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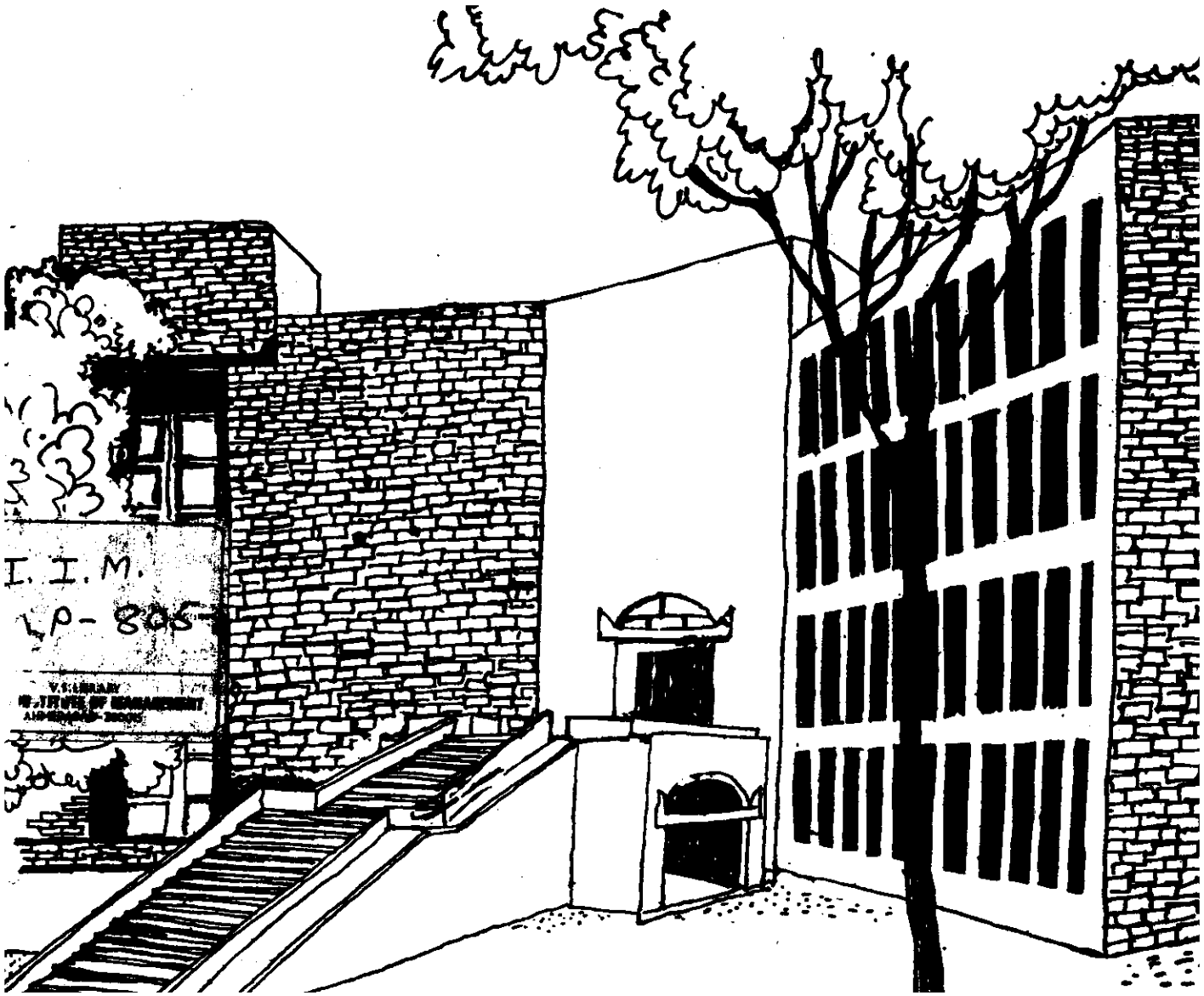

JIT IMPLEMENTATION: OUTLINES OF A STRATEGY

By

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Abstract

The logic of JIT represents the core of a new management paradigm that has been used to devastating effect by Japanese companies during the 1970s and 1980s. In this paper, intended primarily for practitioners and teachers, we consider the problem of a planned changeover to JIT and the strategy this would entail. A strategy matrix is first proposed to distinguish a "True JIT" strategy from three others viz: Anti-JIT, Psuedo JIT and New JIT. A start towards True JIT, on which the paper focuses, is provided by Gunn's (1987) four stage progression model. But in our study we review ten cases of JIT implementation to arrive at an 8 stage model which we call the Eight Fold Way. The cases studied include Toyota and Mazda in Japan; Kawasaki, Bridgestone, Toyota and Matsushita in the U.S.; American exponents of JIT such as Hewlett Packard and Harley Davidson, and finally Matsushita and Suzuki in India. Some broader implications of our findings e.g. for small/medium enterprise and for management education are also suggested.

Acknowledgement

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JIT Implementation : Outlines of a Strategy

JIT (for Just-in-Time) represents a simple but radical view of manufacturing that is rapidly gaining acceptance in the industrial world. Originally developed by Toyota Motor Co. during the 1950s, it was extended to the company's suppliers during the 1960s (Ohno, 1988) to the rest of the Japanese auto industry in the 60s and early 70s (Cusumano, 1988) and to other Japanese industries in the late 70s and early 80s (Japan Management Association, 1986). Since then, JIT has been credited with the remarkable success achieved by Japan in the machinery and equipment manufacturing sector (Lieberman, 1988), one of the few sectors where Japanese industry had a clear competitive edge (Komiya, 1982).

The English speaking world first came to know of JIT from a conference paper presented by Toyota executives in 1977 (Sugimori et. al., 1977). During the 1980s, the approach began to diffuse through the U.S., first via a few Japanese transplants (Schonberger, 1982) and then through some American exponents of JIT (Hutchins, 1986).

Currently, JIT is synonymous with world class manufacturing (Schonberger, 1986; Gunn, 1987). Such manufacturing, according to Gunn (1987, p.26) uses criteria for performance measurement which are different from traditional ones by several orders of magnitude. Take inventory turns per year (for raw material and finished goods). At one time 1 to 4 was considered satisfactory. Today, it takes 25 to 30 turns per year

just to rate "C" Class. "A" class manufacturers are able to achieve 80 to 100 turns or more per year while "B" Class ratings are from 50 to 60. Similarly, quality in such ("A" Class) companies is measured in total defective parts per million of 200 or less (Gunn, 1987, p. 26).

On the organizational side, Abernathy et al (1983, p. 90) observe: "The imperatives of quality and productivity.... are impossible to satisfy without the active, loyal and committed participation of a well trained and constantly improving workforce. In this new environment what passed for labour force policy in previous years is not only out of date, it is poison" (emphasis added).

But, in spite of the mushrooming growth of interest in JIT, very little is known about how to systematically implement it. This places interested companies at a great disadvantage because they are at a loss to know how to proceed even though it is in their interest to do so. As Hayes et. al., (1988: 210) have observed: "Given the [enormous] performance improvements that have been observed when [JIT] principles have been adopted, the issue for many companies really comes down to whether it is wise to wait until a competitive opportunity becomes a competitive necessity."

Take, for example, the case of Ace Industries Ltd. (AIL) of Noharipur in Western India, a Rs. 50 million company (in terms of sales) employing over 500 people to make industrial fans and compressors. Propped up for many years by financial

institutions, the company had become marginally profitable in recent times. Its chief executive, Mr. A.O. Kamraj, was an erudite and internationally experienced person.

Kamraj had seen references to JIT in the media. Subsequently he attended a seminar given by a consultant in this field. Knowing of his interest, the authors approached Kamraj to allow a couple of second year MBA students with engineering degrees and work experience to do their planned JIT study project on AIL. In effect they tried to see what AIL would look like through JIT "lenses".

Towards the end of their 3 month study they made a presentation of their findings to Mr. Kamraj and a few of his associates. The authors and a colleague who was also interested in JIT strategy were in attendance at this session for discussion purposes (Ramachandran and Thomas, 1989). At the end of the exercise Kamraj felt that he now had a better understanding of what JIT was about and it certainly seemed like a fine idea but he was not sure where to start, what to do and how long to continue.

The purpose of this paper is to meet the concerns of executives such as Kamraj. In a nutshell our finding is that JIT requires the strategic determination to cross fertilise learning experience from one selected production line to another in a manufacturing organization continuously i.e. over time and space to achieve ambitious long term goals. Though JIT may appear daunting at the outset it can be (it has to be)

realized in increments whose scope and speed are influenced by the chief executive himself (or herself) in the light of the practical realities confronting the organization. There is no reason to give up on JIT as there are no preconditions to its implementation apart from acceptance of its core logic. At the same time one has to be prepared to "make haste slowly". Impatience during JIT implementation can lead to severe setbacks. Aesop's tortoise is indeed faster than the hare in the JIT context.

Conceptual Foundations

The implementation of a management idea such as JIT can be mapped in a conceptual framework whose dimensions consist of a) the drive to replicate or emulate it and b) the drive to innovate or improve on it. The interaction of these two basic drives results in what may be called a JIT Strategy Matrix. It is presented and discussed below:

Drive to Innovate	Drive to emulate: Low	Drive to emulate: High
High	**Anti JIT** "Not invented here" Rejection of JIT Avoidance of JIT	**New JIT** Transformation of JIT A New Standard
Low	**Psuedo JIT** Form rather than substance of JIT Dilution of JIT Ad hoc implementation	**True JIT** Coordinated absorption and development of JIT practices Step by step, no razzle dazzle

Exhibit 1: JIT Strategy Matrix

1. True JIT:

This strategy is based on a genuine understanding not only of the purposes and practices of JIT but also of the fundamental purposes of the organization in relation to the strategic environment in which it is functioning. It represents the implementation of JIT in the proper spirit. Attitude becomes more important than technical virtuosity. The fundamental premise of the true JIT strategy is that (almost) everything which is cited as an objection, constraint or obstacle is, basically, only an excuse (Walleigh, 1986). These have to be sought out and resolved. JIT management is a "way of life", a never ending "journey", rather than a standard technique to be mastered or a specific goal to be realized. In the long term there are no constraints, only a series of "opportunities disguised as problems".

The use of different terminology should also not confuse things. For example, Harley Davidson calls its approach MAN (for Materials As Needed), IBM refers to it as CFM (Continuous Flow Manufacturing), and Nissan uses the term APM (Action Plate Method). But they all represent variations of the basic JIT theme.

Gunn (1987: 188-191) has identified four "stages in progression to JIT". These are:

Stage 1: No JIT/Emerging Awareness

Stage 2: Beginning JIT/Awakening

Stage 3: Intermediate JIT/Enlightenment

Stage 4: Full JIT/Conviction

He considers that most American practitioners of JIT are somewhere in the middle of Stage 2 (which, incidentally our Mr. Kamraj may have just entered). However Gunn notes that a few U.S. practitioners have reached the stage of level 4.

In this paper we will focus on the True JIT strategy and will return to our version of it later.

2. New JIT:

This is a strategy which aims, right from the beginning, at setting a new management standard. It is built on a deeper philosophical insight into the time (or any other critical) resource and its managerial utilization - worldwide (Bluedorn and Denhart, 1988; Hassard, 1989). On the basis of this insight it is able to transform JIT in the same way Toyota's JIT transformed the ideas of Frederick Taylor and Henry Ford (Ohno, 1988, Cusumano, 1988).

Perhaps there is an organization (or even several, for that matter) pursuing this strategy already. Chances are they are obscure ones just as Toyota was in the late 1940s. Even allowing for accelerated rates of change in the closing years of the 20th century, it may take at least a decade or two for such strategies to become visible and prominent. In this paper New JIT is considered as an extension of True JIT.

3. Psuedo-JIT:

This is a strategy which emphasizes the form rather than the substance of JIT. It launches JIT because that is the fashionable thing to do to gain "respectability". In such cases JIT does not flow from a fundamental business analysis or a real understanding of JIT.

There may be a tendency in such organizations to play a numbers game, citing statistics (of suggestions received or defect rates achieved) perhaps without full justification. It may also include the manipulation of inventory holdings, say by the supplier or distributor, rather than an attempt to achieve lower inventory levels systemwide.

Psuedo JIT is also likely to be marked by a certain impatience with its implementation. An "expert" is quickly designated or hired to "implement JIT" on a delegated basis. He is expected to single handedly sort out all the inter-linked problems a changeover to JIT requires. And when business conditions change or a new top management takes over the enthusiasm for "JIT" also wanes and JIT systems and JIT projects get axed "for economy reasons".

4. Anti JIT:

This is a strategy of rejection based on the thought that JIT is a product of a particular (in this case Japanese) socio-cultural milieu and that we must find our own approaches. Thus because JIT has not been developed here, it must be

inappropriate. Hence, the argument goes, it is best to avoid getting into it and to actively resist its diffusion.

Even in the U.S. JIT was initially viewed as a cultural manifestation but on closer scrutiny it was found to be an adaptable management concept. Schonberger (1982: 102) who has documented one of the early attempts at JIT in the U.S. (to be discussed below) has stated: "The Kawasaki, Nebraska experience is that Western managers and workers behave more like their Japanese counterparts as just-in-time techniques are adopted".

Application of JIT has far reaching implications for organizational behaviour (Thomas, 1988) and if JIT is to succeed such behaviour must become the norm. We are talking here of an industrial culture which must no doubt develop in conjunction with the rest of the cultural environment. If the development of an industrial culture is a national aim as it is in India then JIT practices are entirely consistent with it and need not be rejected out of hand when conflicts arise. However, if leisure is considered an integral part of a work ethic as in some "post-industrial" societies such as in Europe (Turnbull, 1988) or if there is ideological opposition to business or management then JIT will receive a much cooler, if not an actually hostile, reception.

Case Studies

Having outlined the strategic options vis-a-vis the implementation of JIT, we now turn to an examination of some cases in order to be able to refine the "True JIT" option. We

sketch below ten cases and the key JIT lessons to be gleaned from them. These ten cases can be grouped as follows:

1. The Japanese 'Originals' : Toyota and Mazda.
2. Japanese Transplants in the U.S. : Kawasaki, Bridgestone, NUMMI and Matsushita.
3. The American Exponents : Harley Davidson and Hewlett-Packard
4. Indian Experience : Matsushita and Suzuki.

The Japanese 'Originals'

We use the word 'Originals' advisedly. By all accounts Toyota is the originator of JIT (Ohno, 1988; Cusumano, 1988; Schonberger, 1982) and the most advanced practitioner of this approach which is also known as the Toyota Production System. Although some elements of JIT may have either been developed elsewhere in Japanese industry or occurred simultaneously (Schonberger, 1982; Cusumano, 1988), the technical core of JIT (see below) is a Toyota contribution. Mazda in fact was a latecomer to JIT, implementing it under the threat of bankruptcy after the 1973 oil crisis (Toyo Kogyo, 1982). For this reason it has become something of a classic case of JIT Implementation especially in American circles (Abernathy et. al.; Abegglen & Stalk, 1985, Hayes et.al., 1988). It is for this reason that we bracket Mazda with Toyota in the first category.

Toyota:

Emerging from World War II, Toyota was a tiny car manufacturer compared to American companies such as General Motors (GM), Ford, Chrysler etc. It faced a lot of internal problems such as labour disputes. The Japanese economy was beset by inflation and shortages of various kinds. In this kind of environment the chief executive of Toyota expressed his determination to "Catch up with [American car companies] in three years". Taiichi Ohno the architect of JIT (Ohno, 1988) realized that this would be possible only through the systematic elimination of all waste in industrial operations. An outsider to car making, he had come to Toyota from the group's textile unit in 1943. But by 1947 he began to implement JIT in Toyota, beginning with the establishment of a flow process. In his words :

> Just in time means that in a flow process, the right parts needed in assembly reach the assembly line at the time they are needed and only in the amount needed. A company establishing this flow can approach zero inventory.... Therefore the first step was to establish a flow system in the machine shop...
>
> In 1947, I was manager of the machine shop at (Toyota's) Koromo plant. As an experiment I arranged the various machines in the sequence of machining processes... and tried having one worker operate three or four machines along the processing route. We encountered strong resistance among the production workers however, even though there was no increase in work or hours. Their resistance was understandable...It is never easy to break the machine shop tradition in which operators are fixed to jobs, for example lathe operators to lathe work and welders to welding work... The Toyota Production System began when I challenged the old system (Ohno, 1988).

Ohno then developed the second element in the technical core of JIT. This was the introduction of a system of production and transfer based on demand pull.

> I kept thinking about how to supply the number of parts needed just in time. The flow of production is the transfer of materials. The conventional way was to supply materials from an earlier process to a later process. So I tried thinking about the transfer of materials in the reverse direction... From the [American] supermarket we got the idea of viewing the earlier process in a production line as a kind of store. The later process (customer) goes to the earlier process (supermarket) to acquire the required parts (commodities) at the time and in the quantities needed. The earlier process immediately produces the quantity just taken (re-stocking the shelves) (Ohno, 1988).

Two other elements of the technical core of JIT were subsequently introduced by Ohno.[1] These were 1) the use of kanban cards as the basic information and control system (Japan Management Association, 1986) and 2) the levelling of production (within a certain range) by mixing models in final assembly (Monden, 1983).

Toyota kept all these efforts in-house till the early 1960s partly because the system was continuously evolving and also for competitive reasons. When it extended the system to its suppliers it chose to begin with the ones with whom it had the strongest links (Ohno, 1988; Cusumano, 1988). At any rate, as early as 1965, Toyota had succeeded in overtaking the productivity levels in the American car industry (Cusumano, 1988) through the use of JIT.

The Toyota experience enables us to identify four primary elements of the technical core of JIT and four derivative elements. These are:

Primary elements

1. Establishing a product flow process
2. Introduction of a pull system
3. Levelling of loads by mixing models in final assembly and freezing the schedule (to the extent of ± 10 per cent).
4. Operation of Kanban to control production and to trigger productivity improvements.

Derivative elements

1. Standardizing operations and their cycle times
2. Reduction of set up times
3. Automated defect control
4. Numerical process control

The Toyota example can be termed progressive JIT because of the systematic progression which is its hallmark in published accounts.

Mazda:

Originally known as Toyo Kogyo, this company's factory narrowly missed destruction by the atom bomb which obliterated Hiroshima. Mazda was noted for its technological prowess. It led the Japanese auto industry in computerisation (Toyo Kogyo, 1982; Hayes et al 1988). It was the first to commercialize the innovative rotary engine which it had licensed from Dr. Wankel of Europe. Mazda's rotary powered cars proved a big hit in the

U.S. until the 1973 oil crisis adversely affected the market for this particular car and Mazda teetered on the brink of bankruptcy.

Pascale and Rohlen (1988) have detailed the organisational problems which had remained dormant at Mazda during the years of fast growth. Much of the responsibility for this state of affairs was attributed to Kenji Matsuda, Mazda's chief executive since 1970.

Recovery efforts at Mazda were launched in 1975 by Sumitomo Bank with the tacit support of Japan's MITI. Although the latter had been wanting the Japanese car makers to consolidate for economies of scale, it saw merit in Mazda's continued operation perhaps because of its inherent technological capabilities. The Sumitomo turnaround team however launched an effort to changeover Mazda's operations to the Toyota Production System. This effort was spearheaded by a long time Mazda production executive, Mr. Yoshiki Yamasaki who soon replaced Mr. Matsuda as chief executive at the age of about 60 years.

Hayes et al (1988: 186) have capsuled the changes effected at Mazda :

> Synchronizing departments and integrating operations required changes in the location and sequencing of equipment, reductions in set up times, faster, more accurate information about production problems and improvements in process quality. Production scheduling changed as well. It shifted to a "pull" system in which the production of components and subassemblies was triggered by final assembly. All these changes were accompanied by new work assignments, new responsibilities and new training programs at all

levels in the company. Without significant capital investment, Mazda was able to achieve dramatic improvements in performance because of these fundamental changes in its manufacturing system.

Although much has been made of the Mazda case, its main significance lies in the roles of two parties - Sumitomo Bank and President Yamasaki - specifically in relation to JIT. How did they conclude that JIT was the answer to Mazda's problem? There is no information about this anywhere. But the lessons of JIT may be as important to bankers as they are to their customers, the manufacturers. Secondly, how did Yamasaki, who must have been wedded to the "old ways" of manufacturing, convince himself about the value of JIT so quickly? It only means that even "old timers" can take to JIT if they really want to. In fact Yamasaki went on to coin the "river and rocks" metaphor which is widely used in elucidating the effect of inventory reduction on operations improvement.

A third lesson from Mazda is the phenomenon of visualizing "incredible" possibilities through JIT implementation. Yamasaki launched "Operation 50" which meant that he wanted a <u>fifty percent</u> reduction in work in progress inventories. This was a strategic goal in the sense that its achievement required fundamental, far reaching organizational changes rather than incremental ones. A 10 per cent reduction was in fact achieved in just 3 months though subsequent progress was slower (Toyo Kogyo, 1982).

A further lesson from Mazda lies in the fact that it eventually linked up with Ford Motor Co. which took a 25% equity

stake. If Ford is "Company A" in Krafcik's study (Krafcik, 1988) then it has moved fairly effectively towards JIT under Mazda's tutelage, not only in its U.S. plants but overseas as well. The Mazda case can be characterised as an example of "Crash JIT".

Japanese Transplants - USA

Kawasaki:

In Japan, the motorcycle maker, Kawasaki, began to change over to JIT at about the same time as Mazda i.e. 1975 (Hall & Nakane, 1983). Kawasaki arranged with Toyota for 100 days of on the job training in JIT for a five man team. Using a phased implementation strategy Kawasaki decided in 1979 to put the system into all suitable plants.

One such plant was Kawasaki, Nebraska which had been in operation since 1975 making 3 types of motor cycles. Its American managers had been trying to implement an American production planning and control system called MRP[2] (Schonberger, 1982; Pegels, 1984). Around 1980, Kawasaki persuaded its American managers to abandon MRP and to try JIT implementation instead.

Initially they tried to implement "Kanban" straight away but within a few weeks they abandoned this attempt also. However, other projects such as set up time reduction and layout changes were successful. "These improvements all occurred in the space of a few months in spring 1981, which was about a year

after Kawasaki's decision to abandon MRP.." according to Schonberger (1982) who devotes 2 chapters of his pathbreaking book to JIT production and JIT purchasing respectively at Kawasaki, Nebraska. Mixed model sequencing in final assembly even improved further from "5-5" in 1981 to the "ideal" 1-1 which Schonberger calls "full mixed model sequencing".

Schonberger (1982) notes that Kawasaki Nebraska's implementation of JIT coincided with the onset of recessionary conditions in the US motorcycle market. Both the developments combined to expose overmanning problems at Kawasaki Nebraska as a result of which the management had to take recourse to all available options in the personnel area. These included reassignment of employees to offline work, temporary deputation to the local municipality, lay off of white collar staff, voluntary retirement of blue collar staff, furlough of blue collar staff and ultimately termination of 98 production workers out of a total of about 550.

Schonberger (1982) ponders whether a recession is the right time to implement JIT because of the tendency to "exacerbate" the layoff problem. Mazda's experience shows the need to take this bitter medicine in the interests of organizational survival. Hall and Nakane (1983: 91) however counsel: "The need to have a plan that provides for the future of the workforce (and not just a pension plan) is inescapable".

Kawasaki's experience can be called "Normal JIT" or "Dynamic JIT" because of the succession of problems, fumbles, and

false starts encountered (and overcome) during its implementation.

Bridgestone:

This Japanese company is the world's third largest tyre making (after Goodyear, USA and Michelin, France). It took over the business of Firestone of the US beginning in 1983 with one Firestone plant in Tennessee which was on the verge of complete closure. The new chief executive has described the way he revitalized this plant (Ishikure, 1988). Nowhere in his account does he use the term JIT but there is no mistaking the application of the overall JIT framework. Whatever he has done is consistent with JIT practice and hence merits attention.

The reason why the term JIT is not explicitly used by this major supplier to the automobile industry is apparently because a conscious attempt was made to make management methods acceptable to the American workforce. For this reason American terminology such as MBO (Management by Objectives) and TQC (Total Quality Control) was preferred by Bridgestone management.

Through a detailed analysis of product acceptability, the chief executive established the visionary goal of increasing production and sales 4 times in 4 years by improving product quality. The slogan introduced was "Quality today will result in quantity tomorrow". Good housekeeping was used as the first step in the drive to improve quality.

This was followed by the "4M" approach which required attention to machines, materials, methods and manpower. Preventive (rather than mere breakdown) maintenance of the equipment was introduced. To minimise "misproduction", storage containers of various colours, sizes and even shapes were used as visual control mechanisms by the workers. Manpower problems, which proved to be the "most challenging", were dealt with through extensive discussions. To encourage openness, a "one-on-one" format rather than the somewhat intimidating "Three-on-one" format was used for these sessions. The chief executive personally interviewed each manager. He met lower level employees in large groups. The chief executive's constant refrain was "we are all in the same boat" to evoke a crucial sense of collective responsibility.

A notable feature of Bridgestone's approach was the creation of a virtual "internal market for problems". An incentive system was introduced whereby those who brought problems to management's attention were rewarded with small gifts. Bridgestone made it clear that it encouraged "negative information and constructive criticism" from customers. It expanded the scope of the word "customer" to include the workers who worked at the next stage of the production process inside the plant. The applicable rule was "Do not send defective components to the next step". But the broader philosophy involved was expressed in the statement "Whether a mistake was trivial or not it must be reported without exception" (all emphases in the original). The aim was to understand what was

going on, solve problems to minimize their recurrence and thus "learn" from experience.

We can label Bridgestone's experience as Quasi JIT because of the careful attempts to tailor it to local conditions.

NUMMI:

This is the acronym for New United Motor Manufacturing Inc., a 50:50, 12 year venture in 1983 between General Motors and Toyota Motor Co. (Prior to this Toyota had considered teaming up with Ford but this plan fell through). A General Motors assembly plant in Fremont, California, closed since 1982, was renovated by Toyota to produce a Toyota car which is distributed and sold by General Motors under its (GM's) brand name. The workforce, however, was drawn primarily from among the plant's laid off employees, a unionized group with one of the worst absenteeism and disciplinary records in the GM system as of the time of the plant's closure in 1982.

General Motor's purpose in the new venture was to observe and learn first hand the Toyota Production System. For its part, Toyota learned what it was like to deal with the notorious United Auto Workers union (UAW). But since it began operations in late 1984, NUMMI has shown the American auto industry how minimal levels of automation (by US industry standards) and effective work force management can result in an operation which is the most productive not only among GM plants but in the US auto industry (Rehder et al, 1985; Krafcik, 1988; Cusumano, 1988).

GM had simultaneously launched a highly publicized project, known as Saturn, to produce small cars at a new plant using advanced (i.e. computer integrated) manufacturing technology. This ambitious and costly project was quickly modified and scaled down after seeing the results from NUMMI.

Niland (1989) has noted that the NUMMI assembly line stops some 200 times per shift. But since these stops average less than 5 seconds each, the total downtime is only 10-20 minutes per shift. Uptime on the first shift averaged 94% towards the end of 1986. It was 85% on the more recently introduced second shift. The company's target for uptime was 95% on both shifts.

A key feature of the NUMMI operation is the sourcing of components from Toyota's main operations across the Pacific Ocean. Employing satellite communication and innovations in customs clearance procedures, NUMMI has achieved lead times of 5 weeks for the imported components (Niland, 1989).

For its U.S. suppliers, NUMMI operates two progressive pick-up systems (popularly called 'milk runs'), one for California and the other for the more distant Mid-West. The milk run[5] involves the operation of dedicated tractor-trailers (articulated trucks) which go from supplier to supplier (say in California) making pick-ups on a scheduled day and at a scheduled time. When the run is complete the truck goes directly to the JIT automobile plant with the parts.

For the more distant mid-west the operation has been described by Raia (1988) as follows:

> Suppliers get a firm schedule for two weeks and ship the same amount of parts at the same time every day. Ten trucks begin a 'milk run' each day, picking up parts from suppliers in the mid-west and bringing them to consolidation points in Detroit and Chicago. Supplies consolidated in Detroit are then trucked to a transloading area in Chicago where the trucks board a flat railroad car. Every day, a 'NUMMI train' leaves the Windy City terminal for Fremont. The total cycle time from pickup to delivery is four days.

Another point is that, even before production started, a definite period was devoted to personnel training in a simulator mode (Starr, 1988, p. 19). The plant was also designated for the rotating training of GM executives who spent specific periods of time getting live exposure to the new approach to car manufacture. According to Raia, "The lessons learned from NUMMI are now being applied throughout GM's empire" (Raia, 1988) although Lieberman (1988) has noted that this has not been very successful. NUMMI is an example of a JIT collaboration or Joint JIT.

Matsushita:

Just as Toyota is reputed to be the most efficient car maker (thanks to JIT), Matsushita is the world's largest and most efficient consumer electronics company (Baba, 1989). It has not only succeeded in progressively automating its production processes to a great extent but it is among the world leaders in the production of robots for such purposes. Matsushita has for long been identified with the Quality Circle movement. But

surprisingly it is not commonly identified with JIT perhaps because JIT is usually associated with Toyota. In keeping with the philosophy of its founder, the late Mr. K. Matsushita, the company has tended to stress the human resources management element which is, of course, integral to JIT (Sugimori et al, 1977). When a close look is taken, one day, of Japanese electronics companies from the JIT perspective one may well find that these companies are on the road to the "New JIT" which we discussed earlier.

In 1974, Matsushita took over the Franklin Park, Illinois plant of Motorola (Sumanth, 1985) to manufacture colour TVs and microwave ovens. According to Sumanth (1985):

> The quality improvement in the company after the Japanese company took over has been impressive in terms of the reduction in defects and field warranty claims (by a factor of 8 to 1). Along with quality improvement came labour productivity improvement. In fact, the labour productivity improved by 100 per cent in the Colour TV area since 1975. In other words it took on the average about one-half the labour in 1981 to produce the same TV set as in 1975. The number of analysing technicians and office people was reduced by 75% and in 1981, scrap amounted to only 0.19 per cent of the material dollars consumed.

Of all the steps listed by Sumanth (1985) two may be usefully highlighted for our purposes. These are the "flag control system" and the "model line".

The flag control system consisted of 6 monthly quality goals established by a multi-functional group (manufacturing, engineering and quality control) for each manufacturing department. Colored flags on a bar chart indicated whether a

department was above or below the established standard or on the borderline.

The concept of a "model line" was introduced whereby a particular production line was chosen and identified for focusing the efforts of line workers and support staff. The improvements from the model line were then relatively easily introduced into other production lines. All the people involved in the model line met once a week to discuss the problems related to quality and productivity.

For our present purposes the Matsushita case can be characterised as an example of Quasi JIT since it uses a different way to achieve the result of continuous improvement.

The American Exponents of JIT

Harley Davidson:

Founded in 1903, Harley's motorcycle business was "on the ropes" in 1978. It tried and failed to prove a dumping case against Japanese competitors such as Honda, Kawasaki, Suzuki and Yamaha. But the information gathered by Harley's management revealed a dismaying fact that in Hutchins' (1986) words, "galvanized the company into action".

> Japanese manufacturing techniques were yielding operating costs fully 30% lower than Harley's. Harley managers attributed most of the difference to three Japanese practices : quality circles, the use of statistical process controls to ensure high quality and JIT manufacturing. The company quickly began to imitate the Japanese on all three (Hutchins, 1986).

But in 1981, frustrated by their inability to convince the parent corporation that their proposed strategy would be effective, a group of managers executed a leveraged buyout (Severance & Passino, 1988).[3]

In 1981-82 Harley Davidson initiated the JIT approach (Sepehri, 1987) which coincided with the appointment of a new manufacturing vice president from Ford Motor Co. The JIT program was entirely an internal one, not one recommended by consultants or outsiders. The majority of workers were unfamiliar with JIT techniques but they learned JIT concepts from articles, seminars and discussion sessions. Calling their approach MAN (for Materials As Needed), a pilot program was initiated at the engine and transmission plant (Willis, 1986), and then introduced in final assembly at the York plant where a 2 hour repeating cycle was established.

On the strength of these internal efforts, Harley was able to win five years tariff protection for its 800cc motorcycles in April 1983. Then, on the basis of financial progress achieved, it actually petitioned the U.S. Government to terminate the import reliefs in 1987 a full year ahead of its original term of expiry in April 1988. Harley Davidson now continues as the last of the U.S. motorcycle makers which numbered 150 since the turn of the century.

Regarding productivity and quality improvement, Harley's chief executive said, "you must be convinced of what you are doing. If not, don't mess with it - its painful stuff".

(Willis, 1986). Likewise the executive vice president says of vendor relations :

> Sone vendors have done super things in quality and cost control. But some think you are nuts when you send in a group of people and tell them they need to change everything. That is the most difficult part of the process. (Willis, 1986).

Harley scheduled one day a month for tours of its plant and it also began conducting seminars on MAN and SFC even raised the price of the latter to cope with the heavy demand it subsequently experienced. Harley Davidson is also an example, like Mazda, of Crash JIT.

Hewlett-Packard:

This computer and electronics company made the celebrated discovery in 1980 of a serious quality problem in U.S. industry. When it subjected 300,000 semiconductor chips of 3 American and 3 Japanese companies to a test it found that the failure rate for the Japanese chips was zero at incoming inspection (Garvin, 1988) whereas it was 1.1 per thousand for the American sample.

Shortly afterwards it began implementing JIT within the company's numerous manufacturing divisions in a systematic way. The account of how it went about it is central to the argument of the book by Professors Hayes, Wheelwright and Clark of Harvard Business School (1988). One cannot do justice to this fairly long and well integrated account (see pages 205-206, 343-344 and 363-364) by excerpts or even a summary and the reader is referred

to the original book for a complete picture. In fact their publication represents a valuable attempt to move JIT from a narrow manufacturing concern to the general management domain. For our present purposes we will simply point out that the Hewlett-Packard example as presented by Hayes et al (1988) conforms to the classic stages of progression evident in Ohno (1988) and articulated by Gunn (1987). From the available data it is moreover estimated that over half of Hewlett-Packard's 40 manufacturing divisions are currently using JIT protocols. It will also be noted that Hewlett-Packard is the only solid case of an electronics company in our sample and thus points to the need for more JIT oriented studies in this sector.

4

Hewlett Packard, like Toyota, is a clear case of Progressive JIT because of the systematic progression from one stage to the next.

Towards JIT in India

Matsushita:

This company has had twin battery making subsidiaries in India since 1973. Both sell the same batteries to the highly competitive national market, under two separate brand names, from two separate plants and with two different Indian partners. Comparatively more information is available on one of the two units (Matsushita in India, 1983). This unit, popularly known as Novino, has been systematically engaged in transplanting, to the extent possible and with due regard for contextual

differences, the parent company's well known practices in the human relations as well as productivity areas. The plant has been operating on a three shift basis for many years with a practically strike-free record. Progressive automation was evident in component manufacture and in the addition of assembly lines over the years.

The case does not explicitly highlight "JIT practice". Instead it dwells on matters such as good housekeeping, safety precautions, suggestion schemes and the creation of organizational identification through programs such as morning and evening assembly, sports, picnics and cultural events, celebration of production milestones etc. But at one point, an Indian executive engaged in implementing the Matsushita management program remarks in connection with worker development: "The hardest thing to get across to the employees is the concept of time". At Novino time was being measured in minutes when the prevailing concept was of days and weeks if not seasons.

In his aptly titled article "What's your excuse for not using JIT" Walleigh (1986) observes : "The best candidate for conversion to JIT is the organization that has a quality control program and is already documenting its processes, measuring their performance and eliminating problems." Viewed in this light, Matsushita in India clearly has valuable organisational lessons for Indian companies attempting to go over to JIT. In this connection the 16 year length of experience is highly significant - there are no short cuts for effective management. There are no guarantees for survival either.

In the midst of chronically stagnant and fiercely competitive market conditions a new unit, somewhat removed from the present location, is reportedly being planned largely by Novino's Indian executives, an impressive to keep the technical skills of the organisation sharp. By also allotting shares to Novino employees, their continued commitment to the project and to the Matsushita company is also being obtained. The new unit's future operation may be worth observing specifically in the JIT perspective. For the present we can term the Matsushita India example Quasi JIT as in the case of its American counterpart, and the case of Bridgestone in Tennessee.

Suzuki:

This company has a 40% joint venture known as Maruti, with the Government of India for producing minicars (800 cc), vans and jeeps (Maruti Udyog Ltd, 1987). Like Matsushita in India, Suzuki also has a second collaboration though it is for motor cycles in the private sector. Like the previous case this one too does not explicitly highlight "JIT experience" although there are telling references to JIT by its Japanese directors, to "real time problem solving", JIT style vendor development etc.

In the absence of a modern Indian car industry, Maruti, was clearly trying to establish its long term manufacturing (and marketing) capabilities with the benefit of initial multi year order books for its Suzuki designed vehicles. The commissioning of the plant in 1983 was remarkably expeditious in the Indian public sector context and it gave the unit invaluable breathing

room before the onset of the 1985-86 yen crisis. Now with parts imports virtually ruled out because of India's balance of payments position, vendor development has assumed importance if not urgency. And with the Indian car market approaching saturation, marketing has also had to be geared up (including through exports) to keep the plant busy in future (and to justify any imports).

The Maruti-Suzuki operation is in some respects, similar to NUMMI and possibly Ford Mazda about which little is known. But unlike both the latter where the challenge is to transfer JIT practice to another automobile company (GM or Ford) - though clearly gigantic ones at that - in the present case, the transfer has eventually to take place to a motley group (of 200 or so) public enterprises. These are mostly in large scale process or basic industries where JIT relevance is somewhat lagged vis a vis the machinery and equipment sector (Lieberman, 1988). So while this is also a case of JIT Collaboration future progress is likely to be more comparable to that of the other Japanese motorcycle maker, Kawasaki (Dynamic JIT) than Harley Davidson (Crash JIT).

JIT: The Eight Fold Way

From the foregoing review it is possible to conclude that JIT implementation is a journey which can be called the Eight Fold Way. It consists of the following stages:

1. Overcoming cultural resistance: This consists of a period of unlearning old ways and learning JIT ways. It also includes the giving or getting of commitments to act in the new ways. Thirdly, it comprises a period of training to internalize the new ways. This stage is in fact a recurrent one; it is necessary before each of the others which follow.

2. Establishing a JIT Launchpad: This requires the selection of a particular site within a company and a plant where JIT is to be tried on a pilot scale, or as a prototype in order to familiarize organizational members with the working of JIT. JIT has to be seen in operation before it can really be understood. This JIT base needs to be big enough to be significant but small enough to be successfully operated. As we saw, references to this approach were found in Toyota, Matsushita in the US, Harley Davidson & Hewlett Packard.

3. Plantwide JIT Roll-out: Based on direct experience in the JIT base, this stage involves the build up or spread of JIT successively and successfully to other parts of the plant. Hence this phase can involve several sub-phases depending on the size of the plant. The same examples given above apply to this and the next two stages.

4. Comprehensive JIT: This stage involves the spread of JIT to all functions involved in a plant (accounting, personnel, R&D etc) in addition to manufacturing. The spread of JIT from one division to another also belongs this category.

5. JIT Extension: In this stage, JIT practices are extended to suppliers and distributors of a plant or division, based on solid internal experience with JIT changeovers.

6. JIT Dispersion: This comes into operation when a new unit is established in a different geographical location. Site, equipment and personnel selection are all involved. Examples are Kawasaki in the US and Matsushita and Suzuki in India.

7. Collaborative or Joint JIT: This is involved in joint ventures. Examples are GM-Toyota and Maruti-Suzuki.

8. New JIT: This is based on extensive experience with some or all of the foregoing stages and an innovative approach to some factor (hitherto unknown) which provides the necessary logical core for development as JIT did to the previous Fordist Logic of the assembly line.

As stated at the outset of this section, the first stage, overcoming cultural resistance, is a recurrent one. It precedes each of the other stages. In fact, it is the stage which is largely within the domain of the top management of the organization and has to be performed on a continuing long term basis. There may be differences in this role depending on which stage is involved. Thus, the stages up to four involve a primarily internal orientation. Here the attempt is essentially to changeover existing plant. But the subsequent ones entail a more external orientation. Here there is a greater element of choice - of people, sites, machines, collaborators etc.

There may also be differences in terms of the emphasis on "preparatory" type work (unlearning, commitment, initial training etc) and "maintenance" type work (continued communication, training, conflict resolution etc).

This stage should also include the initiation and continuous communication of business information to the rest of the organization. In fact the JIT program should be clearly linked to such conditions. Some programs which cut across the other stages such as safety, good housekeeping, suggestion systems, water and energy conservation etc. will have to be instituted also. In addition, JIT related changes should be fully and completely explained to avoid backlash at critical times. Smooth JIT operation is sensitive not only to quality of materials and machinery but more important, to quality of the work-force and quality of management.

The shift from one stage to the other is carried out as soon as capabilities are internalized and business conditions permit. (On the technical side, the basic mechanisms are the same throughout until we reach stage 8 though there may be a certain amount of "fluctuation" in amplitude as the "scope" involved changes). All in all, this stage provides plenty of opportunity for research and reflection in the organizational and policy spheres.

The other stages up to No. 7, require <u>middle management</u> to play a key role. Based on commitments, understandings and plans generated in stage 1, middle managers have to spearhead JIT

implementation in a controlled way throughout the rest of the organization over the years, continuously.

Given these roles of top management and middle management, the operative level is able to engage in the continuous innovation which results in strategic benefits to the organization as a whole. In order to offset and cushion the pain of eventual lay off of workers due to JIT, top management may have to take advance action in the form of at least freezing (if not cutting) upper management pay scales during critical periods. This is to give the important signal that "everybody is in the same boat". Burdens have to be seen to be mutually shared.

How long will the journey take? Estimates vary. Hellderson (1986) says that 80% of the benefits of JIT can be realised in about 2 years. Hall and Nakane (1983) estimate that it would take three to five years. Hayes et al (1988) observed that Hewlett Packard's pilot and roll out stages in one plant took 18-24 months. But Gunn (1987) notes that Hewlett Packard has 40 divisions. Ohno (1988) says that at Toyota, even after 40 years of JIT, they are improving. They are working on managing the "time line" between placement of an order, delivery of vehicle and collection of cash. In Matsushita India almost all the basic elements are there for realising continuous improvements but they may never use the term JIT.

So it is hard to estimate the JIT Journey which, in any case, is one of continuous improvement. We feel, however, that

Henderson is right. It should be possible to realise palpable JIT benefits in 2 or 3 years if a determined effort is made. After that the implementation ought to develop a momentum of its own. But it cannot be simply initiated and forgotten about. JIT does place a high premium on the will to manage - continuously - to realize challenging long term goals.

Broader Implications

We can now quickly conclude our study by drawing attention to the broader implications of JIT in two areas viz small/medium enterprise management and management education.

Small/Medium Enterprises:

Manoochehri (1988) has observed that "Small companies as well as large ones in a variety of industries could adopt JIT" (emphasis ours). This may be because of the common association of JIT with high volume production. However, we would go further to say that small companies are the best place to implement JIT and must give serious consideration to this. This is because, even a large company implementing JIT has to begin in one of its small units (or departments) as we have explained. Hence small companies as a whole are the logical place for JIT efforts on an economy wide basis.

Small companies do tend to have a greater incidence of sickness or closure, 25% in India according to some estimates. But the introduction of JIT in the healthier ones can reduce the chances of their falling sick as well. Manoochehri (1988) has

identified the advantages which small manufacturers have vis a vis JIT implementation and the benefits they can derive from it. The key to realization of advantages and benefits lies in distinguishing between JIT delivery (of incoming supplies) and JIT production. Small units may well have less flexibility as regards the former especially as they are dependent on large firms for raw materials (eg. SAIL or IPCL in India) but they can and should concentrate on JIT production to reduce costs through process improvements. More important is the creation and maintenance of an organizational climate of continuous improvement and innovation even when conditions become adverse on the input and output interfaces. This will provide a competitive edge of lasting value in the difficult environment in which small units always operate.

Management Education:

Existing programs of management education are basically geared to the requirements of large enterprises. Because of the change in the management paradigm brought about by the implementation of JIT, such companies are now facing major problems of retro-fitting their strategies and structures. As Lieberman (1988) has observed: "The effective internal transfer of manufacturing systems [ie. JIT] knowledge is one of the greatest managerial challenges faced by large companies with decentralized plant operations".

Management educators have a great opportunity to respond to this need. While JIT implementation does involve a

higher and higher order of technical capabilities, the more important challenges in this undertaking are managerial and organizational ones. As Crawford et al (1988) observe: "If cultural resistance to change can be overcome, JIT implementations appear to progress smoothly". Hence management education must take it upon itself to provide the new conceptual support needed by large enterprises including banks and financial institutions. When orchestrated with the actual and widespread implementation efforts at the small unit level, a resurgence in Indian industrialization may be effected in a decade or so, ie. by the year 2000.

Notes

1. Kanban is a Japanese word meaning card. It refers to the information system based on cards used for purposes of production and inventory control. There are several types of Kanban cards and a formula for determining their number. There are also rules for their operation. By reducing the number of cards in circulation, the coupling between stages of production becomes tighter and steps have to be taken to ensure that production does not come to a standstill. (Sugimori et al, 1977; Schonberger, 1982; Ohno, 1988).

2. MRP stands for a computer based system of production planning and control called Material Resources Planning.

3. A Leveraged Buyout or LBO enables a management to purchase a company from shareholders and take the company private, in Harley's case for $80 million.

4. In the course of this study we also considered the case of "Sanyo Manufacturing Corporation, Forrest City, Arkansas" (Harvard Business School Case No. 9-682-045 Rev 8/86) but its JIT elements were insufficient for our purposes. IBM is another electronics company which is reportedly very active in the JIT area but we were unable to obtain any detailed information about these activities.

5. In India the term "milk run" should conjure up an association with the efforts of the National Dairy Development Board which pioneered the organization of milk supply from rural households to produce branded dairy products.

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