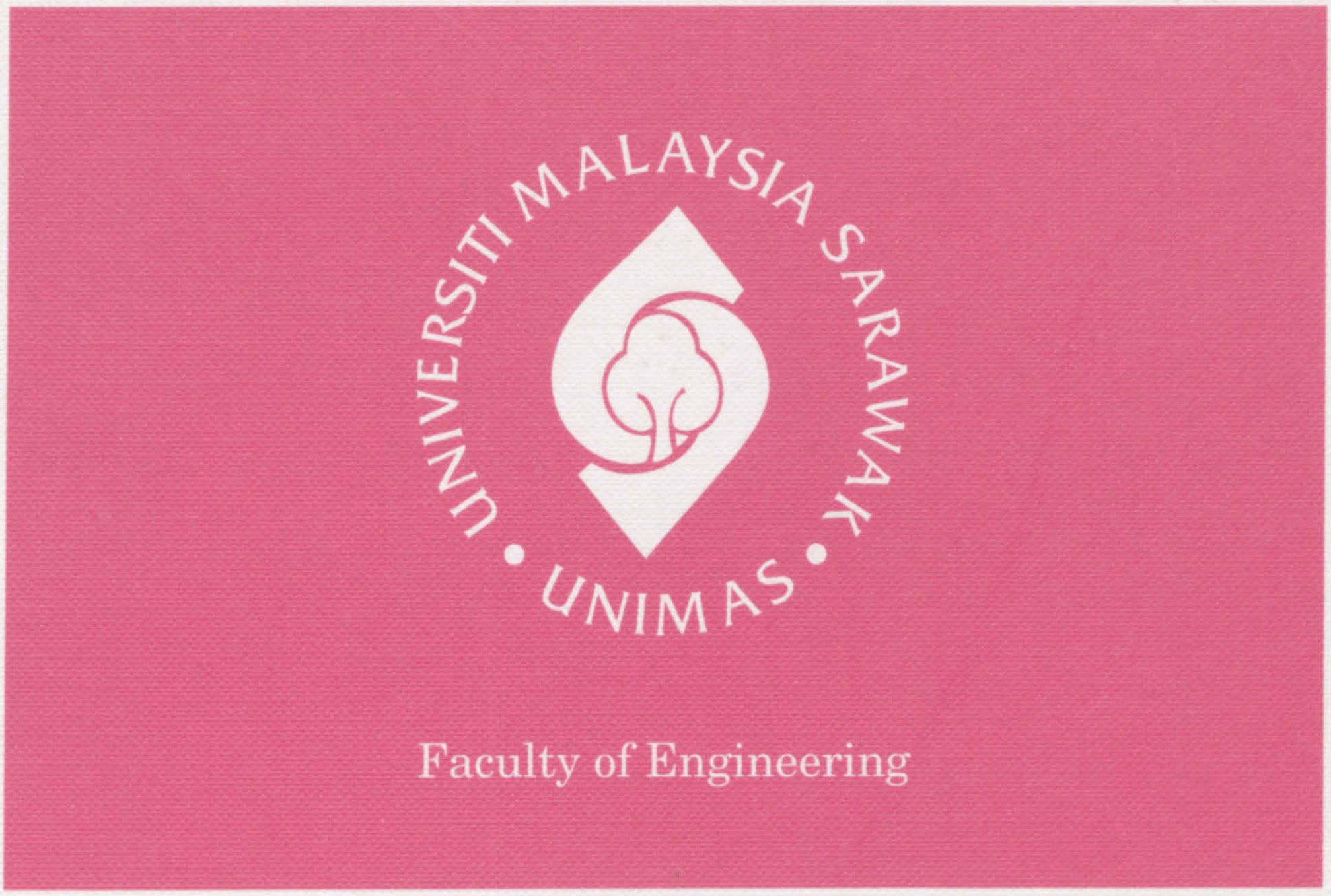

THE CONSTRUCTION OF POKA YOKE WAGON DOLLY

Wan Sharuzi Bin Wan Harun

Bachelor of Engineering with Honours
(Mechanical Engineering and Manufacturing Systems)
2004

Universiti Malaysia Sarawak

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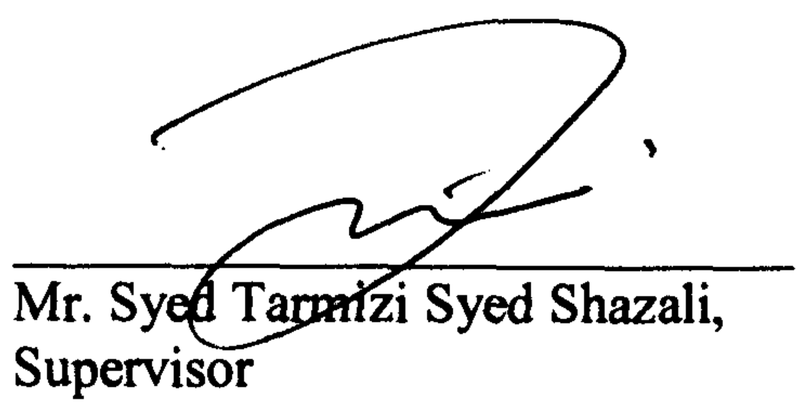
The project report attached hereto, entitle "The Construction of Poka Yoke Wagon Dolly" prepared and submitted by WAN SHARUZI BIN WAN HARUN in partial fulfillment of the requirement for Bachelor of Engineering with Honours in Mechanical Engineering and Manufacturing System in hereby read and approved by:



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30-03-2004

Date

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THE CONSTRUCTION OF POKA YOKE WAGON DOLLY

WAN SHARUZI BIN WAN HARUN

This project is submitted in partial fulfilment of
the requirements for Bachelor of Engineering with Honours
(Mechanical Engineering and Manufacturing System)

Faculty of Engineering
UNIVERSITI MALAYSIA SARAWAK
2004

Dedication

To my parents, for their love, support and great expectations.

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Poka Yoke Wagon Dolly

Wan Sharuzi Bin Wan Harun

ABSTRACT

The purpose of this study was to prove that the zero defect goal can be achieved by applying the Poka Yoke concept into system. The system has been divided into two major tasks, which is mechanical design and control system design. In mechanical design, the task will be carried out are includes designing, fabrication, installation, testing and analysis. By using the model built will enable student to study further about the entire system as well as the individual part. In addition, the model will allowed them to have hands-on experience during their undergraduate study. In this report, the process of designing Poka Yoke module, which is applied on the Wagon Dolly system, is presented. The Poka Yoke module constructed in this project will apply similar concept as the module that can be found in the real automotive manufacturing industries but it far cheaper. Construction of entire system includes sawing and filing process, drilling, milling, joining and ends up by finishing process. The geometry size of the model, weight of model and component used were analyzed and implemented according to the detailed design.

Poka Yoke Wagon Dolly

Wan Sharuzi Bin Wan Harun

Abstrak

Projek ini adalah bertujuan untuk membuktikan bahawa 'kerosakkan zero' dapat dicapai dengan mengaplikasikan konsep Poka Yoke kepada sesuatu sistem. Projek ini boleh dibahagikan kepada 2 bahagian utama, iaitu bahagian mekanikal dan bahagian sistem kawalan. Bagi bahagian mekanikal, perkara yang terlibat termasuklah mereka, mengfabrikasi, pemasangan, percubaan dan analisis. Dengan adanya pembinaan model, ini memberi peluang kepada pelajar untuk mempelajari lebih lanjut dan memahami keseluruhan sistem termasuk setiap komponen yang terlibat. Selain itu, dengan adanya model ini, juga dapat memberi peluang kepada pelajar untuk mendapatkan pengalaman semasa di peringkat pengajian lagi. Di dalam laporan projek ini, proses mereka modul Poka Yoke yang digunakan untuk sistem Wagon Dolly diterangkan. Modul Poka Yoke ini dibina mengikut konsep yang sama seperti yang terdapat di kilang-kilang pembuatan kenderaan pada masa kini, tetapi jika dibandingkan dari segi harga ia jauh lebih murah. Proses-proses yang terlibat dalam membina sistem ini adalah proses pemotongan, memesin, membina, menggerudi, pembetulan kedudukan dan diakhiri dengan proses penyudahan. Saiz geometri model, berat model dan komponen-komponen yang digunakan akan dianalisa serta diimplikasikan mengikut rekaan yang terperinci.

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List of Abbreviations

A	-	Area of cross section
m	-	Mass
f	-	Force
E	-	Energy
v	-	Velocity
t	-	Time
T	-	Temperature
C	-	Capacitor
i	-	Inductor
di	-	Derivative of inductor
L	-	Inductance
V	-	Volume
ρ	-	Density
c	-	Specific heat
Q	-	Net heat transfer rate
Δx	-	Length of heat conduction with a temperature drop of T
k	-	Conductivity
h_c	-	Convection heat transfer coefficient
R_k	-	Conductive resistance
R_c	-	Convection Resistance
σ	-	Stefan-Boltzmann constant
F_E	-	Effective emmisivity of the radiation source

F_A	-	Shape factor of the radiation receiver
dv	-	Derivative of volume
dt	-	Derivative of time
dT	-	Derivative of temperature
SOP	-	Standard Operating Procedure

Chapter 1

INTRODUCTION

1.1 General Overview of Wagon Dolly

Wagon Dolly is a well-known term by mostly of the PROTON workers. It is because mostly every station at the production lines in the factory is using it. Actually, it is does not differ much from a usual parts racking system as we all know. The only difference, it is moveable rather than fixed certain places.

Generally, at PROTON it is used to carry small parts and tools at certain amount for assembly works done by operators. By using it, the operators can save time and steps a lot during working process compared to their using of the existing usual parts rack at line sides for similar job. The following paragraph are some of others reasons why Wagon Dolly is so widely used in PROTON factory line side.

Firstly, it fit the layout of parts rack with operation routine then, it can contributed to increased productivity, produced high quality products, better employee motivation and finally, the operation costs also can be reduced.

The author intends to improve this Wagon Dolly which is will not just for saving the times or movements of operators but also looking to guide the operators to do the jobs correctly without pull through any errors as followed the Standard Operation Procedure (SOP) provided at the work places. It is the basic principle of *Do it right the first time!* It is can be done through *ONE-BY-ONE CONFIRMATION.*

1.2 Standardization of the Wagon Dolly

1.2.1 Basic specification

The Wagon Dolly should be design and constructed to be quite small and light in weight to make possible to put small tools set, small parts, big and medium parts usually for 1 vehicle. Workers should attach tools subdivision box by them in case of widely used.

1.2.2 Standard Size of Wagon Dolly

The table below show that the standard size of wagon dolly. It is very important in order to build the wagon dolly according to their standard.

	Standard Size	Study Item
Height	H= 850mm	• Tool and parts operation ability. • Height of hand in the time of pushing dolly back.
Width	W= 390mm ~ 500mm	• Most suitable arrangement of parts box on the market.
Length	L= 600mm	• Stability while dolly is in motion.

Table 1.1 General Specifications of Wagon Dolly.

(*Source quoted from PROTON Manual Reference Book 1998*)

1.2.3 Detail Specifications of Wagon Dolly

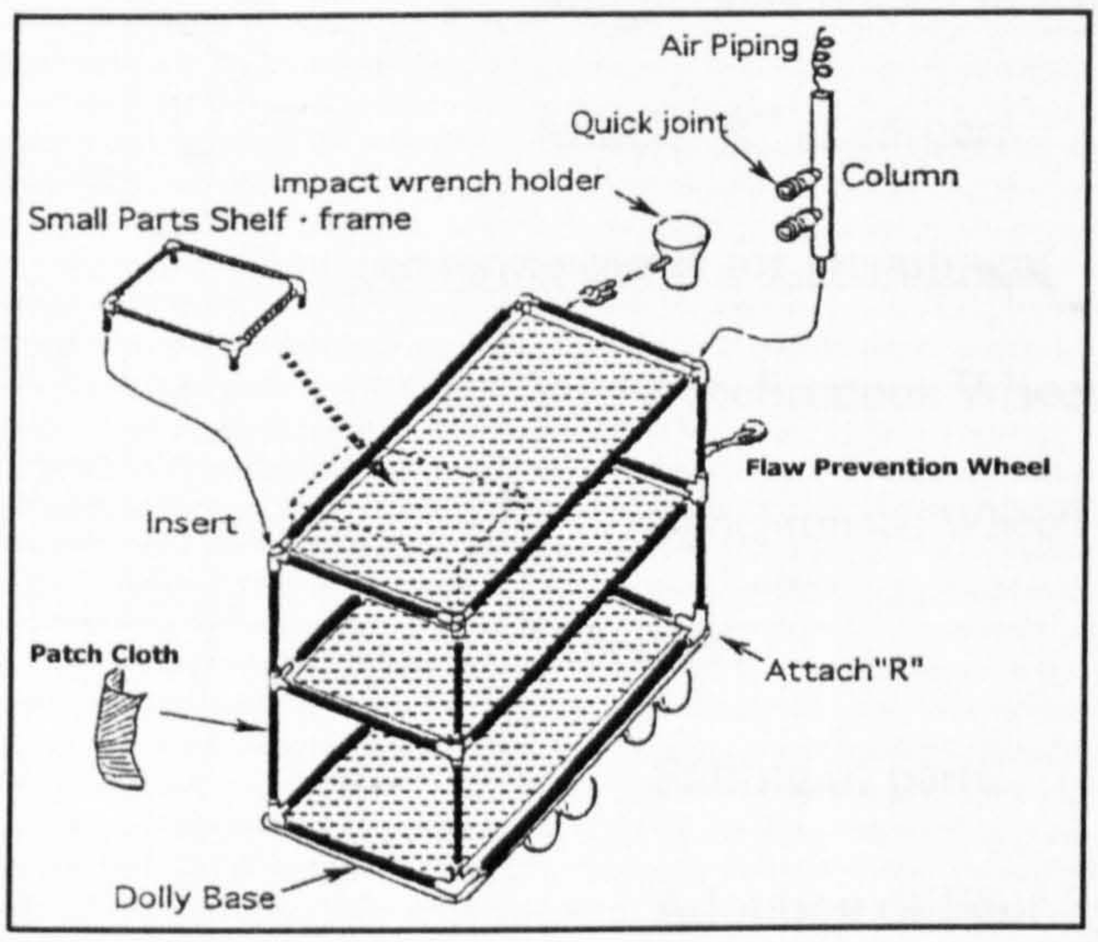

Figure 1.1 Standard Wagon Dolly.

(*Source quoted from PROTON Manual Reference Book 1998*)

The Figure 1.3 shows the detail specifications example of Wagon Dolly that currently being use in PROTON factory. The author tends to listed out the detail specifications as below;

a. <u>Lightenization and Cost Down</u>

- Frame : Pipe
- Section Partition : Plywood

Both of the weight and cost are less than half of Angle steel.

b. <u>Standardization of Option Parts</u>

- Impact wrench holder.
- Small parts box.
- Material for small parts shelf frame.
- Apply cloth (Seat cloth).

c. <u>Column Embedding Type Air Piping</u>

- Column is possible to be put wherever 4 corners.

d. <u>Prevent Body Flaw</u>

- Installation of flaw prevention wheels.

e. Safety Countermeasures

- Height does not hit to Achilles' tendon.
- Attach "R" at corner.

f. Countermeasures for Derailment

- Two Synchronous Wheels.
  - Synchronous Wheels sink in time of going back.
  - Vibration
    - Falling of parts.
    - Adoption of Four Synchronous Wheels.

1.2.4 How the Wagon Dolly Getting Moved

Below shows those two types on how wagon dolly can be moved during it is in used.

a) Guide Rail: Continuance penetration.

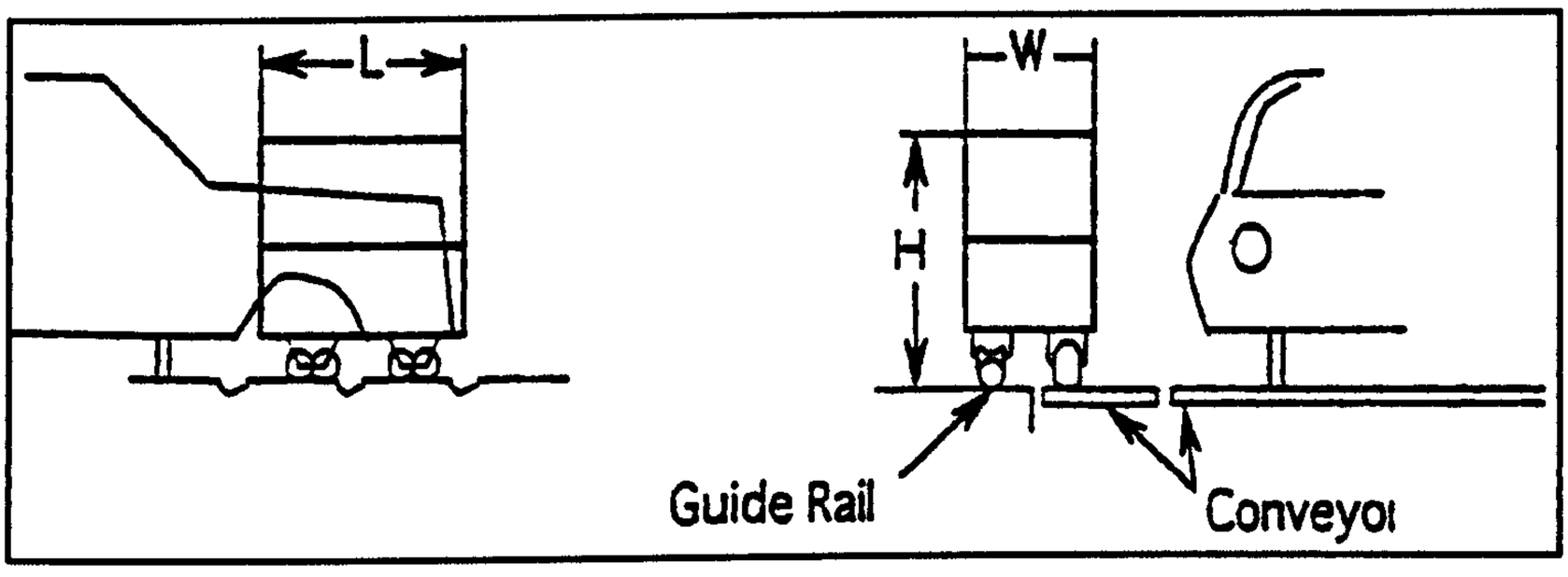

Figure 1.2 Example of the Guide Rail Wagon Dolly.

(*Source quoted from PROTON Manual Reference Book 1998*)

One of the ways how the Wagon Dolly can be moved within the factory is by using guide rail. Basically it is used to keep the Wagon Dolly straightly forward during moving at the line sides.

b) Synchronize System.

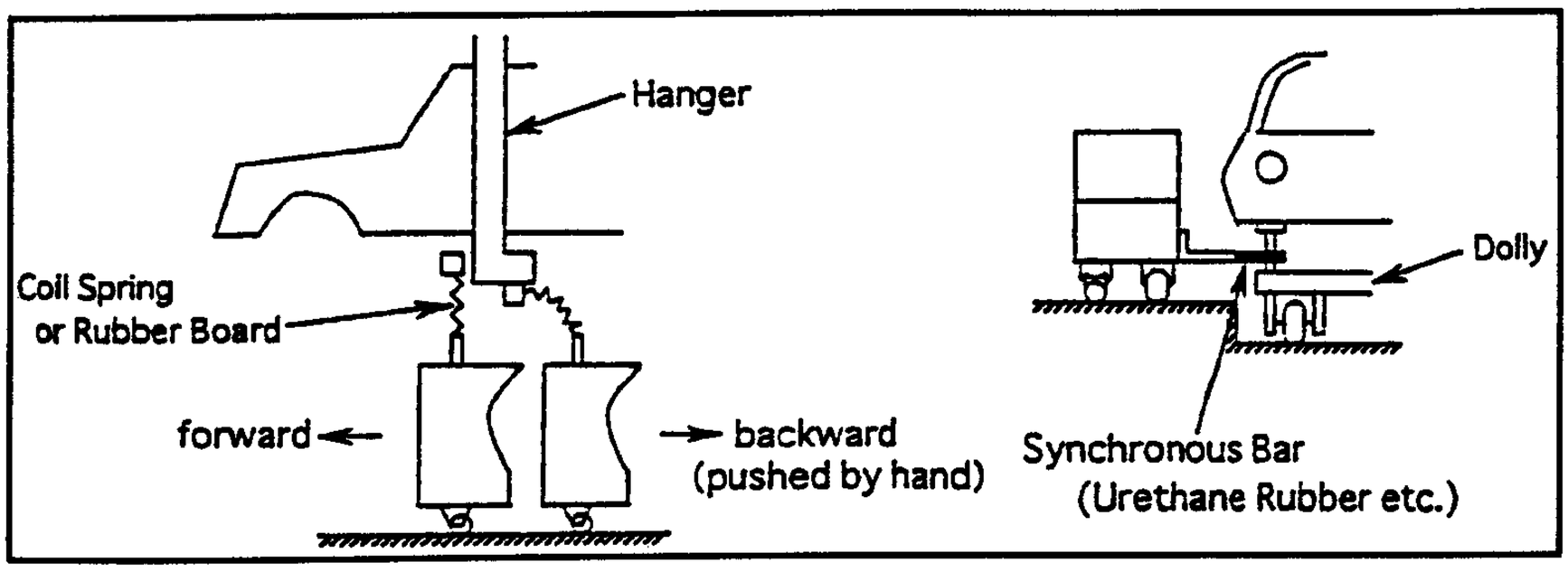

Figure 1.3 Example of the Wagon Dolly with the Synchronous System.
(*Source quoted from PROTON Manual Reference Book 1998*)

Synchronous system is another way for Wagon Dolly can be moved within the factory. The system worked when the operator switching the toggle switch provided on the Wagon Dolly itself. It will cause the pneumatic cylinder bar will hook up to the dolly of the car to be assemble. Thus, the Wagon Dolly will move together with the car until the operator finished their work. Finally, one again the operator switching off the toggle switch to make the pneumatic cylinder bar back to the original position. Then, operator will push back the Wagon Dolly itself to the starting point again.

1.3 Overview of Poka Yoke system

Shingo first got familiar with the Poka Yoke concept the first time in 1961. The word "Poka Yoke" means mistake-proofing in English. The Poka Yoke device is a simple mechanical or electromechanical device, which eliminates the possibility of production mistake if properly used. Poka Yoke systems involve carrying out *100 percent inspections* and requiring *immediate feedback and action when* errors or defects occur. Most of the Poka Yoke devices are also very easy and very cheap to install.

To understand the basic premise of Poka Yoke, firstly, let think about what causes defects. Defects can be caused by a variety of factors including:

- Cultural factors such as awareness, attitudes, incentives, reward systems, and the level of commitment of the individuals.
- Variance or the random and inherent differences between process outputs.
- Complexity factors such as the number of separate parts, lack of commonality.
- Mistakes or human errors that include incorrect intentions or executing correct intentions that result in unintended outcomes.

Fortunately, we have a large variety of tools and techniques to help us eliminate defects:

Cause of Defect	Applicable Tools
Cultural Factors	• Formation of teams. • Management commitment. • Driving out fear.
Variance	• Statistical Process Control • Design of Experiments by Taguchi
Complexity	• Design for Manufacturability (DFX)
Mistakes	• Poka Yoke

Table 1.2 Applicable Tools.

(*Source quoted from Zero Quality Control: Source Inspection and the Poka-Yoke System, Shigeo Sing, Cambridge productivity press, 1986*)

Thus, Poka Yoke systems are specifically designed to eliminate mistakes before they become a defect. When come to understanding mistakes and how they translate into defects, there are two basic rules must remember: