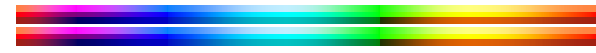


**TESSERACT**  
Management Systems



**EXERCISE BRIEF**

# **Problem Solving: Tessecart Exercise**

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# 1 INTRODUCTION

This document is intended to support experiential training in a problem solving discipline. It outlines the exercise that is to be undertaken, provides the various support documents, and explains the proposed methodology. Its structure is as indicated below:

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## 2 GENERAL OVERVIEW

The task is to use a problem solving discipline to improve the quality and performance of a fictional process. The process concerns making simple toy racing carts. The process is simulated by the participants in the exercise, each of whom is given a description of their task (only known to them) and a position at a point in the process. They then respond as directed by their job description whenever the right stimulus is received.

The simulation proceeds and overall performance is monitored. After a reasonable period the Manager receives an instruction to improve process performance to defined levels, and to achieve this through a problem solving discipline.

The rest of the exercise concerns how this is done.

The exercise is outlined here in its basic form. Simple modifications to the exercise will allow it to be used to illustrate a number of process improvement approaches:

- Cashflow and profit issues
- Delivery time issues and work scheduling
- Statistical Process Control
- Benchmarking
- The impact of specials
- Accommodating fast-track orders
- Training issues
- Workstream Balancing
- Kanban and reorder levels
- OPT and demand flow

### 2.1 The process and flow of work

The process for making the carts is outlined below.

#	Role	Actions
11	Stores Manager	Releases raw materials to the Kanban Operative, and records the event on the Stores Issue Record Sheet.
10	Kanban Operative	Monitors Kanban levels and keeps them stocked. Also clears scrap bins when necessary.
1	Crashbar Fabricator	Forms and perforates Crashbars from strip provided in Kanban A, and places them in Max-Min Bins L & R
2	Floorpan Moulder	Forms and reinforces Floorpan from sheet provided in Kanban B, and places them in Max-Min Bin W.
3	RH Chassis Welder	Fits RH Crashbar (R) to Floorpan (W) using fixings from Kanban D, and passes them to LH Chassis Welder
4	LH Chassis Welder	Fits LH Crashbar (L) to Floorpan (W) using fixings from Kanban D, and places them in Max-Min Bin X.



5	Inertia Engineer	Fits Inertia Component from Kanban G to Chassis (X) and places finished chassis in Max-Min Bin Y
6	Axle Grinder	Cuts axles to required length from rod provided in Kanban C, and places them in Max-Min Bin S
7	Suspension Assembly 1	Assembles rear suspension from shaft (S) and wheels (F), assembles to chassis Y, & passes to Suspension Assy. 2
8	Suspension Assembly 2	Assembles front suspension from shaft (S) and wheels (E), assembles to chassis Y, & places them in Max-Min Bin Z
9	Quality Inspector	Inspects Final Cart (Z), evaluates its downhill performance, and records results on the Quality Log
12	Foreman	Ensures everything is running smoothly, addresses issues, & records overall performance in the Management Report

## 2.2 Balancing the Assignments

The ideal balance for initiating the exercise is to assign one person to each role. This requires 12 people in all and is the ideal number for running the exercise.

Where there are more than 12 people involved in the training, additional people can be used as observers, or can be assigned as assistants to the main production roles. The briefs for the roles are included in section 3 and can be modified if required to reflect the assistant's roles. Where there are 6 people, we would recommend assigning multiple (combined) roles to those participating as follows:

Primary Role	Additional Role (if required)
Quality Inspector	Foreman
Inertia Engineer	Axle Grinder
LH Chassis Welder	RH Chassis Welder
Crashbar Fabricator	Floorpan Moulder
Suspension Assembly 1	Suspension Assembly 2
Kanban Operative	Stores Manager

Where there are more than 6 people but less than 12 we would recommend that you assign jobs from the left hand column to the first six and then from the right hand column in the order listed until everybody has a role.

Additional responsibilities for the remaining jobs in the right hand column should be assigned to the roles listed against them in the left hand column.

## 2.3 Facilities, Equipment & Materials Required

The facilities required for the simulation are as follows:

- |   |                                      |   |
|---|--------------------------------------|---|
| <input type="checkbox"/> Large room > 8x12m | <input type="checkbox"/> Large clock | <input type="checkbox"/> Flipchart, pad & pen |
| <input type="checkbox"/> 4 Tables c. 1.5x3m | <input type="checkbox"/> 12 Chairs   | <input type="checkbox"/> Wall space for chart |

A separate adjoining room is required to analyse the simulation as follows:

- |   |                                      |   |
|---|--------------------------------------|---|
| <input type="checkbox"/> Medium room > 4x8m | <input type="checkbox"/> Large clock | <input type="checkbox"/> Flipchart, pad & pen |
| <input type="checkbox"/> U Shaped Table     | <input type="checkbox"/> 12 Chairs   | <input type="checkbox"/> OHP and Screen       |



The standard equipment required for the simulation is as follows:

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> Single Hole Punch x 2 | <input type="checkbox"/> Cutting mats x 3       | <input type="checkbox"/> Tape Measure > 3m    |
| <input type="checkbox"/> Junior Hacksaw        | <input type="checkbox"/> Pencils x 12           | <input type="checkbox"/> Plastic Wastebin x 6 |
| <input type="checkbox"/> Small Modelling Vice  | <input type="checkbox"/> Trimming knives x 2    | <input type="checkbox"/> Stopwatch            |
| <input type="checkbox"/> Clipboards x 4        | <input type="checkbox"/> Pens x 4               | <input type="checkbox"/> Calculator           |
| <input type="checkbox"/> Sweets for Bonuses    | <input type="checkbox"/> Mats to protect tables | <input type="checkbox"/> Vernier Calipers     |

The special materials (listed in the appendix) required for the simulation are as follows:

- |   |   |   |
|---|---|---|
| <input type="checkbox"/> 30° Launch Ramp      | <input type="checkbox"/> Kanban Mats (16)*    | <input type="checkbox"/> Component Index*               |
| <input type="checkbox"/> Factory Plan*        | <input type="checkbox"/> Job Sheets (12)**    | <input type="checkbox"/> Management Report*             |
| <input type="checkbox"/> Stores Record Sheet* | <input type="checkbox"/> Quality Log*         | <input type="checkbox"/> Kanban Log*                    |
| <input type="checkbox"/> Techcard Sheet x 200 | <input type="checkbox"/> Techcard Strip x 400 | <input type="checkbox"/> 4x610mm Dowel x 80             |
| <input type="checkbox"/> 30mm Wheel x 400     | <input type="checkbox"/> 50mm Wheel x 400     | <input type="checkbox"/> Fastener x 1600                |
| <input type="checkbox"/> Soff Fun Clay x 6Kg  | <input type="checkbox"/> Finished Goods Mat   | <input type="checkbox"/> Paper reinforcing rings x 1600 |

Materials indicated with an asterisk\* can be printed off from file Te\_psx\_2.ppt. Apart from the Jobsheets\*\* which are available in section 4 of this document.

Materials with a grey background can be ordered from Commotion Ltd., Unit 11, Tannery Road, Tonbridge, Kent, England TN9 1RF. Telephone (44) 1732 773390.

The relevant specifications are:

Exercise Reference	Commotion Part #	Description from Commotion Catalogue	Qty/200 Carts	Price each (as at 1/3/00)
A,B	15510-1	Techcard Sheets	5	£12.99
C	64195-1	Pk 20 4x610mm Dowelling	4	£1.99
D	86050-1	Pk 50 Paper Fasteners	32	£0.79
E	64055-1	Pk 100 30mm Card Wheels	4	£2.29
F	64052-1	Pk 100 50mm Card Wheels	4	£2.99
G	05482-1	6x250g Soff Fun modelling clay	4	£13.99



### 3 RUNNING THE EXERCISE

This section provides a basic outline of how the exercise should be run in practice. Because of its real time nature the exercise is flexible to meet many needs, and the following should be seen only as one possible way of using the exercise.

#### 3.1 Introduction to the exercise

Introducing the participants to the exercise is best done some time (perhaps two days to a week) before the exercise is due to be run. This will give the participants time to familiarise themselves with

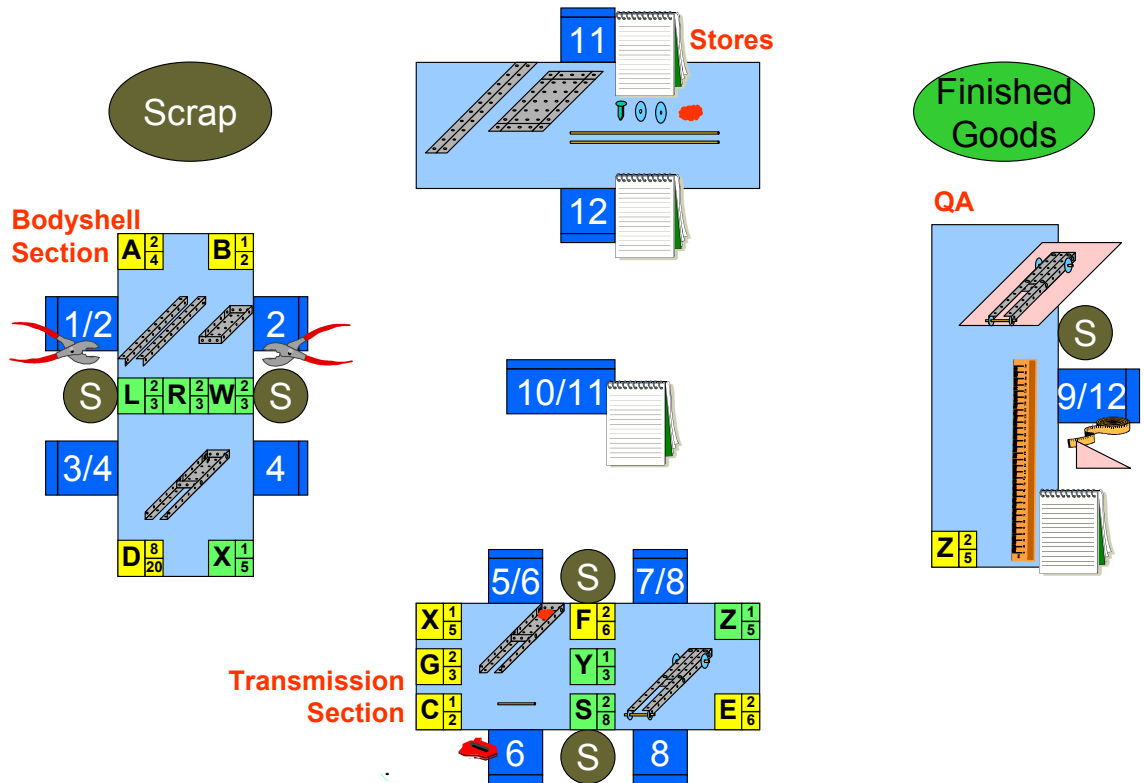
- the role they are to play and the relevant procedures
- an overview of the cart production process
- the problem solving approach that will be taken to improve the process

One way of achieving this is to provide each person taking part with copies of this book, the guide to the Problem Solving Process, and the guide to Problem Solving Tools.

It is also important to inform people as to what role(s) they will be undertaking.

#### 3.2 Setting up the room

We propose the room be set up as follows:



Light blue squares are tables, dark blue are the seating positions for the various roles, yellow/green are 'Work in Progress' locations, and the brown areas are the scrap bins. It is not essential that things are arranged this way since any issues with layout may well be addressed during the problem solving part of the exercise.

We also recommend that the problem solving project work takes place in a separate area, ideally with chairs sited around a flipchart.



Each work area should be set up with the equipment listed in their job descriptions.

### 3.3 Allowing Preparation

Most of the pre-reading should have taken place before the exercise starts. However it is worthwhile giving everybody a few minutes to familiarise themselves with their surroundings, and re-reading their briefs in the context of that.

Providing sample inputs for them to practice on is also useful, and this is best done by giving production time before the timed simulation is to begin.

### 3.4 Running the Simulation

There may be two issues at the start of the simulation, which need to be overcome if it is to work well:

- The first is that there is no work-in-progress at the start of the simulation and so the later roles have some time to wait for work to reach them
- The second is that people will be very unfamiliar with their roles and it will take some time for patterns to become established

These issues can be greatly alleviated by providing two five minute periods before the simulation, in which people undertake their roles. In the first period this can be a leisurely affair, and in the second the challenge can be posed to see how fast we can produce the carts. It is also possible for the organiser to help guide people and sort out obvious teething problems and confusions during these preliminary stages.

The above issues the further alleviate with time, and the simulation can be extended to provide a more realistic pattern over which to gather data. But for most purposes, and providing the team can make some accommodation for the limitations of the simulation, 20 minutes should be sufficient to get value out of the problem solving exercise.

The simulation will be greatly improved if people focus on doing their tasks as quickly and as accurately as they can.

### 3.5 Gathering the Data

Data gathering is an inherent part of the process, and will be recorded as operating times, and observed deficiencies. Further to this, the finished carts and scrap items produced will be available to the team for any more detailed analysis they wish to undertake.

The team may however wish to run more detailed, data gathering simulations as part of their problem solving activities.

### 3.6 Setting up the PS meeting

When the simulation has been completed, allow some time for people to sort themselves out and collate the relevant data.

The facilitator should then move the entire team into the problem solving area and begin to work through the problem solving process – step by step.

The manager should be appointed as the team leader, and the facilitator should check that everybody is clear on the process the team needs to work through.



The facilitator should also emphasise the need to use the simulation experience as a basis for learning about the practice of problem solving – the objective is to learn about the Problem Solving Process, not to learn about Cart Making.

The facilitator should then keep the process on track while the manager leads his or her team to solve the problems in the process.

### 3.7 Accommodating the teams needs

At various stages through the problem solving the team may well wish to try out further simulations, and experiments. Where possible this should be supported and encouraged.

### 3.8 Second Simulation

Once the solutions have been implemented, the team will need to run a second simulation for the evaluation step of the Problem Solving Process. This can be achieved easily by carrying on where the simulation previously left off.

### 3.9 Drawing out the Conclusions

Following the completion of the Problem Solving Exercise, we recommend that the group undertake a general discussion to pull out their conclusions from the exercise.

This can be achieved by working through the following questions:

- What worked well, and why?
- What didn't work well, and why?
- How should we begin to implement this process back in our work environment?



## 4 JOB DESCRIPTION SHEETS

On the following pages are Job Description Sheets for the twelve roles defined in the Tessecart production simulation. These explain

- the nature of the role
- its inputs and outputs and how work flow is controlled
- the step by step procedure for undertaking the role (step numbers link to the numbers on component diagrams where present)
- the equipment required and any special duties where appropriate.

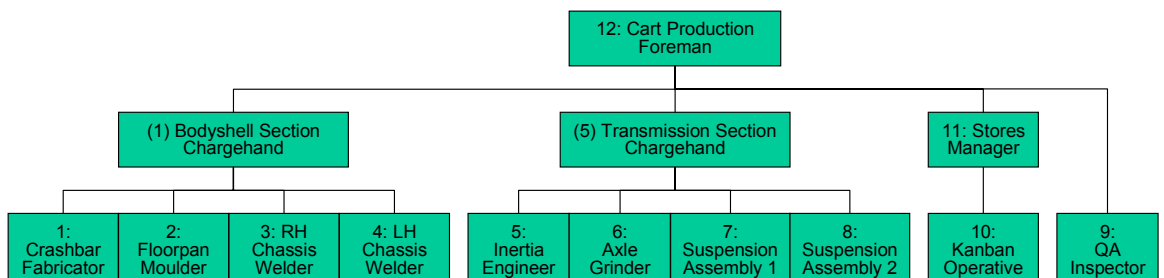
Many of the roles refer to Kanbans and Max-Min Bins as the means of controlling the workflow. Kanbans should only be refilled once the number of components in them has dropped to, or below, the reorder level, and then they should be refilled with exactly the reorder quantity (or a lesser amount if the reorder quantity is not available). If a Kanban is emptied, work depending on that component should cease until it is refilled. All Kanban materials should be placed on the Kanban mat, and only removed, item by item, for immediate production. There should be no stockpiling. Max-Min Bins are used to receive the output from production operations. Production should cease when the Max Level has been reached and only restart when the level of components in the bin has fallen below the Min level.

The Foreman has overall responsibility and authority for work done in the area, but the two Section Chargehands should help to ensure that work is done correctly in their section, and should be the first port of call for anybody working on their section to clear up a problem. Chargehands also have a production role as well as a management role.

Any materials, which are not fit for purpose, should be placed immediately in a scrap bin. This should be done carefully without further damage, because the scrap may well be needed for analysis during the problem solving phase of the simulation.

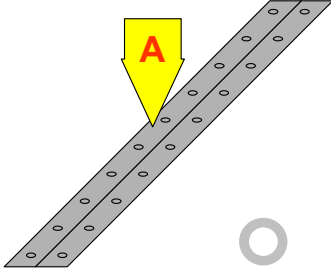
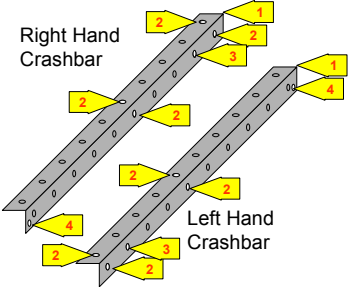
Each role has a requirement under the heading of special duties, These normally refer to a role which may need to be covered if a colleague becomes unavailable. If this should be the case, the operator should endeavour to execute both roles, or flag the Chargehand or Foreman for help.

The following Cart Production Organisation Chart shows how the various roles interrelate, and indicates the first port of call for each role should they encounter any problems or need any help. The numbers in each box refer to the Role Descriptions in this section.



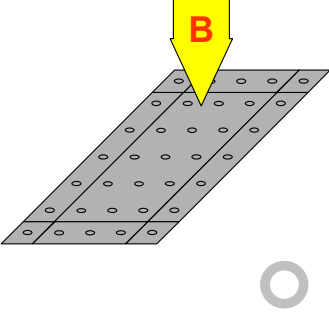
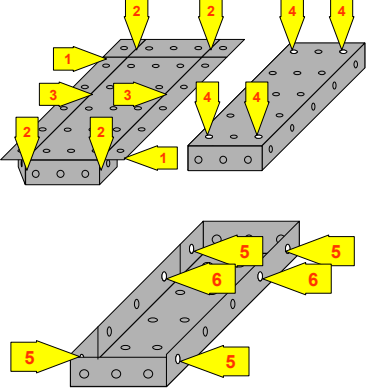


## 4.1 Crashbar Fabricator (and Bodyshell Section Chargehand)

<p>Description of Role</p>	<p>The Crashbar Fabricator produces the Left &amp; Right Hand Crashbars (L&amp;R) by putting a 90 degree fold in the provided strip (A), by punching out the relevant holes using a knife or hole-punch, and by reinforcing them.</p> <p>Also responsible for overseeing the running of the Bodyshell Section as a whole, and dealing with any immediate problems.</p>		
<p>Input Material</p>		<p>Output Material</p>	 <p>Please Note: Components are shown convex - creases face out of the page</p>
<p>Source</p>	<p>Kanban A</p>	<p>Destination</p>	<p>Max-Min Bins L&amp;R</p>
<p>Input Control</p>	<p>Produce if material available in Kanban, stop when material runs out</p>	<p>Output Control</p>	<p>Produce whenever either L or R fall below minimum levels, until at maximum.</p>
<p>Detail Procedure</p>	<ol style="list-style-type: none"> <li>1. Take single strip from Kanban A and fold along centre crease. Ensure that the fold holds a right angle when released.</li> <li>2. Reinforce the first and fifth holes on both sides of the strip</li> <li>3. Hold strip in orientation shown on diagram depending on whether it is to be Left or Right Handed. Reinforce the hole indicated by arrow 3</li> <li>4. Keeping the orientation from above, punch out the hole indicated by arrow 4. This hole should be produced using the hole punch pliers, and should be positioned half way between the last hole and the corner</li> <li>5. Check fold is still at 90°, and place finished Crashbar in relevant Max-Min Bin: L if Left-handed; R if Right Handed</li> </ol>		
<p>Equipment Required</p>	<ul style="list-style-type: none"> <li>• Cutting Mat</li> <li>• Modelling Knife</li> <li>• Single Hole Punch</li> <li>• Reinforcing rings</li> </ul>	<p>Qualification</p>	<p>Requires GNVQ in card bending and making holes in things.</p>
<p>Special Duties</p>	<p>Should cover for the Floorpan Moulder whenever the he/she is absent.</p> <p>Also ensures day to day operation of the Bodyshell Section</p>	<p>Reports To</p>	<p>Cart Production Foreman</p>



## 4.2 Floorpan Moulder

Description of Role	The Floorpan Moulder produces the Floorpan (W) by placing the relevant 90° bends in the provided sheet (B), and by punching out eight holes using a knife or hole-punch.		
Input Material		Interim Stages	
Source	Kanban B	Destination	Max-Min Bin W
Input Control	Produce if material available in Kanban, stop when material runs out	Output Control	Produce whenever Bin W falls below minimum levels, until at maximum.
Detail Procedure	<ol style="list-style-type: none"> <li>1. Take single sheet from Kanban B and fold along the creases that run along the short sides of the sheet. Ensure that the fold holds a right angle when released.</li> <li>2. Fold in the ends of each of the folded strips, so that their edges ride below the remaining unfolded creases along the long sides of sheet.</li> <li>3. Fold down the remaining creases so that a flattish box is produced</li> <li>4. Reinforce a hole in each corner on the top of the box</li> <li>5. Turn the box over, and reinforce the holes at each end of the strips on the long sides of the box</li> <li>6. Reinforce two further holes, just one point in from the last hole, as shown on the diagram above</li> <li>7. Check all folds are holding at 90°, and deliver to Bin W.</li> </ol>		
Equipment Required	<ul style="list-style-type: none"> <li>• Cutting Mat</li> <li>• Modelling Knife</li> <li>• Single Hole Punch</li> <li>• Reinforcing rings</li> </ul>	Qualification	Requires GNVQ in card bending and making holes in things.
Special Duties	Should cover for the Crashbar Fabricator whenever he/she is absent.	Reports To	Bodyshell Section Chargehand



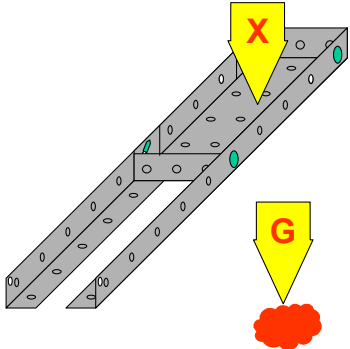
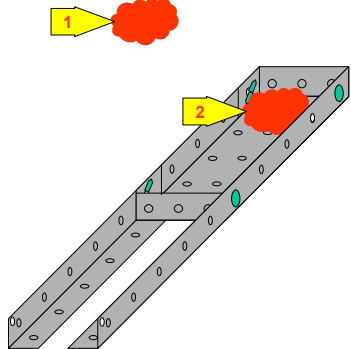


## 4.4 LH Chassis Welder

<p>Description of Role</p>	<p>The LH Chassis Welder final assembles the Chassis (X) by securing the Lefthand Crashbar to the Floorpan/RHC subassembly (X') using four fastenings (D) through the appropriate holes in each component.</p>		
<p>Input Material</p>		<p>Interim Stage</p>	
<p>Source</p>	<p>Max-Min Bin L, Kanban D &amp; direct from RHCW</p>	<p>Destination</p>	<p>Deliver to Max-Min Bin X</p>
<p>Input Control</p>	<p>Produce if item passed from RHCW &amp; material available in Kanban or Bins</p>	<p>Output Control</p>	<p>Produce whenever Max-Min Bin X is below Minimum, stop when at Maximum.</p>
<p>Detail Procedure</p>	<ol style="list-style-type: none"> <li>1. Position the Floorpan/RHC subassembly (X') with the flat surface uppermost, and the newly fitted RH Crashbar away from you &amp; projecting to the right.</li> <li>2. Take Lefthand Crashbar (L) and align it so that the end with two reinforced holes is on your left, the side with most holes is facing you, and the other side is lying along the top. Fit it over the Floorpan/RHC subassembly (X') so that the lefthand edges &amp; the holes align.</li> <li>3. Insert &amp; splay four fastenings (D) in the holes as indicated in the diagram - first &amp; fifth holes from the left on both sides of the Crashbar.</li> <li>4. Deposit completed chassis in Max-Min Bin X</li> </ol>		
<p>Equipment Required</p>	<ul style="list-style-type: none"> <li>• None</li> </ul>	<p>Qualification</p>	<p>Requires GNVQ in clipping things together in the right way to make them work</p>
<p>Special Duties</p>	<p>Should cover for the RH Chassis Welder whenever the RH Chassis Welder is absent.</p>	<p>Reports To</p>	<p>Bodyshell Section Chargehand</p>


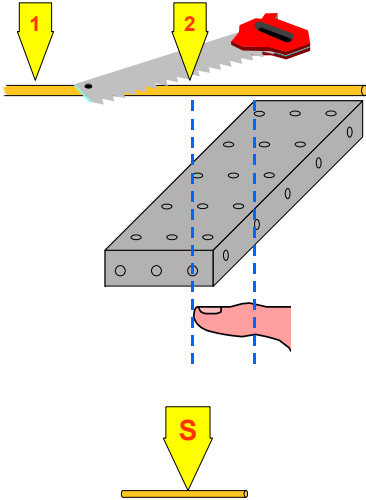


### 4.5 Inertia Engineer (and Transmission Section Chargehand)

<p>Description of Role</p>	<p>The Inertia Engineer selects and prepares the Plasticene Material (G) and fits it into the Floorpan of the Chassis Assembly (X)</p> <p>Also responsible for overseeing the running of the Transmission Section as a whole, and dealing with any immediate problems.</p>		
<p>Input Material</p>		<p>Output Material</p>	
<p>Source</p>	<p>Kanban X, Kanban G</p>	<p>Destination</p>	<p>Deliver to Max-Min Bin Y</p>
<p>Input Control</p>	<p>Produce if material available in Kanban X &amp; G</p>	<p>Output Control</p>	<p>Produce whenever Max-Min Bin Y is below Minimum, stop when at Maximum.</p>
<p>Detail Procedure</p>	<ol style="list-style-type: none"> <li>1. Take a walnut sized piece of modelling clay from the tub of modelling clay, and shape it into a spherical lump. (If you do not have a tub of modelling clay, or if there is not enough in the tub, replace it with another full tub from Kanban G)</li> <li>2. Take a Chassis Assembly from Kanban X, and position it with the flat surface downmost, and the Crashbars pointing toward your left. Insert the lump of modelling clay into the floorpan section and mould into the volume immediately in front of the left-most wall (the backwall of the cart). Ensure the clay sticks well when the cart is inverted.</li> <li>3. Deposit the finished item in Max-Min Bin Y</li> </ol>		
<p>Equipment Required</p>	<ul style="list-style-type: none"> <li>• Modelling Knife</li> </ul>	<p>Qualification</p>	<p>Requires GNVQ in making very simple plasticene models</p>
<p>Special Duties</p>	<p>Should cover for the Axle Grindere whenever the Axle Grinder is absent.</p> <p>Also responsible for ensuring the Transmission Section runs smoothly and effectively on a day-to-day basis.</p>	<p>Reports To</p>	<p>Cart Production Foreman</p>



## 4.6 Axle Grinder

Description of Role	The Axle Grinder cuts axles to length from the specially prepared rod provided (C), using the modelling vice to clamp the doweling, and the Junior Hacksaw to cut the doweling to the appropriate length.		
Input Material		Interim stage	
Source	Kanban C	Destination	Deliver to Max-Min Bin S
Input Control	Produce if material available in Kanban C	Output Control	Produce whenever Max-Min Bin S is below Minimum, stop when at Maximum.
Detail Procedure	<ol style="list-style-type: none"> <li>1. Take a length of doweling material (C) from Kanban C. Ensure the length is greater than 120mm by means of a ruler. If it is not, deposit it in the scrap bin beside you.</li> <li>2. Use the width of a standard floorpan, plus the length of your first thumb joint to measure off the length for the Axle. Grip this point between thumb and forefinger and clamp the dowel in the modelling vice. Cut the dowel through at this point using the Junior Hacksaw.</li> <li>3. Deposit the finished item in Max-Min Bin S, and return the doweling offcut to Kanban C, providing it is greater than 120mm long, otherwise place in scrap bin.</li> </ol>		
Equipment Required	<ul style="list-style-type: none"> <li>• Modelling Vice clamped to table</li> <li>• Junior Hacksaw</li> <li>• Floorpan template</li> <li>• Ruler</li> </ul>	Qualification	Requires GNVQ in making very simple plasticene models
Special Duties	Should cover for the Axle Grinder whenever the Axle Grinder is absent.	Reports To	Transmission Section Chargehand



## 4.7 Suspension Assembly 1

Description of Role	Suspension Assembly 1 manufactures and installs the rear axle assembly, including the rear wheels, into the finished cart chassis.		
Input Material		Interim stage	
Source	Kanban F, Max-Min Bins Y&S	Destination	Pass directly to Suspension Assembly 2 (SA2).
Input Control	Produce if material available in Kanban F, and in Max-Min Bins Y & S.	Output Control	Produce whenever Max-Min Bin Z is below Minimum, and SA2 is waiting input.
Detail Procedure	<ol style="list-style-type: none"> <li>1. Take the shaft (S), and insert it in the open hole immediately in front of the modelling clay, and the rearmost card fastenings. Pass the axle through the width of the cart until it projects through the hole on the other side. Position the shaft so that it projects equally from both sides.</li> <li>2. Affix the larger wheels (F) to the projecting ends of the shaft. Push them onto the shaft so that there is an equal amount of axle projecting from the centre of both wheels.</li> <li>3. Pass the sub-assembly directly across to Suspension Assembly 2.</li> </ol>		
Equipment Required	<ul style="list-style-type: none"> <li>• None</li> </ul>	Qualification	Requires GNVQ in basic wheel tapping and shunting for cardboard trainsets.
Special Duties	Should cover for Suspension Assembly 2 whenever Suspension Assembly 2 is absent.	Reports To	Transmission Section Chargehand

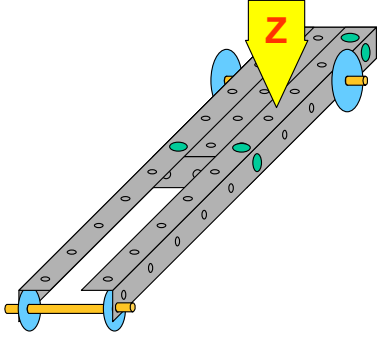
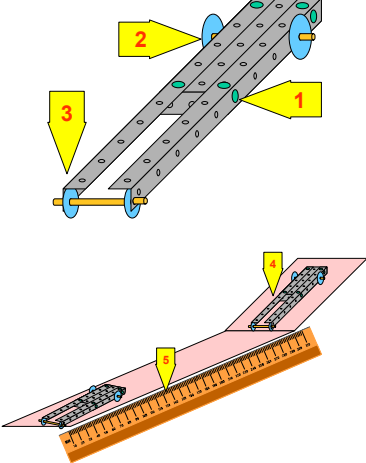


## 4.8 Suspension Assembly 2

Description of Role	Suspension Assembly 2 manufactures and installs the front axle assembly, including the front wheels, into the Cart Chassis/Rear Axle sub-assembly.		
Input Material		Interim stage	
Source	Kanban E, Max-Min Bin S & direct from Suspension Assembly 1 (SA1).	Destination	Max-Min Bin Z.
Input Control	Produce if material available in Kanban E, Max-Min Bin S and from SA1.	Output Control	Produce whenever Max-Min Bin Z is below Minimum.
Detail Procedure	<ol style="list-style-type: none"> <li>1. Take the shaft (S), and affix two of the smaller wheels (E) onto each end. Push them some distance onto the shaft so that approximately 2cm of shaft is protruding outside each wheel.</li> <li>2. Flex the projecting ends of the Crashbars (Forks) on the Chassis Assembly slightly outwards, and fit the ends of the front wheel sub assembly into the holes at the furthest end from the Floorpan.</li> <li>3. Place the finished Cart in Max-Min Bin Z for collection.</li> </ol>		
Equipment Required	<ul style="list-style-type: none"> <li>• None</li> </ul>	Qualification	Requires GNVQ in basic wheel tapping and shunting for cardboard trainsets.
Special Duties	Should cover for Suspension Assembly 1 whenever Suspension Assembly 1 is absent.	Reports To	Transmission Section Chargehand



## 4.9 Quality Assurance Inspector

Description of Role	The QA Inspector evaluates the finished cart to ensure no components are missing or incorrectly positioned, & then grades the cart for performance by running it down the test track. Results are recorded in the Quality Log.		
Input Material		Physical Checks  Performance Testing	
Source	Kanban Z	Destination	Finished Goods Area
Input Control	Undertake inspection if carts available in Kanban Z.	Output Control	None.
Detail Procedure	<p>DO NOT UNDERTAKE REWORK. Carts failing inspection to be scrapped.</p> <ol style="list-style-type: none"> <li>1. Inspect the Cart to ensure all eight fastenings are correctly secured in the corners of the floorpan, that the Chassis is rigid and that the inertia block is firmly in place.</li> <li>2. Inspect the rear axle to ensure all components in place, and that there is at least 5mm of axle projecting out from each wheel.</li> <li>3. Inspect the front axle to ensure that it is securely in place, and cannot fall free if the cart is shaken.</li> <li>4. Place the cart on the Launch Ramp with its front wheels, on the edge of the ramp and the table (as shown). Release the cart and check that it rolls freely down the ramp.</li> <li>5. For carts passing all preceding Quality Checks: Measure the distance the cart travels along the table, &amp; record this against the relevant row/ column of the Quality Log, &amp; on the cart body. Place in Finished Goods</li> </ol>		
Equipment Required	<ul style="list-style-type: none"> <li>• 30° Launch Ramp</li> <li>• Tape Measure</li> <li>• Quality Log</li> </ul>	Qualification	Requires GNVQ in looking at strange bits of cardboard & going "brrrrm".
Special Duties	Should cover for Foreman when Required.	Reports To	Cart Production Foreman



### 4.10 Kanban Operative

<p>Description of Role</p>	<p>The Kanban Operative constantly monitors the Kanban quantities, and moves material to maintain them at their required levels. Also monitors the scrap bin levels and clears them to the Main Scrap Bin when required.</p>		
<p>Input Material</p>	<p>Kanban (Yellow) &amp; Sources (Green) Map</p>		
<p>Source</p>	<p>Stores, Max-Min Bins X &amp; Z</p>	<p>Destination</p>	<p>Kanbans A-G, X &amp; Z</p>
<p>Input Control</p>	<p>Take minimum of: reorder quantity, or max available</p>	<p>Output Control</p>	<p>Replenish Kanbans only when below reorder level.</p>
<p>Detail Procedure</p>	<ol style="list-style-type: none"> <li>Maintain a cycle of observation every 2 minutes, and work through Kanbans A-G, X &amp; Z in that order, noting which Kanbans are below their reorder level (Upper of the two figures beside the Part # Code). If an empty Kanban is flagged to you by an operative in any area, you should respond immediately.</li> <li>Where Kanban levels are below reorder levels, source material from the relevant are as indicated on the sources map above. Components A-G should be sourced from the Stores Manager, who will record their issue. Transfer of assemblies X &amp; Z should be noted on the Kanban Log in the relevant row and column. Transfer the reorder quantity (Lower of the two figures beside the Part # Code), or what is available if this is less than the reorder quantity. <b>KANBAN REORDER QUANTITIES MUST NOT BE EXCEEDED, AND REORDER LEVELS MUST BE OBSERVED AT ALL TIMES.</b></li> <li>Monitor Scrap bin levels every 5 minutes, and empty into the Main Scrap Bin if they become over half full.</li> </ol>		
<p>Equipment Required</p>	<ul style="list-style-type: none"> <li>Kanban Log</li> </ul>	<p>Qualification</p>	<p>Requires GNVQ in getting run off your feet.</p>
<p>Special Duties</p>	<p>Should cover for the Stores Manager when Required.</p>	<p>Reports To</p>	<p>Stores Manager</p>



## 4.11 Stores Manager

Description of Role	The Stores Manager manages the stores component stocks and issues material as requested by the Kanban Operative, and logs these issues on the Stores Issue Record Sheet																																																																																										
Stores Standard Stock Material & Part #		Stores Issue Record Sheet	<p>Stores Issue Record Log for Time Period:</p> <table border="1"> <thead> <tr> <th>Part \ Period</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> <th>8</th> <th>9</th> <th>10</th> </tr> </thead> <tbody> <tr> <td>A </td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>B </td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>C </td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>D </td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>E </td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>F </td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>G </td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </tbody> </table>	Part \ Period	1	2	3	4	5	6	7	8	9	10	A											B											C											D											E											F											G										
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Source	All components in stores	Destination	Direct to Kanban Operative																																																																																								
Input Control	Supply as required unless stocks run out.	Output Control	On request from Kanban Operative.																																																																																								
Detail Procedure	<ol style="list-style-type: none"> <li>1. Ensure all materials are arranged separately (so as to avoid them becoming mixed up), and such that obtaining materials can be done easily and quickly.</li> <li>2. On request from the Kanban operative, supply the requested quantity of the material directly to him/her.</li> <li>3. Note the time and complete the Stores Issue Record Sheet, recording the quantity issued against the row for the relevant component and under the column for the appropriate timeslot. If more than one request for a particular item is received in a time period record both requested quantities in the same cell on the sheet.</li> <li>4. Show the Stores Issue Record Sheet to the Foreman on request.</li> </ol>																																																																																										
Equipment Required	<ul style="list-style-type: none"> <li>• Stores Issue Record Sheet</li> <li>• Store stocks</li> </ul>	Qualification	Requires GNVQ in tapping teeth, and looking away at some imaginary object over the top of the requestees head.																																																																																								
Special Duties	Should cover for the Kanban Operative when Required.	Reports To	Cart Production Foreman																																																																																								





## 5 SUPPORTING MATERIALS

The materials contained in this section can be printed off and enlarged, or, if you have access to the electronic version of this document, they can be cut and pasted into other applications, and then enlarged, before printing.

### 5.1 Letter from Board to Foreman

From the Office of the Managing Director  
To the Foreman of the Cart Production Department (whoever you are)  
Subject Y.A.Q. (yet another quality) Initiative

Dear (please fill in your own name)

I am pleased to inform you that after careful consideration (of all those managers who didn't make themselves scarce) we have selected you to pilot the new YAQ initiative.

Following your first production run tomorrow you will be required to dramatically improve the performance of your process at no cost to us – or you will be fired.

We have had some air-head consultants demonstrate how poor our current management is (and that of course means you) and we have been persuaded to let them help you through some improvement process before we fire you.

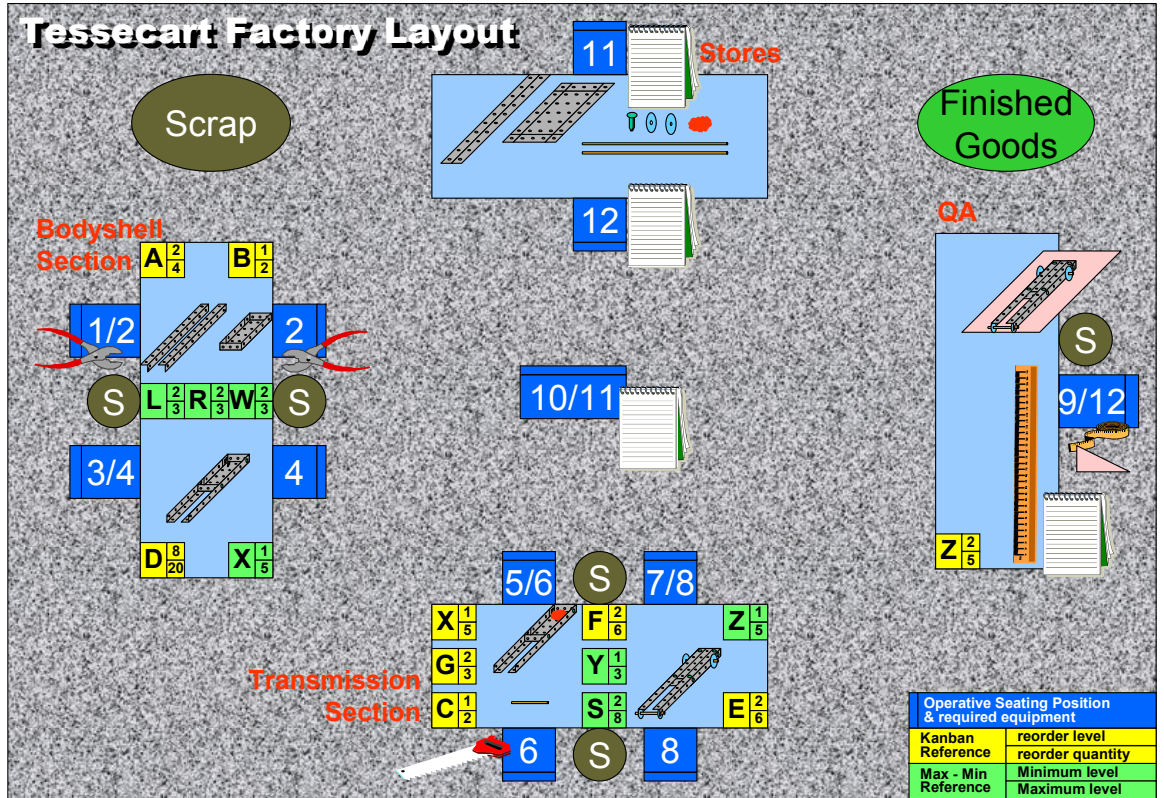
So buck up man (or woman – are you sure we employ women Miss Cranshawe? – not as management surely? – what is the world coming to) and appreciate how much we are doing for you – no other company would give you this opportunity – it never happened in my day.

Yours condescendingly  
(Fawn at this point)

Hiram N. Firam XVII Senior.

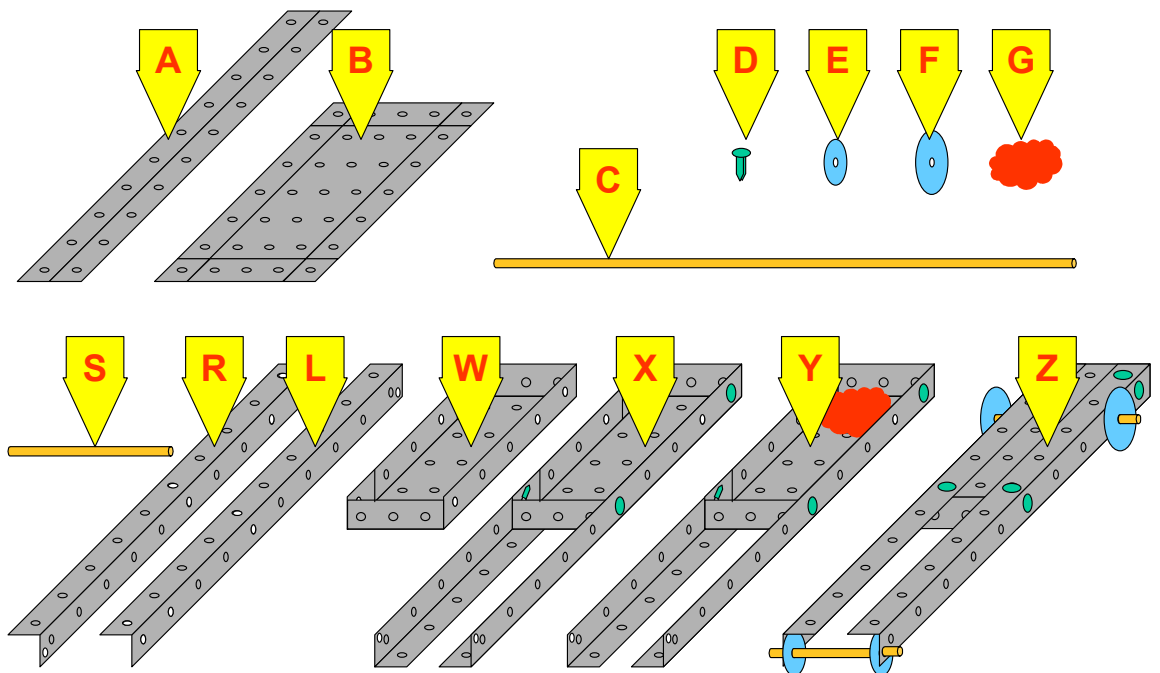


## 5.2 Factory Plan



## 5.3 Component Index

### Tessecart Component & Subassembly Index





## 5.4 Management Report

### Management Report for Time Period:

Period		1-5			6-10			11-15			16-20						
Stores Issues this Period		Qty	Unit Cost	Total	Qty	Unit Cost	Total	Qty	Unit Cost	Total	Qty	Unit Cost	Total				
		X	£6	=	X	£6	=	X	£6	=	X	£6	=				
		X	£10	=	X	£10	=	X	£10	=	X	£10	=				
		X	£5	=	X	£5	=	X	£5	=	X	£5	=				
		X	£1	=	X	£1	=	X	£1	=	X	£1	=				
		X	£2	=	X	£2	=	X	£2	=	X	£2	=				
		X	£3	=	X	£3	=	X	£3	=	X	£3	=				
		X	£3	=	X	£3	=	X	£3	=	X	£3	=				
<b>A</b>	Total Material				Total Material				Total Material				Total Material				
Labour Cost this Period		Staff	Rate	Total	Staff	Rate	Total	Staff	Rate	Total	Staff	Rate	Total				
		X	£25	=	X	£25	=	X	£25	=	X	£25	=				
<b>B</b>	Total Labour				Total Labour				Total Labour				Total Labour				
Revenue this Period		Qty	Unit Value	Total	Qty	Unit Value	Total	Qty	Unit Value	Total	Qty	Unit Value	Total				
		X	£100	=	X	£100	=	X	£100	=	X	£100	=				
		X	£200	=	X	£200	=	X	£200	=	X	£200	=				
		X	£300	=	X	£300	=	X	£300	=	X	£300	=				
		X	£500	=	X	£500	=	X	£500	=	X	£500	=				
<b>C</b>	Total Revenue				Total Revenue				Total Revenue				Total Revenue				
Net Profit this Period		Profit: C-(A+B)				Profit: C-(A+B)				Profit: C-(A+B)				Profit: C-(A+B)			

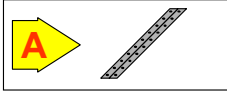
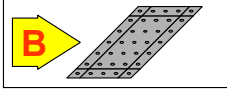
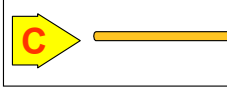
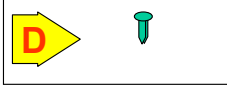
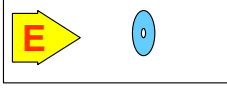
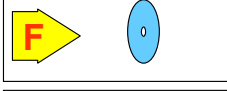
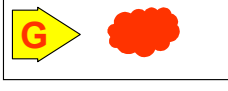
### Performance of Cart Production Department

Period	1-5	6-10	11-15	16-20
Net Profit this Period	£	£	£	£
<b>+£800</b>				
<b>+£700</b>				
<b>+£600</b>				
<b>+£500</b>				
<b>+£400</b>				
<b>+£300</b>				
<b>+£200</b>				
<b>+£100</b>				
<b>£0</b>				
<b>-£100</b>				
<b>-£200</b>				
<b>-£300</b>				
<b>-£400</b>				
<b>-£500</b>				
<b>-£600</b>				
Period	1-5	6-10	11-15	16-20



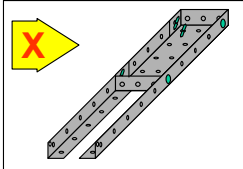
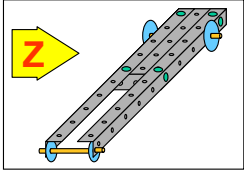
### 5.5 Stores Record Sheet

Stores Issue Record Log for Time Period:

Part \ Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
																					
																					
																					
																					
																					
																					
																					

### 5.6 Kanban Log

Kanban Log for Time Period:

Part \ Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
																					
																					



### 5.7 Quality Log

Quality Log for Time Period:

Fail Pass

Result \ Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
> 3m icon"/>																					

### 5.8 Kanban & Max-Min Placemats

<b>Kanban Mat</b>  	<b>Location</b> Stores A B C D E F G A B C D E F G Bodyshell Section D H X Z H X H F H Z G B Transmission Section C H E H <b>Reorder Level</b> <b>2</b>	<b>Kanban Mat</b>  	<b>Location</b> Stores A B C D E F G A B C D E F G Bodyshell Section D H X Z H X H F H Z G B Transmission Section C H E H <b>Reorder Level</b> <b>1</b>
	<b>Source</b> Stores A B C D E F G A B C D E F G Bodyshell Section D H X Z H X H F H Z G B Transmission Section C H E H <b>Reorder Quantity</b> <b>4</b>		<b>Source</b> Stores A B C D E F G A B C D E F G Bodyshell Section D H X Z H X H F H Z G B Transmission Section C H E H <b>Reorder Quantity</b> <b>2</b>
<b>Kanban Mat</b>  	<b>Location</b> Stores A B C D E F G A B C D E F G Bodyshell Section D H X Z H X H F H Z G B Transmission Section C H E H <b>Reorder Level</b> <b>1</b>	<b>Kanban Mat</b>  	<b>Location</b> Stores A B C D E F G A B C D E F G Bodyshell Section D H X Z H X H F H Z G B Transmission Section C H E H <b>Reorder Level</b> <b>8</b>
	<b>Source</b> Stores A B C D E F G A B C D E F G Bodyshell Section D H X Z H X H F H Z G B Transmission Section C H E H <b>Reorder Quantity</b> <b>2</b>		<b>Source</b> Stores A B C D E F G A B C D E F G Bodyshell Section D H X Z H X H F H Z G B Transmission Section C H E H <b>Reorder Quantity</b> <b>20</b>



<b>Kanban Mat</b> 	<b>Location</b> Stores A B C D E F G A B B QA Bodyshell Section D X Z X F Z Transmission Section G E C	<b>Kanban Mat</b> 	<b>Location</b> Stores A B C D E F G A B B QA Bodyshell Section D X Z X F Z Transmission Section G E C
	<b>Reorder Level</b> <b>2</b>		<b>Reorder Quantity</b> <b>6</b>
<b>Kanban Mat</b> 	<b>Location</b> Stores A B C D E F G A B B QA Bodyshell Section D X Z X F Z Transmission Section G E C	<b>Kanban Mat</b> 	<b>Location</b> Stores A B C D E F G A B B QA Bodyshell Section D X Z X F Z Transmission Section G E C
	<b>Reorder Level</b> <b>1</b> <b>Full Tub</b>		<b>Reorder Quantity</b> <b>1</b> <b>Full Tub</b>

<b>Kanban Mat</b> 	<b>Location</b> Stores A B C D E F G A B B QA Bodyshell Section D X Z X F Z Transmission Section G E C	<b>Max-Min Bin</b> 	<b>Location</b> Stores L R W X Bodyshell Section Z Transmission Section S
	<b>Reorder Level</b> <b>2</b>		<b>Reorder Quantity</b> <b>5</b>
<b>Max-Min Bin</b> 	<b>Location</b> Stores L R W X Bodyshell Section Y S Transmission Section	<b>Max-Min Bin</b> 	<b>Location</b> Stores L R W X Bodyshell Section Y S Transmission Section
	<b>Minimum Level</b> <b>2</b>		<b>Maximum Level</b> <b>3</b>



<p><b>Max-Min Bin</b></p> <p style="text-align: center; font-size: 2em; color: red;">W</p>	<p style="text-align: center; color: blue;"><b>Location</b></p> <p><b>Stores</b></p> <table border="1" style="width: 100%; text-align: center;"> <tr><td colspan="2">Stores</td></tr> <tr><td>Bodyshell Section</td><td>QA</td></tr> <tr><td>L   R   W</td><td></td></tr> <tr><td>X</td><td>Z</td></tr> <tr><td colspan="2">Transmission Section</td></tr> <tr><td>Y</td><td>S</td></tr> </table> <p><b>Minimum Level</b></p> <p style="font-size: 2em; color: red;">2</p>	Stores		Bodyshell Section	QA	L   R   W		X	Z	Transmission Section		Y	S	<p><b>Max-Min Bin</b></p> <p style="text-align: center; font-size: 2em; color: red;">X</p>	<p style="text-align: center; color: blue;"><b>Location</b></p> <p><b>Stores</b></p> <table border="1" style="width: 100%; text-align: center;"> <tr><td colspan="2">Stores</td></tr> <tr><td>Bodyshell Section</td><td>QA</td></tr> <tr><td>L   R   W</td><td></td></tr> <tr><td>X</td><td>Z</td></tr> <tr><td colspan="2">Transmission Section</td></tr> <tr><td>Y</td><td>S</td></tr> </table> <p><b>Minimum Level</b></p> <p style="font-size: 2em; color: red;">1</p>	Stores		Bodyshell Section	QA	L   R   W		X	Z	Transmission Section		Y	S
Stores																											
Bodyshell Section	QA																										
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Y	S																										
<p><b>Maximum Level</b></p> <p style="font-size: 2em; color: red;">3</p> <ul style="list-style-type: none"> <li>• Produce Component until maximum level is reached.</li> <li>• Cease production until level of components in bin drops below the minimum.</li> </ul>	<p><b>Maximum Level</b></p> <p style="font-size: 2em; color: red;">5</p> <ul style="list-style-type: none"> <li>• Produce Component until maximum level is reached.</li> <li>• Cease production until level of components in bin drops below the minimum.</li> </ul>																										
<p><b>Max-Min Bin</b></p> <p style="text-align: center; font-size: 2em; color: red;">Y</p>	<p style="text-align: center; color: blue;"><b>Location</b></p> <p><b>Stores</b></p> <table border="1" style="width: 100%; text-align: center;"> <tr><td colspan="2">Stores</td></tr> <tr><td>Bodyshell Section</td><td>QA</td></tr> <tr><td>L   R   W</td><td></td></tr> <tr><td>X</td><td>Z</td></tr> <tr><td colspan="2">Transmission Section</td></tr> <tr><td>Y</td><td>S</td></tr> </table> <p><b>Minimum Level</b></p> <p style="font-size: 2em; color: red;">1</p>	Stores		Bodyshell Section	QA	L   R   W		X	Z	Transmission Section		Y	S	<p><b>Max-Min Bin</b></p> <p style="text-align: center; font-size: 2em; color: red;">Z</p>	<p style="text-align: center; color: blue;"><b>Location</b></p> <p><b>Stores</b></p> <table border="1" style="width: 100%; text-align: center;"> <tr><td colspan="2">Stores</td></tr> <tr><td>Bodyshell Section</td><td>QA</td></tr> <tr><td>L   R   W</td><td></td></tr> <tr><td>X</td><td>Z</td></tr> <tr><td colspan="2">Transmission Section</td></tr> <tr><td>Y</td><td>S</td></tr> </table> <p><b>Minimum Level</b></p> <p style="font-size: 2em; color: red;">1</p>	Stores		Bodyshell Section	QA	L   R   W		X	Z	Transmission Section		Y	S
Stores																											
Bodyshell Section	QA																										
L   R   W																											
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Transmission Section																											
Y	S																										
<p><b>Maximum Level</b></p> <p style="font-size: 2em; color: red;">3</p> <ul style="list-style-type: none"> <li>• Produce Component until maximum level is reached.</li> <li>• Cease production until level of components in bin drops below the minimum.</li> </ul>	<p><b>Maximum Level</b></p> <p style="font-size: 2em; color: red;">5</p> <ul style="list-style-type: none"> <li>• Produce Component until maximum level is reached.</li> <li>• Cease production until level of components in bin drops below the minimum.</li> </ul>																										

## 5.9 30° Launch Ramp

The 30° Launch ramp can be made by bending a very thick sheet of card 120x710mm at 300mm and 450mm along its length, and then joining the ends together to form a triangle. Alternatively get three pieces of board or thin wood 120x300mm, 120x150mm and 120x260mm and tape the 120mm edges together with thick tape to form a triangle.