Fruit and Vegetable Processing
Level III

Based on May 2019, Version 2 OS and March. 2021, V1 Curriculum

Module Title: - Operating Interrelated Processes in a Production System

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LG #26	LO #1 Prepare the production system for operation

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Confirming Equipment, materials and services
- Identifying and confirming cleaning requirements and equipment status
- Selecting and adjusting machine setting
- Entering the processing / operating parameters
- Loading or positioning materials, ingredients or products
- carrying out pre- start checks as required by workplace requirement
- checking and adjusting Equipment performance
- making the Equipment ready and safe to operate

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Confirm equipment, materials and services
- Identify and confirming cleaning requirements and equipment status
- Select and adjusting machine setting
- Enter the processing / operating parameters
- Load or positioning materials, ingredients or products
- carry out pre- start checks as required by workplace requirement
- check and adjust Equipment performance
- make the Equipment ready and safe to operate

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Confirming Equipment, materials and services

1.1. Introduction

A system typically involves a series of interrelated processes that must be coordinated and concurrently operated to produce the required outcome or an arrangement or assembly of inter-dependent processes (activities) that are based on some logic and function. It operates as a whole and is designed (build) with an intension to achieve (fulfill) some objective or do some work**.**

Production can be explained as an act of either manufacturing or mining or growing of goods (commodities) generally in bulk for trade.

Production is a method employed for making or providing essential goods and services for consumers. It is a process that puts intangible inputs like ideas, creativity, research, knowledge, wisdom, etc. in use or action. It is a way that transforms (convert) tangible inputs like raw-materials, semi-finished goods and unassembled goods into finished goods or commodities

Production system

“The methods, procedure or arrangement which includes all functions required to accumulate (gather) the inputs, process or reprocess the inputs, and deliver the marketable output (goods)."Production system utilizes materials, funds, infrastructure, and labor to produce the required output in form of goods. Food production system includes all processes and infrastructure involved in feeding a population: growing, harvesting, processing, packaging, transporting, marketing, consumption, and disposal of food and food-related items. It also includes the inputs needed and outputs generated at each of these steps.

Production system consists of three main components these are, Inputs, Conversion Process and Output.

1. **Inputs** include raw-materials, machines, man-hours, components or parts, drawing, instructions and other paper works.

2. **Conversion process** includes operations (actual production process). Operations may be either manual or mechanical or chemical. Operations convert inputs into output.

Conversion process also includes supporting activities, which help the process of conversion.

The supporting activities include; production planning and control purchase of raw-materials, receipt, storage and issue of materials, inspection of parts and work-in-progress, testing of products, quality control, warehousing of finished products, etc.

3. Output includes finished products, finished goods (parts), and services.

The three components of a production system are depicted in this diagram**.**

Figure 1 production system components

In short, everything which is done to produce goods and services or to achieve the production objective is called production system.

The examples of a production system are as follows:

Tangible goods: Consider an example of a manufacturing industry like a Sugar Industry. Here, sugarcane is first used as an input, then the juice of sugarcane is processed through a conversion process, finally to get an output known as a refined sugar (used for mass consumption).

Intangible goods: Consider an example from a service industry that of a software-development firm or company. Here, initially, written program codes are used as an input. These codes are then integrated in some database and are provided with a user-friendly interface through a conversion process. Finally, an output is made available in form of an executable application program.

1.2 Equipment, Material and service

Fruit pressers	Peelers/ knife
Fruit crushers	Preparation table
PH meters	Pulper finishers
Refracto meters	washing machine

Stainless steel spoons, various shapes and sizes

Glass jars,	Stainless steel household sieves
Stainless steel vegetable cutter	Plastic lemon-squeezer

Raw materials used in fruit and vegetable processing technologies play a major role in the determination of their physical and chemical characteristics, sensory properties and nutritive value.

Water: it is one of the essential factors in the activity of the processing centers; according to the final utilization, water can be classified in three categories:

a. For technological utilization (when it comes into direct contact with raw materials and enters in the finished product's composition),
b. For steam generators and
c. For receptacle cooling, washing of equipment and general hygiene.

Sweeteners

Sugar is the conventional name applied to sucrose. Physically there is icing, granulated and lump sugar. In fruit and vegetable processing, sugar is used only in its granulated form; this quality must be in the form of uniform crystals, white, shining and completely soluble in water. Concentration of various sugar solutions can be rapidly measured by refractometer reading or with aerometer graduated in various ways, Brix Sweetening power is 50% compared with sucrose. In a 10%-20% proportion with sucrose, addition of corn syrup has certain advantages.

a. it improves the shine and texture of marmalade;
b. it prevents "sugaring" defect and it reduces the too sweet taste of finished products obtained with sugar alone.

Salt

Salt is used in order to give to the finished products a specifically salty taste and as a preserving substance. From a chemical point of view the term salt means sodium chloride but in practice the product is never in a pure state. The presence of a significant quantity of magnesium chloride increases the hygroscopicity, gives a bitter taste and can induce corrosion of receptacles

1.2.1 Prepare, start and operate a fruit and vegetable processing

Additional recommendations and "hints" to prepare, start and operate a fruit and vegetable processing centre are as follows:

a) Assure a raw material temporary storage capacity/ surface for 2-5 processing days. Invest in an adequate size cold room for sensible raw materials;
b) Plan the equipment to operate at the start-up for at least one working shift (about 7-9 hours) per day, for 5 working days per week; when needed, a second shift could be organized;
c) Plan to operate the processing centre for a maximum number of working days per year). In order to achieve this, invest in the buildings and equipment which will be able to:
d) process as many species of fruits and vegetables as possible / as available;
e) Use as many preservation methods as possible, e.g. drying, dehydration, concentration, sugar preservation, etc.
f) Whenever possible, "rush" the utilization of available raw materials during crop season by additional manufacturing of semi-processed products and transform these in consumer finished products during the off-season.
g) Excessive automatization of processing equipment DOES NOT directly imply a good quality of finished product;
h) Raw material quality is a major element with positive impact on finished product quality;

i) Initial and continuous personnel training and motivation is also an important factor in the success or failure of a processing centre and in assuring a constant finished product quality;

j)Keep finished product stocks at a minimum adequate level;

Remember that the three main "outputs" of the processing centre have to be prioritized in the following order:

Priority 1: Finished product quality conforms to specifications and standards: national and/or international, consumer special requests, etc.

Priority 2: Continuous and reliable supply of finished products to the domestic and export markets throughout the year (or at least throughout the "marketing season" of specific products);

Priority 3: Manufacturing and transport costs as low as possible, inside the stringent need to cover the first two priorities;

When deciding on the equipment output, take into consideration all elements specified and mainly raw material availability and market demand for a specific finished product;

k) Invest in simple, modular processing lines which can, with some simple on-site configuration modifications, process various types of finished products; this is mainly important for the first technological steps (preparation of raw materials, etc);

l) Plan to use as much as possible of the raw materials supplied / received to the processing centre.

This should be facilitated by the initial design and by a good day-to-day organisation and management; all these should enable, if necessary, to make a different use of each "quality" or grade of raw materials, e. g. using them for different finished products: one quality for drying/dehydration, on other quality for juices, etc.

m) Take into account the fact that the marketability of finished products will be differ in terms of types and quality for domestic and export markets.

Be sure that an export specialized staff/organization will help with specific export advice. To export successfully is a different job to processing fruit and vegetables.

n) Avoid investing in one "big" processing line, very sophisticated in terms of automation, etc. with a high output capacity but having potential following drawbacks: being able to "generate" / produce only one finished product type from only one raw material; having too high a degree of equipment fixation work for installation and therefore very high difficulties in using the processing equipment in a modular " interchangeable " way.

o) As an initial investment prefer small size processing lines, with modular equipment arrangement (i.e. able to be integrated in various technological configurations for processing of as many raw materials as possible and generating different finished products).

p) As compared with important processing units in developed countries, it is possible to formulate as a very general rule for developing countries, that for the usual size of equipment, for a comparable environment frame, the scale / size should be approximatively1:10 from those actually in use in developed countries.

Self-check# 1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I write Short Answer Questions for the following quesition

1. List some of equipments used in fruit and vegetable processing?(3pts)

2. List examples of production system and explain details (3pts)

Test II Write true if the statement is correct and false if statement is incorrect

1. Production system consists of three main components these are, Inputs, Conversion Process and Output. (2pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers

Information Sheet 2- Identifying and confirming cleaning requirements and equipment status

2.1 cleaning requirements and equipment status

2.1.1 Cleaning requirement

Incoming vegetables or fruits, which are covered with soil, mud and sand, should be carefully cleaned before processing. A second wash must usually be done after peeling and cutting.

Tools, equipment and machinery should be cleaned and sterilized according to the manufacturer's specifications, enterprise procedures and regulations.

This is used to increases life span of tools and equipment and avoids scarcity of tools and equipment at critical periods. Always before storing of tools and equipment cleaning is a must. Plant sap and organic debris builds up on parts of tools and equipment that are in regular contact with produce. This plant sap and organic debris will cause corrosion of metal parts, reducing the life of the tools, equipment and the sharpness of the cutting blades of different machineries. Unnecessary damage to produce occurs and the risk of injury to the operator increases when blunt tools are used. Produce may also be contaminated by the residues leaf on tools and equipment from previous use.

Cleaning reagent: Cleaning reagents are materials used to remove dust, Pesticide and other residue found in fruit and vegetable in order to preserve fruit and vegetables. removal of Surface Pesticide residues by washing. Different washing methods are investigated to study their effectiveness in removing surface pesticide residues from fruit and vegetable. There are different washing reagents $NaHCO_3$ (pH 9.12), and tap water (pH 6.85),sodium chloride.

Safety materials: such as glove, eye glass, hairnet, safety shoe, etc.

- Protect hand (skin) against harmful
- Protect eye
- Head protected
- Protect feet , ankles, and lower legs from harmful

Making the workplace safe includes providing instructions, procedures, training and supervision to encourage people to work safely and responsibly.

Even where engineering controls and safe systems of work have been applied, some hazards might remain. These include injuries to:

- the lungs, eg from breathing in contaminated air
- the head and feet, eg from falling materials
- the eyes, eg from flying particles or splashes of corrosive liquids
- the skin, eg from contact with corrosive materials
- the body, eg from extremes of heat or cold

Personal protective equipment (PPE) is needed in these cases to reduce the risk. Instruct and train people how to use it, eg train people to remove gloves without contaminating their skin. Tell them why it is needed, when to use it and what its limitations are careful selection, maintenance and regular and realistic operator training is needed for equipment for use in emergencies, like compressed-air escape breathing apparatus, respirators and safety ropes or harnesses.

2.2 Cleaning equipment

Impurities in Freshly Harvested Fruits ν Field Soil dust and surface microorganism ν Fungicide / insecticide etc ν Sap black spots Fruit and Vegetable. Cleaning Machine has its specifications capacity.

figure1 Multifunctional cleaning machine

figure3 Brush Type Vegetable & Fruit Cleaning Machice

The machine is a multifunctional fruit and vegetable cleaning equipment with bubbles, spraying and brush available in cleaning with features such as highly cleanness, energy-saving,watersaving, stable and reliable. This equipment is suitable for cleaning fruits and ve getables. It is easy to operate, convenient in maintenance and wiring.

figure2 manual cleaning machine

The fruit and vegetable raw materials are making irregular rotation under the effect of rotary brush roller to carry out spraying and brushing simultaneously. The brush is made of High

temperature resistant nylon wire through two kinds of technologies such as hair planting and stainless steel winding.

2.2.1 **Types of Equipment's**

a) Brush fruit cleaning machine for apple and fruits
b) Brush clearing machine for watermelon
c) Brush cleaning machine for carrot vegetable
d) Brush cleaning machine for citrus fruit

figure3 Surf Type Fruit Cleaning Machine

The equipment is mainly composed of water cabinet, material turning device, fan and lifter etc. It is widely used for soft washing of fruit and vegetable raw materials. The lifter can be made of complete stainless steel and engineering plastic. It can be additionally provided with spray cleaning device

Figure 4 **Roller with Brush Cleaning Machine**

The fruit washing equipment consists of a roller with brush washing (cleaning) machine for washing fruits and vegetables. Roller with brush washing machine is made up of stainles steel tube and brush. The brush is made of polyethylene, and will make revolution as th emovement of stainless steel chain. Fruits are driven to circumvolve and washed by brush. At the same time, the bad or rejected fruits are picked up by manual and then sent away by scrapconveying device

Accessing cleaning records:

Is a means of information exchange between cleaning materials and cleaner by recorded documentation

- The cleaning materials and equipments must be inform or recorded
- Cleaned process operations must be recorded according to cleaning schedule.
- Cleaned process/production lines must be recorded.

HACCP management system applied

The purpose applying HACCP management system is to bring a broad understanding of HACCP in the development of food safety management systems, in relation to products of their choosing, designed to protect consumers from food borne harms arising from the production and basic processing of fruit and vegetables.

Food safety is defined as the 'Assurance that food will not cause harm to the consumer when it is prepared and eaten according to its intended use.

General Hazards Characteristics

- The product contains sensitive ingredients, which can be assumed as potential sources of contamination under normal circumstances.
- The manufacturing process does not contain controlled processing steps that effectively destroy harmful bacteria.
- There is substantial potential for microbiological abuse in distribution or in consumer handling that could render the product harmful when consumed.
- Fruit and vegetable product is subject to contamination after processing and before packaging.
- No terminal heat process after packaging.

HACCP Pre-Requisite Programs

Good Manufacturing Practices (GMP): This provides the sanitary infrastructure for Food Safety that the:

- Plant grounds and building facilities emphasize pest control;
- Equipment design provides ease in cleaning and maintenance;
- Personal hygiene practices and facilities are set;
- Process controls are followed;
- Storage and warehousing are free from contamination.

Sanitation Standard Operating Procedures (SSOP): SSOP are components of GMP that emphasize sanitation procedure. They include:

- Safety of water that gets in contact with food and food surfaces;
- Condition and cleanliness of food contact surfaces;

- Measures to prevent contamination;
- Employee hygiene practices;
- Control of employee health conditions that could result in contamination of food and food surfaces;
- Protection of food and food contact surfaces from adulteration with toxic and other harmful components.

Self-Check #2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List the types of equipment that cleans fruit and vegetable? (3pts)
2. Write HACCP pre-request program? (2pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Tools, equipment and machinery should be cleaned and sterilized according to the manufacturer's specifications, enterprise procedures and regulations.(2pts)

2. Cleaning reagent are materials used to remove dust, Pesticide and other residue found in fruit and vegetable in order to preserve it.

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 3- Selecting and adjusting machine setting

3.1 Selecting and adjusting machine settings

Selection of machine is the process of picking or choosing the right equipment which is most suitable for the production process. It is the process of interviewing the candidates and evaluating their qualities, which are necessary for a specific product and then selection of the equipment is made for the right positions.

The type of the machine and its parameters defines the list of available operations, the operations capabilities, the default parameters, as well as the subsequent behavior of the system.

Operator controlled single station industrial machines and high volume automatic and manually operated them, selvedge and embroidery machines.

Factors or Criteria (Principles) considered for selection of machines

The following factors or principles should be considered while selecting the food processing machine and equipment.

- Fruit_and_vegetable_processing_Requirements**:** The selection of machines and equipment must be based on the food requirements. Every machine used to food processing product should be suitable. selection of machine depends on the following
- **Cost_of_Machine**: The cost of benefits received from the machines should be more than the cost of the machines installed. Generally, the cost of the machine should be low.
- **Savings_of_Time_and_Energy**: The purchased machines should save the time of employees and their energy also. If so, the employees can do some other work fruitfully.
- **Life_of_machine**: The durability of the machines should be large. Short life machines should not be purchased at any cost.

- **Simple in Operation: Many machines require less skill. Besides, no machines lead to fatigue to the operators. Then, the operators may be trained effectively at less expense in short span of time.**
- **Quality: The purchased machines should be of good quality. If so, the work performed by them is also of good quality.**
- **Flexibility: A single machine can be used for many purposes. This will facilitate fullest use of the machine and the machine will not remain idle.**
- **Operating cost: The term operating cost includes the cost of supplies, cost of repairs and maintenance expenses, and the like. A machine with lower operating costs should be preferred.**
- **Portability: A portable machine is usually compact and occupies less space. It can be moved from one place to another or one user to other.**
- **Service: The machines** may be break down due to usage. Even though, such machines should be repaired at an early time. Besides, proper maintenance is also essential for continuous performance of office work. Hence, service facility is also considered.
- **Impact on Staff: The mechanization of office work has little impact on the staff. The existing staff may be required to get training to operate the machines and old employees may be requested to leave their job. The working place and the working atmosphere are also changed to some extent. There may be some chances in work routine.**
- **Fullest Use: The amount of use of the machine in relation to its cost should be considered before purchasing any machine. The machine must be put to the fullest use. If fullest use is not possible, the purchase of machine should be avoided.**
- **Style and Design**: The machines and equipment should be pleasing in design and color. The style of letters should be attractive to everyone.
- **Suppliers**: The integrity and regulation of the manufacturer of machines and equipment should be carefully considered before buying any machines. The guarantee period and after sales service of each machines are enquired.
- **Standardization**: Only standard machines and equipment should be purchased. If so, the following benefits are available.
    i. Less maintenance cost.
    ii. Easy and economical training of operators
    iii. Less depreciation.

iv. Useful for longer period.

The first step in selecting and adjusting food-processing equipment is a clear identification of the need.

3.2 Adjustment of machine

Regarding the definition of adjustment, optimal adjustment needs direct expression of functional requirement. Usually assembly and positioning are two functional studied requirements having a geometrical expression.

The concept of boundary translates cleverly the assembly condition. A part of amechan ism fits all the other parts if none of its manufactured points violates the interchangeability boundary.

Discretion and judgment may be required, for both self and others, in planning and selecting processes, procedures or outcomes. This adjustment machine must cover all maintenance, repair and adjustment functions associated with industrial fruit machines. In particular, skills associated with general engineering (fitting), electrical and electronic systems, and fluid power systems, may be required according to the nature of the set-up, repair or adjustment, and the workplace practices of a particular enterprise.

The openings of these barriers are determined by the movement of the stock. As the operator moves the stock into the danger area, the guard is pushed away, providing an opening which is only large enough to admit the stock. After the stock is removed, the guard returns to the rest position. This guard protects the operator by placing a barrier between the danger area and the operator. The guards may be constructed of plastic, metal, or other substantial material. Self-adjusting guards offer different degrees of protection. The point consider when fitting and adjusting machine component and related attachment

- Become familiar with the machine before the first operation. Read the manual that came with the machine
- Never leave the machine unattended while the engine is running.
- Do not fill the tank while the engine is running
- Keep all flammable materials (including dry straw) away from the engine
- Do not oil, grease, or adjust the machine during operation. Wait until all moving parts have stopped before servicing

- Do not wear loose fitting clothing that may be picked up by moving parts
- While operating, keep all shields and guards in place
- Never extend hands or feet into the feed opening of the machine
- Never operate your machine in a closed shed or garage. Exhaust fumes are dangerous to your health
- Do not operate machine with loose peg teeth, bolts and nuts. Loose peg teeth may be ejected at high speeds, causing injury to operators and damage to the thresher
- Keep a first-aid kit at hand
- Tie up long hair to prevent entangling
- Do not wear neckties or other garments that may be wrapped into moving parts of the machine

Self-Check #3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List at least five Principles considered for selection of machines (3pts)

2. Write the point consider when fitting and adjusting machine component and related attachment? (2pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Identifying equipment variation in the processing area is necessary to ensure accurate, reliable, and timely testing. (2pts)

2. This maintenance is the most technical, it requires advanced technical resources, and at times of strong mathematical, physical and / or technical knowledge (2pts)

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

Score = _____

Rating: _____

Information Sheet 4- Entering processing / operating parameters

4.1 Identifying processing / operating parameters

Fruit and vegetable processing trainee/technician must have the ability to plan, organize, prioritize, calculate and handle during processing

Operating parameters

- Pressure,
- Temperature,
- Flow rate.

The individual must possess reading, writing and communication skills. In addition, the individual must have personal and professional hygiene.

During operate primary processing of fruit and vegetable, enterprise work procedures describe how to do the various operations / tasks on primary processing of fruit and vegetable to be used is based on good practice. In some case these processers are handed down by 'word of mouth' but now in most large processing area the procedures are documented to ensure that all operators know what to do and that work is done using the correct procedures.

Processing parameters that are inherent to any machine operation and should have a suitable finite valuetosmooth and efficient removal of materials. Such parameters directly affect machine performance. Processing parameters include power or current applied to the heating element, weld pressure, peak temperature, and dwell time (time held at peak temperature or current, boiler pressure, energy, time, and velocity.

4.2 Types of processing

- Batch reactors/continuous reactor
- continuous stirred tank reactor
- plug flow reactor
- plug power/energy

4.3 Operating Conditions

Operating parameters of temperature, time, and pressure affect the properties of the finished part to a high degree.

Operating parameters must be adjusted to meet the requirement of the final product of interest.

Self-Check #4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List operating parameters in process operation? (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

2. Operating parameters of temperature, time, and pressure affect the properties of the finished part to a high degree.

   (2pts)

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Score = _____

Rating: _____

Information Sheet 5- Loading or positioning materials, ingredients or products

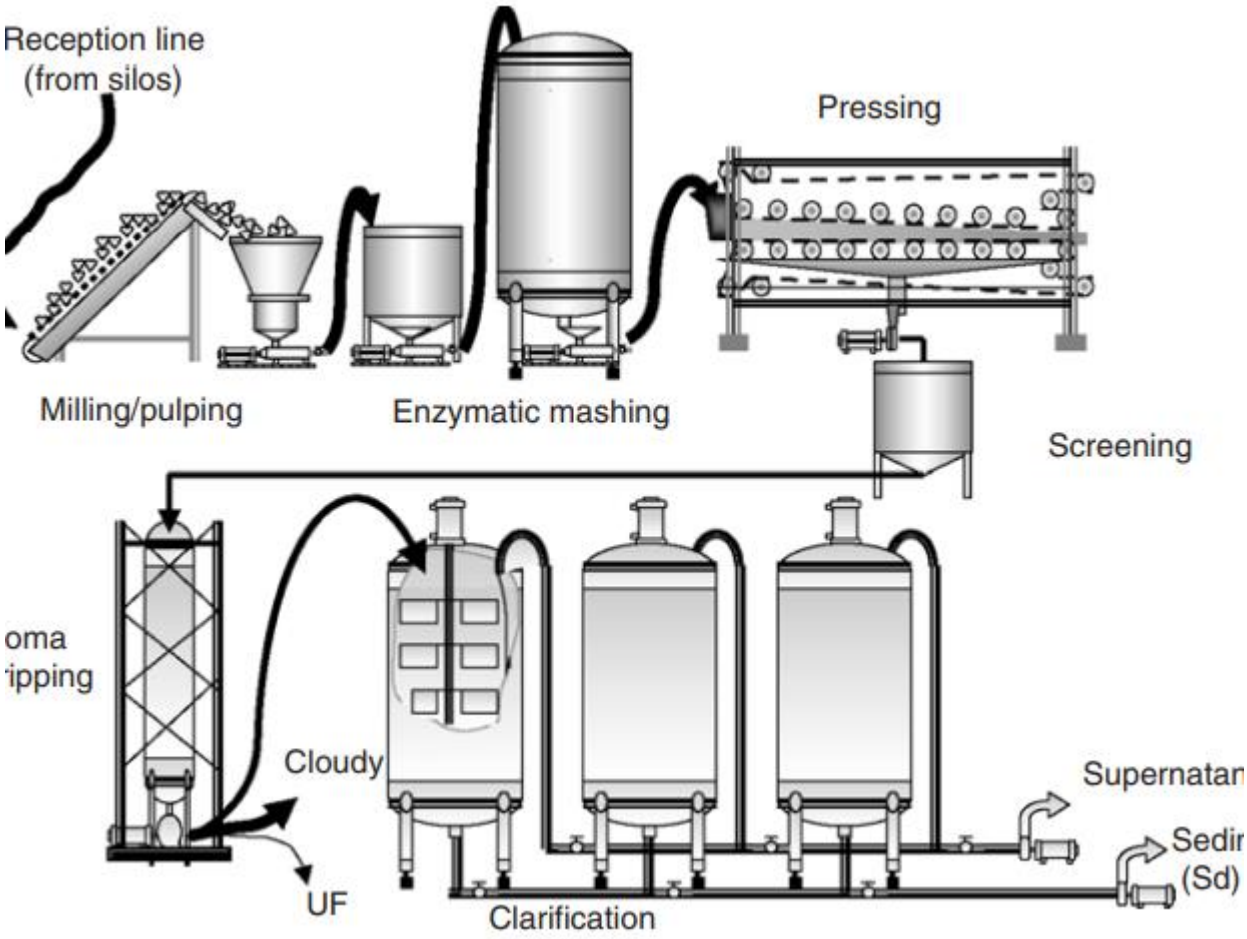
5.1 positioning of materials

Reception line

The ingredients and materials are fed into the processing machine. Unloading of fruits into silos system:

Harvesting containers known as bins are commonly used worldwide for transportation of fruits from the orchard to the processing plant. Up to 30 or more bins may be placed in a single truck. Once in the plant, bin dumping–unloading can be performed at least in three different ways, depending on the fruit sampling and laboratory testing: Other special tests are Magnus–Taylor pressure tester for pears and apples, and background color for peaches. .

Washing of fruit: The harvested fruit is washed to remove soil, microorganisms, and pesticide residues. Spoiled fruits should be discarded before washing in order to avoid contaminating the washing tools and equipment and the contamination of other fruits during washing. Washing efficiency can be estimated by the total number of microorganisms present on fruit surface before and after washing. Apples require heavy spray applications and rotary brush wash to remove any rot. Many fruits such as mechanically harvested berries are air cleaned on mesh conveyors or vibrators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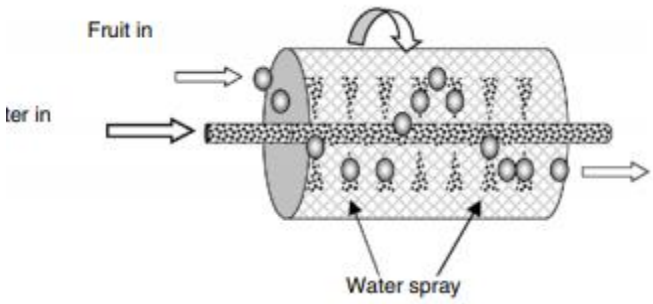
Fruit in
ter in
Water spray

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Self-Check#5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

3. List the important of monitoring processing operation? (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Monitoring is a process of determining how well our plans are being implemented. (1pts)

2. Personnel allocated to quality control need a very good understanding of the quality and quality control of raw material to be processed. (1pts)

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Score = _____

Rating: _____

Information Sheet 6- Carrying out pre- start checks

Introduction

It is important to carry out a series of checks before using a piece of machinery. This is particularly important in situations in which a number of people use the same machine. Larger companies and organizations usually have a system of checks, and a maintenance department that will deal with reported defects. Individuals working alone or in small teams will be responsible for checking and maintaining their own machines. Operator should be able to follow a checklist to ensure that they complete all the necessary checks.

6.2 Pre-Start-Up Check procedures

- Corrosion resistant materials are used for all equipment from the supply source to the membrane including piping, vessels, instruments and wetted parts of pumps
- All piping and equipment is compatible with designed pressure
- All piping and equipment is compatible with designed pH range (cleaning)
- All piping and equipment is protected against galvanic corrosion
- Media filters are backwashed and rinsed
- New/clean cartridge filter is installed directly upstream of the high pressure pump
- Feed line, must be purged and flushed, before pressure vessels are connected.
- Chemical addition points are properly located
- Check/anti-siphon valves are properly installed in chemical addition lines
- Provisions exist for proper mixing of chemicals in the feed stream
- Dosage chemical tanks are filled with the right chemicals.

Self-Check#6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

2. List the pre-start up procedure? (5pts)

Note: Satisfactory rating - 5 points Unsatisfactory - below 9 points

Score = _____

Rating: _____

Information Sheet 7- Checking and adjusting equipment performance

Measuring machinery health by performance monitoring has the potential to give warning of a developing failure through the changing levels of a suitable parameter being measured, thereby indicating a change in condition of a component, machine or system.

- Equipment performance monitoring.
- Equipment condition assessment.
- Equipment health monitoring

7.1 Condition Monitoring and Process Analysis

Most machine and process characteristics which affect

- availability
- capacity
- quality
- safety
- Risk and cost can be continually evaluated throughout an asset's lifetime.

This is essential in identifying impending failure and will be applied to critical areas identified in the reliability plan. The current state-of-health of process plant is important information related to current information, diagnosis and prognosis of various defects, and predicted useful life in the optimization of safety, quality and high production rates. There are the obvious functions of monitoring and controlling the process for reasons of safety and product specification. Additionally, there is invaluable information to be gained from the process parameters that can give an understanding of the current health of the asset.

7.2 Checking Equipment Performance

Equipment's for which Performance Monitoring surveys may be required on a routine basis include the following items:

Poor operational practice is also one of the main causes of problems on treatment plants. It is imperative that operators understand why they are performing certain tasks and what the consequences are if the tasks are not carried out as prescribed. It is the

responsibility of a treatment plant manager to ensure appropriate training of the operating staff.

Lack of maintenance is the most common reason for plant failure. Mechanical equipment requires regular attention to ensure problem-free operation. Maintenance schedules must be strictly carried out. Good housekeeping and keeping equipment, buildings and civil structures clean and tidy go a long way to minimize operational problems. Work area, materials, and equipment are routinely monitored to ensure compliance with purification requirements.

Materials handled and stored need to be monitor can include:

- .Gather the tools to clean in the designed area for cleaning.
- Segregate the tools according to the kinds of dirty they have.
- Submerge the tools in the washing pan.
- Use paint brush to remove the dirty from the tools.
- Get the tools from the washing pan and wipe them with rags until dart.
- Clean and keep all materials used for cleaning.

Self-Check #7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

4. List the checks in equipment performance? (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

3. List the indication of a change in condition of a component, machine or system. (3pts)

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Score = _____

Rating: _____

Information Sheet 8- Making equipment ready and safe to operate

8.1 Equipment Maintenance

Equipment shall be maintained as specified in the technical procedure. Critical equipment shall have documented procedures for the maintenance process. Maintenance procedures and frequencies, either in the form of vendors' manuals or in-house procedures, shall be available for each piece of equipment. The operating and maintenance manuals shall be readily available to the operator. In the absence of manufacturer's Instructions, Instructions shall be provided in the technical procedure. Preventative maintenance procedures (other than basic cleaning) for each equipment item shall be developed by each Section unless already described elsewhere (e.g., the equipment manual) and shall be performed according to a regular, predetermined schedule. Preventive maintenance shall be documented in the maintenance records.

8.1.1 Maintenance Records

Maintenance records shall be maintained and shall include:

- Type of equipment.
- Equipment serial number or unique identifier.
- Date of maintenance.
- Adjustments or repairs made.
- The identity of the individual performing maintenance.

If maintenance is performed by an outside vendor on a lab-wide basis (e.g., microscope maintenance), the quality manager(QA) Manager or designee shall retain the original maintenance records provided by the vendor.

When a piece of equipment is retired from service, maintenance and repair records shall be incorporated into the Section archives by the Forensic Scientist Manager or designee.

8.1.2 Out of Service Equipment

Equipment that has been subjected to overloading or miss handling, gives suspect results or has been shown to be defective or outside specified limits, shall be taken out of service. It shall be isolated and/or clearly labeled (Out of Service – Do Not Use) to prevent use until repaired and shown by calibration or test to perform correctly.
Prior to returning a piece of equipment to use (out of service for any reason – e.g., maintenance, malfunction, leaving the direct control of the Laboratory), the correct operation shall be demonstrated by calibration or performance verification.

Laboratory personnel shall examine the effect(s), if any, of a malfunction on analysis results and implement the Procedure for Corrective Action as required.
An exception may be made if the equipment failure is not directly related to its analytical function, such as a problem with peripheral equipment.

Quality Control Checks

Quality control checks may be carried out at appropriate intervals to verify that equipment is functioning as expected. The procedures for quality control checks shall be included in the technical procedure for which the equipment is being used.

Correction Factors: where calibrations give rise to a set of correction factors, the Section shall ensure that software is updated with these correction factors.

Safeguards: the quality assurance Manager/Supervisor shall designate the personnel (Equipment Monitor) responsible for equipment calibration, maintenance (including outside vendors used for these services).

8.2 Equipment Calibration and Verification

Quality assurance Managers/Supervisors shall include procedures for calibration and/or performance verification of new equipment in Section technical procedures. Calibration procedures shall be appropriate for the intended use of the equipment and shall provide criteria for determining if calibration is satisfactory.

Manufacturer operating manuals shall be consulted to determine the correct calibration interval. Equipment which requires calibration shall not be used if satisfactory calibration cannot be achieved or the calibration date has passed. Equipment used infrequently, such that the manufacturers' recommendations cannot be followed, shall have calibration verified prior to use. Prior to being used in testing, new equipment (or any piece of equipment which leaves the control of the Laboratory) shall undergo calibration procedures or performance verification.

Calibration records shall be maintained and associated with the unique identifier of each piece of equipment. These records shall include:

- The identity of the item of equipment and software.
- Name of manufacturer.
- Serial number or unique identifier.
- Date of calibration.
- Current location.
- Manufacturer's instructions or a reference to location.
- The reference standard certified reference material or reference material used for calibration.
- Copies of all reports, results of calibration, and/or certificates of calibration.
- A maintenance plan and due date for the next calibration.
- The identity of the individual performing calibration.

When external calibrations are performed, service providers that demonstrate competence, measurement capability, and traceability shall be used. Calibration certificates from these providers shall contain the measurement results, including the measurement uncertainty and/or a statement of compliance with an identified metrological specification. If calibrations are performed by an outside vendor, the Section document control custodian shall maintain the original calibration records provided by the vendor and a copy of the relevant records shall be readily available.

Laboratory equipment requiring calibration shall be labeled or coded to indicate the calibration status, including the date when last calibrated and the due date for recalibration (or expiration criteria for when recalibration is due).

Self-Check#8	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Write true if the statement is correct and false if the statement is incorrect

1. All out-of-specification equipment must be clearly identified, rectified, and reported to prevent unauthorized release.(2pts)

2. Calibration records shall be maintained and associated with the unique identifier of each piece of equipment. (2pts)

3. Laboratory equipment requiring calibration shall be labeled or coded to indicate the calibration status. (2pts)

Note: Satisfactory rating - 6 points Unsatisfactory - below 6 points

You can ask you teacher for the copy of the correct answers

Score = _____

Rating:

LG #34	LO #2 Operate and monitor the production system

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Starting up and operating the system
- Monitoring system equipment components
- Identifying Variation in equipment operation and reporting maintenance requirements
- Monitoring production system
- Identifying, rectifying and reporting out –of- specification product
- Maintaining work areas
- Conducting work

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- The system is started up and operated according to company procedures.
- System equipment components are monitored to identify variation in operating conditions.
- Variation in equipment operation is identified and maintenance
- Requirements are reported according to workplace reporting requirements.
- The production system is monitored to confirm that production met specification.
- Out-of-specification product/process outcomes are identified, rectified and/or reported to maintain the process within specification.
- The work area is maintained according to housekeeping standards.
- Work is conducted in accordance with workplace environmental guidelines

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet-1	Starting up and operating the system

1.1 **Preliminary Checks:** Before starting the machine, carry out the following checks:

- Check that the machine has been thoroughly washed and cleaned.
- Check that the inlet and outlet pipes to/from the processing operations have been connected to each corresponding unit operations.
- Check that the power cable from the mains supply is connected correctly.
- Check that all the guards are in their safety positions
- Check that all the machine panels are fixed securely to the frame.

1.2 **START-UP**

To start the machine, proceed as follows:

a. Switch on power to the machine by turning the main switch to the "ON" position.

b. Start the in-line process by pressing luminous button.

c. Start feeding fruit and vegetable to washer to keep production losses down to a minimum, wait until the juice leaving the packaging pipe has reached the desired consistency

Self-check #1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. List the preliminary checks in operating system ?(5pts)
2. List start up procedure to start the machine ? (5pts)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet-2	Monitoring system equipment components

2.1 Monitoring system equipment

Monitoring systems are responsible for controlling the technology used by a company (hardware, networks and communications, operating systems or applications, among others) in order to analyze their operation and performance, and to detect and alert about possible errors.

Monitoring is an important part of advanced manufacturing systems. It should play a crucial role in ensuring agility of manufacturing system and efficiency of control and management.

The number and position of the points in the manufacturing process (including the procurement of raw materials) that should be monitored will also vary according to the assessment of potential hazards if at that point the process deviates from the norm. The points to be monitored will depend on the nature of the product and process as well as the resources available.

The frequency and places of monitoring should be selected jointly by the quality control and production staff. The procedure for establishing the quality control regime is sometimes based on the hazard analysis critical control point (HACCP) concept.

The traditional emphasis of the HACCP concept has tended to be the control of microbiological hazards but the concept is applicable to monitoring other attributes of the product that may determine its acceptability, e.g., net weight, drained weight or composition of the product. The selection of critical control points should be reviewed at regular intervals and changed if experience shows that the system could be made more effective; monitoring of some points may be discontinued or the frequency of monitoring may be changed. In many instances the critical points will already be staffed and under the supervision of production staff. The HACCP concept should therefore be used as a guide for obtaining maximum benefit from the available resources for quality control.

Self-Check#2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Monitoring is an important part of advanced manufacturing systems. (2pts)

2. The HACCP concept should therefore be used as a guide for obtaining maximum benefit from the available resources for quality control.(3pts)

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet-3	Identifying Variation in equipment operation and reporting maintenance requirements

3.1 Identifying variation

Identifying equipment variation is one of the essential elements of a quality management system. Identifying equipment variation in the processing area is necessary to ensure accurate, reliable, and timely testing. The benefits of Identifying equipment variation program are many:

- Helps to maintain a high level of equipment performance;
- Reduces variation equipment, and improves the technologist's confidence in the accuracy of testing results;
- Lowers repair costs, as fewer repairs will be needed for a well-maintained instrument;
- Lengthens instrument life;
- Reduces interruption of services due to breakdowns and failures;
- Increases safety for workers;
- Produces greater customer satisfaction.

3. 2 Types of maintenance

Five types of maintenance have been distinguished, which are differentiated by the nature of the tasks that they include:

- Corrective maintenance: The set of tasks is destined to correct the defects to be found in the different equipment and that are communicated to the maintenance department by users of the same equipment.

- Preventive maintenance: Its mission is to maintain a level of certain service on equipment, programming the interventions of their vulnerabilities in the most opportune time. It is used to be a systematic character, that is, the equipment is inspected even if it has not given any symptoms of having a problem.

- Predictive maintenance: It pursues constantly know and report the status and operational capacity of the installations by knowing the values of certain variables, which represent such state and operational ability. To apply this maintenance, it is necessary to identify physical variables (temperature, vibration, power consumption, etc.).

- Zero hours Maintenance (overhaul): The set of tasks whose goal is to review the equipment at scheduled intervals before appearing any failure, either when the reliability of the equipment has decreased considerably so it is risky to make forecasts of production capacity. This review is based on leaving the equipment to zero hours of operation, that is, as if the equipment were new. These reviews will replace or repair all items subject to wear. The aim is to ensure, with high probability, a good working time fixed in advance.

- Periodic maintenance (Time Based Maintenance TBM): the basic maintenance of equipment made by the users of it. It consists of a series of elementary tasks (data collections, visual inspections, cleaning, lubrication, retightening screws) for which no extensive training is necessary, but perhaps only a brief training. This type of maintenance is the based on TPM (Total Productive Maintenance).

3.3 Reporting maintenance requirement

Each piece of equipment which required maintenance should have reported to the concerned person/supervisor/ manufacturer.

Documenting and reporting all maintenance elements characteristics should include:

- Preventive maintenance activities and schedule;
- Recording of function checks and calibration;
- Any maintenance performed by the manufacturer;
- Full information on any problem that the instrument develops the subsequent troubleshooting activity, and follow-up information regarding resolution of the problem.

In recording problems, be sure to record:

- Date problem occurred and when equipment was removed from service;

- Reason for breakdown or failure;
- Corrective action taken; including a note about any service provided by the manufacturer; date returned to use;
- Any changes to procedure for maintenance or function checks as a result of the problem. Some of the tools that are helpful for keeping records on equipment management are: charts, logs, checklists, graphs, service reports.

Self-Check #3	Written Test

Name……ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions.(10 points)

1. List documenting and reporting maintenance elements characteristics?(5pt)

2. List the benefits of Identifying equipment variation program?(5Pt)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

Information Sheet-4	Monitoring production system

4.1 Introduction

Production function is that part of an organization, which is concerned with the transformation of a range of inputs into the required outputs (products) having the requisite quality level. Production may be understood as “the step-by-step conversion of one form of material into another form through chemical or mechanical process to create or enhance the utility of the product to the user.

Thus production is a value addition process. In any manufacturing enterprise, the main objective of production department is to produce the things in desired quantity at desired time so that they may be made available to end users when they demand it. Production, being a very complex process is very difficult to manage for the people. This includes a large number of activities and operations which need to be planned appropriately and in turn controlled for the effective production of the output.

The main purpose of production planning and control (PPC) is to establish routes and schedules for the work that will ensure the optimum utilization of materials, workers, and machines and to provide the means for ensuring the operation of the plant in accordance with these plans. There are different types of production systems.

The choice of production system depends upon the nature of products, variety of products and volume of products. Production planning and control is necessarily concerned with implementing the plans, i.e. the detailed scheduling of jobs, assigning of workloads to machines (and people), the actual flow of work through the system. Production is an organized activity of converting row materials into useful products. Production system requires the optimal utilization of natural resources like men, money, machine, materials and time.

Production planning and control coordinate with different departments: such as production, marketing, logistics, warehouse and other departments depending upon the nature of organization. Production planning and control receives data related to orders from marketing departments. Production plan based on marketing and production data is

prepared in production planning and control. This production plan provides clear idea about utilization of manufacturing resources for production. Prepared production plan is delivered to production department. Production department manufacture products according to that plan. The ultimate objective of production planning and control, like that of all other manufacturing controls, is to contribute to the profits of the enterprise. As with inventory management and control, this is accomplished by keeping the customers satisfied through the meeting of delivery schedules. The main objectives of PPC may be summarized as followings:-

a) It is used to establish target and check the deviations by comparing on some performance measures.

b) Decides the nature and magnitude of different input factors to produce the output.

c) Coordinates different resources of production system in the most effective and economic manner and to coordinate among different departments.

d) Elimination of bottleneck

e) Utilization of inventory in the optimal way

f) Smooth flow of material

g) To produce in right quantity and quality at right time

h) Scheduling production activities to meet delivery schedule

i) Expediting the system under production

j) To ensure flexibility in production system to accommodate changes and uncertainty

k) Optimizes the use of resources for minimum overall production cost

l) To ensure the production of right product at right time in right quantity with specification rightly suited to customers

m) Stable production system, with least chaos, confusion and undue hurry.

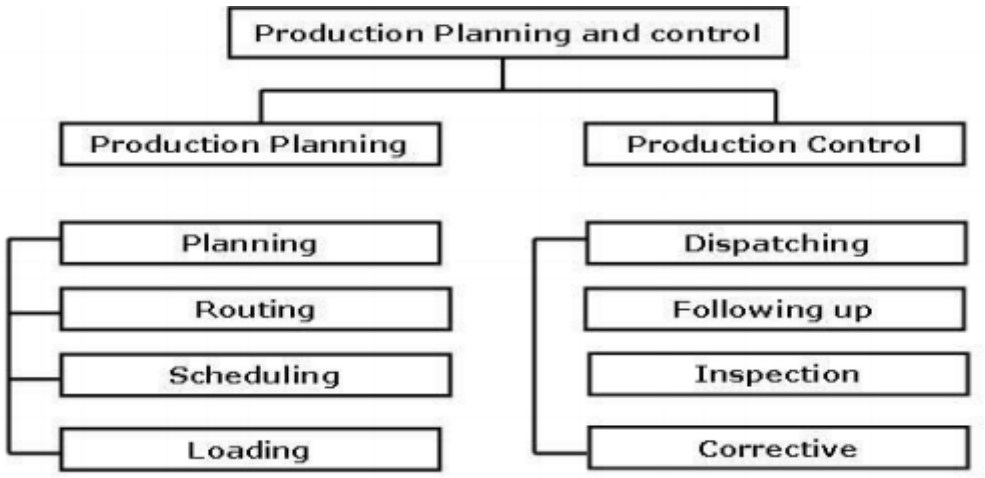

Figure 2 monitoring system of production

a) Scheduling: is the timetable for manufacturing activities.

b) Estimating: is a process of setting operation times after fixing standards both for worker and machines

c) Loading: is the process of converting operation schedule into practices.

d) Routing: is the process of determining the flow of work material handling in the plant, and sequence of operations

e) Loading: machine loading is the process of converting operation schedule into practices in conjunctions with routing. Machine loading is the process assigning specific jobs to machines, men, or work centers based on relative priorities and capacity utilization. Loading ensures maximum possible utilization of productive facilities and avoid bottleneck in production. It's important to either overloading or under loading the facilities, work centers or machines to ensure maximum utilization of resources.

f). Scheduling: scheduling ensures that parts and sub-assemblies and finished goods are completed as per required delivery dates. It provides a timetable for manufacturing activities. Dispatching: This is concerned with the execution of the planning functions. It gives necessary authority to start a particular work which has already planned under routing and scheduling functions. Dispatching is release of orders and instructions for starting of production in accordance with routing sheet and scheduling charts.

g) Inspection: This function is related to maintenance of quality in production and of evaluating the efficiency of the processes, methods and labours so that improvement can be made to achieve the quality standard set by product design.

Self-check#4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What is scheduling? (5 point)
2. List the main purpose of production planning and control.?(5pt)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-5	Identifying, rectifying and reporting out –of-specification product

2.1 Introduction

All out-of-specification products must be clearly identified, rectified, and reported to prevent unauthorized release. Identifying, rectifying and reporting of out-of-specification adhere to the following guidelines for control of non-conforming product.

- Specific individuals should be responsible for decisions pertinent to nonconformance, release, rework, or destruction of product.
- Products that are reported as non-conforming (undesirable particle size; present of on products mould, spoilage, micro-organim, over and under matured, un-recommended moisture content and etc.)
- Clearly label and isolate “on hold” products so that they are not accidentally released.
- Products should only be released after necessary controls are made and specification limits are achieved.
- If non-conformance does not affect the use or safety of the product, then corrective action completes the response.
- If non-conformance affects the safety of the product, recall is initiated with management approval.
- Until the recall is completed, products from the same lot cannot be shipped and must be quarantined.
- Determine the corrective action required to eliminate non-conformance of future product, i.e., through re-work or other means. Upon completion, re-check the quality of the product to ensure the elimination of the non-conformance and seek approval for shipment.
- Document any destruction/disposal of non-conforming product.
- Where customer-branded products not meeting specifications are sold to staff or passed on to charities, this shall be with the prior consent of the brand owner, and shall be fit for consumption, meeting the legal requirements.

- When a quality defect is found and documented, the technician assumes the third role of quality control, which is to report the defect.

This function usually contains four parts:

- ✓ Notification to others of the defect;
- ✓ Follow-up to make sure the defect does not occur again;
- ✓ Documenting how the problem was fixed; and
- ✓ Changing the processing specification as needed.

Equipment should not be used for both treated and untreated products without adequate cleaning and disinfection before use with treated products. Persons handling raw materials or semi-processed products capable of contaminating the end-product should not come into contact with any end-product unless and until they discard all protective clothing worn during the handling of the material at earlier stages of the processing and have changed into clean protective clothing.

Hands should be washed and disinfected thoroughly before handling products at different stages of processing. Out of specification such off flavor, contaminated, discolored products should be report to responsible person. Inspecting fresh produce throughout the processing stream for field contaminants, this may not have been noticed during the incoming produce. Removing from the processing stream damaged or decomposed produce, extraneous matter, and produce that appears to be contaminated by animal feces, fuel, machine grease or oil.

5.2 Out of specification out comes

The term out of specifications, are defined as those results of in process or finished product testing, which falling out of specified limits. The out of specifications (OOS), may arise due to deviations in product manufacturing process, errors in testing procedure, or due to malfunctioning of analytical equipment. When an out of specifications (OOS) has arrived, a root cause analysis has to be performed to investigate the cause for OOS. The reasons for OOS can be classified as assignable and non-assignable.

When the limits are not in specified limits it is called out of specifications. When OOS has occurred, the analyst should inform to quality control (QC) manager. Each out of specification will be identified with a unique identification number.

The OOS investigation involves 2 phases:

Phase I: (laboratory investigation)

The purpose of the laboratory investigation is to identify the cause for OOS result. The reason for the OOS may be defect in measurement process or in manufacturing process. Irrespective of the rejection of batches, the OOS results must investigate for their trend. The investigation can be done to only those batches that are resulted in OOS, or also to other batches and even other products associated with OOS. The OOS investigation should be thorough, timely, unbiased, well documented and scientifically sound.

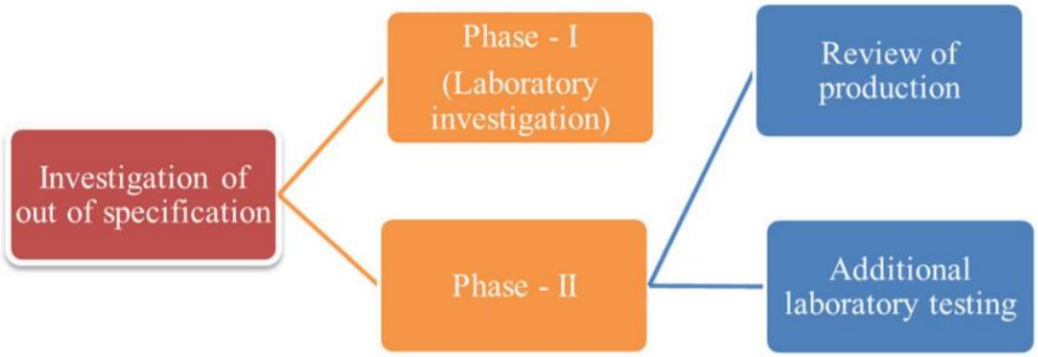

Figure 5. Investigation of out of specification result

Phase II investigation

When there is no possible outcome has obtained from the phase I investigation, the phase II investigation should be commenced in context to investigate the errors occurred in manufacturing processes, sampling procedures along with other additional laboratory testing.

Self-check# 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Write true if the statement is correct and false if the statement is incorrect

1. All out-of-specification products must be clearly identified, rectified, and reported to prevent unauthorized release. ? (5 point)
2. The term out of specifications, are defined as those results of in process or finished product testing, which falling out of specified limit.?(5pt)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-6	Maintaining work areas

6.1 Maintaining work area according to housekeeping standards

Good housekeeping is the foundation of a safe, healthy and pleasant workplace. It is essential that all areas be kept clean, orderly, and with all necessary things in the proper places. Employees should be aware of hazards arising from poor housekeeping. Good housekeeping improves safety, efficiency and quality at the same time.

- **Housekeeping activities**
  - ✓ Keep work areas neat and clean.
  - ✓ Place tools, equipment and supplies in their correct places.
  - ✓ Implementing cleaning schedules for the area
  - ✓ Removing wrapping and packaging waste
  - ✓ Storing all product as soon as possible after delivery
  - ✓ Remove potential hazards
  - ✓ Keep the area clear for future deliveries
  - ✓ Keeping stores area well and ventilated to deter pests and allow for easy identification of product items and problem issues
  - ✓ Keeping shelves, benches, pallets, bins and other storage containers in good order and inspecting the area and fittings on a regular basis for signs of damage or deterioration or other problems such as stability, security and pest infestation
  - ✓ Maintaining all equipment and storage areas in accordance with the relevant occupational health and safety requirements.
  - ✓ Checking the temperature of refrigerated food storage areas
  - ✓ Initiating preventative maintenance servicing for plant and equipment in the stores area before servicing them
  - ✓ Developing and implementing a proper cleaning schedule for the stores areas including ensuring supplies of all necessary chemicals and equipment exist to get the job done

Self-check# 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

3. What is the good housekeeping? (5 point)
4. List at least 5 housekeeping activity/guideline?(5)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-7	Conducting work in accordance with environment

Conduct work in accordance with environmental policies and procedures.

The maintenance of cleanliness in a working area requires frequent or continuous cleaning as well as a clean-up at the end of each day. The purpose of this is to keep waste from accumulating during the operating day. It involves:

- careful organization
- training work scheduling and
- the best available equipment
- Method and materials.

Hazard Analysis Critical Control Point (HACCP): HACCP allows processors/regulator to look at what happens during the process to ensure safety.

Major Concepts of HACCP

1. A preventive system of control particularly on biological hazards
2. A system approach for estimating the risk in producing a food product
3. Universally recognized system as the most effective way to prevent food borne illness
4. Science - based systematic, identified specific hazards and measures for their control to ensure food safety
5. Capable of accommodating change, such as advances in equipment design, processing procedures, or technological developments that can be applied throughout the food chain from the primary producer to the final consumer
6. Applicable to establishments that produce, process, treat, pack, trade, transport, serve, or involve in food production.

Self-check #7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What is the purpose of conducting work environment to keep waste from accumulating during the operating day?(5pt)

2. List major Concepts of HACCP?(5pt)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Score = _____

Rating: _____

LG #13	LO #3 Hand over production system operation

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics;

- Maintaining workplace records.
- Carrying out handover.
- Awaring process operators system and related equipment status.

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to;

- Workplace records are maintained according to workplace recording requirements.
- Handover is carried out according to workplace procedures.
- Process operators are aware of system and related equipment status at completion of handover.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet-1	Maintaining workplace records

Records will be specified in the organization's record keeping processes and procedures and include one or more of the following:

- Hard copy, such as documents, images, reports and forms.
- Electronic, such as documents, images, reports, forms, databases and spreadsheets.
- Physical, such as samples of products or materials.

1.1. Requirement of recording work place information

Any record keeping system should be accurate, reliable, easy to follow, consistent as to the basis used and be very simple. Good record keeping is vital in regards to meeting the financial commitments of the business and providing information on which decisions for the future of the business can be based.

Records contain information that is needed for the day-to-day work of government and None governmental organization (NGO). Their purpose is to provide reliable evidence of, and information about, 'who, what, when, and why' something happened. In some cases, the requirement to keep certain records is clearly defined by law, regulation or professional practice.

1.1.1 Process and record workplace information: -

- Collect information. In a timely manner and ensure that it is relevant to organizational needs.
- Process workplace information. Use business equipment/technology to process information in accordance with organizational requirements.
- Maintain information systems.

1.2 Maintaining workplace record

Accurate records are essential for evaluating your primary processing performance. Accurate analysis requires accurate data. Operational/ workplace records about products and practices can be helpful to firms. First, such records help ensure consistency of production/washing, grading, peeling, slicing and chopping processing operations and end-product quality and safety. They are more reliable than human memory and serve as a useful tool to identify areas where inconsistencies occur in operations and corrective actions or employee training may be needed.

Furthermore, maintaining adequate documentation and records could assist in identifying or ruling out potential contributing factors of contamination if product implicated in an outbreak is traced to a particular farm or facility. Every workplace is different and requires different types of information to keep it running smoothly, efficiently and profitably. Different primary processing operation of fruit and vegetable and by using different types quality raw materials should be recorded for future use as reference. Workplace records in operating cutting, peeling, slicing and chopping of fruit and vegetable include:

- Quantity of raw material
- Quantity control of raw material
- Primary processing condition
- Employee training records
- Equipment monitoring and maintenance records
- Calibration records
- Sanitation records
- Product processing batch records
- Corrective action records
- Pest control records
- Distribution records
- Inspection records (e.g., incoming product, facility, production area)
- Microbiological contamination records (e.g., food contact surfaces, equipment)

Self-check# 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What are organization's record keeping processes and procedures?(2pt)
2. List process and record workplace information? ?(3pt)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-2	Carrying out handover

2.1 Over view of handover

Handover is a process not a date. Planning for it should be from the start of the project and it should be viewed as an incremental transfer of knowledge and operation from project team to business-as-usual. The benefits and deliverables must be measurable and communicable from the start. When are you leaving a position, it is likely that your manager or supervisor will ask you to help in the handover period to your successor. Being organized and proactive will help to ensure that your company has a smooth transition and you leave with an excellent professional reputation. Effective communication is important in all organizations when a task and its associated responsibilities are handed over to another person or work team.

- Identify higher risk handovers;
- Develop staff's communication skills;
- Emphasize the importance of shift handover;
- Provide procedures for shift handover,
- Plan for maintenance work to be completed within one shift if possible.

2.1.1 Shift handover should be

- Conducted face-to-face;
- Two-way, with both participants taking joint responsibility;
- Done using both verbal and written communication;
- Based on an analysis of the information needs of incoming staff;
- Given as much time and resource as necessary.

✓ **Improvements should also be made by:**

1. Designing support equipment, such as logs and computer displays, with consideration of the operator's needs;
2. Involving the end-users when implementing any changes to existing communication methods at shift handover.

2.1 Importance of handover

The goal of handover is the accurate reliable communication of task-relevant information across shift changes or between teams thereby ensuring continuity of safe and effective working. Effective handover consists of three elements:

- ✓ A period of preparation by out-going personnel;
- ✓ Handover where out-going and in-coming personnel communicate to exchange task-relevant information; and
- ✓ Cross-checking of information by in-coming personnel as they assume responsibility for the task.

Many accidents have occurred because of failure of communication at shift handover, the majority of these involved planned maintenance work. The Cullen Report concluded that one of the many factors that contributed to the Piper Alpha disaster was failure of information transmission at shift handover.

Handover Notes includes: -

- A description of your daily tasks and processes.
- Key day-to-day activities.
- Access to all relevant spreadsheets and files.
- Project deadlines and status updates.
- A list of key contacts – customers, clients, stakeholders, managers.
- Any ongoing issues affecting projects. on the other hands, performing a handover using the widely accepted and universally recognized. While handing over manufacturing operations involves:
  - ✓ Preparation of area, equipment and materials for handover,
  - ✓ Cleaning tools and equipment when required,
  - ✓ Confirming the status of the area, equipment and materials for handover,
  - ✓ Handing over of manufacturing operations,
  - ✓ Completing any necessary documentation,
  - ✓ Working in ways which maintain the safety of yourself and others

Self-check#2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What are handover Notes includes?(5 point)
2. List effective handover elements ?(5pt)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-3	Awaring Process operators about the system and related equipment status.

5.1 Awaring Process operators

Awaring process opratoters is a way of exchanging information about system of production and equipment status between operators. These information's are about

- maintenance of equipment
- raw material reception status
- cleaning condition in production system
- processing equipment status
- processing operation status
- product quality and quantity
- packaging materials
- processing parameters

Self-check#3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What are things that awaring Process operators? (5 point)
2. List at least 5 information's in awaring Process operators ?(5)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

LG #13	LO#4 Shut down the production system

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics;

- Identifying shutdown procedures
- Shutting down the system
- Identifying and reporting maintenance requirements.

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to;

- The appropriate shutdown procedures are identified.
- The system is shut down according to workplace procedures
- Maintenance requirements are identified and reported

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand. What are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet-1	Identifying shutdown procedures

1.1. Procedure of shutdown

Before shut down the system the remaining residues that found in the pipes must be rinse by water and collect.

Shut down/isolation means and includes isolation of mechanical, electrical drives, pipe work (pressure) rotating equipment etc. utilizing electrical lock-off isolators, mechanical and power driven valves etc. in accordance with standard operating instructions.

Relevant regulations:

The procedure to successful shut down equipment/machine

Following the steps outlined below will help ensure that equipment / machine next outage will be successful

Step 1: Checklist with every piece of equipment involved in the outage should be available for review.

Step 2: Machine/equipment operational function is determined and understood.

Step 3: Shut-down sequence is undertaken safely and to standard operating procedures.

Step 4: Machine/equipment is depressurized/emptied/de-energized/bled to standard operating procedures.

Step 5: Safe shut-down of machine/equipment is verified.

Step 6: Safety/security lock-off devices and signage are installed to standard operating procedures.

Step 7: Machine/equipment is left in clean and safe state.

Self-check#1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. List the procedure to successful shut down equipment/machine? (5 point)
2. what must be done before shut downing machine?(5)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-2	Shutting down the system

2.1 Shut down the process

The washer, crusher, blancher and heat exchanger operation in fruit and vegetable raw material processing machine should be shut down after completion of work every day according to the standards and procedures of the industry. Cleaning and sanitizing steps are listed below:

- Remove heavy and wet clean processing equipment, if needed
- Pre-rinse the equipment with adequate quality water
- Clean remaining debris from juice
- Rinse juice and residues with adequate quality water using a low pressure hose
- Use dedicated brushes to scrub juice and drains with an effective cleaner, applying adequate quality water as needed
- Foam and scrub the equipment with an effective cleaner and scrub using dedicated brushes
- Thoroughly rinse the equipment, juice and drains with adequate quality water using a low pressure hose
- Sanitize (according to manufacturer directions) the equipment and remained juice from top down for cleaning and sanitizing activities.

Self-check# 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. List the cleaning and sanitizing steps? (5 point)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-3	**Identifying and reporting maintenance requirements.**

3.1 Identifying maintenance

Preventive maintenance is done before a failure occurs and consists of maintenance types like:

- Time based maintenance,
- Failure finding maintenance,
- Risk based maintenance,
- Condition based maintenance and
- Predictive maintenance.

Major maintenance shutdowns can be stressful for both maintenance and operations personnel, but with careful planning and attention to details, they can also be very rewarding.

The events relevant to the topic were classified according to the following categories or groups:

- Plant status
- Type of maintenance
- Method for detection of event
- Affected system
- Affected component
- Direct cause
- Root causes
- Corrective actions
- Effect on safety

3.2. Reporting maintenance requirements

The report shows maintenance details of each event in the time range, including the Setup/Take down Time, Instructions, Event Time, Facility, Event, ID (Rental, Contract or Event), Service, and Customer.

- **Steps Maintenance Report in micro soft (MS) Word**
  - ✓ Create the Cover Page. Open a new document in MS Word and write the title
  - ✓ Cover Letter. On the next page, include the cover letter
  - ✓ Device Information.
  - ✓ New Parts Cost Details
  - ✓ Suggestions and Signature.

Self-Check# 3	Written test

Name…… ID…… Date…

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: give short answer (5)

1. List the information should be included in reporting maintenance requirement

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Note: **Satisfactory rating 2.5 points** **Unsatisfactory - below 2.5 points**

LG #13	LO#5 Contribute to continuous improvement of the production system

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics;

- Reviewing system performance against the targets.
- Identifying and investigating Opportunities for system improvement.
- Developing and implementing proposals.

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to;

- System performance is reviewed against output plan/targets
- Opportunities are identified and investigated for system improvement
- Proposals are developed and implemented for improvement within company planning arrangements, authority levels and according to company procedure

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand. what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet-1	Reviewing system performance against the targets

1.1 Continuous Follow-Up of Performance

Evaluation and follow-up are often used synonymously by manufacturing companies. When a new production system is implemented, the system is evaluated and production is running as required, measurement is carried out to follow-up the production performance. Continuous evaluation of the production system in operation is often called follow-up, which refers to measures and methods for continuous control and management of production systems. Productivity and efficiency are often used to describe and follow-up the production system performance

Different Measurement Systems One way to handle various measures is to gather them into performance measurement systems (PMS). A performance measurement system is a group of measures organized in a certain way. To various degrees the performance measurement system might indicate how to measure and handle the different issues considered. A measurement system can be defined as: "… the mechanism supporting the measurement process, by which the required performance information is gathered, recorded and processed.

System performance may depend on production system because production system of a Company may affect product performance. Production system may be further characterized by flows (channels of movement) in the process: both the physical flow of materials, work in the intermediate stages of manufacture (work in process), and finished goods; and the flow of information and the inevitable paperwork that carry and accompany the physical flow.

The physical flows are subject to the constraints of the capacity of the production system, which also limits the system's ability to meet output expectations. Similarly, the capacity of the information-handling channel of the production system may also be an important measure of a system's output.

Self-check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short A1nswer Questions

2. List the cleaning and sanitizing steps? (5 point)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-2	Identifying and investigating Opportunities for system improvement.

System improvement needs different opportunities. These opportunities includes

- Availability of Trained man power
- ISO certified company have opportunities to improve system of production
- presence of new technology for system improvement

Table 1 Opportunities to improve the product development process

	Practice	Application at the company	Proposal for improvement
NPD Generations	Focus and priority setting	The process indicated the need, but is not a structured process	Carry out an analysis of the project portfolio that can help to show the set of project in the organization, their distribution over time, utilization of resources, financial situation and market perspectives
	Making the process flexible	Does not allow customization of the process according to its type	Create a structure for scale of projects, allowing customization of the process for different types of projects
Maturity analysis	Application of QFD	The method is not applied to development of new products	Introduce the use of QFD in the process, especially for projects for basic products where the focus of development is on market requirements
	Plans for reutilization	Only exist when there is a need for some specific customer	Expand the utilization of plans for reutilization, recycling and exclusion for all the projects
	Incremental improvement	The process contemplates the need for incremental improvement, even though there is no formalization	Structure the incremental improvement process for implementation in the company, in this way meeting an already-existing need
	Integration of the processes for incremental improvement, management of changes and planning of the project	There is no integration among the processes	In addition to the structuring of the incremental improvement process, it is necessary to integrate it into the management of changes and project planning

NDP = new product development

QFD = quality of flexible demand

Self-check#2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

3. List the opportunities to system improvement? (5 pt)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet-3	Developing and implementing proposals.

In the context of production system development, Rozenfeld et al. (2006) propose a maturity model for the product development process to indicate how to apply best practices to product development. The proposed model is based on levels that depend on carry out certain activities and utilizing the established tools. At each level, the tools, activities and methods are added; five maturity levels are proposed:

- Basic: product development activities are carried out in a non-structured manner;
- Intermediate: there is standardization of activities and their results are predictable, established tools and methods are used. Beginning with this level, the company is already utilizing the product development process in an advanced way; the other levels show evolution in terms of control and learning;
- Measurable: performance measures are used for product development activities;
- Controlled: there is a systematic form of work to correct activities in line with the results of the measures;
- Continuous improvement: the support processes are institutionalized and integrated into product development process

The proposal for this maturity model does not contemplate certification, but rather that companies undertake a diagnostic of the process by means of audits to aid in defining plans to improve the process. With this goal and to aid in creating improvements to the product development process, an evaluation of the company which was the main unit of analysis will be done.

Self-check#3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

4. List the five maturity levels are proposed:? (5 point)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

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