RTB | RWANDA TVET BOARD

RQF LEVEL 5

SWDDT501

SOFTWARE DEVELOPMENT

DevOps Techniques Application

TRAINER'S MANUAL

October, 2024

DEVOPS TECHNIQUES APPLICATION

KOICA Korea International Cooperation Agency

TQUM TVET Quality Management Project

2024

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Copies available from:

- *HQs: Rwanda TVET Board-RTB*
- *Web: www.rtb.gov.rw*
- **KIGALI-RWANDA**

Original published version: October 2024

ACKNOWLEDGEMENTS

The publisher would like to thank the following for their assistance in the elaboration of this training manual:

Rwanda TVET Board (RTB) extends its appreciation to all parties who contributed to the development of the trainer's and trainee's manuals for the TVET Certificate V in Software Development, specifically for the module **"SWDDT501: DevOps Techniques Application"**

We extend our gratitude to KOICA Rwanda for its contribution to the development of these training manuals and for its ongoing support of the TVET system in Rwanda.

We extend our gratitude to the TQUM Project for its financial and technical support in the development of these training manuals.

We would also like to acknowledge the valuable contributions of all TVET trainers and industry practitioners in the development of this training manual.

The management of Rwanda TVET Board extends its appreciation to both its staff and the staff of the TQUM Project for their efforts in coordinating these activities.

This training manual was developed:

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ACRONYMS

AWS: Amazon Web Services

CD: Continuous Delivery

CI: Continuous Integration

DevOps: Development and Operations

DevSecOps: Development, Security, and Operations

DNS: Domain Name System

IaaS: Infrastructure as a Service

IaC: Infrastructure as Code

JSON: JavaScript Object Notation

K8s: Kubernetes

KOICA: Korea International Cooperation Agency

OS: Operating system

RTB: Rwanda TVET Board

RTB: Rwanda TVET Board

SSH: Secure Shell

TQUM: TVET Quality Management

TVET: Technical and Vocational Education and Training

VCS: Version Control System

YAML: yet another markup language

INTRODUCTION

This trainer's manual includes all the methodologies required to effectively deliver the module titled. "**DevOps Techniques Application**" Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies. The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

The trainer's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainer, you will begin by asking questions related to the activities to encourage critical thinking and guide trainees toward real-world applications in the labor market. The manual also outlines essential information such as learning hours, didactic materials, and suggested methodologies.

This manual outlines the procedures and methodologies for guiding trainees through various activities as detailed in their respective trainee manuals. The activities included in this training manual are designed to offer students opportunities for both individual and group work. Upon completing all activities, you will assist trainees in conducting a formative assessment known as the end learning outcome assessment. Ensure that students review the key reading and the points to remember section.

MODULE CODE AND TITLE: SWDDT501 DEVOPS TECHNIQUES APPLICATION

Learning Outcome 1: Perform server configuration
Learning Outcome 2: Deploy the system
Learning Outcome 3: Implement monitoring strategies

Indicative contents

1.1 Preparation of environment

1.2 Applying Linux basics commands

1.3 Management of server services

Key Competencies for Learning Outcome 1: Perform Server configuration

Knowledge	Skills	Attitudes
• Description of DevOps key terms • Identification of Linux distribution • Description of Linux basic commands • Description of server services	• Installing Linux operating system • Applying basics Linux Commands • Managing server services	• Being collaborative while installing Linux operating system • Being competent when managing Linux server • Being innovative • Being Practical oriented

Duration: 20 hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe correctly the key terms related to the development operations (DevOps)
2. Identify accurately the Linux distributions based on selected platform.
3. Describe properly Linux basic commands based on selected Linux distribution
4. Describe properly the server services based on selected platform.
5. Install properly Linux operating system based od on selected Linux distribution
6. Apply properly basics Linux commands based on Linux distribution.
7. Manage properly the server services based on Linux distribution

Resources

Equipment	Tools	Materials
• Computer • server machine • storage device	• Linux OS • Oracle Virtual Box	• Internet • Electricity

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have bootable device for installing Linux OS
- Avail computer lab

Indicative content 1.1: Preparation of Environment

Duration: 8 hrs

Theoretical Activity 1.1.1: Description of key terms related to DevOPs

Notes to the trainer:

- Trainer may use small groups for describing the key terms used in DevOps
- Avail Sample image
- Avail Computer connected to the internet
- Avail video to be used as didactic material

Key steps:

While delivering this activity, pass through the following steps:

Step 1 Introduce the activity by asking trainees to answer the following questions:

i. What do you understand by the terms below?

a. Server
b. Linux
c. Development operation (Devops)
d. DevSecOps
e. IaC
f. IaaS
g. CI/CD
h. Container
i. Node

ii. What is the difference between Continuous Integration (CI)and Contin uous Deployment (CD)?

Step 2 Ask trainees to write their answers on flipchart, paper, blackboard or whiteb oard

Step 3 Engage trainees in presentation of their findings

Step 4 Provide an expert view for more clarification.

Step 5 Address any questions or concerns from the trainees

Step 6 Ask trainees to read the key readings 1.1.1, in the trainee manual

Points to Remember

- There is difference between **CI** and **CD** where by Continuous Integration focuses on the early stages of the development process, continuous delivery (CD) takes things a step further, Continuous Integration focuses on the integration and validation of code while continuous delivery (CD) focuses on delivering changes to production or staging environments.
- A container is a standardized unit of software that packages up code and its dependencies so that the application runs consistently across different environments.
- DevOps combines development (Dev) and operations (Ops) to increase the efficiency, speed, and security of software development and delivery compared to traditional processes.
- DevSecOps is an extension of DevOps that incorporates security practices throughout the entire software development lifecycle.

Theoretical Activity 1.1.2: Identification of Linux distributions

Notes to the trainer:

- Trainer may use small group for identifying Linux Distribution
- Avail computer connected to the network

Key steps:

Step 1 Introduce the activity by asking trainee to answer to the following questions:

i. What are Linux distributions?

ii. Explain the components of Linux.

Step 2 Ask trainees to write their answer on flipchart /paper

Step 3 Ask trainees to present their findings

Step 4 Provide expert view for more clarifications

Step 5 Ask trainees to read in key readings 1.1.2

Points to Remember

- **A Linux distribution** is an operating system made from a software collection that includes the Linux kernel and often a package management system. There are the Popular Linux Distributions such as Ubuntu, fedora, Debian, CentOS and more
- **DevSecOps** is an extension of DevOps that incorporates security practices throughout the entire software development lifecycle.
- **A Linux distribution (distro)** consists of several key components: the Linux kernel, which is the core of the operating system that manages hardware resources; system libraries, which provide essential functions and services to applications; system utilities, which are basic tools for managing the system (like file management and process control); package management systems (such as APT or YUM), which handle the installation, updating, and removal of software packages; and user interfaces, which can be command-line (like Bash) or graphical (like GNOME or KDE). Additionally, distributions often include a collection of pre-installed applications and tools tailored for specific use cases, such as desktop environments, server management, or development

Practical Activity 1.1.3: installing Linux Operating System

Notes to the trainer:

- This activity should be carry out the computer lab where the trainees will install Ubuntu Linux operating system
- Avail computers with CPU 2GHz Dual core, RAM 4GB, HD space 25GB and Graphic of 3D acceleration
- Avail Oracle virtual box setup file
- Avail OS Image file

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to perform the following task:

Go to the computer lab to install Linux operating system.

Step 2: Provide clear work instructions (Task, Allocation, Time).

Step 3: Demonstrate how to install Linux operating system and explain the steps to be followed.

Step 4: Ask trainees to install Linux operating system and Monitor.

Step 5: Verify whether the Linux operating system is properly installed

Step 6: Ask trainees to read key reading 1.1.3 in the trainee manual

Points to Remember

- Ubuntu Linux offers many benefits making it one of the most popular operating systems, especially for developers, IT professionals, and general users. Here are the key reasons why using Ubuntu Linux is important: Free and Open Source, Security and Privacy, Stability and Performance, Software Availability, Developer-Friendly
- Creating a bootable USB drive is necessary for several tasks including: Operating System Installation**,** System Recovery**,** Testing or Running Live Systems**,** Updating Firmware**,** Disk Partitioning or Maintenance**.**

Application of Learning 1.1.

An XXX company has a server computer installed with a window server 2012r2, the company needs to upgrade computer with Linux operating system. Request your trainees to install Linux operating system in sever computer.

Checklist

SN	Criteria	Indicators	Yes	No
1	Linux OS is properly installed	Linux distribution is selected		
		Storage device is booted		
		Linux OS is successful installed		

Indicative content 1.2: Application of Linux basic commands

Duration: 5 hrs

Theoretical Activity 1.2.1: Description of basic Linux Commands

Notes to the trainer:

- Trainer may use small groups for describing the Linux basic Commands
- Avail Computer connected to the internet

Key steps:

While delivering this activity, pass through the following steps:

Step 1 Introduce the activity by asking trainees to answer the following questions :

I. What are the following Linux basic commands?

a) System information
b) File and directory management
c) Text processing
d) Package management
e) Process management
f) User and group management
g) System control

Step 2 Ask trainees to write the answers on papers, flipchart, blackboard or whit eboard.

Step 3 Engage trainees in presentation of their findings

Step 4 Provide the expert view for more clarification.

Step 5 Address any questions or concerns from trainees

Step 6 Ask trainees to read the key **reading 1.2.1** in trainee manual

Points to Remember

While using Any Linux Distributions you must understand the following point:

- **Terminal** refers to an interface that allows users to interact with the computer's operating system by typing commands. Originally, a terminal was a physical device

used to input and display data (such as early teletype machines or video display terminals). However, in modern systems, a terminal is typically a **software application** that emulates this function.

- **Commands** are instructions that you type into a terminal (command-line interface) to perform specific tasks. These commands allow you to interact with the operating system, manage files, processes, users, and system resources, and automate various tasks.

- Using basic commands in Linux is essential for several reasons, especially in a command-line-driven environment, Because Linux basic commands are used for Efficiency and Control, Resource Management, Automation, Remote Access, Power and Flexibility, Troubleshooting and Learning Foundation

Practical Activity 1.2.2 Applying Linux basic commands

Notes to the trainer

- This activity should take place in a computer Lab where trainee will apply Linux system information basic commands
- Avail computers connected to the internet.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainee to perform the following task:
   a. Go to the computer lab to apply Linux basic command.

Step 2: Provide clearly instructions on how to do the tasks.

Step 3: Demonstrate how to apply Linux basic commands and explain the steps to be used.

Step 4: Ask trainees to apply Linux basic commands and monitor

Step 5: Verify whether Linux basic commands are properly performed.

Step 6: Ask trainees to read the key reading 1.2.2

Step 7: Ask trainees to perform application of learning 1.2

Points to Remember

- **System control commands** provide essential tools for managing services, processes, system status, and user accounts in Linux. They are key to effective system administration.

Application of learning 1.2.

ABC computer network is a newly opened company that needs to perform the following tasks:

a) Gather system information
b) Perform file and directory management
c) Use text processing tools
d) Handle package management
e) Perform user and group management
f) Use system control commands

Now, as a system administrator, you are hired to help the company in the aforementioned tasks

Checklist :

SN	Criteria	Indicators	Yes	No
1	System information is correctly gathered	Kernel version is checked		
		Uptime is checked		
		Memory usage is checked		
2	File and directory management are properly performed	Navigating is done		
		Creating is done		
		Copying is done		

		removing files and directories are done		
		Users and groups are properly created		
		The running process are properly viewed		
		User and group commands are properly managed		
3	Text processing tools	Text are manipulated		
		Text are viewed		
4	Package management	Linux distribution is checked		
		Packages are installed		
5	User and group correctly managed	User and group are created		
		User and group Modified		
6	system control commands if well applied	Service are Started		
		system is shutdown		
		Check the system well rebooted.		

Indicative content 1.3: management of server services

Duration: 7 hrs

Theoretical Activity 1.3.1: Description of server services

Notes to the trainer:

- Trainer may use small groups for describing the server services used in DevOps
- Avail video used as didactic material

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity by asking trainee to answer to the following questions:

b. What are server services?

c. Differentiate between monitoring and logging

Step 2: Ask trainees to write their findings on paper/flipchart

Step 3: Ask trainees to present the findings

Step 4: Provide expert view and ask question for clarification

Step 5: Trainees address question if necessary

Step 6: Ask trainees to read in key reading **1.3.1** in the trainee manual

Points to Remember

- server service is a software component that runs on a server (a computer that hosts websites and web applications) and provides a specific functionality or service to other computers or devices connected to the network.
- There are many types of server services depending on the functionality or service they provide. Some of the most common used are Web Server Service, Database server service, Mail server service, FTP Server Service, DNS Server Service.

Practical Activity 1.3.2: Configuring server services

Notes to the trainer:

- While delivering this content, trainer may check if computer laboratory is installed Linux operating system
- Avail computers
- Avail of create virtual machine

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the following tasks:

I. Go to the computer Lab and Configure server services.

Step 2: Provide clearly work instructions (Task, Allocation, Time).

Step 3: Demonstrate how to install, configure and manage Linux services

Step 4: Ask trainees to install, configure and manage Linux service.

Step 5: Monitor trainees while installing, configuring and managing Linux services.

Step 6: Verify whether Linux services are managed

Step 7: Ask trainees to read key reading **1.3.2**

Step 8: Ask trainees to perform application of learning 1.3

Points to Remember

- While managing server there are different Services require system administrator to install and manage in order the server operate smoothly such as network, web, DNS, SSH, proxy and more.

Application of learning 1.3.

RTDX company has recently expanded its infrastructure to accommodate a growing number of users and services. As the system administrator, request trainee for setting up and configure essential services across multiple Ubuntu-based servers to ensure the smooth operation of internal and external communications.

Checklist/Solution for application:

SN	Criteria	Indicators	Yes	No
1	DNS service is properly managed	DNS services is installed		
		DNS services is configured		
		DNS services is tested		
2	SSH service is properly managed	SSH service is installed		
		SSH is configured		
		SSH is tested		
3	Network service is properly configured	App is updated		
		BIND9 is installed		
		BIND9 is configured		
		Static IP address is assigned		
4	Web service is properly managed	Web service is installed		
		Web service is configured		
		Web service is tested		

Learning outcome 1 end assessment

Written assessment

Q1. Circle the letter corresponding to the correct answer:

i. The main objective of DevOps is:

A) To deliver software in isolated silos
B) To enhance collaboration between development and operations
C) To slow down the release process
D) To remove automation in development

Answer: B) To enhance collaboration between development and operations

ii. CI/CD stand for:

A) Continuous Input/Continuous Delivery
B) Continuous Integration/Continuous Development
C) Continuous Improvement/Continuous Deployment
D) Continuous Integration/Continuous Deployment

Answer: D) Continuous Integration/Continuous Deployment

iii. One of the following statement describes “Infrastructure as Code” (IaC):

A) Managing infrastructure manually
B) Using code to define and manage infrastructure
C) Using spreadsheets to manage servers
D) Hiring additional staff for server management

Answer: B) Using code to define and manage infrastructure

iv. Which of the following is a version control system widely used in DevOps?

A) Git
B) Docker
C) Slack
D) Kubernetes

Answer: A) Git

Q2. Match the commands (column B) with their function (column C). by writing the letter corresponding with the right answer in provided blank space (column A)

Answer (Column A)	**Commands (Column B)**	**Functions (column C)**
1……B…..	1. Cd.	A) is used to install any package
2…….D	2. sudo shutdown now	B) to change directory
3……E	3.mkdir	C) used to list the contents of a file.
4……C	4.Cat	D) is command used to shuts down the system immediately
5……I	5. Sudo	E) to create directory
6…….G	6. Cp	F) Restarting System Services
7……G	7. PWD	G) to display the root path
8……F	8. sudo systemctl restart service name	I) is used to run commands with superuser (root) privileges. It stands for "SuperUser DO" and allows authorized users to execute administrative tasks without logging in as the root user.
9……..A	9. sudo apt install	J) is command used to copy files and directories
		I) Linux is used to change the file permissions
		H) is command used to shuts down the system immediately

Practical assessment

Rwanda Network Ltd is a new Company hosted the web application, this company is located at Muhanga District. It has a Network system that is Implemented with windows Server Management, it needs to upgrade from windows server to Linux server in order to manage different services. you request trainee to install Linux Server, configure server services and Test server functionalities and apply system information Linux basic commands.

Checklist/Solution for practical assessment:

SN	Criteria	Indicators	Yes	No
1	Linux server is properly set up	Linux OS is installed		
		Linux OS is updated		
2	server services are properly configured	services are installed		
		services are managed		
4	system information Linux basic commands are properly performed	CPU information are checked		
		Memory information are checked		
		OS Version is checked		

END

Further information to the trainer

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SERVES
SERVE
ND
SERVER

Indicative contents

2.1 Preparation of deployment

2.2 Use Continuous delivery and Configure of containerization

2.3 Perform Migration

Key Competencies for Learning Outcome 2: Deploy system

Knowledge	Skills	Attitudes
• Description of deployment key terms • Identification of evolution and Importance of DevOps • Description of Advantages and Disadvantages of DevOps • Description of DevOps Technologies • Description of DevOps principles • Description of DevOps lifecycle • Identification of technologies used in system to be deployed • Identification of data migration • Description continuous integration and continuous delivery • Identification of container	• Installing of dependencies • Configuring CI/CD pipeline • Implementing data migration pipeline.	• Being collaborative while preparing or deploying software • Being flexible while preparing deployment • Being decision make while handling errors

Duration: 30 hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe clearly the deployment key terms based on the system to be deployed
2. Describe properly the evolutions, advantages and disadvantages of DevOps based on the system to be deployed.
3. Describe properly lifecycle used in continuous Integration and continuous deployment
4. Describe correctly technologies and principles of DevOps based on the system to be deployed.
5. Identify clearly the containerization based on scalability of application
6. Identify properly data migration based on system environment
7. Install properly the required dependencies based on system environment
8. Configure properly container-based software to be deployed
9. Configure continuous integration and continuous pipeline deployment based on area of automation
10. Create correctly data migration based on system environment.

Resources

Equipment	Tools	Materials
• Computers • Server	• Docker file • Git • GitHub • IDE (vs code) • Cloud	• Internet • Electricity

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have account on GitHub
- Have computer installed git and IDE software
- Avail computer Lab
- Avail Master card

Indicative content 2.1: Preparation of deployment Environment

Duration: 5 hrs

Theoretical Activity 2.1.1: Description of Deployment key terms

Notes to the trainer:

- Trainer may use small groups for describing the deployment key terms.
- Avail Computer connected to the internet
- Avail sample image to be used as didactic material

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the below questions.

i. Give the meaning of the following terms:
   a. Deployment
   b. Build agent
   c. Containerization
   d. Docker
   e. Kubernetes
   f. Jargon
   g. Dependence

ii. Give DevOps evolutions with their advantages and disadvantages.

iii. Identify the principles of DevOps

iv. Identify phases of DevOps lifecycle

v. What are the tools and technologies used in system deployment?

Step 2: Ask trainees to write their answers on papers, flipchart, blackboard or whiteboards.

Step 3: Engage trainees to present their findings

Step 4: Provide an expert view for more clarifications.

Step 5: Address any question or concern from the trainees.

Step 6: Ask trainees to read the key readings 2.1.1

Points to Remember

- Before preparing the deployment environment you must describe the tools and technologies.
- DevOps life cycle include the different phases such as Continuous development, Continuous integration, Continuous Testing, Continuous monitoring, Continuous feedback, Continuous deployment and Continuous operation.

Practical Activity 2.1.2: Selecting technology and tools

Notes to the trainer

- While delivering this contents, trainer may have a checklist.
- Avail computer
- Avail internet connection

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to perform the following task:
You are requested to select deployment technology and tools

Step 2: Provide clear work instructions (Task, Allocation, Time).

Step 3: Explain how to select tools based on technology

Step 4: Ask trainees to select tools based on technology and Monitor trainees while selecting tools based on technology

Step 5: Verify whether tools are properly installed based on technology

Step 6: Ask trainees to read the key readings 2.1.2 in trainee manual

Points to Remember

- While selecting the technologies and tools, you must understand the below key point:
  Version Control (Git, SVN) for managing code changes, CI/CD Tools (Jenkins, GitLab CI/CD) to automate testing and deployment, Containerization (Docker, Kubernetes) for packaging and orchestrating applications, Configuration Management (Ansible, Terraform) to automate infrastructure, Monitoring (Prometheus, Grafana) and Logging (ELK Stack) for system insights and Collaboration Tools (Slack, Jira) for communication and project management.

Practical Activity 2.1.3: Installing Dependency

Notes to the trainer:

- While delivering this contents, trainer may check if computer Lab is installed IDE.
- Avail computer
- Avail internet connection

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to perform the following task:

Go to the computer Lab and install Node.js and react.js dependencies.

Step 2: Provide clear work instructions (Task, Allocation, Time).

Step 3: Demonstrate how to install backend (node) and frontend(react) dependencies

Step 4: Ask trainees to install node.js and react.js dependencies

Step 5: Monitor trainees while installing dependencies

Step 6: Verify whether dependencies are properly installed

Step 7: Ask trainees to read the key readings 2.1.3 in trainee manual

Points to Remember

To install dependencies in a project or system, the following requirements are typically needed: Package Manager, Dependency Manifest File, Internet Access, Correct Software Version, Sufficient Permissions, System Dependencies, Virtual Environment (Optional but recommended), Configuration Settings (Optional).

Application of learning 2.1

Imagine that XYZ DevOps Company need an IT technician who can manage server hold node.js and react.js application. Request your trainees to help the company to select tools based on appropriate technology and install dependencies for both backend and frontend.

Checklist/Solution for application :

SN	Criteria	Indicators	Yes	No
1	Tools are properly selected based on technology	Technology is selected		
2	Dependencies are properly installed	Project requirement are checked		
		Directories are Created		
		Dependencies are installed		

Indicative content 2.2: Use Continuous delivery and configure containerization

Duration: 15

Theoretical Activity 2.2.1: Description of Continuous Delivery tools and containerization

Notes to the trainer:

- Trainer may use small groups for describing the tool used in DevOps
- Avail of computer connected the internet

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask the trainees to answer the following questions:

i. Discuss on deployment orchestration and CI server
ii. Describe the steps performed on the following CI:
    a) Server configuration
    b) Set up Automated build and testing
    c) Check code Quality
    d) Artefact management
    e) Integration with version control
iii. Describe Continuous Integration and Continuous Deployment Pipeline
iv. Explain the term “containerization” technology.

Step 2: Ask trainees to Write their answers on paper, flipchart, blackboard or whiteboard

Step 3: Engage trainees in Presentation of their findings

Step 4: Provide an expert view for more clarification

Step 5: Address any question or concerns from trainees

Step 6: Ask trainees to read the key readings 2.2.1 in trainee manual

Points to Remember

- There is difference between CI and CD where CD automates the process of preparing code changes for deployment, ensuring that the application is always in a deployable state while CI involves the automatic merging and testing of code changes (usually multiple times a day) to ensure that the codebase is always in a working state.
- While developing and deploying software, remember to select containerization technology that help he/ she to enable applications to run consistently across different environments without compatibility issues, providing isolated environments that prevent conflicts and enhance security.

Practical Activity 2.2.2: Configuring server based on software deployment

Notes to the trainer:

- This activity should be carry out the computer lab where the trainees will configure software deployment
- The trainer may check server is properly installed Linux
- Avail computer connected to the internet

Key steps:

While delivering this activity, pass through the following steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity by ask trainees to perform the following tasks:

Go to computer lab to develop frontend, backend scripts, test script, configure containerization, configure CI/CD using version control and configure server.

Step 2: Provide clear work instructions (Task, Allocation, Time).

Step 3: Demonstrate how to test script, configure containerization deployment

Step 4: Ask trainees to test scripts and configure containerization for deployment

Step 5: Verify whether scripts are properly tested and containerization is configured

Step 6: Ask trainee to read the key readings 2.2.2 in trainee manual

Points to Remember

- The most popular version control we must use according to the key features is GitHub where the developer uses as platform that allows them to create, store, manage and share their code.

Application of learning 2.2.

A university offers a course on Modern Web Development, where students are learning to build full-stack applications using Node.js (for the backend) and React.js (for the frontend). as full-stack you are tasked to set up project, configure Containerization, and automate deployment using CI/CD pipelines and configure server.

Checklist/Solution for application :

SN	Criteria	Indicators	Yes	No
1	Project are properly set up	Node.js and npm are checked		
		Applications are created		
		Project dependencies are configured and tested		
2	Containerization is properly configured	Docker is installed		
		Docker image is created		
		Docker file is stored		
4		Repository is created		

	CI/CD pipelines are properly configured	Files are well committed		
		Workflow file is created		
		Permission are enabled		
		Automation is built		
		Test is well applied		
5	Server is properly configured	Server is updated and upgraded		
		Apaches is installed		
		Dependencies are installed		
		Docked is installed		
		Auto build is configured		

Indicative content 2.3: Perform migration

Duration : 10 hrs

Theoretical Activity 2.3.1: Identification of data migration

Notes to the trainer:

- Trainer may small groups for identifying the containerization tools
- Avail video used as didactic material
- Avail computer connected to the internet

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

i. What are the best practice for data migration to ensure smooth and efficiency process?

ii. How do select the right tools and technologies for successful data migration project?

Step 2: Ask trainees to write their findings on paper, flipchart, blackboard or white whiteboard.

Step 3: Engage trainees in presentation of their findings

Step 4: Provide the expert view for more clarifications

Step 5: Address any question or concerns from the trainees

Step 6: Ask trainee to read the key readings 2.3.1 in trainee manual

Points to Remember

- Data Migration Deployment is a critical phase in DevOps where data is transferred from an existing system to a remote system according the changes of database schema by Define the migration goal, identify source and target systems, assess data quality, create details plan, test thoroughly and training users to new system.

Practical Activity 2.3.2 Creating data migration Pipeline

Notes to the trainer:

- This activity should be carry out the computer lab where the trainees will create data migration.
- Avail Database management system
- Avail computer connected to the internet
- Avail database schema
- Avail didoes and images as didactic materials

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity by ask trainees to perform the following task:

i. You are requested to go to the computer Lab to install database management system and create data migration to new changes of database schema.

Step 2: Provide clear work instructions (Task, Allocation, Time).

Step 3: Demonstrate how to create script and migrate data

Step 4: Ask trainees to create scripts and migrate data

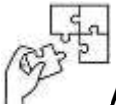
Step 5: Monitor trainee activities while creating scripts and migrating data

Step 6: Verify whether the scripts are created and data are migrated

Step 7: Ask trainees to read the key reading 2.3.2

Points to Remember

- While creating data migration remember that data are transfer form local repository to remote repository by using version control and then data migrate from remote repository to remote server.



Application of learning 2.3.

BNC University is upgrading its Learning Management System (LMS) to a new, more modern platform. The existing LMS holds years of data, including student information, course applications, grades, and feedback. Ask your trainees to migrate all the data to the new LMS, maintaining data integrity and push the changes to remote server.

Checklist/Solution for application:

SN	Criteria	Indicators	Yes	No
1	Database schema are properly prepared	DBMS is installed		
		Database and tables are created		
		Prisma is configured		
		Axion is installed		
2	Data are properly migrated	Remote server Database is configured		
		Data are migrated		

Learning outcome 2 end assessment

Written assessment

Q1. Circle the correct answer on the following questions:

i. Which of the following is a tool commonly used for Continuous Deployment (CD)?

   a. Jenkins
   b. Ansible
   c. SonarQube
   d. Git

   Answer: b) Ansible

ii. **What is the primary role of a Continuous Integration (CI) server?**

   a. Manage code repositories
   b. Automate the building and testing of code
   c. Orchestrate server deployments
   d. Monitor system uptime

   Answer: b) Automate the building and testing of code

iii. Which of the following tasks is related to Continuous Integration (CI)?

   a. Implementing automated rollback
   b. Developing deployment scripts
   c. Setting up automated builds
   d. Using infrastructure as code (IaC)

   Answer: c) Setting up automated builds

iv. Which tool is best suited for deployment orchestration in Continuous Delivery (CD)?

   a. GitLab CI
   b. Kubernetes
   c. Jenkins
   d. Travis CI

   Answer: b) Kubernetes

v. What does Infrastructure as Code (IaC) allow you to do?

a. Automate deployments using scripts
b. Manage code quality
c. Track software versions
d. Create CI pipelines

Answer: a) Automate deployments using scripts

vi. Which of the following is NOT a task in Continuous Delivery (CD)?

a. Configure the CI pipeline
b. Perform code quality checks
c. Implement automated rollback
d. Use a deployment orchestration tool

Answer: b) Perform code quality checks

vii. Which of the following steps would you take when implementing a Continuous Integration (CI) pipeline?

a. A Configure CD pipeline
b. Set up an automated build process
c. Develop deployment scripts
d. Use deployment orchestration tools

Answer: b) Set up an automated build process

viii. Which feature of Continuous Deployment (CD) helps in minimizing

a. Automated rollback
b. Infrastructure as Code (IaC)
c. Code quality checks
d. Artifact management

Answer: a) Automated rollback

Q2. Read carefully and then answer the following questions

i. Describe the CI and CD tools.

- **Jenkins:** A widely used open-source automation server that can be used to build, test, and deploy software.
- **CircleCI:** A cloud-based continuous integration and continuous delivery platform that offers a simple and scalable way to automate the software development process.
- **Travis CI:** Another cloud-based continuous integration platform that integrates with popular version control systems like GitHub and Bitbucket.
- **GitLab CI/CD:** A built-in continuous integration and continuous delivery pipeline in the GitLab platform, providing a seamless experience for developers.
- **Bamboo:** A commercial continuous integration and continuous delivery server from Atlassian that offers a wide range of features and integrations.
- **GoCD:** An open-source continuous delivery server that focuses on value stream mapping and pipeline visualization.
- **Spinnaker:** A multi-cloud continuous delivery platform developed by Netflix that supports a variety of cloud providers and deployment strategies.
- **Argo CD:** A declarative continuous delivery tool for Kubernetes applications that simplifies the deployment and management of containerized workloads.

ii. What are the benefits of adopting a DevOps approach?

Answer: Adopting a DevOps approach can lead to several benefits, including:

- **Faster time to market:** By automating and streamlining the development and deployment process, DevOps can significantly reduce the time it takes to deliver new features and updates.
- **Improved quality:** DevOps practices like continuous integration and testing help ensure that software is delivered with higher quality and fewer defects.
- **Increased reliability:** DevOps focuses on monitoring and maintaining the health of production systems, leading to more reliable and resilient applications.

- **Enhanced customer satisfaction:** Faster delivery of new features and improvements can lead to increased customer satisfaction.

iii. How does DevOps promote collaboration between development and operations teams?

Answer: DevOps fosters collaboration by breaking down silos between development and operations teams. It encourages shared responsibility for the entire software lifecycle, promotes communication and knowledge sharing, and often involves cross-functional teams working together.

iv. What are the challenges that organizations might face when implementing DevOps?

Answer: Implementing DevOps can present challenges, such as:

- **Cultural changes:** Adopting a DevOps culture may require a shift in mindset and practices for both development and operations teams.
- **Tooling and automation:** Selecting and implementing the right tools and automating processes can be complex and time-consuming.
- **Skill development:** Teams may need to acquire new skills or knowledge to effectively utilize DevOps practices and tools.
- **Organizational resistance:** Overcoming resistance from within the organization can be challenging, especially if there are entrenched processes or silos

Practical assessment

Imagine you are part of a development team with responsibilities for building and deploying a scalable web application. As full-stack developer, you are requested to deploy the developed software and perform data migration to a new database system.

Checklist/Solution for application :

SN	Criteria	Indicators	Yes	No
1	Project is properly sated up	Project dependencies are configured		
		Account is well activated		
2	Containerization is properly configured	Docker image is created		
		Docker file is created		
4	CI/CD pipelines are properly configured	Files are committed		
		Automation is built		
		Test is applied		
5	Server is properly configured	Dependencies are configured		
		Database is installed and configured		
6	Data migration is properly performed	Database schema is well analysed		
		Data are well migrated		
		Data migration test is well applied		

END

Further information to the trainer

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Skill Mastery
Quiz

Indicative contents

3.1 Preparation of monitoring tools in DevOps environment

3.2 Analysis of performance metrics and feedback

3.3 Documentation of monitoring report

Key Competencies for Learning Outcome 3: implement monitoring

Knowledge	Skills	Attitudes
• Identification of monitoring tools • identification of performance metrics and feedback • Description of report	• Installing monitoring tool • Utilizing monitoring tool • Writing reports	• Being patient and persistence while analysing data • Being problem-solving Mindset while analysing data • Paying attention to details while analysing data

Duration: 10 hrs

Learning outcome 3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify correctly monitoring tools according to their respective documentation.
2. Identify clearly the performance metrics and feedback data are routinely analysed in accordance with system requirements
3. Describe correctly the documented report based on the work done
4. Install accurately the monitoring tool based on respective documentation
5. Generate properly the report documented based on analysed data

Resources

Equipment	Tools	Materials
• Computer • Server • Printer	• IDE • Browser • DBMS	• Papers • Electricity • Internet

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have computers connected to the interne
- Avail server computer

Indicative content 3.1: Preparation of monitoring tools in DevOps environment

Duration: 4 hrs

Theoretical Activity 3.1.1: Identification of monitoring tools in DevOps environment

Notes to the trainer:

- Trainer may use small groupss for describing monitoring tools

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity by asking trainees to answer the following questions:

i. Give the benefits of DevOps monitoring.
ii. List the importance of monitoring tools
iii. Identify the following monitoring tool types:
    a. Application tools
    b. Networking tools
    c. Infrastructure tools

Step 2: Ask trainees to write their answers on flipchart, papers, blackboard or whiteboard.

Step 3: Engage trainees in Presentation of their findings

Step 4: Ask questions for clarification if necessary

Step 5: Provide an expert view for more clarifications

Step 6: Address any question or concerns from the trainees

Step 7: Ask trainees to read the key readings 3.1.1 in the trainee manual

Points to Remember

- Before performing any monitoring activity, you must understand the different types of monitoring tools such as networking monitoring tools, application monitoring tool and infrastructure monitoring tools.

Practical Activity 3.1.2: Installing Monitoring tools

Notes to the trainer:

- This activity should be carry out the computer lab where the trainees will install monitoring tool
- Avail computer
- Avail videos and images as didactic materials

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to perform the following tasks:

i. Go to computer lab to install the monitoring tools.

Step 2: Provide clear work instructions (Task, Allocation, Time)

Step 3: Demonstrate how to install monitoring tools and explain the steps

Step 4: Ask trainees to install monitoring tools and monitor activity

Step 5: Verify whether monitoring tools are properly installed

Step 6: Ask trainees to read the key readings 3.1.2 in the trainee manual

Points to Remember

- Apart from using commands during installation, there are other monitoring tools which can be downloaded from the official manufacturer website and then be used during installation: these include washark, prometheus, grafana, datadog, nagios, zabbix and ELK stack.

Application of learning 3.1.

Ketty is leading a team in a DevOps-driven project for a SaaS application. The team is focused on optimizing the application's performance, improving deployment frequency, and reducing incident response times. Ask your trainees to install the required monitoring tools.

Checklist/Solution for application:

SN	Criteria	Indicators	Yes	No
1	Monitoring tool is properly managed	New account is created		
		Agent is installed		
		New file is created		
		File is configured		

Indicative content 3.2: Analysis of performance metrics and feedback data

Duration : 4hrs

Theoretical Activity 3.2.1: Identification of performance metrics and

Notes to the trainer:

- Trainer may use small groups for describing the performance and feedback of data.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity by ask trainees to answer the following questions:

i. List down significate of data analysis
ii. Give and explain the types of data in Devops
iii. Differentiate the following data in DevOps
   a) Regular review
   b) Root cause analysis
   c) Actionable insights
   d) Feedback loop integration

Step 2: Ask trainees to write their answers on flipchart, papers, blackboard or whiteboard

Step 3: Engage trainees in presentation of their findings

Step 4: Provide an expert view for more clarifications

Step 5: address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 3.2.1 in the trainee manual

Points to Remember

- Before performing any monitoring activity, you must understand the different types of monitoring tools such as networking monitoring tools, application monitoring tool and infrastructure monitoring tools.
- When installing a monitoring tool in a DevOps environment, first download tool then after follow the installation steps until tool will complete.

- Describe the type of data such as log data, infrastructure data, application performance data and build and deployment data, version control data, security data user experience data, automation data, collaboration and workflow data and business and financial data.

- Apart from using commands during installation, there are other monitoring tools which can be downloaded from the official manufacture website and then be used during installation: these include washark, prometheus, grafana, datadog, nagios, zabbix and ELK stack.

Practical Activity 3.2.2: Analysing the performance metrics and feedback data

Notes to the trainer:

- This activity should be carry out in the computer lab where the trainees will perform data analysis
- Avail computers connected to the internet
- Avail images and videos as didactic materials
- Avail sever

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to perform the following task to analyse performance metrics and feedback data using New relic tool.

Step 2: Provide clear work instructions (Task, Allocated time)

Step 3: Demonstrate how to analyse data performance.

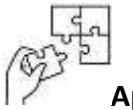
Step 4: Ask trainees to analyse data performance and monitor activity

Step 5: Verify whether data are properly analysed

Step 6: Ask trainees to read the key reading 3.2.2

Points to Remember

- While analysing data performance check the CPU speed, memory speed, data rate, time data taken and errors occurred during transactions process to provide feedback.



Application of learning 3.2.

RFTX Ltd company has a hosted web application on online server for managing its transactions. It needs a competent IT Technician capable to analyse the data in DevOps. Request your trainees to check performance metrics and feedback data.

Solution :

SN	Criteria	Indicators	Yes	No
1	Performance metrics is properly performed	Monitoring tool is selected		
		Monitoring tool are installed		
2	Status of Feedback are properly analysed	Accuracy of data is verified		
		Consistency of data are checked		
		Timeliness of data is checked		
		Completeness of data is checked		

Indicative content 3.3: Documentation of monitoring report

Duration : 2hrs

Theoretical Activity 3.3.1: Identification of Monitoring Report

Notes to the trainer:

- Trainer may use small groups for identifying the monitoring report
- Avail of sample report used as didactic material

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions

i. What is the purpose of monitoring report?

ii. Define the following action items concepts:

a) Executive summary
b) Key metrics
c) Report findings
d) Trends analysis
e) Alerts and actions
f) Action item
g) Optimization or remediation
h) Conclusion

Step 2: Ask trainees to write their findings on flipchart, papers, blackboard or white board

Step 3: Engage trainees in presentation of their findings

Step 4: Provide an expert view for more clarification

Step 5: Address any questions or concerns from trainees

Step 6: Ask trainees to read the key readings 3.3.1 in trainee manual

Points to Remember

- Before performing any monitoring activity, you must understand the different types of monitoring tools such as networking monitoring tools, application monitoring tool and infrastructure monitoring tools.

- When installing a monitoring tool in a DevOps environment, first download tool then after follow the installation steps until tool will completed.

- Describe the type of data such as log data, infrastructure data, application performance data and build and deployment data, version control data, security data user experience data, automation data, collaboration and workflow data and business and financial data.

Practical Activity 3.3.2: Writing report

Notes to the trainer:

- This activity should be carry out the computer lab where the trainees will perform data analysis and write a report the work done.
- Avail computers install monitoring tool and connect to the internet

Key steps:

While delivering this activity, pass through the following steps:

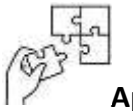
Step 1: Introduce the activity by ask trainee to trainee to perform the following task:

After data analysis, migration and deployment of software project to online server, you are requested to create a report of work done.

Step 2: Provide clear work instructions (Task, allocation, Time)
Step 3: Demonstrate how to write a report the work done
Step 4: Ask trainees to write the report of the work done and monitor activity
Step 5: Verify whether the report is properly generated
Step 6: Ask trainees to read the key readings 3.3.2 in the trainee manual

Points to Remember

- While writing there are many Key Points respect for Comprehensive Work Report.
- Apart from using commands during installation, there are other monitoring tools which can be downloaded from the official manufacture website and then be used during installation: these include washark, prometheus, grafana, datadog, nagios, zabbix and ELK stack.



Application of learning 3.3.

YA Ltd company has a hosted web application on online server for managing its activities. It needs a competent DevOps to analyse the data in DevOps. Request your trainees to write the report of performance metrics and feedback data on the system.

Checklist/Solution for application :

SN	Criteria	Indicators	Yes	No
1	Performance metrics and Feedback is properly analyzed	Monitoring tool is used		
		Performance metrics are analysed		
		Feedback data are analysed		
2	Report is properly generated	Executive summary is written		
		The objective and scope are written		
		Data collection are gathered		
		Conclusion and Recommendation are written		

Learning outcome 3 end assessment

Written assessment

Q1. Read carefully and answer the following questions:

i. **What factors should be considered when selecting and installing monitoring tools?**

- **Answer:** When selecting and installing monitoring tools, consider the following factors:
    - **Scalability:** Ensure the tools can handle the scale of your environment.
    - **Integration:** Consider how well the tools integrate with your existing infrastructure and tools.
    - **Ease of use:** Choose tools that are easy to use and configure.
    - **Cost:** Evaluate the cost of the tools and any associated maintenance or support fees.
    - **Features:** Select tools that offer the features and functionality you need, such as alerting, reporting, and visualization.

ii. **What are the key benefits of effective DevOps monitoring?**

- **Answer:** Effective DevOps monitoring offers several benefits, including:
    - Proactive issue detection and resolution
    - Improved system performance and reliability
    - Enhanced user experience
    - Faster troubleshooting and root cause analysis
    - Optimized resource utilization
    - Data-driven decision-making

iii. **What are the different types of monitoring tools used in DevOps environments?**

- **Answer:** There are three main types of monitoring tools:
    - **Application Performance Monitoring (APM):** Tools that monitor the performance of applications, including response times, errors, and resource usage.
    - **Network Performance Monitoring (NPM):** Tools that monitor network traffic, latency, and bandwidth utilization.
    - **Infrastructure Performance Monitoring (IPM):** Tools that monitor the performance of infrastructure components, such as servers, storage, and databases.

iv. **What factors should be considered when selecting and installing monitoring tools?**

- **Answer:** When selecting and installing monitoring tools, consider the following factors:
  - **Scalability:** Ensure the tools can handle the scale of your environment.
  - **Integration:** Consider how well the tools integrate with your existing infrastructure and tools.
  - **Ease of use:** Choose tools that are easy to use and configure.
  - **Cost:** Evaluate the cost of the tools and any associated maintenance or support fees.
  - **Features:** Select tools that offer the features and functionality you need, such as alerting, reporting, and visualization

v. **What is the importance of integrating feedback loops into the DevOps process?**

- **Answer:** Feedback loops allow teams to continuously gather user feedback and make necessary adjustments to the system based on real-world usage.

Q2. Circle the letter corresponding with correct answer:

i. **What is the primary purpose of performance metrics in DevOps?**

A. To measure the efficiency of development teams

B. To assess the quality of software products

C. To monitor the performance of systems and applications

D. To track user satisfaction

Answer: C

ii. **Feedback data is essential in DevOps for:**

A. Identifying technical issues

B. Understanding user experiences

C. Measuring team productivity

D. Assessing financial performance

Answer: B

iii. **Why is data analysis crucial in DevOps?**

A. To identify areas for improvement

B. To ensure compliance with regulations

C. To track project timelines

D. To measure team morale

Answer: A

iv. Data analysis can help DevOps teams:

A. Optimize resource utilization

B. Reduce development costs

C. Improve team communication

D. Increase employee turnover

Answer: A

v. **Which of the following is NOT a type of data commonly used in DevOps?**

A. System metrics

B. Financial data

C. User experience metrics

D. Feedback data

Answer B

vi. Monitoring tools are used to collect:

A. Financial data

B. Employee performance data

C. System metrics

D. Customer satisfaction data

Answer: C

vii. Regular review of performance data helps DevOps teams:

A. Identify trends and anomalies

B. Measure team productivity

C. Reduce development costs

D. Improve employee morale

Answer: A

viii. Root cause analysis is used to:

A. Improve employee morale

B. Measure team productivity

C. Reduce development costs

D. Identify the underlying causes of performance issues

Answer: D

ix. Feedback loop integration involves:

A. Collecting and analyzing feedback from users

B. Measuring team productivity

C. Reducing development costs

D. Improving employee morale

Answer: A

Q7. Answer by using letter T if the statement is True and use letter F is the statement is false.

b. Report findings should be presented in a clear and concise manner, using graphs, charts, and tables where appropriate___F____
c. Trends analysis can help identify patterns and anomalies in performance data ____T_____
d. Alerts and incidents should be documented in detail, including the time, date, and severity of the event ____T_____
e. It is not necessary to investigate the root cause of alerts and incidents __F__
f. Action items should be specific, measurable, achievable, relevant, and time-bound ___T___

Practical assessment

You are tasked with setting up a monitoring environment for a web application running on a cloud-based infrastructure. You need to install and configure a monitoring tool to track key performance indicators (KPIs) like CPU usage, memory usage, response time, and error rates and generate the report of the work done.

Checklist/Solution for application :

SN	Criteria	Indicators	Yes	No
1	Monitoring tools are properly prepared	Monitoring tool is installed		
		Account is activated		
		Monitoring tool is used		
2	Performance metrics and data feedback are analysed	Response time is checked		
		CPU usage is verified		
		memory usage is verified		
		error rates are analysed		
3	Documentation of monitoring report is generated	Report format is respected		
		Document is error free		

END

Further information to the trainer

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