Modular In-Plant Training (MIT)

A Practical Guide to In-House Training (Project Working Paper)

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Content

Preface

Key policy dimensions in adjusting vocational education and training systems to current needs are focusing on major development issues, as:

- Establishing a demand-driven system oriented on labour market needs

- Increasing the flexibility of training organization and delivery

- Providing better access to training and greater learning opportunities

- Increasing the impact of training on employability of those trained

- Increasing cost-effectiveness of training.

While reforming vocational education and training systems, many countries are introducing employment oriented competency-based training approaches with modular type of design and delivery.

A key challenge within TVET reforms is linked with efforts to improve the orientation of TVET and qualification processes on demand of economy, business sector and labour market.

According to an actual ADB study[1] the following approaches with regard to the involvement of the private sector in TVET can be prioritized:

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1   ADB Study Report (Suliswanto, H., Russel,T.):Lessons Learnt on Public Private Alliances in the Vocational Education System of Indonesia

- Development of a system that fosters synergistic partnerships with economy in order to achieve a better matching between the graduates' skills and the demands from businesses and industries Building a partnership mechanism between governments, educational institutions, and training institutes with entrepreneurs to develop high quality education and training offers

- Encouraging the private sector to develop its own training institutions in order to address their own needs on HRD

- Utilization of the existing potential in the community, business and industrial world to increase the quality of education and training.

With the tightening of the labour market and increasing competition between companies, the demand for training programmes to continually upgrade the skills of employees, company / enterprise / organization-sponsored training and industry specific training has increased drastically in importance and has widened its range in order to meet specialized demands.

Against the relationships as described above, Human Capacity Development programs of GIZ (and formerly InWEnt) were implemented during the period 2008 to 2014 in Indonesia, Vietnam, Laos and the Balkan Region, with the objective to provide workshop participants from companies/enterprises and training organizations with a methodological knowledge base and tools to act as competent

HRD practitioner in designing, developing and implementing company specific demand oriented cost-effective and efficient training by applying the approach of "**M**odular **I**n-**P**lant **T**raining" (MIT) as elaborated in this *'Project Working Paper'*.

The MIT concept is firmly linked with the following inter-related processes:

- Training needs assessment at company/enterprise/ organizational level focusing on problem analysis

- Occupational/job analysis and/or functional analysis

- Modular curricula design

- Training material development (including application of ICT)

- Customized (as a result of the TNA) modular training program implementation and delivery at both company and/or institutional level

- Assessment and skills/competency official recognition.

Several individuals and institutions have been involved in the development of the MIT projects working paper, merely counterpart project national institutions and selected key participants. However, distinctive efforts and inputs in the development of the overall MIT approach and development processes were provided by Jo Wagner, former ILO Senior Advisor, Prof. Bui The Dung, Vietnam and Prof. Frank Bünning, University "Otto von Guericke" Magdeburg in the context of implementing GIZ (former InWEnt) MIT projects in the above listed countries and region.

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Chapter 1

Introduction

1.1. Background

International trading has increased in recent years as a by-product of globalization and many businesses are expanding rapidly as a result. The knock–on effect of such expansion is evidenced in the growth of employment opportunities in developing countries. The range of work available has widened and the consequent demand for employees with a broad portfolio of skills is not being adequately met by national training systems. This has created competition between national and regional businesses as the latter seek to recruit the most highly qualified people for their workforce. A consequence of this phenomenon is the practice of 'poaching', whereby competent workers from one company are lured to a different business by the promise of a higher salary thus causing an overall rise in the cost of training, in terms of time, effort and finance.

The human resource element in every company holds a strategic role. Rapid changes in the corporate environment have led to a need for highly skilled workers who are adaptable and have the flexibility to reflect, manage and anticipate change. A company's success depends on the quality of its human resource.

Although a skilled and productive workforce is clearly an asset to any business, the investment required to achieve such a human resource is significant. Once such an investment has been made, employers are faced with the added dilemma of retaining their highly qualified staff who may be tempted to look elsewhere for more lucrative employment. Companies need to develop specific strategies to retain their skilled and productive employees.

Each year the private sector invests considerable sums of money in human resource development through training, however this investment is not always considered to cost effective. This could be due to a lack of research to identify training needs accurately, resulting in training packages which do not meet the needs of the workers. This is where Modular In-plant Training (MIT) could be of benefit. The aim of MIT is to enable companies to train their employees to work effectively in order to increase production and reduce costs. An added advantage of MIT training is that it is geared towards strengthening the workforce by enabling people to manage and predict unforeseen events. The MIT system always starts with a training needs analysis (TNA).

Training needs analysis is a key part of MIT. TNA is a term used to describe a systematic attempt to diagnose changing requirements in the workplace and to develop creative training programs in response to the changing needs identified. It is the tool which identifies training needs which may emerge as the result of changes to production methodology or high production costs caused by material waste, equipment failure or ineffective use of time. Following the identification of a training need through TNA it is quite common for employers to be reluctant to invest in the training required because of the lack of evidence pointing to the financial benefits to the company following such professional development. TNA identifies the need for training. A calculation helping employers to assess the return on investment (ROI) is an integral element of the MIT methodology and can, therefore help to overcome the issue of reluctance to engage in training on the part of managers.

1.2. Objectives

The objectives of MIT are as follows:

a. To analyze problems in production or operations in an organization and to determine which of these problems, or aspects of problems could be addressed by training.

b. To develop specific training programs, mapped against a set of business competencies following the identification of specific gaps in knowledge, skills or competence, through a TNA audit.
c. To develop bespoke training modules which serve as training guides to enable the organization to address any issued identified through TNA.
d. To evaluate the effectiveness of the training in terms of productivity and the return on investment.

1.3. The Development of Modular In-Plant Training

Many midsize to large companies do not develop 'in-house' training programs. Many prefer to outsource this aspect of human resource management either by sending staff to recognized providers of learning and Continuous Professional Development (CPD) or by hiring a consultant to design a training program. Some companies claim that issuing instructions to workers constitutes training, if carried out by a supervisor. The former two approaches could be quite expensive, while the last example might not achieve the desired objectives.

Not all problems in a company require long or complicated training programs. Most issues can be dealt with by offering short training programs which focus on specific aspects of production. Each training program should be carried out systematically. The quality and accuracy of the TNA is indicative of the quality and effectiveness of the ensuing training program. A training program does not have to be developed by consultant from an external provider. It can be designed and delivered by the internal department responsible for professional development. MIT methodology is a simple training development program which could benefit many companies.

1.4. Instructions for using this Working Paper

This working paper was developed in the Indonesian context. The following points should be considered when using this manual:
a. The objectives should be used only in conjunction with the development of MIT methodology. Other methods may be used for reference only.
b. The strategic mission of the company should be taken into account when applying MIT. The vision of the company should be used as a reference point at each phase of implementation and evaluation.
c. Functional Analysis should be used to determine the goals of the company, the problems to be addressed, and the subsequent action plan to be implemented. Functional Analysis is used to develop a detailed MIT action plan using the general business context and the problems to be addressed to inform the training.
d. The main body of this working paper comprises of Training Needs Analysis and therefore it can be used as precursor to the implementation of MIT in the company as well as a tool for evaluating the success of the program.
e. The MIT flow diagram is used to help identify problems prior to the development of the program itself.
f. Function analysis and operational mapping is used to identify the root causes of any problems identified and training modules are developed based on the outcomes of the Functional Analysis.
g. The training should refer to international or national standard competencies or those recognized by the industry in question.
h. The Return on Investment should be measured to evidence the outcomes of the training in terms of changes in behavior of participants. This would go some way to demonstrate to the management that the costs incurred for the training program demonstrate a sound investment.

Chapter 2

Implementation and Procedures for Modular In-Plant Training

2.1. Understanding MIT Methodology

Modular In-Plant Training (MIT) is a method of training that focuses on tackling a problem in an organizational process which is caused by the incompetence of the operator. This method of training uses TNA as a tool. The difference between MIT and other types of training is that it is planned, managed, and delivered around specific tasks or competencies which relate to a particular production or business process. The training is delivered through modules developed specifically to reflect the production or business process. Unlike other types of training, MIT is tailored to meet particular needs. It is not an 'off the shelf' 'one-size-fits-all' training pack. This unique feature makes MIT an ideal model for helping to solve problems within a company.

The MIT development flow chart in *Figure 1* demonstrates the staged phases of MIT. The program starts with TNA (Training Needs Analysis). TNA is a process of collecting and analyzing data to identify training needs within an organization. Once a problem has been identified it can be deconstructed to ascertain whether it has been caused by a lack of competence in the workforce or by an operational or mechanical error. The particulars of an identified problem should be examined to ascertain whether training might offer a possible solution Problems caused by a lack of ability can be solved through training. Some problems commonly identified in organizations include low productivity, accidents in the workplace, limited knowledge or lack of technical skills. Once it has been agreed that training would be of benefit, a TNA should be undertaken. The training developer should then outline the following in detail:

1. The business process and indication of the section or department experiencing the problem identified.
2. The source of the problem in terms of work activity (Problem Identification). Problem Identification should enable a direct link to be drawn between the problem itself and the stage in the work process in which the problem is occurring.
3. Functional mapping - this will help to determine the function of the department or section within the enterprise. It helps to clarify the business process and competency related issues linked to the problem
4. A Job Description review - where the problem is related to human factors a job analysis should be undertaken to inform the development of a clear job description. One of the tools which can be used to carry out job analysis is DACUM.

Issues related to competency can be assessed against business, national or international standards. Where business competency standards are not available national standards can be adopted and adapted. Generally speaking national competency standards are accessible through the national regulatory bodies. Many competency standards can also be found on the internet. Such standards are a useful tool when developing learning modules in terms of content, stage and performance criteria.

The module is developed systematically. Initially a 'didactic unit' is developed. This unit provides a framework for the training module. It consists of learning outcomes, content, modes of delivery, learning resources and media to be developed for use with the module and includes guidelines relating to pre-requisites and requisites for the trainees and the trainers. A learning module is developed by mapping objectives, activities and content against competency standards.

The didactic unit is also mapped against the competencies to be acquired. This process is carried out by a panel of experts within the business or discipline. It may also involve consultants or other external experts. Once the didactic unit has been approved the module needs to be developed according to the guidelines set out in the didactic unit.

In order to deliver the module the training developer needs to identify potential trainees or target groups. The target group may comprise exclusively personnel from the sections where the problems have been identified or it may also include supervisors or more senior members of staff from the section. An important consideration at this stage is to engage suitably qualified trainers. Trainers could be experts in the business area who are also qualified to deliver training. They could also be sourced from external agencies such as suppliers or from consultancy firms who specialize in training for business solutions.

In order to ascertain the level of the trainees' current understanding, a pre-test is carried out. The pre-test serves as a baseline. It enables the training developer to assess the extent of learning needed by each individual trainee. Some training may be carried out in groups because the whole group may lack particular competencies, some training may be tailored to individual trainees who may have specific needs. At the end of the training the pre-test is re-issued and the difference between the outcomes prior to and following the training enables the trainer to determine how much learning has been achieved.

Each identified need is linked to a specific training module. The training package includes a trainee guide consisting of a set of learning modules and

a record of assessment. The achievement of each trainee is monitored throughout the training process. The system of continuous assessment helps highlight progress in knowledge and skills development of the trainees while simultaneously measuring the success of the training and trainer. The training sessions and resources are considered to be tools and the vehicle through which learning takes place.

During the training process any deviation from the intended aims and objectives should be rectified. This principle should be applied at all stages of the TNA and MIT process. Any necessary corrective action will improve the quality and consistency of any future training sessions.

2.2. TNA Process

2.2.1. Business Process Model

In order to identify a problem which occurs during the production process correctly, a business process model should be developed. Without the systematic application of a business process model, it is easy to assume that the symptoms observed are indeed the problem itself. The business process model explained in this working paper is designed to capture the current production process. A sound model helps to identify and categorize problems caused by inefficient systems or human error.

In designing such a model, every business process should make explicit the following:

1. Goals.
2. Specific inputs.
3. Specific outputs.
4. Resources.

MIT DEVELOPMENT FLOW CHART

DEVELOPMENT PROCESS

TNA Results framework and functional map	**JOB ANALYSIS**	**DACUM AND OTHERS**
TNA Problem Analysis	**JOB DESCRIPTION**	**COMPETENCY STANDARDS** (Modular Units / Step of Work / Performance Criteria)
CORRECTIVE MEASURES	**TRAINING IMPLEMENTATION**	**INDIVIDUAL LEARNING PACKAGE** • Guide for Instructor • Set of Learning Modules • Guide for Trainee • Assessment

Monitoring of Post Training

Monitoring of Training / Learning Process

WORLD OF WORK
Occupational / Competency Standard

LEARNING MODULE(S)
Didactic Unit / Learning Objectives / Content
Methodology / Learning Media / Guides

FINALIZED, APPROVED MTP

TRAINEE REQUIREMENT (TRAINEE SPECIFICATIONS)
Modular
MU 1   MU 2   MU 3   MU 4
MU 5   MU ...   MU ...   MU X

ENTRY TEST

POTENTIAL TRAINEE(S) AND/OR TARGET GROUPS

Compiling Individual Modular Learning / Training Package

Identifying of Individual Training Requirements

IMPLEMENTATION PROCESS

Figure 1. MIT Development Flow Chart

INPUT	BUSINESS PROCESS	OUTPUT & GOAL
• Information • Resources • Capital	Business activity: • Plan • Organize • Implement • Monitor	Value for internal and external customers

Figure 2. Business Process Model

5. A series of sequential activities.
6. How each organizational unit relates to the other and the impact of each on the whole organization.
7. How value is generated for both internal and external customers.

The business process is a collection of activities designed to produce a specific output for particular customers or markets. It entails a strong focus on how the work is done within an organization, no matter what the product. A process is thus a specific ordering of work activities across time and place, with a beginning, an end and clearly defined inputs and outputs. An example of a Business Process Model can be seen in *Figure 2*.

Examples of business processes include receiving orders, invoicing, shipping products, updating employee information, or setting a marketing budget. Business processes occur at all levels of an organization's activities and include activities 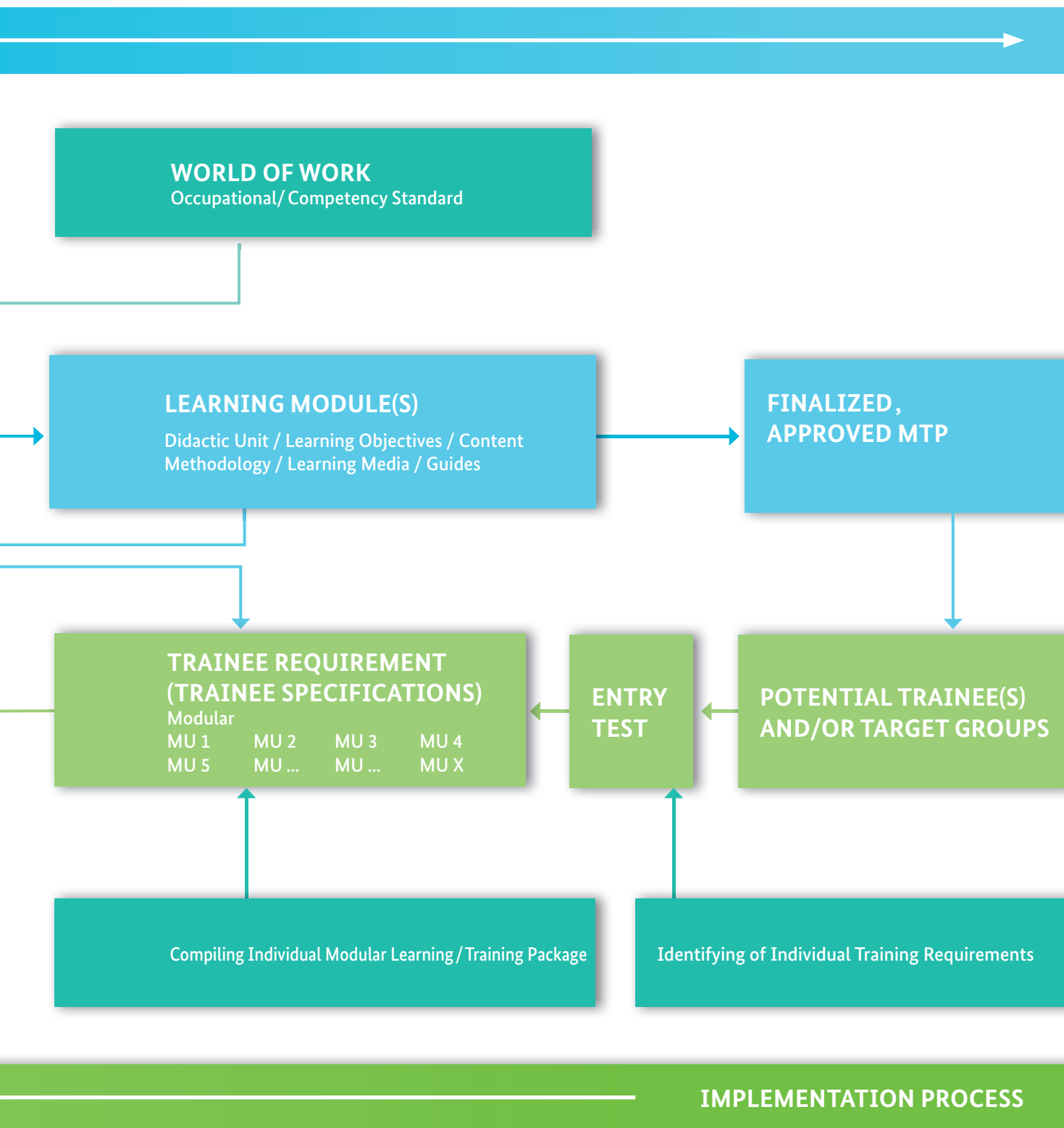which are visible to the customer as well as those which are invisible. The smooth running of all of this activity requires the management functions of planning, organizing, implementing and monitoring.

2.2.2. Conducting Training Needs Analysis

Employees are considered to be the most valuable asset in any organization. An organization is only as good as its people. Only the workforce can achieve the objectives of the organization. It is therefore important that employees possess the necessary and appropriate skills, knowledge and

attitudes (SKA) for the organization to achieve its goals and remain competitive and successful. A common approach to updating job related SKA in the workforce is through a regular program of training. Training is an important element of an organization's infrastructure as it could facilitate a company's expansion or restructure, develop its potential and enhance its profitability. It could also be claimed that training is an investment rather than a cost. Educated and well trained employees are a prerequisite for an organization's competitive advantage. In order for organizations to realize the returns on the training investment, the training itself must be approached systematically. A systematic approach involves deconstructing the training into sequential steps or stages. These steps begin with an identification of training need, designing and developing appropriate training to meet the identified needs, implementing the training according to the plan, and evaluating the training program to determine whether the original needs have been achieved.

When putting together a training program, it is advisable to conduct a training needs analysis to determine the actual needs of the learners. This provides an opportunity for the trainer to research the target client group and their needs in greater depth. It can provide clarity on the direction and results expected from the training program while monitoring the specific outcomes and will ensure that the time and effort put into preparing the program is maximized.

Micro analysis

The Micro analysis is an analysis with a single or narrow scope of focus and it has a particular use for individual units of an organization. This scope of training needs analysis would be limited to specific goals of the unit identified.

The detail revealed in a micro TNA captures the different and specific needs of departments or units of an organization. The data collection process can make use of a variety of instruments such as surveys, interviews, census data etc. One or more training programs can be generated from the analysis of such data. *Figure 3* shows the generic stages of the micro needs analysis.

Functional analysis

All businesses have key functions to carry out, even in the smallest business a number of key tasks, or functions, must be undertaken regularly. Stock must be bought, bills must be paid, customers must be served and customer queries answered. In large organizations, people specialize in different tasks and it is usually easier to identify separate functional areas because people work together in departments. Each department carries out tasks which relate to its particular business area. This is known as Functional Analysis, see *Figure 4*.

A function area is a person, area, or department which carries out a particular business function, for example, finance, sales or customer service. The main purpose of functional areas is to ensure that all important business activities are carried out efficiently. This is essential if the business is to achieve its aims and objectives. In addition, specific areas are responsible for supporting specific types of aims and objectives, for example:

- Sales and marketing are involved in achieving targets linked to developing new markets or increasing sales.
- Human resources are involved in arranging staff training activities and supporting the continuous professional development of all staff.
- Finance is expected to monitor and support the company's aims and objectives while keeping costs down and improving profitability.
- Production will have set targets relating to quality, capacity or meeting planned production schedules.

Figure 3. Flow diagram of micro analysis

Production		Research and development (R & D)

Sales		MAIN FUNCTIONAL AREAS IN

Marketing		ICT

■ Main functional areas in business
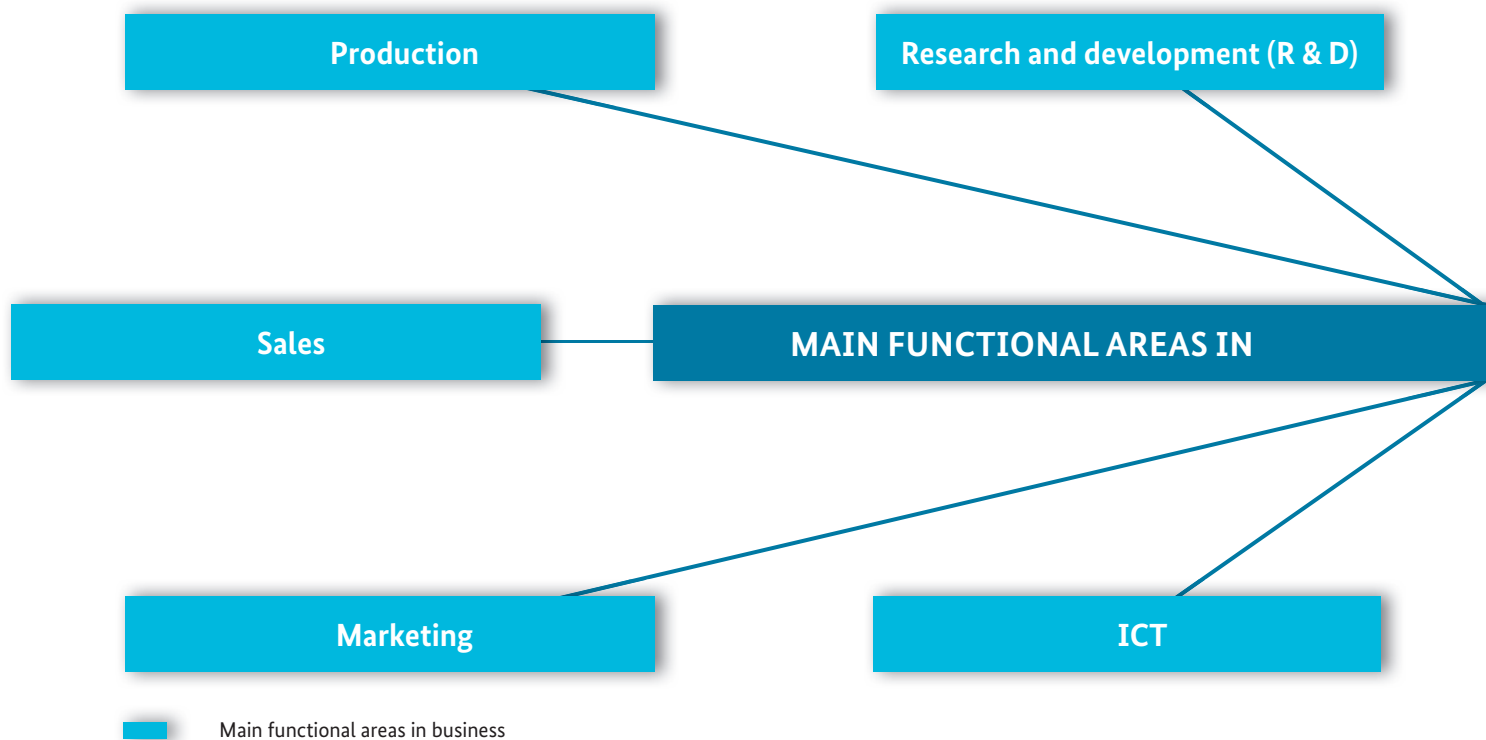
Below are three functions which are important to the operation of a company. The list is not exhaustive; however, the explanation for the three functions should enable understanding of the concept of functional analysis.

1. The administration function.
   Administration is a support function required by all businesses and this does not simply mean keyboarding or filing. Senior administrators carry out a wide range of tasks, from monitoring budgets to interviewing new staff for their departments.
   Routine administrative tasks include opening the mail, preparing and filing documents, sending emails and faxes. Other tasks require more creativity and flexibility, such as arranging travel or important events, coordinating staff meetings or visits by foreign customers. Most administrators also deal with external customers who judge the business on the way their enquiry is handled. Poor or sloppy administration can be disastrous for a company's image and reputation. A lost order, a badly typed letter, an important message that is not communicated or an incorrect date

scheduled for a meeting can cause problems and may lose customers. Efficient administration means that everything runs smoothly and managers can concentrate on the task of running the business.

A summary of the range of tasks administrators carry out is given below:
a. Collecting, distributing and dispatching mail.
b. Sorting and retrieving paper and electronic records.
c. Organizing meetings and preparing documents for those meetings.
d. Preparing documents using word processing, spread-sheets and presentation packages such as PowerPoint.
e. Researching information.
f. Sending and receiving messages by telephone, fax and email.
g. Purchasing supplies of office stationery and equipment.
h. Making arrangements for events, such as interviews or sales conferences.
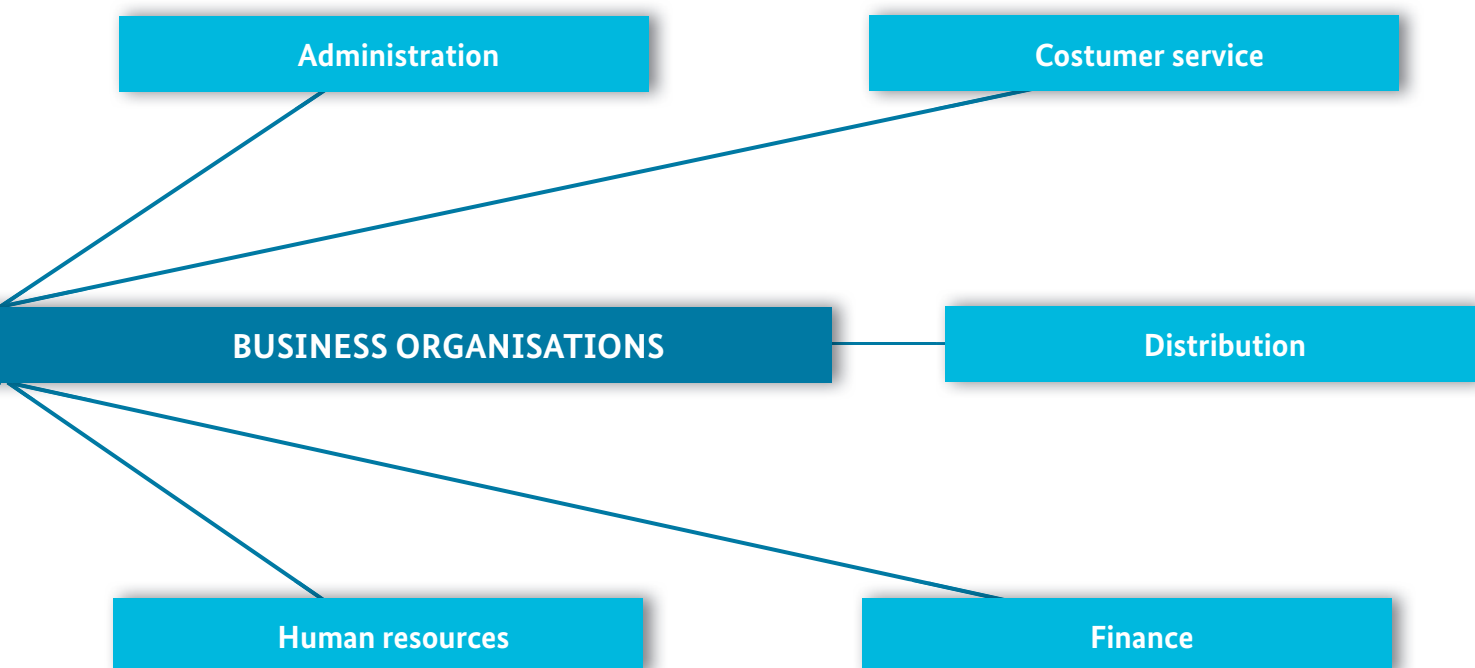
Figure 4. Functional areas in business

2. The customer relations function.
All businesses need to look after their customers or clients whether they have an enquiry, a concern or a complaint. Customer expectations are high. When people contact a business they expect a prompt, polite and knowledgeable response. Unless they get a high level of service they are likely to take their business elsewhere in the future. For this reason, many businesses have customer relations staff – or a customer relations department – where trained staff handle enquiries and complaints positively and professionally. This does not mean that other staff can ignore customers and their needs. It simply means that one group specializes in assisting clients.

A summary of the range of tasks undertaken by the customer relations staff is outlined below:
a. Answering customer enquires about products and services.
b. Providing specialist information and advice to meet customer needs.
c. Solving customer problems.
d. Providing after-sales advice, including advice about how to replace damaged goods, arrange

for repairs or for spare parts to be obtained and fitted.
e. Dealing with customer complaints according to company procedures.
f. Analyzing records of customer complaints to resolve problem areas.
g. Using customers' feedback to improve customer service and satisfaction.

3. The production function
Production refers to the manufacture or assembly of goods. Production staff must ensure that goods are produced on time and are of the expected quality. Quality requirements can vary considerably. Whilst an error of 0.5 mm may not matter in the production of a chair or table, this margin of error would be critical for electronic devices or component parts.
Monitoring quality does not mean simply examining goods after they have been produced. It is normal these days for quality checks to be "built in" at every stage of the process, starting with the raw material. Many buyers set down a detailed specification for the goods order. Today, many production processes are carried out

'automatically'. This means that machines or robots carry out the routine or dangerous jobs. At a bottling plant, for example, the cleaning, filling and labeling of bottles is all routinely carried out by machines. Operators check that the production 'line' is functioning correctly by checking consoles and computer screens, as well as by observing the work as it progresses. Some industries use computer integrated manufacturing, where the process is electronically controlled.

A summary of the range of tasks carried out during production is given below:
a. Ordering stocks of raw material from approved suppliers.
b. Storing and checking the stocks of raw material.
c. Planning production schedules to maximize machine and staff capacity.
d. Producing and assembling the finished product.
e. Monitoring the quality of the product throughout the production process.
f. Checking production is on schedule and resolving delays or problems.
g. Packing and storing the final products before distribution.
h. Scheduling routine machinery inspections and maintenance.
i. Carrying out repairs to machinery and equipment as required.

Task analysis into step of work (SOW)
Before undertaking a skill-based session, a task analysis should be undertaken. A task is a set of meaningful units of work. To identify such tasks, activities are identified which fall within the following criteria:

They must: be able to
a. Represent the smallest unit of job activity with a meaningful outcome.
b. Represent an assignable unit of work.
c. Be achieved in the short-term
   Be performed independently of other tasks.
d. Result in a product, service, or decision.
e. Have a definite beginning and ending point.
f. Be observable and measurable.
g. Consist of two or more steps.

A task analysis is the process of breaking down a job or task into its component parts (steps). The procedure is broken down into manageable (and easy to learn) steps. This process assists in identifying the steps and procedures for a particular task or skill area, so that the training program can be structured in a logical and sequential order.

Undertaking a task analysis helps identify all the parts of a particular job or task. This is essential to ensure that nothing is missed or skipped over. The procedure or tasks of a job need to be broken down and described before an employee is instructed to carry it out. How would you teach someone to ride a bike if you did not know that you first had to sit on the bicycle seat and then balance before you put your feet on the pedals?

Table 1 describes the steps in a task analysis for lighting a candle.

2.2.3. Problem Identification
A problem in an enterprise is anything that may deter the enterprise from reaching its goals or objectives. Most of the time, what is seen at the surface is a symptom of a problem. Increased absenteeism, an increase in defective products and low output are just a few examples. To solve a problem, one needs to go the root of the problem, and not be satisfied with getting rid of the symptom. Problems should be clearly defined. While this may seem simple, many repetitive problems result because a particular symptom has been addressed or only one problem was corrected when there were actually two or more to be solved.

In order to solve a problem, it must be clearly and appropriately defined. Frequently, the abnormality or non-conformance identified is not really the problem, but the symptom of the problem. A flow-down problem is generally a problem identified during a contract review or maybe a quality planning issue. Asking questions similar to the following will help to address the actual problem and not just the symptoms identified

1. What is the scope of the problem?
2. How many problems are there?
3. What is affected by the problem?
4. What is the impact on the company?
5. How often does the problem occur?

Once the problem is defined, it must be clearly stated in simple terms. When the problem is known, the

STEPS	SAFETY	TIPS
Show the trainee each piece of equipment: • Candle holder • Candle • Lighter/match Explain the objective of the task.	Explain that fire is dangerous and the lighter/match must be used with care.	Explain which end of the candle is to be it, which is the one with the wick. Down is the end with no wick and not to be lit.
Clear the bench.	Make sure there are no flammable materials near where the candle is to be lit.	Check that the candle will not be in a breeze so it will not blow out.
Place the candle holder on the cleared bench.	Make sure the surface of the bench is level so the candle won't slide when lit.	
Take the end of the candle (the end without the wick) and hold it in preferred hand horizontally.		Hold the candle near the holder.
With the lighter placed at the end of the candle without wick, ignite the flame and hold at the end of the candle until the candle wax starts to drip.	Ensure everyone stands back and that no clothing or hair gets near the flame. Explain candle wax is hot and can burn.	Hold the candle in this position with the non-wick end over the candle holder.
Allow three drops of wax to go into the candle holder and immediately turn the lighter off.	Don't keep burning the candle as it could catch fire, or excess wax may drip down.	
Quickly place the candle with the recently melted end facing into the candle holder.	Do not touch the melted end of the candle as it may still be hot and burn.	Place it in firmly, so that the melted wax and the candle are now fixed to the candle holder allowing the candle to become free standing.
Light the candle wick and extinguish the lighter.	Take care not to burn yourself, hold flame away from yourself.	Ensure the candle remains in a safe position, away from objects and people.

Table 1

eventual question to be answered can be formed. This eventual question is informed by the "6-W" process. The questions should be short, simple, concise, and focus on the problem. The "6-W" questions ask the following questions:

1. Why (reasons for training)?
2. Whether (training is the solution)?
3. Which (training process)?
4. Who (trainers, trainees)?
5. When/where (training will be conducted)?
6. What (is the estimated Return On Investment in training, i.e. cost-benefit analysis)

The steps involved in problem definition are:

1. Team forming
   A team of stakeholders in the problem should be assembled. To identify the stakeholders of a problem, ask the following questions:
   a. Who owns the problem?
   b. Who has a stake in the outcome and the solution to the problem?
   c. Who are the vested owners of both the problem and the solution?

These are people who know the process, have the data and experience, and they are the ones will have to identify the cause of problem accurately and take responsibility for implementing corrective actions. Without the full support of the stakeholders, long-term solutions are not likely.

Once the stakeholders are identified, consider if additional expertise is needed. If so, the team may need to include qualified team members or ad-hoc members who, while not stakeholders, can contribute information, technical expertise, management support, or offer advice.

2. Data collection and verification
   When the problem is defined, it is time to begin data collection. The factual information and data necessary to assure a thorough cause analysis needs to be collected. Data may have to be collected several times during this process, but the preliminary collection phase occurs immediately and will guide the analysis process. Initial data gathering starts in the workplace. Data has a 'shelf life', the longer you wait the more difficult it becomes to obtain accurate information. When possible, attend relevant work events,

taking note of who was present, what is in place, when the event occurred and where the event happened.

Types of data to collect:
- Location; the site, building, department, or field location where the event took place.
- Name of personnel; operator personnel, etc.
- Date and time.
- Specification; what were the requirements?
- Operational conditions; start up, shutdown, normal operations.
- Environmental conditions; noise level, temperature, etc.
- Communication; verbal or written, what orders were being followed?
- Sequence of events; in what order did things take place?
- Equipment; what was being operated?
- Physical evidence; damaged equipment or parts.
- Recent changes; in personnel, equipment or procedures.
- Training, classroom, on-the-job, none.
- Once gathered, verify the accuracy of the data so that analysis can be evidence based.

2.2.4. Determining the Need for Training

There are number of indicators to suggest that training might improve an organization, together with a range of approaches to identify such a need. These may include:

1) Indicator: Demotivated staff – training may not always be the answer in such cases and sometimes there may be a need for further investigation before training is considered.
2) Approach: Conducting staff interviews.
3) Approach: Staff feedback sheets or questionnaires.
4) Approach: Suggestion boxes.
5) Indicator and Approach: Customer surveys.
6) Indicator: High error rates.
7) Approach: Observation
   a) Observing new and experienced staff.
   b) Observing the interaction between staff and customers.
   c) Observing staff performing certain duties.
8) Indicator: New equipment
   a) When there is new equipment, staff should be trained to use it properly.

b) Determining if there is resistance towards new equipment.

9) Indicator: High staff turn over

    a) High staff turnover could indicate various issues and needs to be investigated immediately.

10) Indicator: High operating costs.

11) Indicator and Approach: Reports.

12) Indicator: A slump in sales figures.

A training need exists when it has been identified that there is a gap between where the target group or learner is now, in terms of skills, knowledge and attitude, and where they need to be. Training needs can include:

1. The improvement of operational skills using equipment or machinery.
2. The improvement of language, literacy or numeracy skills.
3. The deepening of generic skills and knowledge.
4. The improvement of general life skills.
5. Personal development skills.
6. The improvement or refining of technical application.
7. Familiarization of new Health and Safety requirements.
8. Familiarization with change management activity for an organization that is undergoing a restructure.
9. Familiarization with newly created job roles or functions.
10. Understanding the rationale behind staff transfers and role changes.
11. Supporting staff who are about to be or who have recently been promoted.
12. Supporting the launch of a new product or service.
13. The introduction of new technology, software or machinery.

Once a need has been identified, the basis for the training program is formed. It is necessary to understand the needs of the learners when conducting training needs analysis, but it is equally important to understand the needs of the organization or the client who has requested the training. A training needs analysis can be carried out for groups or individuals and could be proposed by any of the following:

1. The learners.
2. The trainer.

3. The organization.
4. A manager or supervisor.

From an organization's perspective, it is important to understand the following:

1. What benefits will the company gain from the delivery of the training program?
2. What are the costs involved? Is it cost effective to the organization?
3. Is the timing appropriate to the needs of the learners? Is it feasible?

2.2.5. Methods

Planning for needs analysis involves the following activities:

1. Identifying the key persons and organizations to be involved in the assessment.
2. Identifying the sample population.

It is difficult, costly and time consuming to involve every possible person or organization in a needs analysis. Thus it is important to have a rationale for selecting the persons or organizations to be included in the sampling. For practical reasons, samples are taken from populations, and estimates made about the total population based on information derived from the sample.

A sample must be large enough to give a good representation of the population, but small enough to be manageable. In selecting a sample, also need to take into account how to gather the required information.

The common methods of gathering information are:

a. Literature searches

A literature search is useful for gathering information from numerous readily accessible sources such as corporate and organization a literature, national and international publications, trade publications, journals, newspapers, annual reports and online databases.

The internet is a popular source for gathering information when used in combination with other information gathering methods. The advantage of this is that it is a low cost method, while the disadvantages include the fact that it often yields outdated information and it is time consuming because it requires skills in

knowledge 'mining' to 'drill down' i.e. read, select and organize the relevant contents into meaningful and useful information.

b. Talking with people
This is a good way of getting information during the initial stages of a research project. This method includes talking to stakeholders, clients, suppliers and other types of conversations at trade shows, professional seminars and association meetings. This method is especially good if you are looking for new information that is not published or available to the public. The disadvantage of this method is that the information obtained may be highly subjective and therefore unrepresentative of the entire population, thus raising questions over its validity.

c. Focus groups
A focus group is useful for gathering input quickly about a specific theme. It involves a meeting of a small group of 6 to 20 people in a non-threatening environment. The meeting is facilitated by a trained moderator. The room may have audio and video equipment for recording and playback purposes, with the agreement of the participants.
The key role of the moderator is to facilitate group discussion, elicit input from a good spread of participants and keep the participants focused on the theme.
The advantage is this method is that it can be organized within a few weeks. The disadvantage is that the sample is relatively small and thus may not be representative of the population in general.

d. Individual interviews
The individual interview is used to gain more in-depth and comprehensive information, usually on a one-to-one basis. For a structured interview, a set of questions must be prepared and pilot tested beforehand. The interviewer asks questions based on the prepared questionnaire and records the answers verbatim. The disadvantage of this method is that it is very expensive and time consuming. One could argue that the benefits may outweigh the disadvantages. The benefits of this method are:

1. The interviewer can control the flow of information.

2. It is possible to get in-depth and comprehensive information.
3. The response rate tends to be good.
4. Respondents can interact with the interviewer to clarify face to face.
5. Attitudinal behaviors can be observed with this method.

e. Telephone surveys
This method can be used when it is necessary to reach out to a relatively larger sample (e.g. 100 – 1000 respondents). Similarly to the personal interview, the telephone interviewer follows a prepared questionnaire to ask questions in a pre-planned sequence. A telephone survey should normally take no more than ten minutes.

Advantages:
1. It is one of the fastest methods of gathering information from a large sample.
2. It allows an opportunity for some opinion probing.
3. It is low cost and could be completed within a few weeks.

Disadvantages:
1. This method of survey might be limited by the telephone network coverage and may not reach people in the poor or remote areas.

f. Mail surveys
In this method, a prepared questionnaire is mailed to a large sample of the population. It requires follow up reminders by mail, email or telephone, and usually takes many months to complete. The response rate is usually low.

Advantages:
1. It is a cost effective method, suitable for large sample sizes covering a wide geographic area.
2. It is more economical than the telephone interview and has no interviewer bias.

Disadvantages:
1. It takes a much longer time to complete a survey compared to the telephone interview.
2. It does not provide any opportunity to probe respondents for more detailed information.

g. Email and internet surveys
This is a relatively new method of surveying which requires the target respondents to have

computer access, internet facility and adequate computer literacy

Advantage:
It could be the most cost effective and fastest method available

Disadvantages:
1. The demographic profile of the internet user may not be representative of the general population.
2. The respondent may not be the intended respondent.

h. Observation
Observation entails watching and recording the behaviors of people, objects or events in a systematic manner. For needs analysis we would focus on the following two methods:

1. Personal observation - A trained person observes the behaviors of people, objects or events, and systematically records the observations immediately, usually in a specially designed format.
2. Mechanical observation - In this method, mechanical devices such as video camera and motion sensors are used instead of human observers to record the behaviors. After that, a qualified person views the recording and notes the behaviors observed in a specially designed format.

Advantages:
1. It allows access to and assessment of actual behavior.
2. There is no reporting bias.
3. There is reduced potential for interviewer bias.

Disadvantages:
1. There is potential for observer bias.
2. It is time-consuming and expensive.
3. Sometimes it's difficult to observe some forms of behavior.
4. There is potential for breach of ethics.

2.2.6. Tools

a. Questionnaires
Questionnaires are often used to conduct a needs analysis. Here are some guidelines for designing a questionnaire.

1. Keep It Short and Simple (KISS) – cluster your questions into two groups:
   a. Must Know and Good to Know.
   b. Discard the Good to Know questions unless there are not enough questions in the Must Know group.
2. Phrase the questions clearly to be concise and precise.
3. Organize the questions so that those which are easy to answer are placed at the beginning of the questionnaire and arrange the difficult or sensitive questions at the end of the survey.

Place the most important questions in the first half of the questionnaire. Some respondents return partially completed questionnaires. By putting the most important questions at the beginning, the partially completed questionnaires will still contain the most important information. The guidelines below should help:

1. Include a "Don't Know" or "Not Applicable" response to tough or sensitive questions as some respondents may be unable to give a clear answer or will not want to be forced into answering such questions e.g. on income.
2. Ask for one thing at a time and avoid multi-part or staggered questions.
3. Ensure that questions are relevant.
4. Try to ensure that questions are short and direct as they can be easily understood and answered quickly.
5. Avoid negative questions such as 'Wouldn't you like to attend our free seminar?'
6. Avoid biased questions such as 'Would you prefer Course A or Course B?' In this question there is no option for the respondents to say no to both.

Type of questions
The two common types of questions used by researchers are multiple-choice and open-ended questions.

Rating scales
Rating scales are commonly used in questionnaires to facilitate information gathering, collating and analysis.

Researchers are divided on whether a 3-point scale, 4-point scale, 5-point scale or 10-point scale should be used and which one is more effective. For most practical purposes, a rating scale with 3 to 5 points is suitable.

Researchers are also divided on whether to use a scale with an odd or even number of points. The key determinant is that if a clear positive or negative response is desired, an even number of points should be used. If a neutral option is sought, use a scale with an odd number of points.

In *Table 2* are some examples of rating scales used in surveys.

Pilot testing of questionnaires

Before sending the survey to the selected respondents, it is good practice to ask a small number of respondents to try it out. The respondents for the pilot test should not include the group of people who were involved in creating the questionnaire. This is to test whether the questions can be clearly understood and the responses are relevant.

STRONGLY AGREE	AGREE	NEITHER AGREE NOR DISAGREE	DISAGREE	STRONGLY DISAGREE
Outstanding	Very good	Good	Average	Poor
Excellent	Above Average	Average	Below Average	Poor
Very Often	Often	Sometimes	Never	
Always	Usually	Sometimes	Never	
Excellent	Good	Fair	Poor	
Very Satisfied	Satisfied	Not Satisfied		
Very Important	Important	Not Important		
Very Helpful	Helpful	Not Helpful		
True	False			
Yes	No			

Table 2

For tough or sensitive questions, it may be useful to add another option such as "Not applicable" or "Don't know"

a. Interview sheets

Interviews are useful for gathering details and in-depth information on a particular topic. It can be used selectively as a follow-up to specific respondents to questionnaires only when it is necessary to investigate further.

An interview is a two-way communication process. Here are some tips for an effective interview:

1. Treat every interviewee as a guest in your organization, starting with a warm greeting.
2. Encourage interviewees to respond positively and share the information.
3. Take notes during the interview and control the flow of the process.

Difficulties encountered during interviews may include:

1. Nervous respondents.
2. Uncommunicative respondents.
3. Talkative respondents.

Handling a nervous respondent:

1. Start with a welcoming greeting.
2. Speak in a slow and relaxed tone with an informal manner.
3. Initiate some casual conversation.
4. Explain your role and the purpose of the survey.
5. Lead the respondent gently to your specific, fact-based questions.
6. Ascertain the fact that respondents understand the questions and if necessary recast the questions to clarify understanding.

Handling an uncommunicative respondent:

1. Encourage respondent to share his/her thoughts.
2. If respondent is unable or unwilling to answer specific questions, give them more time to think about the question and come back to the question later.

Handling a talkative respondent:

1. Talkative respondents may say things unrelated to the survey. Explain to the respondent the need to follow the structured format agreed by your organization, and the time available to complete the interview session.
2. If necessary, remind the respondent of the available time frame.
3. If the respondent digresses, redirect the conversation politely.

Conducting an interview

Steps for conducting an interview:
• Open the interview – put the respondent at ease.
• Gather information – ask questions and listen carefully for the response.
• Close the interview–close with a positive remark to leave a good impression of your organization.

Opening an interview

The purpose is to put both you and the respondent at ease so as to set the scene for an open conversation. There are three steps to follow:
• Build rapport.
• State the agenda.
• Ask for consent.

Gathering information

The steps are as follows:
• Ask main questions.
• Ask follow-up questions.
• Move to the next subject.

Closing an interview

Indicate to the respondent that the information gathering part of the interview has been completed and that the interview is about to finish.
• Summarize the questions posed and answers received.
• Thank the respondent for his / her input.

Choice of information gathering methods

As a researcher it is necessary to familiarize oneself with the advantages and disadvantages of the various information gathering methods available and select those which are most appropriate to the project in hand. There are many possible designs for information gathering instruments. The type of information to be gathered will determine the instrument to be used.

Identify priorities and importance

Raw data gathered during the needs assessment stage is not useful to policy makers. This data needs to be collated, analyzed and interpreted so that findings and conclusions can be derived and reported.

The priorities and importance of the needs to be addressed by training are examined by carrying out the following activities:
• The preparation of a list of the needs for training identified from the information gathering.

- A review of the list in view of the needs identified in relation to the importance to the country and institutional goals, realities and constraints.
- A decision as to whether the curriculum project is worth addressing, taking into account key factors such as:
  - Cost.
  - Executive pressure - do policy makers (e.g. the ministry of education or labor, or health, or the management team from the organization) require a solution and if so, how supportive are they of the proposed training solution?.
  - Target population - will sufficient numbers of suitable students be available for training to ensure sustainability of the curriculum project?
  - Customers - what is the influence generated by industry and their expectations?
  - How many training institutions or organizations already offer courses in the identified areas? How prepared would they be to deliver the training; in terms of facilities, staff, curriculum resources and target groups?

It is important to note that training development requires considerable investment in resources. Policy makers will support and fund projects only when the proposed training course is considered to be critical to the country and the mission of the organization by offering opportunities to a significant number of people and enhancing their employability.

2.2.7. Reporting

After the data has been analyzed, it is presented in a report to relevant stakeholders. Generally speaking charts and tables are often used as they provide accessible information. A key section containing the findings and conclusions drawn from the research and the recommendations is presented for consideration by policy makers.

Most organizations have their own standard format for report writing. A suggested report format is attached to illustrate the key components of a needs assessment report *(Table 3)*.

2.3. Designing and Developing a Learning Module

To train competencies or ability, a good learning module is necessary. A good learning module should be based on the competency unit. A competency

unit should include practical activities which can be undertaken by the trainees. It should have credibility as a stand-alone unit for training and certification and it must add value to the individual and the organization.

Competency units are derived from analyses of the occupations, functions, and work processes of an industry. Competency units are designed based on selected types of analyses most relevant to the workforce development requirements of the specific industry. The competency unit reflects how work is organized and jobs are defined in order to deliver the goods and services of industry.

Difference between competency unit and competency standard

The terms 'Competency unit' and 'Competency standard' are often used interchangeably because competency standards are usually developed on a competency unit basis. When presented in a competency map, competency units help us to understand how work activities and jobs are organized and related within industries. Competency standards help us to understand how well an employee must be able to perform in their job. Competency standards usually include:

- Details of expected performance outcomes.
- A description of an acceptable level of performance required of an employee to perform effectively in their workplace.
- A set of behavioral descriptors related to desired performance.
- An indication of the level of knowledge required for competence.
- An illustration of the types of evidence an employee must show to prove competence.
- A description of the conditions and context under which the employee should demonstrate the expected level of job performance.

In essence, the competency standard serves as the reference document for the competency unit. The relationship between a competency and a competency unit is similar to that between a course title and the course material. Since In-plant training is delivered within the company, the competency unit becomes the modular unit and addresses operational procedures of the jobs at the company. Most competency models are based on selected types of analyses most relevant to the workforce, for example in

SUGGESTED FORMAT FOR A NEEDS ANALYSIS REPORT

1. **Executive Summary** –
   presents an overview of the analysis and findings for decision makers to make decisions more efficiently.

2. **Introduction** –
   introduces the major sections of the report, including the main persons involved in the needs assessment and report writing.

3. **Background** –
   describes the background and reason for the needs analysis.

4. **Purpose** –
   describes the purpose of the needs analysis.

5. **Methodology** –
   describes the research methodology such as observations and surveys. The main activities carried out should be provided.

6. **Sample** –
   describes the personnel in various organizations who participated in the needs analysis.

7. **Instrumentation** –
   describes all the instruments used. Copies of the instruments should be included in the Appendices.

8. **Results** –
   describes the findings. Graphs and charts should be used wherever they are appropriate.

9. **Recommendations** –
   presents recommendations based on the findings.

10. **Summary** –
    presents a synopsis of the report.

11. **References** –
    lists the sources reviewed or consulted during the needs analysis.

Table 3. Suggested format for a needs analysis report

Indonesia, Standar Kompetensi Kerja Nasional Indonesia (SKKNI), in Vietnam (Vietnam Occupational Skill Standards) and in LAO PDR (Labor Standards) have been developed using functional analysis.

The National Occupational Standard of Indonesia states that the functional order of work is as follows:

- Main purpose
- Key function derived from the main purpose.
- Major function derived from the key function, and
- Basic function derived from the major function.
  Ministry of Manpower Decree No.8, 2012, Clause 10 chapter (2)

COMPETENCY MODEL

FUNCTION

UNIT

UNIT

UNIT

JOB PEOPLE

JOB

MU

MU

MU

FUNCTIONAL MAP

KEY FUNCTION

M F

M F

M F

- Element
- Element

- Element
- Element

- Element
- Element

- Steps of work
- Steps of work

- Steps of work
- Steps of work
- Steps of work

- Steps of work
- Steps of work

TRAINING

- Basic function
- basic function

- Basic function
- basic function

- Basic function
- basic function
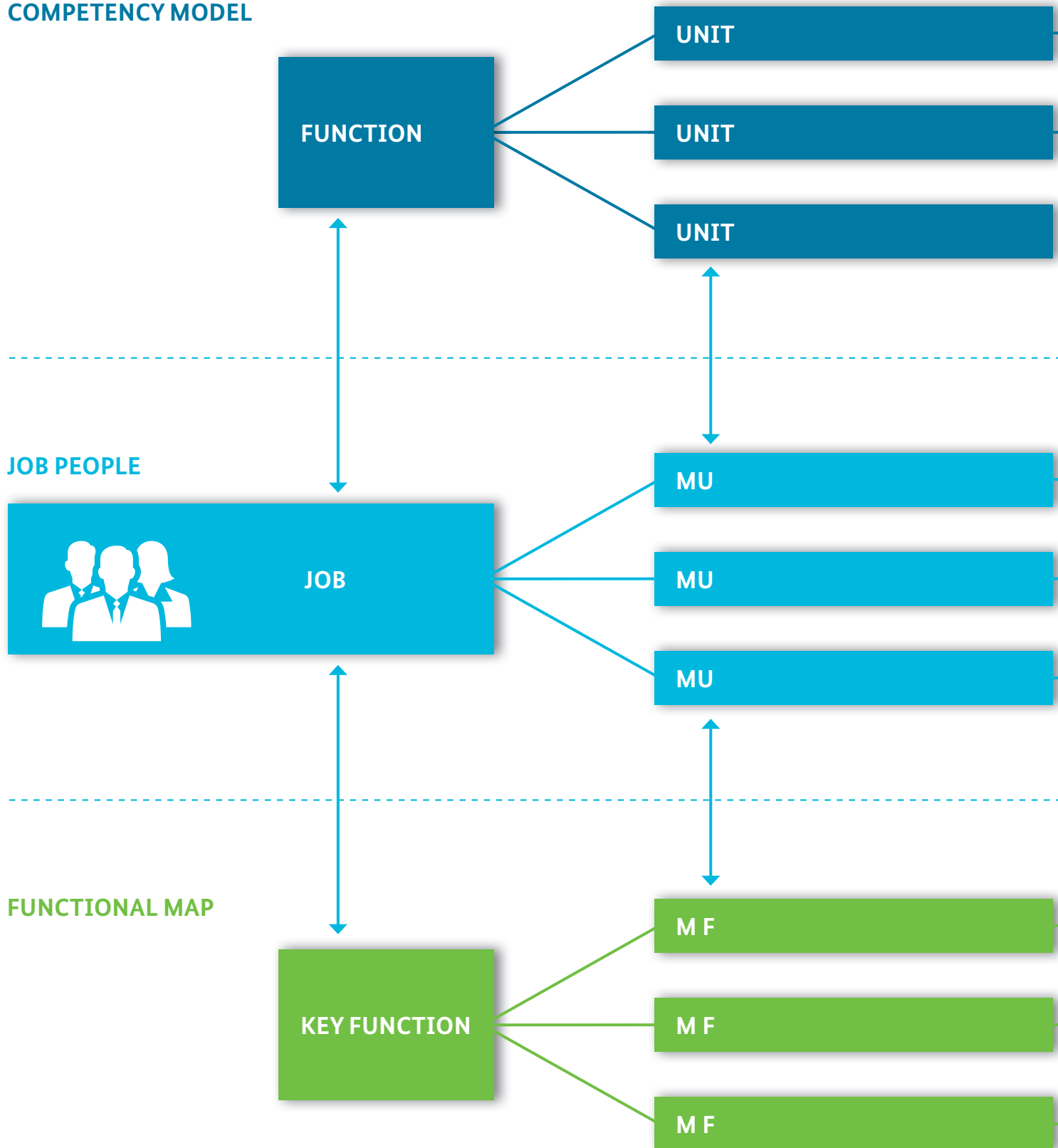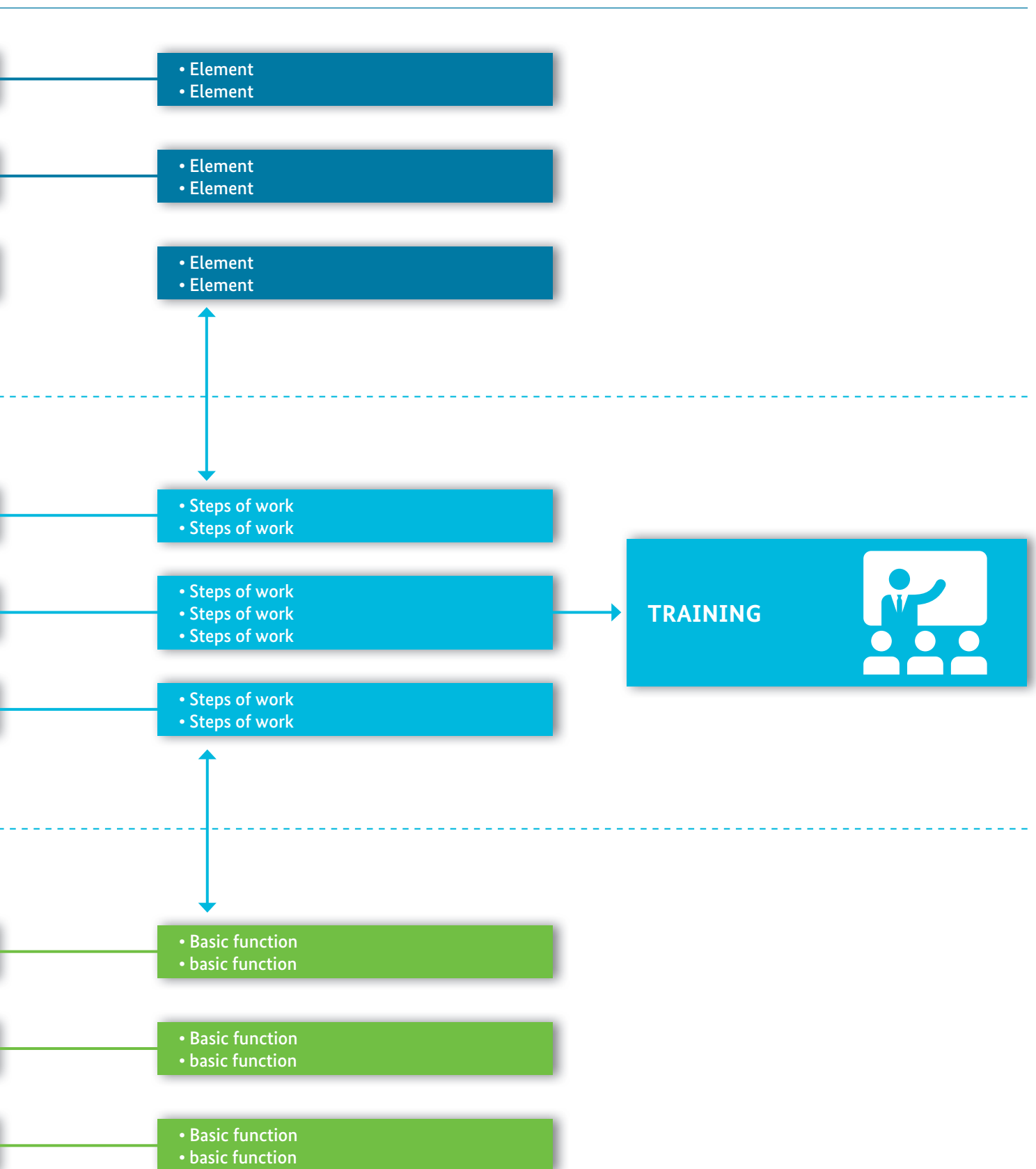
Figure 5. Relation between competency model and functional map

| MU 1 | → | IN-PLANT TRAINING | → | MONITORING PERFORMANCE |
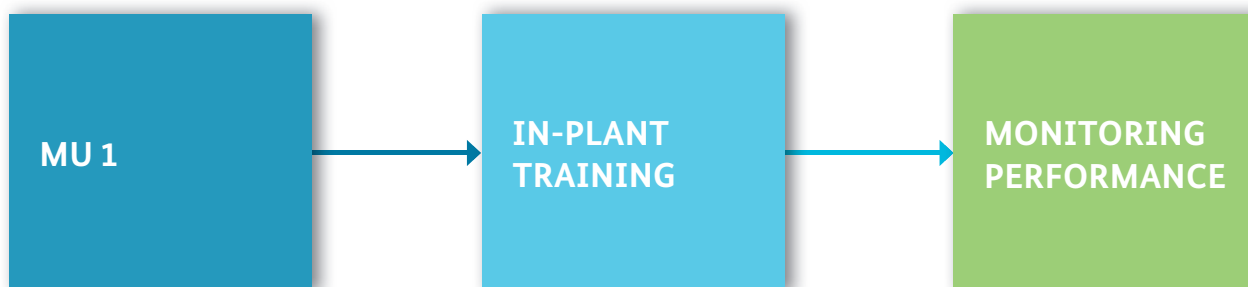
Figure 6. Program covers 1 modular unit (MU)

Using this example as a model, the competency units, applicable in Indonesia, are termed as 'major function' in the functional analysis of enterprise activity. *Figure 5* shows the relationship between a competency model, a job profile and a functional map. In the competency model, the terms 'Function', 'Unit of Competency', and 'Element' are used. The 'Element' is the content of a 'Unit of Competency'. The 'Function' equates to 'Job' in job profile, which equates to 'Key Function' in a functional map. Similarly, the 'Unit of Competency' equates to 'Modular Unit' in job profile and 'Major Function' in functional analysis. Of course, then, 'Element' in a competency model, is equal to 'Step of Work' in a job profile, and 'Basic Function' in functional analysis.

While designing training programs for particular job tasks, the developer must not lose sight of the eventual outcomes of a competent professional. Developers should adopt appropriate training strategies which address all dimensions of competency (task skill, task management skill, contingency management skill, role and job environment skills, and application skills), fulfil requirements of the learner's occupation together with meeting there requirements of the learner's organization and industry. The range of performance criteria (PC) will vary as performance criteria are individual to each modular unit. Performance criteria are based on the learning outcomes of the program and are derived from the critical knowledge and skills expressed in the competency/ modular unit. Clearly the learning outcomes and performance criteria need to be relevant to the learner's occupation and organizational requirements.

Ideally, the training process and material developed will enable the learners to participate actively in the learning process. This means that the profile of the learners has to be considered in the design and development of training. There are many ways of designing modular In-plant training based on modular units:

a. A program based on single modular unit.
(see Figure 6)
This type of program is developed based on one modular unit. It will only cover the competency requirements stated in the competency standard document for one modular unit. It would be suitable for learners who want to "top up" or refresh specific competencies that s/he feels are lacking.

The sequencing of the learning content need not follow the sequence of performance criteria / statements in the modular unit. Learning topics and activities are selected and developed based on requirements stated in the competency unit (refer to SOP organization or national standard). These learning topics and activities are sequenced in a manner most logical and coherent to the needs and profile of the learners. Learning would also take into consideration the needs of the organization, industry and individuals so that the program can be contextualized and made relevant to the learner.

For example in the case of designing a program to train lathe machine operators, the developer would need to understand the procedure (SOP) of operating the lathe machine type CC6000 with which the operator is working.

The developer would then design the training program so that learners would be readily deployed at their job after training. If the developer observes that there are common threads in the steps of work (SOW) and performance criteria, such as safety requirements and measures (e.g. use of protective clothing such as safety gloves and apron, safety helmet, safety shoes, glasses, etc.) s/he may choose to cover the knowledge of safety requirements at the beginning of the course and then reinforce this aspect at key points in the training program The duration of the training would correspond to the recommended training hours indicated in the modular unit and may vary slightly according to the specific profile and needs of the learners.

b. Integrated program with multiple modular units *(see Figure 7)*
   Modular units can be combined based on commonalities among the modular units such as key attributes or competency categories. The combination of the modular units may also be done according to the specific training needs of learners and these competency units may be from different competency categories or key attributes. Any combination of modular units in the development of training module is possible. However, learners should not be made to go through the same competency unit again as they progress from one training module to another.

What is a Curriculum?
Curriculum means different things to different people ranging from a specific course to the whole training experience in a specific environment. In technical and vocational training the curriculum usually refers to the whole training package containing specifications for the competency standards, training program and delivery, learning outcomes, training facilities, and assessment.

What is Curriculum Development?
Curriculum Development comprises the framework, methodology for all the phases as well as the key activities and the production of outputs. It has an impact on everyone involved with the justification, designing, training, learning and evaluation of the curriculum.

The Need for Curriculum Design and Development Model
In this age of rapid industrialization and globalization, training and assessment organizations are faced with great challenges to produce workers who are fit for purpose. Economic competition has shifted from the national and regional arena to an international context.

The increased use of technology has created advances in manufacturing, distribution, and communication. These advances have compelled countries to shift from a low-skilled to a more highly-skilled and high-wage economy. Increasingly, workers employed in the new economy are expected to apply their newly acquired skills and knowledge in their workplace and continue their life-long learning to meet the demands of the changing work environment and global economy.

In order to respond quickly to these challenges, an appropriate Curriculum Design and Development model would be helpful to tailor training and assessment programs to better serve the needs of industry.

PHASE	STEPS	
1. PLAN	**Analyse learning needs**	**Design training program**
2. DO	**Develop training materials**	
3. ACT	**Implement training program**	
4. CHECK	**Evaluate training program**	
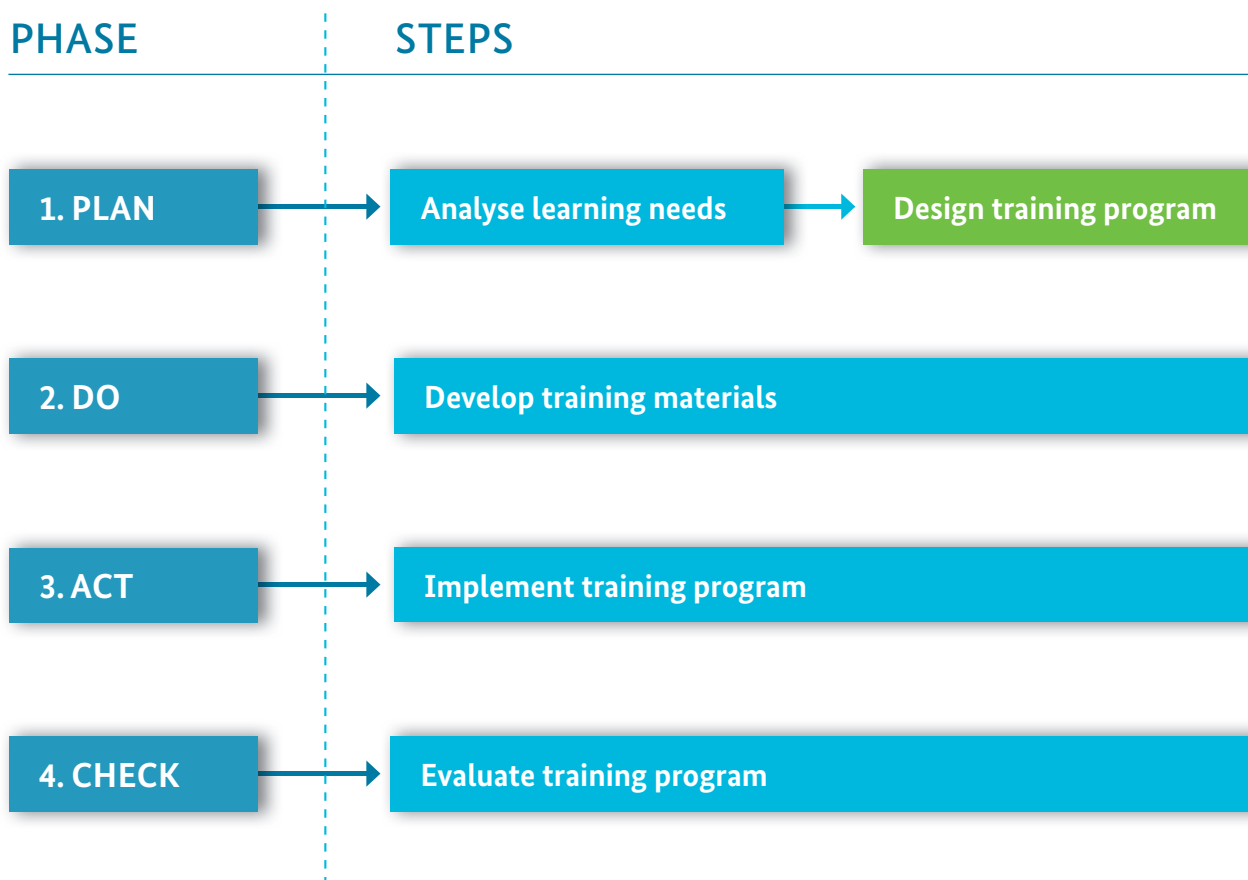
Figure 8. Phases and steps of curriculum development

The phases and steps of curriculum development are as follows: *see Figure 8.*

Phase 1. Planning the curriculum development

a. Analyzing learning needs

The rationale and relevance of the content of training program must be carefully considered in the curriculum development process. A comprehensive training needs analysis will prevent the unnecessary waste of resources spent on developing a training program without focus. The TNA should be conducted 'upfront' to identify the specific performance problems requiring a training solution. Once this has been established, developers can then examine carefully the content coverage in the competency standard in order to identify the modular units which would help address the performance problem. The modular units selected can then be packaged into relevant learning modules, either individual or in multiple modular units, to address the specific performance problems in a targeted manner.

Further analysis at the individual learner and organizational levels would provide information on the profile and characteristics of the learners together with the specific requirements of the organization. This helps to determine detailed performance issues that can be address by training. Such an analysis ensures that the training program would be tailored to the specific needs of workers and would help them to address their performance problems.

b. Designing the training program

Based on the findings of the needs analysis phase, the specific learning objectives and outcomes of the training program are established. The learning objectives and outcomes should match the competencies to be covered in the selected modular unit. Training strategies, topics and activities which are most appropriate for the learners are identified. The lesson plans and assessment schemes are organized into sequential sessions. The duration of the program is confirmed. Training resources such as media, facilities are identified and the requirements of trainers are also confirmed at this stage.

Phase 2. Developing the curriculum

c. Developing training materials
When the training design is finalized, developers design learning materials, resources, assessment instruments, etc. The contents of the training material is guided by the learning objectives/outcomes laid out in the training design. Key considerations include the articulation of training contents that resonate with the required competency level stipulated in the competency standards, incorporating the five dimensions of competency while addressing occupational, organizational and industrial needs.

Phase 3. Delivery of the training

d. Implementing the training program:
The training program should be delivered by qualified trainers. The specific requirements and qualification of trainers are stipulated by BNSP/LSP Certification or other equivalent qualifications. Qualified trainers should be trained and briefed so that they are familiar with the training program prior to meeting the trainees. The delivery of the training should be closely monitored to help to maintain consistency and ensure adherence to the program design. A system to obtain and analyze feedback from learners should be an integral part of the program so that the training program can be evaluated and reviewed with a view to making further improvements for the following delivery

Phase 4. Quality Assurance and Monitoring

e. Evaluating the training delivery
Notes and records gathered during monitoring and observation sessions together with the feedback received from learners should be analyzed to determine areas for improvement in the training. Areas for improvement should be classified for example training material, training delivery, conduct of assessment, trainer performance and other aspects such as duration, facilities, etc.

See Table 5. The Curriculum Development Process.

2.4. Determining Resources

To implement a training course, resources such as equipment, workshop facilities and teaching staff are required. These must be identified in advance so that there is sufficient time to secure a budget and acquire them through the purchasing procedure, which could be a long process.

1. Training equipment
The equipment needed to support a training course may be classified into the following categories *(see Table 4)*.

The major items needed for training are listed in the respective competency standards. From the curriculum outline you have prepared, additional items may be identified. The quantity of an item needed depends on the class size and the learner to equipment ratio. It is important to decide on the class size for the course.

There is no hard and fast rule to define a class size. It depends on the nature of training, safety considerations, the workshop space and, budget available. A class size with 16 learners is typical

Training Equipment	These are the essential equipment and machines, such as lathes and drilling machines, needed to carry out practical elements of the course.
Tools	A set of basic tools such as files, hammers and handsaws is needed for learners to undertake the practical tasks in a workshop.
Simulators	These are the machines or equipment simulating the functions of a larger and more complicated industrial machine (which normally costs a lot more).
Utilities	These are tables, chairs, storage cupboard, work-benches and tools-bench etc.

Table 4

for a practical lesson. For theory classes the number could be significantly higher.

The learner to equipment ratio ideally should be 1:1. However due to its high cost, some equipment has to be reduced to a ratio of 2:1 or 4:1 or even 8:1. This could create challenges in time-table planning and implementation, as every learner should be given an equal chance to use the equipment. As an example, 10 machines are needed for a class size of 20 learners based on learner to equipment ratio of 2:1.

The following information about the equipment needed should be known in order to secure a budget and to satisfy purchasing procedures:

• The technical name of the item.
• The technical specifications.

CYCLE (PDAC)	PROCESS (ADDIE)	KEY ACTIVITIES	RESOURCES
1. Plan	a. Analysis	• Identify problems that can be solved by training. • Clarify instructional objectives and outcomes. • Determine training needs of learners. • Assess current knowledge and skills of learners. • Assess profile / characteristics of learning.	• Training needs analysis tools. • Performance evaluation tools. • Competency standards. Specific information: • Occupation / target group. • Assumed skills and knowledge. • Performance criteria. • Critical aspects. Consideration: • Job / occupation scope. • Industry / organization needs.
	b. Design	• Determine learning objectives. • Determine training strategies. • Determine topic and content to be covered in training. • Sequence topic activities. • Plan lessons. • Confirm duration. • Select training media and facilities • Contextualize training design to specific needs. • Identify trainers' requirements	• Organizational procedures. • Industry practices. • Learner profile. • Competency standard. Specific information: • Competency levels. • Performance criteria. • Recommended training hours. • Trainer requirements. • Curriculum, delivery, assessment advice. • Workplace safety and health requirements. Consideration: • Competency levels. • Job / occupation scope. • Industry / organization needs.

Table 5. The Curriculum Development Process

CYCLE (PDAC)	PROCESS (ADDIE)	KEY ACTIVITIES	RESOURCES
2. Do	c. Development	• Create training materials, assessment tools and instruments. • Create assessment and marking criteria. • Create guides and instructions for trainers. • Validate training. • Refine training.	• Organizational procedures. • Industry practices. • Learner profile. • Competency standards. Specific information: • Competency level. • Performance criteria. • Evidence source. • Recommended training hours. • Trainer requirements. • Curriculum, delivery, assessment advice. • Workplace safety and health requirements. Consideration: • Competency level. • Job / occupation scope. • Industry / organization needs.
3. Act	d. Implementation	• Train the trainers. • Deliver training. • Carry out and mark assessment. • Collect feedback on training.	• Assessment forms. • Training observation forms. • Train the trainers. • Competency standards (as reference for employees and trainees). Consideration: • Competency levels. • Job / occupation scope. • Industry / organization needs.
4. Check	e. Evaluation	• Analyze feedback on training. • Conduct validation session for training. • Refine training program design. • Refine training materials	• Course evaluation form. • Training observation form. • Final report. Consideration: • Training needs analyses. • Job / occupation scope. • Industry / organization needs. • Competency level.

Table 5. The Curriculum Development Process

- The quantity needed (based on declared class size and learner to equipment ratio).
- The estimated unit price.
- The estimated total price.
-
2. Training facilities
   Training facilities are the workshops, laboratories, project rooms and classrooms used regularly for training purposes. The size of the facility should be measured in terms of floor area and any special provisions needed. Remember that

floor space costs money. It is possible to calculate the floor area of a workshop or a facility given the following data:

- A: area needed for one item of training equipment/furniture.
- B: area of working space per learner (say 1 sqm).
- C: number of learners per equipment/furniture.
- D: number of items of training equipment/furniture.

Power Supply	Single-phase and/or three-phase electrical power supplies. Emergency stop buttons (strategically located for the workshop). Surge protectors and UPS or back-up generator
Safety measures	First aid box, contingency power supply and emergency exit route etc.
Toxic waste disposal	Proper toxic waste disposal system
Ventilation	Workshops should be equipped with an exhaust extractor system. Ceiling fans should be provided for air circulation. Workshop roofs should be insulated.
Lighting	Standard fluorescent lighting. An emergency lighting system. Lighting should be sectionalized so as to avoid unnecessary lighting when certain work areas are not utilized.
Fire	To meet the building control regulations
Fighting / Prevention Facilities	Portable fire extinguishers should be provided (e.g. carbon dioxide portable fire extinguisher).
Heavy machinery and heavy engineering work	Should be located at the ground floor. The floor load bearing should conform to the manufacturer's machine specifications
Fixtures	Electrical power points, compressed-air points and fixtures must be carefully planned
Climate-controlled systems	Certain workshops or laboratories may need climate-controlled systems to protect sensitive and high-cost equipment and machinery.

Table 6

Workshop or laboratory areas may also require some or all of the following *(see Table 6)*.

3. Staff requirements or developments
   A new course might need additional or new teaching staff to deliver it. Providing upgrading or retraining of existing staff may be considered before recruiting new staff. It is very important to identify the new requirements from the curriculum content. The following guidelines can be used when considering staff development and staff recruitment. *See table 7.*

2.5. Return on Investment (ROI)

The training program should be treated as an investment; therefore the ROI of the training should always be measured. Training is often perceived by senior managers as merely a cost to the company. It is the role of Human Resources Managers and Training Managers to explain that the desired output of the training is a change in the behavior of the participants. To measure changes in behavior in financial terms is quite challenging.

Outcomes may not be apparent immediately after the delivery of a training program. It may take some time to see evidence of the necessary changes taking place. Training should result in changes and these changes should be measured. A follow-up study conducted after a given period of time following a training program can help to identify behavioral changes. A training manager must be able to measure the ROI from training and be able to articulate this. As part of the business activity in the company, the training activities also need to be evaluated to see how far the training program contributed to the company overall and impacted on its success. There are some basic reasons why the training program should be evaluated. These include the following:

- To confirm that training is an appropriate method to improve performance and productivity.
- To account accurately for funds used for the training.
- To review and update the training program regularly to ensure continuous improvement.

EXISTING STAFF	NEW STAFF
Determine: • Their previous education and training. • Their work experience. • Their present level of competence and the gap between the existing skills and the expected skills required by the new course. • Attitude Whether the staff identified are willing to accept new challenges by taking up new responsibilities and learning new skills at the same time.	**Determine:** • Technical qualifications. • Pedagogic qualifications. • Industrial work experience. • Teaching experience.

Table 7

Chapter 3

Technical Steps, Implementing and Processing MIT

3.1. Determining a structural Business Scenario

Developing a business scenario is required to identify corporate activities and objectives.

It is used to:
1. Learn about and understand business interactions.
2. Describe and map a business perspective, thereby keeping the design activity separate.
3. Draw up an inventory of any required main and supporting sources, thereby revealing gaps in the system. For instance:
   - Check and assess the logical flow of a single path through a business process or use case.
   - Identify the flow of activities involved to isolate the particular activity responsible for the problems.
   - Understand changes of business nature.
   - Use as a case study to support action planning.
4. Collect information as a support or to further develop improvement plans.

The aim of business scenario is to enable the understanding and communication of a single interaction in the organization and to become familiar with systems or anticipated actions of a business or system. In other words, a business scenario maps out the relationship between people or things /objects in the business in order to trace causes of problems.

In order to start a business scenario it is useful to use the concept of holding a discussion, imagine that all the things that exist in the business are people, or invent people who can talk to other people. For example, someone needs a way to assess a training program but s/he is not familiar with tools for assessment. Imagining that assessment is a way to measure performance levels of people, s/he will need to discuss performance levels with people in the organization for whom performance is important; usually line managers in the organization.

Business scenarios can be written as a set of case studies from each area of the business using the sequence construct. A given business scenario can help the trainer to identify any required actions and to develop an improvement program. The structural business scenario describes the flow of business activities with all stakeholders. Training needs analysis is the main focus of this handbook. The diagram below shows how the flow of business activities ends in modular in-plant training. The business process describes the main processes in the company by outlining the flow of activities required to enable the company to achieve its goals. A business process consists of several activities which are called business process events which may have many integrated functions.

Example of a business scenario mapping *see Figure 10*.

The flow diagram is divided into three major sections, namely: vision, business framework and training needs analysis.

1. Vision:
   a. How to achieve a safe and convenient working environment.
      The implementation and control of safety rules supported by adequate equipment and safety tools are the main means of creating a safe working environment. Written procedures and monitoring should be produced to ensure that policies and procedures for safety are followed appropriately.

   b. How to increase market share.
      The investment in new machines should pay off either in higher quality of goods or

productivity. Shareholders anticipate business growth which will need investment from several sources. Failure to produce high quality goods with a high productivity rate will result in a failure to achieve targets set *(see Figure 9)*.

c. How to perform excellent services, achieve customer satisfaction and develop committed people.
   • Excellent service can be described as the correct application of a standard operating procedure by following written work instructions and understanding the instruction manual.
   • Customer satisfaction is determined by meeting agreed delivery times, responding immediately to customer feedback and maintaining good relationships with customers.

• A committed person is the employee who dedicates themselves to their tasks and responsibilities and is committed to fulfilling company requirements as stated in the company's rules and regulations.

Company Business Characteristics
A description of company business characteristics helps to identify the necessary focus of training needs Some examples of company business characteristics include the following:

• Sales Action: Job Order Basis.
• Customer Focus: Government power plant, oil and gas, fertilizer, mining etc.
• Work Performance: Quality Oriented.
• Expertise: Rotating equipment (turbine, compressor, pumps, etc.).
• Production Type: Reverse engineering.

FOCUS

Increase Sales Volume
• Extend customer networking in public and private sector.
• Improve brand image.

Increase productivity
• Intensive technical training.
• Minimize NCR and warranty.
• Reduce overtime.

Increase EBIT
• Maximize local expertise.
• Optimize use of equipment.

Increase asset turnover
• Reduce fixed costs.
• Reduce inventory.
• Reverse engineering.
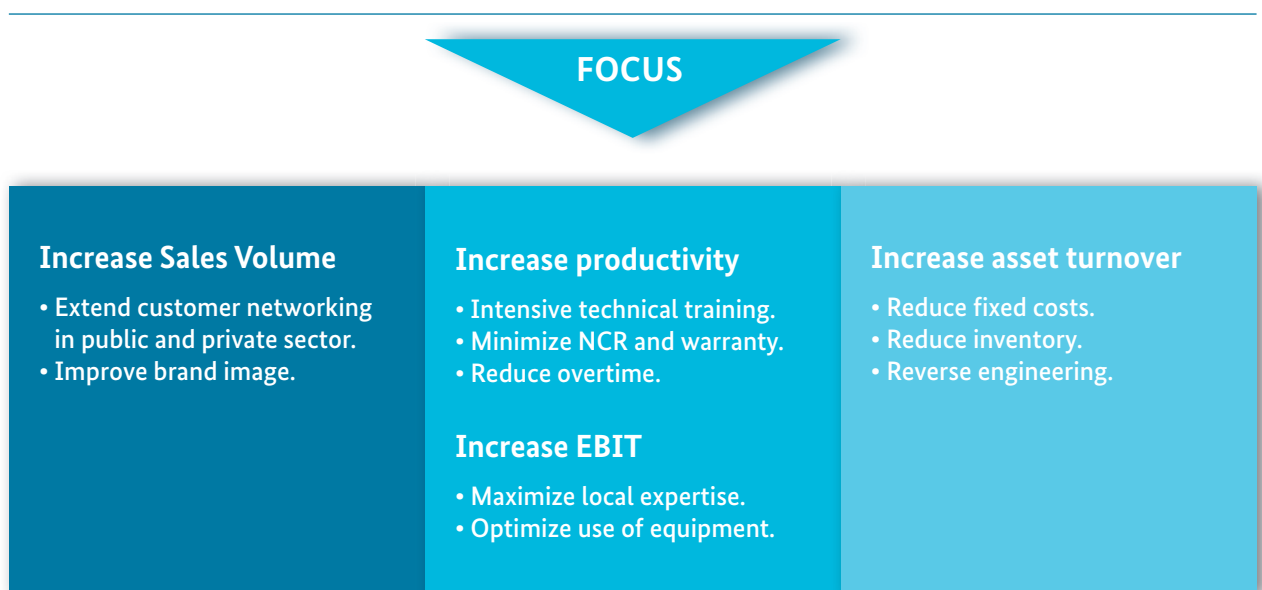
Figure 9. Structured Business Growth

STANDARD SETTING

WORK ORDER FROM PPC → **SUPERVISOR**

SOP	WORK INSTRUCTIONS
PARTS AND TOOLS	MATERIALS

Identify main cause of process failures in order to determine who and what kind of training will be provided.

Rejected / Warranty

Identify potential employee for skills training and job function up grading

Delivery

Next Process

Accept

OPERATOR

MILLING AND LATHE MACHINE

Materials for process

Setting Up the Work

Clamping or Chuck

Holding Work Objects

Setting the Machineries

Check the Alignment

Set the Object

Select Cutter / Insert

Select the Speed and Seed

Set the Feed Trip

People

Tools

Support Parts

Materials

Identify Problems

Reject

Good

Inspect

Finish

Start the Machine

Figure 10. Business process mapping

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2. Business Framework:
   a. Avoiding remedial work
      • Employees must meet required skills and competency levels.
      • Work instructions should be followed correctly
      • Any potential problems should be reported to the supervisor.
   b. Maintaining Quality
      A tolerance level of up to maximum 0.15% for annual sales should be upheld for rejection due to poor quality both internally and externally. 'Internally' refers to a failure to achieve high quality due to operational or human error or incompetence. 'Externally' refers to customers submitting claims due to late delivery and instances of receiving products of poor quality.
   c. Reliability
      Reliable process and services should be maintained by stakeholders.

3.2. Assessing Training Needs

1. Identification of problems
   The nature of problems identified can be linked to characteristics of low performance such as: low sales volume, high rejection during process and quality assurance stages, complaints and claims from customers, high staff turnover. These problems can be analyzed to indicate solutions and in turn inform improvement programs designed to minimize future problems of the same type.

2. Causes
   Any problem occurring during the work process must be related to natural, human or mechanical causes. A problem cannot exist in its own right. The causes need to be defined precisely so that an appropriate solution can be found.
   Example of cause analysis see Table 8.

3. Identification of the Improvement Focus
   The example above can be analyzed to find the related improvement focus for the training program.
   The problem has occurred as a result of a lack of competency of the machine operator. An improvement program for this matter could be skills development through training or job rotation.
   a. An unaccepted quality result has caused delivery delays. Quality acceptance requires the signing off of a written document to confirm quality and trigger release for delivery. The product was not released on time because the production release tag was not approved by the production manager.
   b. A customer submits a claim because of a minor crack in the product which was caused by undersize.

4. Training Needs Analysis
   The training needs analysis needs to be conducted based on the improvement focus described above

5. Modular in-Plant Training
   Once the training needs analysis has been undertaken the then training modules related to each improvement focus are developed.

6. Monitoring and Evaluation
   The delivery of the training should be monitored and evaluated in order to ensure that the

PROBLEM	CAUSES
Undersize of shaft diameter.	Lack of competency of the machine operator.
Late delivery.	Delay of quality acceptance release.
Warranty.	A minor crack due to undersize.

Table 8

PROBLEM (Based on Symptom)	Undersize of rolling shaft diameter for Bearing Sleeve Line Bearing. Job Number: PP/ MM/ NN/ 03.12	Undetected corrosion on the impeller bearing belongs to Job Number: XX.YY/ZZ/BBB/ 07.12
CAUSE (Supporting data/ facts)	Remedial work on lathe machine required additional 125 man hours. Buy materials and remanufacture process.	Warranty case due to complaints from customer caused additional operational expense.
INVOLVE POSITION	Lathe machine operator	Lathe machine operator
6 W	1. **Why (reasons for training):** Not following working instructions and doesn't communicate problem to superior. 2. **Whether (training is the solution):** Due to lack of understanding of the working instruction and standard operating procedure of the machine as issued by the manufacturer therefore skills improvement is required through training. 3. **Which (training process):** a. How to read working instructions. b. Implementation of standard operating procedures (SOP). 4. **Who (Trainer)** Both are internal training by: a. Machining supervisor. b. Engineering manager. 5. **When/ Where (Training Process):** a. First week September 2012 b. Second week September 2012. 6. **What (estimated ROI in training):** Eliminate remedial work so that the loss of man hours is reduced to zero.	1. **Why (reasons for training):** Failure to carry out tagging as identification of operation process status for follow up to next process. 2. **Whether (training is the solution):** Carelessness to attach tags caused process status unidentified by other person. 3. **Which (training process):** Implementation of standard operating procedures. 4. **Who (Trainer)** Machining supervisor. 5. **When/ Where (Training Process):** Second week September 2012 6. **What (estimated ROI in training):** Eliminate complaints from customers so that additional costs do not exceed maximum tolerable additional cost.

Table 9. Mapping of problem analysis

program has been implemented correctly, meeting the objectives of the participants, related topics, time, costs and outcomes.

7. Benefits for the company
   a. MIT supports human resources capacity building.
   Company specific training programs designed in a modular form, based on an action oriented approach will help to upgrade workers' productivity, product quality and reduce workforce problems.
   b. A problem solving approach
   MIT analyzes the cause of production or service failure prior to developing a training plan. It then identifies each activity so that the training plan can focus on the existing problem in the industry.

No.	COMPETENCE AND SKILLS	Budi Hartanto	Berty Matu	Hasan	Tony Latuha
1	Working experience*				
2	Lathe machine operation				
3	Welding				
4	Measurement tools				

Note: *only experience relates to present job position.

Table 10. Simple sample competency and skills level

c. The promotion of internal investment and enhancement of mobility of the labor force by training and re-training workers and developing the qualifications of low/semi-skilled workers.

3.2.1. Problem Analysis

The training module design follows criteria set out in the functional unit analysis. The training module consists of several modular units depending on the complexity of the business and required improvements for the organization. One of the tools for the planning and implementation of training is the modular unit. This describes, performance criteria, required resources, stages of work and the learning objectives together with a didactical unit. The design of the training module begins with the identification of symptoms and analysis of problems identified in the company.

In order to assess whether the problem can be solved by training or not, we can implement the 6W analysis as follows:

• Why (reasons for training)?
• Whether (training is the solution)?
• Which (training process)?
• Who (trainers and trainees)?
• When/where (training process)?
• What (is the estimated Return on Investment in Training)?

An analysis of the impact of MIT suggests that one training module is not usually sufficient to solve an identified problem in a company due to the complexity of causes causing the problem. There are five major activities in the company: Engineering, Repairs, Warehouse and Delivery, Administration and Management. The company suffered from poor performance due to a high level of remedial work, late delivery and complaints from customers. It was then identified that the main sources or root causes emerged from lathe machine operators. Therefore the problem analysis focusses on lathe machine operation especially the operator. *See Table 9 for the problem analysis table as carried out in the company.*

1. Mapping of problem analysis
   Based on problem analysis a company may identify training needs and target the training by analyzing the causes of the problem,

2. Assessing training needs
   Training needs assessment is based on:
   a. Indication of problems
      Based on discussion following identification of issues and problems, problems can be classified as follows:
      • Lack of competency of the technician;
      • Delivery delays because of unacceptable quality
      • Customer claims

b. Cause of problems
  • How can a technician who doesn't meet competency standards perform the work?
  • How can unaccepted quality have passed a quality assurance check?
  • Why does the customer complain about service received?

c. Related job or position holder
Determine any job function and job holder as the object to analyze. The analysis will include what they have performed, identifying problems from their activities at the work site, and identifying their weaknesses and strengths in order to establish appropriate improvement targets through training programs.

d. How to assess training needs
  1) Provide latest competency and skills level assessment Simple sample competency and skills level *(see Table 10).*

Table 11 is to showing the assessed competency and skills level of each employee. It will then be used to identify gaps in order to determine improvement programs for the employee.

The table can be adapted to suit the organization and complexity of the business in question.

2) Determining the required and assessed level of competence
Each section or employee will need different levels of competence to perform the jobs shown on the analysis. The assessment of competency and skills level should be undertaken annually or as required to fulfill company need.

3) Analyzing work instructions
This describes the effectiveness of the job description. It mentions particular

LEVEL	WORKING EXPERIENCE	LATHE MACHINE OPERATION	WELDING	MEASUREMENT TOOLS
5	=>10 years.	Able to modify model and initiate improvement as necessary.	Create and use new welding method as required on the job.	Modify and solve problems.
4	5 – < 10 years.	Operate and set tools including indicator, cutting, size measure (thickness and diameter).	Subsurface welding.	Able to calibrate measurement tools.
3	2 - < 5 years.	Able to set objects and make necessary adjustments.	Welding inspection.	Understand and operate digital measurements.
2	Beginner with less than 2 year.	Only able to operate.	Thick welding.	Operate tight tolerance measurement.
1	New graduate.	Beginner with full assistance.	Basic welding.	Use basic measurement.

5 = highest score/ extra ordinary, 1 = lowest/ below expectation

Table 11

requirements such as: type and quality level of materials, tools or machines to be used, size, thickness, delivery time, quality monitoring procedures, operational procedures including reporting lines etc. Work instructions should be read carefully and any incorrect information requiring changes or adjustments should be highlighted. Work instructions can be used to trace failures in given services or production.

4) Analyzing the job description

This describes tasks and responsibilities of the job holder and is helpful to map the quality of the worker to their ability to perform the job. Does the superior assign qualified employees to perform jobs or not?

5) Analyzing organizational structure

Has the right employee been assigned to the right position in the organization? It is useful to monitor the placement of employees to avoid poor performance which might result in service or production failure.

6) Determining training objectives

Training objectives are determined following a training needs analysis. Availability of data about employee performance helps trainers to determine improvement targets to be achieved in response to problems identified earlier.

7) Deciding on the training module

Once the problem has been identified the training objective is be defined and a training plan developed. Each module of training should describe the identified source of problems which need improvement action through the training program.

Table 12 is an example of a training module.

3.3. Analyzing / Mapping Function

1. Key Purpose (Occupation)

This describes a key aim of the company for example; to become a leading engineering services company.

2. Key Function (Jobs)

There are 4 (four) key functions in the company consisting of:

a. Engineering:

This plays a key role in the company because related technical aspects need initial inspection to identify any damage which may cause operational failure of the machines. Deep analysis also needs to be undertaken to decide on the probability of future failures considering various aspects such as: commerce, technology, materials and risks.

b. Repairs:

Activity at the workshop is based on technical drawing and working instructions. The repair shop comprises several sections such as: production planning and control (PPC), mechanical inspection, machining, welding and coating and quality inspection.

c. Warehouse and Delivery:

This handles packing and delivery.

d. Administration and Management:

This department supports key functions for administration such as human resources, finance and legal affairs

3. Major Function (Modular Units).

The description of the major function focuses on job sections or activities that will become the core of training needs analysis. It identifies the source of problems and their impact and discussions typically include:

• Lack competency of machine operator
• Delivery delay due to defective products
• Customer claims

It was identified that the incompetency of employees caused delivery delays and claims from customers. A lack of competency was shown in the machining tasks where the shaft diameter was produced. This phenomenon is usually termed 'undersized'. Remedial work needed to be undertaken to correct the size of the diameter, bringing with it the further risk of delays in delivery. Customer claims relate not only to delivery delay, but also to an additional problem constituting a minor crack due to undersize. Looking at the description of key functions enables us to determine whether action needs to be taken in the repair shop. Further analysis can focus more precisely on machining operation/ lathe machine operation. Therefore the operation of the lathe machine will be basic focus of the modular unit.

4. Basic Function (Steps of Work)

This divides the modular unit into basic functions/steps of work relating to lathe machine operation as shown below i.e.:

• Read and apply work instructions
• Read and understand technical drawing
• Provide tools and materials
• Set up objects on the machine
• Start machine operation

MU. No.	TITLE AND DESCRIPTION OF MODULAR UNIT	PERFORMANCE CRITERIA	REQUIRED TOOLS
MC-01-12	Title: Read and Apply Work Instruction		
	1. Reading and understanding work instruction sheet.	1. Standardization of size, type of materials, time span as shown on the work instructions.	Working Instructions
	2. Reading technical drawing as approved by related superior.	2. Apply all measurements, symbols, materials specifications accurately without any margin of error.	Drawing
	3. Review relationship of the drawing and work instructions to avoid misinterpretation.	3. Any proposed change needs prior approval from supervisor and/ or customer.	Drawing
	4. Interpreting technical symbols so that they align with the expected target	4. Apply symbols relevant to requirement in order to meet industry standardization.	Engineering symbols.

Table 12. Example of a training module

• Ensure that size measurements not exceed tolerance margin

Figure 11 is an example of functional analyzing and mapping based on the situation described at the engineering services company above.

3.4. Determining Steps of Work and Tasks Analysis based on Function

Knowledge of the steps of work and tasks analysis is required to identify the source of problems and the subsequent course of action required e.g. repair or remanufacture option. It is used to trace the performance that has caused operation failure, failure to follow procedures and work instructions, and failure to follow standard operational procedures among other causes.

Steps of work are described below:
1. Steps of work
   a. Identification Steps of Work
      (see Table 13)
   b. Tasks Analysis (into Steps of Work)
      (see Table 14)
   Competency unit: Lathe machine operation
   (see Table 15)

2. Description of modular units
   Modular units describe the unit of instruction and prerequisites needed to perform the assigned tasks so that problems reflected in the title of the modular unit can be eliminated. The performance criteria should be described clearly in the modular unit so that employees performing the tasks covered in the unit will retain the performance indicators and the task can be carried out effectively and efficiently. The success of the modular unit will be assessed against the following criteria:

ENGINEERING

ASSEMBLY PROCESS

**A LEADER
ENGINEERING SERVICE COMPANY**

WAREHOUSE AND DELIVERY

ADMINISTRATION

MAJOR FUNCTION: Modular Unit **BASIS FUNCTION: Steps of work**

Inspect damages and operation manufacturer
1. Collect machine spec is issued by manufacturer
2. Assess existing condition

Provide Technical Drawing
1. Measure changes
2. Develop CAD drawing

Analyze engineering aspects
1. Analyze quantity and quality to repair
2. Determine material specification
3. Analyze manhours and workforces required

Overhaul Equipment
1. Overhaul engine units based on engineering request
2. Separate damage equipment and part

Welding and Coating
1. Undertake welding
2. Operate coating

Operate lathe machines
1. Read and apply working instructions
2. Read and understand technical drawing
3. Provide tools and materials
4. Set up object on machine
5. Start lathe machine operation
6. Measure result not exceed max. to tolerance

Assembly process
1. Read technical drawing and apply instruction
2. Check equipments and parts
3. Install equipments and parts
4. Check alignment
5. Manual check and test

Quality Inspection
1. Quality standard manual
2. Read assess and inspect quality

Warehouse
1. Packing
2. Loading

Delivery
1. Check packing list
2. Transportation

HR
1. Recruitment
2. Training

Finance
1. Account receivable
2. Account payable

Legal
1. Commercial Contract
2. Compliance

Figure 11.

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STEPS OF WORK	STANDARD	SKILLS
1. Read and Apply Working Instruction.	1. WI-MC.05/2011 2. SOP/WI/061/09	1. Understanding and experience of application of working instruction. 2. Understanding of each unit. 3. Familiarity with related tools.
2. Read and Understand Technical Drawing.	1. WI-MC.05/2011 2. SOP/WI/062/09	1. Able to read technical drawing. 2. Understanding size unit and engineering symbols. 3. Familiarity with material type
3. Provide Tools and Materials.	1. WI-MC.05/2011 2. SOP/WI/063/09	1. Providing list of tools and equipment to use. 2. Organize tools in an orderly and correct fashion. 3. Auditing quantity and quality of tools and equipment. 4. Prepare records of materials received and used.
5. Set Up Object on the Machine.	1. WI-MC.05/2011 2. SOP/WI/065/09	1. Understanding machine facilities function. 2. Understanding of setting and fitting the equipment. 3. Capability to use measurement instruments. 4. Ensuring correct settings
5. Lathe Machine Operation.	1. WI-MC.05/2011 2. SOP/WI/067/09 3. Oerlikon/279/081	1. Understanding operation procedures. 2. Ensure correct speed/ rotation of the machine. 3. Checking size results are be within tolerance margin. 4. Turn on machine operation.
5. Measurements should not exceed maximum tolerance margin.	1. WI-MC.05/2011 2. SOP/WI/069/09 3. QC/GU/012/2008	1. Understand quality assessment procedures. 2. Understanding quality matrix report. 3. Checking quality standard requirements.

Table 13. Identification Steps of Work

- Competency of the technician.
- Punctuality of delivery.
- Customer claims.

See Table 16.

3. Required tools
   a. Employee competency and skills audit
   This is a tool to measure the level of existing competency and skills of employees before and after training. It includes a training effectiveness evaluation form.

b. Production report data sheet
   This is used to identify losses from various areas and then to identify the causes of such losses with a view to applying the training needs analysis program.
c. The training plan
   This is the plan for the training program selected and determined following a request and assessment from superiors and top decision maker in the company.
d. Classroom and equipment
   (clip boards paper and writing devices)

WHAT IS DONE?	HOW IT IS DONE?	WHAT AFFECTS THE STANDARD?	WHAT ADDITIONAL INFORMATION IS NEED?
Evaluate existing problem and evaluate detailed data in the work instructions.	Check detailed data in the work instructions then compare with information in the work instructions with SOP.	Repairs of the equipment. Unusual noises indicating incorrect connection or fitting.	Describe briefly the extra knowledge needed to carry out each section of the tasks.
Analyze size code to trace cause of undersize by comparing with data in the technical drawing	Measure any change.	Technical drawing evaluation as reference to determine size, type of materials, capacity, sensitivity tolerance.	Understand engineering symbols.
Ensure tools and materials stock and availability as required for operation.	Tools and material audit.	Sharpness of cutting tools and material specification	Receiving and using record list. Measurement instruments.
Evaluate machine settings to detect any malfunction	Setting and fitting. Evaluate position of the chuck and blade.	Speed and pulley settings.	Collect machine information issued by manufacturer.
Analyze lathe machine standard operation procedure (SOP) to apply correctly.	Monitor alignment Test machine once alignment is completed by using table list, required type and size, quality and condition.	Adjustment as required.	
Take sample and quality assessment to comply with agreement.	Evaluate final result using quality inspection tools. Take sample to monitor for quality assurance.	Quality standard requirement.	Inspection must follow manual book issued by manufacturer.

Table 14. Tasks Analysis (into Steps of Work)

SOW	LEARNING DOMAIN		
	AFFECTIVE	COGNITIVE	PSYCHOMOTOR
Read work instructions		Describing of WI	
Provide tools and materials.	Accuracy.	Apply SOP.	Selecting and collecting tools and materials.
Set up objects on machines as needed.	Accuracy and responsibility.	Determining base of SOP.	Setting chuck, blade, and shaft based on work manual.
Start machine. operation			Operating machine base on WI.
Measure size tolerance.	Precise	Understanding of measurement base on WI.	Measuring and comparing base on WI.

Table 15. Competency unit: Lathe machine operation

Figure 12. Mechanical Tools

MU. No.	TITLE AND DESCRIPTION OF MODULAR UNIT	PERFORMANCE CRITERIA	REQUIRED TOOLS
MC- 01-12	**Title: Lathe machine operation**		
	1. Read and understand work instruction sheet.	1. There may not any deviation of size, of materials, time span as shown on the work instructions.	**Working Instruction**
	2. Read and understand SOP.	2. All operations shall adhere to instructions on SOP sheet. Changes may only be made following written approval from direct superior and a next higher superior.	**Standard Operation Procedure for Machining Operator**
	3. Qualified to operate machine.	3. Understand relevant manual and have at least 3 years' experience of operating the lathe machine.	**Curriculum Vitae**
	4. Qualified to operate measurement tools and mechanical devices.	4. Correct application and use of measurement instruments and mechanical devices are required	**Tools and devices**

MU. No.	TITLE AND DESCRIPTION OF MODULAR UNIT	PERFORMANCE CRITERIA	REQUIRED TOOLS
ML- 02-12	Title: Checking the order Read and understand work instruction sheet.		
	1. Understand how to use the delivery check list.	1. There may not any deviation of size, type of materials, time span as shown on the work instructions.	Working Instructions
	2. Packing list check.	2. Follow all regulations and instruction for packaging system, means of transportation and insurance.	SOP
		3. Ensure required data on check list are fulfilled prior to delivery	Delivery check list

Table 16

No.	DESCRIPTION	TARGET	ACTUAL	BALANCE
1.	Production	US$. 30,000,000.	21,000,000.	'– US$. 9,000,000
2.	Remedial action	US$. 45,000	24,037	'+US$, 99,932
	Warranty costs		75,895.	
3.	Sales	US$. 27,000,000.–	19,000,000.	' –US$. 8,000,000

Table 17. Summary of annual production and sales report 2011

The training program will be undertaken both in class and on the shop floor for practical activities so that deep understanding of the subjects can be obtained.

e. Computer and LCD Projector
The main devices used for training presentations are the computer and LCD projector.

f. Mechanical tools
It consists of several types of tools such as: wrench, hammer, pliers tang, spanner, thickness gauge, fitter *(see Figure 12)*.

g. Measuring instruments
Steel ruler, sigmat, diameter check, thickness gauge, fitter *(see Figure 13)*.

h. Lathe machine
This is used by participants in order to enable them to apply their classroom learning to a practical context.

3.5. Determining Outputs and Performance Indicators

There is much discussion about outputs and performance indicators within the engineering services industry.

Labor costs represent one of the primary expenses in this business because the company sells its expertise to operate the business.

1. Labor Costs
Each business has its own approach to the calculation of labor costs. Labor costs in a service company is a primary component of the calculation of production costs, whereas in mass production industry the costs attributed to labor are a secondary component of production cost.

2. Warranty costs
Warranties are issued by the provider company to protect the company's liabilities in case of unexpected failure or poor quality. In the services industry, warranty claims can be submitted by customers within a given time period. Warranty claims in mass production industries usually come from internal buyers as opposed to individual customers. If it does happen the company stands to lose far less than the service driven company because the failure can be identified and remedied directly after the production process.

Some examples of warranty claims and subsequent remedial action can be seen in the *Table 18*.

3. The Production Report
A summary of annual production and sales report should be prepared by the management team for evaluation in relation to the company's

Figure 13. Measuring instruments

overall strategic strategy. However it is also usual for monthly production and sales reports to identify problems and suggest actions for improvement. The company's annual report includes details of the company's progress in relation to strategic plans together with a production and sales report. See *Table 17* (Annual production and sales report 2011).

The annual sales report shows that:
a. Production is below target (70 %).
b. Remedial works and warranty costs are above maximum tolerance margin (222 %).
c. Sales are below target (70,3 %).

The data indicates that performance of the company is far below expectations while remedial actions and warranty costs exceed the tolerance margin. Causes of these problems can be revealed by mapping job specification and competency against Standard Operation Procedure. The decision then has to be made as to whether a training program might help solve the issues leading to underperformance.

3.6. Determining Job Specification

1. Job specification
   A job specification describes the knowledge, skill, education, experience and abilities that are believed to be prerequisites to performing a particular job. The job specification is developed from a detailed job description. A job specification summarizes requirements whereas the job description defines the duties and requirements of the employee's job in detail.

   The job specification is the key to successful recruitment Applicants who understand the role of the post in detail are more likely to be successful in gaining and retaining the post. A job specification is also used to monitor employee performance in order to identify gaps in knowledge, skills or attitude which would benefit from training *(see Table 19)*.

2. Competency
   Table 20 explains the competency and skills level of the employees and the training activities relating to development and assessment. It shows the required and actual skills levels, strengths and weaknesses, training activities and achievements of employees over a given period of time, usually conducted on an annual basis.

   It is shown on the competency table above that none of the employees fulfill standard requirement levels to perform their jobs. There is a clear indication that an improvement program should be undertaken and training needs analysis is one of primary action to solve the problems.

No.	JOB No.	PART NAME/ TYPE OF JOBS	DESCRIPTION OF PROBLEMS	ACTIONS	ESTIMATED COST (US DOLLARS)		
					HOURS	MATERIAL	TOTAL
1	SN-0371	Pump Shaft	Broken mechanical seal at area of pump shaft.	Recoating with pre-heat temperature and add air cooling nozzles. It is also required to revise procedure for max preheat to any certain diameter of shaft.	60	15	75
2	SN-1927	Pump Shaft	There is a different threaded hole at motor shaft because of an incorrect dimensions of the drawing.	1. Revise drawing to make correction of the hole diameter. 2. Apply mechanical insert to repair the hole. 3. Revise the reverse engineering procedure to accommodate activity mentioned above.	715	140	855
3	SN-0295	Compressor Rotor	Damage to coupling fitting area of the shaft following drop from chuck during machine work.	1. Due to undersize coupling fit area, apply hard chrome plating, machine and final inspection. 2. Locate copper plates farther from the edge of the shaft so they can achieve 100% contact with the shaft. 3. Revise working instructions to add detail of actions above.	21,025	820	21,845
4	SN-2013	Steam Turbine Diaphragm	Big gap on the newly installed seals at split line area	1. Replace seals 2. Finish cutting should be done by manual rasping. 3. Revise procedure to add more detail about cutting the seal on the split line.	1,015	79	1,094

Table 18. Annual remedial work and warranty report 2011

No.	JOB No.	PART NAME/ TYPE OF JOBS	DESCRIPTION OF PROBLEMS	ACTIONS	ESTIMATED COST (US DOLLARS)		
					HOURS	MATERIAL	TOTAL
5	SN-1194	Pump Shaft	Coating was blistered at seal area of pump shaft at one end.	1. Remove blasting. 2. Re-blasting and recoating. 3. Revise working instruction to add method for rotating the shaft by hand to make sure the center is true	152	16	168
6	SW-019	Steam Turbine Diaphragm	Diameter of diaphragm was larger than required which was caused by wrong reference number.	1. Replace with new seal 2. Inspector report must neat and clear to avoid misunderstanding.	40,102	118	40,220
7.	SW-211	Gland Packing Cover	Gland packing cover was manufactured using different type of material compare to original one due to spectro-analyzer inaccurate result.	1. Reanalyze spectro-analyzer. 2. Remanufacture new parts. 3. Calibration of spectro-analyzer is required prior to operation. 4. Familiarization with the correct procedure prior to operation.	31,200	1,100	32,300
8.	P-102	Penalty	Late delivery of 45 days.	Ensure quality inspection and preparation of technical report are monitored and on schedule.	3,375		3,375
				T O T A L	US$ 97,644	US$ 2,288	US$. 99,932

Maximum tolerable remedial work and warranty costs are 0,15% from annual sales: US$30,000,000 X 0,15% = US$45,000.

Actual total remedial work and warranty costs are US$99,962. I. This is far above the maximum tolerance margin and therefore improvements are required.

Table 18. Annual remedial work and warranty report 2011

JOB SPECIFICATION	WORLDWIDE COMPANY
Job Title:	Machine Operator
Purpose of the Job:	To perform machining works as assigned by supervisor to achieve given targets.
Duties and Responsibilities	**Daily Duties:** a. Work within working instructions. b. Review/analyze and understand technical drawings. c. Pre-operation preparation such as: cleanliness, speed control adjustment position, cutting tools and drills sharpness, chuck test, oil and safety equipment control. d. Receive and implement working instructions from supervisor for every assignment. e. Complete time card and report to superior every day. f. Report any problems or difficulties to superior immediately in order to minimize the loss of man hours. g. Make use of working hours as efficiently as possible by following instructions. **Tasks:** a. Coordinate with machining supervisor, mechanic technician, maintenance technician and quality inspector. b. Receive and implement working instructions for machining tasks using tools with proper maintenance in order to achieve quality standards safely, efficiently, correctly and on punctually. c. Check every receipt of tools, materials or spare parts following company standard for quality and operations. d. Ensure that cleaning procedures are correctly carried out and comply with company policy. e. Comply and follow company working procedure in all tasks. f. Inspect and recheck every task undertaken to identify progress and quality. g. Ensure that the working environment is kept clean and tidy. h. Implement and comply with company procedures and policy. **Responsibilities:** a. Provide regular reports of all activities to supervisor (or in absence, to the next higher superior). b. Maintain condition of measurement instruments and store in dedicated places only. c. Record completed tasks and keep an inventory of material stock. d. Maintain upkeep of machinery including cleaning and lubricating. e. Maintain and store cutting and mechanical tools including measuring instruments. f. Plan and prepare tasks in order to facilitate readiness of tools, spare parts and materials required.
Candidate:	1. 1 year's experience in machine operation. 2. Minimal Diploma (D3) in engineering field certificate. 3. High flexibility in the working environment. 4. Holding basic health and safety certificate from SICS or others.

Table 19. Job specification

JOB SPECIFICATION	WORLDWIDE COMPANY	
Reporting To:	Machining Supervisor	
Employment Status:	Permanent	
Working Hours:	**Days:** Monday – Friday **Normal Hours:** 08.00 – 17.00 **Breaks:** 12.00 – 13.00	
Employee Level:	D-12	
Compensation & Benefits:	**Basic salary:** as regulated for level D-12 / 14 months annually. **Insurance:** health (includes spouse and three children up to 21 years old. **Transport:** pick up from a designated point together with other employees. **Meal:** provided by the company during working hours. **Sport:** weekly sport membership facility. **Annual leave:** 15 days. **Bonus:** as mutually agreed on bonus scheme.	
Commencement Date:	Three months' probation period since first day of commencement in the company.	**Remarks:** Subject to performance assessment 30 days prior to completion of probation period.
Closing Date:	End of probation period	
Knowledge: (Indicate what knowledge is required to do the job, e.g. Do you require an understanding of a defined system, practice, method or procedure?)	**Essential:** a. Must able to operate lathe machine. b. Able to undertake jobs on machines of up to 15 t weight. c. Expertise in at least one of horizontal or vertical lathe machine, boring and or milling. d. Understand and be able to select cutting tools appropriate to the assigned task. e. Understand and be able to use measurement instruments relating to the assigned task. **Desirable:** a. Understand PLC b. Able to operate all related machinery correctly, complying with health and safety regulations. c. Able to fulfill standard requirements or above the agreed tolerance margins. d. Self- motivated to undertake various assignments with reduced supervision and guidance. e. Possess sound knowledge of hand tools, belt sander, bench grinders, vices, heating torches etc. f. An operational understanding of measurement instruments such as: micrometer, dial indicator, vernier caliper, CMM and Stiefelmeyer. g. Ability to read and understand the manual book for machines and equipment.	

Table 19. Job specification

JOB SPECIFICATION	WORLDWIDE COMPANY
Work Skills: (Indicate what skills specific to the job are required, e.g. Language fluency, typing skills, etc.)	**Essential:** a. Demonstrate ability to understand and carry out working instructions safely and efficiently. b. Ability to read and use measurement instruments correctly in relation to machine operation. c. Must ensure that only the calibrated measurement tools are used for machining operation. d. Ability to read and apply blue prints for machining processes **Desirable:** a. Self- motivation and the ability to anticipate fulfilling broader tasks if required. b. Ability to prepare working summaries and reports for all assigned tasks. c. Good understanding of written and spoken English. d. Familiarity with computer packages especially f word, excel and AutoCAD. e. Good team work skills. f. Familiarity and understanding of the quality standards ISO 9001, ISO 14001 and OHSAS 18001. g. Operational understanding of safety procedures relating to cleaning, health, safe working, fire safety including operation of hydrant and fire extinguishers. h. Ability to act on constructive criticism.
General Skills/ Attributes: (What more general characteristics are required to do the job effectively, e.g., Communication skills, writing skills, ability to delegate, motivation etc.	**Essential:** a. Good communication skills. b. Excellent report writing skills. **Desirable:** a. Understanding of delegated authority. b. Self- motivation. c. Highly disciplined. d. Determined.
Experiences: (What experience and/ or achievement in a field, profession or specialism is required. E.g. a minimum period of experience in a defined area of work etc	**Essential:** a. Practical machining operation experience at least 5 (five) years in companies dealing with oil and gas, steam and gas turbines operation/ maintenance/ repairs, centrifugal compressors, pumps, turbo expander and other rotating machines. b. Experience with working at high levels. **Desirable:** a. Qualified with PLC certificate. b. Qualification for technical drawing. c. Certified AutoCAD.

Table 19. Job specification

JOB SPECIFICATION	WORLDWIDE COMPANY
Education: (Indicate the level of education required.)	**Essential:** Graduated from vocational school level 12 specialist in mechanical or machinery operation. **Desirable:** Passed technical college major in mechanical or machining.
Qualifications: (Indicate the professional qualifications and/or specific occupational training needed.)	**Essential:** Pass in basic machine operator course. **Desirable.** Pass in machine programming course.

Table 19. Job specification

Position Holder: Machining Supervisor	Position Holder: Production Manager	Position Holder: HRD Manager
Prepared by:	Reviewed by:	Approved by:
Name:	Name:	Name:
Holder Supervisor	Holder	
Signature:	Signature:	Signature:
Date:	Date:	Date:

No.	NAME:	BUDI SANTOSO		ANIS MANUPUTY		JOHAN ASKILES		REMARKS
	DESCRIPTION	R	A	R	A	R	A	
	INTANGIBLE							
1	Leadership (1)	3	1	2	1	2	1	
2	Communication (1)	3	1	2	1	2	1	
3	Team Work (1)	3	2	3	1	3	1	
4	Experience (2)	3	3	3	3	3	2	
5	Tactful (2)	2	1	2	1	2	1	
6	Relationship (2)	3	2	3	2	3	1	
7	Innovative (3)	3	1	2	1	2	1	
8	Trustworthy (3)	5	3	5	3	5	2	
9	Consistency (3)	3	2	3	2	3	1	
10	Objectivity (3)	3	1	3	1	3	1	
11	Motivation (4)	3	2	3	1	3	1	
12	Cost Effectiveness (4)	3	2	3	2	3	2	
13	Time Efficiency (4)	3	2	3	1	3	1	
14	Foreign Language (4)	2	1	2	1	2	1	
15	Computer (4)	2	1	2	1	2	1	
	Overall:	44	25	41	22	41	18	
	Average:	2.93	1.67	2.73	1.47	2.73	1.2	
	JOB RELATED							
1	Technical Drawing	3	1	2	1	2	1	
2	PLC	2	1	1	1	1	1	
3	Welding	2	1	1	1	1	1	
4	Measurement Tools	3	2	2	2	2	2	
5	Machine Operation	3	3	3	2	3	2	
6	Measurement technology	3	2	3	2	3	2	
7	Cutting Technique	3	2	3	2	3	1	
8	Tools Setting	3	2	3	1	3	1	
9	Housekeeping	3	2	3	2	3	2	
	OVERALL:	25	16	21	14	21	13	
	AVERAGE:	2.8	1.8	2.3	1.6	2.3	1.4	

Score Level: 1 (lowest) to 5 (highest)   NOTES R: Required, A: Actual   Table 20. Competency

No.	NAME:	BUDI SANTOSO		ANIS MANUPUTY		JOHAN ASKILES		REMARKS
	DESCRIPTION	R	A	R	A	R	A	
	SAFETY and ISO							
	ISO 9001	3	2	3	1	3	1	
	ISO 14001	3	2	3	1	3	1	
	OHSAS 18001	3	2	3	1	3	1	
	OVERALL:	9	6	9	3	9	3	
	AVERAGE:	3	2	3	1	3	1	
	TRAINING and COURSES 2011							
	Vibration & Balancing	Mar		X		X		
	Machining	Jan		Mar		May		
	Measuring Tools	Jan						
	Boroscope Inspection	Jun						
	Lifting & Forklift	August		X		August		
	Overhead Crane	X		X		Jun		
	Cutting Tools	Apr		August		Oct		
	Metal Cutting	X		X		X		
	Metrology Industry	X		Feb		X		
	Mechanical Inspection	Feb		Apr		June		
	Technical Drawing	X		X		X		
	Heating Technology	X		X		X		
	Motivation	X		X		X		
	Leadership	X		X		X		
	Fire Fighting	Jun		Dec		X		
	First Aid	X		Nov		X		

Table 20. Competency

LEVEL	WORKING EXPERIENCE	LATHE MACHINE OPERATION	WELDING	MEASUREMENT TOOLS
5	=>10 years	Able to modify model and initiate improvement as necessary.	Create and use new welding methods as required on the job.	Modify and problem solutions.
4	5 – <10 years	Operate and setting tools includes indicator, cutting, size measure (thickness and diameter).	Subsurface welding.	Able to calibrate measurement instruments.
3	2 - <5 years	Able to setting objects and make some necessary adjustment.	Welding inspection.	Understand and operate digital measurement.
2	Beginner with less than 2 year.	Able to operate only.	Thick welding	Operate tight tolerance measurement.
1	New graduate	Beginner with full assistance.	Basic welding.	Use basic measurement .

5 = highest score / extra ordinary, 1 = lowest / below expectation

Table 21. Competency Table

Please see *Table 21* to measure level of competency.

The table is adaptable according to the organization and complexity of business.

3. Standard Operation Procedure

A SOP is a set of instructions or steps which an employee follows to ensure that a job is completed safely, meeting compliance standards, with no adverse impact on the environment and in a way that maximizes operational and production requirements. SOPs are drawn up for every process carried out by an individual or a group, for example unloading raw materials, manufacturing products, shutting down an operation, repairing a faulty electrical circuit, working with patients in a hospital, working in catering, performing activities in a fire station, and thousands of other workplace activities. Although these examples refer to industrial work settings, the SOP can be used in other work contexts too.

Guidelines (or SOPs) for work activities have been produced in large companies for many years, usually under the aegis of the Quality Assurance department. Such guidelines are produced to help workers produce high quality products which help the company compete in the market place. In order to ascertain the regard in which these SOPs are held in a company it is worth considering who is responsible for drawing them up. In many companies, SOPs

STANDARD OPERATING PROCEDURES (SOP) JOB POSITION: MACHINING OPERATOR		WORLDWIDE COMPANY
SOP No.:	Original Date Issue:	Revision No.:
Revision Date:		
Revised by: Name: Job Position: Sr. Operator Machining Signature:	Reviewed by: Name: Job Position: Supervisor Manager	Approved by: Name: Job Position: Production
Purpose: Primarily to provide instructions on how to operate a lathe machine correctly. A secondary purpose is to serve as framework for organizational policy by providing direction and structure in outlining best practice in written documentation. The SOP is the starting point for job descriptions, employee training, corrective and disciplinary action and performance review **Related Standards and Procedures:** 1. Working Instructions 2. Technical Drawing 3. Safety Regulations 4. ISO 14001 and OHSAS 18000 **Procedure:** List the tasks step by step to provide instruction on how to perform this procedure.		

Table 22. Standard operating procedures (SOP)

are written by people who design or "engineer" manufacturing, and, sometimes, environmental control processes but these people are often distanced from the manufacturing process itself and may have limited experience with implementing health and safety regulations.

SOPs also are written by people who supervise activities such as loading, unloading and transferring materials; maintenance; operating vehicles, cranes and similar machinery; mixing or producing chemical substances; performing audits and soon.

If the person or people writing the SOPs have a limited understanding of an operation,the resulting guidelines will often contain errors. In some companies, when technicians and supervisors don't have the time to write SOPs, they hire students on summer internships to write them. Hiring such help is better than nothing, but the students' lack of experience makes this a risky solution. In some rare cases, companies ask workers to write SOPs, however workers rarely have the comprehensive knowledge needed to write a good SOP. They need help. In the end, no matter who writes an SOP, at some point the operational process is altered in some respect and the SOP is rarely updated to reflect the change in practice *(see Table 22).*

Figure 14. Setting an object on a chuck

Figure 15. Speed setting

Standard operating procedures (SOP)

A. Preparation

1. Know the location of start and stop switches or buttons.
2. Ensure the machine and surrounding area is clean and free from obstacles.
3. Read and understand the working instructions and ensure you are able to access them while operating the machine.
4. Read and understand the technical drawings.
5. Prepare all related tools and arrange them in an orderly fashion, ready for use.

B. Safety

1. Ensure clear access to Emergency Stop buttons.
2. Never operate the machine without using extraction fan and an appropriate dust mask.
3. Safety glasses with side shields must be worn at all times.
4. Do not wear loose clothing, loose neckwear or exposed jewellery while operating the machine.
5. Do not work alone in a machine shop. (Implement the "buddy" system.).

6. Long sleeves should be rolled up above the elbows.
7. Long hair should be tied back securely.
8. Do not wear thin fabric shoes, sandals, open-toed shoes, and high-heeled shoes.
9. A machinist's apron should be tied in a quick release manner.
10. Keep hands away from moving cutting tools.
11. Do not make measurements of the stock while the milling machine is powered.
12. Always keep hands and other body parts a safe distance away from moving machine parts, work pieces, and cutters.
13. Use hand tools for their designed purposes only.
14. Report defective machinery, equipment or hand tools to superior immediately.
15. When an operator observes an unsafe condition with the lathe or stock being worked, the operator must report it immediately to the designated superior and the lathe shall be taken out of service until the problem has been corrected.
16. Stop the machine immediately if odd noises are heard or excessive vibration occurs.
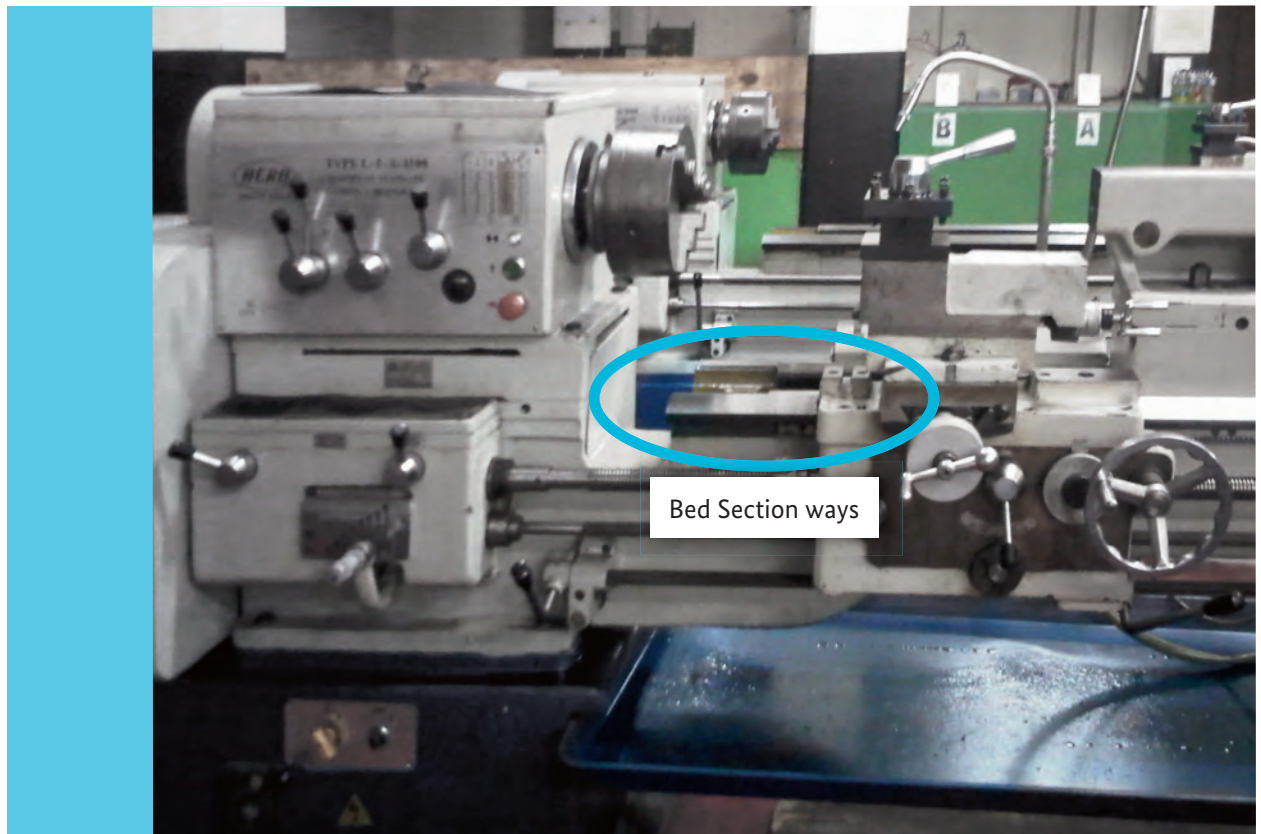
Figure 16. Bed section of ways

C. Operation

1. Ensure all guards and adjustable tables are secured and correctly fitted.
2. Stand squarely in front of machines.
3. Never attempt an operation if you are unsure of what you are doing.
4. Cutting tools must be securely fastened in the machine spindle with the proper accessory. Never try to tighten cutting bits or tools by hand and/ or bare hand.
5. Do not power the machine to tighten or loosen cutting bits or tools.
6. All stock must be properly secured with a vice or clamps prior to a machining process.
7. Never attempt to remove a broken drill with a center punch or hammer.
8. Use only properly sharpened cutter, drill bits, sockets and chucks in sound condition.
9. All stock must be properly secured in the lathe chuck or mounted prior to the machining process taking place.
10. Never leave the key in the chuck. Do not let go of the key until it is free of the chuck and secured in its proper holding place. *See Figure 14.*

11. Set the gear speed as required for the operation.
12. Use appropriate speeds and feeds for the type and size of cutter being used and the material being machined.
13. Use the correct speed and drill for the type of stock being machined.
14. Select turning speed carefully. Large diameter stock must be turned at a very low speed. Always use the lowest speed to rough out the stock prior to final machining.
15. The correct speed and feed for the specific material and cutting tool must be used. Stop the machine before making adjustments or measurements.
16. Never attempt to run the chuck on or off the spindle head by engaging the power.
17. Do not stop the rotation of the chuck by reversing the power to the lathe unless tapping holes.
18. Before starting the lathe, ensure the spindle work has the cup center imbedded; tail, stock and tool rests are securely clamped; and there is proper clearance for the rotating stock *(see the Figure 15. for speed setting)*
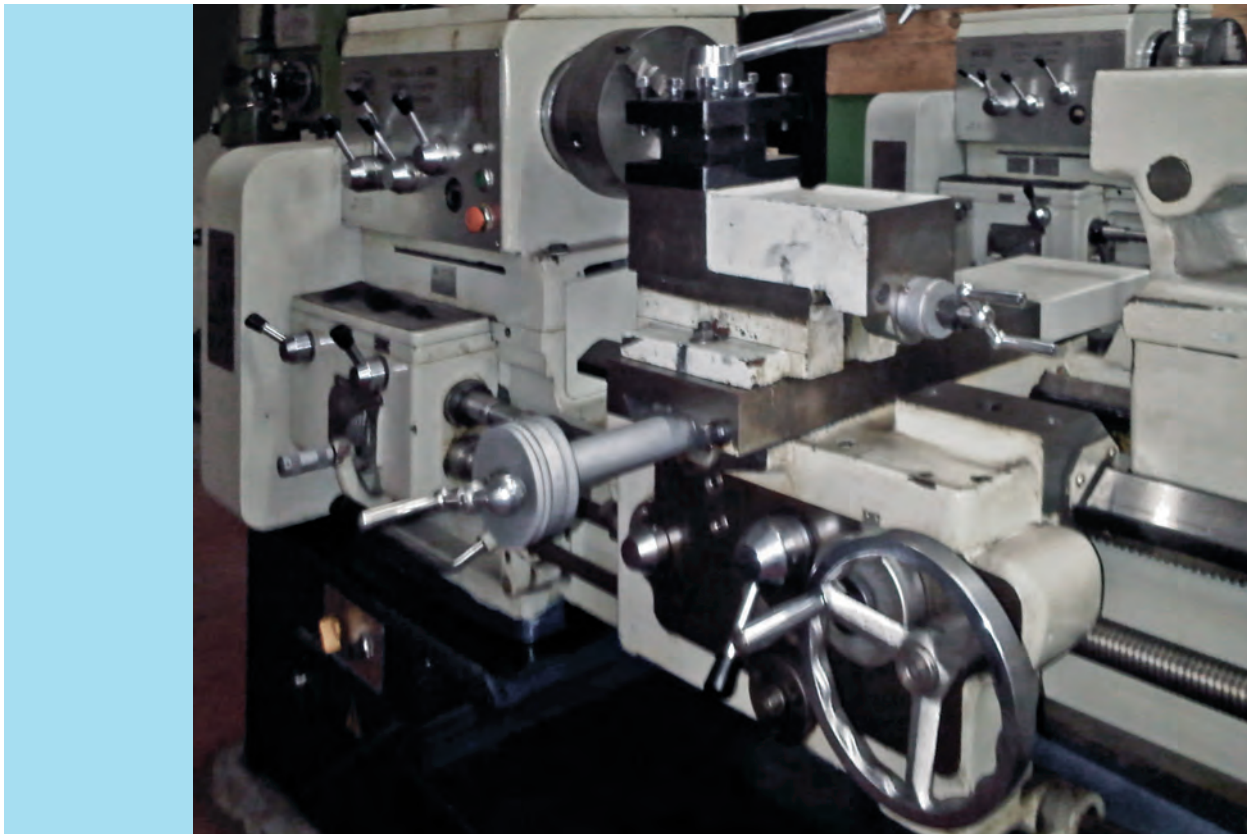
65

Figure 17. A lathe machine in operation

19. Do not leave tools, bits or excess pieces of stock on the lathe bed.
20. Do not attempt to oil the machine or make adjustments to the work while the machine is running.
21. Keep all guards in place while operating the machine.
22. While operating the milling machine do not allow anyone else to touch it.
23. Use the correct sized clamp or vice for the stock being machined.
24. Turn the chuck or faceplate by hand to ensure there is no binding or danger of the work striking any part of the lathe.
25. Check to ensure the cutting tool will not run into the chuck or lathe dog. If possible, feed away from the chuck or dogs.
26. Prior to starting the lathe, ensure that small diameter stock does not project too far from the chuck without support from the tail stock center.
27. The operator must always be aware of the direction and speed of the carriage or cross feed prior to engaging the automatic feed.
28. All belts and pulleys must be guarded. If frayed belts or pulleys are observed, the lathe must

be taken out of service and the belts or pulleys replaced.
29. Do not leave tools, bits or excess pieces of stock on the lathe bed.
30. Only properly sharpened drill bits and cutting tools in good condition should be used.
31. Dull drill bits and chipped or broken cutting tools must be removed from service.
See Figure 16. Lathe machine.

D. Finishing
1. Do not insert a drill chuck key into the chuck until the power is shut off and the machine has come to a complete stop. Disconnect the lathe from power source and follow OSEH Guideline Lock-out/Tag-out - Control of Hazardous Energy Sources.
2. When an operator has finished working on the lathe, and before leaving the lathe for any reason, the power must be shut off and the machine must come to a complete stop.
3. Ensure area is left in a clean condition and any waste is removed.
4. Keep all guards in place while operating the machine.

WORK INSTRUCTIONS | PRODUCTION

Job No.:	SM-00590.12.01.12

Customer:
Received by:
Type of Equipment:
Date:
Manufacturer:
Project Begin:
Year & Model:
Completion Date:

Sent by Department:
Responsible Person:
Dept Manager:

Instructions: Remove/ replace mechanical seal which is to be repaired and
necessary part replacement as shown on the attached drawing date May 27, 2011

Total man-hours request is 460 hours only.

Operation Control and Report

OPERATOR NAME	DATE	WORK RESULT	HOURS	REMARKS

Table 23. Work instructions

5. While operating the milling machine allow no one else to touch it.

6. Do not allow large quantities of chips to accumulate around the work piece or machine table.

7. After stopping the machine, use a brush or rag to remove all excess chips from the mill bed and stock.

8. Use a rag to handle sharp cutting tools.

9. Cutting tools must be securely fastened in the machine spindle with the proper accessory. Never try to tighten cutting bits or tools by hand.

10. Do not power the machine to tighten or loosen cutting bits or tools.

11. Work pieces and stock must be rigidly fastened to the mill bed with clamps, a vice, or special fixtures.

12. Use appropriate speeds and feeds for the type and size of cutter being used and the material being machined.

13. Make sure the cutting tool is clear of the work piece before starting the machine.

14. Know the location of start and stop switches or buttons and keep the drill press table free of tools and other materials.

15. Use only properly sharpened drill bits, sockets and chucks in good condition. Remove dull drill bits, battered tangs, or sockets from service.

16. Do not remove metal or wood chips from the table or stock by hand. Use brushes or other tools to remove chips safely.

17. Do not attempt to oil the machine or make adjustments to the work while the drill press is in motion.

18. Do not insert a drill chuck key into the chuck until the power is shut off and the machine has come to a complete stop.

19. All belts and pulleys must be guarded; if frayed belts or pulleys are observed, the drill press must be taken out of service and the belts or pulleys must be replaced *(see Figure 17).*

Related Forms and documentation:
- Material check list
- Tools check list
- Production report form
- Safety report form
- Quality inspection form

Records:
- Man hours record
- NCR record
- Labeling record
- Handing over record

See Table 23.

3.7. Determining Performance Criteria

Performance criteria are used to assess the performance achieved by employees against the level of performance expected to do the job well. They describe the actions, skills, knowledge and understanding which constitute competent performance of each element of the job. Performance criteria can be described as follows:

1. Performance criteria consist of applicable procedures and other supporting requirements so that job performance can be measured against expectations of the organization for the role in question.

2. Performance criteria indicate the specific characteristics the employee should be able to demonstrate in order to achieve the goal of the role.

3. Performance criteria inform employees about expectations and clarify the target to be reached. They are made up of two parts; performance and conditions. The expected performance must be specified by name, using an observable action verb such as: demonstrate, interpret, discriminate, or define. The verb used should be consistent with the level of learning expected. The conditions under which the behavior will occur are stated. This is the content which is worth knowing, doing, or feeling.
For some performance criteria, a minimum standard of performance may also be stated. These specify the degree of proficiency the employee must demonstrate to achieve the target at a basic level. Future objectives and outcomes can be located in any of the cognitive, affective and psychomotor domains.
Performance criteria describe the effort and ability of a person with supporting equipment / tools to achieve the required standard performance. They are required for each specific modular unit. They also mention procedure and other requirements to achieve targets. For example, the main performance criterion required from machine operators is size tolerance maximum 0,3 micron from the target size as described in the working instruction and technical drawing.

UNIT No.	TITLE AND DESCRIPTION OF ELEMENT	PERFORMANCE CRITERIA	REQUIRED TOOLS
PMC-3-03-12	Title: Prepare Work Area		
	1. Cleanliness	1. Apply all cleaning standard requirements. 2. Clean dirty equipment, discard garbage and clear area to perform work. 3. Ensure work surfaces are dry. 4. Clear the machine table except for the required tools and working instructions.	1. Cleaning inspection form. 2. Cleaning equipment. 3. SOP.
	2. Safety and health	1. Ensure emergency on/ off buttons are operational. 2. (PPE) only are required. 3. Wear safety glasses before turning on the machine. 4. Ensure safety check list form have been completed.	1. Safety guidance. 2. Safety inspection form. 3 Safety record and record form.
	3. Tools and materials	1. Prepare required mechanical tools and measurement instruments. 2. Check sharpness of cutting tools so that it can be used. 3. Check availability of materials.	1. Material check list. 2. Material release form issued by Quality inspector.
	4. Supporting documents and forms		1. Working instruction. 2. Production report form. 3. Safety report form. 4. Additional materials request form. 5. Accident report form. 6. Production label.

Table 24. Performance Criteria

If the size is set bigger it may cause oversize and if set smaller it could cause undersize. Both oversize and undersize outcomes will be rejected because they may cause re-fitting failures. The equipment may become difficult to rotate or loose and defects will appear in the product. Every commercial and industrial sector has their own stakeholders, who are made up of all parties with a vested interest in the business (e.g. employers, employees, vendors, customers and government body). The stakeholders reach a consensus on knowledge and performance levels required for every job within their sector and document these requirements in the form of written standards. These standards are then collated and produced as company rules and policy.

Accredited standards of competence are broken down into a series of units, which describe key areas of the job. These units can be unique to one particular job or common to a range of different occupations (e. g. Operation and Safety) etc. For example, these are the units of competence for Machining Operator in Mechanical Seal Processing.

PMC-03-5-12 Production
• Unit ENG/03-01-12 – Engineering – Auto CAD
• Unit PML-3-02-12 – Mechanical disassembly and assembly
• Unit PMC-3-03-12 –Machining Operation
• Unit PNDT-3-04-12 –NDT Inspection
• Unit PW -3-05-12 –Welding Work
• Unit PC-3-06-12 –Coating Work
• Unit POHS-3-07-12 – Follow Defined OHS Policies and Procedures
• Unit PQA -3-08-12 – Apply Quality Standards

Units are then further broken down into component parts called **Elements**. These are separate tasks that make up each of the functions within the Unit.

Unit PMC-3-03-12 – Machining Operation
• Element 1 – Prepare work area
• Element 2 – Speed setting
• Element 3 – Select and install cutter
• Element 4 - Set-up object
• Element 5 – Chuck setting
• Element 6 – Check alignment
• Element 7 – Implement workplace health and safety practices

The Training Package document for each unit usually contains three sets of statements showing what is required in order to carry out the task:

• The performance capability required (elements and performance criteria).
• The range of conditions, situations or other variables under which the task must be performed (range statement).
• The knowledge required (evidence guide).

Whilst the range statement and the evidence guide are general requirements of the unit as a whole, the performance criteria are mapped to particular elements.

a. Preparation of the work area
   Performance criteria:
   1. The work area and seating are set up according to workplace ergonomic standards.
   2. Cutting equipment is cleaned, checked and basic servicing assessed in accordance with manufacturer's instructions.
   3. Materials are collected and laid out in correct proximity and sequence in accordance with workplace procedures. It is essential when planning assessment that you ensure that the evidence provided by the candidate will be sufficient to demonstrate competence in all of the Performance Criteria. Only when all the performance criteria, range statements and knowledge requirements have been met can the assessment be signed off and the candidate deemed competent.

b. Examples of performance criteria
   Expectations for a machine operator in relation to the preparation of the work area.

   Element: Preparation of the Work Area
   Sub-element:
   1. Cleanliness
   2. Safety and health
   3. Tools and materials
   4. Supporting documents and forms

   If the work area at the machining operation is cleaned consistently after each operation, the employee would probably avoid wasting time and demonstrate the necessary quality for the required standard.
   See Table 24. Performance Criteria.

3.8. Composing a Didactic Unit

A didactic unit is a kind of learning plan designed to achieve improvement. Training is part of a didactic unit which is focused on improving the performance particular work related activities. The trainer explains the details of the topics to be covered and develops the didactic unit to include coverage of skills, competences, time allocation and quality. When planning the didactic unit the trainer needs to take into account what participants have to learn during the course, how classes will be planned and the different needs that participants may present (unstable machine position, speed controls which don't work, operational difficulties, late arrival of materials etc.).

The usual structure of a didactic unit is the following:

1. Rationale and description of target audience (e.g. machining operator, mechanic, technician, welder, etc.), content and range of coverage and delivery date.
2. The goal of the didactic unit and how the required level of quality will be achieved during the training.
3. The objectives of the didactic unit. What the instructor wants to assess from the participants at the end.
4. Schedule and topics (according to the SOP and job specifications), competency level, educational background, specific training relating to jobs, reporting, communication, etc.
5. Methodology and methodological objectives
6. Resources and materials that will be used in class
7. Assumed knowledge of participants. What the instructor thinks that the participants know taking into account what they have learnt from previous years.
8. Anticipated problems: what kind of problems can present themselves in the didactic unit?
9. Planning lessons, developing exercises and learning activities, explaining the purpose of them, time management and the interaction (instructor and participants, group work, etc.)
10. Evaluation criteria. What will be evaluated and how?
11. Attention to participants with specific training needs: in this section, the instructor will have to take into account the extra material that participants may need, maybe because they need reinforcement or maybe because their level is higher than the rest of the participants.

Parts of didactic unit:

1. Introduction
    Identify the topic. Talk about the main ideas of the didactic unit and justify them.
2. Aims
    These can be general or specific (the full infinitive should be used to express the aims)
3. Contents
    a. Concepts:
        Machine or tools: It can be setting objects, speed setting, cutting tools setting. The kind of object setting depends on the size and weight of the object. Speed setting depends on quality and type of materials. Cutting tools setting depends on speed, type of materials and required size. Functions and situations: what parts of SOP is necessary for and when the operator wants to apply to the job.
    b. Procedures
        These are the steps to take in order to perform the job. SOP and working instructions are often used to inform this section.
    c. Attitudes
        This section includes consistent compliance and discipline and the use of company rules and regulations, SOP, working instructions.
    d. Methodology
        This is the means by which contents, procedures and attitudes are understood and acquired by the participants who learn by doing organized and sequenced tasks.
    e. Assessment
        • Initial assessment takes place before starting the training.
        • Formative assessment is conducted during the training.
        • Final assessment takes place after the training.
        • These assessments should be positive, reassuring and also help the participants to feel more confident.
    f. Timing and Organization
        The session is divided into stages:
        • Routines: review, new item, checking
        • Content assimilation
        • Practice time
        • Conclusion
        • Closure
    g. Materials
        All kind of resources can be used in training. The trainer should take into account the competency level of the participants and the characteristics of the topic to be learned and to choose the materials carefully.

KNOWLEDGE AND UNDERSTANDING (COGNITIVE)		
Define Describe Compare	Contrast Identify Discuss	Explain List Name

SKILL (PSYCHOMOTOR)		
Adjust Operate Demonstrate	Create Construct Assemble	Open Load

ATTITUDES (AFFECTIVE)		
Listen Accept Express	Choose Communicate	Associate Discuss Share

Table 25. Common verbs used in learning objectives

The composition of a didactic unit should take the following into consideration:

1. Learning Objectives
   Ensure the training is both effective and caters to the needs and objectives of the learners, a clear understanding of learning outcomes is required by the trainer.
   This may necessitate an understanding of any standards which may need to be addressed in the training such as:

   • Organizational standards which may be addressed in the training.
   • Standards expected from the training package if nationally recognized.
   • Industrial standards and benchmarks which need to be met.
   • Assessment requirements and activities.

   Learning objectives lend direction to the sessions. A learning outcome is a clear description of skills, knowledge and attitudes that the learner should be able to demonstrate as a result of the training. The session outcomes should describe in measurable terms what the learner is required to know or do in order to achieve success. A hint about learning objective is that they will generally begin with verb. (A verb is an action word and demonstrates that change is expected after the learning has taken place).

See Table 25 for some common verbs used in learning objectives.

Objectives must meet three criteria:
a) They must be observable. Can you actually see or observe the progress of the learner?
b) They must be measurable. Can you measure the output or progress of the learner?
c) They must be written using language that is clear and cannot be subject to ambiguity or misinterpretation.

In competency based training, outcomes must be clearly specified in term of:

- Performance – what the learner will be able to do as a result of what has been learned.
- Standards – the minimal acceptable performance level the learner must demonstrate to be considered competent.
- Conditions – under which the learning will take place.

To write a clear and concise training objective ask "What does the learner have to be able to do at the end of the period of training?" For example: make a technical drawing of a machine part with no errors, within 2 days. This training outcome specifies what the learner has to do (make technical drawing of part), under certain conditions (within 2 days) and standard of performance expected (with no mistakes).

2. Defining Content
This part describes the standard operational procedure of the job which caused the problem together with the required skill and knowledge to perform the operation correctly. The content must cover all critical aspects to be taught.

3. Determining methods and media
Resources can include training aids such as visual aids, handouts, workbooks, equipment and other methods used to convey a message. Studies show that learners will retain more information when using visual aids/videos/DVDs or other resources to support the training method. Learners expect visual reinforcement to be included into a training session. Traditional visual methods include data projectors, DVD's, flipcharts, charts, whiteboard and handouts. Traditional resources can include workbooks, technical equipment, audio equipment and demonstrations.

See Table 26.

The trainer will play a significant role in the planning and delivery of a training program. They will also need to ensure that the relevant personnel are informed and consulted when putting together the requirements for a training program. The advantages of this are that the stakeholders will be able to take responsibility, accountability and ownership of a training program thus lending full support for its smooth running.

Some of these relevant stakeholders include, but are not limited to:

- The trainer
- The actual learner
- The learner's supervisor or manager
- HR Manager or staff
- WHS Representatives
- Industry experts

Confirming the roles and responsibilities of relevant personnel includes asking the following questions:

- Who will be responsible for the assessment of the learners?
- Can we utilize relationships with other trainers?
- What reporting arrangements are in place?
- What reports are needed?
- Who is responsible for the planning and organization of the learning strategy?
- Who will be responsible for the sourcing of support resources such as handouts and learning materials?

Parts of the role and responsibilities of the parties involved in the delivery of the training will include:

- Monitoring and evaluation of ongoing training.
- Discussion groups.
- Testing prior to and after the training
- Regular meetings to determine effectiveness of the training

Sometimes the trainer will be sharing responsibility for sharing delivery with other trainers, guest speakers or experts from industry. The trainer should always know the following:

- What parts of the training will they be required to deliver?
- Will the trainer be delivering and assessing?
- Whether a program coordinator has been appointed to facilitate the individual roles in training?
- What reports are expected from the training?
- How many sessions are expected?

Knowing this information can help the trainer to plan the training program according and will determine whether the trainer can deliver on their own or whether they will need assistance from outside experts or other trainers.

DIDACTICAL UNIT SHEET

Job Title: Operator Lathe Machine
Title of Learning Module: Lathe Machine Operation

Learning Objective	Content:
	Lathe machine component, type of lathe machine, type of tools and equipment, reading work instruction, operating lathe machine, product measurement, OSH procedure.

Upon completion of this training module, trainees should be able to:

1. Set up a lathe machine according to work instruction.
2. Operate a lathe machine based on operational procedure.
3. Produce components to fit work instruction within 0.1 micron tolerance.
4. Observe OSH procedure in work place.

Methods:

Discussion, lectures, case study, simulation, practical, demonstration, brainstorming, on the job training.

Media:

1. Lathe machine manual book and operational instructions issued by Oerlikon Machineries 2nd edition1995.
2. Audio visual and slide presentation.
3. Sample of parts and tools.
4. Sandvik Tools and equipment together with lathe operation manual CD title: how to operate lathe machine and setting tools.
5. Oerlikon lathe machine and Sandvik Tools at workplace.
6. Computer, LCD projector, screen, loud speaker, wireless, flipchart, white board.

Trainee Qualification:

1. Lathe machine operator.
2. Familiar with working instructions and standard operating procedure
3. Computer literate.
4. Familiar with and able to operate measurement instruments such as: thickness, alignment, micrometer, caliper etc.
5. Literate in English.

Trainer Qualification:

1. Expert in Oerlikon lathe machine.
2. Expert in using Sandvik Tools and equipment.
3. Certified engineer for machineries operation.
4. Familiar with OSHAS, ISO and Lean.
5. At least 5 years training experience in machining.

Table 26. Didactical Unit Sheet

EXAMPLE TRAINING PLAN

Learner details:	Company details:
Mentor details:	Registered training organization details:
Delivery methods: Duration:	Expected completion date: Training program name: Training program code:

CORE UNIT CODE	CORE UNIT NAME	START DATE	COMPLETED DATE
Visits planned (dates):		Assessment required:	
Trainer/assessor details:		Support/resources required:	
General comments:			
Sign off:		Date of sign of:	

Table 27. Example training plan

RESOURCE	CHECKED
All documents, workbooks and handout have been proof read.	
Document and handout are easy to read and have been contextualized to the learners.	
Software is set up and ready to use.	
Documents, workbook, learner guides have been printed.	
PowerPoint slide are ready to be used and data projector has been checked for functionality.	

Table 28. Resources checklist

3.9. Composing Learning Units and Instructional Units

1. Developing the training plan
   Learners should have training plan to help them to understand their learning, what is expected from them, and how they plan to reach the objectives set out by the training program or didactic unit. Training plans are a necessity when working as part of a traineeship, apprenticeship, distance or online learning, blended learning, off the job learning or flexible learning.

   The training plan should contain details such as:

   • Learning objectives – what are the goals that the learner will achieve?
   • The structure of the learning to be undertaken – activities, how the learning will be monitored, who it will be monitored by, resources needed.
   • Assessment – what is expected from the learner, when the assessment are due, frequency of test.
   • Face to face sessions/meetings – how long the learning is expected to last, how often the learner will meet with their trainer, where the training will be held.

   The trainer should put together a training plan that suit the needs of the organization for which they work, the needs of the learner and that is relevant to the training that is going to be undertaken. *See table 27.*

2. Developing a session plan and document
   A session plan is the map, or blueprint, on how the session will be delivered. A well written session plan should be comprehensive and easy to understand by anyone, so that if a trainer is unable to deliver a session, it can be passed on to another trainer who should be able to deliver the session following the program outline.

   The session plan can only be fully developed after the following steps have been conducted:

   • The learning context has been identified.
   • Learner characteristics have been established.
   • The training program has been developed or sourced.
   • The training resources have been developed or sourced.
   • Any risk or constraints have been identified.
   • A back up plan has been developed.

   A session plan will usually need to include:

   • Date, time, location and name of session.
   • Target learner group.
   • Introduction, including ice breakers.

SESSION PLAN			
Date:	Time:		Duration:
Location:	Trainer:		Validated by:
Learning Outcomes:			
Assessment Criteria:			
Special Needs:			
Time (minutes)	Main Content and Points to be made		Resources needed
Conclusion:			

Table 29. Session Plan

DEVELOPMENT OBJECTIVE	
Measurement:	Date due:
Development objective:	
Measurement:	Date due:
Development objective:	
Measurement:	Date due:

Table 30. Development objective

Problem:	Complaints from customers as users which causes additional work resulting in expenditure of approximately $ 300,000			
Cause:	No detection of corrosion on the impeller bearing on the job no. 54.18/FP/3.12			
Assume	Rework			
	Loss man hours $ 1.5			
	Loss $ 90.000			
Actual cost				

No.	COMPONENT	COST (USD)		REMARK
	Material cost incurred			
1	Row material	$	2.000	Steel plate, steel bars
2	Equipment	$	400	Cutter

No.	COMPONENT	COST (USD)		REMARK
3	Power used	$	10, 03	
4	Water	$	1,7	
5	Machine operator cost	$	60	2 persons @ 3 hours in 2 days
6	Machine cost	$	5.68	3 hours in 2 days
	Sub Total	$	2477.41	

Table 31. ROI

COST TRAINING PROGRAM

No.	Details	Cost (USD)		Remark
1	Training material (hand out)	$	7,5	
2	Cost operator personnel	$	272,73	2 persons, 3 days
3	Equipment (LCD, Sound system, etc.)	$	15	
4	Trainer	$	1000	3 days
5	Meal	$	90	3 days, 2 trainee, 1 trainer @ $ 10 3days
	Total	$	1385.23	

POTENTIAL LOSS

No.	Details	Cost (USD)		Remarks
1	Material	$	50.000	
2	Equipment	$	1000	
3	Cost using machine	$	30.000	3 days @ $ 10.000
4	Operator cost	$	90.000	2 persons, 3 days @ $ 1.500
	Total	$	1385.23	
	Net program Benefit	$	167137.36	
	ROI		2230%	

Net program benefit = Potential loss – (Actual cost + Program cost)

Percentage of ROI (%): (Net profit program / program costs) x 100%

Expected ROI (%) above 125%

- Learning objectives.
- Timing for each segment of the session.
- Delivery methods for each segment.
- Content and overall plan of the session for each segment.
- Learning resources and materials required.
- Summary and wrap up

A session plan should also be supported by checklist such as an OSH checklist, resources checklist and facilities checklist *(see Table 28 and Table 29)*.

3. Arrange for integration and monitoring of external learning activities.

It is often necessary to integrate learning activities to deliver training based on organizational needs. External learning activities can include workshops, external courses, apprenticeships or traineeships, online learning or conferences or seminars outside of the workplace.

It is not always possible for learning activities to be addressed in the workplace and when there is the need for outside assistance or expert intervention, some of the methods mentioned may need to be employed to fulfill these needs. An external consultant may also be able to provide relevant training.

Whenever components of a training program are delivered to learners externally, objectives should be aligned directly to the organizational objective. Ideally the training should be contextualized back to the organization so that the learners are getting the best possible information required.

Learners can sometimes feel as though external training is separate to the organization, but it should be considered as a direct extension of the training that the organization would normally offer. For this reason, the HR Manager or trainer involved should ensure that outside training providers have been properly briefed on what is expected from the training program. Learners who are asked to attend external training that is not relevant to their industry, their organization or the required objectives will be resistant about attending training in the future.

Developing a work based learning pathway for the learners requires regular intervention and monitoring by the relevant managers to ensure the learners feel as though they are on the right track for their learning and career paths.

One way to do this is to work on a performance management plan with the learners and incorporate the learning objectives into the plan. A Performance Management Plan (PMP) is completed yearly and usually consists of performance objective and development objective which can be monitored by the staff member and their manager. The performance objectives can be measured by using key performance indicators. Staff are advised when are not meeting the objectives based on rating system.

See Table 30.

An example of integrating learning with external activities is a traineeship. A traineeship is undertaken by the learner whereby s/he works for four days per week and attends formal training on one day per week. Training is integrated with the learning and gives the learners an opportunity to practice what they are learning in a formal working environment. Practical assessment and work based projects are then tailored directly back to the workplace.

When integrated learning is introduced, the organization that is delivering the learning is required to maintain constant communication with the client and the learner. The external organization will be responsible for the handling of the enrolment, marking assessment, providing feedback to the learner and any additional resources that they need. The external organization should ensure that the learner's supervisor or manager is kept will informed in relation to unit of competency the learner is undertaking.

3.10. Calculating Return on Investment (ROI)

Above (Table 31) is an example of how to make ROI for a training program. The problem statement below shows that the company in question has spent an additional $ 300,000 for remedial production. Additional work for the company means wasting money because to make a component from the beginning means ordering materials, using machines,

using more time and additional deliveries. After further investigation of the problem, it is identified that the source of the problem is found in a lack of competencies at operator level. The solution to this problem was then identified as training. To calculate the ROI, training managers or superiors in the company need to identify three main points:

a. Actual cost: the costs incurred through remedial production
b. Training program costs: the costs to be incurred in planning and delivering training
c. Potential loss: the costs to be incurred when substituting personnel who are to attend the training.

This ROI illustrates the need to clarify when the training investment will be returned after retraining the personnel to eliminate company loss.

Chapter 4

Monitoring and Evaluation

4.1. Monitoring

Monitoring is a form of continuous assessment during the course of the program which highlights the progressive success of the training in relation to its intended objectives on an ongoing basis. Evaluation measures the impact of the training, both, positive and negative, intended and unintended. Evaluation looks for lessons to be learned from both success and failures, and it also looks for best practice which can be applied in the company.

Monitoring and evaluation are usually undertaken by direct or next higher superiors and may include an independent evaluator from quality assurance or human resources section. Data collected during the course of monitoring activities are then fed into and used by the evaluation process. Distinguishing between monitoring and evaluation should enable companies to improve the quality of MIT on a regular basis. There are various company policies and resources dedicated to the harmonization and improvement of monitoring and evaluation. An overview of monitoring and evaluation tools contains methods and approaches, including data collection methods, analytical frameworks and types of evaluation and review. It also describes the purpose, use, advantages and disadvantages, costs, skill requirements, time requirements and key references that can be used for:

• Performance indicators
• The logical framework approach
• Theory-based evaluation
• Participatory methods
• Participants assessment
• Impact evaluation
• Cost-benefit and cost-effectiveness analysis

The evaluation team consists of heads of evaluation in each section or department in the company. By sharing experience and knowledge, harmonizing performance indicators and evaluation methodologies, the evaluation activity is strengthened thus enhancing collaboration between employees, and facilitating the involvement of company management in the evaluation process. This builds capacity at company level for evaluative activity.

The monitoring activity requires an indicator as a quantitative or qualitative variable that enables comparison and measurement of training undertaken by the company. It provides a reasonably simple and reliable basis for assessing what have been achieved, change or performance etc. An indicator is preferably numerical but narrative is also acceptable though very rare and it can be measured over time to show changes. Indicators, which are determined during the planning phase of a program, usually have the following components:

• What is to be measured? (What topics are going to present? E.g., participants, trainer, topics, pre-training assessment and post training assessment, budget etc.)
• Unit of measurement to be used (number of participants, training hours, competency level)
• Pre-program status (actual spent compared to allocated budget, topics covered compared to actual plan)
• Size, magnitude or dimension of intended change (minimum percentage to be achieved in the year, competency level change target, production and sales target change)
• Quality or standard of the change to be achieved (rework cost is maximum 0,1% from sales, employee turnover less than 3%, retaining of key person)
• Target population(s) (100% of employees directly involved to problems, 15% total employees)

• Time frame (January 2014 to June 2014 for employees directly related to problems, January 2014 to December 2014 for other employees).

4.2. Evaluation
What is evaluation?

Evaluation is the systematic and objective assessment of ongoing and/or completed training program that have been implemented. It includes addressing the following questions:

1. How was the training designed?
   • In-house or external training plan?
   • Internal or external trainer?
   • Theory and/ or practical class?
2. How was the training implemented?
   • Number of training hours?
   • Location?
   • Cost?
3. What were the results of the training?
   • Changes in competency level
   • Improvement in quality
   • Reduction in loss of man hours
   • Increased production and sales performance

The criteria applied in the evaluation are:

1. Objectives
   • Increase productivity
   • Increase sales performance
2. Efficiency
   • The cost of remedial production is lower than 0,15 from sales
   • Workforce costs should be lower than the previous year
3. Effectiveness
   • Punctual delivery
   • Reduction in defective products

4. Impact
   • Self-motivation
   • Sense of responsibility
5. Sustainability
   • Maintain good performance
   • Continue improvement program

Evaluation emphasizes the assessment of outcomes and impact rather than the delivery of outputs. For example, a company issued norms and standards performance on the previous year with a view to the harmonization of evaluation in the company relates to training program implementation. The company norms seek to facilitate system-wide collaboration on evaluation, by ensuring that evaluation of the company system abides by agreed-upon annual and quarterly target such as:

• Competency level improvement
• Quality performance better than previous year
• Production waste below tolerable target
• Annual sales targets achieved
• Man hours within requirements
• Compliance
• Reduced staff turnover

4.3. General Guiding Principles
Every training program should include tools for monitoring and evaluation as they constitute key components of assessment of action-based training. Assessment enables the company and employees to gain an indication of the success of the program at all levels (impact, outcome, output, process and input) providing the basis for accountability and informed decision making

When a company proposes a training program the proposal must include the following:
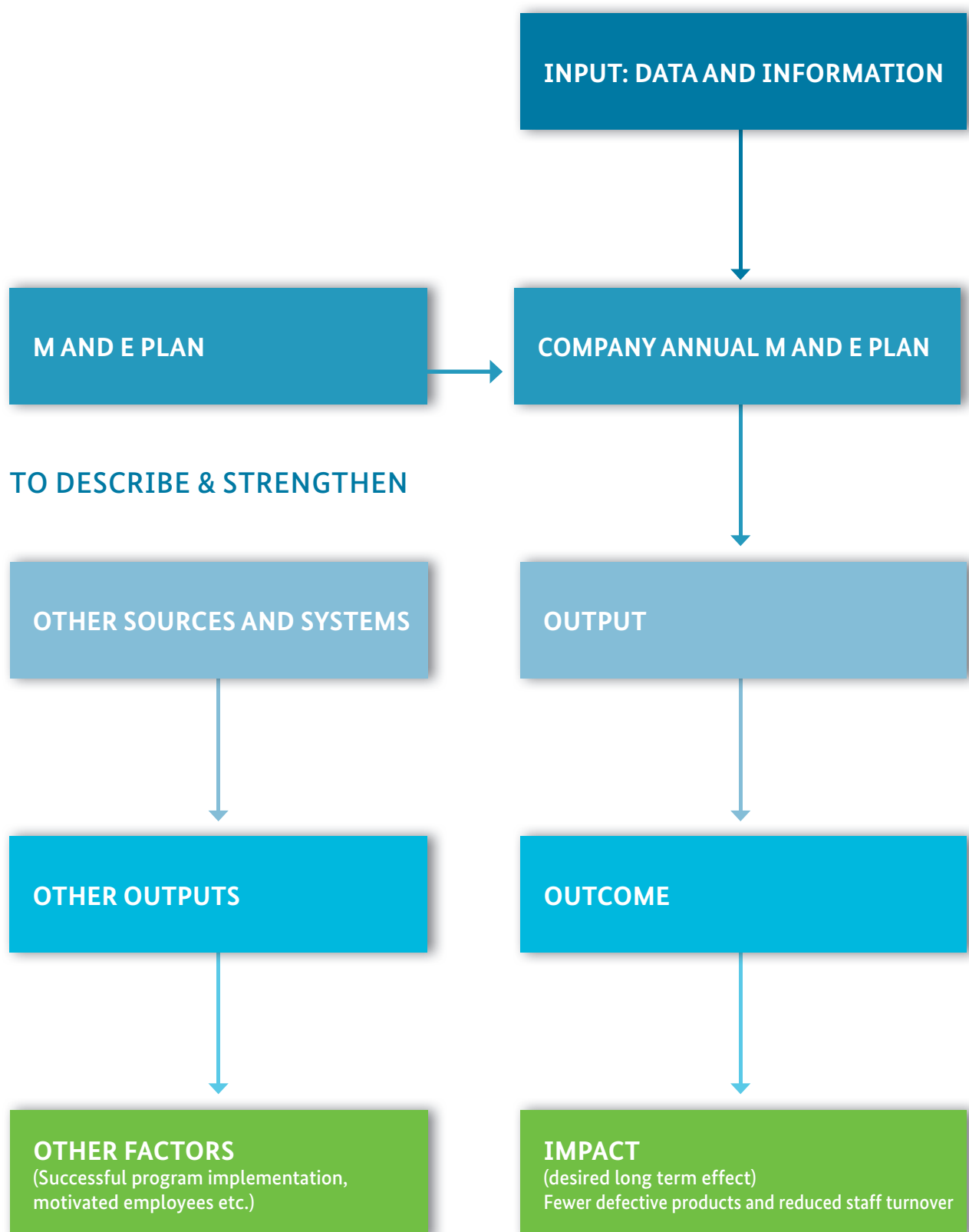
INPUT: DATA AND INFORMATION

M AND E PLAN

COMPANY ANNUAL M AND E PLAN

TO DESCRIBE & STRENGTHEN

OTHER SOURCES AND SYSTEMS

OUTPUT

OTHER OUTPUTS

OUTCOME

OTHER FACTORS
(Successful program implementation, motivated employees etc.)

IMPACT
(desired long term effect)
Fewer defective products and reduced staff turnover

Figure 18. The context of the Monitoring and Evaluation plan

- an implementation framework,
- an action plan; through which the company stakeholders agree the indicators to be used and the targets to be achieved to demonstrate performance and consequently, ensure further training.
- A monitoring and evaluation plan; detailing how the monitoring and evaluation system will be undertaken. This should include a description of the planned monitoring and evaluation activities for each training activity. The detail of the evaluation is reported to the company management.

The monitoring and evaluation system provides access to data which can be collected, processed and transformed to inform decision-making at all levels: director, manager and supervisor level. *Figure 18* illustrates the relationship between the monitoring and evaluation system and the use of information at different levels.

Content of Monitoring and Evaluation Plan

a. Indicator Definitions and Measurement
The monitoring and evaluation plan should include a table presenting all indicators for which data are collected (by the responsible person for training plan, management, supervisors and key personnel). For each indicator included in this framework, the following information should be provided:

1. Indicator definition;
2. Competency level before training;
3. Competency level assessment after training;
4. Data collection method for the indicator (e.g. planned and implemented training topics, trainer (s),
5. Participants, previous year data for comparison, employees skills level and training matrix, cost included allocation of each activities;
6. Frequency of data collection (e.g. monthly, quarterly, annually);
7. Person responsible for data collection and reporting (usually under coordination of HR/ Training).

The indicators included in the performance framework should be aligned with the indicator framework contained in the monitoring and evaluation. However, the indicator framework should contain all indicators for which data are collected by the superiors and responsible person for training, while the performance framework contains only a selection of those indicators.

b. Data and Information
This describes existing systems in place/plans to collect data for measuring impact/outcome indicators. It should include a mapping of relevant data flows. This section should also cover the dissemination and management of information. Descriptions of the following should be provided:

1. Routine data (output indicators) that will be collected and reported routinely from each section/ department and other supporting activities in the company;
2. Data collection and reporting tools (for capturing and reporting data from each requestor for each training program)
3. Reporting frequency and timeline;
4. Information and report flow and feedback mechanisms, including a schematic map of report flow from section/ department and other supporting activities in the company.

Steps in data collection include:

1. Request
A superior under coordination of HR Department provides and submits a request for training form to HR/ Training. The form has to be reviewed and approved by next higher superior and HRD Manager.
2. Interview
Upon receiving the approved training form request then HRD/ Training Manager undertakes a short interview with the employee who has been proposed for the training to ensure that s/he, feels comfortable and motivated to attend the training. It is also to clarify training topics which will meet employee (s) expectation.
3. Competency Level
A competency and training matrix should be provided by HRD as a tool to monitor employees' performance and their relationship with the proposed training program. For example, if the training record shows that the employee has attended similar training in the past, it is unlikely that further training will be effective and a note to this effect is communicated to the superior in question.

4. Training Topics

Selected training topics should be prepared by HRD and demonstrate relevance to each section/ department's improvement focus.

5. Participants

A list of participants should be provided and reviewed to identify cost in time to the company eg how many days will be needed, to implement the training? What will the company activities be during this time? Will the employees attending training be replaced during the duration of the training so that production can continue?

6. Expectations

The expectations for employer and employees are made clear to every training participant. It is advisable to draw up a training agreement prior to sending employee (s) for training. The agreement should detail: the length of training hours/ days and topics, the budget allocated, location, expected knowledge level post training (to be identified on post training assessment). This is a binding agreement and both employee and employer have their rights and responsibilities. This includes consequences for either party if any aspect of the agreement is breached.

c. Monitoring and Evaluation Plan

This section should outline how data and reports are managed at supervisory and managerial levels (including data collection, selecting, processing and analysis). It should describe the training subjects and participants who have been selected based on company needs rather than cost allocation or employees' requests.

d. Company Annual Monitoring and Evaluation Plan

This is a key data collection activity covering training activities for the whole year. Final monitoring and evaluation should be based on this information.

e. Output (Training implementation information)

Prior to completion of training there will be information about the strengths and weaknesses of the program, which will be useful for further improvement. Trainees will come from a range of backgrounds, have various levels of motivation, and different expectations so their diverse feedback is useful for the design of future training plans.

f. Outcome (Completed training)

Training completion produces information about the number of people trained and the finance needed to train these people. It provides information about competency levels assessed before and after training.

g. Impact (desired long term effect) Reduction of defective products and staff turnover

The management team expects all employees to develop self- motivation to achieve better results in their job related activities especially in the short term. In the long term the expectation is to reduce the number of defective products, to improve work ethic and reduce staff turnover.

h. Other sources and systems

(Trainer, Tools, Costs etc.)

The successful implementation of training requires the availability of qualified trainers internally and externally. Trainers should be assessed to ensure that they are able to deliver the training well. All training materials should be available to trainees in both soft and hard copies. It is challenging to allocate funds for training in advance, even for internal trainers because of the unpredictability of supporting resources needed for each training program designed. The allocation of time for participants to attend training should be monitored regularly.

i. Other outputs

(Talent, Improvement Program etc.)

Several supporting tools to monitor training results include an employee competency and skills matrix, key performance indicator assessment, talent pool, succession plan etc. Other outputs resulting from a training program are valuable for long term development as well as for the short term.

j. Other factors (Successful program implementation, motivated employees etc.)

Monitoring and evaluation steps are required to assess the final result of the training so that the company has data on how many training topics have been covered, how many employees participated, how many hours were spent, the cost incurred, the level of impact on employees' performance, motivation, improved self-discipline, production, and better quality.

Chapter 5

Summary

Training needs analysis is the systematic gathering of data to find out where there are gaps in the existing skills, knowledge and attitudes of employees. It involves the gathering of data about existing employees' capabilities and organizational demand for skills and the analysis of the implications for capability of new and changing roles. The TNA often flows from the business strategy. This helps to identify needs, following which a training plan is designed to increase the capability of the organization to meet its objectives.

Careful analysis of need is important because unless the appropriate quality of human resource is employed, organizations may struggle to implement strategies and achieve their goals. Analyzing the areas where capability needs to be enhanced allows organizations to create a staff investment strategy to support business objectives. All training provision should be designed to meet previously identified learning needs in order to be both cost-effective and aligned to helping the organization achieve its vision, mission and key goals.

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Appendix

The following example illustrates how MIT was applied to the Vietnamese context

Introduction

1. Background

    Vietnam is developing its workforce in order to be able to participate in the global market. In order to play a role in the international economy the country's businesses need to develop a qualified and skilled workforce which is able to satisfy market needs by meeting deadlines and maximising output.

    MIT is a methodology for staff development which is designed to help workers to improve their skills and competence in the production process sufficiently well to meet required standards, thus enabling businesses to trade with international customers and reducing costs incurred through the production of defective products.

    By developing and implementing a learning module for enterprise based Training Needs Analysis (TNA) it is envisaged that training costs will be reduced, productivity increased and the quality of the products enhanced. MIT enables the link to be made between the world of

No.	CONTENTS	PARTNER	TIME	METHODS/TOOLS
1	Enterprise's Information	Director, head of administration.	21/10/2012 (8h30'-11h30')	Dialogue Interview
2	Survey workshop	All Head of workshop, workers.	21/10/2012 (13h30'-16h30')	Dialogue Interview Observation Records
3	Collect references	Website, students, workers.	22/10/2012	Process information Analyse
4	Exchange findings and the conclude	Board of directors, Head of technical department, Head of HR Department, Head of workshop.	26/10/2012	Dialogue Analysis

Table 32. Prepare a detailed schedule of the survey

learning and the world of work, partnering college with business. This approach also has the added benefit of exposing the trainee to specialised equipment and processes at an early stage of career development.

2. Objectives
   MIT's business objects:
   • To reduce waste and the production of defective products year on year.
   • To use training to increase the capacity of skilled personnel.
   • To increase the self confidence and motivation of the workforce.
   • To reduce time spent for testing and identifying defects in products.

3. Methodology
   • Research into the business context.
   • Development of a Training Needs Analysis (TNA) for enterprise.
   • Development of a Training Module.
   • Evaluation of Return on Investment.

4. Implementation
   • Identification of experts who can survey the business.
   • Conducting the Training Needs Analysis (TNA) for business.
   • Development of a Learning Module to train workers to produce electronic circuit boards in the assembly unit.

5. Results
   • Successful assessment of training needs of Thanh Long electronic joint stock company, Hap Linh industrial park, Bac Ninh city, Vietnam.

• Design, development and implementation of a modular training package in electronic circuit board production.
• Improved competency and output.

Part 1: Training Needs Analysis

1.1. Preparation for Company Survey
• Research background of Thanh Long Electronic Production Joint Stock Company, company including information about products, international marketing presence e.g website, recruitment and retention procedures e.g. presence of internship students.
• Design questionnaire for business survey.
• Identify and source equipment/ resources needed to carry out the survey, e.g camera, notebook etc.
• Prepare a detailed schedule of the survey *(see Table 32).*

1.2. Context of Training Needs Analysis
Name of company: Thanh Long electronic production joint stock company.
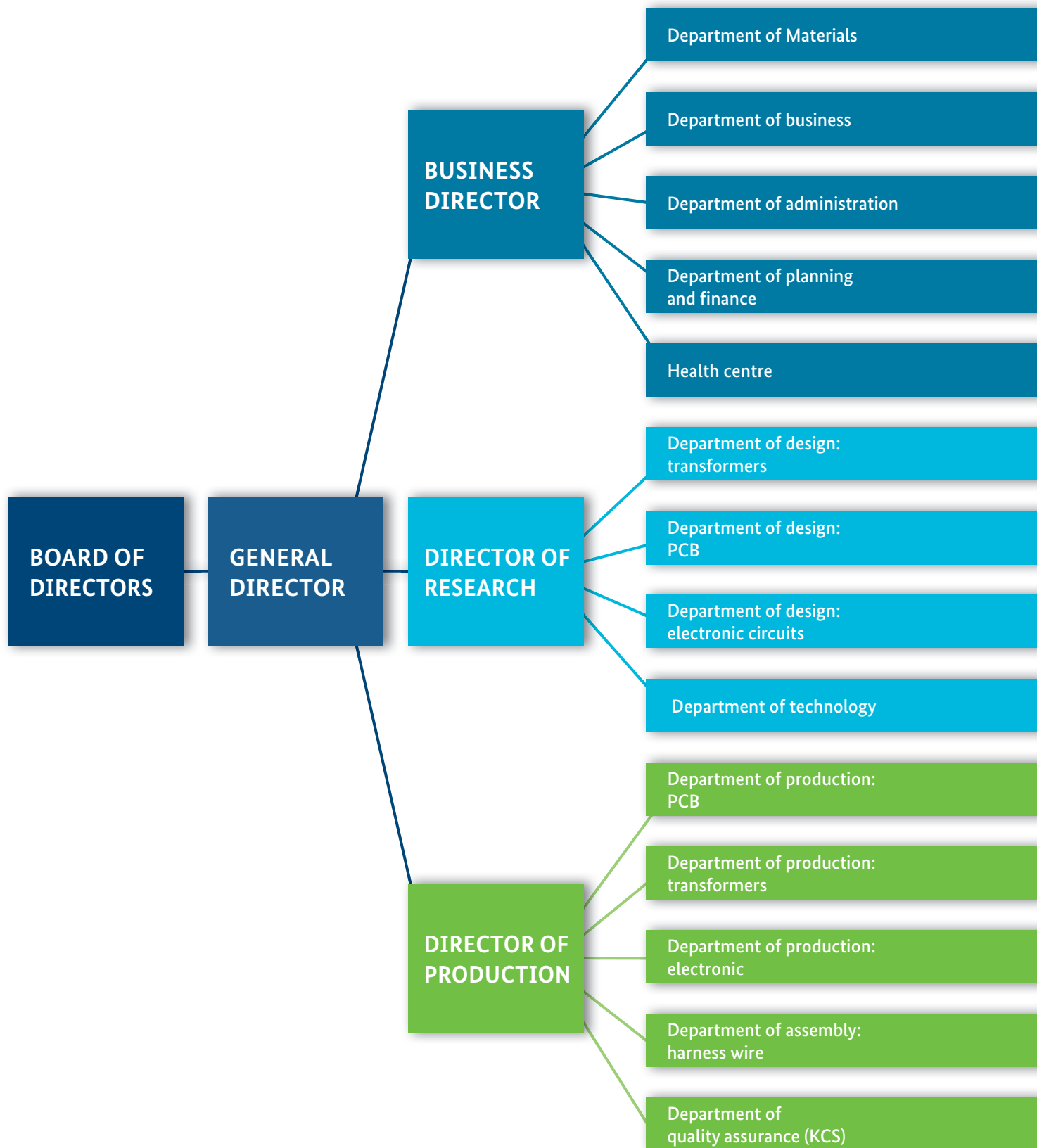**Address:** Hap Linh industrial park Hap Linh – Bac Ninh city – Vietnam.
Level or grade of worker: Trained employer.
Products: One- and two-layer printer circuit board, adapter, sensors and transformers, headphones, LED Matrix, PCB for light compact.

See Table 33.

• **The environmental policy:** meet customer needs and adhere to environmental regulations
• **The 5S as a strategy for continuous improvement**:
  • S1-Sort
  • S2-Stabilize
  • S3-Shine
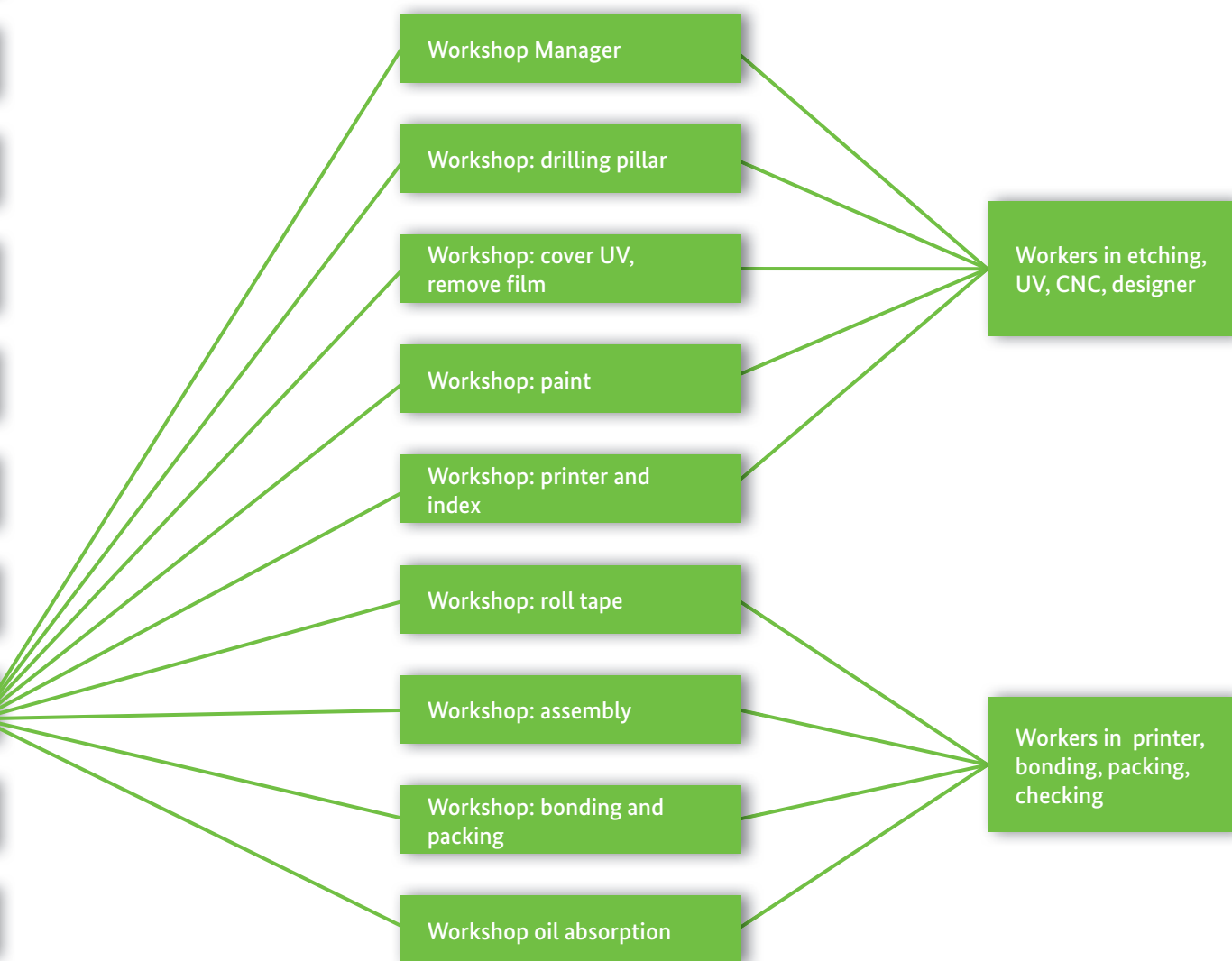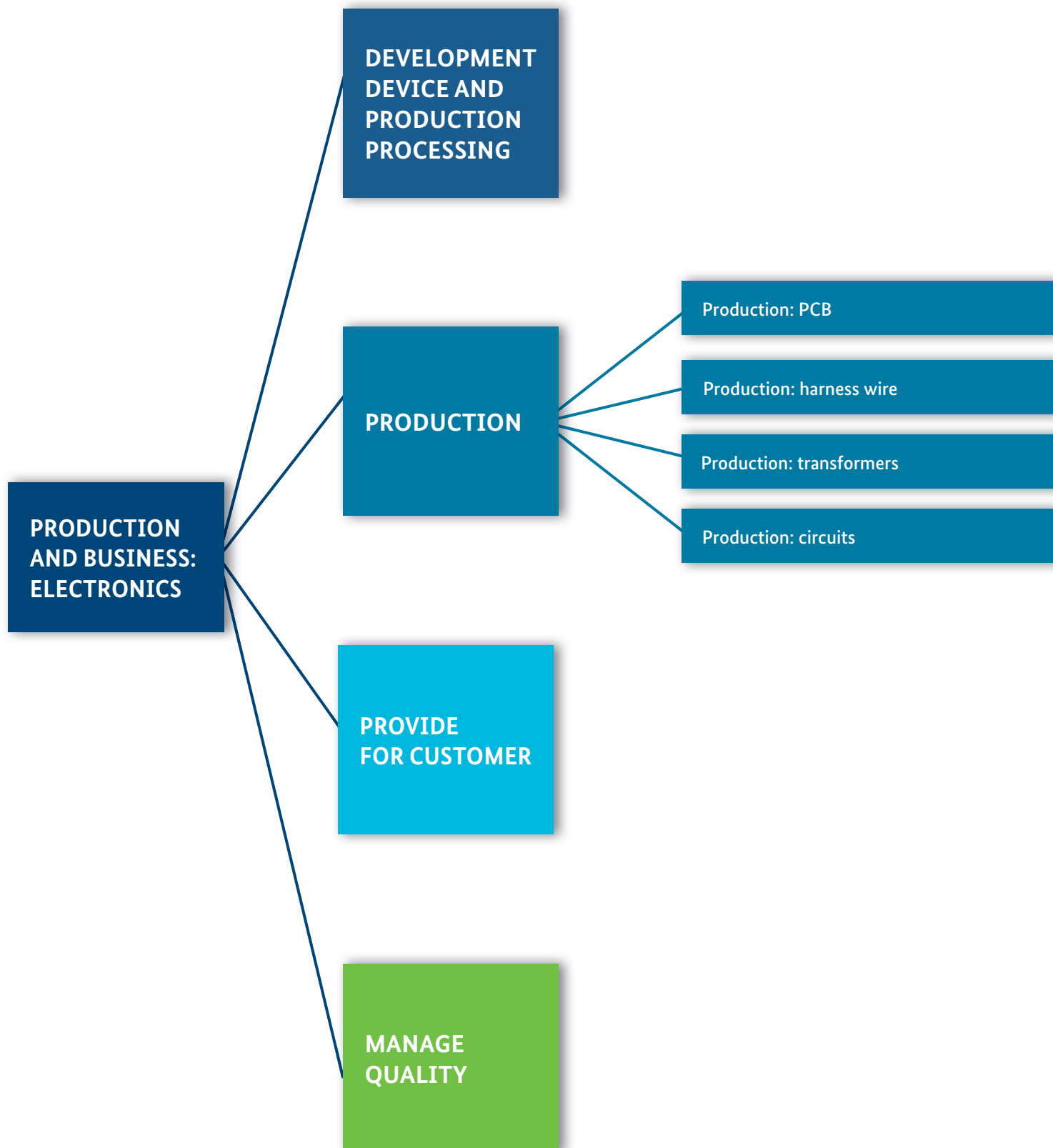 • S4-Standardize

DESCRIPTION OF ORGANISATION CHART

BOARD OF DIRECTORS — **GENERAL DIRECTOR**

BUSINESS DIRECTOR
- Department of Materials
- Department of business
- Department of administration
- Department of planning and finance
- Health centre

DIRECTOR OF RESEARCH
- Department of design: transformers
- Department of design: PCB
- Department of design: electronic circuits
- Department of technology

DIRECTOR OF PRODUCTION
- Department of production: PCB
- Department of production: transformers
- Department of production: electronic
- Department of assembly: harness wire
- Department of quality assurance (KCS)

Workshop Manager

Workshop: drilling pillar

Workshop: cover UV, remove film

Workshop: paint

Workshop: printer and index

Workshop: roll tape

Workshop: assembly

Workshop: bonding and packing

Workshop oil absorption

Workers in etching, UV, CNC, designer

Workers in printer, bonding, packing, checking

Figure 19

DESCRIPTION OF FUNCTIONAL CHART

DEVELOPMENT DEVICE AND PRODUCTION PROCESSING

PRODUCTION AND BUSINESS: ELECTRONICS

PRODUCTION

Production: PCB

Production: harness wire

Production: transformers

Production: circuits

PROVIDE FOR CUSTOMER

MANAGE QUALITY

Analyse customer's request

Design and analyze device for customers

Provide material

Plan production

Function production

Equipment

Condition support

Maintain equipment

Production PCB

Storage material

Cut – drill

Paint

Put on UV

Eating mask

Testing 2 %

Production electronic circuit

Storage of material

Assemble PCB

Control PIN

Bonding

Assemble Core

Roll tape

Checking

Testing 2 %

Figure 20

INDICATORS	MEASURABLE OBJECTIVES
Training for manager	95% for staff, manager
Defect quote (%)	1% for one-layer PCB
	4% for two-layer PCB
	5% for assembled PCB
Number of complaints	12
Customer satisfaction	95%
Waste reduction	20%

Table 33. List of performance for 2012

• S5-Sustain

See Figure 19 and 20.

1.3. Summary of Company Survey Results

During the survey, the participants focused on:

• Determining the company's performance in 2012 (training activity, defect quote, material waste).
• Identifying the indicators of problems which could be solved by training (Defect of two-layer PCB 4,7 %, defect of assembled PCB 5 %).
• Identifying the indicators of problems which could not be solved by training (energy waste).
• Identifying the responsible job holders.
• Identifying the skills gaps of workers (workshop bonding and packing).
• Developing a proposal to meet the identified need.

1.4 Result of Training Needs Analysis

See Table 34.

Part 2: Development of Job Profile

2.1. Job Description

According to the Vietnam National Skills Standards for industrial electronic trade, assembly and soldering of electronic circuit boards consists of installation, maintenance, inspection and repair of PCB in industrial production.

Those who perform the assembly of electronic circuit boards must demonstrate the working knowledge of the following: electronic circuits, measurement techniques, control techniques for industrial contexts and skills in the use of hand tools for testing, repairing and assembling electronic circuit boards in addition to a working knowledge of health and safety procedures in industry.

2.2. List of Tasks

The task related to the defect identified is task CV 2, i.e. the assembly of electronic components onto the board. *See Table 35.*

2.3. Task Analysis

Task name: Assembly of electronic components onto the board

INDICATORS OF PROBLEMS	DETAIL OF PROBLEMS	CAUSE OF THE PROBLEMS	RESPONSIBLE JOB HOLDER
Defect quote of PCB after assembly increases to 5%	Short circuiting, bubble in the soldering position	• Positioning component on PCB. • Inappropriate bonding temperature.	• Assembly workers.
Loss of power supply	Pin of flat pack component is a different size to that on the PCB	• Incorrect layout design as per data sheet. • Incorrect etching of IC pin area. • Incorrect mask used. • Incorrect UV photolithography.	• Layout designer. • Worker in coating workshop. • Lacquer worker. • Photolithography worker.
Defect quote of 2 layer PCB is 4,5 %	Interrupted conduct of 2layer PCB.	• Conductor path too small. • Irregular etching. • Incorrect UV photolithography • Incorrect drilling the through hole.	• Layout designer. • Worker in etching workshop. • Photolithography worker. • Worker in lacquer workshop.
Incorrect assembly of components	Incorrect indicator and name of component PCB.	• Design with incorrect parameter of component. • Incorrect indication of pin position. • Incorrect mask position.	• Layout designer. • Worker in indication printing • Worker in lacquer workshop.

Table 34. Result of training needs analysis

No.	TASK
CV1	Select the electronic components.
CV2	Assembly electronic components onto the board.
CV3	Connect the board with other devices.
CV4	Check and adjust the functions of the electronic board.
CV5	Completion of the board.

Table 35. List of Tasks

STEPS OF WORK	PERFOR-MANCE CRITERIA	EQUIPMENT	REQUIRED KNOWLEDGE	REQUIRED SKILLS	RE-QUIRED ATTITUDE
1. Place the component in correct position on PCB.	Correct position, polarity, stability.	Brake, IC remover, Soldering iron.	Characteristics of basic electronic circuit. Transistor shape, size, parameter of electronic component.	Accurate use of hand tools, testing, repairing and assembly of electronic circuit.	Careful, precise, accurate
2. Bonding the components on PCB.	Glant bond contact.	Soldering iron, brake, remover.	• Characteristics of basic electronic circuit. Transistor • Shape, size, parameter of component. • Soldering removing component technique.	Skilled in handling measurement instruments and soldering iron.	Careful, precise, accurate
3. Testing electronic circuit after bonding.	Testing for correct positioning of pin, stability of solder contact.	Assembly circuit, VOM	Basic electronic circuit Electronic measurement.	Comparison & estimation of solder contact. Handling with VOM.	Careful, precise, accurate
4. Remove colophonium and set aside PCB.	Clear contact, appropriate height of pin.	Brake, clearing solution.	Clearing technique, work safety.	Tool handling skills.	Careful
5. Assembly of radiators for devices.	The power component has thermal radiation.	Isolator Radiator	Basic electronic circuit Safety when dealing with electricity.	Skilled use of electric instruments.	Careful, precise, accurate
6. Testing electronic input and output signals in PCB	Individual units are functioning correctly. Complete PCB functions according to technical requirements	Individual units are functioning correctly. Complete PCB functions according to technical requirements	Basic laws of electricity. Electronic components and circuits. Electrical measurement • Electrical safety	Selection of correct instruments. Appropriate use of testing and measurement instruments	Careful, precise, accurate

Table 36

Task Description:
- Assembly, bonding the component on PCB.
- Testing, clearing bonding position after assembly.
- Assemble radiators for devices, test input and output signals

See Table 36.

Part 3: Development of Competency Profile

3.1   Task Performance Competency
Title of Competency Unit: Assembly of electronic components into board *(see Table 37)*.

3.2.   Competency Gap
- Setting components on PCB.
- Bonding the components on PCB.
- Testing electronic circuits after bonding.
- Removing colophonium and clearing PCB.
- Assembling radiators appropriately for devices.
- Testing input and output signals in PCB.

Part 4: Development of Training Profile

4.1.   Development of didactical Unit
See Table 38.

4.2   Development of Learning Module
A1. Title of Module:
   Assembly of an Electronic Circuit Board
A2. Module's Code: MD-02
A3. Time: 40 h
A4. Objectives:
   Upon completion of the module, learners will be able to:
   - identify and select the correct components for the PCB.
   - assembly electronic circuits.
   - test the basic function of the PCB.
A5. List of Learning Units: *see Table 39.*
A6. Methods: Project method
A7. Assessment:
   Individual assessment for each participant against test card.

COMPETENCY ELEMENTS	PERFORMANCE CRITERIA
1. Setting components on the PCB.	• The components are correctly identified and selected. • The components are correctly placed on the PCB board.
2. Bonding the components on the PCB.	• Component contacts are well soldered.
3. Testing the electronic circuit after bonding.	• The connection jack is correctly matched. • The basic geometry parameters are accurately checked.
4. Remove colophonium and clearing PCB.	• The soldering contacts are cleared.
5. Assembling radiators appropriately for devices.	• Thermal radiators are fixed in the right position. • Radiators are matched to the required type.
6. Testing input and output signals in PCB.	• The functional blocks are identified correctly. • Test instruments are handled and used correctly. • Measurements and data analysis are carried out correctly.

Table 37. Title of Competency Unit: Assembly of electronic components into board

A8. Equipment: Electronic soldering device, circuit tester, safety equipment.

A9. Pre-requisites (academic and experiential) for learners and trainers.
Trainer: is expert in assembly and testing of circuit board.
Trainee: having basic knowledge in electronic circuit, skill in identifying electronic component and in handling measurement device.

4.3 Development of Learning Unit

1. Title of unit:
   Bonding and packing components in PCB
2. Unit's code: MD-02-02
3. Time: 8 h
4. Objectives:
   After completion of the learning unit, learners will be able to:
   • use hand tools specific to the electronics industry.
   • Bond the component according to the technical standard.
   • Remove the components safety.
5. Contents:
   5.1. Hand tools.
   5.2. Methods for bonding and removing bonded components.
   5.3. Methods for processing after bonding.
6. Assessment: assessment criteria and modes.

4.4 Development of the Lesson Plan

Integrated lesson plan 02:
Time: 8 h
Workshop: Assembly of an electronic circuit board
Previous lesson: Assembly of components on PCB
Date of lesson:

Unit title: Bonding and Packing components on PCB
Learning Objectives:
After completing the lesson, learners will be able to:
• use basic hand tools for occupations in electronics.
• bond components onto the PCB correctly.
• check and test PCBs after bonding.

Teaching resources:
• VOM, pliers, Oscilloscopes, Projects, PC.
• Solder, colophonium, PCB, devices.

Methods for teaching
• Project method

Lesson Plan
I - Preparation:
• Period: 5 min
• No. of Trainees: 25 students

II - Conduct the Lesson:
• *See Table 40.*

III - Experience

4.5 Development of Teaching and Learning Material

• Lesson plan,
• module description,
• equipment,
• paper,
• projector,
• PC

4.6 Learning Material

It is not within the scope of this project working paper to include the details of the learning materials used.

Part 5: Calculation of Benefit

See Table 41.

TITLE OF MODULE: ASSEMBLY OF AN ELECTRONIC CIRCUIT

Objective:

Upon completion of the module, the learners will be able to:

• Identify and select the right components for the PCB.
• Assemble the electronic circuit.
• Test the basic function of the PCB.

Content:

• Characteristics of basic electronic components and circuits.
• Shape, size and parameter of electronic components.
• Electrical measurement and testing.
• Soldering removing component technique.

Methods:

• Project method.

Media:

• Projector, Electronic training kit

Trainee / worker:

• Basic knowledge and skills of electronic circuits.
• Skilled use of hand tools and measurement instruments.

Trainer:

• Qualified to level 5 in major electronics.
• Knowledge of electronic circuits.
• Experience in signal testing.

Table 38

No.	NAME'S UNITS	TIME (H)	
		PRACTICE	TESTING
1	Assembly of components onto PCB	4	
2	Bonding and packing components onto PCB	8	
3	Testing electronic circuits after bonding	8	
4	Removing colophonium and clearing PCB	4	
5	Assembly of radiators for devices	8	
6	Testing input and output signals	4	4

Table 39

No.	STEP	TEACHING & LEARNING ACTIVITIES		TIME/ MIN
		TEACHER'S BEHAVIOUR	TRAINEE'S BEHAVIOUR	
1	**General Introduction**	• Role and function of PCBs in electronic equipment. • Interconnecting PCB – electronic components. • Maintenance of the PCB.	• Observe the model, PCB. • Reflection: listening and analyzing	10'
2	**Introduction to the topic** 1. Learning objective 2. Content	• Explain the learning objective. • Explain and clarify the content to be covered.	Listening and familiarization.	10'
3	**Problem solution**			
3.1	Inform: Assembly, solder and test PCB.	Introduce the requirement.	Clarify the task.	10'
3.2	Decision: • Decide how to fix the component on the PCB.	Guide and facilitate the group in selecting an appropriate solution.	Discussion and agreement on solution.	10'
3.3	Planning: Develop the implementation plan.	Facilitate and support groups in planning.	Development of the plan.	20'
3.4	Perform: • Group 1: Check the position of components. • Group 2: Prepare and perform soldering. • Group 3: Finalize the soldering using a hand	Organize the groups and facilitate the task in hand.	Perform the task as assigned.	280'
3.5	Control: The group 1 control the result of Group 2, Group 2 control result of Group 3 and Group 3 control result of Group 1.	Monitoring the activity of groups.	Monitoring and evaluation per assessment criteria.	60'
3.6	Evaluation: General evaluation	Summarizing and analyzing the results of groups.	Record summary and lessons learnt.	60'

Table 40. Conduct the Lesson

| No. | STEP | TEACHING & LEARNING ACTIVITIES | | TIME/ MIN |
		TEACHER'S BEHAVIOUR	TRAINEE'S BEHAVIOUR	
4	**Conclusion** • Deepening knowledge • Strengthening training 1. Disseminate the evaluation results 2. Lessons learned	• Summary of the content and activities. • Report on the evaluation results. • Report on the participation of the learners.	• Listening and recording	15
5	**Guide for self-training**			

EXPERIENCE	
Head of department **Inspector**	Bacninh, / /20 **Teacher**

Table 40. Conduct the Lesson

No.	CONTENT	UNIT	UNIT COST	AMOUNT
1	Number of defective PCBs produced per month in the production workshop of 25 workers before training, defect quote 5%.	Piece		3,750
2	Number of defective PCBs per month in the production workshop of 25 workers after training, defect quote 4%.	piece		3,000
3	Benefits of the training (3,750-3000) piece x 50,000 VND/Piece.	VND	50,000	37,500,000
4	Cost for the 5 days training, 25 participants.	VND		153,100,000
	Material costs.	VND		72,500,000
	Machine costs. 25 participant x 1,000,000 VND/participant.	VND	1,000,000	25,000,000
	Office material.	VND		1,400,000
	Trainer costs including training design & development.	VND		29,200,000
	Salary for participants during the course. 25 participant x 1,000,000 VND/participant.	VND	1,000,000	25,000,000
5	Time of return on investment.	Month		4.08

Table 41. Calculation of benefit