP packages have evolved dramatically over the years. Nonetheless, we expect (E5) would agree that IS academics have to some extent been lax. Perhaps this is due to ERP selection and implementation often being driven by the business unit rather than IT, with IT playing a lesser role; perhaps to some degree a consequence of the ''not invented here'' syndrome; perhaps because ERP implementation is even more multi-disciplinary than earlier IS projects (less IS).

4.1.3. Why a lag?—because its too hard! (E6) states

> I agree; there's a bit of a learning trajectory involved & there isn't that much good ERP reference material around—most of which are practitioner- or vendor-generated. Also there are a number of knowledge & expertise domains to be traversed before getting to a stage of being comfortable with such systems & their potential—first, a familiarity with the complex, advanced business environment & enterprise structures within which such software are deployed for strategic advantage (e.g., that of the large conglomerates, MNCs, M&As, etc.) is beneficial. So is a good (systems) background in one business process or key value chain area—featuring in-depth, real-world expertise in the activities & information flow complexities that make up the area . . . There is also the need to get a handle on the various ERP-related technologies such as client/server distributed architectures, open systems, RDBMS concepts, etc. Added to these, package vendors have never made it easy for those outside their customer/user base to grasp the design concept that they employ, having shrouded their design philosophy & system configuration convention in a vocabulary unique to themselves & packaging it all in a complex, proprietary design that is intended to lock in their customer base . . .

> Coming to grips with such ''entry barriers'' therefore takes a bit of time & effort, following which it becomes possible to appreciate the strengths of the software design, & the unique environments to which they bring their advantages to bear.

Thus, whether seeking to teach or research ERP, there is a significant investment required in understanding the complex melange of technologies, processes and issues involved; a daunting and risky undertaking. Also, it would appear that there exist significant economies of scale in pursuing system-building research into large-scale application package software. Small-scale system-building efforts of academics are unlikely to yield insights into the complexities of large-scale systems integration.

Finally, though not explicitly stated, several survey responses alluded to a further source of reluctance being the high cost of installing and operating an ERP system for teaching and research. Perhaps not surprisingly, increased ERP research and publication activity appears to coincide with increased university activity with ERP in teaching, and correspondend increased ERP vendor support of their systems for this purpose (in example, SAP's University Alliance Program only came into existence in 1997, with the first SAP systems installed in universities for the purposes of teaching and research going live that year. Note that SAP had given their software away freely in Germany for several years prior).

4.1.4. Why a lag?—Fear of change. (E2) implies that fear of change has been a motivation for the delayed response from IS academics.

> ERP are a competency-destroying innovation, not only for traditional IS developers, but for some traditional IS researchers as well. Neither group has been in any hurry to abandon (or perhaps even to question) their existing competency base.

(E5) notes that

> Many IS academics have come from a systems development background. Their expertise is in the areas of traditional requirements acquisition and modeling and systems design. This is particularly the case with the many academics obsessed with object orientation. ERP systems implementation is much more concerned with understanding business processes and focuses on implementation rather than development. I think the realisation that most software is now packaged and much of that is ERP systems is finally dawning.

(E3) suggests that

> If we are not researching this topic, it may mean that we are afraid to face the implications for our own intellectual capital.

A further possible explanation for the lag in IS attention to application packages may be the tendency for academics who develop depth and breadth in the area, to move out of academe. The pull from practice is strong. Universities must move quickly to adjust their reward systems and structures to encourage closeness with practice, while at the same time enticing their increasingly marketable staff to remain.

The alternative strategy is to continue researching and teaching on a micro-scale and avoid or discourage staff gaining the exposure, breadth and relevance they require to be involved with large application software packages. It is our belief that this approach cannot be sustained.

4.2. Question 2—Technical, managerial and marketplace dynamics have influenced the evolution of ERP. please suggest what you feel have been the more influential developments in each of these three areas.

Table 3 reflects a synthesis of comments made by the experts in relation to question 2.

Most often mentioned ''technical developments'' impacting ERP were: the advent of the Internet; faster, better and cheaper computing power; and the scalability and openness of client/server technology. (E5) suggests that ERP themselves are the technical innovation that has made organization-wide systems integration possible.

It is not always easy or useful to separate technical, managerial and other influences. (E9) suggests that

> ... there is a loop-back, i.e. from the managerial point of view these [managerial] concepts will influence and promote new technical developments. Inter-organizational data transfer, which is essential for supply chains, requires standardized data formats and convenient ways to perform the

Table 3. *Dynamics that have influenced the evolution of ERP*

Respondent dynamic	
	Technical
(E7, E9, E10, E6, E12)	The advent of client/server/scalability
(E1, E4, E8, E9, E12)	Internet/need to clean up the back-office for e-business
(E2, E8, E6, E12)	Faster, more reliable and cheaper computing capacity (processing, storage,
(E2)	Improving understanding of how to put together very large systems
(E3)	Frustration with client/server for in-house development
(E5)	The dream of integration was too complex for in-house development
(E9)	XML and standardized data formats
(E10)	Telecommunications and networks
(E6)	Microsoft NT, GUI/Unix, workflow, data mining, executive IS, mess from legacy
	Managerial
(E3, E5, E6, E8, E10, E12),	A desire to fulfill the promise of BPR/move to a process-orientation/recognition of ''best practices''
(E4, E10, E6)	Globalization—1 face to the customer, 1 view of the customer
(E2, E4, E6, E12)	Larger and more complex organizations/The evolution towards ''federal'' firms/lean, Flat, flexible, adaptive organizational designs
(E1, E10)	Continuing desire for improved managerial decision making
(E7, E11)	Focus on timely performance management and ''balanced scorecard'' approach
(E7, E10)	Need to respond rapidly to the changing marketplace
(E10, E6)	e-business/increasingly demanding customers
(E2)	Continuing growth in demand for access to more and more data
(E3)	Need to integrate across functions for competitive success
(E4)	Standardisation of base-level processes in order to empower decision-makers
(E5)	Trend towards outsourching of IT
(E5)	The need for integration to support CRM
(E6)	German strength in manufacturing and production management
(E9)	Supply chain management
	Marketplace
(E1, E3, E5)	Y2K
(E2, E3)	Strong ERP vendor marketing
(E2, E10)	IT skills shortage augers in favor of ''buy'' over ''make''
(E3, E5)	Emergence of a strong slate of alternative ERP vendors, and assured ongoing
(E3, E10)	The promise (maybe not fulfilled) of lower IT/support costs
(E2)	Application service providers put ERP in reach of SMEs as well as large firms
(E3)	Lots of hype
(E7)	Availability of industry solutions
(E10)	The right solution and message at the right time ... following the BPR craze
(E6)	Supply chain competition
(E6)	Increasing customer service/value orientation

transfer. This requirement had a major impact on the development of XML which it is now experiencing. Obviously new forms of business arose due to changed conditions on the markets. Many of them shifted from seller to buyer markets and concurrently consumer needs became more demanding. A way for companies to react was to improve their internal and external structures and processes. The control of these processes implied the use of ERP systems which could provide the necessary information.

Comments on marketplace dynamics were relatively sparse, most ideas having already come out in relation to technology and business dynamics. More respondents mention the Y2K problem here than under technical dynamics. Whether an overreaction to market-hype or a practical reality, Y2K undoubtedly contributed to dramatic growth in ERP sales in the second half of the 1990s as many organizations scrambled to replace their non-2000 compliant legacy systems. This glut of activity is also part of the reason why ERP sales plateaued in 2000.

Overall, respondents have cited a breadth of influences on the evolution of ERP, beyond the more readily identifiable technological developments of client/server, Internet, and declining costs of computing power. Important managerial developments

Table 4. Significant further developments coming

Respondent	Coming development
(E1, E6, E7, E8, E9, E10)	ERP vendors seek to transform themselves into e-business solution providers/ integration of intra- and inter-organizational systems
(E4, E5, E9, E10, E12)	Dominance of the web interface
(E3, E10, E6)	Componentization of ERP
(E5, E7, E9)	Application Hosting/Success in the SME marketplace
(E2, E11)	ERP will become more feature rich
(E3, E9)	Emergence of 3rd-party electronic markets (aka hubs and exchanges)
(E2)	The ERP marketplace will consolidate (as has happened for other packages, e.g., The Desktop)
(E4)	Move away from standard, global processes to data warehouses and middleware
(E5)	Support for interorganizational systems
(E5)	Focus on customer relationship management
(E6)	Partner relationship management (PRM)

include: process-orientation, globalization, outsourcing, new organizational designs, e-business, a focus on timely performance management and supply chain management. Major marketplace developments have been: Y2K, the IT skills shortage, ASPs, customer relationship management, and the emergence of a small number of strong ERP vendors.

4.3. Question 3—What significant, further developments do you see coming?

Table 4 reflects a synthesis of responses to question 3. Over half of the respondents mentioned the movement to integrate intra- and inter-organizational systems, as reflected in the current stampede to e-business and customer relationship management systems. Both client demand and vendor posturing were mentioned. The web is clearly the network and interface of choice. Application hosting was cited as a means of reducing implementation and support costs and for broadening access to ERP. Componentization was cited as the ''holy grail'' in the face of exponentially increasing software complexity (note that the holy grail has never been found).

4.4. Question 4—Please relate your definition of ERP? Do not be concerned that your definition may not be complete or all encompassing. All definitions received will be useful to the study. If possible, please describe any reservations you have with the definition you supply.

Table 5 reflects a synthesis of comments made by the respondents in relation to question 4. Definitions tended to be brief with several expressing difficulty doing justice to the question. Not surprisingly, there was some overlap between responses to questions 2, 3 and 4. Defining ERP seemed to distract from the real issues or in some sense belittle the impact of ERP. Emphasis was on cross-functional integration of

Table 5. Salient characteristics of ERP

Respondent	Characteristics
E2, E4, E5, E11, E7, E8, E9, E10	Complete set of integrated software modules (e.g., production, logistics, finance, human resources, output design)
(E3, E5, E6, E7, E12)	Cross-functional integration (intra-organisation)
(E3, E7, E8, E9)	Configurable software
(E3, E6)	Best practice process models
(E7, E9)	Single, common, enterprise-wide database
(E2)	Cross-enterprise business processes (inter-organisation)
(E7)	Single, common user interface
(E9)	Hooks to other systems (e.g., output design)
(E9)	Multi-tier, client/server architecture

internal processes, comprehensiveness, configurability and ''best practice'' process models. (E1) notes that

> ERP is difficult to define. The enterprise software is only part of the concept. From an academic point of view, the interesting issues are organizational. The impact of ERP has been massive. Industries, organizations, IS departments, outsourcing and employees' jobs have been affected.

Like (E1), (E4) also suggests that

> it is not the ERP that is interesting. It is the implementation and the accompanying new processes that are interesting.

(E10) suggests that

> ''Enterprise resource planning'' system is not an appropriate term for these systems. The term is too close to MRP/MRP II, and many people, even some who should know better, like to say that ERPs developed from MRP systems. Clearly, this is not true for the major players. I support the use of the term ''enterprise system [or] .... Perhaps we might call ERPs BOISEs—back-office integrated systems for enterprises (with thanks to Bob Glass).

In this section we presented results from a survey of twelve notable researchers working in the area. The experts, like the authors have difficulty arriving at a complete definition of ERP; they too appear to feel that ERP is ''in the eye of the beholder'', its definition being a function of perspective and intent. Many feel that IS have not been lax in studying and teaching ERP, that ERP exploded onto the IS scene only in the mid-1990s, and that the lag in IS academic activity is thus understandable. Other reasons given for the lag were: fear of change and loss of intellectual capital, the complexity of ERP and the significant investment required in understanding the complex melange of technologies, processes and issues involved; and the high cost of installing and operating an ERP system for teaching and research, all of which make a commitment to researching and teaching ERP a daunting and risky undertaking. Whether system-building or studying practice (empirical research), survey responses implicitly argue for closer cooperation with practice in research, R&D and curriculum and closer academic awareness of practice. A further difficulty implied in the survey responses, is the need to adjust university reward systems to both encourage the study of large multi-disciplinary systems, and to retain academic staff who are increasingly attracted to industry.

The expert opinion survey has revealed that there are conceptual obstacles to overcome, such as the label ERP and the fact that ERP is strongly rooted in manufacturing. The following discussion will hopefully shed some light on these issues.

5. Discussion: ERP—a Meaningful Label?

There exists dissent regarding the term ERP. Objections to the term usually read as follows: ERP denotes a particular category of software; this software, however, is not necessarily focused on managing resources; it has furthermore, no particular strength in the area of planning; and finally, current software extends its functionality beyond the enterprise. Thomas Davenport and Laudon and Laudon, therefore have attempted to match words with ''reality'' by suggesting we refer to integrated packages as *Business Systems*. The underlying assumption is that the term ERP should denote something unambiguously by the words it contains. We concur with the observations of these authors, without necessarily sharing their recommendations. To clarify this matter we revisit critically the development path of MRP (50s) → MRP II (70s) → CIM (80s) as suggested in section two and compare these predecessors with ERP in more detail. This path suggests a continuous extension of generic integration models.

Firstly, there are strong similarities between the approaches taken by MRPII and CIM and the successor ERP. CIM has been defined as

> The integrated management of information for all business and technical functions of a manufacturer

(Scheer, 1994: 2), while the broader approach of ERP has been captured as:

> It (ERP) integrates logistics, manufacturing, financial and human resource management func-

> tions within a company to enable enterprise-wide management of resources. (META Group, 1998).

In a similar vein, MRPII software solutions in the form of production planning and control systems can be regarded as the predecessors of ERP software. Davenport (1996) sees in ERP as a

> turbocharged version of manufacturing resource planning (MRP II), modified and strengthened to help manufacturers face the competitive challenges of the 1990s.

Thus it can be said that, like ERP, MRPII systems support a range of typical business functions, are based on the concept of one (logically) integrated database, and have one common user interface. In the period of the CIM discussion, various integration models were designed, that served as conceptual models for the development of integrated packages. From a methodological viewpoint, the related CIM research led to the design of easier to understand modeling techniques, that in addition to the traditional data models (Chen, 1976) also included process models. However entire turnkey off-the-shelf CIM solutions were never available, yet related research helped to develop internally and externally used standard interfaces (like STEP or EDIFACT). Despite these similarities several key differences separate ERP from MRPII and CIM and cast doubt on the theory of a linear, incremental development.

MRP, MRP II and CIM are comprehensively addressed in the production literature where accepted integration concepts, independent from specific solutions, are presented. ERP however, is at this stage mainly driven by currently available software products. A reference integration model for ERP, similar to the CIM approaches does not exist. This can be regarded as a major weakness of the ERP-related research up to now. This deficiency may also help to explain that a wide consensus across academe and practice for ERP related concepts and terminology has not been established.

MRP, MRPII and CIM were characterized by the continuous extension of production functionality. ERP however, can be implemented without any production-related functionality. MRPII e.g., is not a sub-module of ERP solutions targeting industries like banking or retailing. Moreover, while CIM included many technical functions like CAD or CAM, ERP solutions typically do not have embedded modules for these functions. Moreover, the problems with integrating an ERP solution with the more technical systems are a major challenge for many companies. As MRP, MRPII and CIM concentrated on internal functions, they could not contribute to current ERP issues like the integration of business partners (supply chain management, customer relationship management).

In conclusion, the suggestion that ERP derives from the MRP discussion is misleading in three ways. First, ERP does not have a particular focus on resources. At least of equal importance to the resource view is the process view. Second, the planning functionality is not the main strength of current ERP packages, which emphasize the execution of operational transactions like sales order processing, more than support for sophisticated planning procedures in the areas of procurement, production, sales or finance. Third, the term ''enterprise'' is now too narrowly focused. While MRP covered all functions related to material management, and MRPII and CIM indeed concentrated on manufacturing issues. The development of integrated solutions for processes that span suppliers, customers or banks, extends the classical perspective that was limited by the borderlines of a company. The term ERP suggest the outcome of the historical development process; yet this process has some discontinuity, and it would be erroneous to assume that ERP literally means enterprise-wide planning of resources.

Thus, Thomas Davenport (2000) and Laudon and Laudon (2000) have argued strongly in favor of replacing the term ERP with business systems. This would also take into account that these systems are universal and not limited to manufacturing installations. Furthermore, this would more closely align the rest of the world with continental Europe, which appears to favor the phrase ''standard business application software.''

Regardless of these terminological deficiencies, scholars in IS have adopted this ''island of technology'' term and an IS research domain is now evolving steadily under this banner. The phrase enterprise resource planning has become the most commonly used term to signify integrated business application packages; this is evidenced by the pervasiveness of the words ''enterprise resource planning'' and their abbreviation ''ERP'' in the

commercial press, in all types of IS publications, and in the vocabulary of widely used indexing services. We prefer to remain impartial in this debate over terminological normalisation; it might suffice to know how a phrase is used, in order to understand its meaning, and the widespread usage of ERP signals that the ambiguity assumed to exist due to its provenance, is apparently a non-issue. Wittgenstein compared those who demand definitions to ''tourists who read Baedeker while they stand before a building and through reading about the building's history, origins, and so on are kept from seeing it'' (cited in Blair 1990:154).

6. Limitations and Future Directions

Finally, we discuss what we believe to be both limitations of the study reported and opportunities for further valuable research.

A major limitation of the analysis is due to our constraining the literature review to information systems academic publications. While we hope this approach yields a clearer indication of developments and insights specific to the IS area, we are very well aware of contributions made to the ERP area from different disciplines like software engineering, production management and accounting. These contributions need to be considered in order to arrive at a more complete repository of ERP publications and conceptions. The variety of competing terms like COTS in software engineering present a special challenge. This is a central goal of future work we are continuing to pursue in the area.

Further, our historical analysis has emphasized the lineage of ERP in MRP II and CIM. Yet we admit there has occurred a parallel evolution of large, administrative application software packages in practice. An example is the predecessor of the current market leading ERP solution, SAP R/2, which entered the market in 1973. A more complete analysis of the history of packaged software would carefully consider this parallel evolution; reasons for the apparent divide, and how the divide has ultimately been bridged by ERP. A further level of important integration not reflected in the preceding discussion and yet to be well addressed in practice, is between data collection hardware and devices and the ERP software.

Our expert opinion survey too is skewed, the sample including a preponderance of empirical researchers. Though the software engineering perspective is marginally represented, a more complete canvassing of alternative perspectives (e.g., OR/MS, OM, and manufacturing) through a similar survey approach would be revealing.

In tackling the question ''what is ERP?'' we did not intend to be prescriptive and arrive at an authoritative definition. While we believe the analyses and discussion have helped to surface complexities associated with ERP-related concepts, we recognize that we are yet far away from compelling and complete definitions.

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