Logistical redesign of the supply chain used to deliver carpets used in motor vehicles assembled at Nissan South Africa

by

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Executive summary

At Nissan South Africa, situated in Rosslyn, Gauteng, there is a trend to improve their current logistical layouts throughout the supply chain and to make manufacturing and assembly more streamlined.

In this project, the carpet supply chain will be redesigned from a Classic call logistical supplier to a Just In Time supplier. By applying innovative Industrial Engineering techniques and carefully analysing the various challenges, the goal of this project will be to eliminate and/or reduce the redundant material handling, quality checks, warehouse costs and the risks of damage that the carpets experience throughout the supply chain.
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Chapter 1

1.1 Introduction and Background

Nissan South Africa’s main assembly plant situated in Rosslyn, Pretoria, currently assembles a selection of six models on its Multi Model assembly line. These six models come in various specifications and trim levels. With engines, exterior trim, interior colour schemes and wheels all subject to customer specification.

Nissan receives all of its interior carpets that are fitted to Nissan and Renault models from a single local supplier situated a few kilometres off site. The current supply plan utilised by Nissan SA regarding the carpets is a Classic Call method which is a very dated approach in modern logistical procurement.

The current Process

Nissan SA’s marketing forecast is a typical 3 month schedule plan created to meet demand. From this marketing forecast, SAP R/3, the Enterprise Resource Planning suite used by Nissan SA, creates the Master Production Schedule (MPS). An MPS is a line on the master schedule grid that reflects the anticipated build schedule for those items assigned to the master scheduler. The master scheduler maintains this schedule, and in turn, it becomes a set of planning numbers that drives material requirements planning (MRP). It represents what the company plans to produce expressed in specific configurations, quantities and dates.

A Car Flow Pipeline or Supply Pipeline schedule is created which contains all the various constraints. These constraints include Multi Model Line capacity, paint shop capacity, warehouse capacity and parts availability. “Paper Cars” are created once the Car Flow Pipeline is scheduled. These Paper Cars are correlated to either meet customer orders or are build-to-stock units.

The MPS creates a Release to the carpet supplier (Feltex). A Release contains a Date, Quantity and Part Number and is contained in the Bill Of Materials (BOM). This Release is called a SAP Schedule Agreement.
Carpets get delivered on pallets every two or three days. Once the carpets are delivered to Nissan SA, it is offloaded in the Receiving area. In Receiving, a Quality Inspection is done by Nissan SA employees. This increases lead time. Once the quality check is completed in Receiving, the pallets are moved to the Warehouse. The warehouse has to be able to keep a buffer of carpets sufficient to supply to line side for 3 days, should something go wrong at the supplier. In the Warehouse, these carpets have an allocated bin location, the pallets take up warehouse space, and each pallet incurs a cost, the carpets in the pallets that are in the warehouse run the risk of getting damaged by cat urine and dust. Whilst in the warehouse, the carpets and the pallets on which they are stacked undergo amortisation.

The warehouse has to have a strategy regarding which carpets to pick from bin locations. There is another risk of the incorrect carpets being supplied to line side. A tractor, forklifts and operator labour is involved in handling the carpets in the warehouse. The forklifts and tractor undergo depreciation and require frequent maintenance. All these are extra costs incurred.

From the warehouse, the carpets are collected by production and moved to a marshalling area before being offloaded alongside the assembly line (KANBAN approach) where the carpets are fitted to the vehicles. The carpets are offloaded using a forklift, because the carpets are packed in pallets.

1.2 Project Aim
From the above mentioned current process, it is clear that redundancy in material handling is a problem. Also, throughout the supply chain, the carpets run a serious risk of getting damaged due to exposure of the elements.

The aim of this project is to redesign the carpet supply chain from the current Classic Call method to a Just in Time supplier (JIT-supplier)

1.3 Project Scope
During the first part of this project, the total carpet supply chain to Nissan South Africa will be analysed. With Nissan already having identified that they want to make
Feltex a JIT-supplier, a thorough study of the various qualities needed to be a successful JIT-supplier will be outlined.

The next part of the project will deal with designing and re-engineering the carpet supply chain from its current state to the improved planned future layout. This will require working in close correlation with Richard Kearney, one of Nissan’s process engineers, to ensure that Chris covers all the aspects involved and meets all the demands to make Feltex a JIT-supplier.

The project scope does not include a practical implementation of the planned model, but Chris’s findings will be used by Nissan SA to consider implementation in the near future.
Chapter 2

2.1 Just In Time (JIT) – The philosophy

Just in Time, in its most basic form, is the elimination of waste in a typical manufacturing system. JIT is not a new concept and has been present in the Japanese manufacturing industry for quite a while. JIT requires that resources, equipment and labour are made available in the amount required and at the correct time required to do the job. [1]

When a company decides to adopt a JIT approach, it acknowledges the fact that their current return on investment can be increased by a reduction in in-process inventory and material handling costs. [3] JIT essentially wants:

“The right product, at the right time, at the right place, delivered in the right quantity, at the right cost”

It has been found that JIT is very effective in its ability to increase productivity, work performance and product quality, all the while having a major positive impact on cost saving.

2.2 Planning for JIT

Since each manufacturing process is inherently different, it is not possible to have a JIT system that can be implemented without modifications. Each manufacturing company should establish its own degree of appropriateness and its final application of JIT. In Nissan SA’s case, the JIT system shall be applied, at first, in the carpet supply chain.

The goal of JIT is to have a system that allows the manufacturer the materials, equipment and people on hand required to do the job in the most cost effective and productive way. Achieving this goal requires six basic objectives: [1]

1. Optimize and integrate every manufacturing step
2. Produce a quality product
3. Reduce the cost of manufacturing
4. Produce the product on demand
5. Develop flexibility in manufacturing
6. Keep the commitments made between the Customer (Nissan SA) and the supplier (FelTex carpets)

Obtaining each of the abovementioned goals do not automatically make a company a JIT manufacturer, but failing to achieve even one of these goals will hamper a company’s ability to establish itself as a successful JIT manufacturer [6]

1. Integrate and optimize

The supply chain system is a continuous process of reducing the required amount of steps to complete a process. Removing bottlenecks in the manufacturing process is critical in integration. Planning for 100% defect free quality is a good way of achieving this. Reducing the need for inspection and rework and eliminating redundant material handling is what is required to achieve integration and optimization.

2. Produce a quality product

Total Quality Control (TQC) is a fundamental goal in JIT supplying. TQC emphasizes quality at every step of manufacturing: from product design, straight down to raw material procurement.

3. Reduce the cost of manufacturing

Design a product to facilitate and ease a manufacturing process to help reduce cost. Establishing a good employee employer relationship ensures that products are designed for manufacturability. This cultivates and taps resources of the production floor employee and the line employees to develop cost saving solutions.

4. Produce the product on demand

Producing the product on demand includes the fact that the product is not held in inventory in the warehouse, but rather delivered on time at the required location. This implies that labour is only expended on goods shipped to a customer.

5. Develop flexibility in manufacturing
Manufacturing flexibility is the rate at which the mix of products can be changed to meet the demands of a customer. JIT's unique feature is to change form the AS-IS (Push) state, to the TO-BE (Pull) state. Production managers should address the following, should they wish to achieve complete manufacturing flexibility:

- Lead time of the supplier
- Fast and reliable delivery of finished goods
- Production process time
- Setup time
- Reduced bottlenecks

6. *Keep the commitments made between the Customer (Nissan SA) and the supplier (Feltex carpets)*

Commitment and trust between supplier and customer is very important when striving for a successful JIT system. A JIT system’s success relies on the fact that the two communicate continually. [7]

### 2.3 Optimizing a Supply Chain

With today’s ever increasing competitiveness in the manufacturing industry, managers are focusing more and more on improving their position and competitive advantage in the Supply Chain. Supply Chain Optimization is the application of tools, skills and processes to ensure the most optimal functionality of a distribution and manufacturing supply chain. [5]

This includes:

- Optimal placement (or complete elimination) of inventory
- Reduced operation cost (including transport, inventory and material handling costs)
- Application of mathematical models to aid in finding optimal solutions
- Gross margin return on inventory invested (GMROII)
- Maximizing gross profit of distributed products

The classic approach to supply chain optimization is to forecast future demand accurately or as accurate as possible using statistical trends and “best fit” [5]
techniques that are based on historical data available to management. Nowadays, Enterprise Resource Planning (ERP) software such as SAP R/3 and Oracle allow companies to predict demand much more accurately.

2.4 Developing a JIT supplier

There are many things that can go wrong in a Just In Time supply situation. Late deliveries and quality problems can cause line stops, and the sequence of parts must be exactly in the right order to maintain a smooth assembly operation at Nissan.

To ensure a long-term business relationship, it is important to develop a link between the companies. A solid link will ensure stability required to increase and optimize profit for both companies involved. For a supplier to perform optimally, it requires four needs to be addressed: [1]

1. Trust
2. Communication
3. Linearity of production
4. Time and visibility to make changes

Trust

Suppliers need to trust that their customers will provide stability, should the supplier meet its requirements. This allows supplier and customer alike to work much more closely than with just an agreed upon contract.

Communication

Setting up communication in a JIT supply situation, one can go about it in two ways:

Supplier contacts: some companies assign a buyer-quality engineer team to be the contact for each supplier. This provides a formal and stable channel of communication for the supplier.

Supplier programs: this keeps the supplier informed and ensures that access to critical information regarding production is available to the supplier. This ensures that supplier and customer alike understands each other’s needs.

Linear production schedules
Reducing setup time, identifying bottlenecks and balancing the production setup is three of the main areas improved when a linear production schedule is utilised. A JIT system creates the need for the supplier to be fully aware of the needs of the customer at all times. This is only possible if the supplier is able to reduce lead time. [1]

2.5 Benefits of JIT

- Reduced lead time and setup time
- Flow of goods from supplier to customer improves
- Multi-skilled employees are used more efficiently and productively
- Demand drives production scheduling which is synchronised with work hour consistency
- Supplier relationship receives a larger focus
- Material and supplies arrive frequently throughout the course of the day
- Inventory and the need for warehouses are reduced
- Line side space is increased due to less back up inventory

2.6 Problems with JIT

Large supply or demand changes might impact suppliers in such a way that demand cannot be met. This in turn causes production or assembly lines to come to a halt, negatively affecting output and profit. A customer may be susceptible to flow interruptions due to low stock levels.

Incorrect sequencing and incorrect products being delivered will also cause line stoppages. A company with a single JIT supplier for a specific product runs the risk of major downtime, should the supplier encounter catastrophic disasters on site.

2.7 Conclusion

It is henceforth seen that to have a successful JIT system, a company-wide commitment, correct materials, people, quality and equipment is required. Once the suppliers, manufacturers and customers function as individual stages and operate accordingly in perspective; they can no longer operate in ignorance. [1] The rules of productivity standards have been changing a lot to shape the economy and markets today; therefore every company must be willing to change and be dynamically responsive to demand. In general, it is said that there is not a KEY in achieving JIT
success; only a LADDER; where a series of steps of dedication in doing the job right every time is what it takes. [1]
Chapter 3

3.1 Analysis of the current carpet supply chain

Currently, there are seven areas where action takes place regarding the carpet supply between Feltex and Nissan SA:

1. Material Control
2. Feltex (Supplier)
3. At the Nissan Security gate
4. At Receiving
5. At the Warehouse
6. At the Marshalling Area (Line feeders)
7. Finance

3.1.1 Material Control

The Material Control Department sends Releases to the suppliers which show them what quantities of what parts must be delivered at what dates in the current month. It also shows the intended schedules (forecasts) for the next 12 months. These get updated monthly, depending on the schedule changes in the pipeline.

In short, a Release is an urgent message to the supplier in which Nissan asks the supplier to advance the next delivery stated on the Release. Production planning must input into the mainframe what parts have an unacceptable low stock level online. Production must do this one day in advance. Material Control then double checks via the main frame (SAP) the total amount of stock of the particular part at Nissan (at the marshalling area, in the warehouse and on line-side)

3.1.2 At Feltex

Feltex uses the Releases from Nissan SA for planning the purchasing of raw materials, and also for planning production and despatch functions. A delivery note accompanies the parts when despatched to Nissan. The document functions as a delivery note and an invoice simultaneously.
3.1.3 At the Nissan security gate

Upon arrival at the Nissan Goods Receiving gate, the driver is given a “Gate Pass” by Nissan Security. The driver then continues onto the Initial Recording office. Here the drivers’ Delivery Note is completed.

3.1.4 At Receiving

This is the physical receipt of parts. At Receiving, the Quality Control is simultaneously carried out by a Nissan employee.

![Figure depicting the receiving area just outside the warehouse](image)

Here in receiving, the redundancy of material handling commences and becomes apparent. The pallets are offloaded from the truck with the forklift, placed on the ground, a Nissan employee counts and inspects the carpets and the pallet is stacked in the marshalling area in front of the warehouse.

3.1.5 At the Warehouse

The forklift operator then moves the pallets from the receiving area to the warehouse storage location. The movement tag attached to the pallet indicates at what location the parts must be stored in the warehouse. If an operator stores the
carpets in the wrong location, the picking of the carpets to the line side increases lead time and causes delays.

### 3.1.6 At the Marshalling Area (Line Feeders)

The Marshalling area, located in the assembly plant, is controlled by Line Feeding, which is part of the Production department. Marshalling areas function as temporary storage areas located close to the assembly lines from which parts are “fed” to the assembly line.

The normal procedure of “feeding” the assembly line is that Line Feeding input data about parts that need to be replenished into terminals located close to the assembly lines.

The output of this activity is that a Movement Tag is printed at a printer located in the Warehouse. The warehouse operators will then pick the respective parts and transfer them to a marshalling area outside the warehouse. From there, the line feeders will take parts either directly to the line or to another marshalling area located in the assembly plant.

All this increases lead time and material handling and increases the risk of carpets getting damaged.

### 3.1.7 At Finance

Finance receives Goods Received notes from Receiving, and these notes enable for correct payment to Feltex. The scope of this study did not extensively include the finance department and the transactions involved in getting carpets from the supplier to the customer.
Chapter 4

4.1 Feltex as a JIT supplier – the new design

The current carpet supply chain has several areas where improvements can be made by implementing Feltex as a JIT supplier.

4.1.1 Material Handling

From initial analysis, it is clear that the carpets and pallets get handled redundantly.

1. Stacked in piles and packed into pallets at Feltex
2. Loaded onto a truck with a forklift at Feltex
3. Offloaded in Receiving at Nissan SA
4. Undergoes a quality check at Nissan SA
5. Moved from Receiving into stock in the warehouse
6. Picked from the warehouse and moved to a marshalling area where the sequence is double checked
7. Moved to line-side for fitment to vehicles

In the newly designed JIT-supply approach, these issues will be addressed. For the purpose of BPJ 420, some objectives were identified along which the success and possible implementation of the new design can be measured, should these objectives be reached.

4.1.1.1 Cause and effect diagram identifying the current problems

Using the help of a simple cause and effect diagram, various problems are identified that lead to the current system having room for improvement.
4.1.1.2 Objectives

- To save space on the vehicle assembly line
- To minimise material handling effort
- To design for ease of use from an operator’s point of view
- To create enough storage capacity on line
- To keep the carpets free from damaging

In assessing these objectives, Chris identified some restrictions and constraints which must be carefully monitored while designing the new JIT-suply system.

4.1.1.3 Restrictions

- Narrow aisle between the trim assembly line and mechanical assembly line in the plant
- No tow tractor available to pull trolleys to the assembly line

Due to this, a one tonner bakkie instead of a small truck will be used. This will enable the one tonner bakkie to fit in the aisles of the assembly plant.

The redesigned carpet supply chain will utilize a modified one tonner bakkie that will transport 10 to 15 carpets at a time from Feltex to Nissan SA. This bakkie will do multiple trips each day in order for Feltex to satisfy the demand of Nissan SA. The extent of the modifications to the bakkie is as follows:

- A roller bed on the back of the bakkie
- A top rack on the bakkie over which a canvas can be put in the case of rain

Material handling equipment at Feltex that need to be manufactured is a trolley with a roller bed on top of it. This will be used to move the carpets from Feltex’s check out onto the modified one tonner bakkie. A trolley that is exactly the same, will be used at Nissan SA, to move the carpets from the bakkie, onto the newly manufactured ‘gravity feeder’ onto which the carpets are packed.
4.1.1.4 Results of the new material handling

There are no material handling activities involved other than the loading of the carpets at Feltex, and the unloading of the carpets from the same vehicle at Nissan SA. No forklift handling is involved.

This means that material handling steps are reduced from 7 steps in the current design, to only 3 in the new design.

Space saving on the line side is 75%. In the current system, there are 4 carpet pallets on the line side which take up 8 meters in total.

In the new design, there will only be one trolley (and one gravity feeder in front of it) on the line side which takes up less than 2 meters space. This equates to a line side space saving of 75%, see figure below.

Figure 2: New situation
4.2 The new method - Feltex

4.2.1 The Despatch procedure at Feltex

4.2.1.1 Terminal operator at Feltex

Approximately every 6 minutes, a unit is transferred to the Multi-Model assembly line and immediately, a ‘Picking Label’ is generated via SAP R/3 and is printed out at a dedicated printer at the Feltex despatch office. The 6 minutes can vary from day to day, depending on the daily rate at which the line is running. It is the responsibility of the terminal operator to check on a continuous basis whether the picking label printer keeps printing picking label at a rate of one every 6 minutes. It is important to note that no cars are put on the assembly line during breaks. Below is a detailed layout of a typical work week at Nissan SA:

<table>
<thead>
<tr>
<th>Nissan Working Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon – Thur: 07:00 – 16:00</td>
</tr>
<tr>
<td>Fri: 07:00 – 13:00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Breaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon – Thur: 07:00 – 07:10</td>
</tr>
<tr>
<td>Fri: 07:00 – 07:10</td>
</tr>
<tr>
<td>09:00 – 09:10</td>
</tr>
<tr>
<td>12:30 – 13:00</td>
</tr>
<tr>
<td>15:00 – 15:10</td>
</tr>
</tbody>
</table>

At specific times, the terminal operator must quit the work he is doing at that time and must immediately raise a delivery note/invoice for the picking labels that are printed out, no matter how many labels are printed out. The operator must do this task at the below specified times:

<table>
<thead>
<tr>
<th>Mon – Thur:</th>
<th>Fri:</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00</td>
<td>08:00</td>
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<td>09:00</td>
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<tr>
<td>14:30</td>
<td></td>
</tr>
<tr>
<td>16:30</td>
<td></td>
</tr>
</tbody>
</table>

Raising the delivery note/invoice should not take more than 3 minutes. Immediately after the terminal operator has raised the delivery note/invoice he must hand the picking labels over to the picking operator dedicated for Nissan SA parts who must immediately start picking the carpets.
4.2.1.2 Picking operator at Feltex

At the times stated below, the picking operator dedicated for Nissan SA parts must quit the work he is doing and go to the despatch office to collect the picking labels for the next batch of carpets from the terminal operator.

<table>
<thead>
<tr>
<th>Mon – Thur</th>
<th>Fri</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00</td>
<td>08:00</td>
</tr>
<tr>
<td>09:00</td>
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<td>13:30</td>
<td>13:00</td>
</tr>
<tr>
<td>14:30</td>
<td></td>
</tr>
<tr>
<td>16:30</td>
<td></td>
</tr>
</tbody>
</table>

The steps used by the picking operator to fulfil the picking process, is henceforth described:

1. Picked and stacked on the table (in sequence)

The picking operator places the picking labels onto the correct carpets and stacks them in ascending sequence on the table without a roller bed. This means in the same sequence in which the picking labels were printed out. It is extremely important that the picking labels are put on the right carpets. The picking labels should be placed on the carpets in such a way that they are still readable even when stacked.
2. Double checked and re-stacked in reverse sequence onto the trolley

After the carpets are stacked onto the table the picking operator re-stacks the carpets one after the other in reverse sequence on the trolley, i.e. the carpet at the top will now be placed at the bottom. While doing this, he must double check whether the right sticker is put on the right carpet.

3. Pushed from the trolley onto the bakkie

The picking operator must now double check the correct sequence of the carpets.

4. The side gate of the rack on the bakkie will then be closed

Now the picking operator can push the stack of carpets onto the vehicle.
5. Close the side gate of the bakkie
6. Inform the driver that the vehicle is ready for delivery.

Appendix A shows the Flow process of the carpet picking operation

Appendix C shows the Flow diagram of the carpet picking operation

4.2.2 Delivering the carpets

Changing Feltex from a Classic call supplier to a JIT supplier has the inherent effect that some procedures have to change. One of which is the fact that carpets do not get delivered by truck in bulk every 3 or 4 days, but rather 10 at a time, several times per day.

At Feltex

1. While the picking operator is picking the carpets, the driver must collect the delivery note/invoice from the terminal operator at the despatch office.
2. Immediately after the picking operator has loaded the carpets on the bakkie, the driver must depart to Nissan.
3. Security at Feltex gate will allow the bakkie to leave Feltex’s premises without any hold up.
4. Nissan Security (‘Goods received gate’) will allow Feltex driver to enter Nissan’s premises without an entrance permit. [Appendix D]
5. The Feltex driver proceeds to the receiving office where he must be accompanied by a Nissan operator to immediately count the carpets. The Feltex driver receives the Goods Received Note (GRN) and the Feltex delivery note/invoice and proceeds as soon as possible to the carpet fitting station in the main assembly plant. Receiving will ensure that the hold-up at Receiving is not more than 5 minutes.
6. The Feltex driver parks the bakkie in such a way that he can directly offload the carpets onto the trolley located at the carpet fitting station without having to move the trolley.
7. Production at Nissan has been given the instruction to keep the lane to the carpet fitting station free from vehicles. If there is an obstruction in the lane, the Feltex driver should got to the carpet fitting station, take the trolley to the
bakkie, off-load the carpets himself, and push the trolley back to the carpet fitting station.

8. The Feltex driver goes back to Feltex for the next delivery. If there is a long queue at the ‘lane out’, Nissan Security will allow the Feltex driver to use the ‘entry lane’ to get out.

9. Feltex security will allow the driver into the premises without any hold-up

At Nissan SA

1. The driver drives directly to the carpet fitting station
2. Opens the side gate of the rack on the bakkie
3. ‘pulls the stack of carpets from the vehicle onto the trolley and
4. Returns to Feltex
5. The carpet operator at the carpet fitting station can easily pull the stack of carpets from the trolley down onto the gravity feeder. From there he will pick the carpets and fit them in the vehicles

Appendix B shows the flow process of the carpet delivery to Nissan SA

4.3 The physical constraints

The below figure is an aerial image taken from Google Maps to indicate how close Feltex is situated to Nissan SA.
From the above figure, it is seen that the distance between the two locations is approximately 1.4km. This is a big driving force in the reason why a JIT supply model will work so well between the two companies. It is absolutely possible to complete multiple deliveries of carpets in a single day.

4.3.1 Calculations

In order for the new proposed method to work, it is necessary to calculate the times involved in the new design.

As mentioned in section 4.2.1.1, a picking label is printed at Feltex every 6 minutes, as a car is dropped onto the trim line at Nissan SA. Thus, 10 cars require carpets every hour. Hence the new design requires that the bakkie deliver 10 carpets every hour to Nissan SA. In the new design, the last picking procedure is scheduled for 16:30pm from Monday to Thursday, and 13:00pm on a Friday.

This last batch of carpets is delivered to ensure the stock will be on hand at Nissan SA for the start of the next morning’s shift. This equates to 90 carpets being delivered from Monday to Thursday, and 60 on a Friday. So the safety stock/buffer for the next morning’s commencement of shift is the usual 10 carpets.

<table>
<thead>
<tr>
<th>Picking label frequency</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpets required per hour</td>
<td>10</td>
</tr>
<tr>
<td>Carpets required per shift (Mon-Thu)</td>
<td>90</td>
</tr>
<tr>
<td>Carpets required per shift (Fri)</td>
<td>60</td>
</tr>
<tr>
<td>Carpets required per week</td>
<td>420</td>
</tr>
</tbody>
</table>

Table 1

It takes the operator in the despatch office literally a few seconds to tear of the 10 printed labels ready for picking and hand them to the picking operator. It is the picking operator’s responsibility to go to the despatch office on the specified times to get the next 10 picking labels. It takes the picking operator on average 7.4 minutes to get the picking labels, pick the carpets, stack them on the table, restack them on the trolley, load them onto the bakkie and close the side gate of the bakkie.

From here, if the driver is already in the bakkie like he should be, it takes him approximately 6.5 minutes to exit the gate at Feltex, drive to Nissan, enter the premises, stop at the goods received office, count the carpets and drive to the line side to deliver the carpets.

This is a total of 13.9 minutes to get 10 carpets to Nissan SA.
4.4 Reduced risk of damage to carpets

Reduced material handling reduces the possibility of pallets getting damaged. Direct delivery to line-side also eliminates the need for the carpets to be stored in the warehouse, where dust, dirt and stray cats and their urine might damage the carpets before it is fitted to the vehicles.

4.5 Cost

Eliminating the need for pallets, inventory and warehouse space and material handling are the key areas where costs are saved when the JIT approach is implemented.

4.5.1 Special trolleys

The two special trolleys required for the implementation of Feltex as a JIT supplier, consists of:

- A roller bed
- 4 wheels
- Light alloy frame

The total estimated cost to manufacture these special trolleys is in the region of R1500 – R2000.

4.5.2 Storage rack on one tonner bakkie

The rack on the back of the bakkie need to be specially built out of square tubing and must have the same roller bed to ease the on and offloading of carpets.

With a bakkie that has an average load bin dimension of 1600mm X 1200mm, the special rack that need to fit on the bakkie will require an estimated
- Required:
  - Steel: Square tubing (25mm X 25mm X 1.6mm wall thickness)
  - (6m lengths, 18m in total) $3 \times R 64.95 = R 194.85$ [Appendix F]
  - 6 rows of rollers, $6 \times R 34.60 = R 207.60$
  - Labour R 1100 (approx)
  - Sundries R 250
- Total: R 1752.45

4.5.3 Fuel cost

Weekly, the trip log for the bakkie will look as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Picking label frequency</td>
<td>6</td>
</tr>
<tr>
<td>Carpets required per hour</td>
<td>10</td>
</tr>
<tr>
<td>Carpets required per shift (Mon-Thu)</td>
<td>90</td>
</tr>
<tr>
<td>Carpets required per shift (Fri)</td>
<td>60</td>
</tr>
<tr>
<td>Carpets required per week</td>
<td>420</td>
</tr>
<tr>
<td>Trips to Nissan per week</td>
<td>42</td>
</tr>
<tr>
<td>Distance from Feltex to Nissan gate (km)</td>
<td>1.4</td>
</tr>
<tr>
<td>Distance from gate to line side (km)</td>
<td>0.65</td>
</tr>
<tr>
<td>Total distance travelled per week (km)</td>
<td>172.2</td>
</tr>
<tr>
<td>Cost per liter of diesel</td>
<td>R 7.52</td>
</tr>
<tr>
<td>Fuel efficiency of bakkie (est.) (Lit/100km)</td>
<td>8.9</td>
</tr>
<tr>
<td>Diesel required per week (Lit)</td>
<td>15.3258</td>
</tr>
<tr>
<td>Cost of fuel per week</td>
<td>R 115.25</td>
</tr>
</tbody>
</table>

Table 2
When one considers the amount of space that will be saved by implementing the JIT supply method, the costs involved to get there is minimal.
Chapter 5

5.1 Conclusion

Re-designing the carpet supply chain of Nissan SA and making Feltex a JIT supplier clearly has a lot of benefits both for supplier and customer. It does involve a certain amount of commitment which will inherently guarantee success due the number of different resources and stakeholders that need to work together effectively.

When reflecting on the goal set about when Chris started this project, it is clear that by implementing a JIT supply method in the carpet supply chain, all of the following goals will be achieved:

1. Optimize and integrate every manufacturing step
2. Reduce the cost of manufacturing
3. Produce the product on demand
4. Develop flexibility in manufacturing
5. Keep the commitments made between the Customer (Nissan SA) and the supplier (Feltex carpets)
6. Optimal placement (or complete elimination) of inventory
7. Reduced operation cost (including transport, inventory and material handling costs)

For these goals to be properly achieved the study recommends the implementation of key measures and good communication up and down the supply chain to manage the important parameters as identified in this report.

5.2 Recommendations

With the recent signing of various export contracts and raising Nissan’s current annual production of vehicles from 45000 to almost 100000, it is clear that there is a lot more room for improvement. This means that double manufacturing shifts will be implemented in the very near future to fulfil demand. This study and JIT supply recommendation will need to be adjusted and re-evaluated to adhere to the almost double in demand.
This poses the very big challenge not only to Nissan, but to Feltex and all other local suppliers to increase their capacity and strengthen their commitment to Nissan to ensure that Nissan can again be competitive in the global market as a class leading exporter of motor vehicles.

It will pose a very interesting challenge to improve JIT supply methods to support such a massive manufacturing endeavour.
Chapter 6

References


[8] Methods, Standards and Work design, 11th ed, Benjamin Niebel, Andris Freivalds
Appendix A

Flow process chart for the picking of carpets – New method

| Location: Feltex               |  
| Activity: Picking of carpets  |  
| Date                          |  
| Operator                      |  
| Analyst: Chris                |  

Circle appropriate Method and Type

Present: Worker

Proposed: Material, Machine

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>idle</td>
<td></td>
</tr>
<tr>
<td>walk to despatch</td>
<td></td>
</tr>
<tr>
<td>receive picking labels</td>
<td></td>
</tr>
<tr>
<td>walk to carpet storage</td>
<td></td>
</tr>
<tr>
<td>in stack</td>
<td></td>
</tr>
<tr>
<td>pick carpet from storage and place on table</td>
<td></td>
</tr>
<tr>
<td>in stack</td>
<td></td>
</tr>
<tr>
<td>restack carpets onto special trolley</td>
<td></td>
</tr>
<tr>
<td>in stack</td>
<td></td>
</tr>
<tr>
<td>move carpets from trolley to back of bakkie</td>
<td></td>
</tr>
<tr>
<td>in stack</td>
<td></td>
</tr>
<tr>
<td>close side gate of bakkie</td>
<td></td>
</tr>
<tr>
<td>inform driver that bakkie is loaded</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix B

Flow process chart for delivery of carpets to Nissan SA – New method

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>in stack</td>
<td></td>
</tr>
<tr>
<td>load onto bakkie</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>on bakkie</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>depart from Feltex</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>pass security at Feltex</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>enter Nissan gate</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>proceed to receiving office</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>carpets counted by Nissan receiving operator</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>proceed to assembly line</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>in stack</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>off load onto trolley</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>in stack</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>off load onto 'gravity feed' rack</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>in stack</td>
<td>![Symbol]</td>
</tr>
</tbody>
</table>

Location: From Feltex to Nissan
Activity: Delivery of carpets to Nissan SA
Date
Operator
Analyst: Chris

Circle appropriate Method and Type
Method: Present, Proposed
Type: Work, Machine
Appendix C

Flow diagram for carpet picking – New method
Appendix D

Nissan SA – Goods received gate
# Appendix E

## GANTT chart

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Create project proposal</td>
<td>3w</td>
</tr>
<tr>
<td>2. Hand off project proposal</td>
<td>1w</td>
</tr>
<tr>
<td>3. Study current and planned methods</td>
<td>2w</td>
</tr>
<tr>
<td>4. Collect summary of current and planned models</td>
<td>3w</td>
</tr>
<tr>
<td>5. Gather data from Nissan SA</td>
<td>2w</td>
</tr>
<tr>
<td>6. Establish PE techniques</td>
<td>1w</td>
</tr>
<tr>
<td>7. Select alternative design</td>
<td>1w</td>
</tr>
<tr>
<td>8. Create various alternative designs</td>
<td>1w</td>
</tr>
<tr>
<td>9. Present layouts to project leader</td>
<td>1w</td>
</tr>
<tr>
<td>10. Present layouts to Nissan SA</td>
<td>2w</td>
</tr>
<tr>
<td>11. Await approval</td>
<td>3w</td>
</tr>
<tr>
<td>12. Select alternative design</td>
<td>1w</td>
</tr>
<tr>
<td>13. Simulate new design</td>
<td>2w</td>
</tr>
<tr>
<td>14. Perform cost of implementation</td>
<td>2w</td>
</tr>
<tr>
<td>15. Submit preliminary project proposal</td>
<td>1w</td>
</tr>
<tr>
<td>16. Applicable changes</td>
<td>1w</td>
</tr>
<tr>
<td>17. Presentation and oral presentation</td>
<td>1w</td>
</tr>
<tr>
<td>18. Applicable changes</td>
<td>1w</td>
</tr>
<tr>
<td>19. Applicable changes</td>
<td>1w</td>
</tr>
<tr>
<td>20. Submit final draft</td>
<td>3w</td>
</tr>
<tr>
<td>21. Communicate to Nissan SA</td>
<td>4w</td>
</tr>
<tr>
<td>22. Preparation of final report and presentation</td>
<td>1w</td>
</tr>
<tr>
<td>23. Hand off final document</td>
<td>1w</td>
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</table>
Appendix F

Alert Steel – Steel prices

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<tr>
<th>SQUARE TUBING - 6m</th>
<th>SIZE</th>
<th>1.6mm</th>
<th>2.0mm</th>
<th>2.5mm</th>
<th>3.0mm</th>
</tr>
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<tbody>
<tr>
<td>12x12mm</td>
<td>R41.50</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>16x16mm</td>
<td>R51.50</td>
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<tr>
<td>15x15mm</td>
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<td>-</td>
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<tr>
<td>25x25mm</td>
<td>R64.99</td>
<td>R92.50</td>
<td>R149.50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>32x32mm</td>
<td>R93.50</td>
<td>R128.50</td>
<td>R169.50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>38x38mm</td>
<td>R114.50</td>
<td>R139.50</td>
<td>R234.50</td>
<td>R292.50</td>
<td>-</td>
</tr>
<tr>
<td>50x50mm</td>
<td>R149.50</td>
<td>R189.50</td>
<td>R309.50</td>
<td>R395.00</td>
<td>-</td>
</tr>
<tr>
<td>60x60mm</td>
<td>R199.50</td>
<td>R247.50</td>
<td>-</td>
<td>R508.00</td>
<td>-</td>
</tr>
<tr>
<td>76x76mm</td>
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<td>R288.50</td>
<td>R472.50</td>
<td>R579.50</td>
<td>-</td>
</tr>
<tr>
<td>100x100mm</td>
<td>R380.50</td>
<td>R460.00</td>
<td>R690.00</td>
<td>R859.00</td>
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</table>

<table>
<thead>
<tr>
<th>ROUND TUBING - 6m</th>
<th>SIZE</th>
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<th>2.0mm</th>
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</thead>
<tbody>
<tr>
<td>16mm</td>
<td>R39.50</td>
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<tr>
<td>19mm</td>
<td>R46.50</td>
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<td>-</td>
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<td>21mm</td>
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<td>R74.50</td>
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<td>25mm</td>
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</tr>
<tr>
<td>27mm</td>
<td>R96.50</td>
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<td>R79.50</td>
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<td>34mm</td>
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<td>R108.00</td>
<td>R159.50</td>
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<tr>
<td>38mm</td>
<td>R99.00</td>
<td>R119.50</td>
<td>R179.50</td>
<td>R219.50</td>
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<td>42mm</td>
<td>R199.50</td>
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<td>48mm</td>
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<td>50mm</td>
<td>R119.00</td>
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<td>R247.00</td>
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<td>57mm</td>
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<td>R190.50</td>
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<td>R206.50</td>
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<td>76mm</td>
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<td>-</td>
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<td>86mm</td>
<td>R398.00</td>
<td>R529.50</td>
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<td>-</td>
<td>-</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>RECTANGULAR TUBING - 6m</th>
<th>SIZE</th>
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</tr>
</thead>
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<tr>
<td>25x12mm</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
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</tbody>
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