TRAINING MANUAL ON
INDUSTRIAL REVOLUTION

4.0

Preface

This training manual is a guiding document for a trainer in conducting training activities related to Industrial Revolution 4.0. It is prepared with the contents collected from different documents and especially designed to encapsulate the needs of the TVET leaders, managers and faculties/instructors in practical and easy strategies to convert TVET in a sustainable development and towards the new industrial revolution direction.

The purpose of preparing this document is to provide a fundamental and step-by-step process for the guidance of the TVET trainers, administrators and academics, which are the target users of this manual.
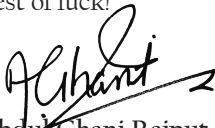
This training manual recognizes the dynamic nature of the topic and thus, can be edited or changed as the authors see fit. It is designed to build the capacity of TVET practitioners on re-designing teaching and learning material in line with industrial revolutions that the trainers can apply to the present training context or to the scenario of their respective countries and localities.

This training manual does not guarantee the success of the training as it is up to the trainers and administrators to manage the activities during the training proper and derive the best outputs from their participants. However, it provides clear, concise and informative strategies that were adopted from CPSC's own experience on the subject as well as from my own knowledge and expertise.

As CPSC successfully implemented Industrial Revolution 4.0 programs in the past, this is a testament of CPSC's continued commitment to provide a simple, applicable and innovative publication that is targeted to increase the knowledge of its trainees.

We hope that this manual will fulfill its intended purpose and may you be able to find inspiration and ideas for its use and dissemination.

Best of luck!

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INTRODUCTION

The trained workforce is the backbone of industries and indispensable for national economic development. The trained workforce is not only required for increased productivity, enterprise competitiveness and further industrialization but it is equally important to maintain the development that was already achieved by previous economic policies.

The world of work is changing day by day and experiencing the Fourth Industrial Revolution. The picture of Industrial Revolution 4.0 (IR 4.0) is still relatively new and nobody can exactly predict what lies ahead. However, this revolution will surely bring with it exciting possibilities, new solutions to global challenges, and employment opportunities for jobs that have yet to be invented. Thus governments, employers, educators and parents alike must ask the questions about how they can prepare present and future generations to thrive in this transforming world.

Technical and Vocational Education and Training (TVET) in the fourth industrial revolution is a complex, dialectical and exciting opportunity which can potentially transform society for the better through sustainable development, which is the end goal of IR 4.0. The fourth industrial revolution is powered by artificial intelligence and it will transform the workplace from tasks-based characteristics to the human-centered characteristics. Because of the convergence of man and machine, it will reduce the subject distance between humanities and social science as well as science and technology. This will necessarily require much more interdisciplinary teaching, research and innovation. To meet the demand of this era, different Asian countries has set forth new initiatives as part of its efforts to cultivate holistic, entrepreneurial and balanced graduates to be globally competitive and meet the needs of Industry 4.0.

The training manual for Industrial Revolution 4.0 is a book for TVET practitioners to reinvent and redesign the teaching learning material in line with IR 4.0 requirements to produce skills workers for new era of industry. IR 4.0 is defining the new sets of teaching and learning requirements which needs to be incorporated
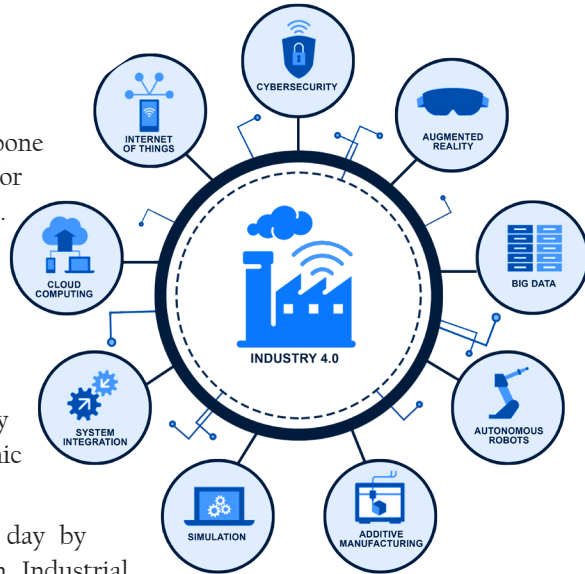
by the TVET stakeholders in curriculum delivery. It is therefore worthwhile to consider and understand change impact of curriculum delivery such as defined by JISC (2011) teaching, learning support, advice and guidance, coaching, mentorship, peer and collaborative learning, feedback and assessment and access to curriculum resources in line with IR 4.0 needs.

This manual will help the trainer to aid the trainees in designing, developing, conducting and evaluating the training activities based on the objectives of the training programs. It helps to keep both the planner and the trainer on right track throughout the training cycle while ensuring that the desired outcomes of the training are achieved. This manual contains practical guidelines on how to organize, run and evaluate an IR 4.0 training, group work task and teaching methods.

OBJECTIVE OF TRAINING MANUAL

This training manual is first step towards designing formal teaching learning material in line with IR 4.0 requirements as well as ensures consistency of the future training programs on IR4.0. The manual equips trainers with a set of competencies and tools that allows them to:

- Analyze the learning needs of the target audience on the subject matter of Industrial Revolution 4.0.

- Share knowledge and methodologies to facilitate and conduct the training workshop.

- Evaluate the learning results achieved by the target audience and to track the impact of the training workshop.

CONTEXT OF THE TRAINING

Curriculum delivery will be transformed to prepare a highly skilled workforce ready to face the new challenges posed by the advent of Industry 4.0. Dr. Ramlee (2011) discussed that "educators are faced with the challenge of adapting their teaching styles to accommodate a new generation of digital learners". These digital learners, who are now entering monotechnics, polytechnics,

colleges and universities, have learning expectations, styles, and needs different from past students.

The question is how to adapt new teaching learning strategies to accommodate the digital learners, in light of their preferences for digital literacy, experiential learning, interactivity, and immediacy. To address this question, we have to conduct this training in order to build the capacity of TVET practitioners to update teaching and learning styles in line with IR4.0.

In this context, this training manual will support and guide trainers to build around the learning needs and interests of the target audience such as trainers, curriculum developers, facilitators, assessors, technical staff from CSOs, NGOs, and other civil society actors being trained and will be benefited from this training. This training manual is also stimulate active involvement and encourage the participants to reflect on their own context and experience.

TRAINING PLAN

The objective of the training plan is to identify the appropriate training activities required to achieve the desired learning outcome of the training program. The training plan also provides a clear understanding and outline the following information:

- Who will deliver the training?
- Will the training happen?
- Where will the participants convene to receive the structured component of the training?
- Is it flexible enough to meet the needs of trainers and trainees?

Usually, the training plan includes training design (objectives, components/ competencies, schedule, training modes/methods), training resources, and roles of trainer, trainees, organization and resource person.

Some training plans also include assessment and certification arrangements. In addition, it should have a contingency plan that will outline all the possible scenarios.

METHODS USED IN TRAINING

There are numerous methods and techniques are available to conduct a training program. In this manual, most effective methods are recommended for IR 4.0 training such as brainstorming, lecture, audio visual, group work, exposure visit and others. However, resource person's are free to device their own strategies depending on the objectives of the training

LECTURE

A lecture is "an oral presentation intended to present information or teach people about a particular subject" (Lamichhane, 2018) . That method is useful if the trainer intends to apply this for the knowledge

1	Background
2	Concepts
3	Elements
4	Examples
5	Critical Information
6	Trends
7	Theories
8	Other Relevant Information

Figure 1: Information that are usually supplied during lectures

delivery part. In this training, lectures are used to convey the following information to the participants. Figure 1 elaborates the information below.

AUDIO VISUAL METHOD

In order to train participants on present-day needs such as innovation in industrial revolution, the audio visual method is very important in the teaching-learning process. The audio-visual method is recommended for the participants to be able to appreciate the interesting ideas and new digital methods such as simulators or real-time elements. Audio literally means "hearing" and visual means "which is found by seeing". So, those endeavors that we adapt using our senses are called "audio visual techniques".

Currently, only limited "smart factories" exist and it is difficult to give the clear picture of IR 4.0 to participants. However, we need a mechanism to understand the needs of new teaching learning materials in line with IR4.0 requirements. Audio visual methods are the only ways to simulate the smart factory concept and provide the real sense of IR4.0.

GROUP WORK

The best way to explore innovation in learning is through group work. It is an effective method in imparting knowledge, skills and attitudes to a large number of participants. In order to maximize its benefits, the trainer can explore assigning a project task for two or more participants in one group. They can create an action plan, revise existing TVET curriculum, online assessment or initiatives, or other possible interventions. As it is a group activity, the trainer has to ensure that the contents of the outputs will be applicable to all trainees.

PROJECT WORK

Project work is a learning experience which aims to provide trainees with the opportunity to synthesize knowledge from various areas of teaching and learning, and critically and creatively apply it to real life situations such as IR4.0 needs. This process, which enhances trainees' knowledge and enables them to acquire skills like collaboration, communication and independent learning, prepares them for lifelong learning and the challenges ahead (MoE, 2018).

BRAINSTORMING

Brainstorming is a method for generating ideas to solve a design problem. It usually involves a group, under the direction of a facilitator. The strength of brainstorming is the potential participants have in drawing associations between their ideas in a free-thinking environment, thereby broadening the solution space.

EXPOSURE VISIT

In this method, the participants are exposed to numerous visits to TVET institutions and industries that are practicing IR4.0 elements in their operations and other organizations. This is to inspire and motivate the participants to adapt these practices or develop their own initiatives by showing them the real scenario. Exposure visits enable participants from different regions to interact with and learn from each other, allowing them to view practical examples of successful integration of IR 4.0 elements in TVET. It is hoped that the participants will be able to replicate any successful models to the benefit of their own institutes, communities and industry.

ICE BREAKERS

An ice breaker is an activity, game, or event that is used to physically motivate the participants to listen and participate by warming up the conversation or introduce stretching exercises that are simple but fun. Ice breakers are "any event that requires people to comfortably interact with each other and a trainer is an opportunity to use an ice breaker" (Heathfield, 2017).

THE PROGRAM BOOK

The program book is an important part of training. It is a printed guide of a plan of action aimed at accomplishing a clear training objective or objectives. It describe that what work is to be done, by whom, when and what means or resources will be used including other important pertinent information pertaining to the conduct of the training.

This guide is an adaptable resource matewrial to support trainers and trainees as they explore and engage Industrial Revolution 4.0. This guide focuses on the re-design of teaching and learning materials to suit the learning needs and interest of the participants from teaching to supervisory in TVET sector. It is the responsibility of the trainer to ensure that the program book is prepared, layouted, distributed and monitored for possible feedback. It is customary to produce the program book at least one week before the training commences and is reproduced for the participants after the approval of the Director General.

COMPONENTS OF THE PROGRAM BOOK

INTRODUCTION

This is the introductory part of the program book which provides information on what the book is going to be about. It gives scope, context, and background information by simply giving brief understanding about the topic. talks about why the book is important, and gives an overview of the contents. It's also including main purpose of the program highlighted and potential outcomes.

A good introduction should identify your topic, provide essential context and indicate your particular focus in the training session.

The world of work is changing day by day and experiencing a Fourth Industrial Revolution (IR 4.0). It is characterized by a fusion of technologies that is blurring the lines between physical, digital and biological spheres, collectively referred to as cyber-physical systems. IR4.0 is merging and fact-growing concept and needs attention to fulfill all requirements to fulfill the needs of the industries.

IR 4.0 is introducing a lot of changes in ways of teaching and learning including the roles of trainers and trainees. The current curriculum provides extensive opportunities to meet the requirements of the industry but still needs to be updated as per the needs of digitalization in line with the requirements of IR4.0. A strong TVET must be adapt to the challenges of automation and digitization to produce skilled workforce.

Figure 2: Sample of a Rationale

RATIONALE

In developing the rationale, a clear explanation of the reason for the program's organization or a general statement about the program's relevance in addressing the challenges is recommended.

Include diagrams, pictures and illustrations if necessary. An example of rationale is illustrated in Figure 2.

OBJECTIVES

Program objectives are a short overview of the value and set expectations to the participants. The overall objective of the Industrial Revolution 4.0 training program is to response IR4.0 requirements by TVET

Figure 3: The SMART Criterion of Forming a Good Objective

providers through empowering students on knowledge, skills, and attitudes. Objectives are important to aim for and performance indicators, which facilitate monitoring and measures for feedback and evaluation.

There are a variety of types of objectives that can be written to address the training program needs, all can be done in the SMARTer format.

An example of program objectives are indicated below:

Specifically, at the end of the program you will be able to:

- *Understand the dynamics of IR 4.0*
- *Identify the components of TVET to address IR 4.0*
- *Retain educators and managers of TVET in dealing with the disruption of IR 4.0.*
- *Understand the application of digital technology in TVET curricula*

TRAINING CONTENTS

The training content is the information presented to learners with the aim of providing knowledge, skills and attitude. The content of the training program can be different types which includes text, static visual and video, audio, and interactive elements. The following topics are proposed for this training program.

CONCEPT OF IR 4.0

The original concept of IR 4.0, also called "Industry 4.0", was proposed in 2011 in a paper – "Industrie 4.0 Smart Manufacturing for the Future" by Germany Trade and Invest. It is also known as the "Smart Industry" and it refers to as technological evolution from embedded system to cyber-physical systems (GTAI - 2011). Industrie 4.0 represents the coming fourth industrial revolution on the way to an Internet of Things, Data and Services. The main idea is to exploit the potentials of new technologies and concepts such as:

- Availability and use of the internet and IoT - Internet of Things
- Integration of technical processes and business processes in the companies
- Digital mapping and virtualization of the real world
- 'Smart' factory including 'smart' means of industrial production and 'smart' products
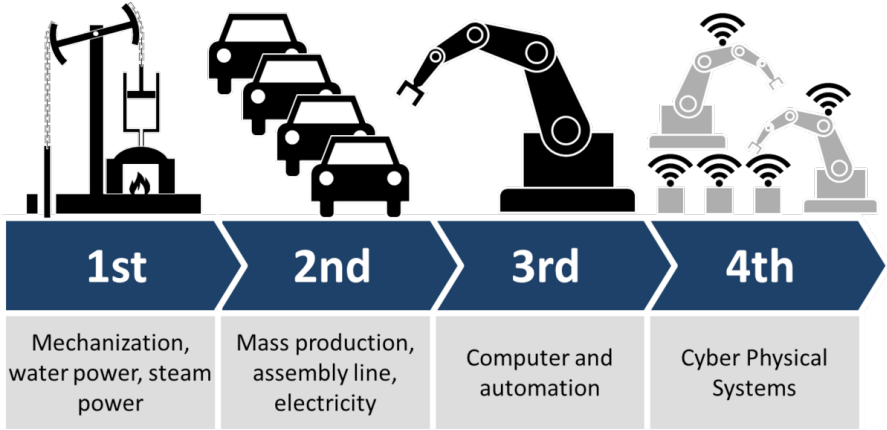
Figure 4: Stages of Industrial Revolution (Wikipedia, 2018)

Industrial revolution has four stages which is the development of industrial manufacturing systems from manual work towards Industry 4.0 concept can be presented as a path through the four industrial revolutions Figure 4.

Big Data	Simulation and Augmented Reality	Industrial Internet of Thing (IoT)
Supply Chain	Horizontal and Vertical Integration	Cybersecurity
Cloud	Autonomus Robot	Additive Manufacturing

Figure 5: Core Elements of IR 4.0

BUILDING BLOCKS OF IR 4.0

The nine advancements in modern technology that form the foundation of IR 4.0.

DESIGN PRINCIPLES OF IR 4.0

The following are the main key design principles of Industrial Revolution 4.0.

- Interoperability
- Transparency in information

- Technical Assistance
- Decentralized Decisions

CHALLENGES AND OPPORTUNITIES OF IR 4.0 ON TVET

Industry Revolution 4.0's primary appeal lies in its ability to act as an economic game-changer, which would open up a myriad of opportunities and challenges to TVET. In TVET, the teaching learning process is very important part to impart
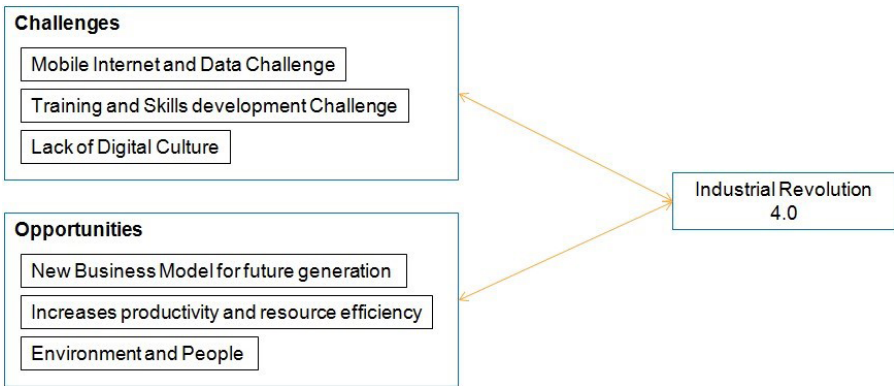

Challenges
- Mobile Internet and Data Challenge
- Training and Skills development Challenge
- Lack of Digital Culture

Opportunities
- New Business Model for future generation
- Increases productivity and resource efficiency
- Environment and People

Industrial Revolution 4.0

Figure 6: Challenges and Opportunities of IR

training. In many research ideas, it is stated that technology can be used as an instructional tool in teaching and learning skills. It also can be useful in the era of IR4.0 by helping communication, making teaching products and assisting learners' self-expression.

RE-DESIGNING TEACHING LEARNING MATERIAL

To support the trend of industrial revolution and sustainable development, it is important to redesign the TVET sector as it plays a a very important role in the development of human capacity. Therefore, it is a time to update and redesign TVET curriculum and teacher education that encourages trainees and trainers' to take the lead and respond to IR 4.0 requirements for industrial growth. Another reason to re-orient the TVET curriculum is to meet upcoming skills.

The new TVET curriculum must be aligned to a new orientation due to IR 4.0. This is to accommodate qualified workers, incorporate new teaching and learning practices and contribute to the development of a quality assurance system. The old practices have, to be strengthened as well as by adding the new competencies (huge data handling, network structures, data formats, etc.), if we would like to produce qualified human resources who can thrive in digital era. The following are the key areas that has to beconsidered to build up TVET 4.0 to address IR 4.0:

- Hybrid / Blended Learning, online
- Establishing life-long learning setup
- Re-Engineering of occupational profiles curricula
- Qualification concepts for TVET staff
- Concepts for learning environments

GROUP WORK

In this type of training program, the group work task is very important as it will involve participants working collaboratively on set tasks, either in or out of the training venue.

Group work include any learning tasks or activities that require participants to work in groups. Thus, it is important to arrange a co-facilitator during the group discussion as part of the circle.

Small group work may be used within the workshop. There are three characteristics that need to be present for small group work to be effective.

GROUP WORK

Review Existing Curricula and Suggest
Elements to Integrate in Line with IR 4.0

Objectives

After the group activity, the participants will be able to:

- Develop the competency-based curricula and material to address IR 4.0 requirement
- Apply digital technologies to Teaching-Learning practices in TVET
- Understand the application of digital technology in TVET curricula

Input

- Special Lectures
- Theme Papers 2 and 3
- Discussion and deliberation of issues and concerns

Instructions

- Bring and existing competency-based curriculum and review its elements
- Brainstorm as a group on elements of a curriculum. Do you find it to be updated to address IR 4.0
- Revise and update the competency-based curriculum to develop TVET
- Present updated curriculum at a plenary

Output

- Updated curricula in line with IR 4.l0, to be submitted to a funding organization

Figure 7: Sample of a Group Work Design

- There should be active participation from all the members of the group
- There needs to be specific task
- There needs to be reflection

SCHEDULE OF ACTIVITIES

It is another important element of a training program which outlines the list of activities, task and events. It is a sequence of events/activities in the chronological order in which such things are intended to take place.

Day/ Time	9:00-10:15 AM		10:30 AM-12:30 PM		1:30-3:30 PM		4:00-5:00 PM
Day 1	Opening Ceremony	T E A	Program Orientation House Rules Levelling of Expectations OnCOURSE Registration (Program Coordinator)	L U N C H	Theme Paper 1 Concept, Stages and Elements of IR 4.0 (Resource Person) Ice Breakers during lecture Group Work 1 (Participants)	T E A	Presentation on Group Work (Participants)
Day 2	M I L Y	Theme Paper 2 Impact and Challenges of IR 4.0 (Resource Person)	B R E A	Group Work 2 (Participants)	B R E A	Theme Paper 3 Develop TVET Curricula to address IR 4.0 (Resource Person) Ice Breakers during lecture	B R E A	Group Work 3 (Participants)
Day 3	M I L Y	Theme Paper 4 Practices of IR 4.0 and Concept in TVET (Industry or Professional)	K	Cont. Theme Paper 4 Audio Visual during lecture	A K	Provide inputs and setting expectations on Action Planning (Resource Person)	K	Project Work Prepare Action Plan to address IR 4.0 into TVET Programs (Participants)
Day 4 -5	Conference / Workshop "TVET 4.0 - Opportunities and Challenges of IR4.0" With paper presentation and panel discussion With Study Visit, action plan presentation, evaluation and closing ceremony						

*MILY: Most Important Learning of Yesterday

Figure 8: Sample of a Program Schedule

An example is shown above. You might like to design your own schedule of activities depending on your creativity. The important thing is to mention the activities, names of the people responsible, time allocations, dates, topics and other additional information or note in the schedule that should be communicated to the participants.

TRAINING PROGRAM FRAMEWORK

Generally speaking, training program framework is managing training expectations to enhance the overall operational performance and moving towards the final output.
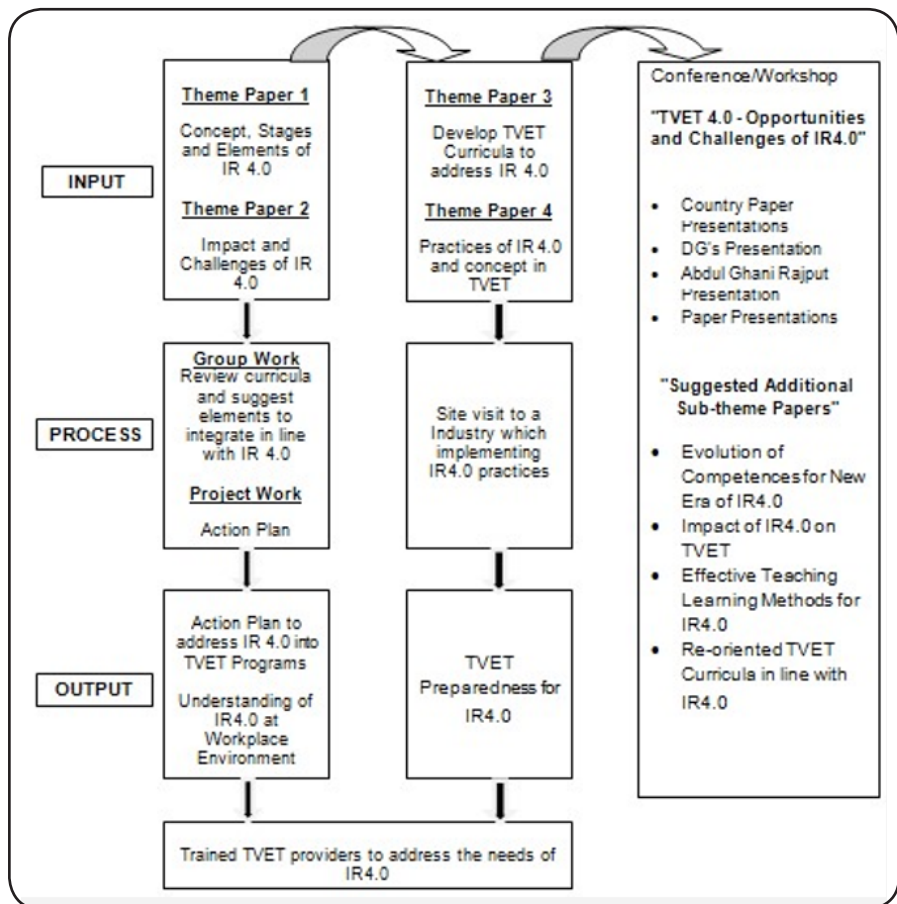

Figure 9: Sample of an Input-Process-Output model for an IR 4.0 Training Program

It is usually presented in an outline, skeleton or diagram showing the interlinked items which supports a particular approach to specific objectives. It can be modified as per requirement by adding or deleting items. Usually, the program framework is represented graphically using the Input-Process-Output model.

A graphical example of training framework based on input-process-output model (IPO) is illustrated below

TRAINING PROGRAM MANAGEMENT

Training management is an action to carry out direction, coordination and transformation of activities to achieve output by personalities involved in the training program from planning to implementation.

Usually, those involved in training management are the following:

1. Program supervisors

   These are the overall managers of the program and has the final say on how the program should be run. They also supervise the program arrangements and may or may not be present in the training program days.

2. Program coordinator

   This is the main head of the program. He is the one in-charge in conceptualizing the program and coordination with the partner organizations regarding arrangements. He also heads in the development of content and production of training materials, seminar arrangement, program budget and other important aspects of the program. He/she also travels in the program venue and has to be present in all program days, as well as to report to the program supervisors regarding the developments emerging during the program.

3. Local coordinator

   If the program is to be held abroad, the local coordinator is the one in-charge with facilitating the local arrangements such as training venue, selection and participation of local trainers, meals, study tours and other arrangements. He/she is constantly in coordination with the program coordinator and supervisor with regards to program arrangements, ensuring that any logistics are agreed upon by both parties.

4. International and national resource persons

   These are locally-sourced experts that usually gives academic resources based on the local context. These academic sources are usually delivered in the local language and uses local examples which targets to align the participants in understanding the local scenario.

5. Logistics staff

   The logistics staff are usually managed by the local coordinator. They are in-charge in facilitating the legwork during the program. They are usually in the registration booth collecting the registration details of the participants or around the venue-taking pictures, ensuring that the snacks and meals are arranged well and answering queries and addressing concerns of the participants.

It is important to include their picture, name, designation/ office and contact details (email addresses or office/business numbers). This is to provide a record in case the participants would seek additional clarification on the topics delivered or interested in establishing connections with them.

ANALYSIS OF TRAINING OBJECTIVES FOR RELEVANCE

It is another important exercise of training program which ensure that the training program is well-prepared and ready to use for delivery of training.

Following are the questions that will aid you in the analysis:

- How objectives of the training is to be achieved? Usually, learning builds on learning. It may be useful to learn certain areas of knowledge and skills before learning new areas.
- Do I communicate my objectives effectively to my intended audiences?
- Will the objectives achieve the overall training goal(s)?
- What are the best learning activities to achieve the objectives?
- Do the methods match the participants' particular learning styles?

- Do the methods stretch their styles, too? Are the methods readily accessible?
- Do the methods take advantage of real-life learning opportunities?
- Do the activities include ongoing reflections about learning? The learners will benefit from regularly taking time to stand back and inquire about what is going on in the training, what are they learning and what, if anything, should be changed.
- What costs will be associated with developing and implementing your plan?
- How will you evaluate the competencies o participants? Think about facilities, technologies, personnel, special expertise, etc. You may want to update the "Budget".
- How will learners' manage time and stress during the learning?
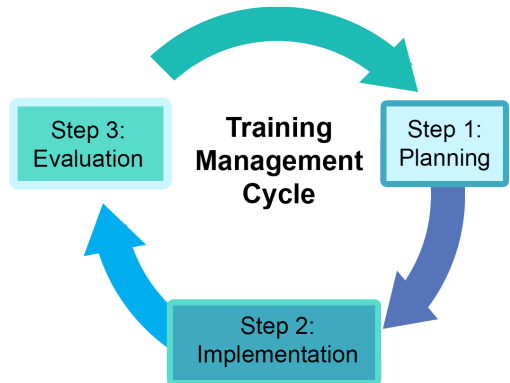
PROGRAM/COURSE EVALUATION

A training program on IR4.0 is based on three steps:

Step 1: Planning of Training on Industrial Revolution 4.0.

Step 2: Implementation of the training; and

Step 3: Evaluation of the training.

Training Management Cycle

Step 3: Evaluation

Step 1: Planning

Step 2: Implementation

The evaluation is the final step of the training program cycle and it will be done before certificates of participation are handed out to the participants. The evaluation of the program is done online through the onCourse website or other learning management tools and covers both administrative and academics aspects of the program.

CLOSING CEREMONY

In the closing of the program, participants receive training completion certificates and are given recognition. It is expected that training is conducted in an organized and professional manner, as it is considered a semi-formal event. Special remarks can be given by the chief guest and remarks followed by participants' representative and program coordinator. It is important to ensure that the trainees have gained a substantial knowledge on re-designing teaching and learning practices towards IR4.0 needs and are capable of applying these lessons in a practical manner by trainer.

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Shared Vision 2023

The Inter-governmental TVET Leader for Sustainable Development

Mission

**Transforming TVET towards Sustainable Societies through
Outcome-Based Quality Training, Accreditation, Research
and Image Building for stakeholders**