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**FIT4FUTURE**

CNC Machining for everybody

# From USE CASE to Learning Path

## CNC - multi-sided machining



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## 1. INTRODUCTION

**USE CASES** play a central role in the **Fit4Future** project. These use cases identify and define the specific requirements and special features of CNC multi-sided machining for the participating companies. They serve as the basis for the development of targeted training content for a digital learning platform. By defining company-specific use cases for CNC multi-sided machining, the training measures can be precisely tailored to the real needs and challenges of the companies, which significantly increases the effectiveness of the training and further education programs.

### 1.1. FROM USE CASE TO LEARNING PATH

#### 1. Identification of the use cases:

- **Objective:** To understand the specific requirements and challenges of companies in CNC multi-sided machining.
- **Result:** Documented use cases that serve as the basis for training.

#### 2. Development of the training content:

- **Contents:** Mathematical and technical basics, materials science, CAD/CAM, practical exercises on CNC machines.
- **Objective:** Creation of training materials based on the use cases.

#### 3. Creation of learning paths:

- **Structure:** Modules and learning objectives that build on each other and enable a gradual deepening of knowledge and skills.
- **Examples:** Introduction to CNC technology, technical drawing and CAD, materials science, CAM programming, machine set-up and calibration, multi-sided machining, quality control, fault diagnosis and problem solving, occupational safety and environmental protection.

#### 4. Integration into the curriculum:

- **Objective:** To ensure that all relevant content is covered and the learning objectives are achieved. In this pilot project, a "generic" curriculum is being developed that can be used



by trainers as a basis for CNC multi-page processing. The case-specific use cases can then be integrated into the curriculum as required. These enable the practical application of theoretical knowledge and promote the development of learners' skills.

- **Evaluation:** Regular reviews and adjustments to the curriculum based on feedback and new requirements.

## 1.2. ADVANTAGES OF THE USE CASES

### 1. Practical relevance:

- Training content is based on real requirements and situations from practice.
- Greater relevance and applicability of what has been learned in everyday working life.

### 2. Effectiveness:

- Precise adjustment of training measures to the needs of the company.
- Increasing the efficiency and quality of training and further education programs.

### 3. Flexibility:

- Possibility to adapt the training content to new challenges and technologies.
- Promoting lifelong learning and continuous professional development.

## 1.3. CONCLUSION

Through the systematic use of use cases, a tailored and effective curriculum is developed that optimally prepares trainees for the requirements of modern CNC multi-sided machining. The practical orientation and continuous adaptation to the real needs of the companies ensure the high relevance and quality of the training measures.



## 2. USE CASE DEFINITION IN CNC MULTI-SIDED MACHINING

### 2.1. DEFINITION AND OBJECTIVE OF A USE CASE

A use case describes the entire process of CNC multi-sided machining of a complex workpiece, such as a machine component with several machined surfaces and holes. The use case includes the planning, programming, setup, machining and quality control of the workpiece.

The aim of a use case is to provide participants with structured and practice-oriented training in CNC multi-sided machining. The training is designed to impart the theoretical knowledge and practical skills required to machine complex workpieces precisely and efficiently. By machining specific workpieces, participants will learn how to create CNC programs, set up machines and carry out quality checks.



### 3. USE CASE 1+2: DESCRIPTION

#### 3.1. USE CASE 1: ROTATING PART

- **Target:**

Teaching the skills for machining the HSK 63 workpiece, which is used as a tool holder in lathes.

- **Description:**

- **Workpiece:** HSK 63 (hollow taper mandrel) according to DIN 69893
- **Application:** Tool holder in lathes, spindle interface for machining centers and precision milling machines
- **Technical drawings:** Analysis and interpretation of drawings to determine the processing steps
- **Processing steps:**
  - Turning, drilling, pre- and final machining of external and internal contours
  - Re-clamping of the workpiece for multi-sided machining
  - Quality control and post-processing
- **Material:** Usually steel or other high-strength materials
- **Programming:** Creation and simulation of CNC programs for efficient machining of the workpiece

**Recommended EQF level 4:** Comprehensive practical and theoretical knowledge to carry out the processing steps and to ensure quality standards.

Under this link you will find the Use Case 1 :

<https://fit4future-project.com/use-cases>



### 3.2. USE CASE 2: BRACKET

- **Target:**

Teaching the skills for processing a mounting rail (bracket) that is used as a mounting, fastening or assembly element in the domestic or commercial sector.

- **Description:**

- **Workpiece:** Bracket
- **Use:** Support hardware used to hold, fasten, mount or secure components in domestic or commercial applications
- **Technical drawings:** Analysis and interpretation of drawings to determine the processing steps
- **Processing steps:**
  - Pre-milling the center slots and the base
  - Milling of chamfers, pockets and arc slots
  - Drilling holes and milling the shoulder
- **Quality control and post-processing**
- **Material:** Usually bronze or other suitable materials
- **Programming:** Creation and simulation of CNC programs for efficient machining of the workpiece

**Recommended EQF Level 5:** Comprehensive knowledge and skills for solving complex tasks and monitoring processes. This includes the ability to program and optimize CNC machining as well as quality assurance and process optimization.

Under this link you will find the Use Case 2 :

<https://fit4future-project.com/use-cases>



## 4. LEARNING PATH

### 4.1. USE CASE 1

The learning path for USE CASE 1 ("rotating part") comprises several learning objectives, competencies and learning modules:

#### 4.1.1. LEARNING OBJECTIVES

1. **Understanding the basics:** Understand the theoretical basics of CNC multi-sided machining.
2. **Programming:** Learning CNC programming for multi-sided machining.
3. **Machine set-up:** Knowledge of the set-up and operation of CNC machines for multi-sided machining.
4. **Tool selection and maintenance:** Selection and maintenance of the tools required for multi-sided machining.
5. **Quality control:** Implementation and documentation of quality controls during and after processing.

#### 4.1.2. COMPETENCIES

1. **Theoretical knowledge:** Basics of CNC multi-sided machining.
2. **Practical skills:** Programming, setting up and operating CNC machines.
3. **Problem-solving skills:** Troubleshooting and process customization.
4. **Quality management:** monitoring and documentation of quality.
5. **Tool competence:** Selection, use and care of tools.

#### 4.1.3. LEARNING MODULES

##### 1. Theory of multi-sided machining

- Introduction to multi-page editing
- Advantages and challenges
- Areas of application





## 2. CNC programming

- Basic programming commands
- Creating and optimizing programs for multi-page editing
- Use of CAD/CAM software

## 3. Machine setup and operation

- Setting up the machines for multi-sided machining
- Security guidelines and best practices
- Maintenance and troubleshooting

## 4. Tool technology

- Selection of suitable tools
- Tool change and maintenance
- Customization of tools for specific tasks

## 5. Quality assurance

- Measuring techniques and tools
- Documentation and reporting
- Analyzing and resolving quality problems

### 4.2. USE CASE 2

The learning path for USE CASE 2 (bracket) comprises several learning objectives, competencies and learning modules:

#### 4.2.1. LEARNING OBJECTIVES

1. Understanding the basics: In-depth study of the theoretical principles of CNC multi-sided machining.
2. Programming: Learn advanced CNC programming for mounting brackets.
3. Machine set-up: Advanced knowledge in the set-up and operation of CNC machines.
4. Tool selection and maintenance: Selection and maintenance of the required tools.
5. Quality control: Implementation and documentation of quality controls.

#### 4.2.2. COMPETENCIES



1. Theoretical knowledge: In-depth understanding of CNC multi-sided machining.
2. Practical skills: Advanced programming, set-up and operation of CNC machines.
3. Problem-solving skills: Error identification and process optimization.
4. Quality management: implementation and documentation of quality controls.
5. Tool competence: Selection, use and maintenance of tools.

#### 4.2.3. LEARNING MODULES

1. Theory of multi-sided machining
  - Introduction to mounting brackets and their applications.
  - Advantages and challenges of CNC machining.
2. CNC programming
  - Introduction to the MTS software.
  - Basic commands and G-code
  - Program optimization and troubleshooting.
3. Machine setup and operation
  - Setting the zero point and safety guidelines.
  - Machine parameters and best practices.
4. Tool technology
  - Selection and adaptation of tools.
  - Tool change and maintenance.
5. Quality assurance
  - Measuring techniques and tools
  - Documentation and quality reports
  - Error analysis and corrective measures



## 5. TRAINING MODULES OF THE LEARNING PLATFORM

The USE CASE analysis reveals basic requirements for people who want to start CNC multi-sided training **as a NEW entrant/for further training/for transfer from another profession.**

The learning content developed for the **10 modules** (10 videos, 19 APPS, in 3 languages: German, English, Turkish, 3 training levels: Basic, Advanced Professional) on the learning platform <https://fit4future-project.com/> serve as the basis for an **introductory scenario or as a transition module** for the start.

The **10 training modules** on the learning platform <https://fit4future-project.com/> cover a wide range of relevant basic topics for CNC multi-sided machining (background: USE CASE analysis and generic curriculum), including the required skills, techniques, safety practices and future competencies. These modules are designed to fulfill the learning objectives of the Fit4Future project by providing innovative training and development approaches with virtual teaching and learning solutions (game-based).

1. Requirements and capabilities for multi-sided processing.
2. Key terms and definitions.
3. Advantages of multi-sided processing.
4. Tools, devices and materials.
5. Understanding of the components of CNC machines.
6. Technical drawings for CNC machining.
7. Security practices.
8. Programming skills.
9. Problem-solving skills.
10. Future skills in CNC machining.



### 5.1. EQF LEVELS FOR LANGUAGES AND QUALIFICATIONS

The pilot project offers access via EQF Level 3 with language level A2.

Examples of 3 different educational levels **BASIC**, **ADVANCED** and **PROFESSIONAL** are offered in 10 modules. In the following table you will find an overview of the EQF levels to be achieved for languages and EQF for qualifications as part of the 10 modules on the learning platform <https://fit4future-project.com/> for all 3 partner countries (Germany, Austria, Turkey):

Educational level	EQR: Language	EQR: Qualification
<b>START</b>	<b>A2</b>	<b>Level 3</b>
<b>BASIC</b>	<b>B1</b>	<b>Level 4</b>
<b>ADVANCED</b>	<b>B1</b>	<b>Level 5</b>
<b>PROFESSIONAL</b>	<b>B2</b>	<b>Level 5</b>

This structure ensures that the training content conveys practical language skills and that the specialists are prepared for the requirements of CNC multi-sided machining in an international environment.



## 6. HANDLING SKILLS FOR CNC MULTI-SIDED MACHINING:

The following skills are important for successfully carrying out multi-sided machining on CNC machines:

- 1. Technical understanding:** A basic understanding of mechanics, electrical engineering and information technology is necessary to understand the functions and possibilities of a CNC machine.
- 2. Programming skills:** CNC programs must be created or adapted in order to carry out multi-sided machining. This requires knowledge of CNC programming
- 3. Planning and organizational skills:** Multi-page processing requires careful planning and organization in order to successfully carry out the individual processing steps
- 4. Problem-solving skills:** Unexpected problems may arise during multi-page processing that need to be solved. It is therefore important to have problem-solving skills and to look for solutions creatively
- 5. Precision work:** Multi-sided processing requires a high degree of precision and accuracy in order to achieve the desired results. This requires a careful working method
- 6. Independence:** Multi-page processing often requires a self-reliant way of working. It is important to work independently and make decisions
- 7. Ability to work in a team:** For larger projects, cooperation with other specialists may be necessary. This requires the ability to work in a team and good communication with others involved
- 8. Flexibility:** In CNC machining, conditions or requirements may change. Here it is important to be flexible and react quickly to changes
- 9. Analytical skills:** In multi-page processing, it is necessary to understand and optimize complex technical processes. This requires analytical skills in order to recognize correlations and identify the causes of problems
- 10. Quality awareness:** A high quality of the machined workpieces is essential for many applications. This requires a high level of quality awareness in order to avoid errors and achieve a high level of customer satisfaction



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**11. Communication skills:** Working with other professionals requires good communication skills to discuss technical problems and solutions

**12. Safety awareness:** High safety standards must be adhered to during CNC machining in order to avoid accidents. This requires a high level of safety awareness in order to identify and minimize risks

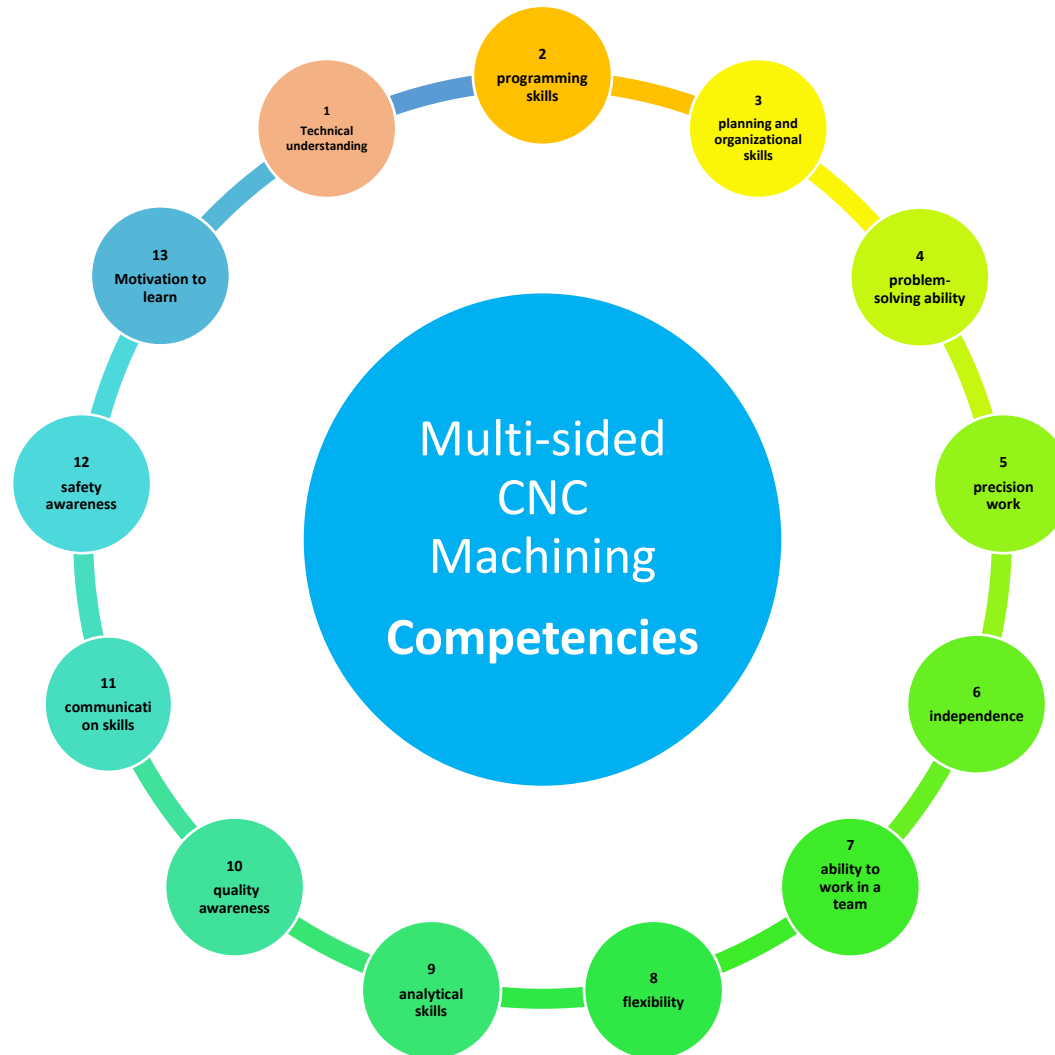
**13. Willingness to learn:** There are always new technologies and developments in CNC machining. A high willingness to learn is necessary to stay up to date and master future challenges.

**By acquiring these skills, successful multi-sided machining on CNC machines can be guaranteed.**



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## 7. ANNEX : LINK TO USE CASES

Under this link, you will also find further USE CASES for processing.

<https://fit4future-project.com/use-cases>

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