

## Internal Supply Chain Management within SMEs: When ERPII Is Not Enough?

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**Abstract:** The aim of this paper is to develop and further advance understandings of the limitations of common ERP (Enterprise Resource Planning) type systems with respect to internal SCM (Supply Chain Management) co-ordination and control. ERP systems are now routinely used within SMEs (Small-to-Medium sized Enterprises) and may be seen to offer many distinct operational advantages, but barriers to enterprise growth and market development still remain. Recent industrial and academic work has been placed upon incremental improvements of existing frameworks to deliver 'ERPII' or solutions based upon extended-enterprise or networked supply chain models. However, indications from this research reveal that as SMEs shift towards more agile and customer focused business strategies, there has to additionally exist, a re-examination of how internal reference frameworks and process systems are supported and operationalised within the new solutions. Results constructed from survey data and case study investigations provide new recommendations and guidelines for researchers, practitioners and ERP solution vendors.

**Keywords:** Supply Chain Management, ERP, SMEs

### I. Introduction

Today's competitive environment can be characterised by intensified competition, resulting from market saturation and increasing global demand for customer-orientated production [1]. Innovations, both in organisational design and manufacturing systems have had a significant influence on the competitive environment. More recently, it has been increasingly acknowledged that manufacturing businesses need to move towards networked and globally-focused operations. These extended operations seek to have a presence in most of the world's major regions. To meet the requirements of modern markets, new paths must be forged in agile management strategies, organisational methods, manufacturing strategy and IT (Information Technology) [2]. Previously the introduction of mass production combined with a greater division and simplification of labour heralded a new manufacturing era. Nowadays a new stage has been entered into, with barriers to market entry being removed, allowing SMEs to bring new MTO (Make-To-Order) or mass customised products to market rapidly and to develop opportunities profitably. This has been facilitated by rapid advances in communications technology and supported by highly co-ordinated and efficient supply chain networks.

The increasing importance of the 'extended-enterprise' has been recognised by both the academic and business communities [3] [4] [5]. The subject though is far from new and many SMEs can be seen to have operated limited internal networks, comprising a separately located headquarters, sales offices, manufacturing sites and distribution locations for many years. Significant research into comparative advantage and partnership has additionally investigated the many implications of the various theoretical models of networked trade and global organisation [6] [7]. This work is solidly founded on an enterprise's ability and scope to exploit its core knowledge, developed in its own locality, globally and at minimum cost. Also, acknowledged is related work on the problems in gaining entry into new foreign markets and how enterprises should organise and compete abroad, supported by rigorous management principles [8]. More recently, Karlsson and Skold [9] describe how 'extraprises', an emerging production network paradigm or open production system, may take contemporary manufacturing systems a step further and contribute to a richer framework for manufacturing enterprise strategy research.

From these concepts, there exists general academic consensus that SMEs are well placed to succeed in such dynamic global environments, evolving from operating as a single enterprise within vertical markets, towards outwardly focused network participants, co-ordinated and embedded inside much wider global supply chains. Within such a context, there exist many trade-offs between strategic priorities and careful resource management. What may be furthermore seen though is a shifting academic and industrial bias towards external orientation at the expense of timely attainment of recognised internal operational pre-requisites. These pre-requisites often comprise: defined organisational structures, proven customer demand understanding, product quality, documented practices, accurate production data, established supplier performance, and effective business intelligence. At a time when SMEs are currently facing unprecedented market and financial turbulence due to the global economic crisis, it can be proposed that those with a stronger internal organisation, customer focus and cost foundation may be better able to weather the storm and emerge within the new marketplace much more successfully. It is argued by the authors of this paper that contemporary SMEs should have an internal supply chain strategy at least equal to any outward perspective.

## II. Background

### Global Business Strategies for SMEs

Contemporary SMEs strive to be World Class and regularly achieve new standards for productivity, quality and time-to-market, which have changed the basis for global competition. The term World Class Manufacturing (WCM) was first used by Hayes and Wheelwright [10] to describe enterprises that achieve competitive advantage through the use of their manufacturing capability as a strategic tool. Developing business excellence and attaining a competitive advantage demands much more than just getting the right product and price. WCM was then popularised by Schonberger [11] who developed the concept on a set of 16 interacting principles and provided examples of world class manufacturers. Contemporary manufacturing SMEs not only desire to achieve WCM, but also need to deliver marketplace ‘agility’. Kidd [12] proposed that agile manufacturing enterprises are not only capable of responding rapidly to changes in customer demand and are able to take advantage of windows of opportunities. Mason-Jones [13] further discussed the attribute as successful knowledge exploitation in volatile marketplaces. Whilst these principles can be advocated for any SME, it is proposed by the paper’s authors that further investigation and analysis should be undertaken with respect to enterprise growth. Namely, how WCM principles and agile theories can be mapped against established models of global trade development detailed within Figure I.

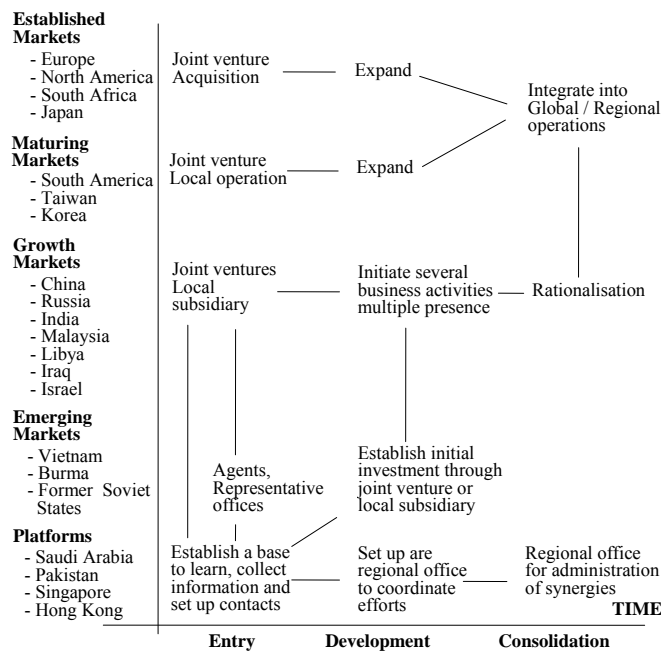


Figure I. Global Market and Organisational Development [2]

### Supply Chain Management and ERP adoption

SCM is recognised as a pre-eminent concept by which enterprises can make instant improvements to their business

strategies [14]. Enhancements to supply chains in terms of improved product quality, faster customer response and greater agility can provide significant marketplace differentiation and increased levels of competitive advantage. Supply chain adoption initiatives strive to match supply and demand thereby driving down costs simultaneously with improving customer satisfaction levels. First step changes to optimising enterprise logistic processes have relied upon concepts such as BPR, Just-In-Time (JIT) and Total Quality Management (TQM) making them faster and more agile [13]. The implementation of SCM techniques externally, as a second step, should lead to enhanced cost saving opportunities as the whole supply chain can be considered and optimised. Whilst, Kehoe and Boughton [15] acknowledge the research need for more coherent and integrated supply chain classifications based upon complexity and uncertainty, their internal model provides only a limited, stable and simple view, Figure II. Holistic mastery of process is one fundamental element of a successful supply chain, however the enactment of traditional hierarchical and functional systems, both external and internal, needs to be re-evaluated in the light of recent IT advancements and in particular, the rapid growth of more flexible, co-ordinated, and geographically dispersed SME organisation structures.

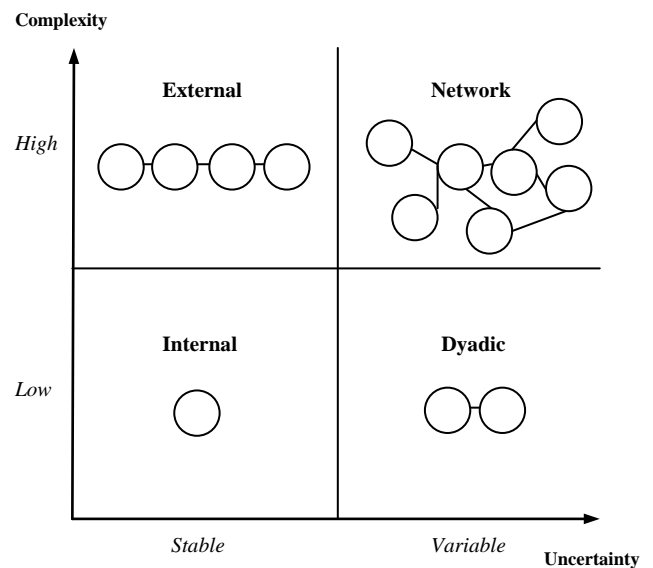


Figure II. Supply Chain Classifications [15]

ERP systems nowadays form the infrastructure of many SMEs and more recent investigations have been conducted, to develop new holistic models of adoption and implementation success [16] [17]. Moreover, contemporary academic thinking has shifted to the extension of ERP or ERP II [5] [18] where much closer integration resides between existing enterprise and new supply chain systems. These not only build upon previous internally focussed ERP systems, but also recognise outwardly facing SCM

imperatives and address changing electronic commerce and Internet-based marketplace trends, Figure III.

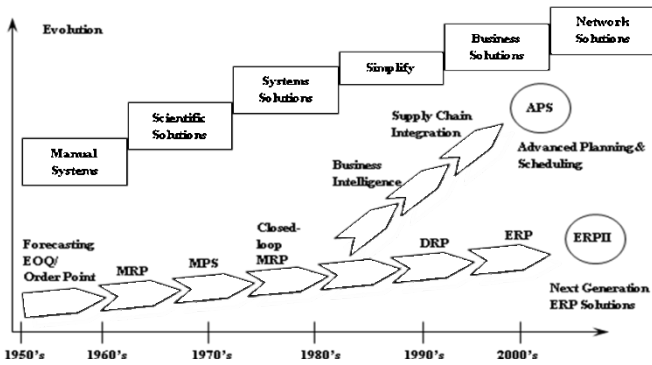


Figure III. Enterprise Systems Evolution, adapted from [19]

Nowadays ‘transactional’ ERP systems are routinely implemented with additional Complementary IT Systems (CITS), such as Customer Relationship Management (CRM), Advanced Planning and Scheduling (APS), Electronic Commerce, Data Warehousing and Business Intelligence, to provide extra business support in terms of superior customer interaction, supply chain control and effective management reporting [20]. However, the problems of effective and latent SCM integration, collaboration and performance measurement often remain [21]. It is widely accepted that SMEs can derive step-change improvements from ERP implementations supported by continuous business improvements programmes. What is considered from this research work is that, as ERP systems have further developed towards ERPII, these next-generation enterprise systems concepts should be equally applied internally to SMEs to better support their greater, distributed locations, which similarly require much higher forms of business co-ordination and activity integration.

**III. Research Objectives**

From the literature reviewed, it may be considered that current research tends to consider ERPII, or ERP combined with SCM, as a sequential implementation process with both solutions facing diametrically opposite. First develop your internal transaction processing capabilities using ERP and then tackle the outward facing, supply chain planning problems. What can be seen from such implementations is a typically hurried pace to see positive return on software investments at a detriment to longer-term effectiveness of the employed SME development strategies. Far too often, it is seen that unmeasured ERPII-type implementations fail to deliver their anticipated business benefits, due to not having appropriate building blocks (e.g. item data, bills of material, routings, resources, lead-time and cost data) in place initially. This poor situation can be further compounded when enterprises try to configure and embed new globally-driven,

MTO processes into functionally structured core ERP systems, for which this has been recognised as a long standing problem with generic, off-the-shelf solutions.

Therefore, the primary purpose of this work is to investigate and document aspects of the perception that, in this time of unprecedented global change, ‘Current understandings of ERPII do not adequately address internal SCM requirements of SMEs who operate global business development strategies’. This research study seeks to be timely in terms of the problems it will address and in the way it will reason on the subject of necessary methodologies and technology that can overcome the key problematic aspects SMEs face. The key questions, which this research paper tries to address comprise:

*RQ1:* How are SMEs responding to the challenge of internal supply chain management and control?

*RQ2:* What are current implementation limitations with respect to adoption of ERPII solutions?

**IV. Methodology**

The methodology of this research work is based on a combination model of descriptive research and experimental research through case studies as described by Yin [22]. From the perception proposed earlier, descriptive research in the form of a literature review, industrial survey, and case studies are to be initially utilised to examine the nature and scope of the problem. This can be seen as a valid approach because a clear statement of ‘what is’ is an essential prerequisite to understanding ‘why it is so’ and ‘what it might be’. Since the main thrust of this work is related to the implementation of ERPII-type systems and only they can be implemented in a real-life experimental context this approach seems clearly justified. Figure IV shows a high-level summary of the research methodology employed.

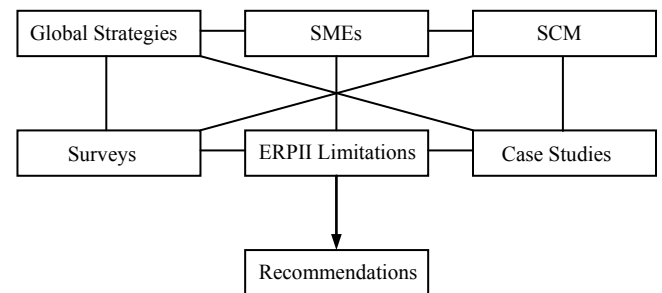


Figure IV. Research Methodology

**Questionnaire Approach**

The aim of the industrial survey was to present work conducted on the applicability and deployment of electronic supply chain tools and techniques within contemporary SMEs to meet global demand. A survey strategy was chosen

at this point of the research as it would assist the authors in two main ways, 1) It would aid the authors, as descriptive research, in attaining a good understanding of the current status or 'what is' of current internal supply chain management and control, and 2) It should lend quantitative support to the work's primary perceptions and rationale. Additionally, it was anticipated that this survey and the further case study work would extend the authors' insights into future enterprise strategy development. As such, a questionnaire based on the literature review, was developed comprising three primary areas: the company demographics or configuration; an assessment of enterprise global development position or 'Reach' as classified by Rhinesmith [23] (National, International, Multinational or Global); and their ERP implementation status, together with identification of internal adoption barriers. From the primary author's leadership of the Advanced Engineering and Manufacturing (AEM) Sector within the Yorkshire and Humberside Region of the UK, 280 sample SMEs were selected for survey and contacted.

### Case Study Design

Case study investigations were undertaken to build upon the initial survey findings and to offer a more detailed and first-hand understanding of the problematic environment. Yin [22] proposes that in studies where there exists a lack of defining theory, limited enquiries can be useful to represent unique cases and provide practical examinations of research questions in more natural settings. It was anticipated that by acquiring knowledge from this direct experience, the authors would be better able to develop informed understandings and to answer the posed research questions in a way more closely aligned to actual business needs rather than being based upon theoretical concepts alone. Through AEM Sector contacts, access was facilitated to 10 independent SMEs who were in the process of implementing various types of ERP and pursuing global MTO development strategies. From this SME group, three were chosen for comprehensive study based on access, willingness to participate, and resource availability. Table 1 summarises their line of business, strategy, development reach, employee size, structure, environment (complexity/uncertainty), growth and competitive risks.

The case study research methodology comprised three phases: 1) Define and Design; 2) Prepare, Collect and Analyse; and, 3) Analyse and Conclude. For all three cases detailed case investigation was carried out to enable a richer level of comprehension of the enterprise processes in which ERP was executed and the benefits or barriers associated with its support of global development strategies. The initial explorations derived data from the earlier questionnaire survey and company archives, such as management reports and internal briefs. Through this process the knowledge acquisition process was enriched and refined. The case studies commenced with initiation meetings between the

researchers and the nominated industrial contacts, at which an executive summary of the survey findings was discussed and a program of subsequent site visits made. On collation of the primary data, formal analysis and documentation was undertaken, with completed reports supplied to the companies for further review and consideration.

Table I. Case Study Enterprise Overview

Case A	Case B	Case C
Equine transportation manufacture	Healthcare product manufacture and marketing	Chemicals manufacture and distribution
Market leadership focus	Business turnover growth	Increased market share
National	National	Multinational
90 employees	70 employees	240 employees
7 locations	3 locations	8 locations
High	High	High
Uncertain	Uncertain	Uncertain
80%	16%	3%
Return on capital and growth management	Legislative compliance and knowledge exploitation	Contractual risk, capability and delivery performance

## V. Results and Findings

### Survey Results

Of the 280 enterprises surveyed, 67 usable responses were received (24%) and comprise selected survey findings. Responding SMEs collectively represented 7 different engineering and manufacturing market segments, with average employee population of 72 employees. Of the survey range, 70% could be classed as primary national in reach, with 18% international, 7.5% multinational and 4.5% truly global. Of the group, a high proportion operated networked structures (79%) with staff located in more than one site and 33% operating in more than one country. The use of company websites was widespread (97%), but only 11 enterprises or 16% of the populations had an integrated e-commerce or payment taking facility built in. The use of Sales Agents (55%) and Regional Sales Offices (42%) demonstrate a potential reluctance of SMEs to invest more in electronic-based sales order management, rather than more traditional face-to-face approaches or contact centres, supported by CRM systems. 17 Enterprises (25%) had distributed manufacturing and warehousing facilities, with a further 4 (6%) having a joint venture agreements. Within the five years prior to the survey 12% of the enterprises had been involved in one or more merger and acquisition activity, with an additional 2 enterprises being able to divest a part of

their business successfully. 48% Of the enterprises surveyed did not have an internal IT department and 9% did not have a dedicated IT resource. Rather, in those enterprises, management responsibility for the IT function generally resided with middle management, who had responsibility for both strategy and day-to-day operation. When considered as a whole, on average the 67 responding SMEs deployed 23 PCs each, this figure equating around one for every three employees. All enterprise management engaged in responding SMEs had a high regard for the business benefits and competitive advantage that can accrue from using ERP based solutions. Of the 67 respondent enterprises, 36 respondents had implemented an ERP solution, typically based upon a re-order point stock control or Material Requirements Planning (MRP) planning engine. Of this small group of SMEs, a further 23 enterprises could be seen to have implemented a solution resembling ERP, or in this case, ERP combined with 2 or more integrated CITS. In such cases, all ERP implementations required additional programming, middleware or the use of other enterprise integration toolsets outside that initially provided by the core advanced business application. System upgrades to the core packages were typically required by responding SMEs every 1 to 2 years. The five main reasons stipulated for implementing ERP:

- 1) To facilitate enterprise business growth.
- 2) To enhance customer services.
- 3) To effectively manage complexity and data integration.
- 4) To achieve a reduction in production costs,
- 5) To provide effective costing and operation decision-making information.

16 out of 23 respondents admitted that they had undertaken no detailed cost / benefit analysis prior to implementation. 13 Stated that they had not sought any professional advice on the selection of software but relied heavily on the reputation of the vendor and its salesmen's performance. Only 9 employed business process analysis techniques to help them to deduce their system requirements. All respondents agreed that resultant implementation of their systems had delivered business benefit and viewed the adopted use of such systems as a crucial step in maintaining successful operation of the enterprise. Late ERP system implementations were generally blamed on a combination of inadequate management commitment, changing business requirements, lack of production data and problems associated with matching system functionality to current enterprise operation. An issue of total cost was a prime consideration driving this decision. It was felt by the majority (75%) of enterprises, that they probably had an inadequate IT capability to effectively select and implement such systems. 100% of projects exceed their original budgets, 89% ran over time and the acceptable implemented period was identified as between 9 and 12 months. With specific

regard to internal supply chain control a range of problem issues were raised, with a selection provided below:

- Costing information cannot be produced per individual manufacturing site with individual overheads rates applied.
- We are limited within the system to one warehouse location and as such we have to use multiple codes, per site for the same production items.
- We do not have system flexibility to schedule manufacturing routing changes easily to balance production between sites for cost improvements.
- It is difficult to include different transportation costs and lead-times for supply to different internal locations.
- We operate differently in each country and one size does not fit all our business processes.
- Within our systems it is very difficult to manage inter-location transfers and appropriate stock valuations. We have to consider each internal site as a customer as this leads to a whole host of administrative problems.
- We would like to provide more system access to our remote users, but networking and client licence costs are prohibitive.

It is evident from the detailed survey results that: (1) ERP-type solutions are now becoming routinely used by a wide range of SMEs operating global; and, (2) SMEs are now deploying highly distributed or networked organisation structures, which have unique system and process requirements. The main problems relate to, technical knowledge, the overall cost, expanded time scales and lack of flexibility (as sufficient change capability is not an inherent property of the contemporary packaged software).

### Case Study Results

Whilst similarities in their overall business operation could be seen, the three study enterprises exhibited varying classes of ERP system adoption, user knowledge and level of implementation resource. All the enterprises selected product specification, customer service, flexibility and quality, not necessarily pure cost, as the key order winning factors. Whilst Enterprises B and C had in employ experienced and dedicated IT professionals, Enterprise A had enlisted the assistance of external consultants and had embarked upon UK Government schemes. Despite the wealth of knowledge contained with these personnel and schemes, all three case study enterprises were found to experience real problems in achieving a high degree of fit between MTO/globally development strategies and standard ERP-type system functionality. In particular the SMEs further highlighted:

- System support for production data input, capture, integration, scheduling and performance reporting.
- Inter-organisation costing and accurate inventory valuation.

- Degree of fit to ETO and global business processes.
- Lack of support for efficient estimation, quotation, product configuration and what-if analysis.
- Level and expense of skilled personnel requirement to operate deployed IT solutions effectively.
- Multi-site system operation, networking costs and remote access security.
- Systems integration, performance, data latency and availability (due to record locking associated with batch processing such as finance, MRP, backups).
- Data proliferation and archiving.
- High installation, modification and upgrade costs.

## VI. Conclusions and Recommendations

This work has deliberately covered much ground and its main thrust of developing improved understandings of these evolving areas are largely in their infancy at this stage. From the initial research conducted within this study, it is clear to the author's that much further practical work is required to focus back on the internal working of SMEs with high regard to their rapidly changing organisational structures and ever more complex market dynamics. As enterprise strategies respond to ever more global market opportunities, it is becoming more apparent that those SMEs who hold an improved internal systems foundation and derived business intelligence, will be better placed to achieve success in the contemporary business goals of quality, speed and price. As towards further directions for this area of research the following recommendations are made:

- Conduct wider and deeper primary research into the scope and extent of the perceived industrial problems.
- Further decompose recorded ERPII limitations and barriers, to develop impact ranking and risk factors.
- Investigate the use of appropriate enterprise engineering concepts to model, classify and construct potential pilot solutions.

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