Production Planning through Customized ERP at a Nordic Manufacturing Company

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The enterprise resource planning (ERP) solutions that gained acceptance in industries world over as they represent a proven, comprehensive, software backbone for achieving excellence in key business areas, have moved forward today to higher levels of innovation and technologies. The management of procurement, manufacturing, product development, finance, sales and service with various ERP modules together with complexities of operations across corporate boundaries and intense global competition have all resulted in a continuing ERP discourse developed in relation to both theory and practice. This paper aims to contribute an empirical study and explore the vital process of production planning in a customized ERP environment. In doing so, it takes a qualitative methodology in the form of the case of a Nordic (Northern European) log house manufacturing company. The favourable ERP implementation in the company tends to justify the customizing of applications at early phase instead of adopting the standard ERP package despite the wide scope of the standard packages. The research findings insinuate preference for customized ERP over standard ERP package for enabling effective generation of production plans.

Key words: ERP system, production planning, MTO, Nordic, supply chain

Introduction

The enterprise resource planning (ERP) systems are developed to provide the information backbone needed to support business decisions and execute the operations. ERP is a software system that integrates application programs in manufacturing, logistics, sales and marketing, finance, human resources and the other functions in a firm (Madapusi and D'Souza 2005; Kim 2009; Vollmann, Berry, Whybark and Jacobs 2010). The ERP systems have evolved from the original material requirements planning (MRP) philosophy to a huge industry today with dedicated professionals and service providers. In fact, the pressure to survive in the new world order and align with

the new paradigm for organizational success has driven the organizations towards adopting integrative approaches like ERP. The ERP system consists of various modules used to perform specific business activities such as production planning, materials management, finance, sales and so on. The integrated modules address all the data requirements of the enterprise and help to improve management of business processes. Individually, each module is designed to perform some specific tasks. For example, the vital production planning module is designed to plan the production phase of a product, such as the type of product and the quantity to be produced on the basis of demand. This module also maintains the master data – bill of materials, routings and work centres. Moreover, it helps plan business activities at various stages such as sales and operations planning and long-term planning. Production planning enables the planner to create feasible production plans across the different production locations to fulfil the demand in time and to the expectations of the customer. Solvers, real-time data and high supply chain visibility support the planner's decision-making process.

Considering the scale of ERP projects as well as the possibility for both large successes and failures, ERP implementation has a significant and measurable effect on day-to-day business operations and decision-making (Somers and Nelson 2004; Parry and Graves 2008). Evidence suggests that ERP implementation success has varied with the industry characteristic viz. make-to-stock (MTS), assemble-to-order (ATO), make-to-order (MTO) or engineer to order (ETO). Babu (1999) argues that the ERP systems have been founded for MTS businesses that are in a repetitive batch manufacturing environment or for large companies. Recently, ERP vendors have attempted to assuage this criticism by developing industry-specific solutions that take cognizance of a particular environment. Nevertheless, companies have to be wary about the appropriate ERP system strategy and selection. The increasing pressure today to transform the businesses from make-to-forecast (MTF) operations to short lead time, make-to-order (MTO) production implies that there is a need for emphasis on greater flexibility and minimal stocks throughout the manufacturing process. The uncertainty of routings processing times, added to that associated with customer orders, has made production planning complex and challenging. The information system has to provide realistic plans and reliable tracking of customer order status while serving as an integrated model encompassing the engineering design, marketing, planning and supply chain processes. The off-the-shelf standard packages together with other options have pros and

cons with regard to cost, compatibility, implementation time, skills and security. As companies realize that the management decisions regarding acquiring packages are crucial for achieving competitive advantage, ERP software selection is typically channelled through three stages: initial selection, candidate evaluation and final evaluation (Bernroider and Koch 2001; Lall and Teyarachakul 2006). The basic selection stage is a filtering stage, while the candidate listing is intended to reduce to a smaller set depending on ranking models. The final stage is based on several sets of criteria such as ERP system attributes that can enable the organization to meet the business needs, software provider profile, complexity and cost of implementation. Although the standard package is in general provisos, it is still the point of departure for many companies. Particularly, the vital production planning module is implemented to comply with the standard form despite the context and multiplicity of production elements of specific nature. It is known that the effective production planning operation at nucleus has the capability to exploit the full potential of any manufacturing process and therefore customized ERP can find preference over standard package in companies. Consequently, it is worthwhile to explore the customized ERP preference empirically and hence the central research question:

Why can customized ERP be preferable to the standard ERP package for enabling effective generation of production plans?

This paper explores the production planning in a customized ERP environment at a log house manufacturing company in Northern Europe. It draws on case study research methodology to comprehend the situation at the plant. The ERP implementation was initiated in this company in a rather turbulent environment and necessitated software system solutions capable of underpinning the business operations from financial to sales order processing and production. The observations and data collection were feasible at the case company, and hence the choice to explore the phenomenon over time.

Research Methodology

The case study research methodology was utilized as an empirical inquiry to investigate within the real-life, Nordic manufacturing context. According to Eisenhardt (1989), case studies are suitable for understanding the dynamics within a single setting. The profound link between the collected data and phenomenon under study as well as the richness of the data allow a consideration of context-specific factors, complex patterns and even causal relationships. In order to tap the theory that is deeply grounded in empirical reality, the qualita-

tive approach was largely adopted for collecting, organizing and analyzing data. The goal was to explore the situation that, as regarded by Glaser and Strauss (1967), is the observation of a phenomenon in its raw form. Thus, the intent of extending the understanding of the phenomenon and building on the ideas of empirical research would rather classify this case as an exploratory qualitative case study with embedded units of analysis. However, to retain the methodological rigour with which the case is constructed (Yin 2003; Yin 2009), the tenets of descriptive and explanatory variants were also considered in alignment with the three characteristics of the exploratory process listed by Berger et al. (2005) as conceptual pre-understanding, systematization plus case research and refinement. The central question – Why can customized ERP be preferable to the standard ERP package for enabling effective generation of production plans? – was addressed through and derived from mostly unstructured interviews with company managers as well as direct observations and company data. The interviewees were encouraged to freely respond and contribute to the topic so as to identify complex behaviours and prevent restricting the field of investigation. Although this approach triggered the general limitations of external validity, valuable insights could be gained.

Case Background

The company KPT Nordic, referred to thus in the paper to maintain confidentiality, is a major Nordic (Northern European) log house manufacturing company. It is part of the PQR forest group having construction material industries and prefabricated housing as the lines of business. KPT Nordic utilizes the close grained northern wood and sophisticated manufacturing technology to satisfy the needs of high quality construction for ecological and healthy living. The quest for improving the health standards and life style, equally for all people, is a typical characteristic of the Nordic countries that are reputed as advanced industrial economies with sustainable development. KPT follows policies of corporate responsibility and conservation of the environment. The constructional solutions and patents developed by KPT have contributed to the development of this sector all over the world. The annual production at KPT is about 1800 log buildings and the products are sold to more than 15 countries. The maximum customer orders are received during the first quarter of the year with deliveries in summer. The demand is much lower during the winter. The production strategy prevalent in the company for many years was make-to-forecast with stocks

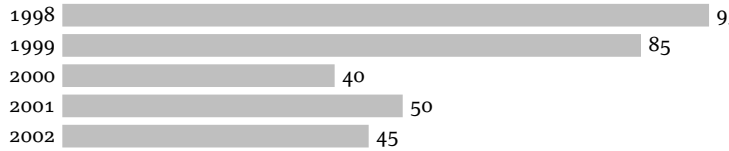

FIGURE 1 KPT Nordic Annual Turnover (USD million, 1998–2002)

essentially built at several locations. Moreover, there was an understanding with the suppliers and high service levels were assured.

In the early 2000s, KPT Nordic started facing increased competition, cash flow problems, very demanding customers and unreliable information systems. Figure 1 indicates the declining turnover and spiralling stocks. This was attributed to the turbulent environment, new market players and emergence of make-to-order environment. Initially, the marketing attempt was to lower the prices in order to increase the sales and accept significantly decreased profit margins. However, the financial analysis indicated that this strategy would not be sustained over the long-term.

The make-to-forecast treatment led to increased locked investments in inventory. The production process was driven by levels of stock rather than by customer orders and focus leaned towards efficiency and economies of scale. This was linked in Nordic to higher capacity utilization and three shift operations during summer, absorbing the labour cost variances. MTF implied that the specifications were similar and inventory transitions were under stable conditions. However, the emergence of an MTO environment directed KPT towards difficult to predict customer requirements and specifications.

Research shows that the move to make-to-order systems necessitates new manufacturing strategies to manage the variability of customer orders (Bish, Muriel and Biller 2005). The information system has to become a tool for engineering in addition to a realistic production planning function (Becker, Dreiling, Holten and Ribbert 2003; Persona, Reattieri and Romano 2004). However, since the specification details are phased, the planning becomes less accurate, causing the operations schedule to be revised frequently during the manufacturing. Moreover, the finite nature of the manufacturing resources creates inevitable conflicts of delivery priorities that are made even more difficult by delays in delivery of materials and components, maintenance problems, absenteeism, and so on. This comprehends the evolution of supply chain philosophy, customer driven with performance metrics of customer satisfaction and value addi-

tion (Aitken, Childerhouse, Christopher and Towill 2005; Günther and Meyr 2009). Evolving a supply chain from the forecast-driven model to the demand-make-to-order model requires a total change of mindset about how information is shared in the supply chain. The information flow up and down the supply chain is complicated further if each link runs its own specialist IT system.

At KPT Nordic, the design and manufacturing planning was accorded with the customer requirements after the receipt of customer order. The traditional customers agreed with the quoted lead times and the company kept its promises. However, attracting new customers in the dynamic market posed serious difficulties and the company lost several opportunities. In the same year, the management board recommended significant changes including direct investments in advanced information systems, customer-driven planning and introduction of flexible production facilities. Soon KPT Nordic had to make significant changes in the production planning model and initiate ERP implementation in this scenario.

Case Research Findings

KPT Nordic develops a business plan for the year that they describe as the 'charted' plan. This is a comprehensive document including strategic goals, budget statements, sales plan, inventory holdings, work force stability, production rates and customer service. This document is reviewed at least twice or more during the year, depending on the market situation. These details can be retrieved from the information system for perusal and statistical analysis. The executive sales and operations plan is developed by limiting the planning horizon. This is not a forecast, but the basis on which the manufacturing activities are accomplished. The production is more in the first six months, and the same is indicated in figure 2 that shows the sales distribution of one type of building product sold by the company. Some vendor items can be stocked, such as doors and certain panels, and generally the capacity inputs for the second quarter are thus balanced.

The short term plan can be constrained by available material supplies, raw materials and parts in addition to other resources. This assessment is possible through shop status and material plans. The planners adopt the planning strategies with the management board approval. The two different strategies of chase and level are commonly the starting points. A chase strategy matches demand during the planning horizon by varying either the work-force level or the output rate, whereas a level strategy maintains either a constant

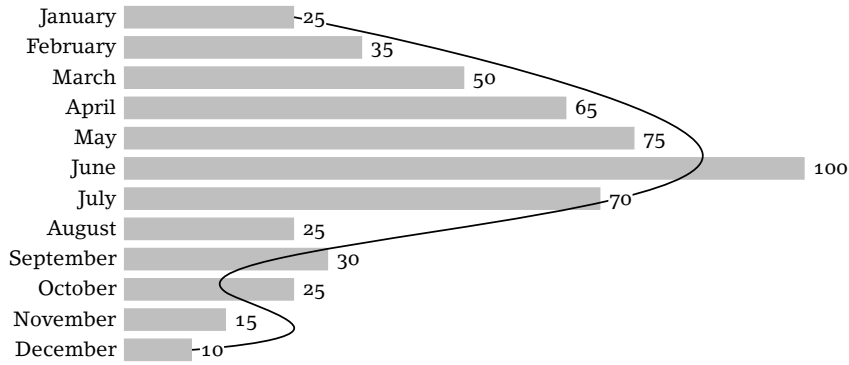

FIGURE 2 Monthly Sales Trend at KPT

work-force level or constant output rate. However, there are several considerations such as overtime, stock accumulation, resource utilization and backorders and hence, the company applies a mixed strategy that implements a range of reactive alternatives and goes beyond pure chase or pure level strategy.

The make-to-order approach introduced change at KPT Nordic with order promising based on backlog and estimates for the design and supply chain network. The production planning and marketing interactions became crucial for determining quotations. The manufacturing was attempting to achieve reliability in delivery with optimal utilization of resources, but this largely depended on the feasibility of plans and scheduling decisions. Figure 3 shows the production planning interactions in MTO at KPT Nordic; the inclusion of engineering design is a specific feature.

The master production scheduling (MPS) provides the statement of the particular products that make up the output. The MPS specifies how the product will be supplied to meet the future demand and takes into account the capacity constraints and production costs. The planners at KPT Nordic find that sometimes there is an overlap of marketing, design and planning activities, and MPS becomes complicated. Moreover, the scheduling process for implementing MPS faces the variability of job routings, work line constraints and priorities. The human schedulers have attempted to determine the shop floor schedules by utilizing loaded Gantt charts as the possible viable approach that considers due date changes and releases. They believe that, along with the shop floor tasks, the vendor coordination plays a significant role in the manufacturing dynamics. Consequently, the vendor negotiations have been extensive with regard to updating

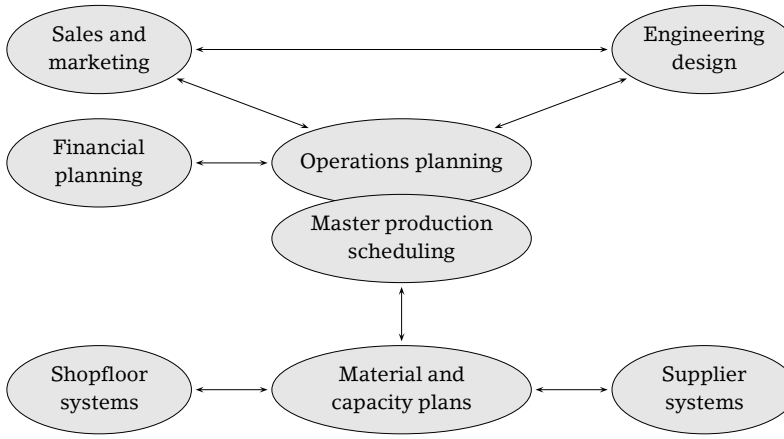

FIGURE 3 Production Planning System Supporting MTO Environment

the vendor with relative priority data, degree of changes that can be made and follow-up procedures. The time hierarchies for weekly and monthly feedbacks are organized by the production planners.

Clearly, all these production planning modifications have to be supported, and the ERP implementation at KPT Nordic aimed to bring ease and sophistication in the whole process by providing timely and accurate information in all aspects of business. The decision about selecting the ERP package was the first significant step at KPT Nordic, with several software providers competing to promote their software solutions. KPT Nordic selected a reputed package and embarked on the demonstrations, compatibility testing and hardware requirements as the initial phase of ERP implementation. However, some board members and the project managers raised several issues. The package was too big and comprised features different than those needed for KPT. The relevant interfaces were missing. The software providers had industry solution sets for most industry sectors based on their acknowledged talents and in-depth knowledge of the processes driving the businesses, however, the providers did not possess the state-of-the-art industry solution for the forest industry construction material and the log house sector in which KPT operated. The reason was that this sector was a comparatively small, niche market, perceived to be developing steadily with limited lucrative opportunities for large IT companies. The ERP package marketed by the providers had extensive scope but lacked the relevance to the business processes of KPT Nordic. Moreover, the supply chain links would need modifications and network verifications. One man-

ager even reported that the direct implementation of this ERP package had failed in the competitor company. Therefore, the implementation team had two options, either to push forward and substitute the business processes of the company for the package processes as much as possible, or to customize the applications for KPT. This implied a careful consideration of current and anticipated needs. As in modern ERP systems that endeavour to create a seamless, integrated information flow from suppliers, through manufacturing and distribution (Davenport 1998; Davenport and Brooks 2004; Kuhn and Sutton 2010), the core included applications in financials, sales, distribution, manufacturing, and operations management. In addition, the company attempted to link special modules with standard modules, creating customized software, tailoring applications for specific needs.

There is some evidence that customization can increase the cost of ERP implementation and cause difficulties for upgrading (Helo, Anussornnitisarn and Phusavat 2008). Also, adequate resources must exist internally or externally for successful customization, with less customization resulting in reduced implementation time. At KPT Nordic, the management board invited consultants for mapping the scenario accurately and to provide recommendations. After a systematic investigation, the consultants favoured the customization decision and suggested that the benefits would be substantial and costs would be justified, falling lower than those of adapting to the broad, standard ERP package. It was further suggested that the MTO environment needs a customer order driven framework and developing production planning approaches specifically for MTO production is crucial. The traditional systems utilize bill of materials (BOM) and routing to support production planning and control, but in MTO the multi-level and multiple line items on an order have to be linked and the data structure has to possess this capability. The customized system at KPT Nordic incorporates configuration tools that can model during the feasibility and estimation phase and then translate the confirmed orders into releases. The product tool automatically generates the BOM, but a manual modification scheme is also available. The master production scheduling is integrated to take into account the front end and material and capacity plans. Thus, realistic delivery promises are possible and the settings can be monitored. This is of particular significance for the company in the current market conditions. The scheduling process at KPT involves the parameters such as promised date, customer credit and management priorities. Hence, the decision support is provided

by the optimal scheduling function that suggests the formulations. The planners utilize the advanced scheduling module of the customized package. This is basically a finite loading mechanism with forward and backward scheduling features. Also, there are advanced project planning tools, Gantt charts, graphics, risk analysis, and performance measurement metrics. The back scheduling starts with scheduling jobs backward from their due dates, whereas forward scheduling starts with the current date scheduling into the future. The adhoc mills order combining is possible by transferring to excel sheets from the planning module. The scheduling establishes detailed work centre schedules with feasible time for shop floor operations. The work centre's actual output can deviate from the planned output and backlogs have to be controlled. The release of excessive orders to a work centre has to be limited but, at the same time, the priorities have to be included. So, the running system schedules are followed and decision making is related in the short term. It applies to KPT manufacturing that, just as capacity planning with sufficient capacity and level loading simplifies shop floor control, so too the vendor support and vendor capacity factors can decrease the overall costs with mutual benefits. The collaborative manufacturing applications enable sharing information with vendors in order to increase responsiveness. The next step is to achieve interfirm integration by internet links, that is, e-based systems. Collaboration is then the ability to electronically share information and interact on a real time basis across the network. This is dependent upon trust and contractual obligations with the suppliers, since some suppliers also supply their products to competitor companies. The inventory settings require joint planning and visibility across the supply chain, and some features of the customized ERP in this regard are operational at KPT Nordic, but there are further opportunities to achieve continuous information flow and manage the material and capacity constraints. The customized system is based on the company working patterns, and hence the planners could relate their formats during implementation. The noticeable benefits were better methods for planning and recording of shop orders, streamlining of processes, high level of integration, cost control, improved management reports and capability to support the company's strategic requirements. The core members at KPT Nordic ensured intensive training for the users, and this is as such an ongoing requirement.

Conclusion and Future Challenges

The study aimed to explore the preference for customized ERP in the Nordic log house manufacturing context. In doing so, the complex-

ities of the vital production planning process in the changing business scenario, specificities of the forest industry sector and shortcomings of standard ERP packages were probed as part of a qualitative research. The findings from the case research suggest that customized ERP was imperative at KPT Nordic for effective generation of production plans and building a customer-focused business model. The changes introduced with the MTO approach had to be incorporated together with the assured supply chain visibility toward e-based systems and future collaborative commerce (c-commerce). The adherence to standard packages could be a virtue for companies seeking a proven structure, and particularly where the standard package provides a set industry-specific solution. However, for KPT Nordic log house manufacturing, the available standard package did not really possess a set, established solution. In fact, the standard ERP package was too large and packed with rather irrelevant features that might put the organization at the risk of turmoil with significant resistance from production planners and key users. On the other hand, the customized ERP enabled special tools, such as the configuration tools, and made the processes responsive in accordance to the market conditions. Thus, customized ERP proved a better option at KPT Nordic, although significant future challenges do exist. Some issues persist despite streamlining operations and increasing preparedness for collaborative planning through the customized ERP system.

The first problem is retaining the ERP trained employees and hiring more qualified people. The aging human resources and in particular the senior production planners, who would retire in the next few years, is of significant concern. The company is ready to impart training on customized modules for qualified and motivated planners but there is a lack of candidates for the plant sites. The young, talented individuals with techno-commercial skills are in demand and, as such, these people aspire to the more lucrative high technology sector instead of the forest industry sector. Furthermore, the union agreements have a bearing on the hiring practices, apart from the fear of losing information technology (IT) edge to competitors.

The second problem is inventory management; there are several inventory locations and traceability has become difficult. In fact, the reduction in inventory locations is envisaged but the management decision is pending. The implicit reasoning is that the stocks of redundant but expensive log profiles cannot be reduced immediately. Another aspect is that double checking has been undertaken in some locations for absolute ERP materials management data reliability, and there is already a proposal for applying RFID technolo-

gies. The automatic identification technologies would directly input data to information systems. The information such as physical location, quantity and transportation status would be captured into the systems with little human intervention. The network interrogators could be arranged so that the inventory is tracked automatically.

Even though the production planning has been largely effective by customized ERP system implementation, KPT Nordic has to move ahead towards e-business alliances and emerging markets. The company has to make efforts to attract excellent human resources and to take the future decisions carefully in the uncertain market conditions.

References

Aitken, A., P. Childerhouse, M. Christopher, and D. Towill. 2005. 'Designing and Managing Multiple Pipelines.' *Journal of Business Logistics* 26 (2): 73–96.

Babu, S. 1999. 'Strategies for Enhancing Agility of Make-to-Order Manufacturing Systems.' *International Journal of Agile Management Systems* 1 (1): 23–29.

Becker, J., A. Dreiling, R. Holten, and M. Ribbert. 2003. 'Specifying Information Systems for Business Process Integration: A Management Perspective.' *Information Systems and eBusiness Management* 1 (3): 231–263.

Berger, C., K. Möslein, F. Piller, and R. Reichwald. 2005. 'Co-Designing Modes of Cooperation at the Customer Interface: Learning from Exploratory Research.' *European Management Review* 2 (1): 70–87.

Bernroider, E., and S. Koch. 2001. 'ERP Selection Process in Midsized and Large Organizations.' *Business Process Management Journal* 7 (3): 251–257.

Bish, E. K., A. Muriel, and S. Biller. 2005. 'Managing Flexible Capacity in a Make-to-Order Environment.' *Management Science* 51 (2): 167–180.

Davenport, T. H. 1998. 'Putting the Enterprise into the Enterprise System.' *Harvard Business Review* 76 (4): 121–131.

Davenport, T. H., and J. D. Brooks. 2004. 'Enterprise Systems and the Supply Chain.' *Journal of Enterprise Information Management* 17 (1): 8–19.

Eisenhardt, K. M. 1989. 'Building Theories from Case Study Research.' *Academy of Management Review* 14 (4): 532–550.

Glaser, B. G., and A. L. Strauss. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research.* New York: De Gruyter.

Günther, H., and H. Meyr. 2009. 'Supply Chain Planning and Advanced Planning Systems.' OR *Spectrum* 31 (1): 1–3.

Helo, P., P. Anussornnitisarn, and K. Phusavat. 2008. 'Expectation and Reality in ERP Implementation: Consultant and Solution Provider Perspective.' *Industrial Management and Data Systems* 108 (8): 1045–1059.

Kim, J. 2009. 'Activity-Based Framework for Cost Savings through the Implementation of an ERP System.' *International Journal of Production Research* 47 (7): 1913–1929.

Kuhn, J., and S. G. Sutton. 2010. 'Continuous Auditing in ERP System Environments: The Current State and Future Directions.' *Journal of Information Systems* 24 (1): 91–112.

Lall, V., and S. Teyarachakul. 2006. 'Enterprise Resource Planning System Selection: A DEA Approach.' *The Journal of Computer Information Systems* 47 (1): 123–127.

Madapusi, A., and D. D'Souza. 2005. 'Aligning ERP Systems with International Strategies.' *Information Systems Management* 22 (1): 7–17.

Parry, G., and A. Graves. 2008. 'The Importance of Knowledge Management for ERP Systems.' *International Journal of Logistics: Research and Applications* 11 (6): 427–441.

Persona, A., A. Regattieri, and P. Romano. 2004. 'An Integrated Reference Model for Production Planning and Control in SMEs.' *Journal of Manufacturing Technology Management* 15 (7): 626–640.

Somers, T. M., and K. G. Nelson. 2004. 'A Taxonomy of Players and Activities across the ERP Project Life Cycle.' *Information and Management* 41 (3): 257–278.

Vollmann, T. E., W. L. Berry, D. Whybark, and F. Jacobs. 2010. *Manufacturing Planning and Control Systems for Supply Chain Management.* 6th ed. New York: McGraw-Hill.

Yin, R. K. 2003. *Case Study Research: Design and Methods.* 3rd ed. Newbury Park, CA: Sage.

———. 2009. *Case Study Research: Design and Methods.* 4th ed. Newbury Park, CA: Sage.