

The Role of Information Technology in the Lean Enterprise

ABSTRACT

What happens when the Lean Production System and Enterprise Resource Planning Systems meet within the same organization? Enterprise Resource Planning systems, the leading use of information technologies in the business sector, now represent a cumulative multi-billion dollar investment built on thirty years experience with Manufacturing Resource Planning, adding extensions for supply-chain management and capacity constraints, and are commonly recognized as a key enabling technology for “World-Class Companies”. Likewise, the Lean Production System, with only a decade of worldwide exposure, has become recognized as a leading enabler of “World Class Competitors”. One cannot do a web search for Lean without finding dozens of consulting firms offering to guide companies through an implementation. As is often the case when companies retool their operations to gain a competitive advantage, dual implementations of Lean and ERP, rather than the implementation of a single system, has become a practical reality.

“Lean vs ERP” (Bartholomew, 1999) introduces the likely negative interactions and incompatibilities between the Lean Production System and Enterprise Resource Planning Systems. “Advanced Planning Systems as an Enabler of Lean Manufacturing” (Liker, 1999) provides a case in favor of dual implementation by focusing on advanced planning systems such as ERP in a secondary, subservient role to the Lean Production System. “Does ERP Fit in a LEAN World?” (Bradford, Mayfield, Toney, 2001) discusses emerging trends in software that as ERP solution vendors begin to provide tools targeting their perception of the needs of the Lean Enterprise.

INTRODUCTION

Both the Lean Production System (Lean) and Enterprise Resource Planning (ERP) systems have gained common recognition as enablers of “World-Class” production operations in academic and trade journals, and in corporate boardrooms. Many companies have undertaken the implementation of either one or both of these in the quest for sustainable competitive advantage. However, it appears that little if any academic attention has been paid to the potential positive and negative interactions between Lean and ERP in a dual-implementation scenario. The more common focus of the academic studies of Lean are identifying and classifying the various elements of Lean production, providing heuristics to aid in the

implementation of these various elements, the development of practical metrics for the Lean Enterprise, and point-solution information technology strategies such as the use of simulation to test line balancing. The academic studies of ERP seem to focus on optimizing scheduling algorithms, improving supply-chain management, and building cases in support of ERP systems. The lack of academic crossover studies serves to underscore the major differences in the philosophical underpinnings of the two systems, with Lean's heavy reliance on flow and simple visual signals to schedule workflow through the shop, and ERP's demands of tight control, detailed transactions for all operations and materials movements, forecasting, central planning, and push scheduling of all production activities.

In reading "Lean vs ERP" (Bartholomew, 1999), I expect to learn of the major systems disconnects that can present problems during a dual implementation or when implementing one system after the other is in place. "Advanced Planning Systems as an Enabler of Lean Manufacturing" (Liker, 1999) is expected to provide information on using the capabilities of an ERP system to enhance the performance of a Lean Enterprise. Finally, "Does ERP Fit in a LEAN World" (Bradford, Mayfield, Toney, 2001) is expected to provide information of current industry trends as ERP systems vendors' adapt their products to meet the needs of the Lean Enterprise.

Article 1: Lean vs ERP

"Lean vs ERP" (Bartholomew, 1999) provides a cautionary introduction of the interactions between Lean Production and Enterprise Resource Planning. The tone of the article is clearly stated when the author quotes Stephen McMahon, director of the lean-manufacturing business unit at Coleman Consulting Group in San Francisco, California:

"To do both ERP and lean jeopardizes the success rate of either."

This is clearly an "all or nothing" approach that, as noted earlier, will not always be the real-world experience of Lean practitioners in their business lives. The article does provide a very clear, although somewhat superficial, contrast of the approaches of ERP and Lean to developing and executing a production plan. This information has been summarized in table 1 following. Three items were especially note-worthy in this article, the first two dealing with transaction processing in support of manufacturing operations. The first point seems highly unlikely to those who have spent years attempting to perfect the systems that track manufacturing activities,

and is best summarized by the quote in the article attributed to Stacy Alexander, process manager at Greencastle Metal Works Inc. in Chambersburg, Pennsylvania:

“If you have your process correct, there’s nothing to track—it’s moving too fast.”

This is clearly at odds with the ERP tradition of detailed production transactions used to monitor the execution of the master schedule by the production system. The second point is that the transactions that are required in Lean are not just quantitatively different from those under ERP, but qualitatively different as well. The author punctuates this point with a quote from Karin Bursa, vice president of marketing at American Software in Atlanta, Georgia:

”We found it necessary to develop a complete flow-oriented application because the transactions were so different. For instance, our product supports kanbans so that triggers for a kanban go from the line to the suppliers automatically.”

In other words, the carefully planned orders and timed releases of ERP are replaced with signal kanbans implemented using the information technology infrastructure in a support role rather than as a command and control system. The final point worth special mention in this article is that in the case of a dual implementation, if given the choice of which to implement first the selection should be Lean. This is because ERP tends to codify sub-optimal processes rather than create process improvements whereas Lean focuses first and foremost on perfecting the process. Also, implementing Lean first will avoid setting up and maintaining costly and wasteful shop-floor transaction systems that serve mainly to keep the push-scheduling engine at the core of ERP fed with data.

The ideal is rarely approximated in reality, so it is likely that Lean practitioners will encounter an ERP system at some point in their careers. This is especially likely given the deployment head start of twenty years enjoyed by such ERP systems over Lean. I recommend this article as basic background preparation for this eventuality.

Table 1. A Comparison of Planning and Execution Schemes Between ERP and Lean		
Planning and Execution Item	ERP	Lean
Process Focus	<ul style="list-style-type: none"> • Planning and Execution Control 	<ul style="list-style-type: none"> • Continuous Improvement and Flow
Production Volume	<ul style="list-style-type: none"> • Sales Forecasts 	<ul style="list-style-type: none"> • Customer Demand (Pull)
Execution Tracking	<ul style="list-style-type: none"> • Transaction and data intensive • Focus on tracking all material movements and process operations 	<ul style="list-style-type: none"> • Simply visual cues • Focus on maintaining flow • Action Oriented
Implementation	<ul style="list-style-type: none"> • Top-down 	<ul style="list-style-type: none"> • Bottom-up

Article 2: Advanced Planning Systems as an Enabler of Lean Manufacturing

“Advanced Planning Systems as an Enabler of Lean Manufacturing” (Liker, 1999) provides some interesting thoughts on what to do with an ERP system to enhance the capabilities of Lean. There are core capabilities built into even those ERP systems not specifically designed for the Lean Enterprise that can be harnessed rather than simply discarding the system as scrap. These include calculations to rebalance the entire production line when takt time changes due to swings in customer demand, the calculation of takt time for mixed product assembly lines with variable routings and non-uniform work-hours, calculating kanban sizes (reorder points) and number of kanbans to stock (inventory levels) for supermarkets supporting multiple product families fed by operations with non-uniform arrivals, and schedule leveling to smooth fluctuations in customer demand as seen by the production area with the leveled schedule output to a heijunka box as the interface between ERP (planning) and Lean (plan execution).

The shortest of the three articles reviewed, “Advanced Planning Systems as an Enabler of Lean Manufacturing” (Liker, 1999) proved to be a quick and easy read packed with value. It serves to remind us that there is much planning that takes place throughout the value stream

even in the Lean Enterprise, and to highlight ways in which even the most dated ERP system can be used to facilitate that planning while the simple visual cues of Lean Production are left alone to take care of the plan's execution. This is highly recommended reading for Lean practitioners who find themselves in organizations attempting the dual implementation of Lean and ERP.

Article 3: Does ERP Fit in a LEAN World

Does ERP Fit in a LEAN World” (Bradford, et. al, 2001) provides the results of a series of interviews with directors of product management at leading ERP software companies exploring the product adaptations in place, or planned, to specifically support the Lean Enterprise. These interviews focused on two major areas of capability, both subdivided into two subcategories. The interview survey results are presented in table form and reproduced as tables 2 and following.

The areas of capability and subcategories and some of the criterion used to represent the needs of the Lean Enterprise are:

- Planning
 - Material Planning – ability to disconnect push scheduling and implement pull (not explicitly used in the table), support of kanbans (not explicitly used in the table), the ability to incorporate demand forecasts with uncertainties (flex bounds) to develop materials plans, and the ability to use multiple sets of uncertainties in developing the plan
 - Capacity Planning - support of kanbans (not explicitly used in the table), the ability to incorporate demand forecasts with uncertainties (flex bounds) to develop materials plans, and the ability to use multiple sets of uncertainties in developing the plan
 - Line Design Tools – given a passing mention in the article and excluded from the table
- Supply Chain
 - Distribution - ability to configure the product as scheduler for distributors (plan communication)

- Suppliers - traffic pattern analysis to enable adjustment of order sizes (kanban quantities) and timing (number of kanbans), on demand point-of-sale to purchased parts explosion to enable sharing pull data with vendors, the ability to provide demand forecasts to suppliers to enable their efforts to plan capacity and forecast takt time changes

While the approach of asking ERP vendors what capabilities they perceive as representing the needs of Lean is a valid method of assessing product capability, directly surveying Lean practitioners to assess their needs would have added value to this article. This would have provided the basis for a gap analysis testing the hypothesis that ERP software provides the needed tools for the Lean Enterprise. Lacking this type of analysis, this article provides a brief overview of the state of ERP systems as they respond to global trends toward Lean Production. The article does provide the Lean practitioner some useful background information on a variety of ERP packages that have attempted to adapt to Lean that can be useful if serving on a cross-functional team tasked with making a selection of an ERP package to support a dual implementation. Although the coverage of the topic is incomplete, I recommend this article as general information reading to keep the Lean practitioner up to speed on ERP since dual implementations are likely to be encountered.

Table 2. ERP Software as Assessed against the Perceived Needs of the Lean Enterprise (from Bradford, et. al, 2001)

	DANBARD (NOW NAVISION)	DEMAND MANAGEMENT, INC	FOURTH SHIFT	AMERICAN SOFTWARE	I2	IFS	INFINIUM	JD EDWARDS	MACOLA	MADE2MANAGE	ORACLE	PEOPLE SOFT	SAP	QAD
PLANNING														
Material Planning														
Does product have capability of using range of values (flex bounds) for a given product family or end item to develop material plans?	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Does product have capability to project material plans around several boundaries as projected further out into the future?	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Capacity Planning														
Does product have capability of using range of values (flex bounds) for a given product family or end item to develop capacity plans?	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Does product have capability of planning number of orders to be placed in a given time period for product/part family using flex fences?	*	*	*	*	*	*	*	*	*	*	*	*	*	*
SUPPLY CHAIN														
Distribution														
Can product be configured to act as scheduler for distribution?	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Suppliers														
Does product have capability of analyzing incoming/outgoing traffic patterns to evaluate reducing quantities received from suppliers and sent to customers?	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Does product explode demand data into bill of materials to share point-of-sale data with suppliers?	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Does product provide forecasts for suppliers?	*	*	*	*	*	*	*	*	*	*	*	*	*	*

INCORPORATION

The Lean Production System is action oriented and focused on supplying customer demand. It is not a fully integrated set of business applications like ERP. Even in Lean Enterprise functions that support product like planning, accounting, payroll, and employee relations management must take place. ERP supports these disparate functions within a single framework of applications and data warehouses. For this reason, despite the warnings voiced by experts (Bartholomew, 1999) about the likelihood of negative synergies, the dual implementation of Lean and ERP is likely to be the rule rather than the exception. In light of this, novel solutions (Liker, 1999) are quite likely to emerge from practical experience that allow a newly Lean operation to continue extracting value from an existing ERP system (or one that the corporate home office imposes), rather simply abandoning the sizable amount of money and effort that the planning system represents to the organization. It is comforting to see that ERP vendors have begun to acknowledge that the data needs of the Lean Enterprise are qualitatively different than those of the traditional manufacturing companies even though it appears that much of the support for Lean in ERP packages is limited to the ability to turn off push schedules, size kanbans, and implement signal kanbans (Bradford, et. al, 2001). It is, however, disappointing to find a lack of evidence of academic interest in the effects of such a dual implementation scenario. Such balanced academic studies could prove invaluable to ERP system vendors who may truly desire to support Lean to the fullest.

As a member of a cross functional team within a Lean Enterprise that has been tasked with recommending a disposition for an existing ERP system, I will find the information contained in “Advanced Planning Systems as an Enabler of Lean Manufacturing” (Liker, 1999) to be an invaluable starting point. As the organization’s data is very likely to be tightly bound to the existing application portfolio, simply scrapping the ERP system may amount to “throwing the baby out with the bathwater.” If the push scheduling modules can simply be disconnected, or reconfigured to only schedule the bottleneck, then the existing functionality that is not inconsistent with Lean may be preserved intact, representing a substantial savings of time and money to the organization. Additionally, novel uses of the core capabilities of the ERP system may ease the task of determining takt time for mixed-product production lines and determining the location, quantity, and number of kanbans and supermarkets. On the other hand, as a

“would-be academic” the dearth of articles on dual implementation scenarios suggests a novel, and needed, area of study.

SUMMARY

Coverage in both the academic and trade journals concerning dual implementations of Lean and ERP is very scant. Based on the information that was uncovered, it appears that the movement among ERP software developers to support the Lean Enterprise is still in its infancy despite the proliferation of dual implementation organizations. While the smaller, privately owned business may have little difficulty with the decision to scrap an existing ERP system, individual plants operating Lean under a corporate-wide ERP system may not be fortunate enough to be able to simply disconnect life support from their ERP system, nor might this be the best option available. Because of the high likelihood of dual implementation scenarios, the synergies, both positive and negative, between Lean and ERP deserve serious attention. As stated earlier, given that some ERP vendors are moving toward support of Lean in their applications, balanced academic attention to this area is not only deserved, but probably past due as a potential influence on this movement.

References:

Bartholomew, D. (1999). Lean vs. ERP. Industry Week 248(14). (July 19, 1999). pp.24-30.

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