

Just-in-Time Under Fire: The Five Major Constraints Upon JIT Practices

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ABSTRACT

Though increasing usage of just-in-time (JIT) practices is reported, academics—including Shapiro at Harvard Business School, Karmarkar at UCLA (Anderson) and Cusumano at MIT (Sloan)—as well as a number of practitioners have warned against the unrestricted pursuit of just-in-time practices. They suggest that pure JIT is appropriate only for limited economic environments, that it is ineffective in some organizational cultures, that it is unattainable by many small suppliers, and that, in practice, it does not truly reduce an organization's total/global costs. Such constraints are typically overlooked in descriptions of JIT philosophy. Accordingly, this paper originates, through an examination of the academic and popular literature, five major constraints regarding just-in-time philosophy toward future use in such descriptions: customer-driven & economic conditions, logistics, organizational culture & conditions, intractable accounting & finance practices, and small supplier difficulties.

INTRODUCTION

The just-in-time (JIT) production philosophy continued to gain acceptance through the late 1980s, the 1990s and into this decade. In 1990, Intel's global customer service manager stated that 98% of its customers expected JIT treatment (Wise, 1990) and a St. Louis logistics consulting firm found that 18% of all US products were delivered just-in-time (Johnson, 1994). Further, a 2001 survey conducted by *Advanced Manufacturing* resulted in a PriceWaterhouseCoopers white paper that found that 92% of manufacturers believe that just-in-time delivery by key suppliers is now a critical success factor (Pescon, 2001).

However, the JIT philosophy is being increasingly and seriously questioned—or even reversed—by some academics and practitioners. For example, the slow demand and simultaneous surge in inventories during the second quarter of 1994 was interpreted by the *Wall Street Journal* as an end to the "wishful nature" of the JIT theory of production management (Norris, 1994). Ranaganath Nayak, head of global operations management services at Arthur D. Little, found "paltry gains" amidst \$950 billion of capital and training expenditures by US manufacturers invested to mimic Japanese concepts such as JIT (Naj, 1993). Uday Karmarkar, currently Director of Center for Management in the Information Economy at UCLA's Anderson School of Business, suggests that JIT practitioners during the late 1980s "just didn't know when to stop." (Karmarkar, 1989) Roy Shapiro, Professor of Operations Management Harvard Business School, states that "companies run into trouble" when they stress "squeezing out the last iota of inventory" above the more important goals of quality and process improvement (Bleakley, 1994). Shapiro also notes that even firms in Japan—where JIT practices were first heavily developed—increased their inventory levels as they learned more about the inefficiencies of small order/lot quantities (Bleakley, 1994). Michael Cusumano, currently a Distinguished Professor at the Massachusetts Institute of Technology's Sloan School of Management, notes that Japanese managers encountered a number of limitations on JIT practice that were so significant that other economies might actually exploit them for competitive advantage (Cusumano, 1994). Even a recent best-selling book, ominously titled *The End of the Line*, (Lynn, 2005) extensively argues that global corporations are mistakenly reliant upon extensive supply chains that are disastrously under-buffered.

Historically, the literature has been rich with JIT philosophy advocacy, while it falls short with respect to skepticism (Waters-Fuller, 1995). There is much discussion regarding the benefits and successes of just-in-time practices. However, the literature does also reveal legitimate constraints and implementation failures as well ... though they are typically excluded from standard discussions of the nature JIT philosophy. Accordingly, this study sought to develop an informal categorization of such constraints that could be presented in future literature that describes and/or defines just-in-time philosophy. This study concludes that there are five major constraints that should be described by academics ... and considered by practitioners prior to JIT implementation: customer-driven & economic conditions, logistics, organizational culture & conditions, intractable accounting & finance practices, and small supplier difficulties.

CONSTRAINT ONE: CUSTOMER-DRIVEN & ECONOMIC CONDITIONS

Just-in-time practices face difficulties under certain economic environments. JIT does not fare well under raw material price fluctuations. Norris (1994) points out that just-in-time savings are based on the implicit assumption that additional inventory is always available for quick delivery at the same price as old inventories (or at least at a cost that does not negate the savings attributable to JIT). Norris argues that inventories built during the second quarter of 1994 because businesses that were excessively focused on JIT eventually reacted to the scarcity and the rising prices of raw materials ... and that such scarcity and price increases ultimately caused stockouts of finished goods. Norris further argues that the stockouts drove finished goods prices higher, prices that contributed to subsequent inflation and reactionary bond market.

The ability to commit to JIT practices can also be diluted by other economic factors such as the business cycle or by capital availability and costs. *The Economist* notes that the increase in JIT practices to more closely match inventories to demand was expected to help tame the portion of business cycle driven by the widely fluctuating inventory levels and production that result from a trailing response to true demand ("Cleaned out," 1991). Rather than JIT effecting the business cycle, however, *The Economist* found the reverse—that, in 1990, businesses pushed inventories lower, in their usual fashion, when responding to rising interest rates and an economic downturn. *The Economist* further notes that the shift from building inventories to draining inventories accounted for no less than two-thirds of GNP decline during the next several quarters that followed. According to Cusumano (1994), Japanese companies eventually found that new product development (NPD) (and the associated changeovers) could not always be carried out in a just-in-time fashion, as their ability to source the longer-term capital needed was diminished by availability and interest rates. It is interesting to note that, if it is true that JIT practices can effect the decline of filled orders and bond prices as well as the rise of finished goods prices, it might be well argued that a significant portion of organizational savings due to JIT are captured, not as efficiencies, but as externalities.

The rate of customer demand as well as the nature of customer expectations can also place limitations on the effectiveness of just-in-time practices. JIT implicitly assumes a reasonably level rate of customer demand. Karmarkar (1989) and Aggarwal (1985) agree that just-in-time systems do not perform well under high fluctuations in demand. Karmarkar (1989) states that "JIT doesn't plan well," arguing that in a highly variable environment, JIT is even less likely than a traditional planning system (e.g., Material Requirements Planning) to operate in a stockless manner. Further, while customers continue to dictate ever-higher levels of responsiveness and customization, these types of demands are also not well tolerated under JIT. According to Cusumano (1994), Japanese managers have found that, despite their massive efforts toward setup reduction, increases in product variety have pushed JIT practices toward a practical limit.

Reported cases appear to support these arguments. GE Appliances, after finding that low inventories of some critical parts prevented it from quickly filling customer orders, increased its long lead time inventories by 25%; GE management believed that the benefits from non-stockouts and customer responsiveness greatly outweighed the incremental inventory costs (Naj, 1993). Bollinger Industries, a sports and fitness equipment manufacturer, after successfully implementing a JIT environment, reverted to an increase of 30% in certain finished goods inventories after finding JIT was not sufficiently flexible in an environment of rising customer demand (Bleakley, 1994).

CONSTRAINT TWO: LOGISTICS

As might be expected, serious logistical issues constrain the success of just-in-time philosophy. Interruption of material delivery along the supply chain can quickly effect manufacturing shutdowns and/or finished goods shortages when insufficient raw material buffer stock is maintained along the chain. American's brief 1992 railroad strike is but one of many examples of this inherent risk within JIT (Seideman, 1992). General Motors was forced to shut down certain factories involving 75,000 workers on the first day of the railroad strike, and would have experienced a total shutdown had there not been an immediate resolution of the strike. In March, 1996, a 17-day UAW strike at two General Motors brake factories in Dayton, Ohio idled virtually all of GM's North American automobile production at a cost of \$47 million/day (Bradsher, 1996); just-in-time practices were blamed for the immediacy of the shutdowns ("The General Motors strike," 1996). More recently, the lack of significant gasoline buffer stocks at the distributor level effected retail shortages almost immediately after Hurricane Katrina interrupted nearly 1,500,000 bbl./day of Gulf Coast refining production (Healey, 2005). Examples such as these suggest that

removal of raw material buffer stocks along the supply chain may well be capturing immediate cost savings in exchange for increased risk of finished goods stockouts as well as a greater overall cost should those stockouts occur.

Traditionally, it has been argued by US manufacturers that greater distances along their supply chains place incremental burden on their effecting successful just-in-time practices. Clearly, the longer the delivery lead time, the higher the level of buffer stock required; in fact, this was noted by Henry Ford when describing his own preference for just-in-time inventory, stating that "with bad transportation, one has to carry larger stocks." (Ford, 1922) However, experience taught Japanese management that *close* proximity also constrains JIT. At first, Toyota managers did not initially face any logistical constraints upon JIT philosophy since its manufacturing facilities were geographically proximate. However, Nissan, with its factories more dispersed, soon found the addition of buffer stock, well above that of those levels maintained by Toyota, to be a useful tool to offset traffic congestion in urban areas. Eventually, Toyota's own industrial growth in its Toyoda City and Aichi Prefecture areas created similar congestion. By the 1990s, the Japanese government was forced to launch a media campaign encouraging companies to actually reduce the frequency of their material deliveries, making "JIT a bit less timely" today than it was in the 1970s (Cusumano, 1994). The fact that the onset of the global marketplace places additional constraints upon the just-in-time approach is recognized in the academic literature, for example, see Vickery (1989). According to Cusumano (1994), "the days when even Toyota can operate in a highly predictable and geographically small area within Japan are now over." Global sourcing, with its greater delivery distances, requires even higher levels of buffer stocks. According to a recent *Inc.* magazine article:

"For more than a decade, American business has relied on just-in-time delivery of inventory and components to improve efficiency, reduce lead times, and trim costs. Now, the physical limits of the global distribution network are being tested." (Gunderson, 2004)

One GE manager suggests a minimum of four to six weeks of incremental supply chain inventory when sourcing from South America, Europe, or Africa for US manufacture (McClenahan, 1990).

Global sourcing places other constraints upon JIT as well. Such sourcing means organizations must also increase buffer stock in the face of greater risk of supplier interruption due to political upheavals, nationalization of suppliers and/or natural disasters (McClenahan, 1990). Further, effecting JIT practices through a network of global suppliers may require significant financial and human resource commitment from the manufacturer (McClenahan, 1990). Just-in-time requires consistent and high levels of material quality in order to avoid work stoppages (Songini, 2000; Wise, 1990), yet one practicing manager advises that even the imperfect filtering of operational definitions of quality through differing cultures and languages effects significant rework costs (McClenahan, 1990).

Just-in-time practices are expected to reduce cost, in part, due to the fact that reductions in (traditionally underestimated) inventory carry costs will more than offset any increase in logistical/transportation costs effected by JIT. However there are many suppliers that claim to find the opposite in practice (Bleakley, 1994; Sheridan, 1989). One example is found within the fashion apparel industry; given that such trend items can quickly obsolete when inventoried, their distributors already tended toward lean inventories and relied upon timing ocean freighter deliveries from its Oceanic manufacturers to precisely match demand. However, as retailers moved further toward their own just-in-time environment, they slipped their own ordering closer and closer to the beginning of their seasons. Distributors, unable to buffer stock and forced to deliver on short lead times, increasingly had to adopt much more expensive overnight air freight as their standard shipping method (Armbruster, 1992). Then, of course, there is the issue that the shipment of small quantities typically results in higher shipping cost per unit. George Newman (1993), economist and senior staff member of the Conference Board, notes that increments in transportation costs are not linear, that they rise sharply when quantities drop below demarcations such as LTL (less-than-truckload). Bleakley (1994) and Sheridan (1989) both note that manufacturers will often choose to capture the immediate and visible cost savings from shipping larger quantities before opting for longer-term, less visible costs reductions expected from lowering inventory levels.

CONSTRAINT THREE: ORGANIZATIONAL CULTURE & CONDITIONS

Prerequisite to the success of just-in-time is adequate human capital as well as the implementation of a Theory Z approach toward the management of labor (Keys, 1991; Ouchi, 1981). Theory Z, coined by William Ouchi, a professor at UCLA's Anderson School of Management, embraces worker-based collective decision-making, implicit trust between workers and between workers and management, informal worker control

combined with explicit worker measurement and responsibility, long-term assured worker employment as well as a broader paternalistic management concern for worker and worker family welfare (Ouchi, 1981). This perspective coincides with others such as Aggarwal:

"[Just-in-time] has its roots in employee motivation and assumes workers will perform at their best when they are entrusted with increasing responsibility and authority. ... The approach also assumes that employees will help each other ..."
(Aggarwal, 1985)

Theory Z contrasts the narrower assumptions regarding workers that are expressed within McGregor's Theory X and Theory Y (McGregor, 1960). If Ouchi's argument is accepted, then organizations lacking a Theory Z culture will fail at any attempt to implement just-in-time practices. Recent empirical research supports the perspective that this type of organizational culture is requisite (McLachlin, 2004; Salaheldin, 2005). There is also preliminary work suggesting this is true even in public sector organizations (Yasin, Wafa, & Small, 2001).

The well noted experience of Allen-Edmonds, a high-end American shoe manufacturer, exemplifies the important effect that the state of the organization can have upon successful just-in-time implementation. The company quickly discovered that its piecework system (paying labor by units of production rather than by the hour) and just-in-time practices to be at odds with one another. Allen-Edmonds management (correctly) believed that a move from piecework to hourly pay was necessary to create the kind of quality & teamwork-based culture required to implement a just-in-time environment. Improvements in delivery times and inventory levels were quickly achieved, however management was disappointed with the decreased worker productivity and eventually returned to the piecework system, whereupon a portion of the improvements in delivery times and inventory levels were lost (Marsh, 1993). More recently, a tire manufacturer also reports the need to adjust its incentive system to accommodate JIT implementation (Mukhopadhyay & Shanker, 2005).

Japanese management has found these organizational constraints to be true even in their own companies. Historically, they could rely upon a ready supply of well-educated, well-trained workers capable of the broad responsibilities and skills needed to accomplish reduction of waste and just-in-time productivity gains (Aggarwal, 1985; Cusumano, 1994). More recently, however, talented Japanese labor has tended to avoid blue-collar manufacturing work, forcing the importation of less-skilled foreign labor. This change, in turn, negatively impacted quality and productivity and so forced them to even sometimes revert to the once-maligned practice of final inspection (Cusumano, 1994). The phenomenon of foreign workers is an American issue as well; recently, an American office furniture manufacturer reported that it found internal language barriers to be its greatest barrier to effective JIT implementation (Qualters, 2004).

Japanese managers have also experienced cultural constraints upon JIT as they globalize their supplier operations; e.g., they discovered that the requisite trust was could not be assumed of its foreign suppliers (Cusumano, 1994). They also found that other aspects of their organizational culture upon which they had relied did not translate well across borders; for example, Toyota encountered difficulty in persuading supplier adoption of its traditional familial references, i.e., where direct laborers are referred to as "children" of the company (Gaffney, 1991).

CONSTRAINT FOUR: INTRACTABLE ACCOUNTING & FINANCE PRACTICES

Traditional cost accounting systems can confound attempts to implement just-in-time practices in various ways. Such systems focus upon measuring manufacturing variances, but contribute little in terms of measuring efforts toward resolving their underlying causes (Wise, 1990), hence directing efforts toward the management of variances before the resolution of causes. Cost accounting measures are typically cycled monthly or quarterly, while worker improvement efforts take place daily or even hourly. Hence the actual results of specific worker efforts are essentially disconnected from the performance measures for which they are held accountable (Keys, 1991; Wise, 1990). For example, if many small efforts are successful, while one large effort is unsuccessful, the efforts will sum to a single negative measure. Further, that negative measure might well discourage any future efforts altogether. In that sense, performance as measured by cost accounting discourages the trial-and-error approach to improvement upon which Japanese production theory relies. The traditional cost accounting focus upon direct labor cost is also problematic. It ignores the primacy of time minimization in a just-in-time environment (Wise, 1990). Further, that emphasis upon individual measurement tends to defeat the worker-based collective decision-making that is requisite to Theory Z and, in turn, JIT practices. The traditional use of machine efficiency/usage measures also is at odds with JIT. Such measures tend to enforce maximum possible usage, in order to improve reported efficiency rates and

financial payback schedules. In contrast, Japanese companies routinely schedule excess capacity to accommodate line stoppages due to unanticipated difficulties encountered during improvement efforts (Keys, 1991). Given these conflicts, it is not altogether surprising that some successful JIT implementers have reported no less than a total abandonment of standard cost accounting, a move that can set the stage for resistance to JIT implementations within accounting units (Wise, 1990).

Traditional financial practices also confound. Goldratt & Fox (1986) provide one intuitive example within their book *The Race*. If reducing total inventories by, say, 50%, can be accomplished by some fixed cost, eventually, at some point, the proposal for further reduction of inventory will fall short of the hurdle rate imposed by financial staff. Said another way, traditional financial practice will reject a proposal for perpetual zero inventory no matter how little the total cost (Zangwill, 1992). In addition, the short term focus of financial measures such as ROI and quarterly earnings often deter executive commitment to the longer term goals of JIT. According to Aggarwal (1985), just-in-time systems take at least two years to be considered operational, and do not normally achieve optimum results until five to ten years. Yet JIT implementations typically have negative impact on short-term financial measures (Keys, 1991).

All of the aforementioned accounting and financial practices contribute to driving labor to first focus upon improvement of measures before improvement of processes, contribute to misdirecting efforts away from the aim of implementing a just-in-time environment. This, even though many of these problematic accounting and finance issues have been well acknowledged within American academic literature by authoritative scholars since as early as the 1980s. Such works include those by Johnson & Kaplan (1987), Hayes & Abernathy (1980), Hiromoto (1988), and Skinner (1986). There is some recent evidence that accounting systems are beginning to respond and adapt to these issues (Waldron, 2005).

CONSTRAINT FIVE: SMALL SUPPLIER DIFFICULTIES

Academic literature (Lee, 1996) as well as empirical reporting note that small suppliers can experience tremendous difficulties and resistance to JIT implementations. A survey of such suppliers says that only half believe they can ever hope to take advantage of the efficiencies attributed to just-in-time (Sheridan, 1989). Small companies cannot reap the same scale of benefits from JIT since they lack the economies of scale that their high volume, repetitive manufacturing customers possess (Sheridan, 1989). They are forced to purchase in much smaller quantities, and hold far less influence over their suppliers to reciprocate just-in-time policies, and so view themselves as the "whipping boys" for JIT (Sheridan, 1989). In the aforementioned case of Allen-Edmonds, its hide supplier refused to cooperate with JIT efforts, requiring the company to tolerate \$1,000,000 of raw material inventory (Marsh, 1993). These small suppliers are often forced into JIT policies and higher costs at the behest of the major accounts (Inman & Mehra, 1990; Sheridan, 1989). John Cassidy, director of research at United Technologies, states that to implement JIT, manufacturers focused on material handling aspects and forced suppliers to take extraordinary measures, rather than examining their own manufacturing processes (Naj, 1993). Historical sales-to-inventory ratios clearly bear out that, during the late 1980s, JIT manufacturers often did little more than transfer inventories to suppliers through purchasing power and also to retailers through encouraging quantity discounts ("Cleaned out," 1991; Sheridan, 1989; Songini, 2000). Over a third of small JIT suppliers must tolerate higher FGI, and 40% report higher WIP and higher raw material inventories (Sheridan, 1989). In addition, 75% report some increase in both transportation and manufacturing costs (Sheridan, 1989). Small suppliers lacking the financial strength to endure such constraints (Inman & Mehra, 1990) are also the suppliers least capable of affording the external talent that successful JIT implementation requires (Inman & Mehra, 1990), nor can they provide such support to their own suppliers. In contrast, Jacobs Brake's successful JIT implementation was accomplished with the help of Arthur Andersen (Sheridan, 1989).

In sum, such arguments suggest that JIT actually raises global product costs, costs experienced by small suppliers and passed down the supply chain. Some small suppliers have made that cost explicit; according to Newman (1993), some suppliers charge a 5% "premium" for JIT (an inventory carry cost by any other name) and he argues such a premium charges the purchaser \$2 for every \$1 saved by its internal JIT effort. Suppliers also report JIT adds to cost of paperwork and packaging (Sheridan, 1989), requiring further pricing adjustments. Most suppliers endure the costs if possible, avoiding the risk of lost business. Here again, it seems, it might be well argued that a significant portion of organizational savings due to JIT are captured, not as efficiencies, but as externalities.

CONCLUSION

From the above discussion, it should be clear that there are many constraints upon successful JIT implementation, that it is certainly not universal in applicability. Managers considering just-in-time implementation and practices must clearly give due consideration toward the lower limits that are placed upon buffer stocks due to logistical issues, toward what changes may be required of its organizational culture and condition, toward whether its present or future market conditions will fit with JIT practice, toward whether the organization is sufficiently large enough to afford and benefit from the practice, and toward how to properly interpret and/or modify its accounting & financial perspectives. There is also sufficient evidence to warrant that academics who author practitioner papers or student textbooks should append appropriate caveats. The authors believe that this paper gives some introductory guidance to those managers and academics with regard as to what types of major constraints are currently known to exist with regard to the just-in-time philosophy.

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