Evgeny Lukov

Training Program for Electrical Engineers

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Foreword

It's hard to believe this is it!

The thesis writing process has been exciting, but also one of the most challenging periods for me in recent times. When I first started the thesis, I had a certain fear that it might not work out. What if I had picked the wrong topic? What if, for some reason, I would have to give it up? Now looking at the finished work, I know there are things I could have done differently if I had had a little more time, but I'm definitely proud of the result.

I would like to thank M.A. Sonja Holappa, Dr. James Collins, and especially Dr. Thomas Rohweder for all the help with writing this thesis, as well as for your lectures and the way you presented your material to us. Additionally, I want to thank our lecturers Ira Keskitalo and Timo Hietala. Your courses were some of my favourites. Perhaps I should leave engineering and go to finance or sales...

I would also like to thank my boss, Jari Halla-aho, and all my colleagues for always finding time for interviews and workshops with me. A special thanks goes to my lovely wife, Sveta, for supporting me all this time.

Finally, I want to thank Metropolia University of Applied Sciences for giving me this opportunity. It was fun to go back to my student days, meet such wonderful people, and learn a lot of new and useful information that I hope to put into practice in the near future.

Evgeny Lukov
Helsinki
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Abstract

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Training is an effective way to develop employees' skills and competencies. Moreover, training is required not only to close skill gaps but also to maintain the current knowledge, allowing companies to compete effectively and adapt to new technologies.

This study was carried out in a large multinational company, where electrical engineers face different challenges with project delivery due to a lack of technical skills. Constant and regular training is required to improve technical skills in such cases, however, no systematic training program exists for electrical engineers in the company. The study objective was to create an outline of a training program, that allows its implementation in practice and supports the development of electrical engineers.

The study is based on an applied action research approach, conducted in four stages, and utilizes qualitative methods of data collection. In the first stage, the current state analysis was arranged by interviewing the relevant stakeholders and identifying the essential and current technical skills, as well as discussing skill gaps of electrical engineers. Focusing on the major skill gap and gathering valuable concepts and ideas from the literature allowed to form the conceptual framework of the training program design. Following the framework's principles, the outline of the training program was first co-created with the targeted stakeholders and then validated by the decision-maker.

The outcome of the study is the outline of the training program for electrical engineers. The training program is focused on improving one of the core technical competencies related to knowledge of Medium Voltage systems.

Keywords: Training Program, Electrical Engineer, Skill, Skill Gap, Medium Voltage

The originality of this thesis has been checked using Turnitin Originality Check service.

Contents

Glossary

ADDIE	Analysis, Design, Development, Implementation, Evaluation
EIA	Electrification, Instrumentation and Automation
FAT	Factory Acceptance Test
ISD	Instructional System Design
VSD	Variable Speed Drive

1 Introduction

Nowadays, in a fast-growing world, businesses tend to prioritize achieving better results and streamlining their processes. The engineering industry is not lagging in this regard. On the one hand, there is a critical shortage of talented and experienced professionals in the current engineering labour market. On the other hand, companies are increasingly trying to focus on the efficiency of their internal processes to suspend productivity. That situation tends to affect specialists by creating increased pressure to perform under constrained resources, leading to heightened workloads and the need for continuous upskilling to meet evolving demands.

Skills and technical knowledge are necessary for engineers to succeed in the workplace. The word “**skill**” means a type of work or activity which requires special training and knowledge (Collins COBUILD Advanced Learner’s Dictionary, 2003). Motivating employees to train and improve their technical skills, as well as providing opportunities for that, are crucial for companies and primarily the responsibility of line managers and team leaders.

Well-trained and constantly developed engineers impact the team's efficiency and successful project delivery. The purpose of this study is to propose a training program for electrical engineers in Metso, where at this moment such a program does not exist.

1.1 Business Context

Metso is a multinational company headquartered in Espoo, Finland, and focused on providing technology and services for the mining, aggregates, recycling, and metal refining industries. Metso’s clients are mainly large mining and processing operation companies worldwide. Metso employs around 2000 people in Finland and more than 17000 globally. Product and service areas of Metso are various process technology equipment, such as crushers, screens, feeders, mills, filters, different kinds of furnaces (i.e. Flash Smelting Furnace, Electric Furnace, etc.), and in addition to that, equipment spare parts, engineering and repair services. Metso is divided into several business areas:

- **Aggregates** – provides crushing and screening equipment for the production of aggregates.
- **Minerals** – provides equipment and full plant solutions for minerals processing, covering comminution, separation and pumps, as well as processing solutions and equipment for metals refining.
- **Services** – provides spare parts, refurbishments, and professional services for mining, metals, and aggregates customers.
- **Consumables** – provides a comprehensive offering of wear parts for mining, metals, and aggregates processes.

Each business area has several product teams related to supplied equipment and technology, and, in addition to that, separate engineering teams responsible for designing and engineering work and integration of that equipment into the whole plant. One example of such an engineering team is the Electrification, Instrumentation and Automation (EIA) team. The EIA team leads and manages plant and equipment electrification, instrumentation and automation engineering tasks in the global implementation of technology projects, considering all contractual scopes i.e. engineering, supplies, and site activities. The team is responsible for the engineering solutions and making sure the projects´ quality and budget objectives, time schedule, and customer satisfaction, are achieved. There are 2 independent EIA teams inside Metso nowadays. The first team is responsible for engineering related to minerals processing. The second team works on the projects for metals refining and processing and it includes 11 people, i.e. 3 electrical engineers. This thesis focuses only on the Electrical engineers of the second EIA team.

1.2 Business Challenge, Objective and Outcome

The business challenge is that electrical engineers quite often are not able to do a part of their engineering activities because their technical knowledge and skills are not sufficient. Such activities include, for example, performing complex network calculations in special software, programming a variable speed drive (VSD) from a certain vendor, selecting and specifying some electrical equipment, and hereafter commissioning this equipment at the site. The lack of these important skills affects the efficiency and productivity of each engineer and the whole team. This leads to project delays, increased costs due to exceeding the expected man-hours or outsourcing these tasks to external engineers, and potential mistakes in the design that could affect the safety of the equipment.

Therefore, the objective of this thesis is to create an outline of a training program for electrical engineers.

The outcome is an outline of a training program for electrical engineers.

1.3 Scope and Structure

The scope of this thesis contains a training program for developing the technical skills of electrical engineers of the EIA team focused on projects for metals refining and processing in the headquarters of Metso in Finland. Instrumentation and Automation engineers from the same team, as well as the whole EIA team of minerals processing projects, are outside of the area of this study.

The study consists of 7 chapters. The study starts with a project plan in Chapter 2 to define the steps needed to reach the proposed objective and outcome. The analysis of the current skills and competencies of electrical engineers is a part of Chapter 3, which is supposed to summarize current skills, essential skills, and skill gaps in the team. Research is done by interviewing relative stakeholders and collecting data from the company documents. The next Chapter 4 includes a Literature review that helps to find ideas, tools and practices from the relevant literature, to look at the problem from a different angle, and finally to create a conceptual framework. The further work of creating a preliminary outline of the training program is included in Chapter 5 and based on two previous stages. In Chapter 6, the outline of the training program is validated by the decision-maker, who provides the final recommendations on potential improvements. The thesis ends with conclusions in Chapter 7, which includes the executive summary, practical next-step recommendations, and self-evaluation of the thesis.

2 Project Plan

This chapter discusses the plan of the study. In the first section, it describes a selection of the appropriate research approach, including the reason behind choosing qualitative, quantitative, or mixed methods. Further, it shows Research Design, indicating the sequential phases of the study and the interconnections between them. Finally, the third section elaborates on Data Plan, which visualizes the data collection methodology, specifying the tools, techniques, and timelines for collecting and managing data effectively.

2.1 Research Approach

The choice of a research methodology or approach is dependent on the research problem and whether there are existing theories that explain the research problem. If the research problem has been subject to prior research there are existing theories and models that explain the phenomenon (Kananen, 2013).

According to Saunders et al. (2013), the research methodologies are divided into **basic (fundamental or pure) research** and **applied research** due to their purposes and focus. **Basic research** aims to enhance the theoretical understanding of business processes. It focuses more on the problems in the academic community, almost without giving attention to practice. (Saunders et al. 2013).

In contrast, **applied research** is goal-oriented and focused on solving specific and practical problems faced by companies. Saunders et al. (2013) state that this type of research is directly related to managers' needs. It highlights issues which are important for business in a clear way. (Saunders et al. 2013).

According to Kananen (2013), the basic division between approaches is embedded in qualitative and quantitative research. Strauss and Corbin (1998) define **Qualitative research** as the type of research that mostly focuses on exploring persons' lives, lived experiences, behaviors, emotions, and feelings. Additionally, it may examine organizational functioning, social movements, cultural phenomena, and international relations. It generates findings not taken by statistical procedures or other means of quantification. Therefore, the core of qualitative research lies in the interpretative analysis, even if some data may be quantified. (Strauss and Corbin, 1998).

In opposite to that, Kananen (2013) states, that **Quantitative research** produces numbers to structured questions and qualitative research words and sentences to open questions that help the researcher to form an understanding of the phenomenon.

Case, **design** and **action researches** can be considered as variations of applied research. At the same time, design research is often a mixture of qualitative and quantitative research.

This study is focused on the existing real-business problem, with the objective to create an outline for a training program for electrical engineers. In line with this goal, applied action research was identified as the most suitable research approach, since it supports a deep understanding of complex issues within a specific organizational context.

Applied action research emphasizes collaboration with different stakeholders, which is essential for the development of an effective training program. Involving electrical engineers from different teams, as well as the decision-maker in the design process, by conducting interviews and taking feedback, ensures that the program is practical, relevant, and aligned with professional requirements.

This study utilizes qualitative research methods for data collection. Interviews and workshop with key stakeholders, alongside the review of the relevant company's existing documentation, were chosen as the primary data sources to align with the context-specific nature of the study

2.2 Research Design

To achieve the stated objective, the study was divided into 4 stages as presented in Figure 1 below.

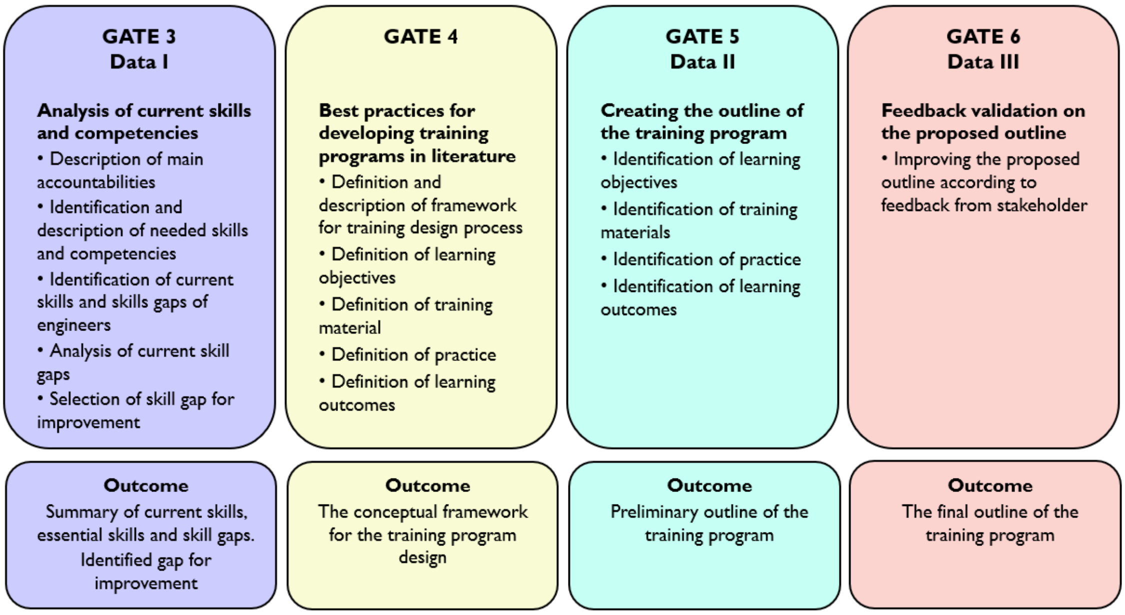

Figure 1. Research design of this study

As shown in Figure 1, the study starts with a deep analysis of the current skills and competencies of electrical engineers in the case team. This stage focuses on identifying existing job tasks, assessing essential skills required for electrical engineers, and identifying any gaps between current and required competencies. The outcome of this stage is a summary of current skills, essential skills, and skill gaps, followed by the selection of the most critical gap for further improvement.

In the second stage, it is planned to review relevant literature to gather ideas, tools, concepts, and best practices for developing training programs. This stage provides theoretical insights and practical examples that guide the creation of a conceptual framework. The resulting framework combines the findings from the literature and provides a structured approach to designing a training program tailored to the needs of electrical engineers.

Based on the conceptual framework, the third stage involves creating a preliminary outline for the training program. This stage includes selecting appropriate subject areas of learning, setting clear learning objectives, and designing the structure of the program. The preliminary outline is a practical representation of the training program, incorporating the results from two previous stages.

Finally, in the fourth stage, the proposed training program outline is validated through stakeholder feedback. This feedback is used to improve the outline, ensuring that it aligns with organizational goals and effectively addresses the identified skill gap. Adjusting the outline according to the stakeholder’s recommendations results in the final outline of the training program for electrical engineers.

2.3 Data Plan

This study collected data from different sources to minimize the risk of bias and inaccuracies. Data collection methodology was carefully aligned with Research design and structured into three data points, as shown in Figure 2.

DATA PHASE	DATA TYPE	DATA SOURCE	INFORMANT	TIMING	OUTCOME
DATA I ANALYSIS OF CURRENT SKILLS AND COMPETENCIES	• Description of main accountabilities • Description of current and essential skills	• Job descriptions • Interviews with stakeholders	• Electrical engineers from the case team • Electrical engineer from a different team • Director of EIA	January 2025	Summary of current skills, essential skills and skill gaps. Identified gap for improvement
DATA II CREATING OUTLINE OF THE TRAINING PROGRAM	• Comments and recommendations from key stakeholders	• Workshop with stakeholders	• Electrical engineers from the case team	March 2025	Preliminary outline of the training program
DATA III RECEIVING FEEDBACK ON THE PROPOSED OUTLINE	• Feedback the from stakeholder	• Interview with stakeholder	• Director of EIA	April 2025	The final outline of the training program

Figure 2. Data plan of this study

As illustrated in Figure 2, the data collection starts with Data I, which focused on analyzing the current skills and competencies of electrical engineers. The main goal of this data point was to gain a clear understanding of the skills currently possessed by electrical engineers, the essential skills required for their roles, and the challenges they face in skill development. Data I involved a detailed review of job descriptions to identify the expectations and responsibilities associated with these roles, as well as interviews with stakeholders to gather insights about their experiences.

The key informants for this phase included electrical engineers from both the case team and a separate team, providing a balanced view of the current situation and challenges engineers face in projects. Additionally, input from the Director of EIA was incorporated to align the findings with broader organizational objectives. The timing is set for the data collection in January 2025. The outcome is a summarized report that highlights the current skillset, essential skills, and areas where skill gaps exist focusing on the identification of the major skill gap.

Based on the findings from the first data point, Data II focused on designing a preliminary outline for the training program. This data point emphasized collaboration with stakeholders to ensure that the program addressed real needs. Stakeholders provided comments in the common workshop, which was conducted in March 2025. The workshop included discussions about the training program’s structure and main components, ensuring that the design was practical and relevant. As a result, a preliminary training program outline was developed, reflecting the collective input of stakeholders.

Finally, Data III was dedicated to completing the training program based on stakeholder feedback. During this data point, the preliminary outline was presented to the Director of EIA for review and validation. The feedback collection process involved an interview conducted in April 2025, which provided an opportunity to evaluate the strengths of the proposed program and identify areas for further improvement. Data III ensured that the training program was aligned with organizational objectives and effectively addressed the skill gaps identified in the earlier data points. The proposal was validated and thereby the final outline of a training program tailored to the needs of electrical engineers was created.

The study continues with the findings from Data I in the next chapter “Analysis of current skills and competencies”.

3 Analysis of Current Skills and Competencies

This section describes the analysis of the current skills and competencies of the electrical engineers of the case team. It starts with an overview describing how the data collection and the analysis were carried out. The following subsections represent the description of main accountabilities, identification and description of current skills and competencies, identification and analysis of current skills and skill gaps, and selection of the major skill gap that was aimed to be improved and focused on with this study.

3.1 Overview of Data 1 Collection

The objective of this stage was to capture information about the essential skills required for electrical engineers, as well as their current skill levels and existing skill gaps.

In the first phase, the company job descriptions were studied to gain a clear understanding of the main accountabilities of electrical engineers assigned to electrical engineers within the organization.

Following the document analysis, several one-to-one interviews were conducted with the relevant internal stakeholders directly involved in the teamwork and project execution to get the knowledge of their views on the current skillset within the team, their descriptions of the competencies necessary for success in the role, and their opinions on where skill gaps exist. These stakeholders included electrical engineers from different teams and experience levels and relevant managerial staff. Due to the lack of resources, the number of relevant stakeholders was limited to four informants. Two informants were Electrical Engineers from the studied team. One informant was the Director of EIA, who headed the studied team and was considered a decision-maker. In addition, an Electrical Engineer from another team was selected as another informant to gain a deeper understanding of the topic from a different angle. Therefore, Electrical Engineers were named as Informant 1, Informant 2, and Informant 4, and a decision-maker was named as Informant 3.

Different sets of questions were prepared for the engineers and the manager to gather insights from multiple perspectives and ensure the study aligned not only with engineering needs but also with the company's strategic objectives and future planning. The interview questions for both engineering and management-level informants can be found in Appendix 1 and 2.

Since all the informants were located in Espoo or Helsinki, the interviews were conducted face-to-face in the meeting rooms of the Metso office, and each interview lasted 40-60 minutes. Technically, the interviews were carried out using Microsoft Teams, enabling both the recording of the discussions and the transcription of the notes.

The interviews were chosen as the primary data source for this stage of the study. To provide a better understanding of the collected data and a structured visualization of the analysis of current skills and competencies, a concept map was created based on the framework proposed by Ausubel (1963, 2000, cited in Novak, 2010) and later developed by Novak (2010). According to Novak (2010), concept maps should be read from the top to the bottom, following the idea that more general concepts are placed at the top and more specific concepts are placed at the bottom.

Observations and findings derived from the interviews, along with the creation process of the concept map, are described in the following subsections.

3.2 Description of Main Accountabilities

Reviewing the company's internal documents was a starting point for the analysis of current skills and competencies by getting a general understanding of the job duties of electrical engineers, their main responsibilities, and the company's requirements for them. The required data for that step was found in

Metso’s Job Catalogue. This is a document created by the Human Resources (HR) department, and where the role and main accountabilities of the employee's position are described.

Metso has a so-called Job leveling system, which is a system for evaluating, defining and communicating the relative size and the main accountabilities of jobs. The job leveling system is based on a set of pre-defined jobs that have been grouped into job families (e.g., Engineering, Sales, Procurement, Project Management, etc.) according to their common characteristics. Job leveling provides understanding and structured visibility to Metso's organization and the types of positions the company has globally. As a result of the leveling, each white-collar job is classified into a job family, job, and grade with identification in the Metso’s Job Catalogue document.

Thereby, Metso’s Job Catalogue describes the Engineering role in general with the following main accountabilities:

- Develop and carry out engineering (*electrical*, process, mechanical, etc.) procedures to achieve quality and productivity
- Conduct engineering analyses to produce and interpret drawings and technical documents
- Support the sales, aftersales, and production teams
- Coordinate and oversee subcontracted engineering work

Based on the information gained from Metso’s Job Catalogue, the concept map for visualizing an electrical engineer’s skills and competencies has been started with the main accountabilities, as illustrated in Figure 3 below.

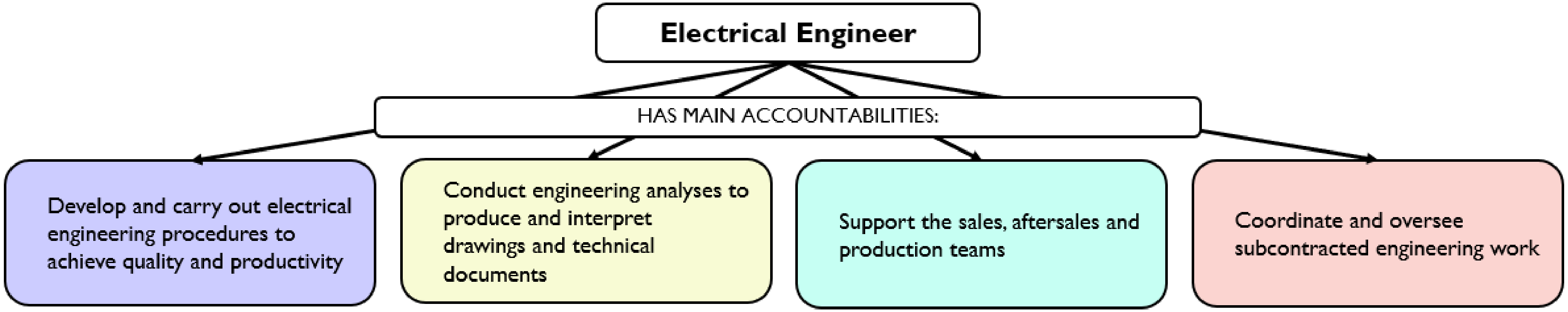

Figure 3. Main accountabilities of Electrical Engineer

As shown in Figure 3, following the principles proposed by Novak (2010), the main accountabilities are assigned at the second level of the map, giving the general concept of understanding the essential skills identified in the next sub-section, where Electrical Engineer occupied the top level due to the central role in the whole concept of the current study.

3.3 Identification and Description of Needed Skills and Competencies

To determine the training needs for improvement, the analysis continued with identifying the necessary skills and competencies required for electrical engineers to meet performance expectations. This knowledge was gathered through a series of interviews with relevant internal stakeholders.

The interviews revealed that electrical engineers must have a solid skillset to be able to effectively perform the activities described in the Metso Job Catalogue. Informants identified the skills essential not only for executing technical tasks but also for ensuring compliance with industry standards, supporting cross-functional collaboration, and adapting to evolving project requirements. The interviews also highlighted the importance of both theoretical knowledge and practical expertise, as engineers are expected to work on diverse projects that require a strong understanding of electrical systems, regulatory compliance, and process electrification.

Table 1 presents the skills and competencies required for electrical engineers mentioned and described by the informants during the interviews.

Table 1. Essential skills and competencies

Skill or Competence	Description
Knowledge of standards	Understanding and applying international and local electrical standards such as IEC, IEEE, NEC, and ISO to ensure compliance and safety
Knowledge of Electrical Engineering (in general)	A strong basis in electrical principles, including knowledge of fundamental physics and mathematics
Knowledge of Low Voltage systems	Expertise in low voltage power distribution, control circuits, and protection methods
Knowledge of Medium Voltage systems	Understanding the design, operation, and protection of medium voltage power networks, including switchgear, transformers, and substations
Knowledge of Process Electrification	Familiarity with electrical systems used in industrial processes, such as motor control, variable speed drives and power supply for production equipment
Knowledge of Building Electrification	Understanding the electrical infrastructure for buildings, including lighting, lightning protection, electrification of HVAC systems, fire protection, communication systems, etc.
Knowledge of Process technology	Understanding industrial processes, technologies, and equipment
Technical communication and collaboration	The ability to explain complex technical concepts clearly to colleagues, clients, and subcontractors through written documentation and verbal discussions
Proposal preparation	Preparing technical proposals and cost estimations for electrical engineering projects to support sales activities
Electrical equipment programming or parameterization	Configuring, programming, or setting parameters for electrical devices such as, relays, drives, and protection systems to ensure correct operation and performance
Field supervision and advisory	Overseeing on-site electrical installations, testing, commissioning, and troubleshooting, providing guidance to contractors to ensure compliance with the project design
Project management (basics)	Applying fundamental project management principles, including task planning, scheduling, resource allocation, and risk management to electrical engineering activities
Vendor management	Coordinating with equipment suppliers and manufacturers to ensure the correct selection, procurement, and integration of electrical equipment in the project
Technical oversight	Providing expert guidance and review of electrical designs done by subcontractors or equipment suppliers, ensuring that all solutions meet technical requirements, safety standards, and best practices

Additionally, software proficiency was recognized as a key competency for engineers to perform their tasks. The most commonly used tools mentioned during the interviews are shown in Table 2 below.

Table 2. Key Software Tools

Software Tools	Description
Microsoft Office	Used for creating, formatting, and managing technical documentation. Includes tools like Word (for technical specifications), and Excel (for calculations and creating different kinds of lists, e.g. Part list or List of electrical consumers)
AutoCAD	Used for creating 2D layout drawings, relatively simple electrical schematics and single-line diagrams
Eplan	Used for designing detailed and complex circuit diagrams and control schematics
Navisworks	Used for reviewing, visualizing, and coordinating 3D models in projects
Neplan or ETAP	Used for electrical network modelling, load flow analysis, and fault calculations to ensure power system reliability, safety, and efficiency
Metso Excel tools	Custom-built tools based on Microsoft Excel, created by other Metso employees and used for specific engineering calculations, equipment selection, and sales support

After all interviews were conducted and the relevant information was gathered, the concept map creation was continued with visualization of the needed skills and competencies identified by informants. First, these skills and competencies were categorized into four major groups as shown below in Figure 4.

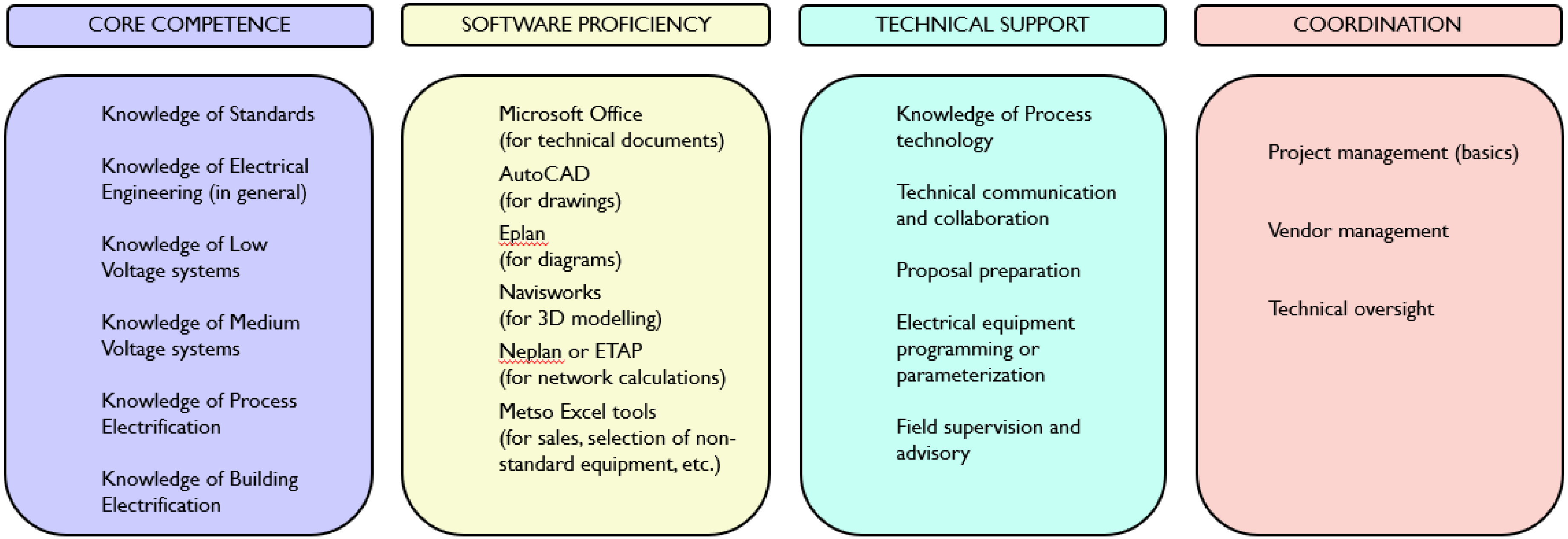

Figure 4. Categories of needed skills and competencies

As illustrated in Figure 4, each group corresponds to a specific aspect of the electrical engineer's role:

- *Core competence* – fundamental engineering knowledge and technical expertise essential for performing daily tasks
- *Software proficiency* – the ability to work with industry-standard software for design, modelling, calculations, and documentation
- *Technical support* – skills necessary for assisting different teams inside the company
- *Coordination* – a set of skills required for smooth collaboration and execution of engineering tasks

The next step involved linking these skill categories to the main accountabilities of electrical engineers, following a logical structure aligned with role expectations as shown in Figure 5 below.

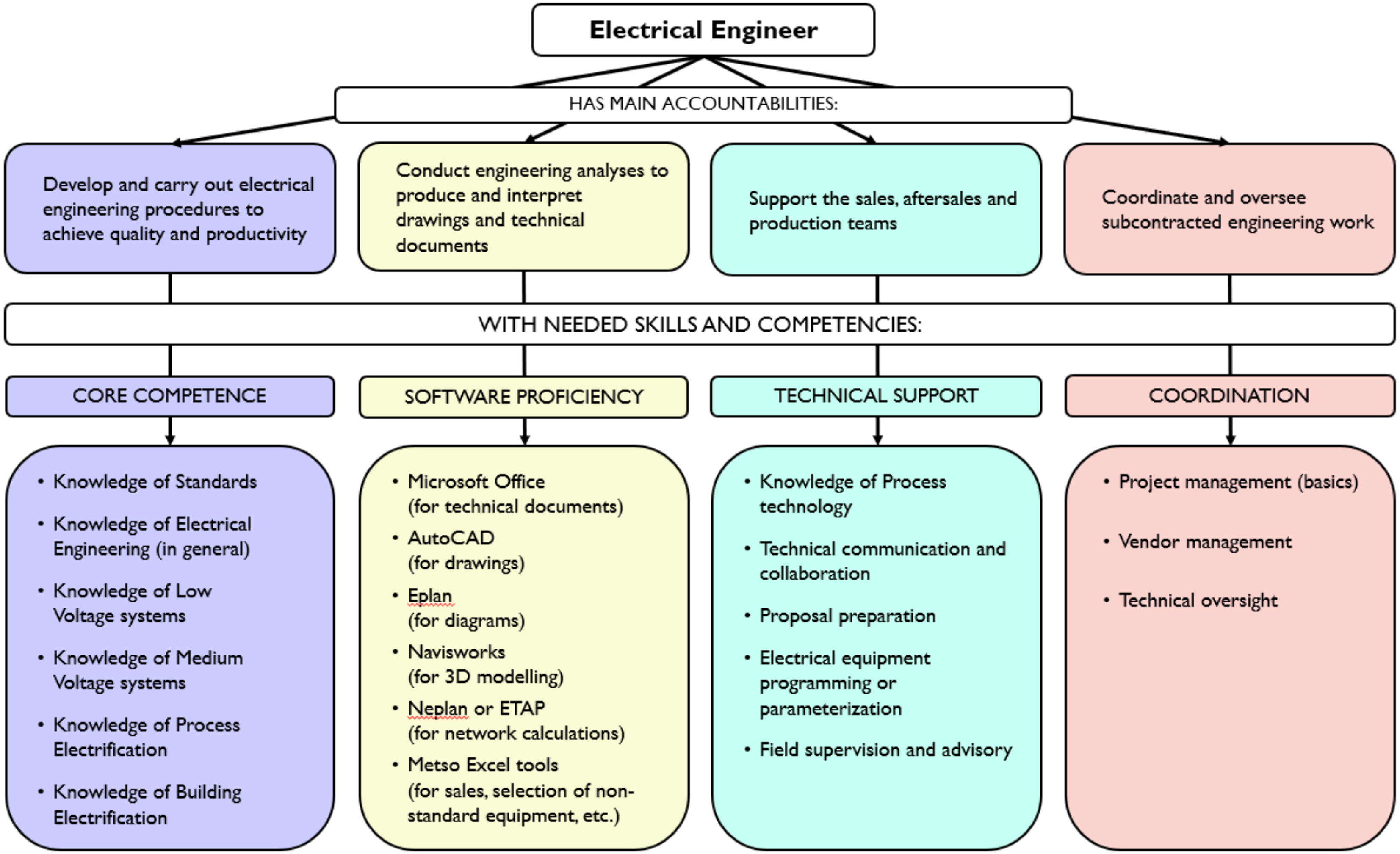

Figure 5. Concept map of main accountabilities, needed skills and competencies

As demonstrated in Figure 5, the groups of essential skills and competencies were placed on the third level of the concept map. This helped visualize the relationships between engineering skills and main responsibilities.

The following subsection discusses which skills were obtained by electrical engineers and where the skill gaps were identified by different informants.

3.4 Identification of Current Skills and Skill Gaps of Engineers

According to McGuinness and Ortiz (2016), lack of performance could be explained by skill gaps inside a company. The correct identification of skill gaps is important to define the training's goals, while wrong identification of skill gaps may lead a company to reduced competitiveness. (McGuinness and Ortiz, 2016).

A thorough analysis of the current skills, competencies, and skill gaps of electrical engineers was conducted by validating findings through the same stakeholder interviews, supported with additional relative questions.

When the questions about the evaluation of professional weaknesses and also about difficult tasks required more effort due to lack of knowledge were asked, Informant 2 answered as follows:

> I could mention VSD parameterization. There are many parameters, and you need to know them very well
>
> Also, the calculation of some of our specific equipment. We have a special Metso Excel tool for that, but it is not very clear how to use it.

In addition, Informant 1 replied to the same questions:

> I might have some difficulties when I start doing a new project in some country outside the European Union. The European IEC standards are familiar to me. But I am less familiar with the American standards.

Informant 4 stated for the same questions as follows:

> I have worked mostly with low voltage systems. So, the medium voltage is less familiar to me.

Informant 3 received different questions for a deeper exploration of the decision-maker's perspective. For example, one of the questions was "Have you observed any repeating challenges or inefficiencies that could be linked to a lack of specific skills or knowledge?" and Informant 3 replied in the following way:

> Building electrification is something that seems to be challenging for us now.

Additionally, Informant 3 was asked questions related to skills or competencies foreseen as becoming important for electrical engineers in the studied team according to the Informant's understanding and the company's strategy and planning, and Informant 3 stated that:

> Medium voltage. I would say that this is what we already have on a good level, but I think there's still much more to learn.
>
> We also need to support our sales more with proposal preparation.

In summary, all four informants identified more positive findings rather than negative ones. Figure 6 below demonstrates all current skills and skill gaps defined during the analyses.

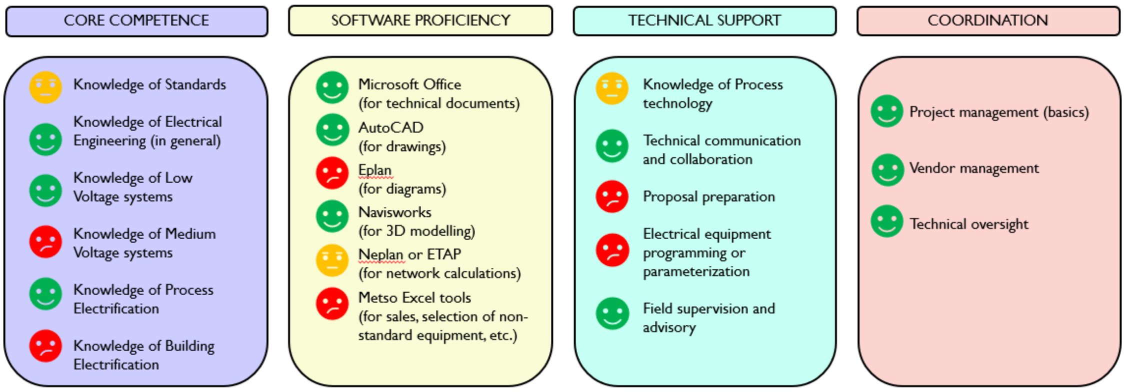

Figure 6. Current skills and skill gaps.

For better visualization and easier understanding of the current problem, a simple identification by color and emoji was used. Based on the gathered information, the current skills were marked with a green happy face emoji. Conversely, the skill gaps were divided into two categories according to the personal evaluation of informants: minor and major skill gaps. After that, minor skill gaps were marked with a yellow neutral face emoji. Accordingly, the major skill gaps were marked with a red sad face emoji.

As shown in Figure 6, there were a total of nine skill gaps identified in the interviews. Three of them were minor skill gaps: Knowledge of Standards, Software proficiency in Neplan or ETAP, and Knowledge of Process technology. Six of the uncovered skill gaps were the major ones: Knowledge of Medium Voltage systems, Knowledge of Building Electrification, Software proficiency in Eplan and Metso Excel tools, Proposal preparation, and Electrical equipment programming or parametrization.

3.5 Analysis of Current Skill Gaps

Since the objective of this thesis is to create an outline of a training program, this study focused on the current skill gaps by prioritizing one of the major skill gaps evaluated by informants. Figure 7 below shows how informants identified the major skill gaps in the interviews.

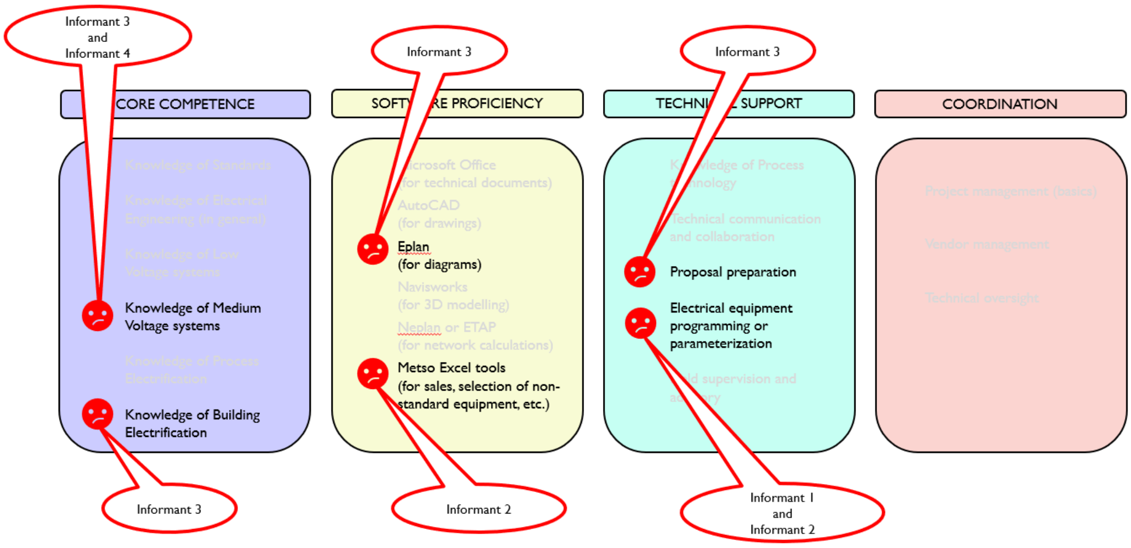

Figure 7. Identification of the current skill gaps by informants

The differing perspectives between a decision-maker and electrical engineers highlighted the complexity of skill gap identification and analyses within the case team.

Electrical engineers (Informant 1, Informant 2 and Informant 4) seemed more concerned with a few skill gaps related to the execution of technical tasks that directly impact their ability to complete work efficiently, while the biggest part of the other gaps in three different skill categories was highlighted by a decision-maker (Informant 3).

The skill gaps identified by Informant 3 were more strategic in nature, focusing more on the areas crucial for project success and business development. It is understood that a decision-maker had a broader view considering the current situation in the team and long-term business objectives compared with electrical engineers.

Most of the informants' observations were varied and did not duplicate each other. However, the overlap in identifying two gaps was discovered through the interviews – Informant 1 and Informant 2 noted insufficient competencies in **Electrical equipment programming or parameterization**; the lack of **Knowledge of Medium Voltage systems** was specified by Informant 3 and Informant 4.

The fact that multiple informants independently observed two skill gaps suggests recurring and significant issues within the team. Even though informants may have had different viewpoints, the fact that they identified overlapping gaps indicated a shared understanding of the critical lack of competencies.

3.6 Selection of Skill Gap for Improvement

Due to the time limitation, it was practically impossible to study further all the skill gaps identified through the interviews.

Since the gap in Knowledge of Medium Voltage systems was acknowledged by both managerial (Informant 3) and engineering sides (Informant 4), it indicated a clear need for targeted improvement. Figure 8 visualizes the selection of the most critical skill gap in the case team of electrical engineers.

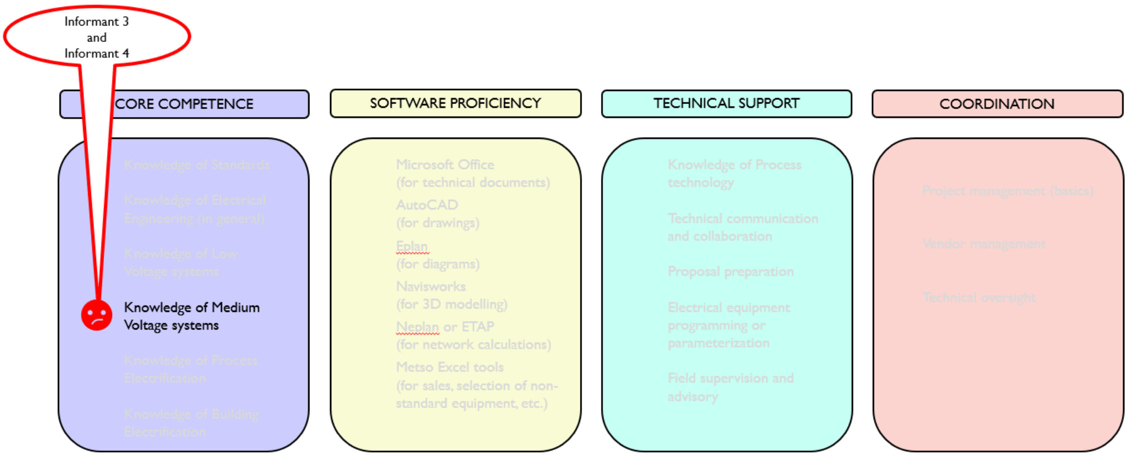

Figure 8. Selection of the major skill gap

The fact of identification of the skill gap related to **Knowledge of Medium Voltage** systems represented two different perspectives. From the managerial point of view, this gap was likely identified by a decision-maker as one of the critical business concerns. From the engineering point of view, the electrical engineer suggested that this skill gap may directly impact daily engineering tasks. Insufficient knowledge in this area can lead to design errors, operational failures, or safety hazards.

The following chapter of this thesis researches the improvement ideas among the relevant literature, focusing on the selected skill gap.

4 Best Practices for Developing Training Programs in Literature

This chapter discusses existing knowledge of ideas, concepts, tools, and best practices drawn from relevant literature, and it uses them to develop the conceptual framework for the study.

The previous chapter provided the results of the analysis of the current skills and skill gaps inside the studied electrical team of the company and the identification of the major skill gap. This chapter consists of two sections and four sub-sections. The first section contains the definition of the concept of training. The second section describes the selected framework for training process design and its sub-sections present the details of the major steps of the selected framework. The last section summarizes the knowledge into the conceptual framework of this study.

4.1 Concept of Training

According to Noe (2010), companies provide training to employees to improve job-related competencies such as knowledge, skills, or behaviours. After the training, it is expected that employees can apply these competencies in their daily work. Therefore, the developed competencies improve the job performance of employees and the company itself. (Noe, 2010)

In the context of the current study, in addition to teaching basic skills, the training should also help employees grow, adapt, and solve problems in real work situations. At the same time, by including hands-on practice and real examples, it could be possible to build a skilled team that not only does the job well but also helps improve and keep the business competitive. Thus, training should match the company’s goals.

Noe (2010) states that if a company wants to be competitive, it must train its employees in new technologies, business processes, communication and collaboration.

4.2 Framework Definition and Description

Myers et al. (2007), mention the so-called "systems'' view to describe the current learning models. Practically it means that in such models efforts are equally directed to all aspects considered important for learning. This way requires the identification of learning objectives, which help to improve certain skills and behaviours in practice. (Myers et al., 2007).

Allen (2006) suggests that the most widely used methodology for developing new systematic training programs is often called Instructional Systems Design (ISD), also known as Instructional Design (ID). However, it is not well known what the origin of the name of this methodology is, but the roots of ISD can be traced to the model developed for the United States armed forces in the mid-1970s (Molenda, 2008). After World War II, ISD principles started being used in the U.S. military to find a more effective way to create training programs (Swanson and Holton, 2001 cited in Allen, 2006). Myers et al. (2007) state that ISD uses a comprehensive, structured approach to training. It is based on principles from the technology of education and instruction as applied sciences and is rooted in both cognitive and behavioral psychology. (Myers et al., 2007).

Visscher-Voerman and Gustafson (2004) discuss that throughout history ISD methodology has been used to be analysed and explained by different authors as a comprehensive problem-solving approach that typically consists of several steps, including Analysis, Design and Development, Implementation, and Evaluation (ADDIE). Beyond that, Molenda (2008) argues that these steps shall be not only sequential but also iterative, as shown in Figure 9 below.

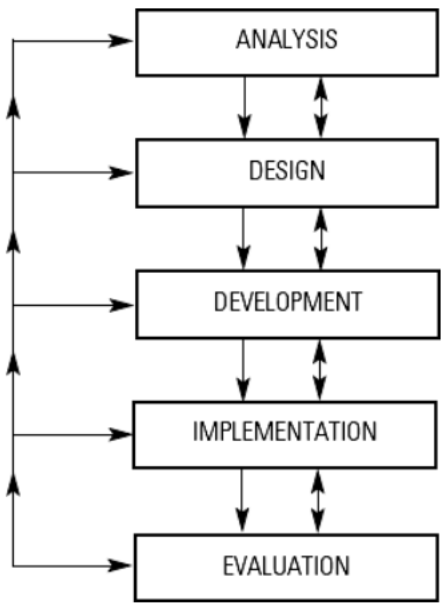

Figure 9. The ADDIE Model (Hodell, 1997)

The initial conceptual framework selected for this study is based on the model created by Raymond A. Noe (2010), and it is shown in Figure 10 below.

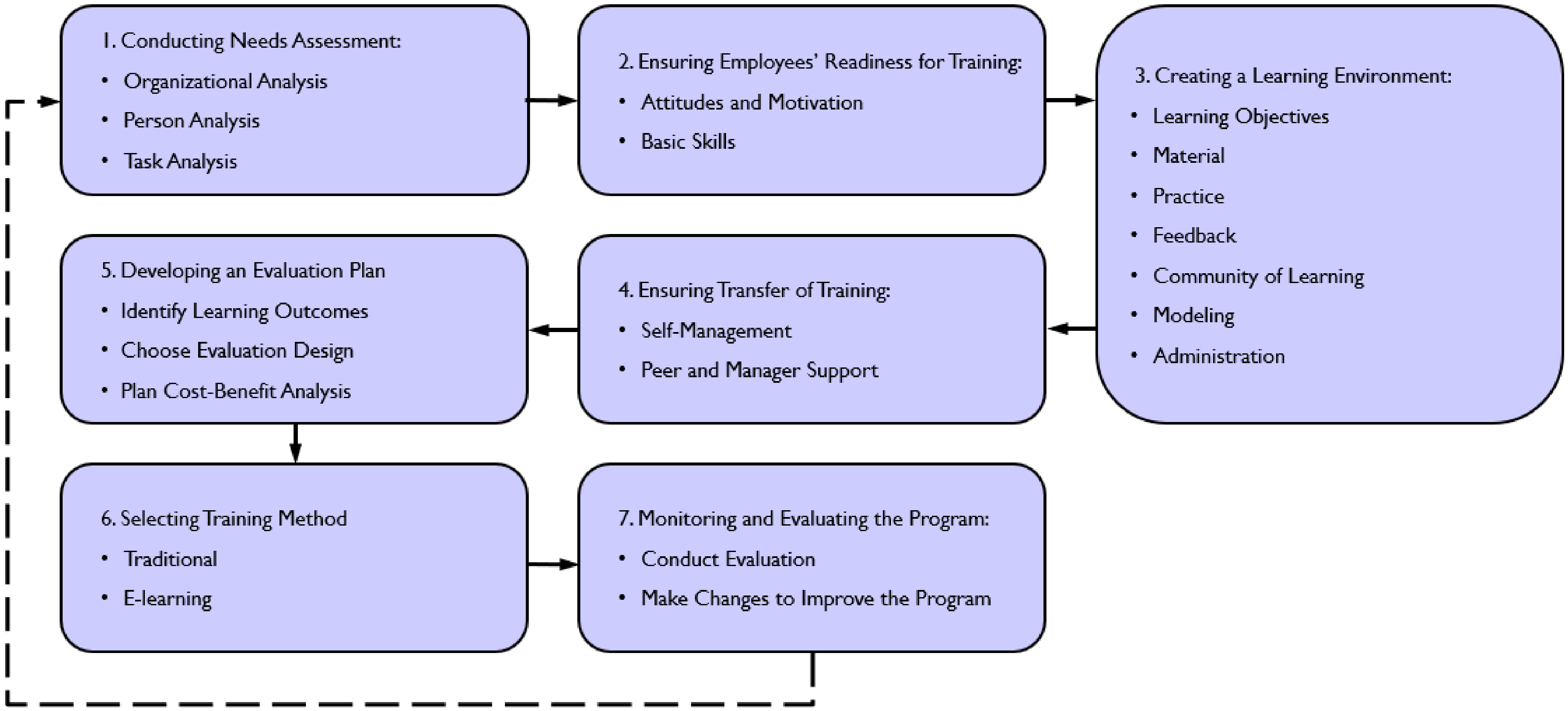

Figure 10. Training Design Process Framework (modified from Noe, 2010)

The proposed framework consists of several key steps for developing a successful training program. It begins with a needs assessment (Step 1) and identification of whether training is the right solution for performance gaps. According to Noe (2010), needs assessment starts with organizational analysis that examines the current organizational environment. It focuses on evaluating whether training is suitable based on the organization's business goals, available resources, and the level of support from both the managerial level and their subordinates. Then it is followed by person analysis to determine which employees require training. During that step is it required to identify if the training is needed because of any skill gaps or lack of motivation. Finally, task analysis focuses on identifying the key duties and the specific knowledge and skills the training should address to improve the job performance of employees. (Noe, 2010). A need assessment was already performed in Section 3 of this study.

Once the need is established, the focus shifts to assessing whether employees are prepared and ready to learn. According to Noe (2010), Step 2 focuses on evaluating employees' readiness. This includes checking if employees are motivated enough to participate in training and possess the right mindset to benefit from it. During this step, it is also important to evaluate that employees have basic skills such as reading and writing to be able to understand training content (Noe, 2010). For example, in the case of a multinational company where the common language is English, the trainees must be able to read and write in it, not only in their mother tongue.

An effective learning environment then must be created in Step 3, incorporating elements that facilitate knowledge retention and skill development. This is one of the most comprehensive steps of the whole framework and it includes identifying Learning objectives, Training material, Practice, Feedback, Community of learning, Modeling and Administration. (Noe, 2010).

However, training design does not end once the content is delivered. The next Step 4, Ensuring the transfer of training, verifies that employees successfully apply the training to their work. This step involves strategies for self-management, as well as peer and management support. By self-management Noe (2010) means an individual's effort to regulate their own decisions and actions. Employees should have the ability to independently apply newly acquired skills and behaviours in their work environment after training. Managerial support also plays a crucial role by encouraging trainee's participation in training activities. Finally, creating a peer support network among trainees can further strengthen the transfer of training. This allows employees to regularly communicate with each other, share their thoughts on what they've learned, and discuss how they implement the gained knowledge successfully in practice. (Noe, 2010).

The next Step 5 is required to measure the effectiveness of a training program by developing an evaluation plan. According to Noe (2010), this step includes identifying learning outcomes, choosing an evaluation design and planning a cost-benefit analysis. Defining learning outcomes clearly shows the impact of the conducted training, these could be gained knowledge, behavioural changes, or skill improvement. The evaluation design describes the ways by which a company could gather the data for analysis of the benefits or needs for future improvement of a training program. Additionally, a cost-benefit analysis needs to be planned to demonstrate the financial benefits of the training to its overall cost. (Noe, 2010).

Selecting of traditional or e-learning training method is proposed by Noe (2010) to be a part of Step 6. A traditional training method normally includes face-to-face interaction with a trainer in a training room at the office of the company or a training provider. E-learning means Web-based training and allows a trainee remote access to the training process. (Noe, 2010).

Finally, Step 7 is needed to evaluate the training program, which means its regular review and refinement based on feedback and results.

As seen in Figure 10, the training design process proposed by Noe (2010) is fully based on the ADDIE model. Step 1 and Step 2 can be considered as the “Analysis” stage. Step 3, Step 4 and Step 5 are combined in the “Design” and “Development” phases. Step 6 relates to the “Implementation” stage. Step 7 is practically part of the “Evaluation” phase.

Due to time limitations, the study focused only on Step 1, Step 3 and Step 5, selecting them as the most crucial for creating the outline of the training program. For the same reason, such parts of Step 3 and Step 5 as Feedback, Community of learning, Administration, Choose evaluation design, and Plan cost-benefit analysis were excluded from the current study. As a result, the edited conceptual framework is presented below in Figure 11.

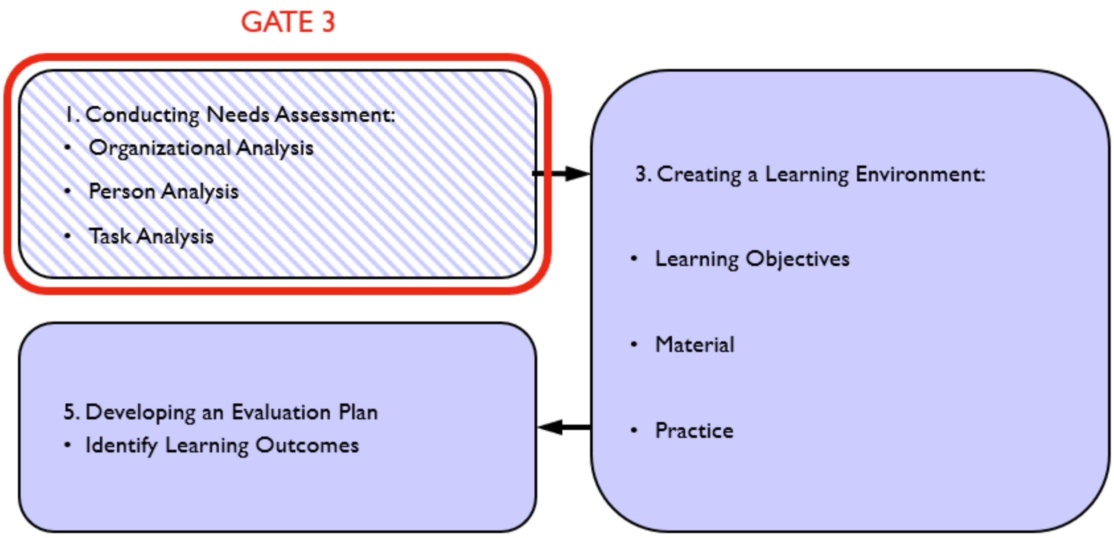

Figure 11. Edited Conceptual Framework

In the following subsections, the selected steps are explained in greater detail. Additionally, each element of the steps has been enriched with insights from other authors, who have contributed specialized knowledge on the subject, which allowed the completion of the Conceptual Framework.

4.2.1 Learning Objectives

Creating a learning environment starts with defining the learning objectives. Noe (2010) suggests that employees could learn more effectively when they have a clear understanding of what exactly they are learning and what are their goals in the training. These goals of the training program are called learning objectives, and they help to define the purpose of the training. Depending on the training program, learning objectives can be set for individual sessions as well as for the whole program. Trainees must be aware of them, agree with them, and be motivated to reach them. Learning objectives should be linked to the results of a needs analysis developed at the beginning of the training process design. Following that principle, learning objectives will refer to specific knowledge or skills that need to be acquired. (Noe, 2010)

In addition, Phillips (2010) suggests that it is helpful to link objectives to evaluation strategies and therefore to learning outcomes. This linkage provides a systematic, results-based process. Six levels of objectives position programs for success from multiple stakeholder perspectives. (Phillips, 2010). Figure 12 below describes the six levels of objectives.

Level of Objective	Measurement Focus	Typical Measures
0—Inputs and Indicators	Scope, volume, efficiencies, and costs of the project	• Participants • Hours • Costs • Timing
1—Reaction and Perceived Value	Reaction to the project or program, including the perceived value	• Relevance • Importance • Usefulness • Appropriateness • Intent to use motivation to take action
2—Learning and Confidence	Learning to use the content and materials, including the confidence to use what was learned	• Skills • Knowledge • Capacity • Competencies • Confidence • Contacts
3—Application and Implementation	Using content and materials in the work environment, including progress with actual items and implementation	• Extent of use • Task completion • Frequency of use • Actions completed • Success with use • Barriers to use • Enablers to use
4—Impact and Consequences	The consequences of using the content and materials expressed as business impact measures	• Productivity • Revenue • Quality • Time • Efficiency • Customer satisfaction • Employee engagement
5—ROI	Comparing monetary benefits from program to program costs	• Benefit-Cost Ratio (BCR) • ROI (%) • Payback period

Figure 12. Levels of Objectives (Phillips, 2010)

This structure of Objectives' level proposed by Phillips (2010) could be used as a basis for the identification of the learning objectives in different training programs for different needs. Depending on the outcome of the training program, the training creator should refer to the particular level of objectives. Phillips (2010) states that Level 2 assesses the participants' learning during the program. The typical measures for this level are Skills, Knowledge, Capacity, Competencies, Confidence, and Contacts. Most of these measures are directly related to the current study and the issues identified in the Current State Analysis. Additionally, Phillips (2010) states that Learning objectives (Level 2) in Figure 12, also known as Instructional objectives, are the most common. The learning objective refers to the performance of the participant and assesses the participants' learning during the program. The knowledge the participant gains to implement a particular skill or apply information on the job drives business results. Learning objectives begin to illustrate the chain of impact of powerful objectives. Constructing the learning objective appropriately ensures program success (Phillips, 2010). Therefore, referring to Level 2 could practically be used in the study allowing building properly the first element of the training program for electrical engineers.

According to Hodell (1997), an objective must indicate the expected competencies that learners should demonstrate upon completing the training program. For that, Hodell (1997) proposes to build an objective with 4 “blocks” – the components, as shown below. Hodell (1997) wrote them in a specific format and called them A-B-C-D objectives:

- Audience
- Behavior
- Condition
- Degree

The **audience** part of the objective should provide a detailed description of who the learners are. It gives helpful information about what learners may need to know beforehand and how the learning objective fits into the learning goals. (Hodell, 1997).

Hodell (1997) states that **behavior** is the most important component here, and it should be specific, measurable, and described as clearly as possible. For example, the general words “learn” or “understand” should be avoided because they do not clearly show what is expected from the learner. (Hodell, 1997).

The third component of an objective is **condition,** and it describes the situation and environment of the learning process. According to Hodell (1997), depending on the learning, the condition can be simple or complex. The simple condition relates to access to books or tools, whereas the complex condition may refer to the completion of a course. (Hodell, 1997).

Finally, Hodell (1997) suggests that **degree** could help to define the efficiency level (e.g. four out of five times, or in an hour or less).

The ideas, proposed by Hodell (1997) provide a clear framework for creating the learning objectives. However, not all of these components can be easily used. For example, the final component **Degree** may not be formulated due to the specifics of engineering learning and sometimes it may not be required at all.

4.2.2 Training Material

The next important element of creating the learning environment is selecting training materials. According to Noe (2010), one of the most crucial criteria for training material is it should be meaningful. Practically it means that training content should be delivered using language, examples, and ideas that trainees are already familiar with. Trainees are more likely to absorb new information when it is relevant to their everyday job, their real job duties and responsibilities. This relates not to only the content itself, but also to the actual work environment, including the physical surroundings and emotional atmosphere of the training. (Noe, 2010).

Feeney (2007) also highlights the importance of creating training content around employee competencies by developing a job-specific curriculum. Incorporating competencies into the curriculum increases success for learners and offers clear guidance on how to perform their roles effectively. Thus, aligning courses with defined competencies supports not only the effectiveness of the training but also the employees' professional growth and career development. (Feeney, 2007).

O'Connor (2007) refers to "media" when describing the training materials. Media includes the relevant literature in paper and e-learning content. O'Connor (2007) suggests that it is important to consider how well the media can support the learning process. The media should be aligned with the learning objectives and the preferred learning styles of the audience. Other significant factors are cost and time. Creating content from scratch always requires significant time and financial resources. (O'Connor, 2007).

Based on those suggestions O'Connor (2007) divides training materials into several groups and highlights the advantages and disadvantages for each of those groups as presented in Figure 13 below.

Approach	Commonly Used in Situations Where	Advantages	Disadvantages
Books and Journals	The content to be learned is reflected in excellent concept/skill materials that already exist	Excellent self-paced instruction; materials are extremely portable; inex-pensive, familiar	To be effective, must be coupled with quality training activities
Audio and Video recordings	Learning program is con-tinuous; need to reach dispersed audience	Additional sensory input (sight and sound) valuable	To be effective, recordings must be of high quality; this is time-consuming, costly to develop, and hard to maintain
Podcasting	Information changes quickly	Ease of distribution and learners have additional options as to where they learn; easy to update	Recordings must be of high quality; this is time-consuming to develop
Satellite Radio	Information changes quickly	Ease of distribution	If not recorded and saved centrally, learners are bound by time constraints
Computer-based Instruction	The content to be learned is required by a large population; content lends itself to programmed instruction	Learners can use tools on own time; continuous feedback; learners are active participants	Time-consuming and expensive to develop; hard to maintain
Performance Support Systems	Dispersed users need just-in-time assistance	Quick, easy access to expert assistance at the time training is needed; reduces the need to memorize procedures	Development time can be long and costs can be high
E-learning (Groupware and Learning Support Systems)	Content needs frequent updating; learners are geographically dispersed	Easily distributed learning option; communication with instructor and other learners supported	Course development and delivery time can be high
M-learning (Wireless—Cellular Phones, PDAs, and the like)	Geographically dispersed learners; need reference materials, updates, or communication capa-bilities	Easily updated; just-in-time performance support	Small device size does not always lend itself to full-scale instructional options
Knowledge Management and Expert Systems	Individuals can share tacit solutions to work-based problems, and the organi-zation needs to capture this information	Can be an invaluable learning resource when workers are dispersed or tackling new problems	The development and use of information requires both technical expertise and personal motivation to share ideas

Figure 13. Advantages and Disadvantages of Instructional Approaches (O'Connor, 2007)

As seen in Figure 13, O'Connor (2007) suggests books and journals as the most affordable, familiar, and useful source of training materials, which is crucial to the efficiency of the training program. Most of the other types of media presented in Figure 13 have more disadvantages than advantages, mainly because of their expense, high development and delivery time, and high requirements for their quality. Giving preference to books, journals, technical guides and different manuals would not only reduce the cost of the training program but also help with the preparation of training materials in time constraints.

4.2.3 Practice

Noe (2010) states that practice involves the mental or physical repetition of a task, skill, or knowledge to build proficiency. In training, it means having employees apply what they have learned under the conditions and performance standards defined by the learning objectives. As with all other elements of a training program, it should be relevant to the training objectives and reflect the real tasks expected on the job. Practice is considered effective if it engages the learner and provides sufficient time for repetition (this is also called "overlearning") with an appropriate amount of training content. Effective practice includes relative examples to help learners form mental models, which they can apply during practice. This approach also prevents memory overload and supports key cognitive processes like selecting, organizing, and integrating content. Another benefit of linking practice to the learning objectives is that it makes it possible to better evaluate the training program at the end. Therefore, it is important, that practice allows trainees to identify and correct their mistakes, improving confidence in applying new skills. (Noe, 2010).

Practice must always be meaningful. According to O'Connor (2007), trainers should engage learners to practice real job-related tasks more than just complete textbook exercises. Learning is more effective when trainees can apply new knowledge and skills directly to their work soon after the training. (O'Connor, 2007).

The practice in training closely relates to the concept of experiential learning. With reference specifically to the training or courses related to engineering, Roberts (2012) describes experiential learning as a set of methods and approaches used to help achieve specific learning outcomes.

One of the pioneers of experiential learning Kolb (1999, cited in O'Connor 2007) describes the concept of experiential learning as a cyclical process as shown below in Figure 14.

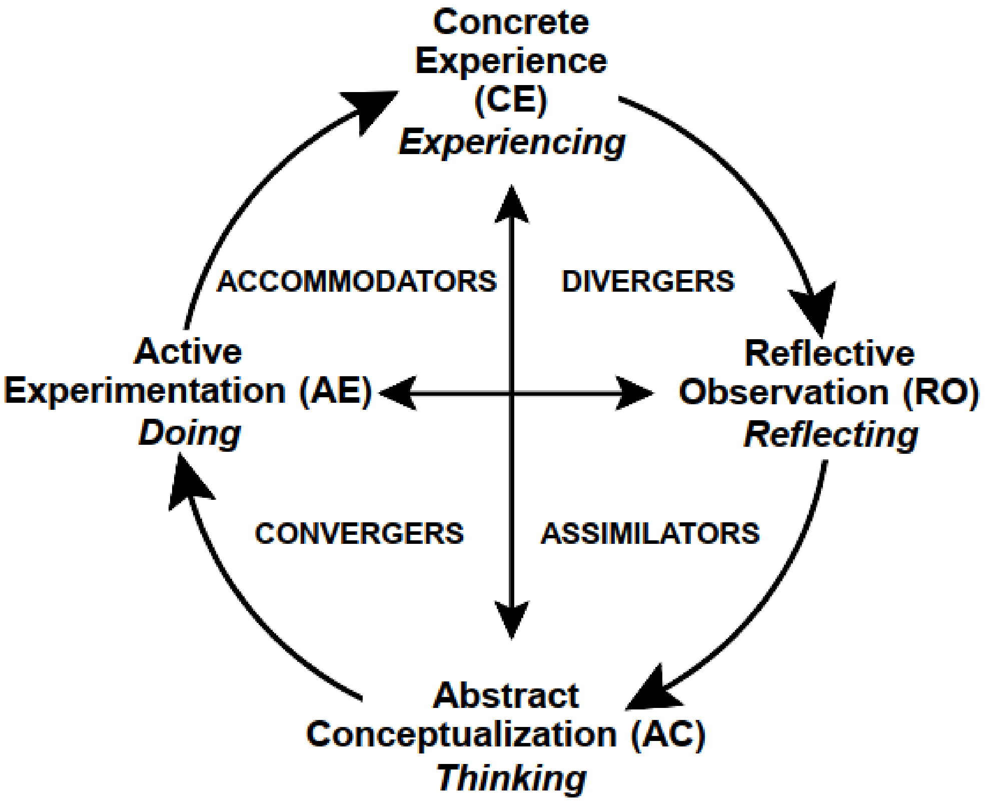

Figure 14. Experiential Learning Model (Kolb, 1999, cited in O'Connor 2007:146)

Kolb (1999, cited in O'Connor 2007) defines four learning stages: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), Active Experimentation (AE).

Concrete Experience (CE) relates to the "Experiencing" type of Learning and accordingly a hands-on experience. Reflective Observation (RO) relates to "Reflecting" Learning and it reflects on the experience and examines what happened. Abstract Conceptualization (AC) relates to "Thinking" Learning and it helps to develop theories based on the reflection. Finally, Active Experimentation (AE) relates to "Doing" Learning and it helps to apply new knowledge or improve skills.

Additionally, four learning styles based on a person’s preference for two stages of the cycle may be defined: **Divergers** (CE + RO) prefer observing and brainstorming before acting; **Assimilators** (RO + AC) prefer theoretical concepts and models over hands-on experience; **Convergers** (AC + AE) prefer problem-solving and applying theories to practical situations; **Accommodators** (AE + CE) learn best by hands-on experience and trial-and-error.

This should be considered in the training program since the preference of learning styles could affect the training process. Additionally, according to Hobbs (1992), the various learning styles allow a trainee to learn more effectively and acquire a wider range of skills, which then help a company use that accordingly within its workforce.

4.2.4 Learning Outcomes

The final step of the training program developed in this study is identifying the learning outcomes. Noe (2010) states that learning outcomes should be aligned with the company’s requirements for successful job performance. Noe (2010) differentiates the learning outcomes into five types:

Verbal information relates to facts and knowledge necessary for job tasks. (Noe, 2010).

Intellectual skills refer to the ability to apply different rules and concepts. (Noe, 2010).

Motor skills include the physical coordination required to perform specific movements or physical work. (Noe, 2010).

Attitudes consist of beliefs and emotions. Key job-related attitudes include job satisfaction, organizational commitment, and engagement. (Noe, 2010).

Cognitive strategies help learners to manage and control their learning processes. (Noe, 2010).

Additionally, Noe (2010) proposes to link each of these types of learning outcomes to **Internal** or **External Conditions** depending on the selected type of learning material at each step of the learning process as shown in Figure 15 below.

Learning Outcome	Internal Conditions	External Conditions
Verbal Information		
Labels, facts, and propositions	Previously learned knowledge and verbal information Strategies for coding information into memory	Repeated practice Meaningful chunks Advance organizers Recall cues
Intellectual Skills		
Knowing how		Link between new and previously learned knowledge
Cognitive Strategies		
Process of thinking and learning	Recall of prerequisites, similar tasks, and strategies	Verbal description of strategy Strategy demonstration Practice with feedback Variety of tasks that provide opportunity to apply strategy
Attitudes		
Choice of personal action	Mastery of prerequisites Identification with model Cognitive dissonance	Demonstration by a model Positive learning environment Strong message from credible source Reinforcement
Motor Skills		
Muscular actions	Recall of part skills Coordination program	Practice Demonstration Gradual decrease of external feedback

Figure 15. Internal and External Conditions Necessary for Learning Outcomes (Noe, 2010)

As seen in Figure 15, referring to conditions provides the link not only between learning outcomes and training material but also between practice and the training process itself. According to Noe (2010), **Internal conditions** relate to the mental processes within the learner, such as how information is absorbed, stored in memory, and later retrieved. **External conditions** relate to aspects of the learning environment that support and promote learning, for example, the physical setup or practice opportunities. Therefore, external conditions may affect how the training is designed and delivered. Learning can be ineffective if the training material is not properly processed. Additionally, visual content like diagrams or models can help learners faster and easier understand the training material. (Noe, 2010).

The identification of the correct learning outcomes is crucial for the evaluation of the training program. Even if the evaluation is the final step of the framework proposed in Figure 10, the training program design is supposed to be a cyclical and iterative process. After evaluation, findings can feed back into a new needs assessment, ensuring continuous improvement. Companies may select different evaluation strategies to understand the benefits of the conducted training and to see if there is a need for training improvement. Noe (2010) proposes at least three main evaluation techniques: Formative Evaluation, Pilot Testing, and Summative Evaluation.

According to Noe (2010), **formative evaluation** involves the evaluation of the training program during its design and development stages. By that technique, it is possible to ensure that the training is well-structured, effectively delivered, and also fully meets the learner’s expectations. It focuses on collecting qualitative data, such as participants’ opinions, beliefs, and feelings about the training. (Noe, 2010).

Noe (2010) states that **pilot testing** involves testing the training program with a small (pilot) group of different directly or indirectly relevant stakeholders. These could be trainees, managers, or clients funding the program. The outcome of such testing is valuable feedback before the full implementation of the training program. (Noe, 2010).

In contrast, Noe (2010) proposes that **summative evaluation** should be conducted after the training has been delivered to determine its overall impact. In this way, it is similar to formative evaluation. However, summative evaluation assesses more precisely whether trainees have acquired new knowledge, skills, attitudes, or behaviours, as defined in the training objectives. (Noe, 2010).

The evaluation plan and strategy were excluded from this study due to the time limitations. However, the identification of the learning outcomes provides the ground for the future development of a comprehensive evaluation to assess the effectiveness and impact of the training program. Noe (2010) states that training outcomes should be relevant, reliable, discriminative and practical. Relevance refers to how closely the outcomes align with the specific skills and knowledge emphasized during training. Reliability refers to the consistency of measurement. Reliability may include, for example, the test measuring knowledge given to a trainee before and after the trainee attends the program. However, in the current study, it is hard to measure reliability due to the specific job tasks and identified knowledge and skill gaps. Regarding discrimination, Noe (2010) suggests that it should indicate differences in trainees' performance levels. Finally, practicality relates to how easily and efficiently the outcome measures can be collected. (Noe, 2010).

4.3 Conceptual Framework for the Training Program Design

The details and ideas related to all key steps and elements of the framework are explained in the previous section 4.2 and its sub-sections 4.2.1 – 4.2.4. Figure 16 below illustrates the final outline of the conceptual framework for the training program design, including the ideas and practices from the relevant literature.

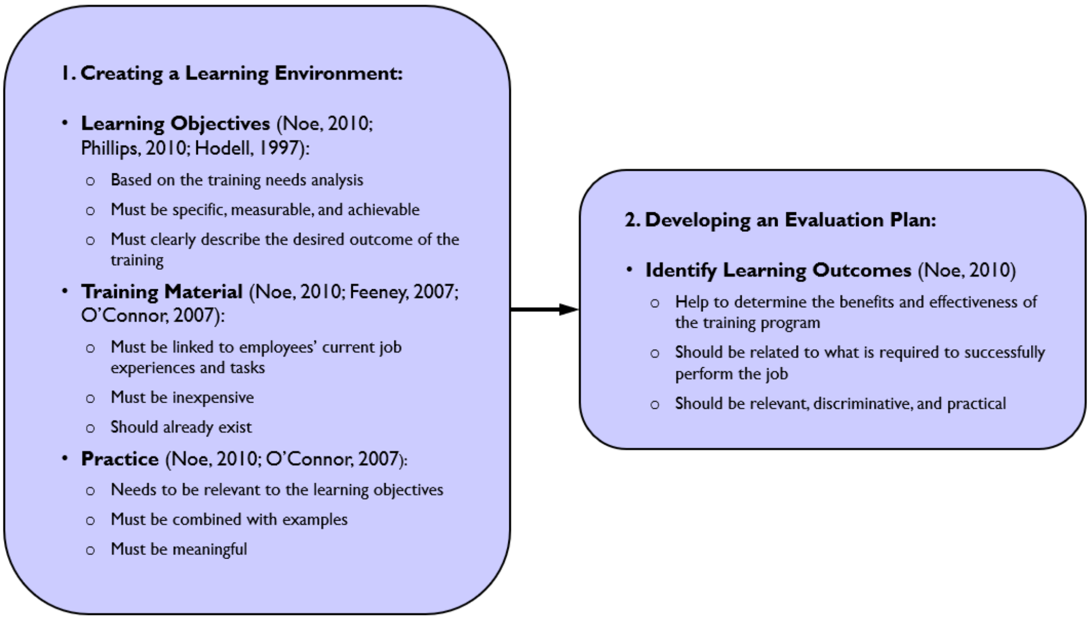

Figure 16. Conceptual Framework for the Training Program Design

Figure 16 shows the conceptual framework, which is divided into two key stages. The first stage of training design is **Creating a Learning Environment** for effective learning. This stage includes defining learning objectives, material and practice. The second stage of the framework is **Developing an Evaluation Plan** by identifying learning outcomes. Although **Needs Assessment** was conducted during the Current State Analysis, it was not done according to Noe's (2010) methodology. Therefore, that step was excluded from the final version of the Conceptual Framework for this study.

Many authors and works propose a different methodology for designing a training program. Simplicity, likewise, the depth of the framework suggested by Noe (2010) distinguishes it from others. Enriched with the ideas of such authors as Feeney (2007), Hodell (1997), O'Connor (2007), and Phillips (2010), the conceptual framework provides a structured approach to developing the training program.

In section 5, this framework is used to start designing the outline of the training program for electrical engineers by co-creating an initial proposal with the key stakeholders.

5 Creating the Preliminary Outline of the Training Program

This chapter combines the findings from the Analysis of Current Skills and Competencies and the relevant literature. First, it starts with a description of a general overview of the stage. Then it is followed by the recommendations from the stakeholders collected in Data II. Finally, it describes the outcome of this chapter as the preliminary outline of the training program with a summary.

5.1 Overview of the Preliminary Outline Creation

The objective of this study is to create an outline of the training program. A summary of the creation process of the preliminary outline is visualized in Figure 17 below.

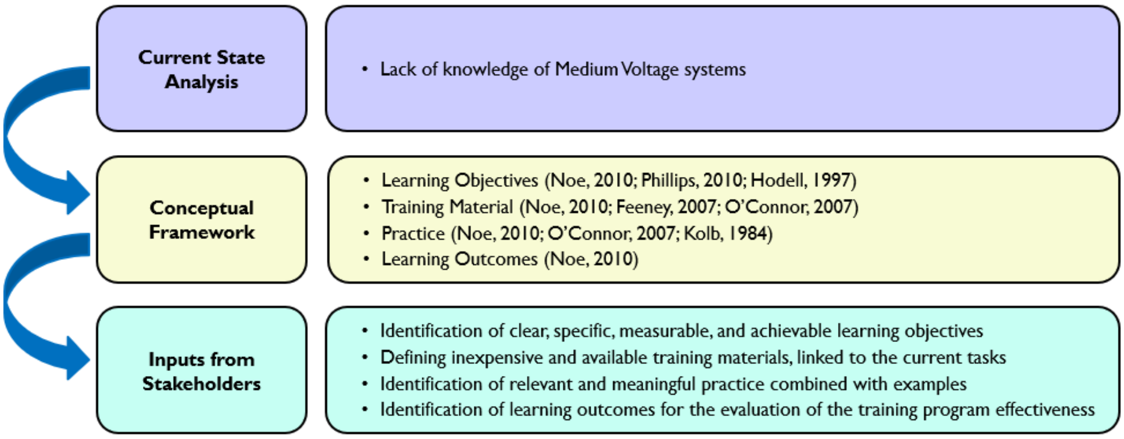

Figure 17. Creation Process of the Preliminary Outline

As shown in Figure 17, the creation process was done in three steps. During the first step, the lack of knowledge of Medium Voltage systems was identified as the major gap skill. In the second step, the conceptual framework was formed based on the reviewed relevant literature. Finally, during the third step, the inputs were collected from the stakeholders.

Since the main target audience of the training program are the electrical engineers of the case team, the preliminary outline of the training program was co-created with two electrical engineers in one workshop. The stakeholders who participated in the workshop were also included in the interviews for the analysis of current skills and competencies as informants 2 and 4. The workshop was conducted in Microsoft Teams due to the remote work of one of the informants.

5.2 Findings of Data Collection II

The workshop started with presenting the findings from the current state analysis and the relevant literature together with the conceptual framework for the training program design, providing a basis for the informants to co-develop the preliminary training outline based on the identified gaps.

According to the conceptual framework, four key elements must be identified to design the training program: **Learning Objectives**, **Training Material**, **Practice**, and **Learning Outcomes**. Initially, the stakeholders were introduced to the definitions of each element to ensure a common understanding. Following this, they were given 10 minutes to individually think about potential learning objectives related to Medium Voltage systems and close to their current job tasks. After that, over the next 10 minutes, participants were instructed to submit their proposed learning objectives to the shared Microsoft Teams chat and start discussing them. This same process was then repeated for the remaining three elements.

The next subsections discuss the findings collected during the workshop for each step of the conceptual framework described in more detail.

5.2.1 Identification of Learning Objectives

The first step towards creating the training program was identifying learning objectives. As stated in the conceptual framework, the learning objectives must be clear, specific, measurable, and achievable. Based on the suggestions proposed by the stakeholders, the objectives were formulated in a way that they were aligned with the framework requirements.

During the workshop, it was mentioned by one of the informants that some basic principles related to Medium Voltage systems were familiar to them due to special education and experience from past projects. That allowed them to perform some activities as stated by Informant 4:

> For example, we normally can develop single-line diagrams for Medium Voltage power distribution, and also to calculate short-circuit currents, and we do now this in some of our projects

However, the rest of the topics related to Medium Voltage systems and equipment were unfamiliar to both stakeholders. Defining their expectations from the training, Informant 2 mentioned that:

> We develop these diagrams, and after that, a supplier of Medium Voltage equipment or a client will check the drawings and select the correct type of equipment. Or this sometimes could be in the scope of some subcontractor. But we need to see if this equipment was selected correctly or not, for example

During the discussion, there was defined a strong need to gain knowledge of understanding the operational principles and performance characteristics of Medium Voltage equipment. Thus, the first learning objective was formulated, aligning it with the conceptual framework: **Select and specify Medium-Voltage equipment (switchgear, circuit breakers, protective relays, etc.) based on the project needs**.

Both stakeholders agreed with the identified first learning objective and the importance of such knowledge. However, the selection of the correct equipment is closely linked to the understanding of the right settings of the main components of the equipment, responsible for its protection. Informant 2 mentioned that:

> I think protection is also an important topic. Normally, we know only that there will be Medium Voltage switchgear, it has an incoming breaker, and then if you have some outgoing lines, there are also breakers for those lines. That's it. But each breaker will have a protection relay. And for these protection relays, you can get a lot of different kinds of protection options. But we are not so familiar with those protections, their coordination, selectivity analysis, and such things

It was noted in the workshop that there is no ability within the team to select the right protection and to arrange the protection coordination between different Medium Voltage equipment. Informant 4 discussed that topic as follows:

> Protection coordination is quite important and not an easy task. Because, for sure, we can do some calculations in "Neplan" software, but then how to apply it physically? In the previous project, we did these kinds of setting values by ourselves. It was some kind of proposal from us to the client and its contractor. And then it went so that when installation started, the contractor said that these values were not good. Then they had to do a new analysis

Both concerns mentioned separately by informants are practically related to one important competence of the ability to calculate the appropriate protection parameters and provide proper coordination between devices, for example, by applying coordination techniques such as time-current curves and cascading protection. The goal is that protection devices operate in a logical sequence to isolate faults quickly and selectively, minimizing system disruption and equipment damage. This discussion helped to define together the second learning objective: **Configure protective relay settings and design a protection coordination scheme**.

It was acknowledged that since such general topics as the correct equipment selection and protection were not very clear to both informants, this also contributed to the lack of knowledge in more specific topics. Thus, the importance of learning related to arch flash hazards was highlighted by Informant 2, described as follows:

> It is again, maybe somehow related to equipment selection, but there are specific requirements and principles for avoiding arc flash in this equipment. Sometimes equipment vendors may indicate this to us. But when we just start the project, we need to specify in our specifications what the requirements are for the equipment. The arc flash can also physically go up or behind the equipment, and there are different standards for defining that. So, this should be known and described from the beginning

By this suggestion, it meant the recommendation to learn different arc flash mitigation techniques, including the proper protective device settings and the use of arc-resistant equipment to enhance personnel safety and reduce equipment damage. Decisions are normally based on applicable standards and best practices. That concern identified the last learning objective for the training programs: **Demonstrate the ability to mitigate arc flash hazards**. This objective highlights the ability of engineers to learn not only how to understand arc flash hazards but also how to apply mitigation strategies effectively during the early project phases, particularly in specifying technical requirements.

5.2.2 Identification of Training Material

Next, the discussion moved to the identification of training material. As it was stated in the conceptual framework, the main requirements for the training materials are to be inexpensive, available, and linked to the current engineering tasks. Based on that idea, the stakeholders decided that the main source of the training materials could be **Equipment manufacturers’ manuals and handbooks**. Since there are relatively few highly accomplished equipment manufacturers on the market that are familiar to both informants, the process of selecting the relevant training material could be challenging. On the other hand, the low variety of the equipment types and requirements from one vendor to another allows for gathering sufficient scope of information for the understanding of common principles.

In addition to that, both informants mentioned such possible sources of training materials as specific **industry international standards (IEC, EN)** and **relevant technical literature and guides**.

Regarding industry international standards, it was emphasized that these documents provide a foundation for understanding the technical and safety requirements associated with Medium Voltage systems. Familiarity with these standards as well as with other electrical standards is a part of the engineer's competencies. However, during the Current State Analysis, it was noted that there is a minor competency and skill gap related to this topic in the team. Thereby, the standards would not only serve as the relevant source of training material for Medium Voltage systems but also could improve another skill gap identified separately.

Similarly, relevant technical literature and guides were recognized as important supplementary resources. These materials, including textbooks, application guides, and engineering handbooks, usually offer a deep explanation of principles and design approaches for Medium Voltage systems. It was agreed that using such literature would help link theoretical concepts to practical engineering applications.

5.2.3 Identification of Training Practice

The discussion was continued with the stakeholders' suggestions about the practice that shall be included in the training. It was described to the informants that practice shall be meaningful to them, be relevant to the identified learning objectives, and also be combined with examples.

Visiting live industrial Medium Voltage installations was proposed as the main available option for the practical part. Informant 2 recommended considering a visit to the recently constructed plant involved the installation of Medium Voltage equipment as follows:

> It would be very good for anyone to visit it there. Then we would go there and ask anything from the maintenance crew. I think it would give us quite a lot of extra info

It was discussed that logically, this kind of activity related to the practice would be more useful for learning if it was arranged after the theoretical part. Then, potentially, a learner might have more specific questions for the local personnel responsible for the maintenance and service of the existing Medium Voltage system. That will help a learner to clarify some topics not covered by information gained from the training materials.

Another option for practice is already available in the team. It was supposed by both informants that **Simulations and calculations in the software tool "Neplan"** could be used as an effective method to apply the new skills gained from the theory, allowing engineers to model a Medium Voltage system, test different protection settings, and analyse fault conditions in a controlled and risk-free environment.

Additionally, Informant 2 mentioned that the Metso company collects so-called "Lessons learned" after and during each project. Practically, these are the Word and PowerPoint files stored on the company network drive. Each of these files includes summaries of technical challenges encountered in the previous and current projects, as well as solutions implemented there. These files may also include recommendations for future projects, and insights into best practices or areas for improvement, providing a valuable internal knowledge base for continuous learning and skill development. Therefore, arranging the review of the relevant **Company's case studies** was agreed as a part of the practical module of the training program. By discussing the real case studies in the workshops, the trainees may have an opportunity to share their thoughts and ideas on how the Medium Voltage systems could be improved and what critical issues could be avoided in a particular project.

5.2.4 Identification of Learning Outcomes

Finally, the discussion was completed by the identification of learning outcomes of the training program. According to the conceptual framework, the learning outcomes must define the expected benefits and effectiveness of the training program; they should directly relate to the competencies required for successful job performance; they should be relevant, discriminative, and practically applicable.

After the learning objectives were identified at the beginning of the workshop, it became clear to both informants what was expected from them to define the relative learning outcomes. This preparation helped ensure that the outcomes remained focused on the real tasks and challenges faced by electrical engineers in their daily work.

By linking the learning outcomes to objectives, the informants first discussed that after the training, learners shall be able to make informed decisions based on technical requirements, confidently choose the appropriate equipment, and assess its suitability for the project. Applying the principles proposed in the conceptual framework, the first learning outcome was formulated as **Ability to select, specify, and evaluate Medium Voltage equipment**.

Another required achievement for learners discussed by stakeholders was understanding the fundamental concepts of different types of protection in Medium Voltage systems. Practically, this means that after the training, learners must be able to design and implement proper protection schemes. Following the same principle as before, the second learning outcome was described as **Understanding protection and coordination principles**.

Finally, according to the third learning objective, learners must know how to confidently align design practices with legal and industry-specific standards, ensuring equipment and personnel safety. This target was described by informants as **Competence in mitigation of arc flash hazards according to safety standards**

It was confirmed during the discussion that all identified outcomes aligned closely with the practical requirements and competency expectations of electrical engineers. Furthermore, they provide a required basis for evaluating the effectiveness of the training, by focusing on the skills and knowledge that are important for doing the job successfully.

5.3 Summary of Preliminary Outline of the Training Program

The suggestions shared by the stakeholders in the workshop and described in the previous subsections were combined into the preliminary outline of the training program visualized in Figure 18 below.

Program Title:
Knowledge of Medium Voltage systems

Target Audience:
Electrical Engineers

Learning Objectives:
1. Select and specify Medium Voltage equipment (switchgear, circuit breakers, protective relays, etc.) based on project needs
2. Configure protective relay settings and design a protection coordination scheme
3. Demonstrate the ability to mitigate arc flash hazards

Training Materials:
1. Equipment manufacturers' manuals and handbooks
2. Industry international standards (IEC, EN)
3. Relevant technical literature and guides

Training Practice:
1. Simulations and calculations in the software tool "Neplan"
2. Visiting live industrial Medium Voltage installations
3. Company's case studies

Learning Outcomes:
1. Ability to select, specify and evaluate Medium Voltage equipment
2. Understanding protection and coordination principles
3. Competence in mitigation of arc flash hazards according to safety standards

Figure 18. Preliminary Outline of the Training Program

As shown in Figure 18, the preliminary outline of the training plan consists of four main elements following the conceptual framework: Learning Objectives, Training Materials, Training Practice, and Learning Outcomes. Each of these main elements includes the three items described and identified by the stakeholders. The training program Title and Target Audience were also added at the top for better clarity and general understanding.

Since the target stakeholders provided suggestions for creating only a preliminary outline, further validation was required. The next chapter discusses the relevant feedback received from the decision-maker, which enabled the completion of the final outline of the training program.

6 Feedback on the Proposed Outline of the Training Program

This chapter provides feedback and validation from the decision-maker on the proposed preliminary outline of the training program. The first section discusses an overview of this stage. The next section explains the comments received during this stage. The last section presents the final outline of the training program created according to the received comments.

6.1 Overview of the Validation Stage

The validation was carried out by getting recommendations and feedback from the decision-maker, the Director of EIA. The same stakeholder took part in the interviews conducted in the Current State Analysis as Informant 3.

The stakeholder was invited to a one-to-one interview, where the current study was presented from the beginning in a presentation view, including the findings of the Current State Analysis, the conceptual framework, and the preliminary outline of the training program. The general feedback received from the decision-maker was positive, and it was stated by the stakeholder that there was no need for any improvement of the initial proposal. However, the necessity and importance of the detailed feedback in the validation stage were discussed with the stakeholder. As a result, the stakeholder mentioned that additional time for a deeper review of the presentation should be given. Thus, one week later, an additional one-to-one interview was arranged with the same stakeholder, where the preliminary outline of the training program was discussed with the purpose of receiving more detailed recommendations and comments. Based on these comments the initial proposal was updated and formed into the final outline of the training program.

6.2 Findings of Data Collection III

The second interview with the decision-maker was more productive and insightful. The positive feedback was repeated at the beginning, strengthening the fact that the thesis topic was considered important and valuable for the team. The decision-maker stated that the implementation of the proposed training program is indeed necessary and should be prioritized in the near future. Most of the key elements of the preliminary outline of the training program co-created with stakeholders and shown in Figure 16 were approved by the decision-maker. However, certain modifications were required to align the training program with the company's needs and the decision-maker's expectations. The summary of comments and recommendations received from the stakeholders is presented below in Table 3.

Table 3. The decision-maker's suggestions on the preliminary outline of the training program

Category of the initial proposal	**Suggestions from the decision-maker**
General	Change the training program outline design to the table format
General	Add a short description to each item of the training program outline
Learning Objectives	To better align the training program with the company's strategy please replace Learning Objective 3 with another one: *Electric furnace transformer size calculation*
Learning Outcomes	Accordingly, update Learning Outcome 3 with a new one: *Competence in the calculation of the proper transformer size for an electric furnace*

As shown in Table 3, the two first comments from the decision-maker were related to the overall structure and design of the training program. It was suggested that converting the training outline into the table format may improve the readability and provide opportunities for easier editing in the future. Additionally, recommendations to include brief descriptions for each key component of the training program should help to improve the clarity of the program and ensure that all stakeholders involved in the training can better understand the purpose and content of the training program.

During the discussion, it was mentioned by the stakeholder that the company started being focus more on projects that involved electric furnaces due to the tightening of environmental regulations. In such projects, the scope of work for electrical engineers is usually limited by calculating and selecting the proper size of a specific type of transformer to supply an electric furnace. Providing learning for electrical engineers on how to do those calculations and how to apply them in practice was considered by the decision-maker as the top high priority. Following this discussion, it was agreed to replace Learning Objective 3 "*Demonstrate the ability to mitigate arc flash hazards*" defined earlier by electrical engineers with "*Electric furnace transformer size calculation*" suggested by the decision-maker. Following the principles of the conceptual framework, the learning outcomes should be directly linked to the corresponding learning objectives. Ensuring the matching of objective and outcome, it was requested by the decision-maker to update Learning Outcome 3 accordingly to "*Competence in the calculation of the proper transformer size for an electric furnace*".

6.3 Final Outline of the Training Program

Based on the comments, recommendations, and other feedback described in the previous section, the final outline of the training program was created as presented in Table 4 below.

Table 4. The Final Outline of the Training Program

Knowledge of Medium Voltage Systems for Electrical Engineers		
№	**Learning Objective**	**Description**
1	Select and specify Medium Voltage equipment (switchgear, circuit breakers, protective relays, etc.) based on the project needs	• Learn how to select equipment according to voltage ratings, current capacity, fault levels, and environmental conditions • Learn how to create detailed equipment specifications
2	Configure protective relay settings and design a protection coordination scheme	• Study the different types of faults in Medium Voltage networks • Learn how to calculate the correct relay settings to protect different types of equipment • Learning protection zones and fundamental principles of selectivity
3	Electric furnace transformer size calculation	• Study basic principles of electric furnace operation • Learn how to determine the appropriate transformer size based on electric furnace power requirements and operational parameters

№	Training Material	Description
1	Equipment manufacturers' manuals and handbooks	• Support trainees with technical requirements and instructions from major manufacturers to ensure proper selection, installation, and use of Medium Voltage equipment
2	Industry international standards (IEC, EN)	• Help trainees study standards' requirements and apply them in engineering practices
3	Relevant technical literature and guides	• Support trainees with an understanding of methods, calculations, and best practices

№	Training Practice	Description
1	Simulations and calculations in the software tool “Neplan”	• Modeling and analyzing Medium Voltage networks • Perform calculations to understand how the system performs under different operating conditions
2	Visiting live industrial Medium Voltage installations	• Observing real-world equipment in operation and understanding practical aspects
3	Company’s case studies	• Learn from real project experiences in a group by discussing engineering challenges and suggesting how to improve practical problems

№	Learning Outcome	Description
1	Ability to select, specify, and evaluate Medium Voltage equipment	• Help to measure and evaluate how well learners can choose and justify appropriate MV equipment based on the project requirements
2	Understanding of protection and coordination principles	• Help to measure and evaluate the learner’s ability to apply protection criteria of equipment in medium voltage networks, including proper coordination for safe and reliable system operation
3	Competence in the calculation of the proper transformer size for an electric furnace	• Help to measure and evaluate the accuracy and correctness of transformer sizing based on furnace load and operational parameters

As seen in Table 4, the comments and recommendations were incorporated into the final outline of the training program. The updated learning objective and outcome were highlighted in red colour. The applied table format improved the visual outline of the training program. Short descriptions were formed in order to clarify each component's purpose and role in the training process.

The validation of the initial recommendations from the stakeholders was done according to the planned research design of this study. The next chapter summarizes the study.

7 Discussion and Conclusions

The previous chapter discusses the validation of the initial proposal and the creation of the final outline of the training program. This chapter summarizes the findings of the thesis. It starts with the Executive summary, continues with Practical next-step recommendations for implementing the proposed training program, and finally ends with Thesis evaluation and Closing words.

7.1 Executive Summary

Timely training for employees focusing on the most critical skill gaps has a positive impact on the overall productivity of not only the employees but the whole team. However, companies can often overlook this fact. During several projects, it was observed in Metso that electrical engineers quite often cannot properly perform their engineering tasks due to many skill gaps. Since the business challenge was that lack of these important skills leads to project delays, increased costs due to exceeding the expected man-hours, or outsourcing these tasks to external engineers, the objective of this study was to create an outline of the training program for electrical engineers. Accordingly, the outcome of the study was the outline of the training program for electrical engineers in the EIA team responsible for metal refining projects.

The applied action research was selected for this study as the most appropriate approach since the study was focused on the existing real-business problem in the specific team of the specific company, providing a clear framework for deeply understanding complex issues within a specific organizational context. The study included four stages divided into gates according to the GATE model.

Applied action research emphasizes collaboration with different stakeholders, which is essential for the development of an effective training program. Electrical engineers from different teams, as well as the decision-maker, were involved in the training program design process. Conducted interviews and workshops with the electrical engineers, as well as taking validation feedback from the Director of EIA, ensured that the program was practical, relevant, and aligned with professional requirements.

This study utilized qualitative research methods for data collection. Interviews and workshops with key stakeholders, together with the review of the relevant company's existing internal documentation, were chosen as the primary data sources. Therefore, three of the four gates of the study included the data collection stages.

During the first data collection, the current state analysis was arranged inside the studied team. Practically, that meant conducting a needs assessment for the training including identifying the current skills and competencies available in the team, as well as defining the minor and major skill gaps with the subsequent selection of the most major skill gap. First, the essential skills required for the daily work of electrical engineers were identified with the key stakeholders in the interviews. Based on the list of essential skills, in the same interviews, the stakeholders discussed which skills were available, and where they noticed the lack of competencies. The data collected in interviews was categorized into four big groups and linked to the main accountabilities of electrical engineers in the company. The lack of knowledge in Medium Voltage systems, identified by two different informants belonging to different levels (managerial and engineering) in the company, was selected as the major skill gap that requires further improvement.

In the next stage, the relevant literature was studied to gain the necessary theoretical knowledge and practical guides on the creation process of a training program. The findings from that stage were formed into the conceptual framework for the training program design.

In the third stage, data gathered in the current state analysis alongside the conceptual framework allowed the co-creation of the preliminary outline of the training program. This stage included the second data collection, performed by conducting the common workshop with two electrical engineers from the studied team. During the workshop, the stakeholders defined the components of the training program according to the conceptual framework. As a result, the preliminary outline of the training program was developed including all the valuable suggestions received from the electrical engineers.

The final stage included the validation process from the Director of EIA. Two rounds of interviews were conducted with the decision-maker to gather the relevant comments and recommendations in addition to positive feedback. During the first interview, the slides of the study were presented to the decision-maker describing the whole design process of the training program, including the conceptual framework and findings from the previous data collection stages. In the second interview, the relevant comments and recommendations were received allowing to form the final outline of the training program with a focus on improving the knowledge of Medium Voltage systems.

7.2 Practical Next-step Recommendations

The training program was designed according to the conceptual framework based on the ADDIE model. However, only the first three steps (Analysis, Design, and Development) were partly covered in the study, while the last two steps (Implementation and Evaluation) were completely excluded from the study due to time limitations.

Therefore, the following list presents the steps recommended for the management to consider before starting to implement the training program in the company:

- Define the owner of the training program
- Estimate the budget
- Set the deadline for the training
- Select training method
- Consider outsourcing some training activities
- Start the pilot training for one of the engineers
- Select evaluation methods
- Collect the feedback
- Modify the training program according to the evaluation results and feedback

There will be possible challenges during the training program implementation, including resistance from different stakeholders. The goal of management is to lead that process in a way that employees accept and support the process, and their resistance is minimized. The Director of EIA should clearly translate the learning outcome to not only the electrical engineer but also to all involved stakeholders to avoid any kind of misunderstanding.

7.3 Thesis Evaluation

The evaluation of the study is based on the discussion of its validity, credibility, reliability, and relevance.

7.3.1 Validity

According to William (2024), validity refers to how well a study captures or represents the concepts it is claimed to measure. (William, 2024). In the context of this study, the outcome was “To create an outline of the training program”, which completely corresponds not only with its objective “The outline of the training program”. The more important fact is it is aligned with the final result of the study ensuring that the study remains focused on its intended purpose.

7.3.2 Credibility

Stenfors et al. (2020) state research can be considered credible if the selected methodology is clearly explained and well justified. Additionally, the data collection methods and the amount of data gathered should be appropriate for the chosen methodology. (Stenfors et al., 2020). The current study used data triangulation meaning the collection of data in three different stages from the relevant stakeholders with different roles (the director of EIA and the electrical engineers from different teams) following the qualitative methods in one-to-one interviews and common workshop. The number of questions prepared for interviews was sufficient to identify all the current skills and skill gaps inside the team. The data collected from the current state analysis and initial recommendations from the key stakeholders together with the knowledge gained from the relevant literature was sufficient to form and validate the final outline of the training program. All in all, the applied practices ensured a high level of credibility for the study.

7.3.3 Reliability

According to William (2024), reliability means the degree to which a research study has consistent and stable results over time and under similar conditions. (William, 2024). Applying the GATE model throughout the study ensured that findings from all the data collection stages were stable and accurate. The research design provided a structured approach to data collecting, that helped to minimize the risk of gathering unnecessary data.

7.3.4 Relevance

Toffel (2016) describes the meaning of “relevant research” in two ways: Relevant research should provide outcomes that are meaningful to managers. Relevant research should clearly communicate implications that motivate practitioners to take action based on the results. (Toffel, 2016). The topic of the study came from an idea conceived before the work on the study began. After several observations during several months in a real working environment, it was decided to not only start studying it deeper but also to provide a practical solution, that supports improvement of the identified issue. The topic was greeted with enthusiasm and accepted by the decision-maker from the beginning. All meetings with the decision-maker and other stakeholders were laced with positive feedback. Finally, at the last meeting, it was confirmed that further implementation of the training program is already planned, and all the necessary next steps will be discussed and considered in the short term.

7.4 Closing Words

Developing the knowledge of Medium Voltage systems by implementing the training will help the company to improve the electrical engineer’s efficiency, decrease the outsourcing of the relevant tasks to external engineers, and avoid potential mistakes in the design of Medium Voltage equipment.

The study provides the training program customized according to the existing major skill gap of electrical engineers in the studied Metso team. Moreover, conducting additional needs assessments and following the principles of the proposed conceptual framework will enable the possibility of identifying and improving other minor and critical skill gaps of employees. Therefore, the structured approach applied by the study provides a clear road map for the further development of different engineering disciplines and teams of the company.

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Appendices

Current State Analysis Interview Questions to Electrical Engineers

	Question	Interviewee response
1	How long have you been working at Metso?	
2	What is your educational background?	
3	What are the main tasks you perform in your daily work?	
4	What software/tools do you use for your work?	
5	Do you have to work with some equipment, for example, during FAT testing / commissioning activities?	
6	How often do your tasks change depending on the project?	
7	Can you describe the essential skills and technical competencies required to perform your role successfully?	
8	How would you evaluate your current professional skills for handling your current work tasks? What are your strengths and weaknesses?	
9	Do you face difficulties completing tasks due to a lack of certain knowledge or skills?	
10	Do you have access to any resources that help you maintain your knowledge, such as technical documentation or internal knowledge bases?	
11	Are there tasks in your work that require more time or effort due to complexity or lack of knowledge/experience?	

12	Are there situations where you have to seek help from colleagues due to a lack of knowledge or skills?	
13	How did you get the skills you use in your work (from past experience, education, trainings etc)?	
14	What aspects of your current job help you maintain or develop your skills?	
15	How do you evaluate the overall level of professional skills in our team (Electrical Engineers at Metso Metals)?	
16	How well do you think our team handles solving complex and challenging technical tasks in current and past projects?	

Current State Analysis Interview Questions to Director of EIA

	Question	Interviewee response
1	What are the key priorities for the electrical engineers in achieving organizational goals?	
2	Are there any recent changes in organizational strategy that have impacted the expectations for the electrical engineers? We have had this reorganization recently and of course, we now combine our business lines, maybe it was also somehow mentioned that there are some new expectations from us?	
3	How would you evaluate the current level of skills and competencies within electrical engineers?	
4	Are there specific skill gaps that you believe are hindering the team's performance?	
5	Have you observed any repeating challenges or inefficiencies that could be linked to a lack of specific skills or knowledge?	
6	How do these skill gaps affect the team's ability to meet deadlines, maintain quality, or handle complex tasks?	
7	Have you been in a situation when you had to request support from external teams/subcontractors due to a lack of skills and knowledge in our electrical team?	
8	How would you describe the role of employee development at the moment?	
10	Are there any existing programs or initiatives for upskilling electrical engineers?	

11	Are there any challenges in implementing training programs within the team?	
12	What are the expectations of internal and external stakeholders regarding the performance and capabilities of electrical engineers?	
13	Are there any stakeholder concerns or complaints about the engineering team's capabilities?	
14	What factors influence decisions about allocating resources for training or skill development programs?	
15	What outcomes would you consider critical for evaluating the success of a training program for electrical engineers?	
16	How do budget constraints impact decisions about training or professional development opportunities?	
17	Looking ahead, what skills or competencies do you foresee becoming increasingly important for electrical engineers?	
18	How do you see the skill development of electrical engineers aligning with the long-term strategy of the organization?	