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# An International Analysis of the Maturity of Enterprise Resource Planning (ERP) Systems Use

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## Abstract

Enterprise Resource Planning (ERP) systems dominate the Information Technology (IT) landscape of global companies. Organisations are at different stages in the implementation process ranging from the initial strategic analysis of implementation options, through completed standard implementations and to the sophisticated exploitation of ERP systems using advanced knowledge management, decision support and supply chain management systems. There are also variances in the perspective of managers regarding the strategic potential of ERP systems. We present a maturity model for ERP systems that identifies three key implementation stages. The model is illustrated using case data from 24 organisations in the US and Europe. In stage one, organisations are managing legacy systems and starting the ERP project. In stage two, implementation is complete and the functionality of the ERP system is being exploited across the organisation. In stage three, organisations have normalised the ERP system into the organisation and are engaged in the process of obtaining strategic value from the system by using additional 'satellite' systems including knowledge management and supply chain planning. It is shown that the organisations follow an S shaped curve, and that most companies are in the middle stage.

Keywords: Enterprise Resource Planning (ERP), Maturity, Systems Implementation, competitive advantage, legacy systems.

## Introduction

ERP strategies represent over 80% of new large-scale systems development projects, dominate the IT infrastructure in large companies, and are becoming accepted as the standard approach in small and medium

sized enterprises. There are significant differences in ERP strategies across organisations, primarily in terms of how they are initially implemented, and how they are linked to satellite systems such as customer relationship management software (e.g. Siebel), supply chain management systems (e.g. i2 and Ariba) or existing specialised legacy systems (Holland et al 1999, Holland and Light 1999a, Li 1999, Light 1999, Bingi et al 1999, Davenport 1998). The research to date is characterised by detailed individual case studies, and broader surveys carried out by market research companies (Holland and Light 1999b, Cambridge Information Network 1999, Ross 1998, KPMG 1998, Dolmetsch 1998). In this study, we present an analysis of qualitative and quantitative case data collected from 24 organisations using stage theory. It is shown that there are three sequential stages that associated with ERP system use. For analytical purposes, the stages are described as discrete. However in practice, the stages are overlap. Although organisations display characteristics of more than one stage although one stage is likely to dominate. The first stage is characterised by the management of existing legacy systems and planning activities concerned with the implementation of the new ERP system. The second stage involves the post implementation exploitation of the ERP system and its widespread adoption throughout the organisation measured by the impact of the system upon business processes, and organisational coverage. The third stage involves the strategic exploitation of the core ERP system using innovative business process and IT initiatives that extend the ERP transaction data into high value processes such as customer relationship management. The value of the ERP stage model is that it provides a road map for understanding the evolution of ERP systems in organisations. This can help managers understand the implementation process and provide guidance on how to move towards realising the strategic potential of the ERP system when used in conjunction with satellite systems. From an academic perspective, the model provides a useful framework for the development of further research

questions in problem areas as technology diffusion, IT and competitive advantage and the process of information systems implementation. In the next section the research method and framework for the study is discussed before presenting an analysis of the data.

## Research Method

An ERP stage model was developed using concepts and ideas from the authors previous research in this area (Holland et al 1999, Holland and Light 1999) and the stage theory literature (Galliers and Sutherland 1991, Nolan 1979). To determine the position of an organisation on the stage model, a questionnaire was developed to perform the basis of semi-structured interviews with senior managers and directors of organisations that were at different stages of ERP implementation. Interviews were conducted directly with managers, or by telephone conferences. On-site interviews were conducted by two researchers, and telephone conferences by one researcher. Initially, the organisations included in the study were identified using alumni networks and a collaborating consultancy group's resources. Further contacts were generated by directly approaching organisations identified in the business press. A total of 80 companies were approached during the study, of which 24 agreed to participate. Of the 24 participants, 5 were interviewed by telephone and 19 through on site visits. The study included 12 US companies, and 12 European companies. The questionnaire comprised a series of best practice statements and interviewees gave responses based on the degree to which they agreed with the point in question. The survey statements gave the participants scope to expand. This created a wealth of qualitative data that was used to triangulate data and clarify the stage of maturity of the respective organisation. The theoretical constructs used in the questionnaire are described in the next section.

## Research Framework

The research framework is composed of five theoretical constructs: strategic use of IT; organisational sophistication; penetration of the ERP system; vision; and drivers and lessons. Each of the constructs is defined below:-

**Strategic Use of IT** - the importance of the IT function within the business. For example, is the IT function considered an operational expense the use of which is ad hoc, or is it part of the company strategy? Statements in this section focussed on how IT is viewed throughout the organisation and at the senior level. Is there an IT representative on the senior management team? How close is this person to the CEO? Do other areas within the company control how IS evolves based on their own requirements?

**Organisational Sophistication** - how the organisation structure has evolved as a result of the ERP system implementation. This evolution occurs as ERP systems are generic tools that are based upon standard business model designs that are highly integrated in nature. Therefore some form of compromise must occur, via a combination of customisation and business process re-engineering.

**Penetration of the ERP system** - how extensively the system is utilised within the company. This construct includes the organisational and technical penetration of the system and the human aspect i.e. employee's acceptance. This encompasses the proportion of sites using the system, the number of functions covered, geographical spread and the retention of legacy IT systems.

**Vision** – the identification of the strategic potential for, and the use of the system. ERP systems can be used to support high level decision making in organisations or as simple transaction processing systems. This construct is concerned with identifying the higher level uses of the ERP system, current or planned. These may include the use of the ERP system to support financial and non-financial performance indicators, internal and external benchmarking, or the implementation of further innovative IT systems in areas such as data warehousing, supply chain management, e-commerce or customer relationship management to work in parallel.

**Drivers & Lessons** - the drivers behind the implementation and the lessons learned during the implementation and beyond. This construct is concerned with the general feelings concerning the system implementation. The companies that had received the greatest returns generally had the most specific drivers, whilst those that had faced the greatest struggles were able to express the underlying reasons.

## Assessing the Stage of Maturity

A scoring process was used to identify company maturity rankings. The process was to calculate a score for each of the constructs in the research framework to provide a comparative analysis of maturity. The process was also undertaken by applying weightings to the various constructs but this had no effect on the overall results. The overall results are presented in table 1. Company 9, for example, is the most mature company. Since there are 24 companies the highest result is ranked as number 1. For example, company number 8 got the highest result for the strategy growth factor and is ranked 1 however, it is ranked 19 out of 24 in respect of penetration.

**Table 1. ERP System Maturity Scores for the Research Sample**

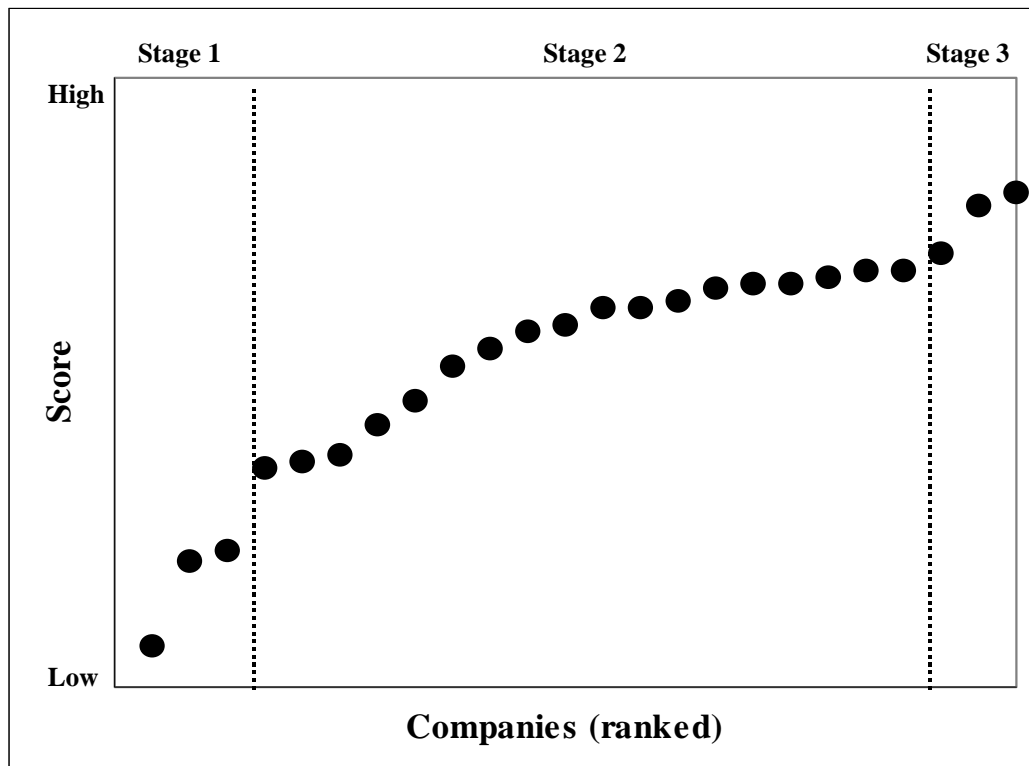
Company	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Strategic Use Of IT	17	16	22	5	15	19	14	1	4	21	24	11	23	10	9	6	20	13	8	12	7	3	18	2
Organisational Sophistication	20	4	19	13	12	3	9	1	7	24	18	11	21	15	14	8	23	17	2	6	10	5	22	16
Penetration Of The ERP System	9	5	12	8	4	7	11	19	3	23	22	17	21	2	14	6	18	13	24	1	16	10	20	15
Vision	11	16	15	8	5	14	12	21	7	20	22	17	24	6	13	1	19	23	4	3	10	2	18	9
Benefits & Drivers	4	15	14	10	6	5	12	8	2	21	24	1	18	11	13	19	17	23	7	20	9	3	16	22
Overall Maturity	12	11	17	5	3	8	14	7	1	23	24	10	22	6	15	4	20	19	18	9	13	2	21	16

Rankings: Overall maturity ranking and rankings according to the five growth factors.  
(n = 24, Rank one represents highest degree of maturity)

The company scores plotted in figure 1 show no clear clustering into three maturity stages, but a continuous distribution that is similar to the original 'S' shaped curve identified by Nolan. However, closer analysis of the

qualitative case data highlights the three broad maturity stages. An organisation that is characteristic of each stage is presented using the research framework.

**Figure 1. Ranked Maturity Scores For Case Organisations**



## Case 1: Company 10 (Stage 1)

**Strategic Use of IT** - The ERP system was initially championed by a CIO who had a seat on the board and the backing of his two immediate staff, the Director of IS and the IS Manager. However, none of these people remain in the company and the role of CIO has been dissolved, giving IS no board level voice. Moreover, the company has implemented cost cutting exercises which have reduced spending on IS to that of a maintenance level. The highest-ranking technical person is the chief Technology Officer, this role concerns product development, not operations. There are new pushes for a strategic IS direction, which is based on a business strategy that is tied to the company's internal consulting arm. However, IS is not considered able to support strategic decision-making. Top management only approaches the IS department on an ad hoc basis.

**Organisational Sophistication** - The organisational structure statements were unanimously given a grade of '1', indicating very little thought given to a process orientation and the flow of information for example. However, organisational members did remember a steady stream of consultants being brought into the organisation in an attempt to introduce a new corporate mentality. One group for example, was contracted to guide a BPR exercise. Although \$100K's were spent on the exercise, the only memory of the project was a multitude of stickers that the consultants placed on every board. There was no follow-through and nothing changed.

**Penetration of the ERP System** - Approximately 25% of the company utilise the system, although there are cost based issues that prohibit the number of users. Rather than empowering staff, the system has, in some instances, made people feel very uncomfortable with making decisions based upon the generated reports due to known inaccuracies in data input and manipulation. Staff retention has also been a problem, with only two of the original implementation team remaining. There are few formalised training tools with one-on-one introductions whenever a new user is brought into the company.

**Drivers and Lessons** - Drivers of the purchase were concerned with improved management information as the highest priority - an aspect that has yet to be realised. Costs were also highlighted as an issue, particularly with respect to consultancy and maintenance requirements. Furthermore, they felt that the system was very unforgiving - when using it, mistakes that are made are often very difficult to correct. A staff member dedicates half a day to correcting mistakes. One reason for this is that people don't know how the system works. The learning curve has been high. The company did expect the skill set of the employees to increase although this has yet to occur.

**Vision** - Although the company has found the implementation and use of the ERP system incredibly problematic, they feel that once on the ERP track, it is impossible to get off. Therefore, they are looking to extend their implementation, both geographically and functionally in terms of business knowledge and e-commerce. The company is also involved in external benchmarking and is attempting to integrate their supply chain using the ERP system.

## Case 2: Company 1 (Stage 2)

**Strategic Use of IT** - The use of the ERP system for strategic decision making is patchy and the systems capabilities are not appreciated by decision-makers. The IT strategy is the subject of regular reviews and there is strong evidence to support an appreciation of the potential value of the ERP system. The high level of the ERP maintenance team leader reflects the importance attached to the ERP system within the organisation. They operate at the same level as the global information systems manager, have a business background and are two levels below the strategic business unit CEO.

**Organisational Sophistication** - The nature of the business has conferred significant organisational change on the company during the implementation of the ERP system. The bulk of this change is considered independent to that required to implement the system. Examples include, the shift to an asset based structure, changes in the overall corporate structure, pending merger activity and a new joint venture agreement with a major player in the industry. There is evidence of improved transactional efficiency arising from the ERP system but the strategic potential has yet to be realised.

**Penetration of the ERP System** - The ERP system supports most business groups with the exception of sales and marketing and human resource management. The extent of usage by employees is high though it falls off at higher management levels. This is partly attributed to limitations of the reporting capabilities of the system. The company is keen to see the introduction of the data warehouse to improve penetration.

**Drivers and Lessons** - The key drivers behind the decision to implement were the potential for reduction in costs, replacement of legacy IT systems, the prospect of a single information system integrating all business processes and the prospect of improved access and use of management information. The company has realised all of these benefits with the exception of the latter. The provision of management information has been recognised as an ongoing challenge that is being addressed through senior management education and improved reporting mechanisms.

**Vision** - A strong performance orientated culture exists based on financial and non-financial measures. The company frequently benchmarks its business processes externally but little use is made of the ERP system in these campaigns. Progress has been made on internal supply chain control and integration although optimisation is proving elusive. This is due to the absence of an ERP based business process control system to calculate the benefits of performance improvements. Key suppliers are being encouraged to integrate with the ERP system and access has been granted to plant maintenance records and parts inventories. Customer integration is not seen as beneficial as existing trading processes are well established through long term contracts.

### Case 3: Company 9 (Stage 3)

**Strategic Use of IT** - This company had a strong vision of what was required and one that was easy to sell to top-level management: 'One single face to the customer – one single system'. The sell was made easier by existing in an industry where top management agrees that consolidation is good and requires a change of direction. From a more general strategic IT position, there are differences amongst the business units. There was complete agreement that a single unifying system should be installed world-wide. However, whilst subsidiaries are happy to concede control over the integrated system, they are not interested in taking orders concerning strategic IT matters in general. They argue that if it is not an ERP issue, they should be allowed to do it their own way.

**Organisational Sophistication** - The company is completely process oriented, with little pain experienced in the changeover due to the understanding of the business requirements. Top level support is fully acknowledged, and there is a strong understanding of the implications on the business. However, it has developed a more complex rather than simpler organisation structure. There is so much information that it is changing the organisation instead to use the data. However, this makes the organisation larger because there is so much data. A senior manager believed that the benefit was improving the organisation – building a company using a more strategic model rather than simplifying it.

**Penetration of the ERP System**- The company implemented on instance of the database rather than 'boxes' in each country that are integrated. The result is complex as the database runs 24/7. However, the company feels it has learned to love the system. They now have 5,000 named users and 1,700 concurrent users at any time during the day. It is a truly integrated company that requires no reconciliation and has total freedom of access

(e.g. inventory can be seen by anyone in any location). It is agreed that to remove the ERP system would be disastrous. The company uses the system throughout 98% of the business. Most users find the system easy to use, staff skills have not changed dramatically. Headcount has reduced in certain areas, but an overall increase in headcount has been experienced due to the creation of new technical and information handling roles.

**Drivers / Benefits** - The company had a clear driver – the creation of a single supply chain to create advantage in a consolidating market. Many other issues such as problems with legacy IT systems and year 2000 for example were mentioned as secondary drivers.

**Vision** - The company scored itself above average for most of the vision statements except for those concerning integration of suppliers and customers. This was because their customers are laggards. For example, they deal with hospitals who are generally facing severe cost pressures and so often have extremely basic systems and procedures. They belong to a consultancy run benchmarking group.

### Conclusions

This paper presents a framework for understanding the process and content of the development of the maturity of ERP systems in organisations. As shown in figure 1 and illustrated by the case vignettes organisations move continuously through the S curve. However it is still possible to discern three broad categories of ERP maturity. Organisations often implement a series of overlapping projects and initiatives and move gradually towards a increased maturity in the usage and perspective of the ERP system. There might be specific dates, such as the "going live" deadline or the completion of a benchmarking project, but not a stepwise change in the attitude towards the ERP system. Organisations are becoming more sophisticated in their approach to implementation and the strengths and weaknesses of ERP systems are being more readily identified. As a result, large and small and medium sized enterprises that embark upon ERP strategies are likely to move through the stages of maturity quicker in the future.

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