6 JUST IN TIME

6.1 INTRODUCTION

Just-in-Time is an operational management philosophy that is widely used in the manufacturing industry. It has its roots in the Japanese manufacturing industry but has been applied in many other countries since. From its humble beginnings as a system of flow management invented by Taiichi Ohno (Womack & Jones, 1996:37) it has developed into a fully-fledged operational management philosophy. Murphy & Schreffler (1999:68), for example, states that Just-in-Time has been enormously beneficial to automakers and suppliers alike.

Just-in-Time has been hailed as an excellent improvement tool, and therefore a study of the primary principles, tools and techniques thereof is needed to determine what aspects of the philosophy can successfully be used as building blocks for the operational management model in a coal mining environment. The chapter starts by discussing the overall management philosophy – a general description of what Just-in-Time is. The Core principles are listed and discussed and the impact of Just-in-Time on a company is deliberated. Problem solving and measurement tools and techniques are described as well as the prerequisites for implementing Just-in-Time.

6.2 OVERALL MANAGEMENT PHILOSOPHY

In the manufacturing industry Just-in-Time is often mistakenly perceived as an inventory control system, whilst it is actually much more than that. Just-in-Time only comes into its own when it is applied to inventory control as well as to production (Womack, Jones & Ross, 1991:161). This section establishes the nature and extent of Just-in-Time.

According to Wheeler (1986:5) Just-in-Time is "an enterprise wide operating philosophy which has as its basic objective the elimination of waste." Waste is defined as any entity that does not add value to the manufacturing/ development of the product. From this definition it is clear that Just-in-Time does not only have a direct impact on the production line, but also on the logistical chain, the quality management process, the design process

and all other functional areas within an organisation. All these processes are necessary to change raw material into final products, but all these processes can have non-value adding activities (waste) included in them. Walter (1986:28) describes Just-in-Time as a philosophy that re-examines every production step with the aim to eliminate every step that is not absolutely necessary and that does not directly add value.

Songini (2000:50) describes Just-in-Time as "...a process where inventory is delivered to the factory by suppliers only when it's needed for assembly". This implies that detail production planning is a prerequisite for Just-in-Time operations, with the throughput determined by the market demand, and the material releases controlled by the production flow pull.

Therefore, Just-in-Time can be described as an operational management philosophy that aims to deliver the required product, within very strict time limitations, to the exact requirements of the customer, without any waste present in the value chain.

6.3 THE KEY VALUES OF THE PHILOSOPHY

6.3.1 Elimination of waste

The basis of Just-in-Time is the elimination of waste. The categories of waste as first defined by Taiichi Ohno are defects in products, overproduction of goods not needed, inventories of goods awaiting further processing, unnecessary movements of people, unnecessary transport of goods and waiting time. Another waste is the design of goods and services that do not meet user's needs (Womack & Jones, 1996:15). The concept of having the right materials at the right time at the right place is an integral part of eliminating waste within a company. There are no unnecessary storage of materials and no excessive stock levels of materials.

(Womack & Jones, 1994:93) argues that it is not enough only to eliminate waste within a company. What is needed is a "lean enterprise". A lean enterprise is where the elimination of waste in internal systems (within companies) as well as the non-value adding activities taking place throughout the whole supply chain (across companies), occurs.

6.3.2 Quality

Deming, Juran and other Just-in-Time practitioners presented the statement "no low cost without high quality" to the manufacturing world (Sandras, 1986:11). Just-in-Time advocates a principle of zero defects in the production process, which will lead to low production costs due to the elimination of waste in the system. To be able to reach the goal of zero defects a highly focused quality management program is needed. Wheeler (1986:6) comments as follows on the quality emphasis needed in a Just-in-Time program:

- Variance in the processes must continuously be reduced if one wishes to improve manufacturability. This can be achieved by using statistical methods to identify and prioritise the opportunities for productivity and quality improvements.
- The operator assumes responsibility for zero defects on his machine. To achieve this management need to provide the appropriate tools, techniques and mechanisms needed to manage the quality process.
- Emphasis must be placed on eliminating the chronic quality problems first, as these disrupt the process flow more significantly than the sporadic problems.
- Pro-active maintenance must be the operators' responsibility.
- With the launch of a new product all functions (design, marketing, production, maintenance) must be involved from the beginning. To ensure a quality product the involvement of these departments throughout the whole product development phase is crucial.
- Extensive training in quality assurance techniques must be given to all operators and inspectors. The long-range goal is to minimise the number of inspectors by achieving zero defects in the process.

Just-in-Time cannot be successful without Total Quality Control (TQC). Using TQC techniques the root cause of a problem is found and eliminated. This solution is then standardised in other related processes to ensure that the problem does not occur again. With the focus on the individual to contribute totally in preventing defects and solving quality problems the function of the quality department changes from quality control to quality audit, and quality is built into the process and product from the beginning. (Sandras, 1986:11)

By eliminating non-value adding activities and reducing work-in-process it becomes critical to control the quality of the production processes very strictly, as there are no buffers to

protect the system. Therefore Just-in-Time cannot function properly without a Total Quality Management Program in place.

6.3.3 Continuous process improvement

A key feature of Just-in-Time is that it is an ongoing cycle. No matter how good a company is, or how good they get, they should constantly strive to improve and work more productively. (De Vries, 1987:1). In the management review *The Antidote Issue* (1997:p13) this is referred to as "...the continual hunt for perfection...".

A technique used to achieve continuous improvement is the use of quality circles. Quality circles are discussed in the chapter on Total Quality Management. Teams of people from all levels of the organisation form quality circles where they discuss ideas on how to improve on the current processes.

Performance measurement in a Just-in-Time company is also focused on measuring improvement over the previous performance level and not just the acceptability of the current performance (Hall, 1987:44). Top management need to promote and entrench a culture of continuous improvement among employees.

6.3.4 Total employee involvement

Just-in-Time cannot succeed without the total commitment and involvement of all employees. For example, production line workers must have the confidence to stop a process line when they determine that a problem exists. They are also encouraged to improve their workplaces. The improvement of a workplace starts with basic cleanliness and checks (e.g. for safety measures and first line maintenance) but evolves into active participation in problem solving. Workers are expected to contribute to quality and productivity improvements. Finch & Cox (1986:335) describe an approach to obtain such a culture:

- Managers need to be visible on the shop floor, but not only when they are expediting work. Their focus must be on the workers, determining the morale levels, interacting with the workers etc.
- Reasonably permanent employment is guaranteed.
- Infrequent but steady performance evaluations and promotions as well as generalised career paths for all employees are needed. This will ensure that an employee knows what is expected from him, and how he can progress within the company.
- A culture of collective decision-making and responsibility must exist.
- A holistic concern for employees must be displayed.

The profile of the shop floor worker in a Just-in-Time plant changes from being a production operator only to being a creative value-adding employee. There is respect for fellow human beings, for their aspirations, capabilities and their integrity (Fogarty, Blackstone & Hoffman, 1999:59). Sandras(1986:12) describes the changing role of the shop floor worker in a Just-in-Time environment. In a traditional manufacturing environment only the specialists and management have the responsibility for problem solving. Under a Just-in-Time approach a thinking worker is developed. The worker must have a continuous improvement attitude and a sense of urgency for solving problems. The Just-in-Time worker also knows that producing an item before it is needed does not add value. He/she knows the total production process well and is flexible enough to function within any related production process. Multi-skilling is an essential part of the make-up of the Just-in-Time worker. Therefore the work is done when needed, and there is flexibility in the teams to be able to cover for unforeseen occurrences. If the machine they operate becomes idle, and they do not have any activities that need to be performed on the machine, they can easily move to the next machine within the work center to assist with the operation of first line maintenance.

By creating a culture of total participation a constantly improving process of waste elimination and maximum productivity of all resources can be obtained. This needs to be an ongoing process to prevent stagnation and possible failure of a Just-in-Time program.

6.4 IMPACT ON FUNCTIONS

Just-in-Time impacts the whole organisation. This chapter explores the functional areas where a company that applies Just-in-Time principles differs from one that does not.

6.4.1 Procurement & Supply Management

6.4.1.1 Supplier management

Just-in-Time advocates a reduced supplier base. Sandras (1986: 8) describes the logic residing behind this approach. With fewer suppliers it is much easier to find the cause of incoming material problems. Furthermore, it becomes possible to help the supplier with implementing a quality structure. With more commitment from the manufacturing company better service levels from the supplier can be expected.

Supplier selection is not only based on the basis of price and the bids that they present to supply particular items, but rather on the basis of past relationships and a proven record of performance. Suppliers are also selected to supply whole components not just individual parts. Such a supplier is called a first tier supplier. Womack et al(1991:146) uses the example of a complete motor seat that must be supplied instead of the different parts of a motor seat with the motor manufacturer assembling the parts.

Excellent supplier relations play a crucial part in a Just-in-Time supply chain. As a Just-in-Time system demands consistent and precision delivery, joint commitment and open communication are essential between the suppliers and the Just-in-Time company. To achieve this the purchasing department has to work closely with suppliers and constantly improve their relationship with suppliers. Imai (1986:212) lists some of the actions that need to be taken by the manufacturing company:

- Establish criteria to measure optimum inventory levels
- Improve the quality of the information provided to suppliers
- Establish optimum physical distribution systems
- Understand suppliers' internal requirements better

Just-in-Time companies also assist suppliers in establishing Total Quality Control programs and facilitate Kaizen activities.

One method used to bring the manufacturing company and supplier closer together on an operational basis is defined in the concept of Just-in-Time II (Deierlein, 2000:2). With this

concept a supplier employee works full-time in the manufacturing company's purchasing office. The supplier representative is responsible for purchasing the materials or services that his company supplies, utilising the manufacturing company's procurement system and documentation.

An open communication network from the supplier to the manufacturing company is needed. This ensures a quick response to problems. It is necessary that the required schedule for the short as well as the long-term needs is made available to the suppliers, preferably on-line. Any changes to the schedule need to be communicated to the suppliers immediately. The Internet and electronic commerce have made this process very streamlined and efficient. With developments in EDI (electronic data interchange) suppliers and manufacturing companies can communicate instantly, internationally and without the human error that always was a part of the process. Murphy & Schreffler (1999:70) mentions that some transport companies relay information from their trucks to border posts before the trucks arrive there, thus enabling a smooth and fast clearance at customs. Where suppliers and manufacturing companies operate in a Just-in-Time II relationship, restricted access to each other's ERP systems are provided (Atkinson, 2001: 43). This greatly enhances communication.

Walter (1986:28) states "Just-in-Time processes require Just-in-Time information delivery systems". He explains that the actions of reducing lead-times and inventories result in on-line storage of large numbers of active documents. This is due to more frequent orders for supply materials, more receipts of delivered materials, more job runs planned, EDI communication etc. An advanced, integrated ERP (enterprise resource planning) system will support a Just-in-Time company in the daily operations, decision-making, communication with suppliers and strategic planning.

6.4.1.2 Design & development

Just-in-Time companies utilise the knowledge of their suppliers from the beginning of a new product development cycle. The designated supplier of parts will assign design engineers to the development team of the new product. As the blueprint phase is completed the different designs are turned over to the supplier specialists to scrutinize the designs. The first tier suppliers have full responsibility for the design and manufacturing of parts that will perform

to the original specifications. The supplier involves design engineers from the manufacturing company during the detail development and design phase. (Atkinson, 2001: 41)

This approach is not applicable to those parts that the manufacturing company deems to be vital to the success of the new product: items that are classified as proprietary technology.

6.4.1.3 Storage

Just-in-Time proposes decentralised storage. The materials needed as input for specific processes should be delivered at the production line, not at a warehouse removed from the area. The ideal is for the materials to be sent directly from the supplier to the point of use. This ensures a simple but flexible storage system. A term used to describe this is DTS (dock to shop). The manufacturing company sends a request for material to the supplier, who will then ship it to the manufacturing company. It is received at the receiving dock on the manufacturing company's system and the material is then directly delivered to the required location in the plant bypassing the warehouse. The benefit of this method of operation can be greatly enhanced if consignment inventory is used. The manufacturing company does not own the material until it is consumed, before then it is still owned by the supplier even if it is sitting on the manufacturing company's shop floor (McBride, Harrison & Clark, 2000: p34). Using the DTS process the supplier keeps a certain amount of material in stock based upon the forecasted requirements provided by the manufacturing company. A danger is that Just-in-Time companies can utilise this method to shift stock holding to the suppliers with the result that the holding cost for the inventory will ultimately make its way back to the manufacturing company. (Murphy & Schreffler, 1999: p67)

6.4.2 Production and scheduling

6.4.2.1 Group technology

Finch & Cox (1986:332) describe the impact that Just-in-Time has on the grouping of machines within a production line. Just-in-Time breaks the traditional pattern of grouping identical machine types together (all the lathes together, all the drills together etc.). With a Just-in-Time production system machines are grouped together not based on their function but on the family of parts that will be routed through them. This ensures shorter queues and more flexibility in the system. It also decreases the work-in-process traveling time. The group of different machines used together is treated as a work centre, and work is planned

and allocated to the work centre. High reliability in a work centre is essential as a single breakdown can stop the whole work centre. Therefore the workers in a work centre are skilled in preventative maintenance practices, in identifying maintenance problems and in alerting the correct maintenance teams if problems occur. Workers in a work centre are multi-skilled enabling them to assist their co-workers in the work centre.

6.4.2.2 Model mixes

Traditional production methods favour long runs of the same product: so called fixed model runs. In contrast Just-in-Time stresses the importance of mixed model runs. (Sandras, 1986:10) A mixed model run is a small lot size run of part A, followed by part B in a small lot size run, followed by part C in a small lot size run. The production flow will be A, B, C, A, B, C... With a fixed model run a small change in the schedule (e.g. due to demand) has a large impact on the production capacity and stock levels (i.e. not enough stock, or too much stock). With the smaller lot sizes of a mixed model run it is easier to adapt to the changes.

6.4.2.3 Reduced set-up times

To achieve the small lot size goal, set-up times need to be reduced drastically. The Japanese have revolutionised this concept by showing that set-up times can be reduced dramatically through applying a scientific approach. (Sandras, 1986:8) This is accomplished in two steps: firstly the set-up tasks are separated into internal and external tasks. The external tasks are all those that can be accomplished while the machine is producing. Secondly the internal tasks are analysed and improvements made to reduce the total set-up time. It may be that some tasks are eliminated, or the time required per task is reduced. (Fogarty et al., 1991:584) In their aim to reduce set-up time they initially sought SMED (single minute exchange of dies i.e. set-up of machines under 10 minutes). Next they aimed for OTED (one touch exchange of dies, i.e. set-ups under one minute) and the ultimate goal is NTED (no touch exchange) where either no set-up is needed or the set-up can be accomplished in the time it takes to transfer a completed part out of and another into the machine (Sandras, 1986:9).

6.4.2.4 Scheduling

Production scheduling in a Just-in-Time environment is based on the actual need and not planned need. This implies that production is driven by market demand (pull system) versus

the push system (produce to make stock). A push system assumes the next workstation will be ready to process the material, where-as in a pull system the material is not sent to the next workstation until it is requested. Toyota's pull system is called the Kanban system due to the Kanban cards and containers originally used. Toyota also utilises an electronic form of Kanban within their distribution and logistical network. (Murphy & Schreffler, 1999: 72)

Kanban cards and/or containers are used to indicate when a workstation can start with the fabrication of a new batch of items. De Vries (1987:5) describes the process as follows: "As a container is emptied of parts at the second work centre, the container and kanban are returned to the preceding, or first, work centre, where the kanban authorises production of another container of parts".

The secret of the Kanban system lies in the number of Kanban cards that are circulating in the system at any one time. The number of cards controls the number of parts produced per time period. Fogarty et al (1991:591) presents a formula to derive the number of Kanban cards to use in a sequential flow process.

$$N \geq \frac{D\,(M + P)(1.0 + S)}{Q}$$

Where

N = the integer number of cards/containers required

D = the demand rate per hour

M = the average wait and move time required for the card/container

P = the average set-up, run and inspection time required to manufacture the parts in the card/container

S = a safety factor, expressed as an percentage

Q = the quantity of parts held by each container

To implement Just-in-Time scheduling is therefore "...to move towards producing a set of products across the range, with quantities in proportion to the current sales mix, in shorter time buckets." (Bicheno, 1986:22). However, Bicheno emphasises that it is dangerous to move towards Just-in-Time scheduling unless good inventory control have been achieved. Just-in-Time scheduling (pull system) assumes that the material for a specific work centre will be available when that work centre needs it. If the inventory control system is not

working satisfactorily, work centres may be stopped due to a lack of feed material. This can lead to late deliveries of final products.

6.4.2.5 Uniform work loads

Just-in-Time demands smooth and stable production rates due to the nature of the Just-in-Time deliveries of feed materials from suppliers and the lack of large work-in-process buffers. The daily production schedules determine the production rates – make daily what you want to sell daily. A uniform workload is defined as the cycle time required to meet, but not exceed demand. It is a production rate for all components and assemblies that is synchronous to the demand rate (Wheeller, 1986:7). It is not possible to keep the production rate the same for all machines, but the bottlenecks should be occupied fully and the non-bottlenecks can be allowed some idle time. (Bicheno, 1986: 22)

6.4.2.6 Engineering

With the demand for a stable plant the reliability and availability of the production line is very important. Engineering problems can affect the total production line and bring production to a standstill. As there are no excess buffers in the production line a breakdown can shut the whole line down. Therefore preventive maintenance management is a crucial element in a Just-in-Time environment. The focus of the preventive maintenance program is on process control: to eliminate the production of defective units. The operators also have a big responsibility in understanding and identifying maintenance problems. The operator needs to be responsible for first line maintenance. The engineering department also needs to focus on the automation of equipment. The more tasks that the equipment can perform itself (health checks etc.) the more flexible the operator becomes.

The maintenance and production departments must be aligned to understand each other's needs. Engineering problems that arise must be discussed between the two departments, prioritised and given attention to as planned. The traditional communication methods and barriers between production and maintenance do not allow for quick response time. In a Just-in-Time environment people from production and maintenance will be part of the same quality circles (Sandras, 1986: 14).

6.5 PROBLEM SOLVING AND MEASUREMENT TOOLS & TECHNIQUES

A Just-in-Time company focuses on continuous improvement in the process of eliminating waste. Therefore the problem solving and measurement tools used within a Just-in-Time company are focused on these two aspects. It is important to note that the problems that are focused on are firstly the chronic problems, then the sporadic problems (Hutchins, 1988:52). The sporadic problems are normally dramatic and sudden, but their solution would present no change from past performance. It would just normalise the situation. Chronic problems on the other hand are those problems that have always been there. They go unchallenged and people have become accustomed to them. These are the problems that the Just-in-Time problem solving and measurement tools aim to isolated and solve. This chapter explores these tools.

6.5.1 Problem solving sequence

Hutchins (1998:54) describes a universal problem solving sequence as presented by Dr Juran.

- Firstly the symptom is clearly defined:
  - A set of theories on the causes of the symptom is defined. This is done by utilising typical TQM techniques such as brainstorming, Pareto analysis and the fishbone diagram.
  - Next these theories are tested in an effort to identify the true cause of the symptom.
- Secondly a remedy for the cause is developed:
  - All possible remedies are listed.
  - The optimum remedy is selected.
  - The remedy is tested for validity and implemented.
- Thirdly the remedy needs to be sustained:
  - The ever-present RTC factor (resistance to change) must be addressed.

- The remedy must be transformed into a solution that will last without constant supervision. If this is not possible regular process audits need to be conducted.

An example of this process in practice can be observed at the Toyota SA plant in Durban (as observed by the author on a visit in May 2003). The different teams make use of process flows describing the part of the process they are responsible for. Any deviations picked up within the process are captured on a problem identification sheet, referring to detail such as the process step, time and date. These deviations range from a part falling from a specially designed bracket to a product deviation. As the teams rotate (work in shifts) the information is clearly visible for all teams working in that work centre, and all contribute to the problem solution process. The team then discusses all the problems during their daily meeting. Possible reasons for the deviation are listed and explored. When the team has identified the root cause of the problem this is captured on the problem identification sheet. This illustrates step 1 in the above sequence. The decision on what action to take to fix the problem is handled in the same way.

6.5.2 Specific measurements

Just-in-Time requires an appropriate measurement system that will focus on the key values of the philosophy. Fogarty et.al. (1991:600) list the following key criteria to be measured:

- *Raw materials*: inventory dollar days, raw material stock outs, setup reduction, vendor delivery performance, vendor quality performance
- *Equipment*: machine breakdowns, setup reduction
- *Facility*: space requirements (utilisation)
- *Employee*: morale, education and training acquired, labour effectiveness
- *Final product*: cycle efficiency, process improvement, lot-size reduction, material stock-outs, WIP reduction
- *Transformation process*: cycle efficiency, process improvements

They also describe a KPI to measure manufacturing efficiency (ME) that differs from those used in non-Just-in-Time companies. Traditionally ME is calculated by dividing the total of setup time and operation time by the total manufacturing lead-time. However this will provide a misleading result, as the queuing or waiting time is included in the calculation of

the total setup and operations time. A more accurate measure of ME is VAE (value added efficiency). VAE is calculated by dividing the processing time by the total manufacturing lead-time of the part. This result is an accurate measure of the percentage of time a part is being processed and therefore having its value increased.

6.5.3 Process improvement

Identifying deviations can be by observation (refer to the Toyota SA example) or by statistically analysing the process. As quality management is a key value of Just-in-Time, process capability and improvement studies are used extensively in a Just-in-Time company. The aim of these studies in a Just-in-Time company is to eliminate variability, and therefore increasing predictability. Hutchins (1988:120) describes it as being the essence of Just-in-Time: parts leaving a machine can be assembled without the need for any checking, and they will always be defect free (no waste in the system). Just-in-Time utilises control charts and Statistical Process Control to determine process capability and then improve the process. These methods are discussed in detail in the chapter on Total Quality Management, paragraph 5.5.1.

6.6 IMPLEMENTATION

It is important to realise what is needed for a successful implementation of Just-in-Time as it can have disastrous effects if handled wrongly. Womack & Jones (1996: 140) state two reasons why lean production efforts do not deliver on the promised results. One is that many companies understand and utilise the underlying concepts (as discussed in paragraph 6.3) but they cannot integrate the concepts into a coherent business approach. In essence they grasp the power of the individual concepts (i.e. Kanban, pull scheduling, work centers) but are not able to implement the different concepts together in a balanced system. Secondly, it is very difficult to introduce the concepts into mature organisations (organisations that are not in the start up phase any more, that have entrenched systems and processes), as these organisations are usually not susceptible to change. Specific areas to focus on before introducing Just-in-Time in a company are described in the following paragraphs.

6.6.1 Suppliers

Just-in-Time production schedules can play havoc with suppliers. They may experience uneven demand for labour and equipment that can result in excessive set-up and production control cost. This is due to the demand for smaller lot sizes to be delivered more frequently. The suppliers need to change the way that they manage the transport of the items. De Vries (1987: 13) mentions the term "contract shipping" as a mechanism for suppliers to manage their logistical cost. It is essentially a transport plan developed between the supplier and the manufacturing company with the aim to keep trucks moving with as full as load as possible – thereby reducing the handling cost per unit and increasing the time between deliveries. With contract shipping components are off-loaded at a plant and finished products loaded for delivery at another point.

6.6.2 Employee commitment

The role of employees in the success of Just-in-Time has been mentioned before. Therefore it is a vital pre-requisite that the employees are totally committed to the new method of operations to be followed. Keys (1991:22) describes the management style that is needed within a Just-in-Time company to create the new culture. Employees should be managed according to Theory Z (a theory of behaviour). According to this theory everyone in the organisation:

- Trusts everybody else
- Has an in-depth understanding of their fellow employees
- Has a common heritage and cultural background.

In a diverse country aspect number three cannot easily be achieved, but nevertheless the company needs to develop a culture and shared values that will bind the employees together regardless of heritage and cultural background.

Keys (1991:22) also underlines the value of the Just-in-Time elements trust, subtlety and intimacy. These must be in place to enable everyone in the organisation to co-operate fully

in achieving the Just-in-Time goals of the organisation. These elements support the Theory Z principle to achieve fully motivated people.

Also, the demands that Just-in-Time places on the workers imply that they need to be well educated. To be successful with Just-in-Time a company may have to retrain a major part of the organisation.

6.6.3 Capacity production

During the process of implementing Just-in-Time many disruptions may occur as waste is identified and eliminated. To curb the impact of these disruptions Keys (1991:24) advises that Just-in-Time companies should attempt to operate at less than full capacity. The spare capacity is needed otherwise disruptions are magnified. Where possible the production rate should also be stabilised. By not having to solve problems caused by erratic production scheduling the company can focus on process control, waste eliminations and the successful implementation of all Just-in-Time elements.

6.6.4 Long term emphasis

Just-in-Time is inherently a long-term approach to doing business (Keys, 1991:24). It is questionable if a company will see any results with implementation of Just-in-Time when the reason for the change is to get a quick fix. If middle management is under short-term pressure to increase profits any hope of a successful Just-in-Time implementation are doomed.

6.7 CONCLUSION

In this chapter the management philosophy Just-in-Time was discussed. Just-in-Time can be described as an operational management philosophy that aims to deliver the required product, within very strict time limitations, to the exact requirements of the demand. It is a

philosophy that embraces the production chain from the designing phase through to the client receiving the final product.

This chapter presented the key values of Just-in-Time and explained the impact these values have on the functions within a company. The unique measurement tools and techniques used in a Just-in-Time company were discussed. Finally the pre-requisites for successful implementation of Just-in-Time in a company were determined.