PRODUCTION PREPARATION (CYLINDER BLOCK TILTING EQUIPMENT)

CASE SYUDY: TOYOTA DAIHATSU ENGINEERING & MANUFACTURING CO., LTD.

MR. THANADET SUKKAWAT

THIS REPORT IS A PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF ENGINEERING IN INDUSTRIAL ENGINEERING

FACULTY OF ENGINEERING

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Thai – Nichi Institute of Technology

Project name	Production preparation (cylinder block tilting equipment)
Writer	Thanadet Sukkawat
Faculty	Faculty of Engineering, Industrial Engineering program
Faculty of Advisor	Dr. Ek-u Thammakonbunjut
Job Supervisor	Mr. Tarit Tilokkul
Company's Name	Toyota Daihatsu Engineering & Manufacturing Co., Ltd. (TDEM)
Business Type/Product	Research and development center and operational support to Toyota production facilities in Asia

Summary

Now IMC Pakistan plant of Toyota is produce engine A and B in 1 line assembly. They will replace engine model A by engine model C in production line that is assembly 2 models. so I have to make a machine specification sheet of new block tilting unit that can use with 2 models (model B and C) and other equipment to support this project such as flywheel pin press jig, piston ring assembly jig, Turn table for block sub line assembly and turn table for head sub assembly.

All of equipment has achievement smoothly. Block tilting unit can rotate both 2 cylinder block model 90 degree by using adapter jigs to make the same rotating position by changing some work elements without effect the takt time. Specification sheet have sign by TDEM staff, maker and plant staff. With cooperative period I have participate with production preparation job in process planning, machine specification, procurement process and design process. This equipment can adapt with another nearly case in the fut

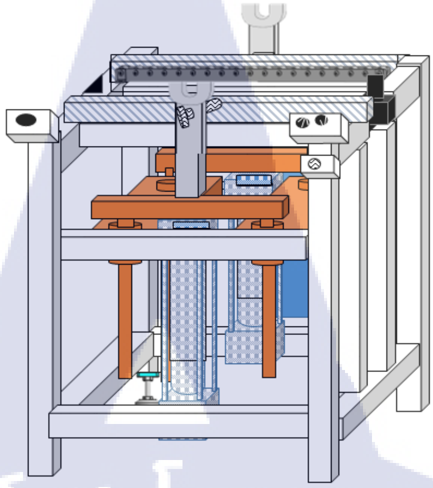


Figure Block tilting machine

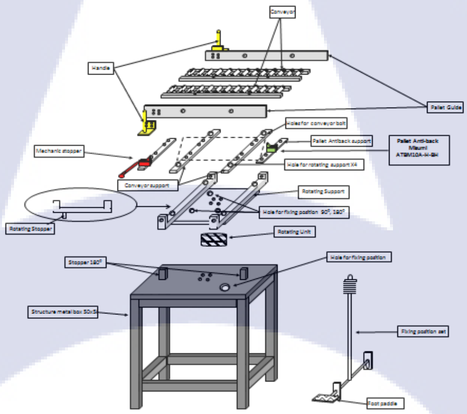


Figure Turn table (Block sub assembly line)

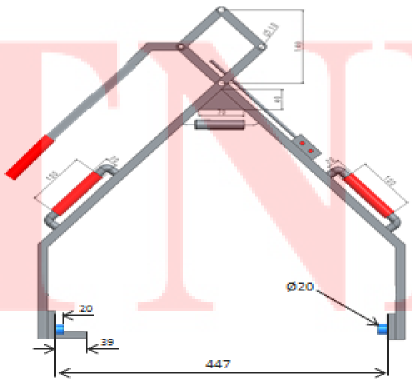


Figure hanger

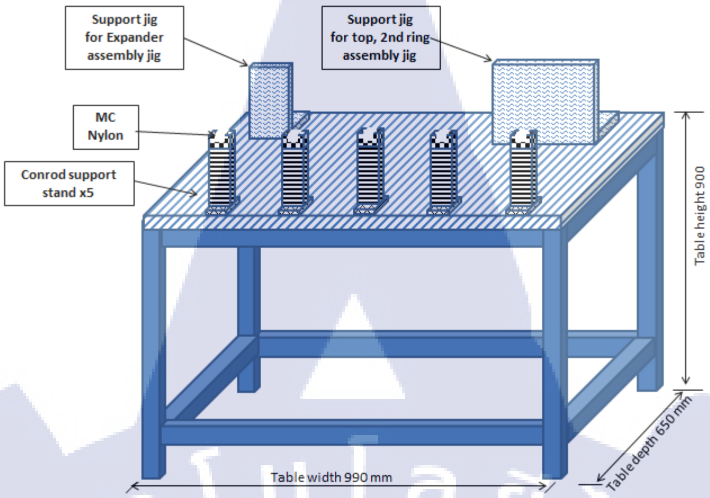


Figure Oil rings assembly jig and table

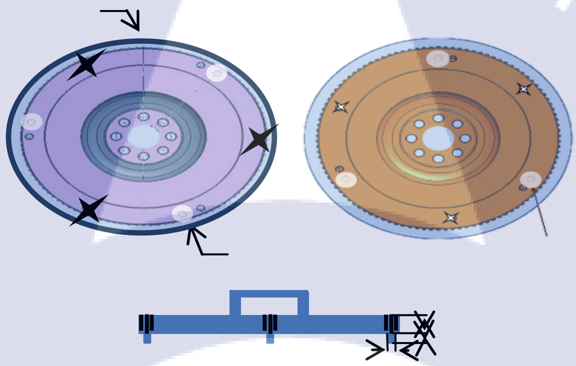


Figure Flywheel press pin jigs

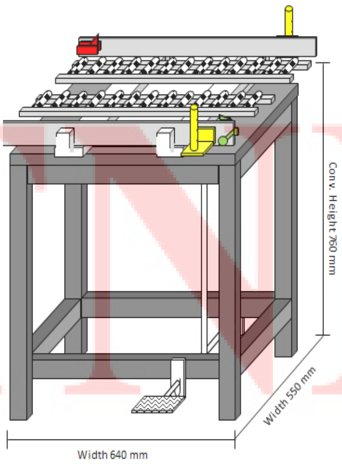


Figure turn table (Head sub line assembly)

Acknowledgments

During this cooperative program from beginning of June, 2018 to 17 August, 2018 at Toyota Daihatsu Engineering & Manufacturing. I gain many knowledge and experience that can't learn in classroom. This report can't be done if I don't have support from these employee.

1. Mr. Chakapan Tesukul (Manager)
2. Mr. Hirun Punyawansiri (Senior Engineer)
3. Mr. Tarit Tilokkul (Senior Engineer)
4. Mr. Kanapon Klunsupa (Engineer)

I want to thank you everyone for always support me and make me improve myself. I will bring this to working in the future. Lastly thank you TDEM for giving me a chance to this cooperative program.

Thanadet Sukkawat

Contents

List of figures

Chapter 1

Introduction

1.1 Name, Address and Background of Company

Company Name : Toyota Daihatsu Engineering & Manufacturing Co.,LTD (TDEM) (Fig 1.1)

Address : 99 Moo.5, Ban-Ragad Sub-district, Bang-Bor District, Samutprakran Province 10560, Thailand as shown in the (Fig 1.3)

Telephone : 02-790-6517

Fax : 02-790-501

Figure 1.1 Toyota Daihatsu Engineering & Manufacturing Co.,LTD (TDEM)

Figure 1.2 Logo of Toyota and Toyota Daihatsu Engineering & Manufacturing

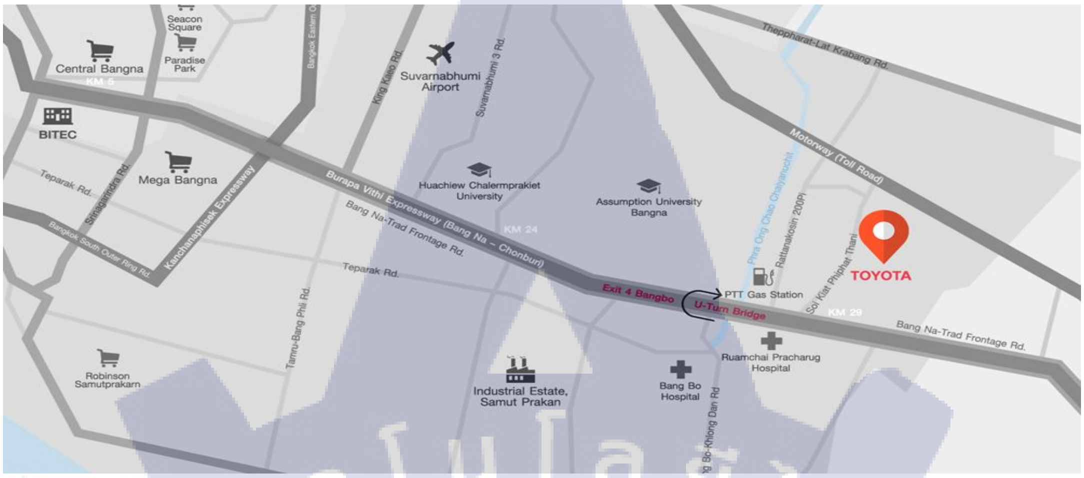


Figure 1.3 Map of Toyota Daihatsu Engineering & Manufacturing Co., LTD (TDEM)

TDEM Mission

• Providing timely, efficient and high quality support to Toyota Group members in the AMENA and other regions.

• Banding Team-Toyota members together and leading them to achieve.

• Enhancing collaboration among product development, production, sales and other functions across the region incl. takes Initiative for Region-Led Management

• Synergizing Toyota & Daihatsu strengths on the area of Engineering and Manufacturing.

TDEM Vision To become the most trusted and respected automobile group in the world.

1.2 Business Type

Research and Development Center and Operational support to Toyota Production facilities in Asia

1.2.1 RESEARCH & DEVELOPMENT

1.2.1.1 Technical Research

1.2.1.2 Technical Planning

1.2.1.3 Body, Chassis, Vehicle, Material, Electronics

1.2.2 MANUFACTURING SUPPORT

1.2.2.1 Purchasing

1.2.2.2 Production Engineering

1.2.2.3 Production Control/Logistics

1.2.2.4 Production/Project Planning

1.2.2.5 Conversion & Accessories

1.2.3 ADMINISTRATION

1.2.3.1 Corporate Planning

1.2.3.2 Human Resources

1.2.3.3 Accounting & Finance

1.2.3.4 Information System Etc.

1.3 Organization Management

TDEM (Thailand)

Foundation	April 2007
Company Name	Toyota Daihatsu Engineering & Manufacturing Co., Ltd.
Location	Head Office (Bang-Bo), AP-GPC (Banpho), TPCAP (Banpho)
Capital	1.3 billion Thai Baht (4 billion yen)
Shareholder	Toyota Motor Corporation (TMC), Japan 100%
Activities	Production and Service parts Sourcing, Manufacturing and Engineering Support Research and Development etc. (Fig 1.6)

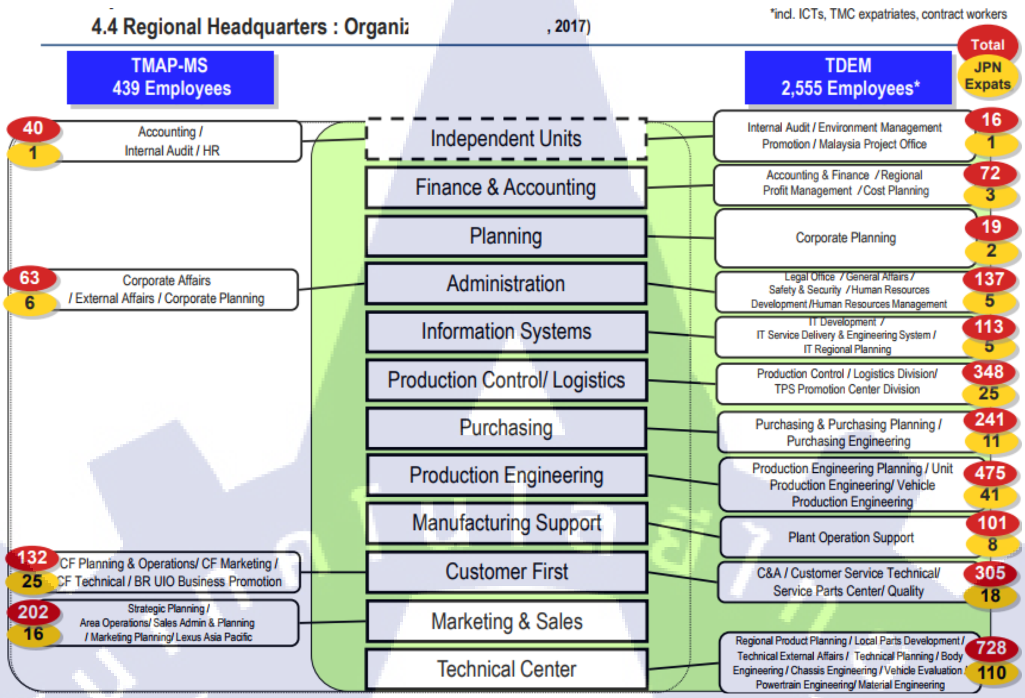


Figure 1.4 TMAP-EM Organization and Management

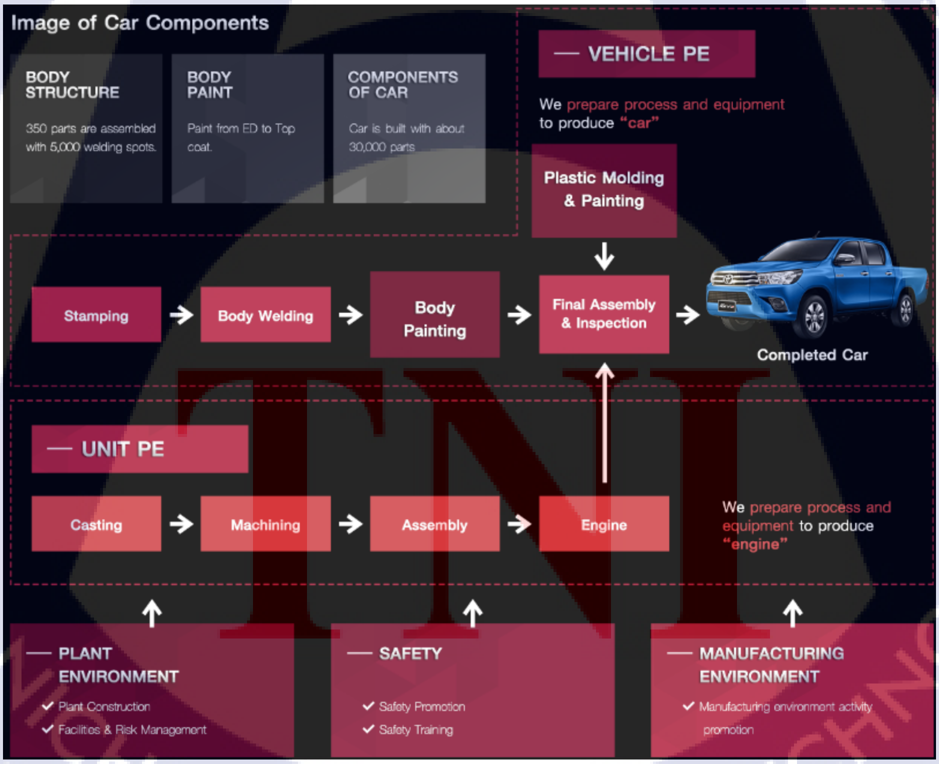


Figure 1.5 Image of car components

Figure 1.6 Responsible Area of PE (TDEM)

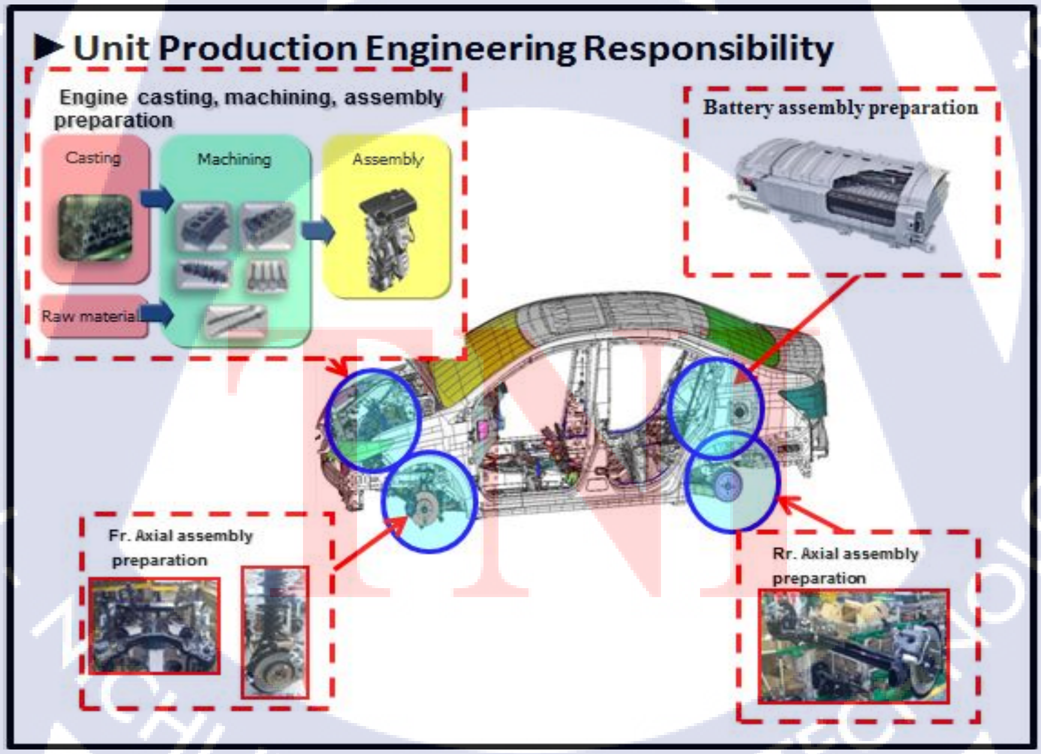


Figure 1.7 Unit Production job scope

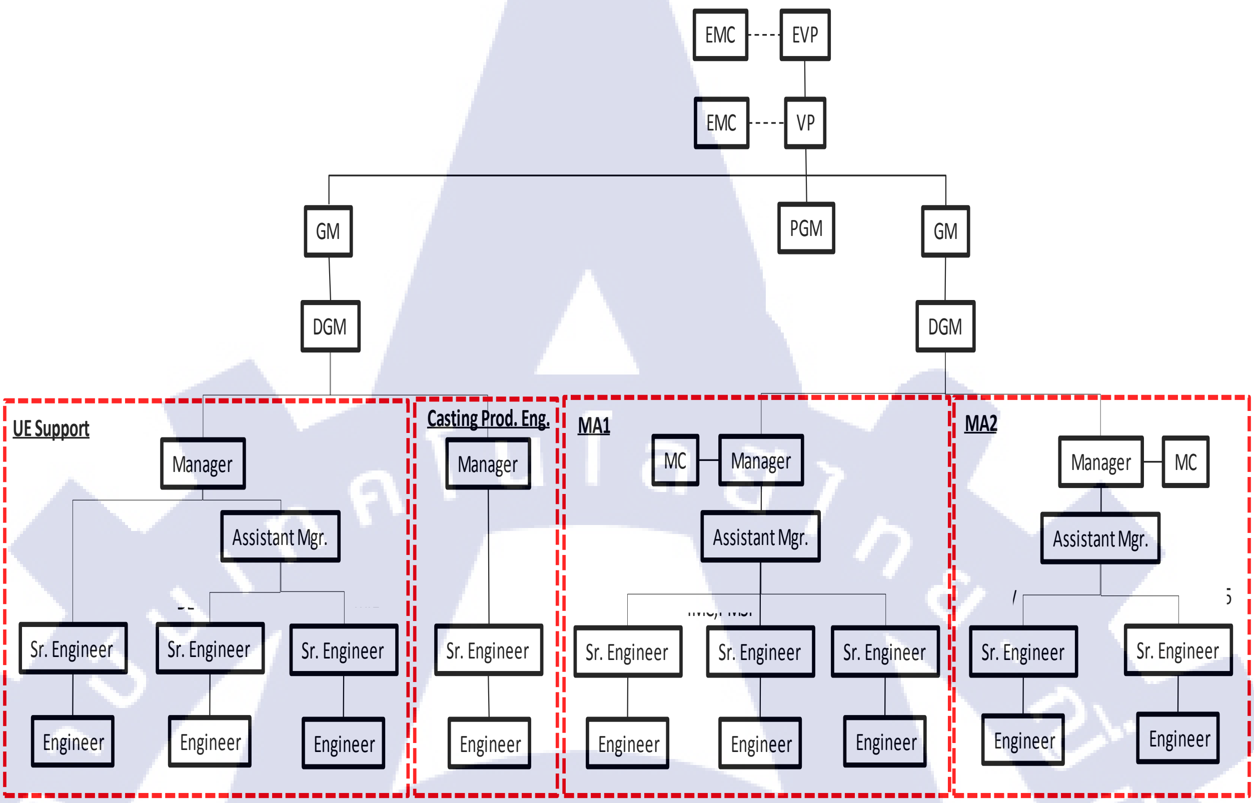


Figure 1.8 Unit Production Engineering Organization

1.4 Position and My Responsibility

Mr. Thanadet Sukkawat (Fig 1.9)

Trainee

Engine Assembly Production Engineering Section

Unit Production Engineering No.2 Department

Unit Production Engineering Division

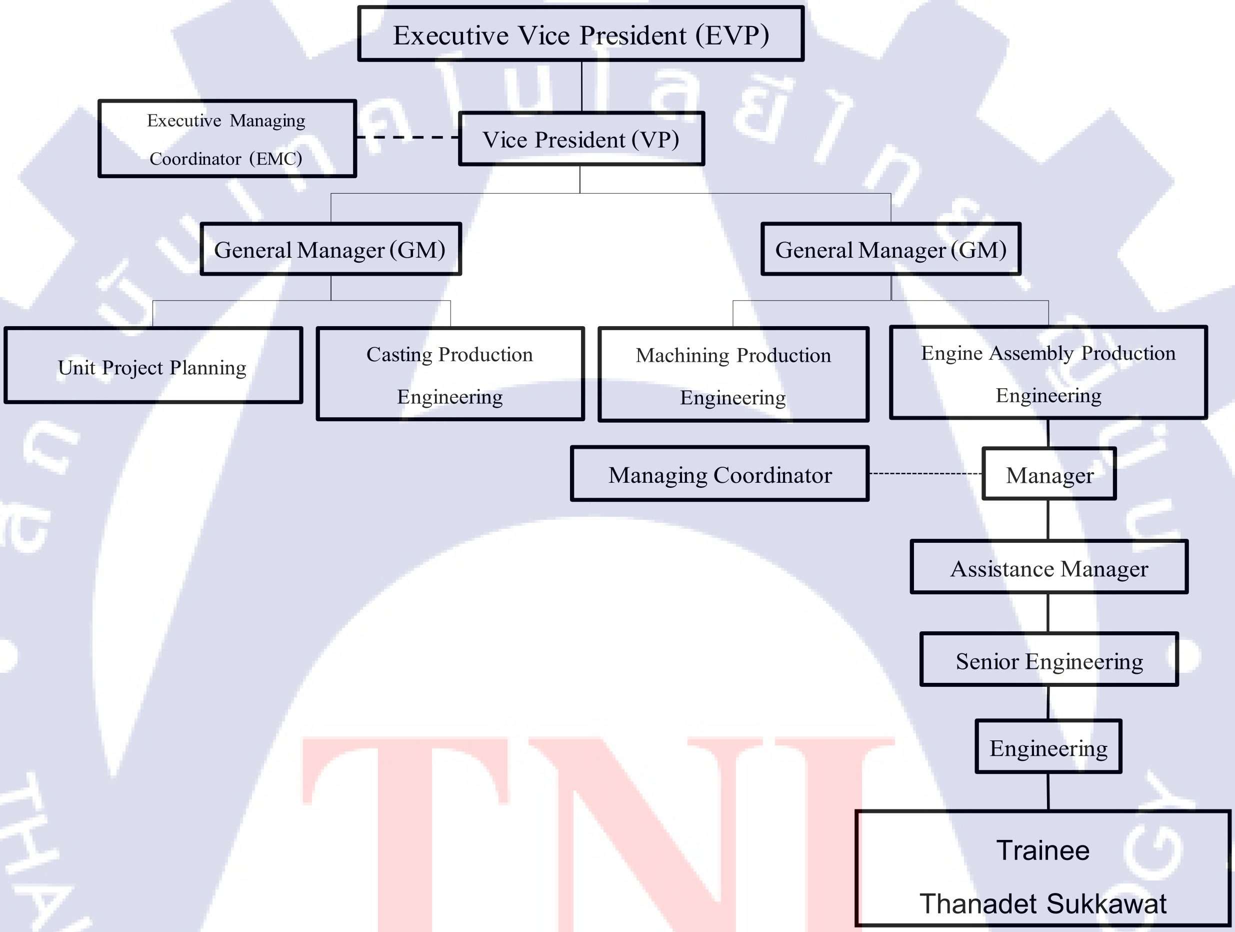


Figure 1.9 Positions for Internship Chart

1.5 Staff Advisor and Position of Staff Advisor

Mr. Tarrit Tilokkul (Fig 1.10)

Senior Engineer

Engine Assembly Production Engineering Section

Unit Production Engineering No.2 Department

Unit Production Engineering Division

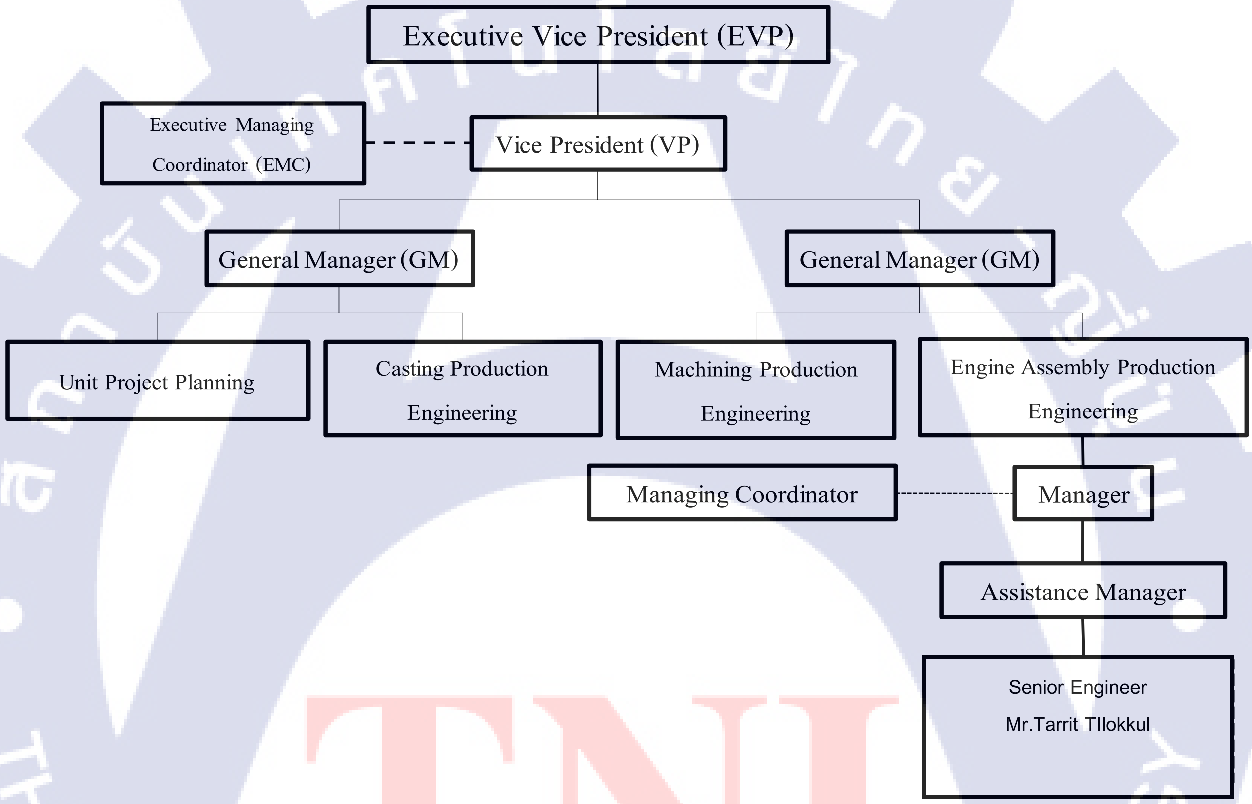


Figure 1.10 Position for job Advisor chart

1.6 Period Time of Internship

Start form 1st July 2018 to 17st August 2018, Totally 2 months 17 day.

Work Hours: Total 465.5 hours.

Week: Total 12 weeks

1.7 Background of Project

Regarding to IMC Pakistan is the last plant of Toyota in Asia that will produce engine model C on 2019 and because of low capacity this new engine model will produce with another engine model in the same production line so it have to modified production line and some part have to make a new assembly line.

1.8 Objective of the project for work or Project

Making cylinder block tilting unit to tilt cylinder block 90 degree for assembly rear oil seal, flywheel and clutch cover.

1.9 Expected of the Project (Fig 1.11)

1.9.1 Basic Toyota knowledge

- To understand Toyota's way & Toyota production system.

1.9.2. Basic Engine knowledge

- To understand how engine work
- To know parts in engine and their duty

1.9.3. Engine Assembly Process

- To know and understand Engine assembly process
- To know the machines, production line and tools

1.9.4. Basic software knowledge (Pro E, Excel, PowerPoint)

- To understand how to use and adapt to use with production preparation & Equipment planning

1.9.5. Production preparation & Equipment planning

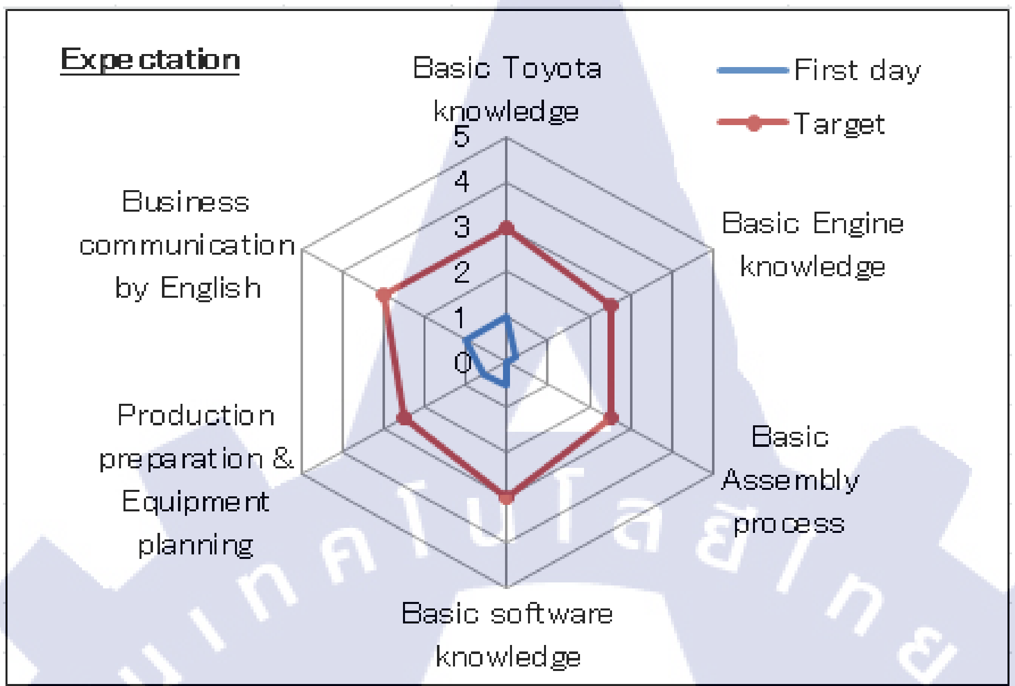
- To understand thinking way of production Engineering field, job responsibility and how equipment work

1.9.6. Business communication by English

- Level up Business English communication skill

1.9.7. Get ready to be efficient engineer

- Practicing to work with the experience engineer and get real experience



Skill Level

Beginner = 1

Can do by instruction = 2

Can do by suggestion = 3

Can do by self = 4

Expert = 5

Figure 1.11 Training expectation

Chapter 2

Operation Theory and Technology

2.1 Toyota way (2001) [1]

The Toyota Way 2001 (Fig 2.1) is an ideal, a standard and a guiding beacon for the people of the global Toyota organization. It expresses the beliefs and values shares by all of us.

The Toyota Way 2001 is based on the Guiding Principles at Toyota, which define the mission of Toyota as a corporation and the values the company delivers to customers, shareholders, associates, business partners and the global community. The Toyota Way 2001 defines how the people of Toyota perform and behave in order to deliver these values. It functions as the autonomic nervous system for Toyota organizations.

The concepts that make up the The Toyota Way 2001 transcend language and nationality, finding application in every land and society.

The Toyota Way 2001 is supported by two main pillars. They are "Continuous Improvement" and "Respect for People". We are never satisfied with where we are and always improve our business by putting forth our best ideas and efforts. We respect people, and believe the success of our business is created by individual efforts and good teamwork.

All Toyota team members, at every level, are expected to use these two values in their daily work and interactions.

Figure 2.1 Chart of TOYOTA WAY (2001) [1]

First: Continuous Improvement

Challenge: We form a long term vision, meeting challenge with courage and creative to realize our dreams. As following

– Create value through production, and deliver products and services.

–Spirit of challenges.

– Long Perspective.

–Thorough Consideration in decision-making.

"A product should never be sold unless it has been carefully manufactured & has been tested thoroughly & satisfactorily" Sakichi Toyoda

Kaizen: We improve our business operations continuously, always driving for innovation and evolution. As following

– Kaizen mind and innovative thinking.

–Building lean systems and structures.

–Promoting organization Learning.

"We are working on making better products by making improvements everyday"Kiichiro Toyoda

Genchi Genbutsu : We practice Genchi Genbutsu go to the source to find the facts to make correct decision , build consensus and achieve goals at our best speed. As Following

– Efficiency consensus building.

– Commitment to achievement.

Second: Respect for People

Respect: We respect others, make every effort to understand each other, take responsibility and do our best to build mutual trust. As following

– Respect for stakeholder.

– Mutual trust and Responsibility.

– Sincere communication.

Teamwork: We stimulate personal and professional growth, share the opportunities of development and maximize individual and term performance. As following

– Commitment to education and development.

– Respect for the individual; Realizing consolidated power as a team.

2.2 Toyota Production System (TPS) [2]

The Toyota Production System (TPS) (Fig 2.2) was established based on two concepts: The first is called "jidoka" (which can be loosely translated as "automation with a human touch") which means that when a problem occurs, the equipment stops immediately, preventing defective products from being produced; The second is the concept of "Just-in-Time," in which each process produces only what is needed by the next process in a continuous flow.

Based on the basic philosophies of jidoka and Just-in-Time, the TPS can efficiently and quickly produce vehicles of sound quality, one at a time, that fully satisfy customer requirements.

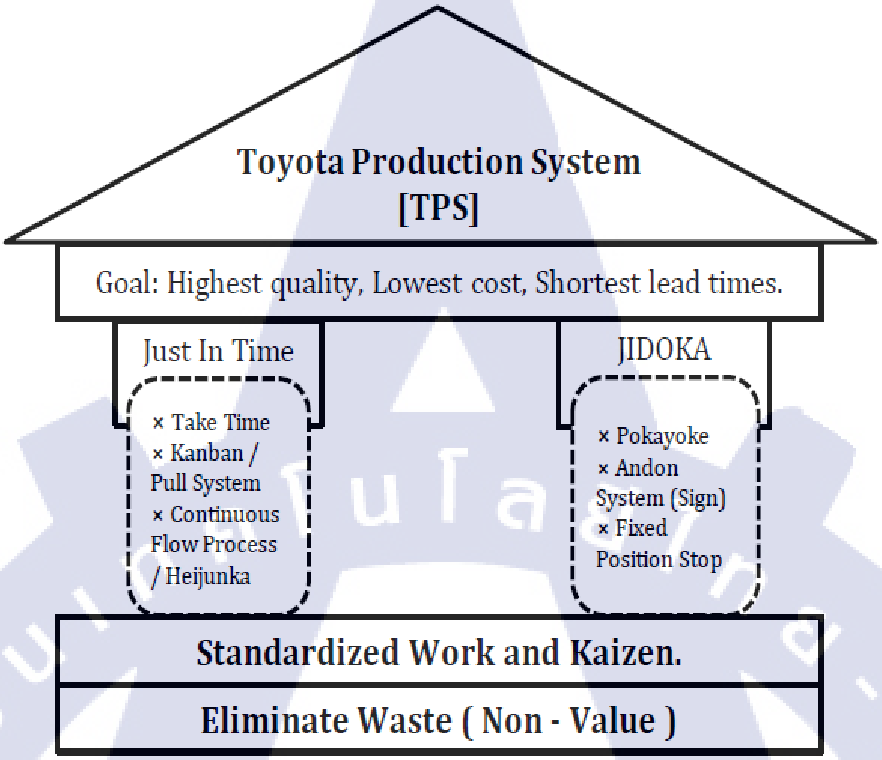


Figure 2.2 Toyota Production System (TPS) House diagram [2]

2.2.1 Just-in-Time

"Just-in-Time" means making "only what is needed, when it is needed, and in the amount needed." For example, to efficiently produce a large number of automobiles, which can consist of around 30,000 parts, it is necessary to create a detailed production plan that includes parts procurement. Supplying "what is needed, when it is needed, and in the amount needed" according to this production plan can eliminate waste, inconsistencies, and unreasonable requirements, resulting in improved productivity.

In the TPS (Toyota Production System), a unique production control method called the "kanban system" (Fig 2.3) plays an integral role. The kanban system has also been called the "Supermarket method" because the idea behind it was borrowed from supermarkets. Such mass merchandizing stores use product control cards upon which product-related information, such as a product's name, code and storage location, are entered. Because Toyota employed kanban signs for use in their production processes, the method came to be called the "kanban system." At Toyota, when a process refers to a preceding process to retrieve parts, it uses a kanban to communicate which parts have been used.

A supermarket stocks the items needed by its customers when they are needed in the quantity needed, and has all of these items available for sale at any given time. Taiichi Ohno (a former Toyota vice president), who promoted the idea of Just-in-Time, applied this concept, equating the supermarket and the customer with the preceding process and the next process, respectively. By having the next process (the customer) go to the preceding process (the supermarket) to retrieve the necessary parts when they are needed and in the amount needed, it was possible to improve upon the existing inefficient production system. No longer were the preceding processes making excess parts and delivering them to the next process.

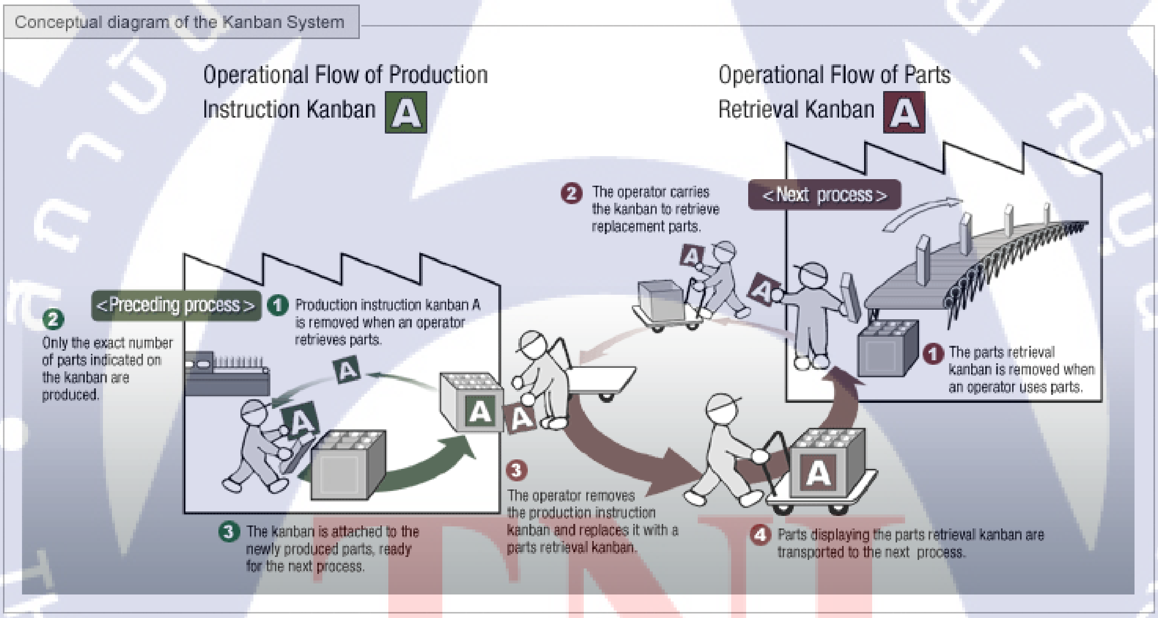


Figure 2.3 Conceptual diagram of the Kanban system [2]

2.2.2 JIDOKA

The term jidoka (Fig 2.5) used in the TPS (Toyota Production System) can be defined as "automation with a human touch." The word jidoka traces its roots to the invention of the automatic loom by Sakichi Toyoda, Founder of the Toyota Group. The automatic loom is a machine that spins thread for cloth and weaves textiles automatically.

Before automated devices were commonplace, back-strap looms, ground looms, and high-warp looms were used to manually weave cloth. In 1896, Sakichi Toyoda invented Japan's first self-powered loom called the "Toyoda Power Loom." Subsequently, he incorporated numerous revolutionary inventions Into his looms, including the weft-breakage automatic stopping device (which automatically stopped the loom when a thread breakage was detected), the warp supply device and the automatic shuttle changer. Then, in 1924, Sakichi invented the world's first automatic loom, called the "Type-G Toyoda Automatic 1oom (Fig 2.4) (with non-stop shuttle-change motion)" which could change shuttles without stopping operation.

The Toyota term "jido" is applied to a machine with a built-in device for making judgments, whereas the regular Japanese term "jido" (automation) is simply applied to a machine that moves on its own. Jidoka refers to "automation with a human touch," as opposed to a machine that simply moves under the monitoring and supervision of an operator.

Since the loom stopped when a problem arose, no defective products were produced. This meant that a single operator could be put in charge of numerous looms, resulting in a tremendous improvement in productivity.

Since equipment stops when a problem arises, a single operator can visually monitor and efficiently control many machines. As an important tool for this "visual control" or "problem visualization," Toyota plants use a problem display board system called "andon" that allows operators to identify problems in the production line with only a glance

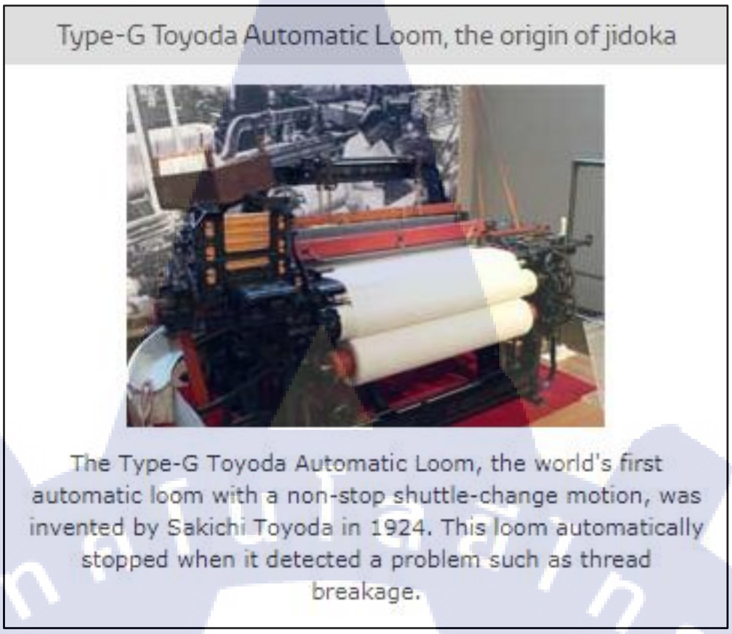


Figure 2.4 Type G Toyota automatic 1oom [2]

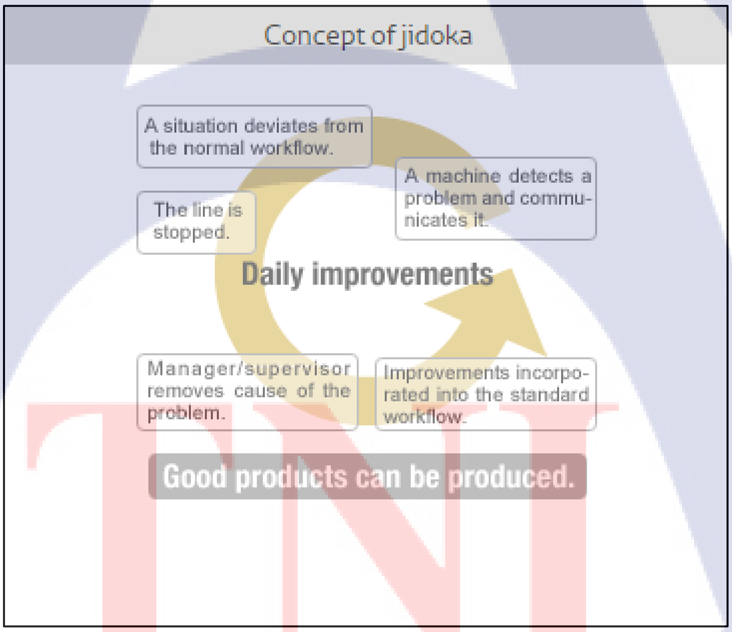


Figure 2.5 Concept of Jidoka [2]

2.3 Pneumatic System [3]

A pneumatic system is a system that uses compressed air to transmit and control energy. Pneumatic systems are used in controlling train doors, automatic production lines, mechanical clamps

Pneumatic control systems are widely used in our society, especially in the industrial sectors for the driving of automatic machines. Pneumatic systems have a lot of advantages.

Many factories have equipped their production lines with compressed air supplies and movable compressors. There is an unlimited supply of air in our atmosphere to produce compressed air. Moreover, the use of compressed air is not restricted by distance, as it can easily be transported through pipes. After use, compressed air can be released directly into the atmosphere without the need of processing.

Pneumatic components are extremely durable and cannot be damaged easily. Compared to electromotive components, pneumatic components are more durable and reliable.

The designs of pneumatic components are relatively simple. They are thus more suitable for use in simple automatic control systems.

Pneumatic components can be divided into two categories Components that produce and transport compressed air and components that consume compressed air. All main pneumatic components can be represented by simple pneumatic symbols. Each symbol shows only the function of the component it represents, but not its structure. Pneumatic symbols can be combined to form pneumatic diagrams. A pneumatic diagram describes the relations between each pneumatic component, that is, the design of the system.

2.3.1 Transport compressed air

Compressor

A compressor can compress air to the required pressures. It can convert the mechanical energy from motors and engines into the potential energy in compressed air .A single central compressor can supply various pneumatic components with compressed air, which is transported through pipes from the cylinder to the pneumatic components.

Pressure regulating component

Pressure regulating components (Fig 2.6) are formed by various components, each of which has its own pneumatic symbol:

Filter – can remove impurities from compressed air before it is fed to the pneumatic components.

Pressure regulator – 19tabilize the pressure and regulate the operation of pneumatic components

Lubricator – To provide lubrication for pneumatic components

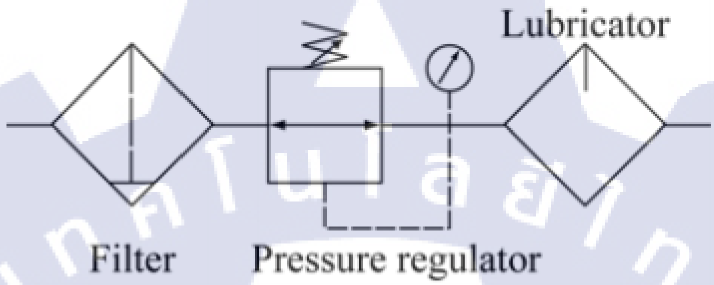


Figure 2.6 Filter, Pressure regulator and lubricator symbols [3]

2.3.2 The consumption of compressed air

Examples of components that consume compressed air include execution components (cylinders), directional control valves and assistant valves.

Execution component

Pneumatic execution components provide rectilinear or rotary movement. Examples of pneumatic execution components include cylinder pistons, pneumatic motors, etc. Rectilinear motion is produced by cylinder pistons, while pneumatic motors provide continuous rotations. There are many kinds of cylinders, such as single acting cylinders and double acting cylinders (Fig 2.7).

A single acting cylinder has only one entrance that allows compressed air to flow through. Therefore, it can only produce thrust in one direction . The piston rod is propelled in the opposite direction by an internal spring, or by the external force provided by mechanical movement or weight of a load

In a double acting cylinder, air pressure is applied alternately to the relative surface of the piston, producing a propelling force and a retracting force. As the effective area of the piston is small, the thrust produced during retraction is relatively weak. The impeccable tubes of double acting cylinders are usually made of steel. The working surfaces are also polished and coated with chromium to reduce friction.

Figure 2.7 Cylinders [3]

Directional control valve

Directional control valves ensure the flow of air between air ports by opening, closing and switching their internal connections. Their classification is determined by the number of ports, the number of switching positions, the normal position of the valve and its method of operation. Common types of directional control valves include 2/2, 3/2, 5/2, etc. The first number represents the number of ports; the second number represents the number of positions. A directional control valve that has two ports and five positions can be represented by the drawing in, as well as its own unique pneumatic symbol

Control valve

A control valve (Fig 2.8) is a valve that controls the flow of air. Examples include non-return valves, flow control valves, shuttle valves, etc.

Flow control valve A flow control valve is formed by a non-return valve and a variable throttle

Shuttle valves are also known as double control or single control non-return valves. A non-return valve allows air to flow in one direction only. When air flows in the opposite direction, the valve will close. Another name for non-return valve is poppet valve

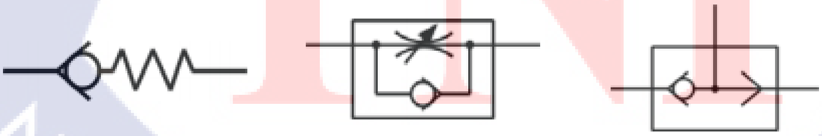


Figure 2.8 Control valve symbols [3]

2.4 Ergonomic [4]

The seven keys to ergonomic production (Fig 2.9) Although increasing numbers of robots and machines on UK's production lines have helped with difficult tasks, it is very clear that people remain a key and important resource. Ross Townshend, an expert in manual production systems at Bosch Rexroth, examines how to make people more productive by focusing on workstation ergonomics. A recent study by the Health and Safety Executive stated that one million people every year are affected by musculoskeletal disorders as a direct result of poorly designed workstations. The impact on the bottom line for UK manufacturers was 11.6 million lost working days at a cost of £5.7 billion.

With statistics like these, it is no surprise that the study of ergonomics is becoming more and more important in UK manufacturing. Done well, ergonomic design can increase motivation, satisfaction with resulting benefits in performance and productivity. However, it remains a badly under-utilised concept in industry, too often regarded as difficult to measure, costly to implement and low on the priority list.

Ergonomics is the study of human interaction with the environment, which in a factory consists of tools, equipment, working methods and the tasks that an individual is being asked to perform. To fully implement an ergonomic solution, there are seven key factors that must be taken into account

2.4.1 Body and working height

Working at the wrong height can lead to a hunched posture, craned neck and strained eyes. Manual workstations must accommodate a wide range of body heights to ensure that a tailored, rather than a 'one size fits all', approach is taken

The most important factors in the design of work stations are the working height, proper sizing of reach zones, leg room and range of vision. It is vital that operators have the opportunity to either sit down or stand up at their workstation, which Bosch Rexroth refers to as the "sit down, stand up" concept. "Sit down, stand up" promotes changes in posture, which reduce stress and increases performance, which is not possible with a solely sitting or standing workstation.

The work area height should always be between 800mm and 1500mm. Working above this height, or above heart level, reduces the blood circulation and oxygen supply, leading to a drop in performance. Work that requires bending (below 800mm) can also hinder productivity and should be avoided.

2.4.2 Work area

Ergonomically designed stations reduce the risk of injury by adapting to fit the person instead of the other way around. No two workstations will be alike so it is imperative to find the correct working method for each individual to achieve the best results. Within the work area the following rules must be observed:

1. Avoid work above the heart (over 1500mm)
2. Promote dynamic activities by avoiding standing still or static holding which inhibits circulation and oxygen supply to muscles;
3. Allow for varying physical exertion through use of "stand up, sit down" or job rotation;
4. Minimize exertion through use of manual roller sections or lifting aids.

2.4.3 Reach zones

There are three key rules to follow when designing an employee's reach zone at their workstation:

1. All containers, equipment and operating elements must be easily accessible and arranged in the optimum anatomic/physiological range for employees;
2. Torso rotation and shoulder movements, particularly when under exertion (with weights of more than 1 kg) should be avoided whenever possible;
3. A well-designed workstation should be set up into three zones. Primary; for equipment used constantly throughout the working day with equipment or tooling within easy reach when elbows are at an operator's sides; secondary, for tools and parts that are often reached with one hand with everything being available within a 1800 sweep of both arms when outstretched; and reference, for occasional handling such as reference files or transferring parts to the next workstation.

2.4.4 Parts presentation

The presentation of parts to the operator is key in minimizing physical exertion and unnecessary movements. The key issues that need addressing are

1. Frequently used grab containers should be placed at short distances
2. Heavy parts should be stored within easy reach in lower containers
3. Where possible use a slide rail or roller conveyor to minimize employee exertion

2.4.5 Range of vision

Each head turn or change in line of sight, results in lost time and decreases productivity. For the optimal workstation design, it is important to address every detail, including head and eye movement. Key vision issues for workstation planning are

1. Avoid unnecessary eye and head movements
2. Vision distances should be as identical as possible to eliminate refocusing;
3. Avoid fastening locations not visible to the operator.

2.4.6 Lighting

The correct light, adapted to the activity of the workstation, is a basic prerequisite for high efficiency and quality. It is therefore important to

1. Avoid strong lighting contrasts
2. Avoid glare and reflection
3. Ensure all workstations are free from shadows, flickering and glare.

2.4.7 Adjustment of work equipment

To maintain performance levels and promote productivity, the correct adjustment of a table, chair, footrest and position of tools and material shuttles must be easily achieved. For example, Bosch Rexroth's versatile aluminium structures ensure that tables, footrests and grab containers can be easily adjusted. What's more, the correct sitting posture is vital with worker's calves forming a 90o angle and appropriate lumber support.

A very important message for production line designers and planners to understand is that specialist help and software tools are available at the planning stage. These tools can enable correct design before any material is ordered. Ergonomics starts with design, not adjustment of equipment on the shop floor - this will always be a compromise. In conclusion, specialist planning and design tools, such as Rexroth's MT pro, are available to help in the design of ergonomic workstations, which will ultimately deliver a more efficient daily work routine and benefit the bottom line.

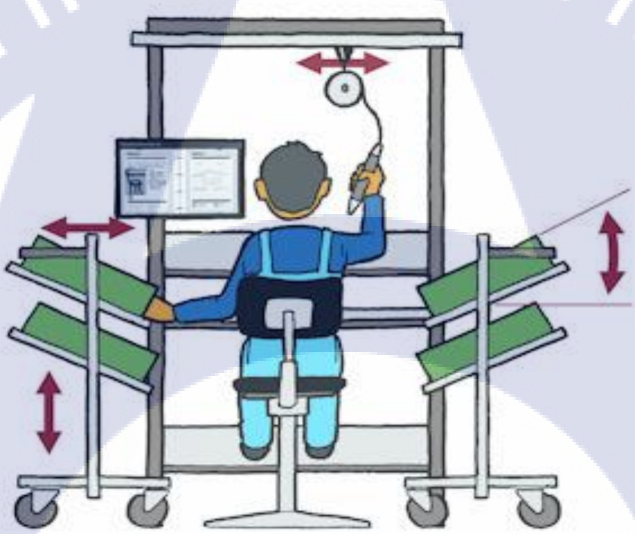


Figure 2.9 Work ergonomic [4]

2.5 Basic engine components and functional [5]

An engine or motor is a machine designed to convert one form of energy into mechanical energy. Heat engines burn a fuel to create heat which is then used to do work. Electric motors convert electrical energy into mechanical motion; pneumatic motors use compressed air; and clockwork motors in wind-up toys use elastic energy. In biological systems, molecular motors, like myosins in muscles, use chemical energy to create forces and eventually motion.

2.5.1 Pistons

The pistons are cup-shaped cylindrical castings of steel or aluminum alloy. The upper, closed end, called the crown, forms the lower surface of the combustion chamber and receives the force applied by the combustion gases. The outer surface is machined to fit the cylinder bore closely and is grooved to receive piston rings that seal the gap between the piston and the cylinder wall. In the upper piston grooves there are plain compression rings that prevent the combustion gases from blowing past the piston. The lower rings are vented to distribute and limit the amount of lubricant on the cylinder wall. Piston pin supports (bosses) are cast in opposite sides of the piston and hardened steel pins fitted into these bosses pass through the upper end of the connecting rod.

2.5.2 Combustion chamber

The combustion chamber is defined by the size, location, and position of the piston within the cylinder. Bore is the inner diameter of the cylinder. The volume at bottom dead centre (VBDC) is defined as the volume occupied between the cylinder head and the piston face when the piston is farthest from the cylinder head. The volume at top dead centre (VTDC) is the volume occupied when the piston is closest to the cylinder head; the distance between the piston face and cylinder head at VTDC is called the clearance. The distance traveled by the piston between its VTDC and VBDC locations is the stroke. The ratio of VTDC to VBDC normalized to the VTDC value—i.e., (VBDC/VTDC):1—is the compression ratio of a reciprocating engine. Compression ratio is the most important factor affecting the theoretical efficiency of the engine cycle. Because increasing the compression ratio is the best way to improve efficiency, compression ratios on automobile engines have tended to increase. This requires stronger, more-durable materials. In practice, fuel ignition characteristics, often represented by octane number, limit engine compression ratios.

2.5.3 Connecting rod and crankshaft

A forged-steel connecting rod connects the piston to a throw (offset portion) of the crankshaft and converts the reciprocating motion of the piston to the rotating motion of the crank. The lower, larger end of the rod is bored to take a precision bearing insert lined with babbitt or other bearing metal and closely fitted to the crankpin. V-type engines usually have opposite cylinders staggered sufficiently to permit the two connecting rods that operate on each crank throw to be side by side. Some larger engines employ fork-and-blade rods with the rods in the same plane and cylinders exactly opposite each other.

Each connecting rod in an in-line engine or each pair of rods in a V-type engine is attached to a throw of the crankshaft. Each throw consists of a crankpin with a bearing surface, on which the connecting-rod bearing insert is fitted, and two radial cheeks that connect it to the portions of the crankshaft that turn in the main bearings, supported by the cylinder block. Sufficient throws are provided to serve all the cylinders, and the angles between them equal the angular firing intervals between the cylinders. The throws of a six-cylinder, four-stroke-cycle crankshaft are spaced 120° apart so that the six cylinders fire at equal intervals in two full rotations of the shaft. Those of an eight-cylinder engine are 90° apart. The position of each throw along the shaft depends upon the firing order of the cylinders. Firing sequence is chosen to distribute the power impulses along the length of the engine to minimize vibration. Consideration is also given to the fluid flow pattern in the intake and exhaust manifolds. The standard firing order for a six-cylinder engine is 1-5-3-6-2-4, which illustrates the practice of alternating successive impulses between the front and rear valves of the engine whenever possible. Balance is further improved by adding counterweights to the crankshaft to offset the eccentric masses of metal in the crank throws.

The crankshaft design also establishes the length of the piston stroke because the radial offset of each throw is equal to half the stroke imparted to the piston. The ratio of the piston stroke to the cylinder bore diameter is an important design consideration. In the early years of engine development, no logical basis for the establishment of this ratio existed, and a range from unity to $1^1/_2$ was used by different manufacturers. As engine speeds increased, however, and it became apparent that friction horsepower increased with piston speed rather than with crankshaft rotating speed, there began a trend toward short-stroke engines. Strokes were shortened to as much as 20 percent less than the bores.

From the requirement for the two-cylinder engine, a general rule for the layout of the throws of four-stroke-cycle multicylinder crankshafts can be expressed. Regardless of the number of cylinders, two pistons must arrive at top dead centre in unison so that a second cylinder is ready to fire exactly 360° after each cylinder fires. Half the cylinders will then fire during each turn of the crankshaft. To follow this rule, there must be an even number of cylinders in order that there may be pairs of cylinders whose pistons move in unison.

An eight-cylinder engine fires each time its crankshaft makes a quarter turn if the intervals between impulses are equal. The crankshaft for an eight-cylinder, in-line engine is designed with each of its eight throws a quarter turn away from another throw.

For best lengthwise balance, the cylinders whose pistons are in phase are the first and last cylinders of an in-line engine, the second and next to the last, continuing in that order with crank throws that are in alignment equidistant from the centre of the engine.

2.5.4 Valves, pushrods, and rocker arms

Valves for controlling intake and exhaust may be located overhead, on one side, on one side and overhead, or on opposite sides of the cylinder. These are all the so-called poppet, or mushroom, valves, consisting of a stem with one end enlarged to form a head that permits flow through a passage surrounding the stem when raised from its seat and that prevents flow when the head is moved down to contact the valve seat formed in the cylinder block. Another group of engines uses sliding valves that are usually of the sleeve type surrounding the cylinder bore.

The valve-in-head engine has pushrods that extend upward from the cam followers to rocker arms mounted on the cylinder head that contact the valve stems and transmit the motion produced by the cam profile to the valves. Clearance (usually termed tappet clearance) must be maintained between the ends of the valve stems and the lifter mechanism to assure proper closing of the valves when the engine temperature changes. This is done by providing pushrod length adjustment or by the use of hydraulic lifters.

Noisy and erratic valve operation can be eliminated with entirely mechanical valve-lifter linkage only if the tappet clearance between the rocker arms and the valve stems is closely maintained at the specified value for the engine as measured with a thickness gauge. Hydraulic valve lifters, now commonly used on automobile engines, eliminate the need for periodic adjustment of clearance.

The hydraulic lifter comprises a cam follower that is moved up and down by contact with the cam profile, and an inner bore into which the valve lifter is closely fitted and retained by a spring clip. The valve lifter, in turn, is a cup closed at the top by a freely moving cylindrical plug that has a socket at the top to fit the lower end of the pushrod. This plug is pushed upward by a light spring that is merely capable of taking up the clearance between the valve stem and the rocker arm. A small hole is drilled in the bottom of the valve-lifter cup to admit lubricating oil that enters the cam follower from the engine lubricating system through a passage in the cylinder block. A small steel ball serves as a check valve to admit the oil into the valve-lifter cup but prevent its escape. When the clearance in the entire linkage between the cam profile and the valve stem is being taken up by the spring in the valve lifter, oil flows into the lifter chamber, past the ball check, and is trapped there to maintain this no-clearance condition as the engine operates. Expansion or contraction of the valve linkage is compensated by oil seepage from the lifter to correct for expansion of parts and oil flow into the chamber if clearance tends to be produced between the pushrod and the lifter. Complete closure of the valve is then assured at all times without tappet noise.

The intake valve must be open while the piston is descending on the intake stroke of the piston, and the exhaust valve must be open while the piston is rising on the exhaust stroke. It would seem, therefore, that the opening and closing of the two valves would occur at the appropriate top and bottom dead-centre points of the crankshaft. The time required for the valves to open and close, however, and the effects of high speed on the starting and stopping of the flow of the gases require that for optimum performance the opening events occur before the crankshaft dead-centre positions and that the closing events be delayed until after dead centre.

All four valve events—inlet opening, inlet closing, exhaust opening, and exhaust closing—are accordingly displaced appreciably from the top and bottom dead centres. Opening events are earlier and closing events are later to permit ramps to be incorporated in the cam profiles to allow gradual initial opening and final closing to avoid slamming of the valves. Ramps are provided to start the lift gradually and to slow down the valve before it contacts its seat. Early opening and late closure are also for the purpose of using the inertia or persistence of flow of the gases to assist in filling and emptying the cylinder

2.5.5 Camshaft

The camshaft, which opens and closes the valves, is driven from the crankshaft by a chain drive or gears on the front end of the engine. Because one turn of the camshaft completes the valve operation for an entire cycle of the engine and the four-stroke-cycle engine makes two crankshaft revolutions to complete one cycle, the camshaft turns half as fast as the crankshaft. It is located above and to one side of the crankshaft, which places it directly under the valves of the L-head engine or the pushrods that extend down from the rocker arms of the valve-in-head engine. Because of the long pushrods and the rocker arms, the speed of the valve-in-head engine is limited to that at which the cam followers can remain in contact with the cams when the valves are closing. Above that limiting speed the valves are said to float, and their motion tends to become erratic. For this reason, the overhead-camshaft engine is quite popular. Located immediately above the valves, this type of camshaft is driven either by a vertical shaft and bevel gears or by a cog belt.

2.5.6 Flywheel

The cycle of the internal-combustion engine is such that torque (turning force) is applied only intermittently as each cylinder fires. Between these power impulses, the pistons rising on compression and the opposition to rotation caused by the load carried by the engine apply negative torque. The alternating acceleration caused by the power impulse and deceleration caused by compression result in nonuniform rotation. To counter this tendency to slow down and speed up is the function of the flywheel, attached to one end of the crankshaft. The flywheel consists of a heavy circular cast-iron disk with a hub for attachment to the engine. Its heavy rotating mass has sufficient momentum to oppose all changes in its rotational speed and to force the crankshaft to turn steadily at this speed. The engine thus runs smoothly with no evidence of rotational pulsations. The outer rim of the flywheel usually carries gear teeth so as to mesh with the starter motor. The driving component of a clutch or fluid coupling for the transmission may be incorporated in the flywheel.

2.5.7 Bearings

The crankshaft has bearing surfaces on each crank throw and three or more main bearings. These are heavily loaded because of the reciprocating forces at each cylinder applied to the crankshaft and the weight of the crankshaft and flywheel. All but the smallest engines use split-shell bearings, usually made of bronze with babbitt metal linings. The surface material is sufficiently soft to minimize the possibility of scoring the crankshaft in the event of inadequate lubrication. The smallest engines usually have cast-babbitt bearings. A small amount of bearing clearance is necessary to permit an oil film to separate the surfaces.

2.5.8 Ignition

Electric ignition systems may be classified as magneto, battery-and-coil, and solid-state ignition systems. Although these are similar in basic principle, the magneto is self-contained and requires only the spark plugs and connecting wires to complete the system, whereas the battery-and-coil and solid-state ignition systems involve several separate components.

A magneto is a fixed-magnet, alternating-current generator designed to produce sufficient voltage to fire the spark plugs. A high-tension magneto is entirely self-contained and requires only spark plugs, wires, and switches to meet ignition requirements.

The battery-and-coil system consists of a battery, one terminal of which is grounded while the other leads through a switch to the primary winding of the coil, and then to a circuit breaker where it is again grounded. Rotation of the circuit-breaker cam opens and closes the primary circuit. The secondary circuit, consisting of several thousand turns of fine wire, leads to the rotor of the distributor, which acts as a rotary switch, selecting the spark plug to be placed in the circuit. Each plug is connected to one of the outer terminals of the distributor to receive an electrical impulse in proper sequence. When the primary circuit is broken, a high potential (up to 20,000 volts) is developed in the secondary winding and conducted to the appropriate spark plug.

The high voltage for the spark plug may also be produced by a capacitordischarge ignition system. Such a system consists of a source of 250 to 300 volts direct-current power applied to a storage capacitor, a device for storing an electric charge. A lead from the capacitor goes to one side of the spark coil primary through cam-actuated breaker points or an electronic switching device. At the instant this switching device establishes a contact, the capacitor discharges through the primary of the spark coil, and an instantaneous high voltage is delivered to the distributor and thence to the spark plug. The capacitor discharge system provides a more intense spark, thus improving the start-up of a cold or flooded engine. It continues to fire the plugs when they are fouled by carbon or other deposits or when the spark gap has widened because of erosion of the points. Other notable advantages include increased spark plug life, improved firing over a wider speed range, and better moisture tolerance.

Solid-state ignition systems, unlike battery-and-coil systems that use a distributor, use an electronic module to collect information from engine sensors, compute engine operating parameters, and control ignition discharge to a separate coil for each spark plug. The electronic control module activates a transistor to break the ground circuit leading to each plug’s coil, thereby causing a spark. In addition to eliminating the high-voltage spark plug wires, electronics allow for more precise control of ignition timing, which improves fuel efficiency, reduces emissions, and increases power.

2.5.9 Spark plugs

The spark plug is an important component of the ignition system and is the one that must operate under the most severe conditions. Because it is exposed to combustion chamber temperatures and pressures and contaminating products of combustion, it requires more service attention and is usually the shortest-lived component of the gasoline engine. It consists of a steel shell threaded to fit a standard 14-mm hole in the cylinder head. Spark plugs may use a gasket or a tapered seat to ensure a gastight fit between cylinder head and plug. A fused ceramic insulating element is molded into the plug body, and the steel centre electrode passes through the insulator up to the connector to which the high-voltage lead from the distributor is attached. The other electrode is welded to the metal body of the plug, which is grounded to the cylinder head. Electrodes are found in a number of configurations and are made of a variety of alloys.

In application it is essential that the spark gap be as specified for the particular engine. Gauges are available to aid in making this adjustment by bending the ground electrode as required. Manufacturers specify gaps ranging from 0.508 to 1.016 mm between the centre electrode and the ground electrode. If the plug gap is too large, the possibility of misfiring increases. If the gap is too small, the spark will not be sufficiently intense. Gap growth from erosion of the electrodes may be corrected. Modern spark plugs often incorporate a resistor to minimize radio frequency emissions that could interfere with sensitive electronics.

2.5.10 Carburetor

The gasoline carburetor (Fig2.10) is a device that introduces fuel into the airstream as it flows into the engine. Gasoline is maintained in the float chamber by the float-actuated valve at a level slightly below the outlet of the jet. Air flows downward through the throat, past the throttle valve, and into the intake manifold. A throat is formed by the reduced diameter, and acceleration of the air through this smaller passage causes a decrease in pressure proportional to the amount of air flowing. Any increase in airflow caused by change in engine speed or throttle position increases the pressure differential acting on the fuel and causes more fuel to flow.

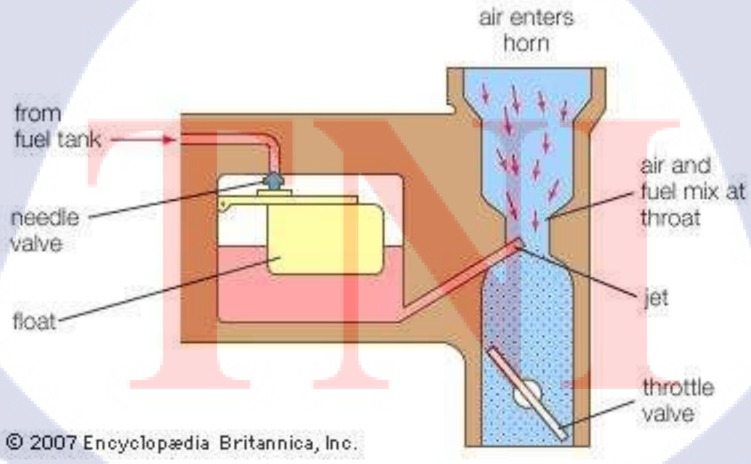


Fig 2.10 Carburetor [5]

The volume ratio of fuel to air established by the throat and fuel-jet sizes will be maintained with increased flow, but the weight ratio of fuel to air increases because the air expands to a lower density as the throat pressure decreases. This enriching tendency necessitates the inclusion of a compensating device in a practical carburetor. Carburetor design is further complicated by the need for an enriching device to provide a maximum-power ratio at full throttle, a choke to facilitate starting a cold engine, an idling system to provide the special needs of light-load operation, and an accelerating device to supply additional fuel while the throttle is being opened.

2.5.11 Fuel injection

Most modern automobile engines use an electronic fuel-injection system in the intake manifold of the engine instead of a carburetor. The fuel-injection system is a closed-loop feedback system controlled by an engine management system that consists of sensors, an electric fuel pump, fuel injectors, fuel tubing, and valving. The engine management system controls both the ignition firing and the fuel management. In some designs the engine management system also controls the transmission. Sensors monitor the engine's operation and environmental conditions and transmit the data to the engine management system to determine how much fuel should be pumped to the fuel injectors for delivery to the engine. Typical sensors include the following: mass airflow, exhaust oxygen, engine revolutions per minute, manifold absolute pressure, barometric pressure, coolant temperature, throttle position, knock, vehicle speed, air-conditioning load, power steering load, crankshaft position, and camshaft position.

The principal advantages of gasoline injection over carburetors are improved fuel economy as a result of more-accurate fuel and air proportioning, greater power because of the elimination of fuel heating, elimination of inlet icing, and more-uniform and direct delivery of fuel load to the cylinders. Since fuel injection does not rely on an intake manifold vacuum to deliver fuel, electronic fuel injection is used with turbocharged engines.

2.5.12 Cooling system (Fig 2.11)

The cylinders of internal-combustion engines require cooling because of the inability of the engine to convert all of the energy released by combustion into useful work. Liquid cooling is employed in most gasoline engines, whether the engines are for use in automobiles or elsewhere. The liquid is circulated around the cylinders to pick up heat and then through a radiator to dissipate the heat. Usually a thermostat is located in the circulating system to maintain the designed jacket temperature—approximately 88 °C (190 °F). The cooling system is usually pressurized to raise the boiling point of the coolant so that a higher outlet temperature can be maintained to improve thermal efficiency and increase the heat-transfer capacity of the radiator. A pressure cap on the radiator maintains this pressure by valves that open outwardly at the designed pressure and inwardly to prevent a vacuum as the system cools.

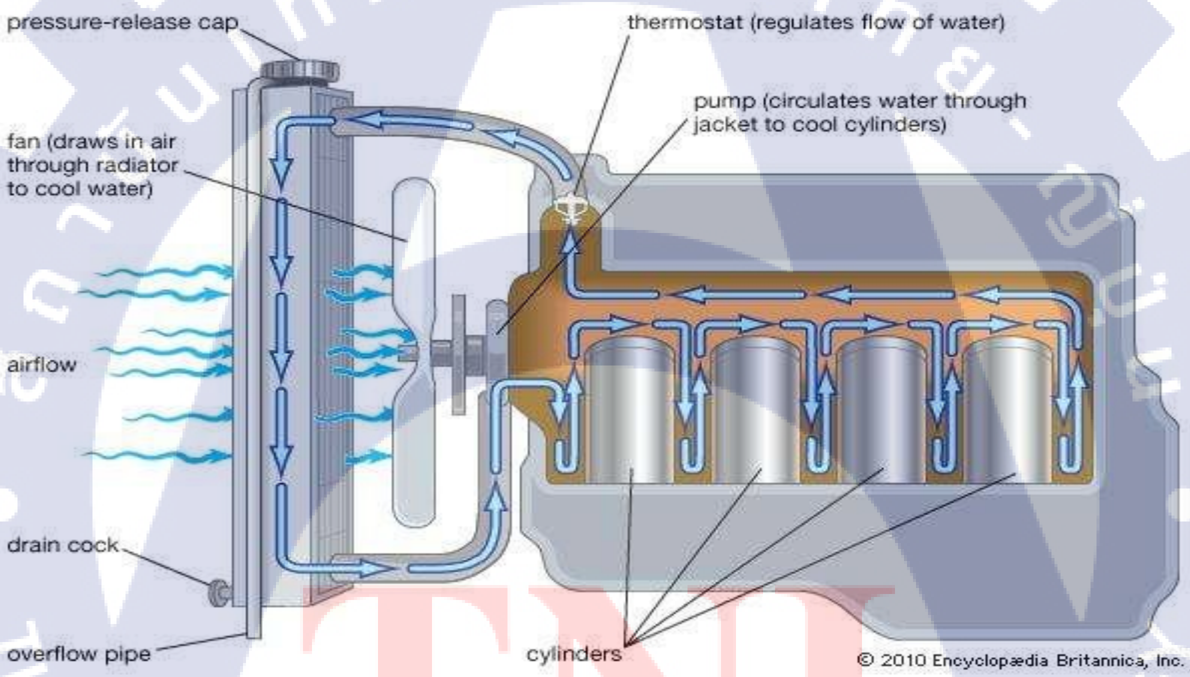


Fig 2.11 Cooling system [5]

Some engines, particularly aviation engines and small units for mowers, chain saws, and other tools, are air-cooled. Air cooling is accomplished by forming thin metal fins on the exterior surfaces of the cylinders to increase the rate of heat transfer by exposing more metal surface to the cooling air. Air is forced to flow rapidly through the spaces between the fins by ducting air toward the engine.

2.5.13 Lubrication system

Lubrication is employed to reduce friction by interposing a film between rubbing parts. The lubrication system(Fig 2.12) must continuously replace the film.

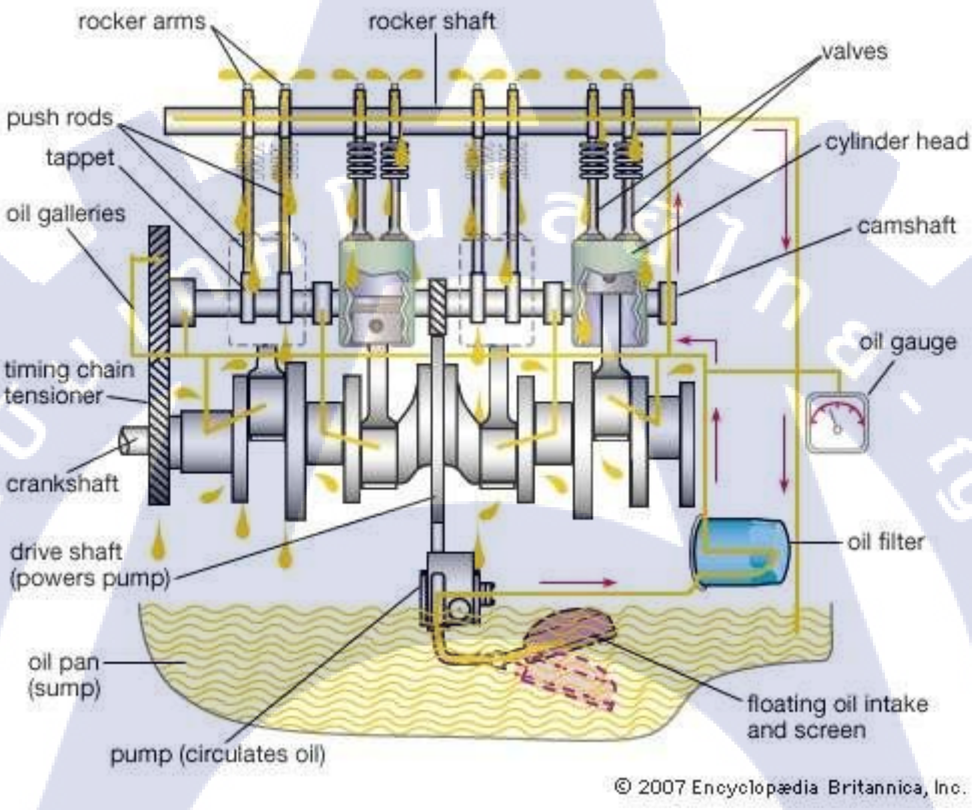


Fig 2.12 Lubrication system [5]

The lubricants commonly employed are refined from crude oil after the fuels have been removed. Their viscosities must be appropriate for each engine, and the oil must be suitable for the severity of the operating conditions. Oils are improved with additives that reduce oxidation, inhibit corrosion, and act as detergents to disperse deposit-forming gums and solid contaminants. Motor oils also include an antifoaming agent. Various systems of numbers are used to designate oil viscosity; the lower the number, the lighter the body of the oil. Viscosity must be chosen to match the flow rate of oil through a part to the designed cooling requirements of the part. If the oil is too thick it will not flow through the part fast enough to properly dissipate heat. Certain oils contain additives that oppose their change in viscosity between winter and summer.

Oil filters, if regularly serviced, can remove solid contaminants from crankcase oil, but chemical reactions may form liquids that are corrosive and damaging. Depletion of the additives also limits the useful life of lubricating oils.

The lubrication system is fed by the oil sump that forms the lower enclosure of the engine. Oil is taken from the sump by a pump, usually of the gear type, and is passed through a filter and delivered under pressure to a system of passages or channels drilled through the engine. Virtually all modern engines use full-flow type oil filters. Filtered oil is supplied under pressure to crankshaft and camshaft main bearings. Adjacent crank throws are drilled to enable the oil to flow from the supply at the main bearings to the crankpins. Leaking oil from all of the crankshaft bearings is sprayed on the cylinder walls, cams, and up into the pistons to lubricate the piston pins. Additional passages intersect the cam-follower openings and supply oil to hydraulic valve lifters when used. A spring-loaded pressure-relief valve maintains the pressure at the proper level. Oil is important for both lubrication and cooling.

2.5.14 Exhaust system

Combustion products exit the engine cylinder through the exhaust valves in the cylinder head. Engines may be configured with either an exhaust manifold or an exhaust header. The exhaust manifold is a common chamber to which all the cylinders directly feed combustion products. The advantages of this method are manufacturing and positioning simplicity. The disadvantage is irregular backpressure at the exhaust ports of the cylinders. Headers are composed of a group of tubes, all of common length, connected on one end to each cylinder exhaust-valve location and on the other end to a common exit throat.

The exhaust gases in modern automotive engines next pass through an emission-control device. Emission-control sensors and catalytic converters for reducing air pollution are additional exhaust-system components. Typically, exhaust gases enter a catalytic converter to reduce nitric oxide emissions. The next chamber reduces unburned hydrocarbons and carbon monoxide exhaust emissions.

The reactor system for controlling emissions is often composed of a belt-driven air compressor connected to small nozzles installed in the exhaust manifold facing the outlet from each exhaust valve. A small jet of air is thus directed toward the red-hot outflowing combustion products to provide oxygen to consume the hydrocarbons and carbon monoxide. Sensors monitor exhaust-gas parameters (e.g., temperature and oxygen content) and, in electronic fuel-injection systems, provide information to the control unit to assist in reducing pollutant emissions.

Exhaust gases from an internal-combustion engine are passed through a muffler to suppress audible vibrations. When the exhaust valve opens, the pressure in the engine causes an initial gas outflow at explosivevelocity. Successive discharges from the cylinders set up pressure pulsations that produce a sharp barking sound. The muffler damps out or absorbs these pulsations so that the gases leave the outlet as a relatively smooth, quiet stream.

Mufflers of early design contained sets of baffles that reversed the flow of the gases or otherwise caused them to follow devious paths so that interference between the pressure waves reduced the pulsations. The mufflers most commonly used in modern motor vehicles employ resonating chambers connected to the passages through which the gases flow. Gas vibrations are set up in each of these chambers at the fundamental frequency determined by its dimensions. These vibrations cancel or absorb those present in the exhaust stream of about the same frequency. Several such chambers, each tuned to one of the predominant frequencies present in the exhaust stream, effectively reduce noise.

2.5.15 ACIS

The engine control unit (ECU) controls the position of one or more air control valves based on input signals from throttle angle and engine RPM. The vacuum switching valve (VSV) which controls the vacuum supply to the actuator is normally closed and passes vacuum to the actuator when it is energized by the ECU. By energizing the VSV vacuum is passed to the actuator, closing the air control valve. This effectively lengthens the intake manifold run. By de-energizing the VSV, vacuum to the actuator is blocked and trapped vacuum is bled off of the actuator diaphragm. Toyota ACIS (Fig 2.13) is an On/Off system. The valve (or valves in newer models with multiple valves to create more than 2 lengths) is either fully opened or fully closed. The ECU actuates the VSV to close the valve when the throttle position is 60% or greater and engine speed is 3,900 RPM or more.

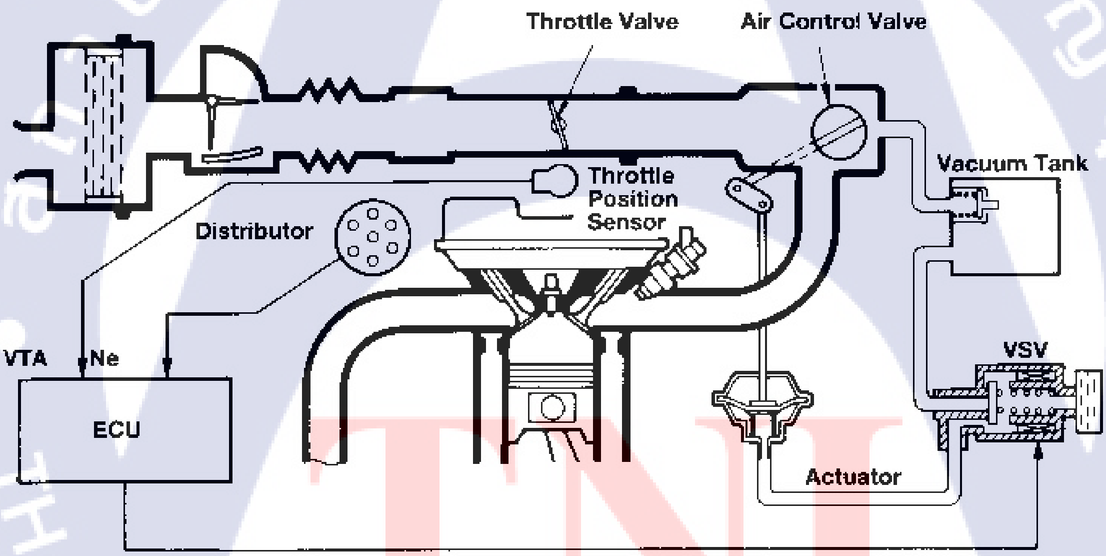


Fig 2.13 ACIS system [5]

Chapter 3

Work Plan and Procedure

3.1 Plan of Work

Mgr.	AM.	Mentor
		Tanit T.

►Unit Production Engineering Responsibility

Issued by Thanadet Ch. 2018/06/12

1.Background

Forth year Industrial Engineering at Thai-Nichi Institute of Technology. Will participate in Cooperative program for 3 months beginning of June until end of August. In order to gain experiences and knowledge of Enginering field.
To adapt knowledge from University in real work situations and get the way of thinking.

2.Trainee Name	Mr Thanadet Sukkawat (Industrial Engineering Major)
3.Division	Unit Production Engineering
4.Department	Unit Production Engineering No.2
5.Section	Machining Assembly Production Engineering No.1
6.Duration	1 June 2018 – 17 August 2018

Activities detail	Strategy	Output	Mentor	Jun-18 W1	Jun-18 W2	Jun-18 W3	Jun-18 W4	Jul-18 W1	Jul-18 W2	Jul-18 W3	Jul-18 W4	Aug-18 W1	Aug-18 W2	Aug-18 W3	Aug-18 W4
1 Basic Toyota knowledge															
- Self study Toyota way & TPS	Read books [TPS Simulation Training, The Toyota Way(Supplementary), and The Toyota way 2001]	Can use Toyota way and Toyota Production system in this cooperative program and in the future correctly.	Patikarn												
- TPS simulation	Train with TIAP.	Truthly understand Toyota Production System and can use in real work situations.	TIAP			★ (2018/06/22)									
2 Basic Engine knowledge															
- Study engine function and component	Study Basic Engine Components sheet from Toyota data base. Observe line production at STM.	Have own short note about basic engine function and components.	Tanit												
3 Engine Assembly process															
- Study engine assembly process	Self study the Operation drawing of engine assembly line(STM NR G8 and ZR G5).	Know the process of engine production.What tools, materials and machines need.To adapt for production preparation job. Have own short note.	Tanit												
	Genchi Genbutsu to study the real process.	Clearly understand the process. Know what is needed, How it made. To make short note and adapt for production preparation.	Tanit												
4 Basic Pro E knowledge															
- Study Pro E program	Training with DE team & Practice using program.	Can adapt using in designing machine specification for equipment planning.													
5 Production Preparation and equipment planning															
- Study Production Preparation Scope for PE field	Learn field of production engineering job through OJT (On Job Training) study machine function from Genchi Genbutsu and manual.	Understand PE job scope for production preparation and proceed for equipment preparation by self (1 equipment) until drawing approve	Tanit												
- Issue M/c specification and M/c preparation schedule			Kanapon												
- Follow up maker and progessive			Kanapon												
- Approve drawing			Kanapon												
6 Business communication by English															
- Daily communication	Gain experience from morning talk, another employees, and in any activities.	Can communicate with others in English.	Tanit												
- Make report in English	Make report every month.	Can make the report in the real situations correctly.	Tanit												
- Presentation	Prepare with mentor and present the work every month.	Can present project in real work situation correctly.	Tanit				★ (Monthly)				★ (Monthly)			★ (Final Report)	

Figure 3.1 Master schedule issued by Thanadet Sukkawat

3.2 Detail of Work and Project

For first two months of cooperative program I have learn Toyota knowledge and trained be Toyota group. In first 2 week I have study about Toyota Production system and Toyota way from the book and for the whole 2 month I have trained

1. Induction Training (June 5 th, 2018) - Toyota way, Safety, ISO related and Quality in Toyota
2. Eco Forest & Plant Tour (June 20th, 2018) - Learn about environment care and car assembly process
3. Toyota Production System Simulation Training June 22nd, 2018
4. Safety Awareness Training (SAW) June 28th, 2018
5. Basic painting and assembly process 10 th Jul, 2018
6. Introduction of Unit product & Unit PE Class 13 July, 2018

At first week I have study about basic engine knowledge by basic engine knowledge sheet of Toyota database

For the second week I have study about assembly process of 2 engine models by operation drawing. After that I have study by observe real line assembly for two week

At second week I have trained about drawing program (Pro E) by Digital Engineering team

During second week until last day of cooperative program I have learn field of production preparation and equipment planning through on job training. There are issue machine specification, make machine spec sheets, follow up maker and progressive then approve drawing

In this cooperative program I have learn English for business and improve my English skill through on job training, making report and presentation.

3.2.1 Background

Topic: Cylinder block tilting equipment

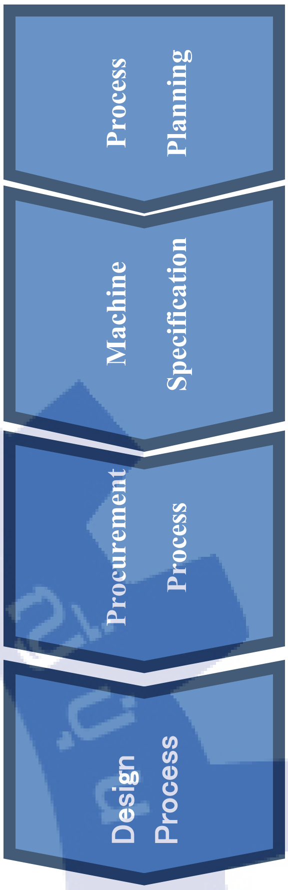
Cylinder block is one of the big part in automotive engine it is like a body of engine that carry many parts for example cylinder bore, piston, crank shaft, oil pan, and etc. This part will assembly in short block sub assembly line that there are process about 60 process and there is process that have to assembly rear oil seal, fly wheel and clutch cover and it have to assembly at rear side of engine so it need block tilting unit for tilt block 90 degree clockwise from bottom up to Rear up because another process assembly top or bottom up position.

Due to IMC Pakistan block sub assembly line current is using dolly for transfer in each station with a bad ergonomic because they use heavy dolly for transfer engine in each station, not good layout because of big dolly it make pitch between each station about 1100 mm as a result can't capacity up and every dolly there are tilting equipment with a bad quality and safety for work because use bolt cross with bolt for join tilting equipment and engine as a result they will use pallet and conveyor instead of dolly the pitch in each station is 650 mm for capacity up and good ergonomic for transferring.

So I have a duty on making cylinder block tilting equipment spec sheet then making consensus with maker and IMC plant at last approve drawing the equipment. With a conditions of tilting 2 engine models in 1 equipment with a different dimension, use with pallet and free conveyor, and can tilt block 90 degree form bottom up to rear up.

3.3 Procedure of Project

1. **Process Planning**
   - 1.1 Genba study
   - 1.2 Discuss with mentor about solving problem
2. **Machine Specification**
   - 2.1 Issued M/C Specification
   - 2.2 Internal approved and get feedback
   - 2.3 External approved and get feedback
3. **Procurement Process**
   - 3.1 Explain M/C Specification with supplier for request quotation
   - 3.2 Check and discussion with internal
   - 3.3 OP by purchase
4. **Design Process**
   - 4.1 Check Drawing and discussion with supplier
   - 4.2 Internal approved and get feedback
   - 4.3 External approved and get feedback
   - 4.4 Discussion about feedback with supplier



Chapter 4

Work Procedure and Analyze

4.1 Step of the Project

4.1.1 Study

First I was study about philosophy of Toyota and Production Engineer job responsibility for prepare myself to work and thinking like Toyota's group a detail as following:

1. Toyota way (2001), TPS (Toyota Production System)
2. Training with Toyota team
3. Basic safety knowledge for protect myself when work

Thinking way like Toyota

4. Learn drawing program (Pro E)
5. Basic engine knowledge
6. Genba study Engine plant (STM)
   - Operation Process and Assembly process

Production preparation process

4.1.2 Process Planning

After I got an assignment. I created Master schedule of the project to planning the activity period and this master schedule would affect to 3 parties (TDEM, IMC, and Supplier) and during project I progressive work every week (Fig 4.1) .

Confidential

Figure 4.1 Master Schedule of Project

4.1.3 Machine Specification

Next I was study about Machine Specification for issued M/C Spec. M/C spec has a detail about project such as concept project, job scope, schedule of project, Equipment location for communicate with 3 parties.

4.1.3.1 Work layout

Make Yamazumi chart to understand work process and assign tilting block duty to operator for the result this work element will be for operator who assembly flywheel (Fig 4.2).

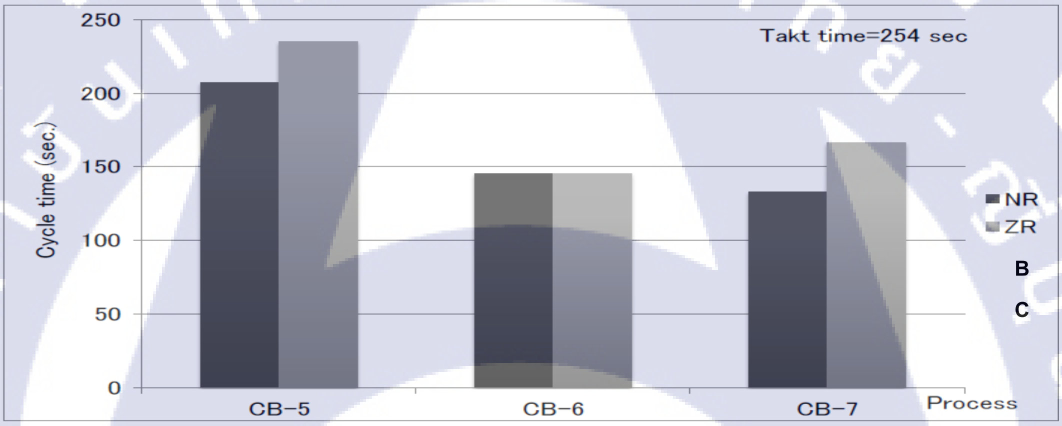


Figure 4.2 Yamazumi chart of block sub line ass. operator

Design work layout (Fig 4.3, Fig 4.4) and working process sequence

- Operator no.5 has duty to assembly oil pan and adapters
- Operator no.6 has duty to tilt block, assembly rear oil seal and flywheel
- Operator no.7 has duty to assembly clutch disk and clutch cover then load to main line

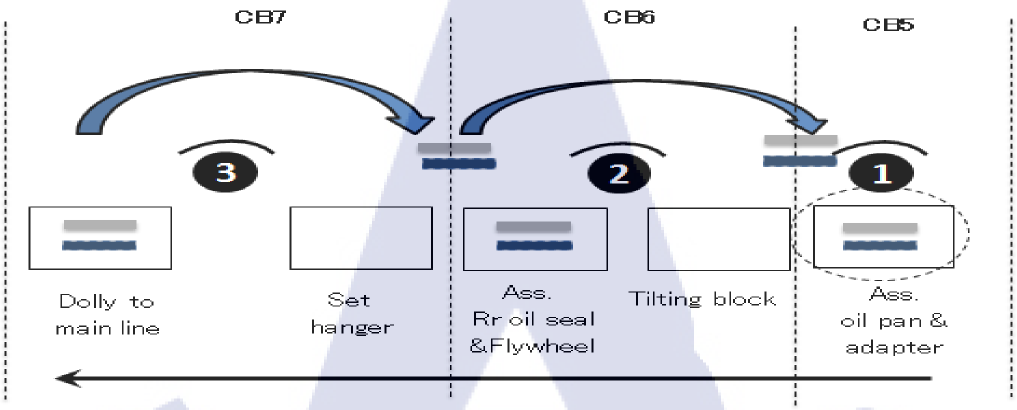


Figure 4.3 Work layout 1

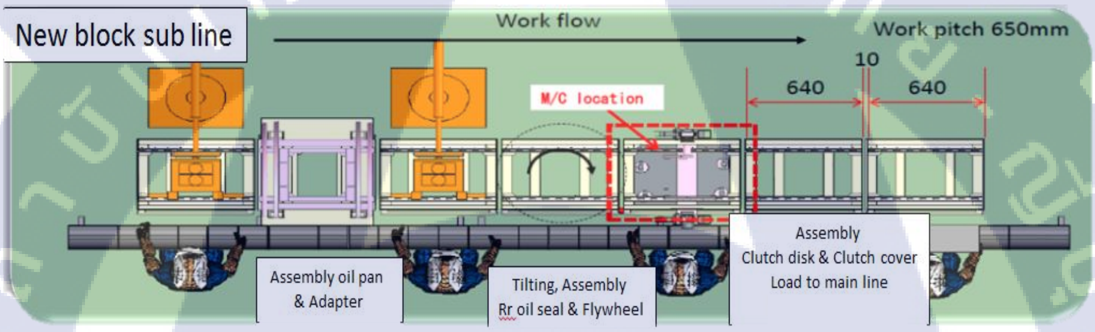


Figure 4.4 Work layout 2

4.1.3.2 Investigate different point

Study different point and point that can common of 2 engine models and assembly process with 2D&3D drawing, operation drawing and genba at STM as a result the block have a different height of tilting position because of different dimension, pallet and station limit (Fig 4.5).

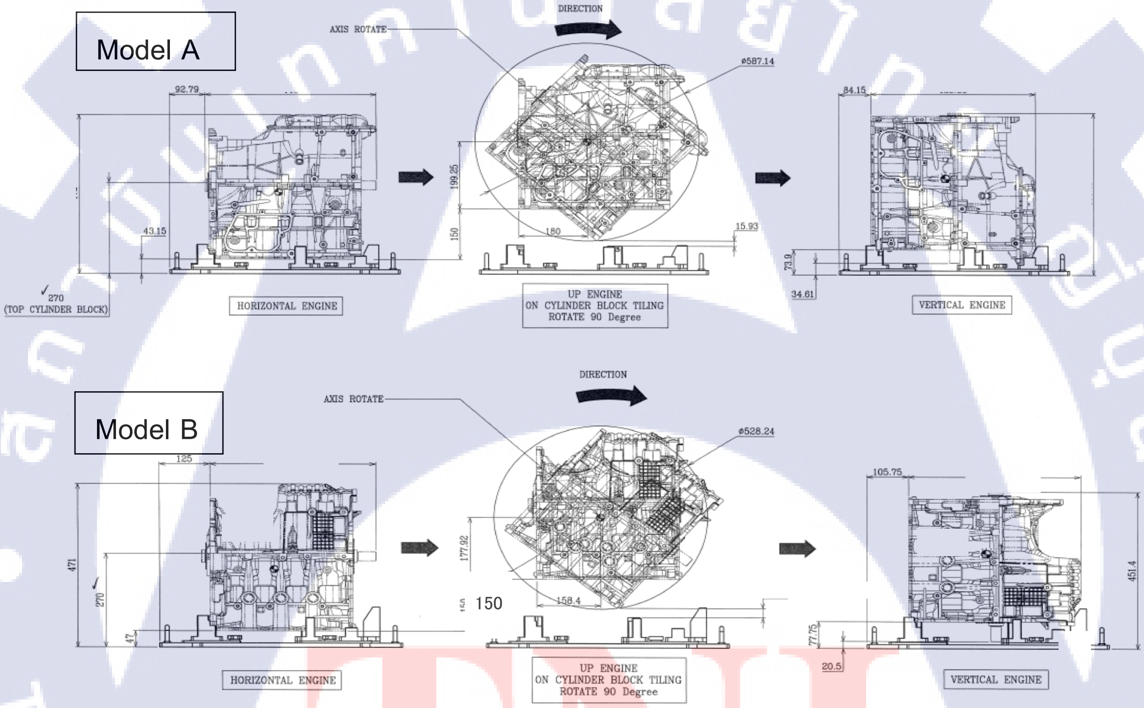


Figure 4.5 Different point of dimension (Tilt gap, block size and tilting position)

4.1.3.3 Investigate common point

After find a common point by compare both engine model in 3D drawing and genba genbutsu at line production can find common point and make adapter jig that can common both 2 engine models without effect quality of work, safety, ergonomic and takt time but have to change 1 process by move altenator bracket assembly process to main line because without altenator bracket on left side of engine adapter can joints the engine without interfere of 2 models (Fig 4.6).

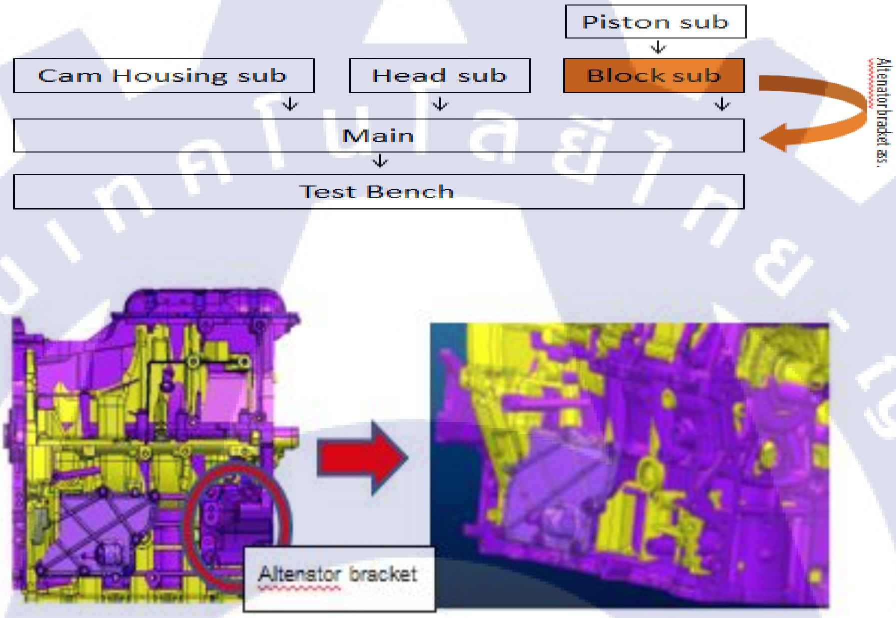


Figure 4.6 Compare 2 engine models with 3D program

After find common point design adapter jigs for the same tilting point the result is can design common adapter jigs both side (left & right) for model A and B

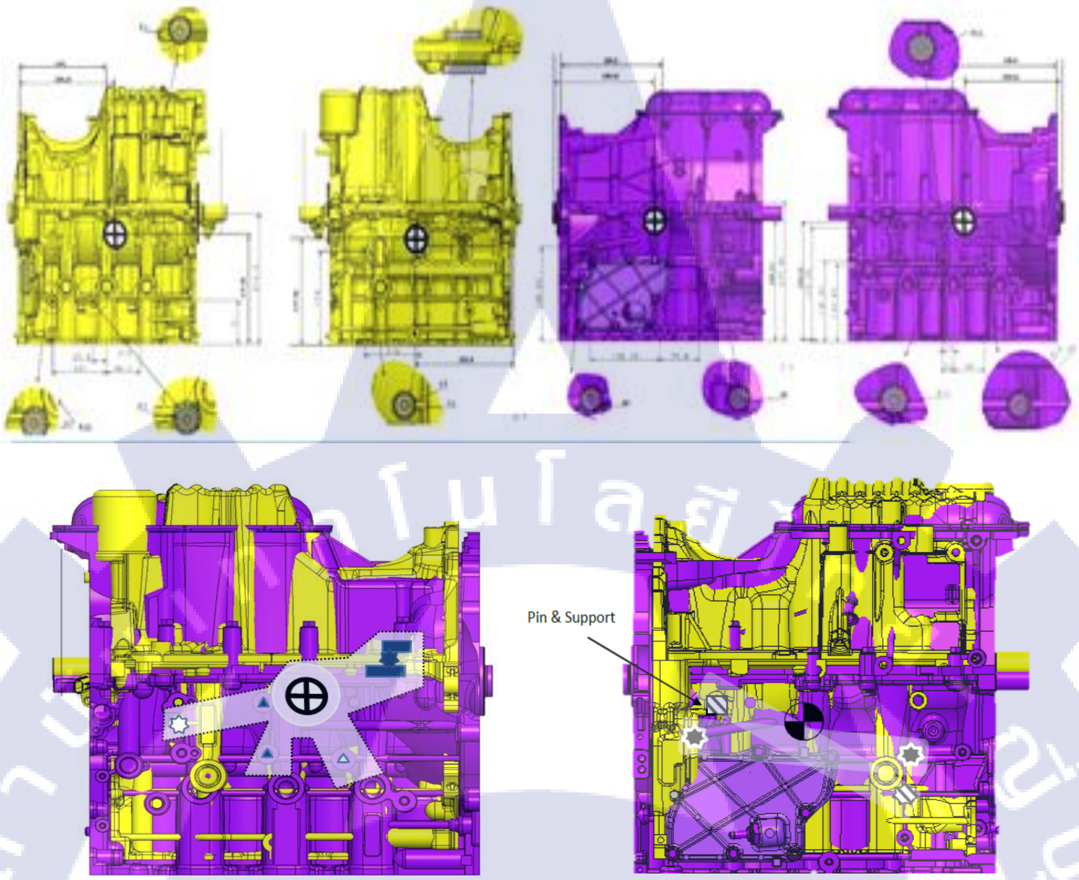


Figure 4.7 Adapter jigs concept

4.1.3.4 Design concept of block tilting

Design equipment concept by use 2 SMC cylinders lift up block at adapters jigs from pallet , use plunger for fixing position and use free conveyor for transport (Fig 4.7).

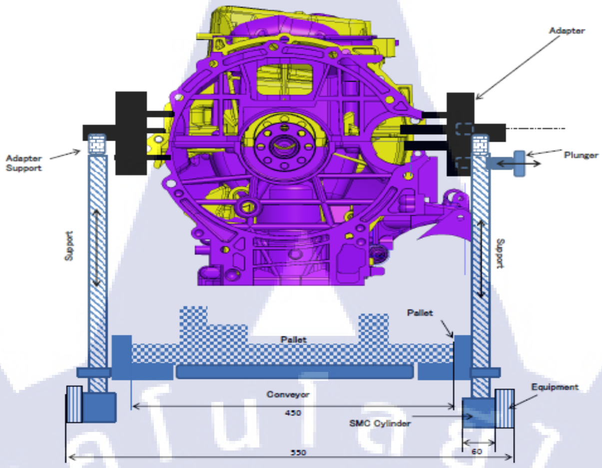
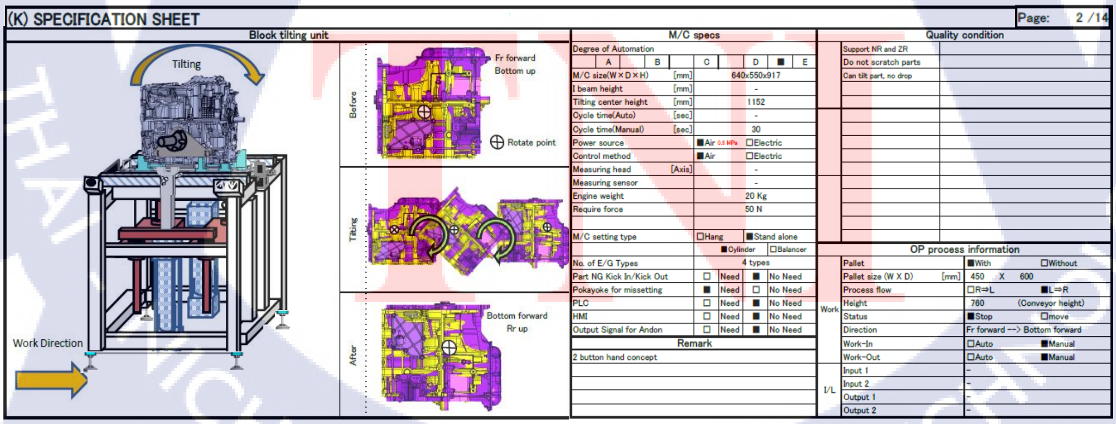


Figure 4.7 Block tilting concept

4.1.3.5 Specify machine

Specify machine condition such as can tilt block 90 degree from front forward bottom up to bottom forward rear up machine size tilting, center height, Power source, control method, engine weight, require force, setting type, concept operation process information



M/C specs				
Degree of Automation				
A	B	C	D ■	E
M/C size(W×D×H) [mm]	640x550x917			
I beam height [mm]	-			
Tilting center height [mm]	1152			
Cycle time(Auto) [sec]	-			
Cycle time(Manual) [sec]	30			
Power source	■Air 0.6 MPa	□Electric		
Control method	■Air	□Electric		
Measuring head [Axis]	-			
Measuring sensor	-			
Engine weight	20 Kg			
Require force	50 N			
M/C setting type	□Hang	■Stand alone		
	■Cylinder	□Balancer		
No. of E/G Types	4 types			
Part NG Kick In/Kick Out	□	Need	■	No Need
Pokayoke for missetting	■	Need	□	No Need
PLC	□	Need	■	No Need
HMI	□	Need	■	No Need
Output Signal for Andon	□	Need	■	No Need
Remark				
2 button hand concept				

Quality condition	
Support NR and ZR	
Do not scratch parts	
Can tilt part, no drop	

OP process information			
Work	Pallet	■With	□Without
	Pallet size (W X D) [mm]	450 X 600	
	Process flow	□R⇒L	■L⇒R
	Height	760	(Conveyor height)
	Status	■Stop	□move
	Direction	Fr forward --> Bottom forward	
	Work-In	□Auto	■Manual
	Work-Out	□Auto	■Manual
I/L	Input 1	-	
	Input 2	-	
	Output 1	-	
	Output 2	-	

Figure 4.8 Block tilting specification sheet

Design operation flow (Fig 4.9)

1. Work load to station

2. Lift up with 2 button hand concept (common button and lift up button)

3. Pull the plunger tilt block 90 degree clockwise

4. Lift down with 2 button hand concept (common button and lift down button)

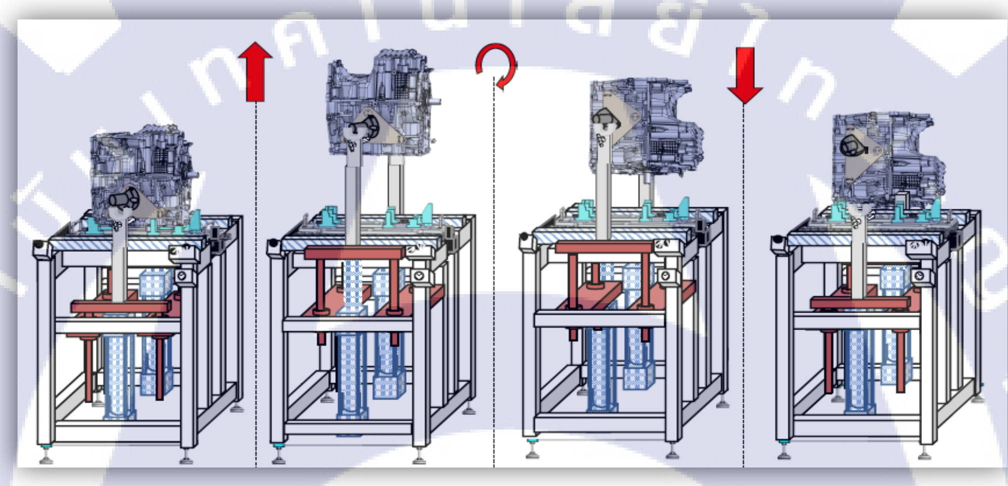


Figure 4.9 Operation flow

Design dimension and concept of mechanism (Fig 4.10)

1. Work load in adapters machine will stop in position by anti back pallet and pallet stopper that groove and plunger are parallel in vertical with a gap

2. SMC cylinder lift up and adapter support will lift adapters up them plunger will in groove position for work fixing position

3. After lift up pull the plunger to unlock the adapter and tilt block 90 degree clockwise by hand plunger will automatic lock adapter when it in 90 degree position to fixing position
4. Lift down work plunger will out of position from adapter in vertical after work down to pallet

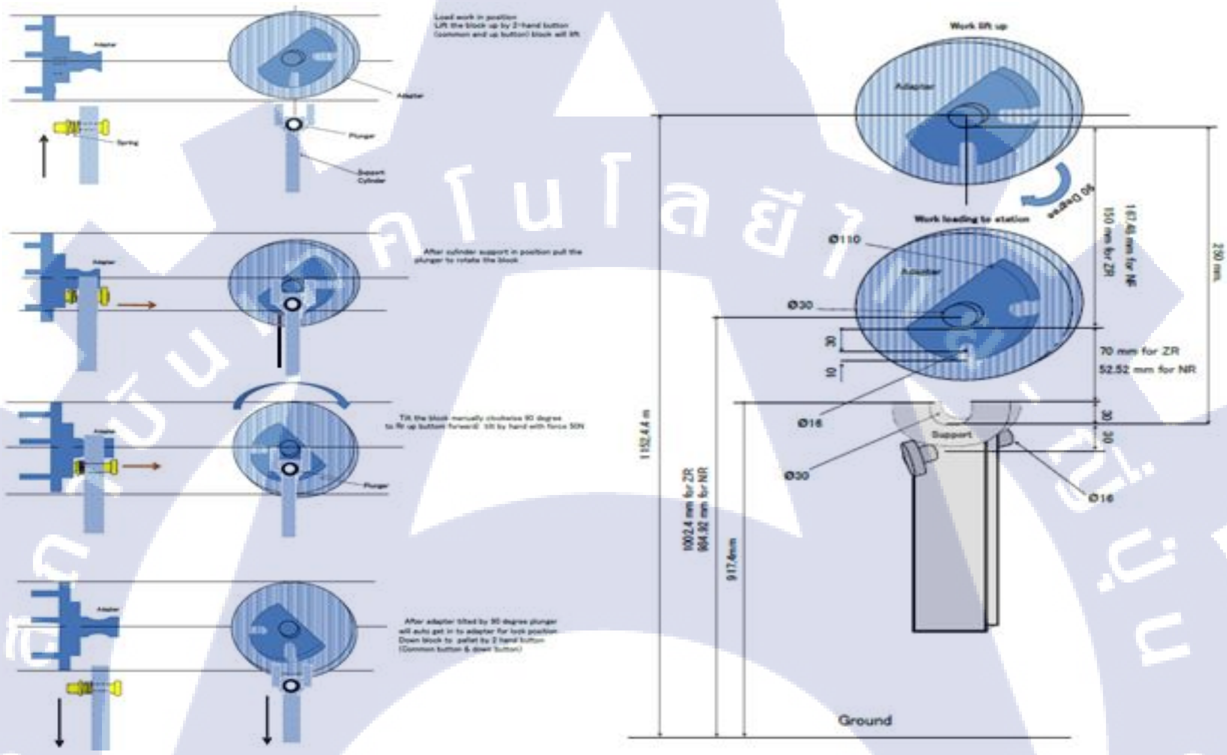


Figure 4.10 Mechanism function

Design pneumatic system

The pneumatic system design in concept of A-3 that is when press emergency stop button or not press the button work will stop in that current position use pneumatic with SMC cylinder to lift up and lift down and pallet stopper (Fig 4.11).

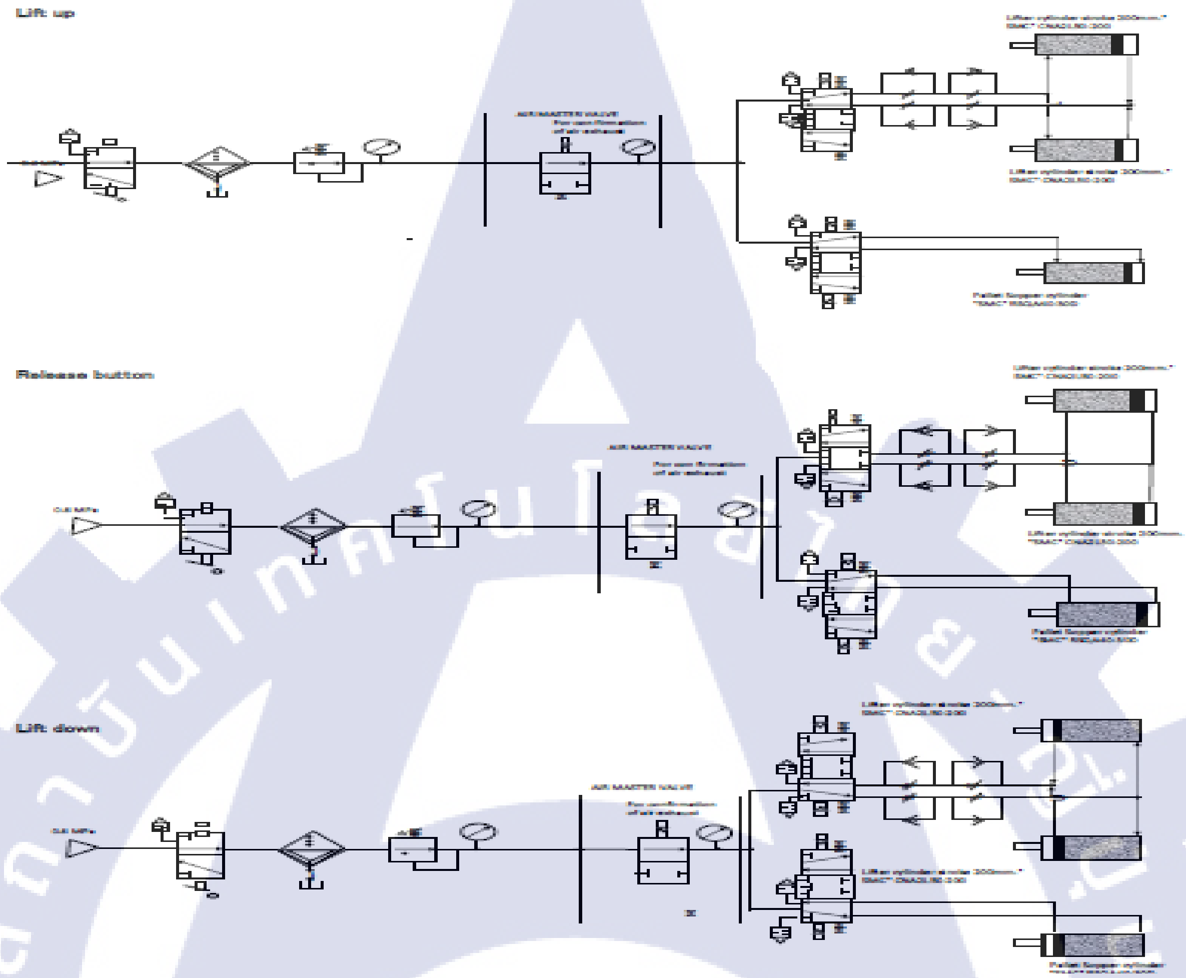


Figure 4.11 Pneumatic system

Specify machine components, materials, color and model (Fig 4.12)

1. Conveyor
2. Pallet anti-back
3. Common button
4. Plunger (Metal with heat treatment HRC45 and diameter 16)
5. Linear bush set

6. Structure (Metal square tube 50x50 mm and Toyota color)

7. Adapter Support (U shape, metal with heat treatment HRC45)

8. Pallet guide (Metal SS400 Zinc coating)

9. Lift up and lift down button

10. Cylinder support

11. Emergency stop button

12. Pneumatic board

13. SMC cylinders stroke 250

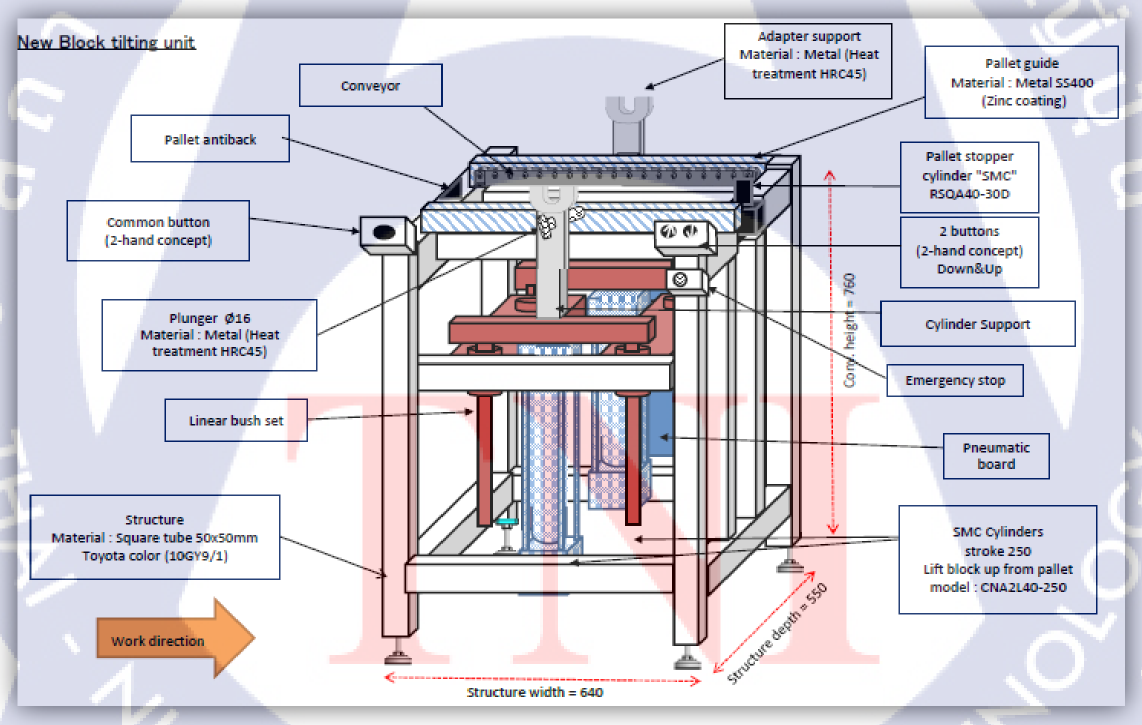


Figure 4.12 Machine details

4.2 Result of Project

Current block tilting unit (Fig 4.13)

- Station pitch 1100 mm
- Heavy for transfer
- Set block tilting unit in every dolly
- Use bolt cross to hang work with tilting unit

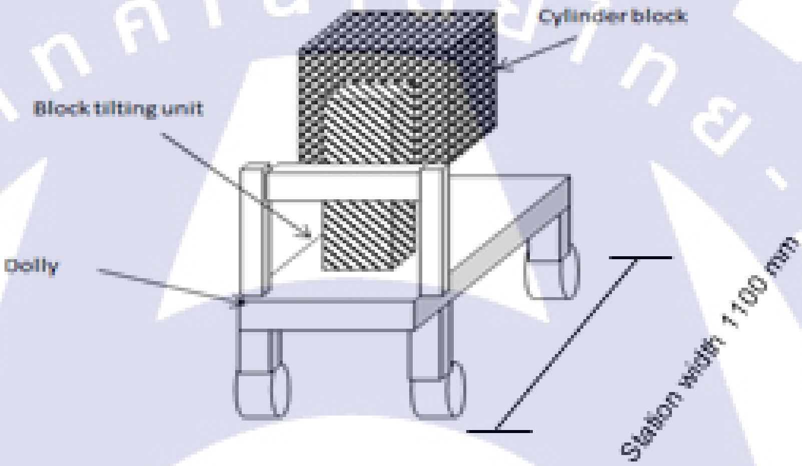


Figure 4.13 Current Block tilting unit

New block tilting unit (Fig 4.14)

- Station width 650 mm
- Easy and require less for transferring because use light pallet and free conveyor
- Use adapter to join work and block tilting unit
- Use only one block tilting unit

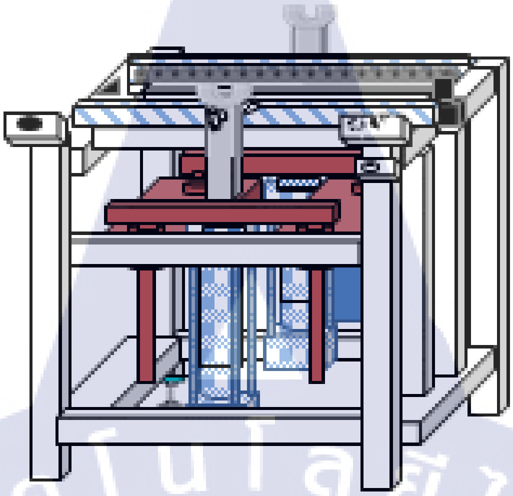
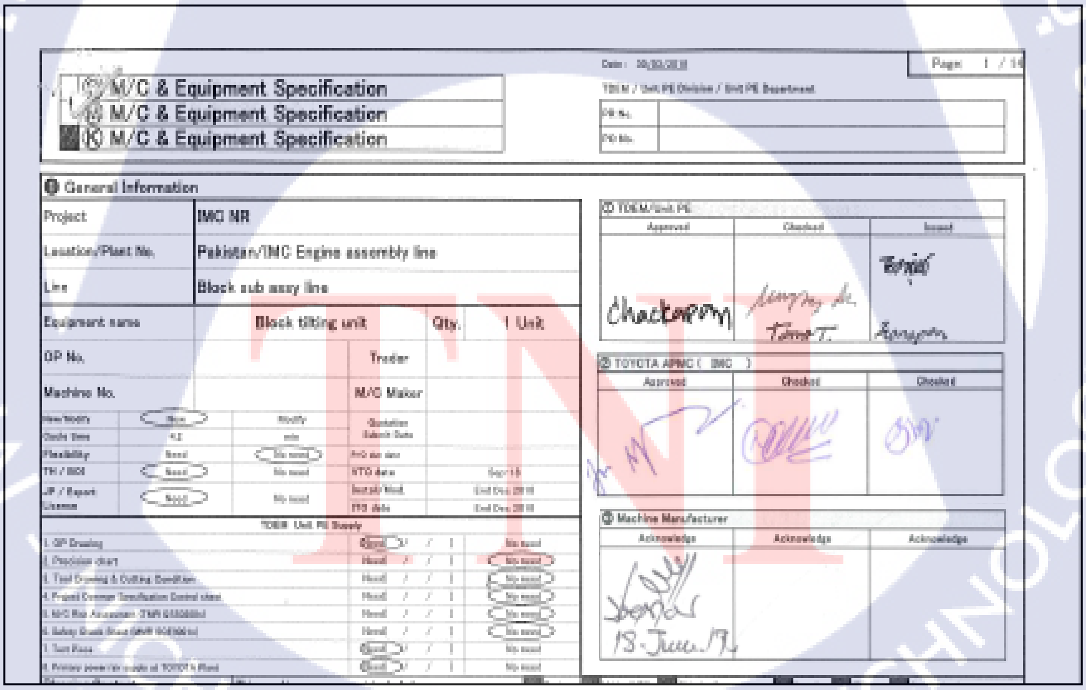


Figure 4.14 New Block tilting unit

TDEM staff, Machine maker and IMC plant staff all agree with block tilitng M/C spec (Fig 4.15)



M/C & Equipment Specification
M/C & Equipment Specification
M/C & Equipment Specification

Page 1 / 14

General Information

Project	IMC NR		
Location/Plant No.	Pakistan/IMC Engine assembly line		
Line	Block sub assy line		
Equipment name	Block tilting unit	Qty.	1 Unit
QP No.		Trader	
Machine No.		M/C Maker	

TDEM Unit PE Supply

TDEM/Unit PE: Approved / Checked / Issued

TOYOTA APMC (IMC): Approved / Checked / Checked

Machine Manufacturer: Acknowledge / Acknowledge / Acknowledge

Figure 4.15 Machine specification approved by internal and external

Chapter 5

Conclusion and Suggestion

5.1 Conclusion

Block tilting unit is on every dolly, can't capacity up because of big station and heavy to transfer because of have to transfer dolly, tilting unit and cylinder block. After make new machine specification sheet. It can work in the condition of use with pallet, free conveyor, can tilt 2 models of engine cylinder block by making decision with safety, work ability, quality of work, operation time and budget. The new block tilting unit can capacity up because of reducing size of work station width from 1100 mm to 650 mm and easy for transferring using common adapters for adjust tilting point of different dimension of 2 engine models

5.2 The way to solve the problem

Find root cause of the problem to design improvement concept refer with ergonomic standard and follow up from production preparation process.

5.3 Suggestion

There are many models of engine in Toyota if there is case of making new line production or modify to produce 2 engine models in 1 line production. This concept can adapt or improve in the future.

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[5] Theerawit Satasuratanon, 2015, **Basic Engine Components,** Unit production Engineering TOYOTA MOTOR CORPORATION

Apendix

(Weekly Report)

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สัปดาห์ที่ 1

ชื่อ-สกุลนักศึกษา [illegible] รหัสนักศึกษา 5814007-6

คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา อุตสาหการ

วัน/เดือน/ปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ ../../..				
อังคาร ../../..				
พุธ ../../..				
พฤหัสบดี ../../..				
ศุกร์ 1/6/61	8	- First meet - Self study "engine"	Engine function	
เสาร์ 2/6/61	8	"Self study" Engine"	Engine function	
อาทิตย์ ../../..				
จำนวนชั่วโมงงานในรายงานฉบับนี้	16	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	
จำนวนชั่วโมงในรายงานฉบับก่อน	-	ลงชื่อ [illegible] ([illegible])	ลงชื่อ Tomit T. ([illegible])	
จำนวนชั่วโมงรวมทั้งหมด	16	วัน/เดือน/ปี 2/6/61 นักศึกษา	ตำแหน่ง Sr. Engineer วัน/เดือน/ปี 2/6/2561 ผู้ควบคุมการปฏิบัติงาน	

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สัปดาห์ที่ 2

ชื่อ-สกุลนักศึกษา [illegible] รหัสนักศึกษา 58114007-6

คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา [illegible]

วันเดือนปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 4/6/61	8	-Compare battery 2 models	Battery Excel	Excel
อังคาร 5/6/61	8	-Induction Training for Internship & Cooperative Program	Toyota way Business Equity Environment & safety	
พุธ 6/6/61	11.5	-ProE Training -Making Purpose report -self study operation drawing Engine Ass'	Drawing Excel Engine assembly	
พฤหัสบดี 7/6/61	10.5	-STM plant visit observe line production -self study operation drawing "Engine Ass"	Engine Assembly	
ศุกร์ 8/6/61	8	-ProE Training -Selfstudy operation drawing "Engine Ass"	Drawing Engine assembly	
เสาร์ ..../..../....				
อาทิตย์ ..../..../....				

จำนวนชั่วโมงรวมในรายงานฉบับนี้	46	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ
จำนวนชั่วโมงในรายงานฉบับก่อน	16	ลงชื่อ [illegible] ([illegible])	ลงชื่อ [illegible] ([illegible])
จำนวนชั่วโมงรวมทั้งหมด	62	วันเดือนปี 8/6/61 นักศึกษา	ตำแหน่ง Sr. Eng วันเดือนปี 8-6-2018 ผู้ควบคุมการปฏิบัติงาน

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สัปดาห์ที่ 3

ชื่อ-สกุลนักศึกษา นายธนเดช สุวรรณ์ รหัสนักศึกษา 59114007-6

คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา อุตสาหการ

วันเดือนปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 11 / 6 / 61	9	- ProE Training - Self study "Operation drawing engine"	Drawing 3D Engine assembly	
อังคาร 12 / 6 / 61	8	- Pro E Training - Self study "Operation drawing engine"	Drawing 3D Engine Assembly	
พุธ 13 / 6 / 61	8	Assembly Engine by Pro E	Drawing Engine	
พฤหัสบดี 14 / 6 / 61	8.5	compare engine 2 model make machine spec	Drawing Specification	
ศุกร์ 15 / 6 / 61	8	Specification Engine	Specification	
เสาร์ ... / ... / ...				
อาทิตย์ ... / ... / ...				

จำนวนชั่วโมงรวมในรายงานฉบับนี้	41.5	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ ธนเดช สุวรรณ์ (นายธนเดช สุวรรณ์) วันเดือนปี 15/6/61 นักศึกษา	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ Tomo T. ([illegible]) ตำแหน่ง Sr. Eng วันเดือนปี 15 - 6 - 2018 ผู้ควบคุมการปฏิบัติงาน
จำนวนชั่วโมงในรายงานฉบับก่อน	62		
จำนวนชั่วโมงรวมทั้งหมด	103.5		

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แบบฟอร์มรายงานการปฏิบัติงานประจำสัปดาห์

สัปดาห์ที่ 4

ชื่อ-สกุลนักศึกษา นายอินทร สุขวัฒน์ รหัสนักศึกษา 58114007-6

คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา อุตสาหการ

วัน/เดือน/ปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 18/6/61	9	Equipment Specification	Specification ProE Excel	
อังคาร 19/6/61	8	Equipment Specification	Specification ProE Excel	
พุธ 20/6/61	8	- Eco forest & Plant tour for internship & cooperative, TMT Banpho plant	Line Assembly Quality control	
พฤหัสบดี 21/6/61	12.5	VTO maker at AI tech	PE field communication	
ศุกร์ 22/6/61	8	- Toyota production system simulation training	TPS	
เสาร์ 23/6/61	8	Equipment specification	Decision Equipment Excel	
อาทิตย์ ..../..../....				

จำนวนชั่วโมงรวมในรายงานฉบับนี้	53.5	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ อินทร สุขวัฒน์ (นายอินทร สุขวัฒน์) วัน/เดือน/ปี 23/6/61 นักศึกษา	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ [illegible] ([illegible]) ตำแหน่ง Sr. Engineer. วัน/เดือน/ปี 23-6-2018 ผู้ควบคุมการปฏิบัติงาน
จำนวนชั่วโมงในรายงานฉบับก่อน	103.5		
จำนวนชั่วโมงรวมทั้งหมด	157		

หมายเหตุ นักศึกษาต้องส่งรายงานฉบับนี้ถึงอาจารย์ที่ปรึกษาสหกิจศึกษา / ฝึกงานทุกคณะวิชา ทุกสัปดาห์อย่างเคร่งครัด อย่าลืมถ่ายสำเนาเก็บไว้เพื่อทำรายงานฉบับสมบูรณ์

ศูนย์สหกิจศึกษาและจัดหางาน สถาบันเทคโนโลยีไทย - ญี่ปุ่น

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แบบฟอร์มรายงานการปฏิบัติงานประจำสัปดาห์

สัปดาห์ที่.....5.........

ชื่อ-สกุลนักศึกษา นายธเนศ สุขวัฒน์ รหัสนักศึกษา 58114007-6

คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา อุตสาหการ

วันเดือนปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 25 / 6 / 61	8	Equipment specification	Specification	
อังคาร 26 / 6 / 61	8.5	VTO maker at AI Tech	PE Field communication	
พุธ 27 / 6 / 61	8	Equipment specification	Specification Excel	
พฤหัสบดี 28 / 6 / 61	8	Safety Awareness for internship & cooperation program	Safety	
ศุกร์ 29 / 6 / 61	8	Equipment Specification	Specification	
เสาร์ ..../..../....				
อาทิตย์ ..../..../....				

จำนวนชั่วโมงรวมในรายงานฉบับนี้	40.5	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ.....ธเนศ สุขวัฒน์..... (นายธเนศ สุขวัฒน์) วันเดือนปี 29/6/61 นักศึกษา	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ.....Taw T..... ([illegible]) ตำแหน่ง Sr. Eng. วันเดือนปี 29/6/2018 ผู้ควบคุมการปฏิบัติงาน
จำนวนชั่วโมงในรายงานฉบับก่อน	157		
จำนวนชั่วโมงรวมทั้งหมด	1975		

หมายเหตุ นักศึกษาต้องส่งรายงานฉบับนี้ถึงอาจารย์ที่ปรึกษาสหกิจศึกษา / ฝึกงานทุกคณะวิชา ทุกสัปดาห์อย่างเคร่งครัด อย่าลืมถ่ายสำเนาเก็บไว้เพื่อทำรายงานฉบับสมบูรณ์

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สัปดาห์ที่ 6

ชื่อ-สกุลนักศึกษา [illegible] รหัสนักศึกษา 58114007-6
คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา อุตสาหการ

วัน/เดือน/ปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 2 / /	10	Equipment Specification	Specification	
อังคาร 3 / /	-	ลาไปทำวีซ่ากับทางมหาวิทยาลัย		
พุธ 4 / /	8.5	Equipment specification	Specification	
พฤหัสบดี 5 / /	8	Equipment Specification	Specification	
ศุกร์ 6 / /	-	ลา		
เสาร์ 7 / /				
อาทิตย์ 8 / /				
จำนวนชั่วโมงรวมในรายงานฉบับนี้	26.5	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ [illegible] ([illegible]) วัน/เดือน/ปี 16/7/18 นักศึกษา	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ [illegible] ([illegible]) ตำแหน่ง Sr. Engineer วัน/เดือน/ปี 16-7-18 ผู้ควบคุมการปฏิบัติงาน	
จำนวนชั่วโมงในรายงานฉบับก่อน	197.5			
จำนวนชั่วโมงรวมทั้งหมด	224			

หมายเหตุ นักศึกษาต้องส่งรายงานฉบับนี้ถึงอาจารย์ที่ปรึกษาสหกิจศึกษา/ฝึกงานทุกคณะวิชา ทุกสัปดาห์อย่างเคร่งครัด อย่าลืมถ่ายสำเนาเก็บไว้เพื่อทำรายงานฉบับสมบูรณ์

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สัปดาห์ที่ 7

ชื่อ-สกุลนักศึกษา [illegible] รหัสนักศึกษา 58114007-6
คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา อุตสาหการ

วัน/เดือน/ปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 9 / /	-	ลา		
อังคาร 10 / /	8	PE training class "Basic painting process & Basic assembly process"	Painting process Assembly process	
พุธ 11 / /	8	Equipment Specification	Specification	
พฤหัสบดี 12 / /	8	Self study "Pneumatic system" Equipment specification	Pneumatic Specification	
ศุกร์ 13 / /	8	Introduction of Unit product & Unit PE Toyota driving experience	PE field Driving	
เสาร์ 14 / /				
อาทิตย์ 15 / /	2.5	Equipment Specification	Specification	
จำนวนชั่วโมงรวมในรายงานฉบับนี้	34.5	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	
จำนวนชั่วโมงในรายงานฉบับก่อน	224	ลงชื่อ [illegible] ([illegible])	ลงชื่อ Tana T. ([illegible])	
จำนวนชั่วโมงรวมทั้งหมด	258.5	วัน/เดือน/ปี 16/7/18 นักศึกษา	ตำแหน่ง Sr Engineer วัน/เดือน/ปี 16-7-18 ผู้ควบคุมการปฏิบัติงาน	

หมายเหตุ นักศึกษาต้องส่งรายงานฉบับนี้ถึงอาจารย์ที่ปรึกษาสหกิจศึกษา / ฝึกงานทุกคณะวิชา ทุกสัปดาห์อย่างเคร่งครัด อย่าลืมถ่ายสำเนาเก็บไว้เพื่อทำรายงานฉบับสมบูรณ์

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สัปดาห์ที่ 8

ชื่อ-สกุลนักศึกษา นายธนพร สุวัฒน์ รหัสนักศึกษา 58114007-6

คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา อุตสาหการ

วันเดือนปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 16/7/18	10	Machine specification	specification	
อังคาร 17/7/18	8.5	Machine specification	Specification	
พุธ 18/7/18	11	Machine specification	Specification	
พฤหัสบดี 19/7/18	11.5	Machine specification Make Final Report	Specification Report, software	
ศุกร์ 20/7/18	8	Make Final Report	Reporting	
เสาร์ 21/7/18	8	Make Final Report	Reporting	
อาทิตย์ 22/7/18				
จำนวนชั่วโมงรวมในรายงานฉบับนี้	57	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	
จำนวนชั่วโมงในรายงานฉบับก่อน	258	ลงชื่อ ธนพร สุวัฒน์ (นายธนพร สุวัฒน์) วันเดือนปี 23/7/2018 นักศึกษา	ลงชื่อ Tanes T. (นายธเนศ ตันติกุล) ตำแหน่ง Sr. Engineer วันเดือนปี 23-7-2018 ผู้ควบคุมการปฏิบัติงาน	
จำนวนชั่วโมงรวมทั้งหมด	315			

หมายเหตุ นักศึกษาต้องส่งรายงานฉบับนี้ถึงอาจารย์ที่ปรึกษาสหกิจศึกษา / ฝึกงานทุกคณะวิชา ทุกสัปดาห์อย่างเคร่งครัด อย่าลืมถ่ายสำเนาเก็บไว้เพื่อทำรายงานฉบับสมบูรณ์

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สัปดาห์ที่ 9

ชื่อ-สกุลนักศึกษา [illegible] รหัสนักศึกษา 5911400?? [illegible]

คณะวิชา [illegible] สาขาวิชา [illegible]

วันเดือนปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 23/7/18	11.5	Making Final Report	Microsoft Office PowerPoint	
อังคาร 24/7/18	9	Final Report	Communication	
พุธ 25/7/18	8.5	Approve drawing Equipment Specification	Specification	
พฤหัสบดี 26/7/18	9	Equipment Specification	Specification	
ศุกร์ 27/7/18				
เสาร์ 28/7/18				
อาทิตย์ 29/7/18				
จำนวนชั่วโมงรวมในรายงานฉบับนี้	36	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	
จำนวนชั่วโมงในรายงานฉบับก่อน	315	ลงชื่อ [illegible] ([illegible]) วันเดือน/ปี 1/08/2018 นักศึกษา	ลงชื่อ Tane T. (นาย [illegible]) ตำแหน่ง Sr. Engineer วันเดือน/ปี 1-8-2018 ผู้ควบคุมการปฏิบัติงาน	
จำนวนชั่วโมงรวมทั้งหมด	351			

หมายเหตุ. นักศึกษาต้องส่งรายงานฉบับนี้ถึงอาจารย์ที่ปรึกษาสหกิจศึกษา / ฝึกงานทุกคณะวิชา ทุกสัปดาห์อย่างเคร่งครัด อย่าลืมถ่ายสำเนาเก็บไว้เพื่อทำรายงานฉบับสมบูรณ์

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สัปดาห์ที่....12............

ชื่อ-สกุลนักศึกษา [illegible] สุขวัฒน์ รหัสนักศึกษา 58114007-6

คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา [illegible]

วัน/เดือน/ปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 30/7/18				
อังคาร 31/7/18	8	Approve drawing	Drawing Dimension	
พุธ 1/8/18	8	Machine Specification	Mechanism Dimension	
พฤหัสบดี 2/8/18	10.5	Machine specification	Mechanism Dimension	
ศุกร์ 3/8/18	10.5	Approve drawing	Drawing Pneumatic	
เสาร์ 4/8/18	8	Make Final Report	Making report	
อาทิตย์ 5/8/18				

จำนวนชั่วโมงรวมในรายงานฉบับนี้	45	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ [illegible] ([illegible]) วัน/เดือน/ปี 8/8/18 นักศึกษา	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ Tom T. ([illegible]) ตำแหน่ง Sr Engineer วัน/เดือน/ปี 8-8-2018 ผู้ควบคุมการปฏิบัติงาน
จำนวนชั่วโมงในรายงานฉบับก่อน	351		
จำนวนชั่วโมงรวมทั้งหมด	396		

หมายเหตุ นักศึกษาต้องส่งรายงานฉบับนี้ถึงอาจารย์ที่ปรึกษาสหกิจศึกษา/ฝึกงานทุกคณะวิชา ทุกสัปดาห์อย่างเคร่งครัด อย่าลืมถ่ายสำเนาเก็บไว้เพื่อทำรายงานฉบับสมบูรณ์

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1771/1 ถนนพัฒนาการ แขวงสวนหลวง เขตสวนหลวง กรุงเทพฯ 10250 โทรศัพท์: 0-2763-2762, 02-763-2750 Fax: 0-2763-2600 ต่อ 2788 www.tni.ac.th

แบบฟอร์มรายงานการปฏิบัติงานประจำสัปดาห์

สัปดาห์ที่ 11

ชื่อ-สกุลนักศึกษา [illegible] รหัสนักศึกษา 58114007-6

คณะวิชา วิศวกรรมศาสตร์ สาขาวิชา [illegible]

วันเดือนปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหาอุปสรรค
จันทร์ 6/8/61	8	Making report	presentation	
อังคาร 7/8/61	8	Equipment specification	specification	
พุธ 8/8/61	9	Maker meeting	communications	
พฤหัสบดี 9/8/61	8.5	Equipment specification	specification	
ศุกร์ 10/8/61	8	Equipment specification Making report	Presentation	
เสาร์ 11/8/61				
อาทิตย์ 12/8/61				
จำนวนชั่วโมงรวมในรายงานฉบับนี้	41.5	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ	
จำนวนชั่วโมงในรายงานฉบับก่อน	396	ลงชื่อ [illegible] ([illegible])	ลงชื่อ [illegible] ([illegible])	
จำนวนชั่วโมงรวมทั้งหมด	437.5	วันเดือนปี 14/8/18 นักศึกษา	ตำแหน่ง Sr Engineer วันเดือนปี 14-8-2018 ผู้ควบคุมการปฏิบัติงาน	

หมายเหตุ นักศึกษาต้องส่งรายงานฉบับนี้ถึงอาจารย์ที่ปรึกษาสหกิจศึกษา / ฝึกงานทุกคณะวิชา ทุกสัปดาห์อย่างเคร่งครัด อย่าลืมถ่ายสำเนาเก็บไว้เพื่อทำรายงานฉบับสมบูรณ์

ศูนย์สหกิจศึกษาและจัดหางาน สถาบันเทคโนโลยีไทย - ญี่ปุ่น
Co-operative Education and Career Center
1771/1 ถนนพัฒนาการ แขวงสวนหลวง เขตสวนหลวง กรุงเทพฯ 10250 โทรศัพท์: 0-2763-2762, 02-763-2750 Fax: 0-2763-2600 ต่อ 2788 www.tni.ac.th

แบบฟอร์มรายงานการปฏิบัติงานประจำสัปดาห์
สัปดาห์ที่......12.......

ชื่อ-สกุลนักศึกษา ....นาย ธนเดช สุขวัฒน์.......รหัสนักศึกษา....5811-007-6.......
คณะวิชา.....วิศวกรรมศาสตร์.......สาขาวิชา.....อุตสาหการ.......

วัน/เดือน/ปี	จำนวนชั่วโมง	งานที่ปฏิบัติโดยย่อ	ความรู้/ทักษะที่ได้รับ	ปัญหา/อุปสรรค
จันทร์ 13/8/18				
อังคาร 14/8/18	8	Making report Machine specification	Specification	
พุธ 15/8/18	4	ลารับภาษาที่ช่วงเช้า โครงการ IOT Research TNI Making report	Presentation	
พฤหัสบดี 16/8/18	8	Approve drawing	3D program Drawing	
ศุกร์ 17/8/18	8	Approve drawing	Drawing	
เสาร์ 18/8/18				
อาทิตย์ 19/8/18				
จำนวนชั่วโมงรวมในรายงานฉบับนี้	28	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ....นายธนเดช สุขวัฒน์.... (....Thanadet Sukkawat....) วัน/เดือน/ปี....17/8/18.... นักศึกษา	ขอรับรองว่ารายงานฉบับนี้เป็นความจริงทุกประการ ลงชื่อ....Kanapon.... (....Kanapon Klunsupa....) ตำแหน่ง ....G4.... วัน/เดือน/ปี....17/8/18.... ผู้ควบคุมการปฏิบัติงาน	
จำนวนชั่วโมงในรายงานฉบับก่อน	437.5			
จำนวนชั่วโมงรวมทั้งหมด	465.5			

หมายเหตุ นักศึกษาต้องส่งรายงานฉบับนี้ถึงอาจารย์ที่ปรึกษาสหกิจศึกษา / ฝึกงานทุกคณะวิชา ทุกสัปดาห์อย่างเคร่งครัด อย่าลืมถ่ายสำเนาเก็บไว้ เพื่อทำรายงานฉบับสมบูรณ์

Profile

Name Thanadet Sukkawat

Date of birth 21 Febuary 1997

Education

Primary School Chok Chai School 2003

High School Satriwitthaya 2 School 2009

University Thai-Nichi Institute of technology 2015

Scholarship **Internship Program in Japan (JTECS)**

Training experience

- case study on Automotive Part Design at Mitsubishi Motors(Thailand)
- case study on Automotive Part Design at Murakami Ampas(Thailand)
- case study on Automotive Part Design at JTEKT
- case study on Automotive Part Design at Nissan Motor Asia Pacific
- The training of the use and maintenance at Thai-Nichi Institute of technology
- TNI Internship Development Program at Thai-Nichi Institute of technology
- Design and Development course at Thai-Nichi Institute of technology
- Process Improvement by Automation and IOT course at Thai-Nichi Institute of Technology
- Induction Training Toyota way, Safety, ISO related and Quality in Toyota at Toyota Daihatsu Engineering and manufacturing

-Toyota Production System Simulation Training at Toyota Daihatsu Engineering and manufacturing

-Safety Awareness Training (SAW)

- Basic stamping, welding, painting and assembly process