A Critical Success Factors Model For Enterprise Resource Planning Implementation

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Abstract

Enterprise Resource Planning (ERP) systems are highly integrated enterprise-wide information systems that automate core business processes. The ERP packages of vendors such as SAP, Baan, J.D. Edwards, Peoplesoft and Intentia represent more than a standard business platform, they prescribe information blueprints of how an organisation's business processes should operate. In this paper the scale and strategic importance of ERP systems are identified and the problem of ERP implementation is defined. A Critical Success Factors (CSFs) framework is proposed to aid managers develop an ERP implementation strategy. The framework is illustrated using two case examples from a research sample of eight companies. The case analysis highlights the critical impact of legacy systems upon the implementation process, the importance of selecting an appropriate ERP strategy and identifies the importance of Business Process Change (BPC) and software configuration in addition to factors already cited in the literature. The implications of the results for managerial practice are described and future research opportunities are outlined.

Keywords: Enterprise Resource Planning Systems, Critical Success Factors, Legacy Systems, Implementation, Business Process Change, Software Configuration.

Introduction

Companies are radically changing their information technology (IT) strategies by moving away from developing IT systems in-house and purchasing standard package software. Price Waterhouse predict that by the year 2000, two thirds of all business software will be bought off the shelf. More specifically, Deloitte and Touche state that ERP systems are now the preferred method by which businesses replace legacy systems. This shift is very clear in the ERP market. AMR Research state that the 1997 market for ERP systems was worth $15.68 billion and that this is likely to increase at a compound rate of 36% to $72.63 billion by the year 2002. The associated consultancy market is in the region of $30 billion.
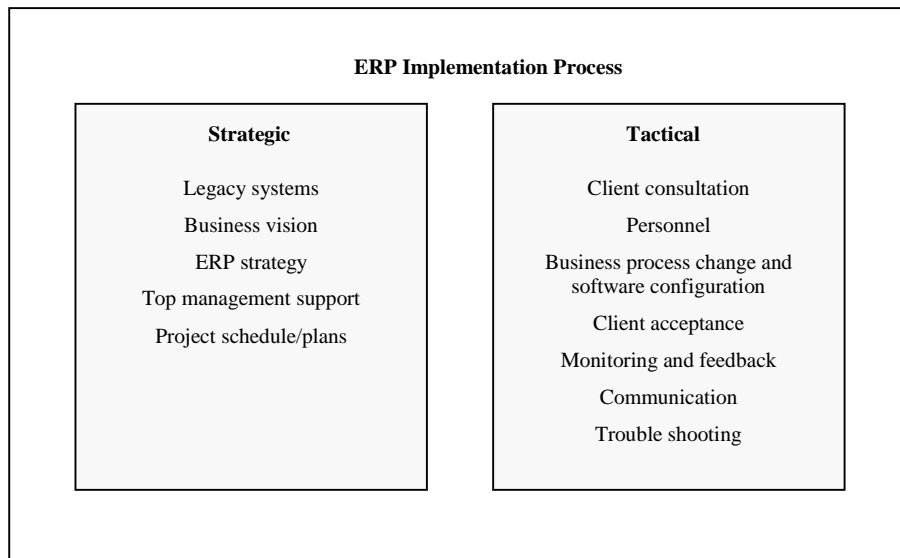
ERP software automates core corporate activities such as manufacturing, human resource, finance and supply chain management. The systems are sold on the basis of incorporating 'best practice' that facilitates rapid decision-making, cost reductions and greater managerial control. However, there is extensive evidence of IT implementation project failure in the academic and business literature. The Standish Group's 1996 IT survey showed that 40% of software projects fail completely, that is, the system is not delivered or is unusable. There are mixed reports concerning the outcome of ERP projects. Many successful ERP implementations are publicised such as those at Pioneer New Media Technologies (Datamation 1998) and Monsanto (Edmondson et. al. 1997). However, in the case of FoxMeyer Drug it has led to bankruptcy proceedings and litigation against the principal IT supplier (Bicknell 1998). Furthermore, it is estimated that at least 90% of ERP implementations are late or over budget. However, this may be due to poor cost and time estimation or changes in project scope rather than a failure in project management. The concept of ERP software being integrated makes it complex. Enterprise consensus is required to reengineer an organisation's core business processes and to take advantage of the software (Davenport 1998). If the system is to be implemented globally then global consensus is required (Holland and Light 1999). Software configuration is also more complex and intricate than is typical of a bespoke system. This is because bespoke systems are designed for individual companies leading to an emphasis upon systems analysis and design. With standard software, and especially ERP software, the focus of the development effort shifts from systems analysis and design to software configuration. That is, the majority of the systems analysis and design effort has already been captured within the software and consequently, much of the systems development effort is focussed upon enabling the required functionality embedded within the ERP system's business model. It is clear that ERP implementation is a complex and difficult process that can potentially reap enormous benefits for successful companies and be disastrous for those organisations that fail to manage the implementation process. The questions that arise are therefore: *How can ERP systems be implemented successfully? What are the CSFs for ERP implementation?*

Although the ERP software is standard, there are different strategic approaches to implementation, which differ in terms of the technical and business scope of the project. There are two main technical options - the implementation of the standard package with minimum deviation from the standard settings provided by the supplier and the bespoke adaptation of the system to suit particular local requirements. The main business options revolve around the issue of compromise over fitting the system to the organisation or vice versa. ERP implementation therefore involves a mix of BPC and software configuration in order to align the software with

the business processes. From a management perspective, the nature of the ERP implementation problem includes strategic, organisation and technical dimensions. In this paper we apply the concept of CSFs, those factors that need to be considered and managed to ensure the success of a project, to explain differences in project outcomes. CSF models have been applied to both general project management problems (Slevin and Pinto 1987), manufacturing system implementation (Lockett et al 1991) and the area of reengineering (Bashein et al 1994). The approach is particularly suitable for the analysis of ERP projects because it provides a framework for including the influence of tactical factors such as technical software configuration and project management variables together with broader strategic influences such as the overall implementation strategy. The contribution of the paper is twofold. It provides a framework for practising managers to aid their decision making and guide them in the development of an implementation strategy, and it identifies the role and influence of individual factors on each other and on the project outcome.

Critical Success Factors For ERP Implementation

Based on the review of literature (Grover et. al. 1998, Kotter 1995, Benjamin and Levinson 1993, Hall et. al. 1993, Slevin and Pinto 1987) and the experiences of the organisations in the study, a CSF research framework is presented in figure 1. The structure of the model is based on grouping the CSFs into strategic and tactical factors. Each group of factors is discussed in turn with an emphasis on the factors that are specific to ERP projects.

ERP Implementation Process

Strategic	**Tactical**
Legacy systems	Client consultation
Business vision	Personnel
ERP strategy	Business process change and software configuration
Top management support	Client acceptance
Project schedule/plans	Monitoring and feedback
	Communication
	Trouble shooting

Figure 1. A Critical Success Factors Model for ERP System Implementation

Strategic Factors

The strategic factors business vision, top management support and project schedules/plans are based on Slevin and Pinto (1987). In addition, we have identified the importance of ERP strategy, and the role of legacy systems which is similar to what Roberts and Barrar (1992) refer to as 'antecedents'. A brief definition of Slevin and Pinto's factors are given before describing the role of legacy systems and ERP strategy in more detail. Business vision is the clarity of the business model behind the implementation of the project. Is there a clear model of how the organisation should work? Are there goals / benefits that can be identified and tracked? Top management support is the level of commitment by the senior management in the organisation to the project in terms of their own involvement and the willingness to allocate valuable organisational resources. Project schedule/plans is the formal definition of the project in terms of milestones, critical paths and a clear view of the boundary of the project.

Legacy Systems

Legacy systems are the business and IT systems that encapsulate the existing business processes, organisation structure, culture and information technology (Adolph 1996, Bennett 1994, Roberts and Barrar 1992). It determines the amount of IT and organisational change that is required to successfully implement an ERP system. Business and IT legacy are not separate problems since many components of a business (e.g. work flow and processes) are bound up in the design and operation of the existing IT systems.

ERP Strategy

The ERP strategy is concerned with the broad approach to the implementation process. For example, a skeleton version of the software package can be implemented initially, and extra functionality can then be added gradually once the system is operating and the users are familiar with it. A much more ambitious strategy is to implement a system that offers all the functionality that the organisation requires in a single effort. Independently of the level of functionality chosen, there are different approaches to linking with the existing system ranging from implementing one ERP module at a time and interfacing with the legacy system or going for a big bang approach. The single module approach can be done in parallel with the existing system or on its own. International projects add further complexity regarding the choice of country by country roll-out of the ERP system or parallel teams operating in different regions. It is clear that an organisation's propensity for change should influence the choice of ERP strategy. A further technical choice is whether to carry out bespoke development on the package software and how this will affect the organisation when upgrading the system in the future. The amount of bespoke development depends on whether an organisation is willing to change their business to fit the software, or whether they prefer to change the software to fit their business. However modifying the software to fit the business means that it is possible that the benefits from reengineering business processes will not be achieved. Once a decision has been made on the ERP strategy, issues surrounding how the project should be managed can be considered.

Tactical Factors

Client consultation, personnel, client acceptance, monitoring and feedback and communication are based on Slevin and Pinto (1987). Client consultation is the involvement of the users in the design and implementation of business process that includes formal education and training. Client acceptance is the user acceptance of the system and represents 'buy-in' from the owners of the business processes. Monitoring and feedback is the exchange of information amongst members of the project team and the analysis of feedback from organisation users. Communication is the formal promotion and advertisement of the project's progress from the project management team to the rest of the organisation. Troubleshooting is ability to manage crises and deviations from the plan. The additional factor BPC and software configuration recognises the critical role of aligning business process to the ERP software in implementation. Although the standard project management factors are still important, they play a supporting role to the BPC and software configuration.

Business Process Change and Software Configuration

Organisations need to understand their current business structure and business processes associated with the existing IT system, and relate their existing situation to the business processes contained within the ERP system (Osterle 1995). There are process modelling tools which help organisations to align business processes with the standard package. For example, the ERP vendor Intentia offers a tool that models business processes and automatically configures their software. This tool is referred to as the Movex Visual Enterprise (www.intentia.com). The tool has a repository of business processes that can be used as a reference when reengineering current processes and designing new ones. For every core and support process in their generic business process model there are several alternative processes relating to best practices in different types of operations and business environments. These processes can be modified, for example unwanted activities and sub-processes can be deleted online and others can be added from different reference processes. Therefore business processes can be customised to a certain extent without making bespoke changes to the code. This tool can be used at any stage after the initial implementation process to enable continuous business process improvement.

Discussion of the Critical Success Factors Model

The legacy systems of the organisation need to be fully understood in order to provide the baseline from which the magnitude of change that the ERP project may bring can be anticipated. The existing situation within an organisation will determine the amount of change that is required and will therefore influence the choice of ERP implementation strategy. A clear business vision for the project is required to give the project direction and scope. Without this, implementation is likely to be lengthy, costly and the result misaligned with the organisation's overall strategic vision. The various ERP strategies that are available to the organisation need to be evaluated against the legacy systems and business vision for the project to ensure that an appropriate one is selected. The selection of an inappropriate ERP strategy can lead to implementation difficulties and potentially a failed project. The final factor of the strategic aspect of the framework, top management support, is required because implementing an ERP system demands creation of organisation wide commitment. Top management support should ensure: consensus throughout the BPC and software configuration phase of the project and ensure resources are available for continuous improvement after the main project has finished, the appropriation of people and resources to the project and the usage of the system post 'go live'. The importance of the CSFs for the tactical phase of the project is now explained.

The process of client consultation aims to generate 'buy in' to the project and system in order to ensure that it meets business needs and facilitate the client acceptance of the system later in the implementation process. Obtaining the right personnel for the project is important to ensure the technical and organisational aspects of the project run smoothly. Organisations need to secure technical experts in their chosen ERP package to configure the system and need to decide how they are going to manage the BPC / organisational change aspects of the implementation. This can be done using internal staff, external consultants and more usually, a mixture of both. A successful BPC and software configuration process makes a large contribution to the alignment of the ERP system and the organisation. If this process is not given enough attention then the system may take longer to implement, and the resulting misalignment may inhibit the use and acceptance of the system. The ERP project team must ensure that the client acceptance of the system is high. Several implementations have not managed this process and have found that this has required further attention post 'go live' in the form of costly re-training. Many users were still trying to use the ERP system in the same way that they used their old systems and this led to significant drops in business performance. Monitoring and feedback is essential to ensure that the project is progressing as planned in technical and organisational terms particularly given the mix of internal and external staff working on the project and the resulting relationships. Communication is required for similar reasons to the last factor. ERP projects require cross-functional teams who have different goals and for international projects different cultures and languages. A conscious effort to manage the communication between the project group and the wider user community is therefore essential to ensure commitment and identify problems quickly. Finally, trouble shooting must be performed continually throughout the project. Mistakes and potential problems need to be dealt with rapidly so that the project stays on target.

Obviously, all of these factors are important to ERP projects but the CSFs of legacy systems, ERP strategy, and BPC and software configuration are specific to ERP implementations and require special attention. The research method is described in the next section and two illustrative cases are analysed. The case analysis demonstrates the interaction of the strategic and tactical aspects of the CSFs framework and highlights the particular importance of legacy systems, ERP strategy and BPC and software configuration.

Research Method

A series of case studies was conducted across a range of industries looking at companies implementing ERP software (Table 1). The names of the organisations involved have been anonymised but the case details are true in all other respects. Case study research to build theory (Eisenhardt 1989) was used to understand the implementation process of ERP systems in companies. Theoretical sampling was used to choose cases, with the intention of selecting companies that represented different industries and implementation strategies. Cases were added to the research sample until a clear pattern in terms of the general implementation model was reached. The framework for data collection (see Figure 1) gave a well-defined focus for the data collection method of semi-structured interviews. Questions were asked about the IT and business legacy of the company, the approach taken for implementing the ERP software and the outcome from the implementation. General background information on each of the companies was also obtained. The framework was revised as the theory developed through the iterative process of case study research. Data were collected by interviews with key company business and IT personnel including managers, users and consultants and through project documents and company literature such as annual reports and the internet. Interviews were held every six months during the ERP projects starting from the formation of the strategy through to the 'go live' and the period of bedding in the system in the organisations. The data were analysed within case and across cases to generate and refine theories. The next stage of the research is to develop quantitative measures in addition to the qualitative ones already used and to test the model on a much larger sample of organisations. To illustrate the model in practice, two case vignettes from the theoretical sample, Threads and StatCo, are presented in more detail.

Company	Industry	ERP Project
Threads	Textile	Global SAP System
Chemical	Chemical	Global SAP System
Bell	Manufacturing - Retail	Global SAP System
StatCo	Office Supplies	European SAP System
CompCo	Information Technology	National Masterpack System
Pump	Manufacturing - Industrial	Global SAP System
PlasCo	Plastics	National Movex System
PharmCo	Pharmaceuticals	Global SAP System

Table 1. Case Sample

Threads

Strategic Factors

Threads is a global firm operating in the world textile market. Threads European *legacy systems* were fragmented. There were over 40 separate accounting systems in Europe for example. The information systems were a mixture of bespoke and heavily tailored packages that had year 2000 compliance problems and could not cope with the strategic vision of a pan-European organisation that would be much more customer-focused with integrated marketing systems across the different national manufacturing sites. Threads was geographically dispersed and the legacy systems did not allow a co-ordinated approach to the European Market. The senior management at Threads recognised this and developed a *business vision* which incorporated a new organisation structure in Europe based upon a pan-European business model. Links were to be forged between national sales units and the production and distribution sites across Europe. he strategic objectives were to improve the customer interface by linking sales and marketing with production and distribution systems across the whole of Europe. The financial target was to reduce overhead costs by at least 10%. The *ERP strategy* was to roll-out the SAP R/3 package over Europe country by country. The full functionality of the system was exploited immediately and the system was run in parallel with the existing systems. Threads aimed to implement a 90% common core of business processes for each country.

Tactical Factors

Top management support for the project was present at Threads. Board approval for the project enabled the secondment of top managers to the project. Furthermore, board pressure to reduce overhead costs in Europe gave the project a high profile within the company. At least two senior directors were actively involved in the day to day execution of the project. There was a clear p*roject schedule* that was divided into phases organised around the design of common business processes. However, the growth in the scale of the project (to include all parts of the business) and the geographic complexity of designing common systems across Europe has led to delays. Numerous workshops were held to facilitate *client consultation*. These workshops were used to examine business processes and involved approximately 150 staff from the businesses. The necessary *personnel* were also recruited. The project team included consultants, internal staff (top people from functional areas of business) and a change manager. The *BPC and software configuration* process of the project was highly managed by the team. Around 150 staff were involved in workshops to examine generic business processes. Thirty main business processes were identified then defined in detail. This provided the basis for configuring SAP. In isolated instances, some local systems were retained but the objective was still to achieve 90% commonality across all countries. *Client acceptance* was secured by involving users in the system testing process at pilot sites and requesting feedback. *Communication* and *monitoring and feedback* throughout the project were also high. Regular meetings were held by the senior project group and project directors involved in the day-to-day implementation. The change manager was responsible for ensuring that users were aware of the current state of the project and managing human resources issues. The high levels of communication throughout the project have facilitated the t*roubleshooting* aspect of the project although some problems were difficult to resolve such as differences in national business processes. Threads were faced with a high turnover of external consultants that has delayed the project. The Threads change manager and the external consultants also had different approaches to managing the change process. The consultants preferred a radical approach whereas the company preferred a more incremental process of chantge.

StatCo

Strategic Factors

StatCo is a European stationery supplier. StatCo's *legacy systems* were a function of its history of mergers and acquisitions. The business was therefore comprised of autonomous companies, each with their own IT system. These systems were not year 2000 compliant and were not capable of running an integrated business. There had been problems in the past when some of these autonomous companies had tried to integrate. The senior management of StatCo wanted to create one UK business and chose an ERP system to support this *business vision*. The *ERP strategy* was to provide each site with a system that matched or exceeded the functionality of its existing legacy system. When all of the sites were on the common platform they then aimed to implement the remaining functionality of SAP. StatCo chose not to carry out any bespoke development and staggered the implementation throughout the different European countries. The company did not run the old and new systems in parallel.

Tactical Factors

The project had t*op management support*. The Managing director was actively involved in the project because it is viewed as the enabler of creating a single, integrated European organisation from a group of what were separate businesses. The *project schedule* is to implement SAP quickly across all sites to establish

commonality and then build up the functionality across the whole business. The methodology was fast-track SAP implementation where only the minimum of the ERP functionality was adopted. ***Client consultation*** was conducted with users via a project newsletter and 'business champions' at each site. The ***personnel*** for the project included managers taken out of the business to work full time on the project. The project team is cross functional and has a 'team charter' detailing the philosophy for the project. The ***BPC and software configuration*** activities were split between in-house staff and consultants. Technical expertise for software configuration was sought from experienced SAP consultants. Business expertise was sourced internally. The philosophy of the BPC was to align the business processes to the software and simplify business processes to eliminate redundant activities. ***Client acceptance*** was obtained through user testing trials and extensive training on system and new business processes. Training continued after 'go live' to maintain standards. The main forum of ***communication*** throughout the project was weekly meetings so that decisions could be made rapidly. Information was made available to users via a project newsletter. ***Monitoring and feedback*** mechanisms were incorporated into the communication and this identified issues relating to data quality, training and change management in the first implementation. The initial implementation problems informed the t*roubleshooting* process. Careful testing and trial runs of the system before the 'go live' date avoided additional potential problems.

Discussion of Threads and StatCo.

Threads set a clear business vision to overcome extremely complex legacy systems but the implementation process has been very slow. The scope of the project was changed to include all parts of the business and this coupled with the geographic complexity of the organisation slowed the implementation process. The difficulties of implementation were exacerbated by the ERP strategy of attempting to implement the full functionality of SAP immediately on each new site. The combination of these factors meant that even with top management support and a clearly articulated business vision, the ERP implementation process was very slow and difficult. Tactically, the client consultation and user acceptance was exhaustive and the philosophy of the human resources director was to involve users at all stages in the BPC activities. This approach reflected the paternalistic culture of the firm and their non-adversarial approach to change. Although the implementation is viewed as a success overall, the time-scales have been much longer than was first anticipated and the associated implementation costs are much higher than the original estimates. Threads contrasts sharply with StatCo. The legacy of StatCo. was much simpler than Threads and although it is international, the actual business is simpler from an information management perspective. The lack of a dominant culture and accepted ways of working also meant that the managers in the separate business units were more open to change - the inertia from the legacy systems was much lower than in Threads. The ERP strategy was a fast-track implementation in which the minimum functionality was implemented across all the sites that will provide the basis for further development. The project schedules and plans were therefore simpler to manage and the testing of basic SAP systems was simpler than that which occurred in Textile where full-functionality systems were tested in parallel with the legacy systems.

Conclusions

Enterprise resource planning systems link together an organisation's strategy, structure and business processes with the IT system. Although the technical risk from developing software is considerably reduced, risk during implementation is associated with aligning the processes with those of the software package and the corresponding change management and software configuration issues. The pervasive nature of the ERP platform means that it will form a critical infrastructure for many firms into the twenty first century. The analysis of the cases reveals that in addition to standard project management CSFs, there are also other factors that influence the implementation process. These are legacy systems, ERP strategy and BPC/software configuration. The comparative analysis of Threads and StatCo illustrates the interplay of the strategic and tactical factors, and the specific importance of the additional factors legacy systems, ERP strategy and BPC and software configuration and this is generally true for all of the cases. An organisation that intends to implement and ERP system needs to understand its legacy systems and this should influence the selection, in conjunction with the overall business vision for the project, of the ERP strategy. The ERP strategy is important because it affects the BPC and software configuration process. However, it should not be forgotten these ERP-specific factors need to be viewed in the context of the general CSFs of: business vision, top management support, project schedule, client consultation, personnel, client acceptance, monitoring and feedback, communication and troubleshooting.

ERP systems are now the most common IT strategy for all organisations, and this paper has presented a CSFs model that can aid management thinking in this difficult and complex problem. In addition to the identification of the role of legacy systems in the implementation of ERP systems, it has also been shown that there are different approaches to ERP strategy ranging from skeleton implementations to full functionality. There are also important differences in how organisations manage the gap between their legacy systems and the ERP business

processes. It appears that it is easier to mould the organisation to the ERP software than vice versa. Looking ahead, it is clear that organisations will continue to develop their ERP systems by upgrading their systems and continuing to enhance their business processes. The next stage in the research will be to develop the framework, specifically focussing upon creating a set of quantitative measures for assessing the impact of each factor on the implementation outcome for a large sample of companies.

References

Adolph W.S. (1996) "Cash Cow In The Tar Pit: Reengineering A Legacy System", *IEEE Software*, May, pp. 41- 47.

Bashein B.J., Markus M.L. and Riley P. (1994) "Preconditions for BPR Success and How to Prevent Failures", *Information Systems Management*, Spring, pp 7-13.

Benjamin R.I. and Levinson E. (1993) "A Framework for Managing IT-Enabled Change", *Sloan Management Review*, Summer, pp 23-33.

Bennett K. (1994) "Legacy Systems: Coping With Success", *IEEE Software*, January, pp. 19-23.

Bicknell D. (1998) "SAP to fight drug firm's $500M. suit over R/3 collapse", *Computer Weekly*, 3 September, p. 3.

Datamation (1998) "Implementing R/3", *Datamation*. Datamation.com/PlugIn/toolkits/implr3/diary1.htm.

Davenport T.H. (1998) "Putting The Enterprise Into The Enterprise System", *Harvard Business Review*, July-August, pp. 121-131.

Edmondson G. Baker S. and Cortese A. (1997) "Silicon Valley On The Rhine", *Business Week*, 3 November, pp. 40-47.

Eisenhardt K.M. (1989) "Building Theories from Case Study Research", *Academy of Management Review*, **14(4)**, pp.532-550.

Grover V. Seung Ryul J. Teng J.T.C. (1998) "Survey Of Reengineering Challenges", *Information Systems Management*, Spring, pp. 53-59.

Hall G. Rosenthal J. and Wade J. (1993) "How To Make Reengineering Really Work". *Harvard Business Review*, November/December, pp. 119-131.

Holland C.P. and Light B. (1999) "Global Enterprise Resource Planning Implementation", *32nd Hawaii International Conference On System Sciences*. Hawaii.

Kotter J.P. (1995) "Leading Change: Why Transformation Efforts Fail", *Harvard Business Review*, March-April, pp 59-67.

Lockett A.G. Barrar P.R.N. and Polding M.E. (1991) "MRPII systems: success factors in the process of implementation", In *Production Research: Approaching the 21st Century, M. Pridham and C. O'Brien (eds.)*, Taylor and Francis.

Roberts H.J. and Barrar P.R.N. (1992) "MRPII Implementation: Key Factors For Success", *Computer Integrated Manufacturing Systems*, **5(1)**, February, pp. 31-38.

Slevin D.P. and Pinto J.K. (1987) "Balancing Strategy and Tactics in Project Implementation", *Sloan Management Review*, Fall, pp 33-44.