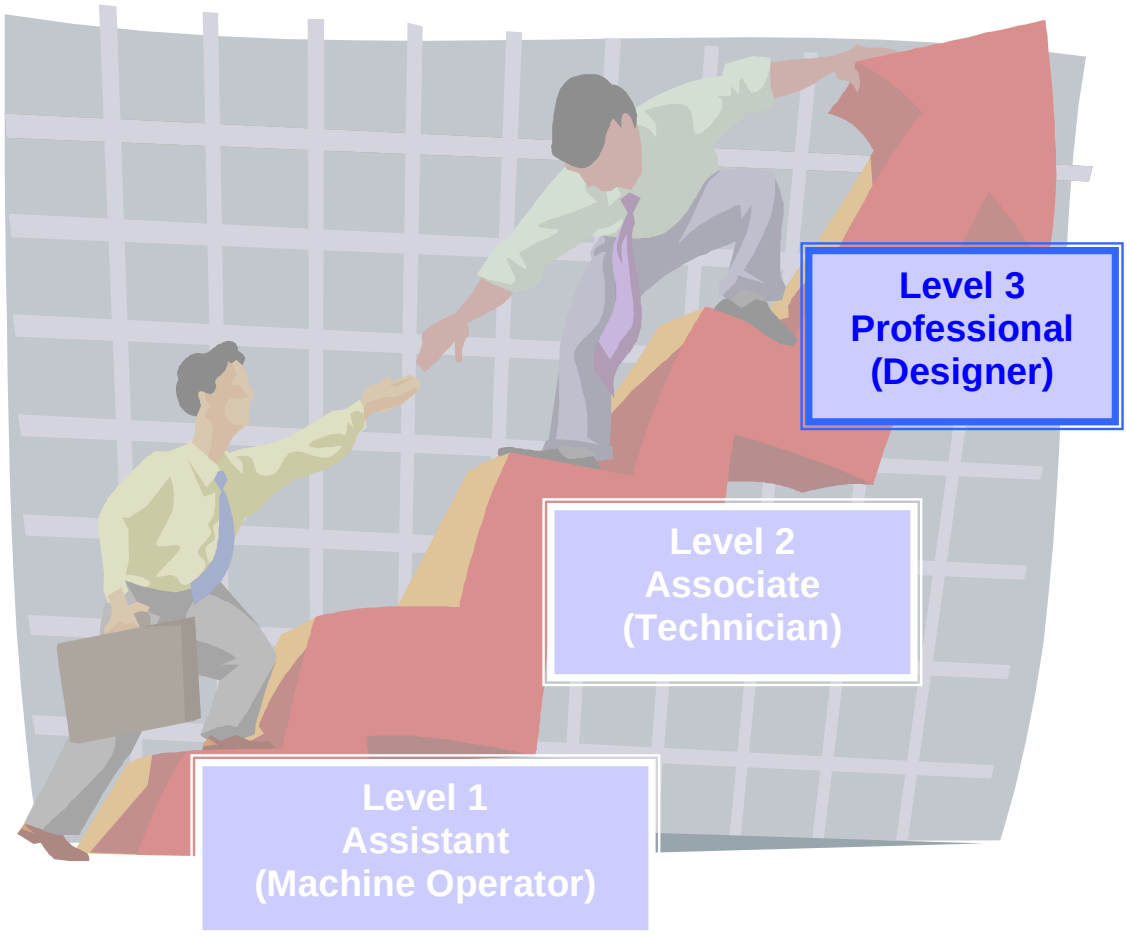
Siemens Mechatronic Systems Certification Program



Level 3 (Mechatronic Systems Professional)

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Overview Level 3 (Mechatronic Systems Professional)

The Siemens Mechatronic Systems Professional certification is the third of three certifications in a series. Each certification is based upon a specified, industry-driven **job profile** which can help an employer determine where the certified person can be best placed within their organization. The job profile is a guiding or steering document that helps to determine many other administrative and content-related attributes of the level as well as content.

Further, the job profile helps to differentiate Level 3 from the levels immediately below. A person who successfully completes the training and passes the exam for Level 3 should be able to perform job functions as given in the job profile.
Note: Certification is not a guarantee of performance but rather a recognition of achievement.

Job Profile

A Siemens Certified Mechatronic Systems Professional will function as a skilled designer of and expert on complex mechatronic systems. A Certified Professional will be able to apply selected project and system engineering practices, like requirements engineering, project management, process management, quality assurance & management, etc. in a project with the goal to design or improve a mechatronic system upon customer and user needs.

Normally a Siemens Certified Mechatronic Systems Professional would carry out most of their work in an engineering office environment; however they may also carry out some of their work at production facilities, workshops, and service sites that use complex mechatronic systems. Certified Professionals (SMSCP Level 3 certified) usually start their career as a team member of a project team which is responsible for the design, management and improvement of complex mechatronic systems.

The Curriculum

Level 3 (Professional) Certification consists of two main content areas, designed to be integrated within a college curriculum or to be implemented as continuing education. Each content area should be covered within a mechatronic system project, which students need to complete within the SMSCP Level 3 course. Consequently the Project and Process Management part and the Mechatronic System Project part are taught in an integrated way. Both content areas together consist of roughly 160 hours of classroom instruction with additional laboratory work on a physical system located at the training institution.

The content areas are:

- Project and Process Management
- Mechatronic System Project

Once a student has successfully completed the two content areas, he or she should be well-prepared to sit for the Level 3 certification examination. This will preferably be administered through a neutral testing center, but could be administered in other ways as well at the discretion of the SMSCP Management.

Only by successfully passing the Level 3 Certification Examination will the student be awarded the certification of Siemens Certified Mechatronic Systems Professional.

System Approach in Level 3

The underlying theme of the curriculum of the Certification Program is the System Approach, which has been used with high effectiveness for the training of Siemens' own coworkers in Germany.
This process is the same at all three levels of the Certification Program, and as Level 2 progresses into Level 3, the emphasis is moved to designing and optimizing complex mechatronic systems as well as project and process management principals.

Siemens Certified Mechatronic Systems Professionals learn how to work their way into and through a new system, and by means of the designing/optimization process and project management methods which they learn, they are able to transfer their knowledge and expertise easily to another system and project.

This makes for an employee who is flexible, autonomous and professional in his or her dealings with complex mechatronic systems.

Hardware Requirements

All Hardware Requirements are highly dependent of the chosen project. The student has to use all tools needed to complete the project and process management and mechatronic system project parts. Specific hardware components are not given; a list with required content to assist with the decision for a project can be found in the content paragraph of the mechatronic system project part on the pages 11 and 12. A good choice of a mechatronic system will use most of the listed content. The final hardware product has to be a mechatronic system, e.g. Robot, Conveying System, Assembly Line.

Prerequisites

- Basic project and process management knowledge as covered in SMSCP Level 2 Course 6
- Technical education or experience equivalent to SMSCP Level 1 and Level 2
- SMSCP Level 1 and Level 2 certifications are highly recommended!

Materials

Recommended basic course materials are in digital form:

Course materials provided by SMSCP Partner Schools to their students are at the partner school's discretion, and may include special project and process management assets.

Students must also have access to tools for executing the mechatronic system project.

Syllabus
Content Area - Project and Process Management

Overview

This content area presents a framework for managing projects related to mechatronic systems and its components. It contains basic practices for successful project execution based on PMI ideas.

The content area starts with understanding and managing requirements.
The agreed scope serves as input for estimation and planning practices.
The impacts of changing/new requirements on existing components are discussed. Methods for design, construction, integration and testing of components and systems are presented.
Ways of tracking all management and engineering activities are looked into to ensure that work remains aligned to plans and requirements.
All covered topics are incorporated smoothly into the mechatronic systems projects offered to the students.
The exercises will help the student to understand how the project management and system engineering concepts belong into the development of their mechatronic systems.
The content also covers the implementation and continuous improvement of these concepts at an organizational level.
CMMI® is introduced as an organizational improvement model to achieve a learning organization and provide quality management insights.

Philosophy

All important tools and methods will be learned and trained using a sample project of developing a mechatronic system mentioned on the pages 13 to 15.
By using typical examples from real life companies students will learn to use tools for project management and systems engineering as the basis for successful mechatronic system projects.

Goals

Upon completion of the course students should:

- Apply reliable Project Management practices, methods and tools (based on PMI concepts)
- Understand fundamentals of requirements engineering and management.
- Be able to use effective methods for system engineering; covering design, construction, integration and test methods on unit, component and system level.
- Fit the presented practices into the ideas of continuous process improvement (e.g. using CMMI) and their use for business improvements.

Content

Initiating, Planning / Requirements Engineering

Upon completion of the course, students should be able to understand the goals and desired outcomes of the project in terms of being aware of how to initiate, scope, estimate and plan a project as well as to identify the necessary stakeholders and their roles. They will learn how to structure and document planning activities, including risk management. The participants will possess a common understanding of eliciting and clarifying requirements using interviews, workshops, user stories, etc.

Planning, Executing / Product Design

For this particular section it is important to gain knowledge of how to keep the scope aligned with plans and work results; this includes change and configuration management. Methods for making decisions for optimal architectures and design and how to allocate requirements and quality attributes are presented.

Executing, Monitoring / Implementation

The participants should be able to gain insight into the construction and different implementation methods. They will learn how to use effective verification methods. Another goal for the implementation is the know how to monitor and measure the project performance correctly in order to be able to make adjustments as needed. To achieve this goal the participants make use of Key Performance Indicators (KPI), status reports and milestone reviews. The handling of deviations from plans will be explained as part of managing action items.

Integration, Test / Release

The participants have the skills to ensure a seamless integration of the product, which meets the agreed customer environment and expectation. The participants use testing methods derived from clear coverage and test end criteria. The release, problem and defect management are handled systematically.

Closing

Finally, the participant should be aware of the project activities and phases, so they are able to provide insight into project status and dependencies. Lessons learned are collected, included into process assets and shared within the organization. The participants should understand how processes are continuously improved and how they support business objectives.

Syllabus
Content Area – Mechatronic System Project

Overview

This content area includes a common set of skills and knowledge a productive junior technical engineer needs to use in an engineering project team.

Depending on the team size parts of the mechatronic system are designed, constructed, integrated (if necessary) and tested by the system engineer.

To develop system requirements, customer wishes have to be understood and translated into technical terms and vice versa. Therefore a determined communication is mandatory.
The mechatronic system project is executed using project management.

Stepping away from the traditional approach, the time used for the construction of a complex mechatronic system uses only a small part in the whole project. Planning (i.e. calculating parameters, determining layout) the system using design tools ahead of the construction is performed in a structured and well organized way. System-external influences (i.e. environmental conditions and workforce capabilities) are included in the design.

To prevent harm to the human body and life, the use of regional and enterprise-wide safety regulations has to be ensured.

Philosophy

A real life situation is created by developing and building a complex system using project management tools.
Every project is different in detail, but similar on a system level. The knowledge gained during the project can be transferred and fitted to others, standardizing as much as possible and preparing for the future in an efficient and realistic way.

Goals

With knowledge of the content in the Mechatronic System Project, students should be able to…

- take a productive, self organizing part in a project team.
- understand and translate customer wishes to technical requirements to reach customer satisfaction.
- internal and external testable and clear communication.
- create technical documentation of the system based on the technical requirements using regional standards and design criteria.
- conduct processes during the construction and integration of the system.
- test and adjust system parameters to fit them to the customer’s wishes.
- transfer knowledge gained easily to other projects.

Content

Content to be covered is split up into skills and knowledge. Since every mechatronic system is different, not all content can be covered by executing one mechatronic design project. The student certification content differs per project to fit its needs, while the certification process stays the same.

Skills
The student is able to reach his or her target in an efficient and professional way. Any tool, method or standard can be used to achieve the best result. In addition to the listed skills, students must be able to apply skills that are on the same level as SMSCP Level 1 and Level 2.

Electrics

- Motors
  - Choose type, supply and control depending on needs
  - Calculate power consumption
- Board Control
  - Choose type (µC, PLC,...), supply and control depending on needs
  - Minimize the power consumption and delay by optimizing program code
- Wiring
  - Calculate needed wire type, diameter, length and isolation
  - Create wiring diagrams for the technician
- Semi Conductors
  - Choose used type by function and rating
- Printed Circuit Board (PCB)
  - Layout and print PCBs
  - Maximize Battery Lifetime by optimized layout
- Safety
  - Choose and program different machine modes using authorization
  - Develop safety circuit for human / machine / wiring

Mechanics

- Motors
  - Choose type depending on needs
  - Calculate output power and speed
  - Find out the motor lifetime
- Components
  - Choose components (screws, shafts, bearings,...) based on calculations and given maximum forces and environmental influences (heat, humidity,…)
  - Set up, adjust and test the mechanics (statics and dynamics)
  - Design case and mold for the (mass) production using CAM or CAD tools
- Fluids and Liquids
  - Calculate needed liquid tank to sustain pressure
  - Choose liquid control system (valves, hoses, pump,…) based on calculations

    - Choose precision for filling
- Interfaces
    - Create a handover application to neighboring systems considering a maximum efficiency
    - Develop a mechanical system for the user input
    - Set up safe state for error case

Informatics

- Interface
    - Develop a digital system for the user input
    - Develop a system for observing system values
- Hardware
    - Choose PLC / Computer for system evaluation (modular or compact)
    - Develop a data storage concept
- Evaluation and Control
    - Program needed control on components needs
    - Process / project data to make it easily understandable for the operator
- Network
    - Choose a secure and stable data transmission system (LAN, Bus,…) and construct a physical layout
    - Choose the network layer corresponding to the needs
    - Encrypt the data packages to a secure level

Knowledge

The student is able to use known standards and rules to fulfill the customers' needs, using a broad portfolio of technical data. Worldwide and regional specific regulations have to be known by the student.

The student has to proof that he or she can use databases to fulfill the needs of all chosen components during the planning