



# MORPHEMIC

## Training plan and activities

Modelling and Orchestrating heterogeneous Resources and Polymorphic applications for Holistic Execution and adaptation of Models In the Cloud

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### Executive summary

This document presents a comprehensive plan for the MORPHEMIC training programmes in the context of the project's outreach and outlines the training activities roadmap which will be realised during the course of the MORPHEMIC project.

The training plan is comprised of a set of guidelines, action sequences and specific learning objectives, which aim to deliver a clear and complete understanding of the platform's usage, considering the needs of each intended audience.

The training activities approach defined in this document serves mainly as an internal guide for discovering potential target audiences based on the MORPHEMIC project's envisioned value network and defines the guidelines that encompass the management and realization of scheduled training seminars and workshops.

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## Table of Contents

1	Introduction.....	3
1.1	Scope of the document.....	3
1.2	Deliverable structure.....	3
1.3	Document target audience .....	3
2	Training requirements.....	3
2.1	Target training groups.....	3
2.2	Platform features.....	3
2.3	Implementation methods.....	4
3	Training plan.....	4
3.1	Training objectives .....	4
3.2	Training approach.....	5
4	Training activities .....	7
5	Conclusions.....	8

## List of Tables

Table 1 - Training approaches .....	5
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## 1 Introduction

### 1.1 Scope of the document

This document presents a comprehensive plan for the MORPHEMIC training programmes. The training plan is an integral part of the MORPHEMIC Work Package 7, Outreach, which aims to deliver a set of definitions, guidelines and goals for carrying out training activities, as well as gauging the most relevant audiences in order to maximise engagement. This deliverable also presents a preliminary training activities roadmap which will be realised during the course of the MORPHEMIC project.

### 1.2 Deliverable structure

Beginning in **chapter 2**, *Training requirements*, the basic platform definitions, and target group requirements, and applicable implementation methods for the training plan are delineated based on the project's description of action. **Chapter 3**, the *Training plan*, presents the core training objectives of the programme and the standardized training approach. Furthermore, in **chapter 4**, *Training activities*, a preliminary training schedule is introduced based on the knowledge presented. **Chapter 5**, *Conclusions*, summarizes the contents of this deliverable and presents the next steps of the training programme.

### 1.3 Document target audience

The intended audience of this document is comprised of the MORPHEMIC project's consortium partners whose affiliation with the project is relevant to the audiences they represent, or their assigned platform features. It is also directed to the project's consortium partners who are involved in outreach activities as part of the Work Package 7, Outreach, as defined in the project's Description of Action. Any other external parties interested in the training plan and activities of the MORPHEMIC project for the developed platform are included in this deliverable's target audience, as it is publicly accessible.

## 2 Training requirements

This section defines the training requirements for the programme. The following subsections cover the training groups, the predefined platform features that will be presented, as well as the available implementation methods.

### 2.1 Target training groups

The groups that are being targeted in the training programme are mainly derived from the MORPHEMIC project's value network proposition defined in the Description of Action. The following groups constitute a baseline audience for carrying out the training materials and providing further guidance for adopting and using the MORPHEMIC platform in a business or academic environment:

- **Application Developers** – The software developers and engineers of cloud applications who are interested in configuring their source code for the MORPHEMIC platform.
- **DevOps** – The development operations professionals who are interested in the MORPHEMIC platform's technical value offering with respect to cloud computing operations automation.
- **Business IT Managers** – Highly ranking IT professionals, cloud solution providers and cloud application owners who are interested in the MORPHEMIC platform's business value offering with respect to cloud computing operations efficiency.
- **Academics (Open Science)** – Cloud computing and cloud infrastructure scholars and researchers who are interested in cloud computing infrastructure data analytics and dissecting the architecture of the MORPHEMIC platform for further advances in cloud computing. This group also includes students and professors who are interested in presenting or being presented an exemplar implementation of a cloud computing operations automation platform.

### 2.2 Platform features

The MORPHEMIC platform's features that will be presented in the training programme in its entirety are directly influenced by the feature definitions set unanimously by the MORPHEMIC project's consortium for internal development progress planning and the MORPHEMIC platform validation, as defined in MORPHEMIC deliverable



*D6.1 Industrial requirements analysis.* These are the following platform features that are part of the training programme's design:

- **Feature 1: Polymorphic adaptation** – The *Polymorphic adaptation* feature represents all functionality related to the adaptation of a given application's software architecture for the optimisation of its deployment plan, and consequently, its execution. This feature also includes end-to-end *polymorphic* support, separated into the following categories: modelling, optimisation, deployment, reconfiguration as well as hardware support and integration with the MORPHEMIC platform.
- **Feature 2: Proactive adaptation** – The *Proactive adaptation* feature represents all functionality related to the dynamic adaptation of a given application's configuration overall – both in terms of available resources and architecture variants – based on forecasted service level objective violations. This feature set also includes end-to-end proactive reconfiguration support, separated into the following categories: modelling, advanced forecasting modules, utility functions, deployments, and reconfigurations.
- **Feature 3: Self-healing capabilities** – The *Self-healing capabilities* feature represents functionality related to the detection of component failures, application performance deterioration and triggering of reconfigurations, while it covers important aspects of monitoring system resilience.
- **Feature 4: Hardware accelerators support** – The *Hardware accelerators support* feature represents all functionality related to the efficient usage and provisioning of hardware accelerators for the optimisation of a given deployed application.
- **Feature 5: Security Concepts** – The *Security concepts* feature represents a set of operations which provide an adequate security level for the MORPHEMIC platform in terms of secure communications between clouds, platform components, deployed applications, as well as authentication and authorization modules.
- **Feature 6: Unified user interface** – The *Unified user interface* feature represents all functionality related to the user interface elements provided for application modelling, management, monitoring and other administrative operations (e.g., resource management).

## 2.3 Implementation methods

The training program's implementation methods vary greatly depending on the scheduled training opportunities, but the following list of methods represents a basic outline:

- **Workshops** – The presentation of training materials in hands-on technical workshops and discussions.
- **Seminars** – The presentation of training materials in a guided environment.
- **Webinars** – The presentation of training materials in a guided digital environment.
- **Course Materials** – The inclusion of training materials in courses for students enrolled in postgraduate programmes.

A detailed mapping of the implementation methods for each of the platform's features is presented further in subsection 3.2, the training approach.

## 3 Training plan

The training plan introduces a sophisticated systematic process of enhancing the learning of the MORPHEMIC platform's capabilities aiming to equip the target groups to build highly reliable and efficient solutions on the Cloud-Edge continuum using innovative design patterns. It covers a multi-layer training strategy including various courses, hands-on experience with the technologies covered in either of those courses. Since each of the MORPHEMIC features provides different internal and innovative functionalities, different and specific training procedures will be followed in order to provide a holistic and deep knowledge of the platform components. Through a combination of presentations, design activities, and hands-on labs participants learn to define and balance business and technical requirements to design MORPHEMIC application deployments that are highly reliable, highly available, secure, and cost-effective.

### 3.1 Training objectives

The MORPHEMIC project addresses challenges in the research domain while providing a solution that exploits the advantages of public and private cloud infrastructure. Therefore, the objectives of the training activities should not cover researchers and academics alone, but also Business IT Managers, application developers etc.



The main objectives of the training activities are the following:

- Obtain a baseline understanding of the MORPHEMIC platform.
- Identify the purpose and business value of the core MORPHEMIC platform functionalities and services.
- Use of the MORPHEMIC platform's features including Polymorphic adaptation, Proactive application adaptation, application deployment based on a unique and automated process flow under a robust privacy and security framework, the integration of FPGA acceleration due to the optimization of traditional and modern applications.
- Learn to deal with infrastructure potential failures by leveraging the MORPHEMIC platform's self-healing capabilities.
- Explore the dynamics of automation through a functional User Interface familiar to third-party users.
- Provide a baseline knowledge of the science behind the main features of the Platform.

### 3.2 Training approach

The MORPHEMIC project intends to disseminate the knowledge and functionalities of its powerful and innovative platform features by providing data-driven training solutions, thus exploiting a comprehensive set of resources and a complete learning experience that includes Learning Paths, Courses, live hands-on labs and workshops within real case scenarios, aiming to fine-tune the participants to deepen knowledge all within the platform.

More specifically, the training map includes lectures that reflect the definition of the core components of the MORPHEMIC platform, their provided functionality, and the holistic added value in the IT infrastructure community. The lectures are accompanied by a fruitful series of practical courses designed to give a comprehensive view on the agile deployment of cloud and edge applications by exploiting the complete path on data analysis and Artificial Intelligence. The training covers a multitude of technologies that comprise the modern concept of cloud and edge computing applications that constitute a technology revolution that impacts many enterprise computing systems in major ways. Nevertheless, the MORPHEMIC platform will be accompanied by a series of educational webinars and hands-on workshops in order to increase the attendee's technical education level regarding the core fundamentals and benefits of the platform, also live training sessions will be served in order to provide operational excellence.

In order to cover the different MORPHEMIC features and provide suitable knowledge to our potential target training groups, the following table has been created containing a preliminary listing of basic training approaches. Additional approaches could be added based on the project's evolution. The title refers to the content of the training and may cover more than one feature listed in section 2.2.

*Table 1 - Training approaches*

Title	Description	Audience	Training forum
<b>Communication interfaces for Cloud platform</b>	This training will focus on the three types of communication (REST-API, Queueing systems, Workflow) interfaces and their integration on MORPHEMIC in order to provide more compact and autonomous applications. The main objectives include a deep understanding of different types of interfaces and their application on cloud platforms.	Application Developers, DevOps	This feature will be covered by organizing interactive <b>workshops</b> , due to the practical difficulties that the participants may confront.
<b>Forecasting module</b>	The forecasting module belongs under the aegis of Proactive Adaptation feature, including all the functionality related to the dynamic adaptation of a given application's configuration overall – according to a dimensional space of available resources and architecture variants. The relevant training will	Application Developers, Academics	Both <b>webinars</b> and seminars are proposed to cover the theoretical aspects of the mentioned feature and interact with the participants even for



	focus on demonstrating the challenge introduced by the reactive adaptation on a cloud environment (MELODIC: the application is running underperformance until a satisfying solution is applied according to the application objectives) and then the representation and implementation of the innovative capabilities of the forecasting module (included: different forecasting methods, orchestration, and critic of the forecasters).		practical implementation by emphasizing the actual utility of the proposed functionality that the forecasting module provides.
<b>Polymorphic application development</b>	The Morphemic platform provides powerful polymorphic adaptation and hardware accelerator features supporting both the capability to recommend different variants for a) implementing applications (docker container, serverless etc.) achieving a high level of performance and b) integrating hardware acceleration including GPU and FPGA across the cloud and edge applications. Therefore, a training set of courses will be provided to develop applications that perform on different accelerators and also are easily adaptable.	Application Developers, DevOps	<b>Webinars</b> will cover the specific innovative feature since it is advisable to implement related scenarios in real-time.
<b>Cloud solver/reasoner</b>	Solver/reasoner is a primary key component of a cloud platform that deals with complex challenges related to the application's configuration. The Morphemic platform introduces a variety of solvers under the scope of Polymorphic adaptation feature by exploiting advanced computer science techniques, algorithms, and innovative machined and deep learning techniques (Genetic programming, Alpha star, Reinforcement learning, etc.).	Application Developers	<b>Seminars</b> and webinars are proposed to be implemented, providing a good opportunity for the participants to learn the functionality and usage of the specific feature.
<b>AI for Cloud/edge computing</b>	This training will consist of studying the application of AI for solving cloud/edge challenges on both Polymorphic and Proactive adaptation features.	Application Developers, Academics	<b>Course Materials</b> including courses, explicit documentations, instructor guides, and computer-based training will be provided for acquiring fundamental knowledge related to AI and its challenges on both Polymorphic and Proactive adaptation features.
<b>MORPHEMIC installation and application deployment</b>	This training involves learning the requirement in terms of hardware and software for installing MORPHEMIC. A second part will be dedicated to the deployment of an	Business IT Manager	<b>Webinars</b> and <b>seminars</b> will cover step by step every angle related to the





	application by using MORPHEMIC. Furthermore, the Camel creation will also be discussed and analyzed.		installation and configuration of the Morphemic Platform. Furthermore, live documentation will be provided containing the deployment of applications consisting of real use-case scenarios.
<b>Science behind the real-time adaptation</b>	This training covers a span of functionalities derived from the self-healing capabilities feature. The real-time adaptation for cloud/edge applications is a robust topic in literature where many techniques are presented (i.e., time series analysis, forecasting methods, performance model analysis, etc.) in order to solve the challenge of dynamic resource allocation. The MORPHEMIC as a concrete platform implements these learning methods and evaluates their efficiency regarding real-time adaptation.	Academics	<b>Course Materials</b> will be provided to the participants, including lectures and specific use-case scenario presentations in order to gain fundamental knowledge related to real-time adaptation for cloud/edge applications by using MORPHEMIC Platform.

## 4 Training activities

Organizing activities for learning the MORPHEMIC platform is a fairly complex task, taking into account the different technologies present and the diversity of the targeted audience. Training activities should cover different types of audience defined in section 2.1. Therefore, training activities will be scheduled by the type of audience.

- **Application Developers:** For application developers, our activities will center on hands-on programming sessions and tutorials. These workshops will aim to familiarize participants with configuring their source code for the MORPHEMIC platform. For instance, one training activity may involve a step-by-step tutorial on code configuration and the subsequent deployment on the platform. This training will boost their efficiency in cloud application development, allowing them to take advantage of the benefits that cloud computing brings, such as scalability and availability.
- **DevOps Professionals:** This target audience will benefit from advanced technical sessions, workshops and forums where they can learn about the MORPHEMIC platform's operational efficiencies and automation capabilities. Activities might include detailed exploration of how to leverage the platform for continuous integration and continuous delivery (CI/CD), infrastructure as code (IaC), and automated deployment strategies. By improving understanding of these key features, these professionals can enhance operational efficiency and reliability in their organizations' cloud operations.
- **Business IT Managers:** Our approach for Business IT Managers, cloud solution providers, and application owners will be focused on workshops and seminars that highlight the business value of the MORPHEMIC platform. Topics may cover areas such as cost-efficiency, resource optimization, and overall operational agility that the platform provides. Case study presentations and panel discussions will be included to demonstrate the real-world application and benefits of the platform. This can result in better strategic decision-making and optimized investments for their respective businesses or organizations.
- **Academics (Open Science):** Academic-oriented activities will encompass research symposiums, postgraduate workshops, and conferences. These events will delve into the technical underpinnings and data analytics capabilities of the MORPHEMIC platform. For instance, a postgraduate workshop may involve an in-depth look at the architecture of the platform, fostering critical understanding and analysis among researchers, students, and professors. Conferences could present the platform as a case study in automation of Cloud computing operations. Not only does this aid in advancing research in the field, but it also provides a concrete, industry-standard example for educational purposes.



In summary, the activities in the MORPHEMIC project's training plan will be varied and tailored, addressing the diverse interests and needs of our target audiences. Our aim is to not just impart knowledge but to also facilitate the exchange of ideas, promote innovation, and foster collaboration across different sectors. Through this approach, we can ensure a comprehensive understanding of the MORPHEMIC platform and its potential applications, enhancing the overall impact and usability of our offering.

## 5 Conclusions

This document has described the training plan and has given an overview of the training activities which will be enacted during the course of the project. The MORPHEMIC deliverable *D7.4 Training materials*, provides complete, in-depth information about all the training materials which will be created in preparation for the aforementioned training activities and additional training opportunities presented during the course of the project. The results of the training programme's activities are included in section 4.2 as "Scientific Events" in MORPHEMIC deliverable *D7.2, Final Dissemination and Communication Report and Plan*.