

IO 6: Guidelines for successful cooperation between learning venues in the use of workplace-oriented learning projects

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1. Foreword

In the VACIDE project, the customer order "Production and delivery of a training robot" was implemented in three European regions by four network partners across the country. With the work on IO 6, prerequisites and conditions for success for the cooperation of the learning locations through the use of workplace-oriented learning projects were identified and described.

This guideline sheds light on the role of learning location cooperation for the quality of vocational education and training, provides theoretical introductions to cross-learning training projects, explains the VACIDE approach, documents the cooperation of the learning locations in VACIDE, names

success factors and also includes the results of the evaluation.

The guideline is presented as an innovation of VACIDE in relation to the cooperation between learning venues in the occupational fields of metal and electrical engineering as well as in commercial-administrative professions. At the same time, it should enable a transfer of experience to other applications.

The guideline as a result of IO 6 was developed by the partner GEBIFO and supported by the other project partners by providing access to relevant addressees for surveys, especially trainees/learners and trainers/trainers, as well as by providing the results of the work-oriented learning projects and digital learning sequences.

In order to complete tasks in IO 6, the following work steps were implemented by the project partner GEBIFO during the VACIDE project period:

- Conception of the guideline,
- Research on the framework conditions relevant to the occupational fields in the participating regions,
- Development of a grid for the questioning of selected relevant actors and observation criteria for observations of test situations,
- Survey and interviews in the project team on the impact of the learning projects and the digital learning sequences,
- Survey and interviews of teachers/trainers on the impact of the learning projects and the digital learning sequences at the learning locations in the project,
- Survey and interviews of the learners/trainees on the impact of the learning projects and the digital learning sequences at the learning locations in the project,
- Observation of the learning process with the work process-oriented learning projects and the digital sequences at different learning locations (observations),
- Evaluation of interviews, surveys and observations,
- Implementation of LTTA 5 for cross-learning cooperation.

2. Role of cooperation between learning venues for the quality of vocational education and training

Cooperation between learning venues in vocational training plays an important role in ensuring practical and high-quality training for young people. The demand for up-to-date training, which imparts comprehensive competencies and includes independent planning as well as the execution and control of work tasks, has comprehensively changed vocational training practice. The boundaries between theory teaching and training practice are becoming more permeable and this has an impact

on the cooperation between in-company training and vocational school. A well-organized cooperation between learning venues can help to combine theoretical and practical learning. In Germany, for example, initial vocational training usually takes place in the dual system, i.e. trainees learn both in companies and in vocational schools. This cooperation between the places of learning has several objectives and characteristics:

- 1. Practical relevance:** The in-company training enables trainees to gain practical experience in their chosen professional field. You will work directly in companies and learn the specific skills and knowledge that are needed in the world of work.
- 2. Theoretical foundation:** School education in vocational schools complements practical experience with theoretical knowledge. Here, general basics and job-specific content are taught, which are necessary for the exercise of the profession.
- 3. Cooperation between the learning locations:** The cooperation between the companies and the vocational schools is crucial to ensure that the training content in both learning locations is coordinated. This is done, among other things, through curricula and communication between teachers and trainers.
- 4. Training support:** The trainees are accompanied and supervised throughout their entire training period. This makes it possible to identify problems at an early stage and find solutions.
- 5. Final exam:** At the end of the training, trainees take a final exam that includes both practical and theoretical elements. This examination is organised and carried out by the Chambers of Commerce and Industry or the Chambers of Crafts.

Dual training in Germany is often seen as a model of success, as it ensures that trainees have both practical skills and theoretical knowledge. Close cooperation between learning venues and quality assurance through examinations are key factors in the success of this system. In addition, the cooperation between the learning venues helps to continuously improve training and adapt it to the requirements of the changing labour market.

In addition, inter-company training centres and training centres play an important role in vocational education and training and cooperation between learning venues. These educational institutions are specialised schools or training centres that are not directly linked to a company, but are usually operated by public or private institutions. They make a major contribution to ensuring that training is not only company-specific, but also job-specific. The inter-company vocational training centres serve to supplement in-company training. The main functions and roles of inter-company training centres and training centres can be summarised as follows:

- 1. Supplementation of in-company training:** Inter-company training centres complement in-company training by imparting special skills and knowledge that may not be sufficiently imparted in the training companies.
- 2. Teaching basics:** They provide a solid theoretical training that serves as a basis for practical work in the companies. This includes, for example, technical basics.
- 3. Standardisation and quality assurance:** Inter-company training centres contribute to the standardisation of training by ensuring that all trainees acquire the same basic skills and knowledge in a given occupational field. This is important for quality assurance in vocational education and training.
- 4. Flexibility and access to resources:** They allow for flexible use of resources, as they can bring together different companies and trainees. This is especially useful in industries where small businesses may not have the infrastructure or resources to provide comprehensive training.
- 5. Supplement to vocational school:** Inter-company training centres complement vocational school training by imparting specific vocational qualifications. They are part of the learning location cooperation and work closely with the companies and the vocational schools to ensure that the training content is well coordinated.

In the cooperation between learning venues, inter-company training centres ensure that trainees receive both practical experience and theoretical knowledge. They help to improve the quality of vocational education and training and better prepare trainees for the demands of the labour market. Close cooperation between the various learning locations - companies, vocational schools and inter-company training centres - is crucial to ensure holistic and practical training.

However, there are different system-specific framework conditions and goals between the individual learning locations, which must be taken into account in a successful cooperation. While in-company training is characterized by business considerations and the framework conditions of the manufacturing process, the vocational school focuses on the theoretical part of the training as well as the teaching of general learning content and reflection on work and profession. The establishment of a sustainable cooperation is a long-term and step-by-step process that requires a great deal of initiative, tact and patience on the part of the actors.

Status quo of learning location cooperation

Cooperation between places of learning can occur in different levels of intensity and forms:

- Communication
- Coordination
- Cooperation and
- Collaboration.

In many cases, the company, vocational school and inter-company training centre still operate side by side largely without overlapping. The status quo of learning location cooperation is largely limited to communication and coordination. The reality in educational practice is a low intensity and limited scope of lived cooperation between learning venues. Trainees also often experience cooperation as not very pronounced. Occasions of contact between the learning venues are limited to questions of organization and disciplinary problems:

- event-related exchange on the performance of the trainees or on specific problems,
- Coordination of the time/content of the company's learning content with the teaching/schedule of the vocational schools,
- mutual insight into teaching/learning materials,
- formally organised regular exchanges within the framework of trainer-teacher meetings, advisory board meetings or participation in examination committees.

Cooperation and collaboration as forms of cooperation as places of learning are not widespread in educational practice. In VACIDE, therefore, the approach of cross-learning location training projects was taken into account in order to further strengthen cooperation and collaboration as forms of learning location cooperation.

3. Strengthen cooperation through the use of cross-learning location training projects

In the following, the focus is on learning projects in order to show a possible pedagogical approach on how learning location cooperation can be strengthened. The implementation of cross-learning location projects is a suitable approach to better interlink learning venues on a methodological-didactic level and to expand cooperation and collaboration as forms of learning location cooperation. In learning projects, trainees from different disciplines work together in the development, production and distribution of a product, across learning locations. In the VACIDE model, a learning project was developed and implemented across institutions and countries (see Section 4.1).

3.1 What are training projects?

The aim of training processes is to enable trainees to act independently. In particular, independent thinking, information and decision-making processes have a positive effect on the development of trainees' professional competence. This can be supported with the help of learning projects in training.

Learning projects are an instrument for developing the skills of trainees. This is a work-oriented form of learning that focuses on independent approach and development.

Working and learning take place directly through the processing of real operational tasks and/or customer orders. The aim is for the learners to acquire the skills needed to cope with the company's work tasks through the self-controlled and project-based processing of operational tasks. For this purpose, they receive a specific task from their field of activity. Depending on the area of work and tasks, very specific learning tasks can be set.

The processing of the learning assignment is carried out independently by the trainees. Thus, the independent learning of the trainees is coupled with the practical implementation. The trainees plan their work steps, carry them out and control the quality of their work independently. This means that they take responsibility for their learning assignment and thus for their own training (the trainee as the person responsible for the quality of the training).

3.2 How is a learning project created?

For the creation of learning projects, suitable tasks are selected from the workplace-related range of tasks. Above all, it makes sense to convert customer orders into learning projects. Recurring standard orders are particularly suitable, as they can be used again and again. The following checklist helps to check sales orders in terms of their suitability as a learning project:

Checklist for the suitability of a sales order as a learning assignment		
Does the assignment contain enough work typical of the profession?	The amount of work is not worth it if the assignment contains very little relevant training content. The more relevant training content a customer order contains, the more suitable it is for training purposes.	<input type="checkbox"/>
Is it an (exemplary) standard order?	The development effort for a learning project is particularly effective if it can be used often (possibly in parts or slight modifications).	<input type="checkbox"/>
Is there enough lead time for planning?	In particular, you should choose those assignments that allow enough time to prepare and create the learning project.	<input type="checkbox"/>
Is the assignment to be carried out independently and on time by the trainee?	The possibly lower pace of work of a trainee should be taken into account. In addition, there are the downtimes due to the vocational school, the additional time for information gathering and evaluation by the trainee and, if necessary, for practical instructions by the training staff.	<input type="checkbox"/>
Are the quality standards required in the assignment to be met by the trainee?	In order to avoid over- and under-challenging the trainees, the trainee's level of training should be taken into account when deciding whether the assignment is suitable as a learning project. Furthermore, care should be taken to ensure that the customer order (or work task) is not associated with a high risk of accidents and that the work contains many activities that are susceptible to damage.	<input type="checkbox"/>

In order to convert a customer order into a workplace-oriented learning assignment, the following steps can be followed:¹

From a customer assignment to a workplace-oriented learning assignment

¹ See, inter alia, Federal Institute for Vocational Education and Training (ed.). Training with learning assignments.

1. Select a sales order or work item.
2. Break down the work item or sales order into subtasks and individual activities.
3. Assign the activities to the knowledge and skills required in the training plan.
4. Compare the knowledge and skills with the level of training of the trainees.
5. Select a subtask that corresponds to the trainees' level of training.
6. Formulate the scenario of action.
7. Provide necessary work aids (guiding texts, written instructions, sketches, technical drawings, etc.). Include only the most necessary information material. Instead, point out other information options to encourage trainees to obtain information independently.

The learning project is formulated by the training staff and fixed in writing. In addition to the formulation of the tasks, it contains further information (depending on the level of training of the trainees in varying intensity) on

- clarifying questions,
- the desired results,
- overarching objectives,
- Reference to the training regulations,
- if applicable, further sources of information.

Further criteria for the conception of a learning assignment can be summarized below:

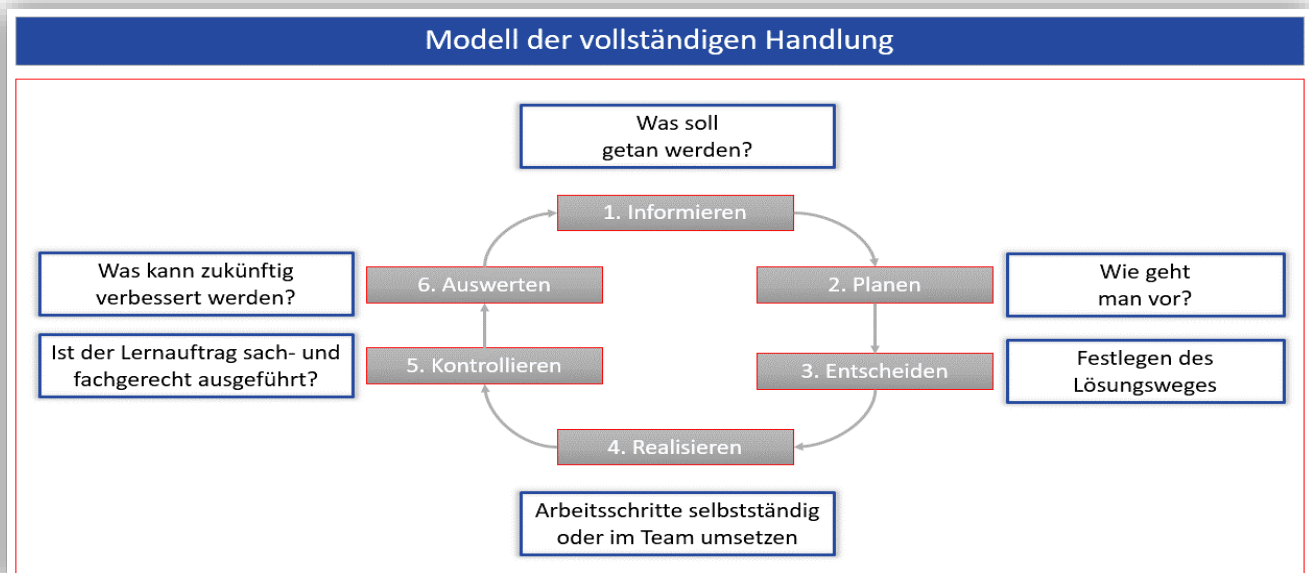
Criteria for the conception and implementation of learning projects

- The learning project promotes independent action and active learning.
- Different areas of learning are addressed: knowledge, skills, attitudes (head, hand, heart). Corresponding learning objectives have been formulated.
- The assignment refers to sources of information instead of attaching comprehensive information material.
- Knowledge and skills of the corresponding job description are linked to the learning project.
- The processing of the learning project follows the model of the complete action.
- Training staff are available to advise on the work in their role as learning process facilitators.

3.3 How are learning projects worked on?

The trainees work on the learning project according to the six-step method or .dem the model of the complete action. The model consists of the following sub-steps:

The processing of the learning assignment according to the model of the complete action enables



the trainees to learn in a self-directed manner. The individual steps are accompanied by processing instructions below:

Preparation of a learning project according to the model of the complete plot	
Inform	<ul style="list-style-type: none"> • The learning assignment and, if necessary, other important information and materials are handed over to the trainee and explained. The training staff ensures that the learning assignment has been understood by the trainee. • The trainees deal with the task. They clarify the following questions: <ul style="list-style-type: none"> ○ What? ○ When? ○ Where? ○ Wherewith? ○ How? ○ For what? ○ For whom? • The familiarization with the topic complex takes place independently. • If necessary, the trainees obtain additional information using various media (e.g. PC/Internet, textbooks, worksheets, YouTube videos, explanatory films).
Plan	<ul style="list-style-type: none"> • The trainees develop concepts independently (or in a group) to solve the task. • Trainers support the trainees in brainstorming (but: do not prescribe solutions to problems). • Trainees draw up a work plan (see 3.4.2). The work plan sets out the procedure for completing the learning project (expected work steps, planned time expenditure, etc.). • The trainees define their own control criteria.
Decide	<ul style="list-style-type: none"> • The trainees make a decision on a solution. • The proposed solution and the intended way of carrying out the order is presented by the trainee.

<p>Implement</p>	<ul style="list-style-type: none"> • The trainees carry out the work steps independently. • Trainers are on hand to provide advice with their specialist knowledge. • Completed work steps are documented, e.g. date, process, remarks (see 3.4.3). • In the case of a special project, the intermediate status of the work can be presented by the trainees. • In principle, the trainees should have sufficient time and freedom to process the order.
<p>Check</p>	<ul style="list-style-type: none"> • The trainees use their self-imposed test criteria to check the result.
<p>Evaluate</p>	<ul style="list-style-type: none"> • The result of the work and the course of the project are presented by the trainee. • The evaluation of the learning assignment and the result takes place by the trainee himself and by the trainers in a final discussion (see 3.4.4 and 3.4.5). • The evaluation by the trainee can be carried out by means of a self-assessment according to the following criteria: <ul style="list-style-type: none"> ○ How did I cope with the learning project? ○ Which subtasks did not cause me any problems? ○ What difficulties did I have? • The evaluation by the trainers can be carried out, for example, according to the following criteria: <ul style="list-style-type: none"> ○ Independence in processing ○ Confidence in the application of knowledge ○ Quality of the work result ○ Mastery of working techniques ○ Use of work equipment ○ Time exposure ○ Compliance with health and safety at work ○ Handling of working documents

3.4 Work aids and tools

Below you will find a list of various tools and tools for creating and editing learning projects:

- Key questions for trainees on how to work on learning projects
- Order of Work Plan Form
- Form Documentation Learning Project
- Key questions for self-assessment for trainees
- Evaluation form

3.4.1 Key questions for trainees to work on learning projects

Phase 1: Inform – What should be done? What do I need to know?

- What result is expected and by when?
- What conditions must be met?
- Can I solve the task with known information? What information am I missing? How can I get them?

Phase 2: Planning – What are the solutions? How do I proceed?

- Are there different ways to solve the problem?
- Can the task be divided into subtasks? What's the timeline?
- What tools do I need?

Phase 3: Decide – Which approach do I choose?

- What solutions are available?
- What criteria are decisive for the decision?

Phase 4: Implementation – How is the plan implemented efficiently and comprehensibly?

- What do the individual sub-steps look like?
- What help can the trainer provide to support me?

Phase 5: Control – Have I solved the task according to the requirements?

- Do the test criteria prove to be correct and complete? Are improvements necessary?
- Will the discovered deficiencies be taken into account and avoided in another task?

Phase 6: Evaluate – How was it? What needs to be improved?

- What did I learn from this task? Where can I apply what I have learned in the future?
- What did I do well? What can I improve in the future?

3.4.2 Order of business plan form

Planning			
Start on:			
Done until:			
Job step	Process	Remarks/Tools/Aids	Estimated time required
1.			
2.			
3.			
...			
...			
...			

3.4.3 Form Documentation Learning Project

Documentation of the learning project				
Name:				
Task:				
Date	Job step	Process	Remarks/ Tools/Aids	Time exposure
	1.			
	2.			
	3.			
	...			
	...			
	...			

3.4.4 Guiding questions for self-assessment for trainees/apprentices

Are you satisfied with your work result?








What did you particularly like about working on the learning project?

What did you like less?

What should definitely be retained in the future use of the learning project?

In your opinion, what could be improved when using the learning project as part of the training?

3.4.5 Evaluation form

Evaluation form	
Name:	
Apprenticeship:	
Apprenticeship year:	
Task:	
Evaluation criteria <div style="display: flex; justify-content: space-around; align-items: flex-start; text-align: center;"> <div style="width: 18%;">  <p>Eine den Anforderungen in besonderem Maße entsprechende Leistung.</p> </div> <div style="width: 18%;">  <p>Eine den Anforderungen voll entsprechende Leistung.</p> </div> <div style="width: 18%;">  <p>Eine den Anforderungen im Allgemeinen entsprechende Leistung.</p> </div> <div style="width: 18%;">  <p>Eine Leistung, die zwar Mängel aufweist, aber im Ganzen den Anforderungen noch entspricht.</p> </div> <div style="width: 18%;">  <p>Eine Leistung, die den Anforderungen nicht entspricht.</p> </div> </div>	
Quality of the work result	
Remarks:	Stars: 
Use of work equipment	
Remarks:	Stars: 

Autonomy of processing	
Remarks:	Stars: 
Handling of working documents	
Remarks:	Stars: 
Confidence in the application of knowledge	
Remarks:	Stars: 
Compliance with health and safety at work	
Remarks:	Stars: 
Mastery of working techniques	
Remarks:	Stars: 
Time exposure	
Remarks:	Stars: 

4. Success factors in the VACIDE model for the design of a successful learning location cooperation

4.1 Explanation of the VACIDE model

The degree of automation and networking associated with the digital transformation places increasingly high demands on interdisciplinary and procedural understanding as well as on personal and methodological skills for trainees as prospective specialists. In order to meet these and other requirements of Economy 4.0, the VACIDE approach and the orientation towards holistic business processes were developed and tested as a solution approach for the design of learning location cooperation via work process-oriented learning projects.

VACIDE developed learning projects to promote workplace-oriented vocational learning in the context of the requirements of Economy 4.0 for metal, electrical and commercial-administrative professions. In the project, the customer order "Production and delivery of a training robot" was implemented in three European regions by four partners across countries.

The training robot, consisting of the assemblies housing and support structure (activities in the occupational field of metal) and electronic systems and controls (occupational field of electrical), was manufactured according to a (designed) customer order and supported by measures of procurement and stockpiling as well as marketing and sales (commercial-administrative professions).

The learning objective is the action-oriented acquisition of skills, knowledge and abilities in the respective training occupations in the fields of metal, electrical engineering and commercial-administrative professions. The learning projects developed in VACIDE are based on the model of the complete action. Part of the learning projects are digital learning sequences (IO 5) as well as further materials and vocational pedagogical information for trainers and teachers. The results of IO 2 – IO 4 are didactic documents for the processing of the "training robot" assignment with corresponding guiding texts for the implementation of the learning project as well as a corresponding teacher/trainer manual.

Summary of workprocess-oriented learning projects (IO 2 - IO 3 - IO 4)

The partner SC Skofja Loka implemented IO 2 with the development of the learning project "Production of the housing and support structure of a training robot consisting of base frame, carousel, swingarm and central hand" for the professional field of metal. The learning project describes the "outer shell" of the robot or instructs trainees in the metal profession to competently carry out this partial order for the manufacture and delivery of a training robot. With the learning project, the

trainees acquire specialist qualifications in the following areas of activity, among others:

- Manufacture of components,
- assembly and disassembly,
- Testing and handover,
- maintenance of components and assemblies,
- Business processes and quality assurance systems.

The network partner EUROCULTURA implemented IO 3 with the development of the learning project "Procurement and stockpiling, marketing and sales for the product training robots" for commercial-administrative professions. This learning project describes the operational support processes that are necessary to be able to manufacture the training robot with the appropriate materials without disruption, to deliver it to customers and to communicate with market participants and to competently execute this partial order for the production and delivery of a training robot. With the learning project, the trainees acquire specialist qualifications in the following areas of activity, among others:

- Business processes and markets,
- Information, communication, work organization,
- Order initiation and preparation,
- Order follow-up,
- Procurement and stockpiling.

VHS-Bildungswerk GmbH implemented IO4 with the development of the learning project "Installation, configuration and programming of electronic systems and controls of a training robot". This learning project describes the "inner workings" of the robot, its control and work programs or instructs trainees in the electrical profession to competently carry out this partial order for the production and delivery of a training robot. In the occupational field of electrical engineering, trainees acquire specialist qualifications in the following areas of activity, among others

- control programming,
- Manufacture of basic circuits,
- production of electronic and communication equipment,
- use of microprocessor-based devices,
- Design of automated systems.

4.2 Success factors

In the following, the experiences and findings from the development and testing of the learning projects developed in VACIDE are summarized, prepared in the form of ten success factors and supported by examples.

Success factor 1: Intensive coordination and pedagogical-didactic cooperation

The basis of the cooperation is the joint organizational and pedagogical-didactic cooperation of the (inter-)company training and school teaching staff. In VACIDE, cooperation and coordination took place both within and between the partner institutions.

For example, at the project partner Solski Center Skofja Loka from Slovenia, an interdisciplinary project group of teachers and learners from different educational programs was formed in the vocational school center. At the project partner EUROCULTURA from Italy, a working group of project staff and teachers from vocational training institutions was set up.

An intensive technical as well as methodological-didactic coordination took place between the partners, as the technical functionality has a significant share in the quality of the teaching/learning materials and thus in the success of the project. The robot arm was manufactured by the Slovenian and German partners in a process based on the division of labour. For this purpose, additive and subtractive processes were used, which are part of the training plans of metal and electrical professions in Slovenia as well as in Italy and Germany.

Success factor 2: Product with sufficient complexity for training requirements

Action-oriented learning arrangements are intended to create activating action situations for learners. Competence to act is only developed if learners actually act themselves, make experiences themselves, reflect on them and thereby develop further.

This requires complex tasks with a high degree of practical relevance. The learning conduciveness of tasks can be measured by whether the tasks allow complete action.

The product "robot" was chosen because it is sufficiently complex from a process perspective to map operational core and support processes. The production and assembly of components and assemblies of a robot as well as the associated procurement and sales tasks are part of the teaching and learning processes at the partners.

Since robots are part of the working environment of future specialists, there is also a motivating reference to the living environment.

Success factor 3: Action scenario as the focus of didactic planning

At the beginning of the project, a formative fundamental decision was made jointly by the partners: the description of an action scenario in order to derive work assignments for the learners in the sense of the business process orientation of vocational education and training. The scenario of the customer order became the action-triggering element in the project implementation and the focus of the didactic planning. On the basis of the customer order "Production and delivery of a training robot", an action scenario was developed by the respective partners as a basis for the learning project.

Example: Action scenario for the learning project "Installation, configuration and programming of electronic systems and controls of a training robot" for the occupational field of electrical engineering of the VHS-Bildungswerk GmbH (IO 4)

The training company ALU KG

ALU KG (340 employees) is a medium-sized company that has been successfully operating on the market for 35 years. Professional tools and equipment are developed, made ready for series production and distributed through a dealer network.

-Prologue-

The task of developing a robot arm with various gripping tools was initiated by the management of ALU KG in order to expand the product range and establish itself on the market of robotics and robotic tools.

Risk management determined that the robotic arms market posed too much risk; the uncontrollable development costs and the highly competitive sales market were the main arguments. The management reacted by breaking new ground, tendering the development of the robot arm as open source and, based on this, launching further market analyses with regard to gripping tools. The idea behind this is to save the development costs for a robot arm by using the know-how of the online community and to serve the self-generated market with its own developments of gripping tools.

Since universities, schools, independent educational institutions and private individuals are very interested in open source solutions for the robot arm for reasons of cost savings and better understanding through self-implementation (self-construction), the sales market for suitable gripping tools generates itself and is not subject to the rules of open source.

The choice of robotic arm solutions developed by the online community fell on a combination of two versions of the THOR robotic arm. This was chosen because of its wide range of applications, relatively low manufacturing and hardware costs, and its open source software. The online community also led to previously unimagined synergy effects: a factory specializing in additive and

subtractive machining (Loka Professional Production-LPP) in Slovenia and a company from Italy specializing in marketing (Eucur World Wide Marketing-EWWM) agreed to contribute their know-how. This circumstance appears to the management of ALU KG as a further guarantee that their considerations will lead to the desired success. In addition, the "level of awareness" of the companies involved will be increased, which may result in unexpected positive opportunities in the future.

The head of prototype construction at ALU KG received the order to produce five THOR within eight months and make them available to the head of the development department. This step turns the THOR into a training robot on which the possibilities of gripper developments can be tested and realized. The head of prototyping is skeptical about the open source solution. He decided to implement a robotic arm in the form of project work for the time being in order to have the opportunity to identify possible errors or improvements with project management tools.

Success factor 4: Self-organized learning and process orientation

The work process as a basis opens up many possibilities for the design of learning processes. Learning and work tasks can be identified directly from the work process and a real work situation (customer order), thus enabling self-organized or self-directed or even exploratory learning.

When working on the learning project, trainees acquire the necessary skills in "real work" by mastering work tasks independently in sometimes new, complex situations. When processing the customer order, learners are enabled to recognize their own learning and action needs, to set their own goals for action and to plan, implement and evaluate their own approaches to work and learning. They shape their own learning processes by selecting appropriate learning and working methods, reflecting on and controlling learning outcomes and processes. They learn from their experiences, sometimes also from mistakes they make in coping with the tasks. In addition to the acquisition of specialist qualifications, an additional understanding of processes is developed among the target groups by mapping business processes within the tasks in the learning projects. In this way, the target groups deal with the processes in the overall system of companies across activities and professions, guided by the learning projects, and acquire competence to act.

In VACIDE, trainees were supported in independently planning, executing and controlling their training-related work orders and in developing an understanding of the overall process by integrating them into the customer order "Production and delivery of a training robot". The understanding of the process is supported by the inclusion of digital sequences that map the activities and the working environment in the respective occupational fields (metal, electrical, commercial/administrative professions).

Success factor 5: Structuring the learning project

When creating materials for learning projects, attention should be paid to a clear structure. The VACIDE learning project is divided into the following sections, following the principle of complete action (informing, planning, deciding, executing, controlling, evaluating):

- Introduction to the task and reference to the training regulations in various professions,
- Presentation of the overall work process with naming of the respective parts of the training occupational profile,
- Presentation of the sub-work processes with the skills, knowledge and abilities to be acquired,
- Guiding text "Production of a training robot" with learning objectives, sources of information and tools, digital sequences, guiding questions and work tasks
- pedagogical information for trainers and teachers on the creation and use of learning projects and digital sequences, with methodological suggestions and information on information options.

According to this model, trained persons are able to carry out work processes independently in their professional lives; they acquire the competence to act. They are able to move independently in the professional fields of activity, to find their way independently in changed work situations, to familiarize themselves with new procedures that were not taught in the training.

Success factor 6: Formulation of a guiding text

In addition to the action scenario, the success factor for effective learning projects is, among other things, a clearly formulated guiding text to provide learners with guidance in finding independent solutions to a complex problem.

Example: Excerpt from the guiding text of the learning project "Installation, configuration and programming of electronic systems and controls of a training robot" for the occupational field of electrical engineering of the VHS-Bildungswerk GmbH (IO 4)

Welcome to our Thor robotic arm project.

Thor is a printable robotic arm that is open source and has six degrees of freedom. It was designed for use in robotics classes at universities and schools, which is why the design is affordable and the source file is freely accessible.

This project is intended to enable you to independently develop and execute complex manufacturing and assembly tasks. For this purpose, you should work out the stages of configuration, installation and programming together and independently in small learning groups. Your trainer takes on the role of a trainer, which is comparable to that of a consultant in a company. He/she will be at your

side to advise you while you independently search, implement and document solutions. As a team, you should:

1. look at the key questions together, draw up a work plan and submit it to the learning advisor for review;
2. answer the key questions in writing;
3. compare your solution with the control sheet and make an assessment of your solution (not in grades, but in a verbal description);
4. talk to the learning consultant about your solution;
5. Presentation of the results with a final feedback.

The technical knowledge you need to accomplish the tasks was imparted to you during your training. This knowledge must now be applied. You will find that your grown technical understanding is intuitively applicable to new technologies, such as 3D printing.

For answering the questions or for carrying out the work and assembly steps, you will be provided with a reasonable period of time and suitable sources.

In order to better understand and comprehend the working method in the project, there are introductory exercises. It is important that you formulate the answers yourself. A copy and paste is rated as "Unanswered".

Each part of the guide text is preceded by an overview with which you can document your learning success.

We wish you every success!

Information material, aids:

- Internet research on the topics of "robotics", "additive manufacturing"
- self-chosen literature
- digital learning sequences

Hint

Please do not begin the lead text without first reading the following:

This guiding text is structured in such a way that your information gathering, application tasks and control are linked. Therefore, it is necessary that the tasks are processed in the given order!

A guiding text is not "rigid", but can be used in relation to the company. From this it can be deduced that individual questions can be modified, supplemented or updated.

In the event that problems arise during the project work regarding the question or the processing, these should be discussed with the learning support. In general, however, the guiding text must be edited and checked independently.

Your results will then be evaluated together with your learning support.

The decisive factor for the success achieved is not to edit the leading text as error-free as possible, but to practice how to work out a given task independently and to learn from it.

Excerpt from the tasks of the guiding text for the learning project IO 4:

<p>Teil 1: Einführung</p> <p>In diesem ersten Teil geht es darum, einen ersten Einstieg in die Robotik zu gewinnen. Dabei liegt der Fokus auf den Gebieten: Robotik und Open Source. Diese Einführungsübungen dienen dazu, dass der gesamte Kurs auf einem gleichen Wissensstand ist und dass neues elementares Wissen über diese Gebiete angeeignet wird.</p> <p>1. Robotik</p> <p>Zeitvorgabe: 2 Stunden Aufgabenart: Einzelaufgabe Informationsquellen: Internet, Lernsequenz</p> <p>Aufgabenstellung</p> <p>Ihr Vorgesetzter, der Leiter des Prototypenbaus, ist weiterhin skeptisch bezüglich eines Roboters als Open Source-Lösung. Da Sie sich sehr für die Robotik interessieren, möchten Sie die Initiative ergreifen und ihre Auszubildendengruppe über das Thema Robotik aufklären. Sie setzen es sich als Ziel, alle von dem Projekt zu überzeugen, um als Team an der Entwicklung und Überprüfung der ausgewählten Version von Thor zu arbeiten. Nachfolgend finden Sie Fragen, die dabei helfen sollen. Nutzen Sie zur Beantwortung dieser Fragen ebenfalls das Einführungsvideo.</p> <p>1. Woher stammt der Begriff Roboter und was bedeutet er?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>2. Was ist „Robotik“?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>3. Was ist ein Industrieroboter?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>4. Wo können Roboter in der Industrie eingesetzt werden? Erläutern Sie dies und nennen Sie 3 spezielle Beispiele.</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>5. Wann ist eine Maschine ein Roboter? Erklären Sie dies genau und geben Sie 2 Beispiele.</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
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Success factor 7: Use of digital learning sequences

The workplace-oriented learning projects developed in VACIDE promote process orientation through cross-professional and cross-activity learning. This approach is supported by the digital learning sequences for the explanation of working environments and for the accompaniment of learning in the processing of the customer order "training robots" at different levels:

- With digital learning sequences in the form of videos, audio files, presentations and information in various open and closed formats, learners receive additional information and explanations that support them in working on the learning projects. The digital learning sequences are integrated into the learning projects, but can also be used on their own in other contexts, for example in career orientation.

- The occupational field-related learning sequences illustrate the specific activities as well as learning and working environments. This promotes an understanding of the processes in other contexts of action. The users of the learning sequences involved in the customer order are thus given the opportunity to better classify their own learning, their own work actions in the context of the upstream and downstream as well as supporting processes.
- By mapping work steps, learning situations and environments, it is possible to reflect on the learning process flexibly in terms of time and place in relation to the customer order.
- The possibility of documenting the personal work and learning progress or that of the learning group with their own digital devices promotes the media competence of the trainees.
- The media pedagogical competence of trainers/trainers and trainees/trainees is promoted.

Success factor 8: Empowerment of training staff

An important success factor for the use of learning projects to strengthen cooperation between learning venues is also the sensitization and support of training staff. As part of the LTTA activities in the VACIDE project and on the basis of their participation in the development of the "Training Robot Learning Project", trainers will be enabled to independently develop and use learning projects in the future. In addition, the didactic materials in the form of practice-oriented handouts enable training staff to develop learning projects independently (teacher/trainer manual). In addition, the tutorial developed in IO 5 supports the trainers in designing digital learning sequences and using them appropriately. As a result, trainers can design the training for a digitized working world in the context of Industry 4.0, taking into account the special requirements for the professions addressed within the framework of the project, and the trainees can be prepared and trained accordingly as the skilled workers of tomorrow.

Success factor 9: Learning process support

An important prerequisite for success is the accompaniment of the learners in their self-organized learning processes during the processing of the learning project. This goes hand in hand with the paradigm shift: "From instructor to learning companion". The role of educational staff has changed dramatically in recent years. In contemporary learning processes, it is no longer a matter of explaining the solution to tasks in advance, demonstrating activities or processes in detail, guiding learners closely and telling them how to do it or what they need to do. A trainer sees himself as a learning companion if he sees his main task in supporting, initiating and maintaining comprehensive learning processes in the learners. In this way, trainers, teachers and lecturers at the places of learning become creators or "facilitators" of learning situations. They stay in the background, observe, are available for questions, then guide when necessary, they repeatedly ask for interim results in the course of the process and discuss them. They are helpful with questions and learning cliffs and intensively

evaluate learning projects or subtasks with the learners, they allow their own experiences and solutions and support the learners in finding a way themselves. Learning facilitators can take on different roles:

- Supporter
- Planner
- Expert
- Connoisseur:
- Mentor
- Coordinator
- Reflector
- Impulse generator
- Consultant etc.

The many facets show that the spectrum of learning process support is very broad. Learning process facilitators support self-directed learning processes and act as problem-solving consultants on site (advisory process support). Instead of providing solutions or instructions, they accompany learners in finding their own solution to a specific task. They are the central point of contact for all learning-related problems in the processing of the learning project and support the organization and reflection of what has been learned.

Success factor 10: Framework conditions

Finally, other general framework conditions are decisive as a success factor for strengthening the cooperation between learning venues through learning projects:

- personal commitment and motivation of those involved (added value through synergies),
- common objectives, clear responsibilities and responsibilities, sustainable structures,
- mutual appreciation of work,
- regular personal contact, exchange and coordination (trusting and respectful interaction with each other),
- clear guidelines regarding the design of didactic-methodological concepts,
- intensive didactic cooperation in terms of content, exchange of content,
- institutional framework, in particular sufficient time and human resources,
- Willingness to innovate.

5. Evaluation

An important subtask in IO 6 was the evaluation of the approaches and products developed in VACIDE.

5.1 Methodological approach (interview guidelines, observation criteria)

The task of the sub-project partner GEBIFO was the development of a study design for the practice-oriented evaluation of the products developed in the VACIDE project (product evaluation). The evaluation is carried out in an accompanying, supportive and evaluative manner on the basis of the study design presented below.

The main focus of the study was to identify the results and effects of the learning projects developed in the VACIDE project and their effects on the cooperation between learning venues.

The evaluation of the practical implementation of the newly developed offers included the evaluation of the methods used (workplace-oriented learning projects), materials (teacher/trainer manual) and media (digital learning sequences) with regard to their appropriateness, acceptance and impact on the competence development of the trainees/learners. Evaluation tools used for this purpose are interviews and online surveys.

Within the framework of the surveys conducted in VACIDE, different perspectives/target groups/addressees were taken into account, which are reflected in different research settings:

Setting	Target group	Focus on content
<p>Survey setting 1: Guideline-based interview (see Appendix)</p>	<p>Project staff → the VACIDE project and the learning venues cooperating in it themselves:</p> <ul style="list-style-type: none"> • VHS-Bildungswerk • Eurocultura • Solski Center Skofja Loka 	<ul style="list-style-type: none"> • The focus was on the assessment of the development, creation and practical implementation of the learning projects and materials (scenario, learning assignments, digital sequences, etc.). • The primary goal was to identify adjustments.
<p>Survey setting 2: Online survey (see Appendix)</p>	<p>Trainers/trainers in company, school and inter-company contexts</p>	<ul style="list-style-type: none"> • The focus was on their own acceptance, the assessment of benefits and the identification of challenges in the practical implementation of the adapted teaching-learning concepts with work process-oriented learning projects. • The survey included feedback on the test phase of the developed learning materials. • At the same time, the survey recorded the assessment of the trainers/trainers on the acceptance of the methods by the trainees/learners and an assessment of the learning successes on the part of the trainees/learners. • Particular emphasis was placed on qualitative suggestions for improvement as a basis for the further development of the methodological-didactic concept.
<p>Survey setting 3: Online survey (see Appendix)</p>	<p>Trainees/apprentices</p>	<ul style="list-style-type: none"> • Here, the immediate reaction of the participants in relation to the learning projects was queried (acceptance, satisfaction, etc.). • The survey included feedback on the test phase of the developed learning materials. • In addition, the survey should serve to convey to the trainees/learners that their opinion is important and that changes can be derived from it.

For the implementation of the online surveys as part of the product evaluation, a standardized questionnaire will be created and coordinated with the project partners. In order to ensure that the results are reliable and meaningful, the following factors, among others, were taken into account:

- The questionnaire is tailored to the respective target group (project staff, trainers/trainees and trainees/learners) and the questions are understandable for the respective group.
- The questions are formulated clearly and concisely to avoid misunderstandings. Technical terms and abbreviations that could be incomprehensible to the various target groups have been avoided.
- Questions were asked in a logical order to maintain the attention of the respondents.
- The number of questions was limited to a reasonable level in order to maintain respondents' attention and minimize the bounce rate.

The online survey application LimeSurvey was used to implement the online surveys. Data protection was guaranteed by providing the software and also the survey on the sub-project partner's own server GEBIFO. LimeSurvey offers a comprehensive package of functions that also meets scientific requirements to design extensive surveys. By using a web template system, the layout and design of the online survey could be adapted to specific projects.

The statistical evaluation (descriptive) and graphical presentation of the results is carried out using standard company software. The results are provided below.

5.2 Results of the evaluation

(see Appendix)

6. Summary

The work process-oriented learning project "Production and commissioning of a training robot" is a learning setting for use at the three learning locations school, company and inter-company training center or training center. With the VACIDE products, a pedagogical approach has been developed and tested to overcome the separation between practical and theoretical learning and to strengthen learning places for joint cooperation and collaboration. The following aspects were identified in the VACIDE project as conditions for success in strengthening cooperation between learning venues through the use of work process-oriented learning projects and confirmed by the evaluation results:

- 1. Intensive coordination and pedagogical-didactic cooperation**
- 2. Product with sufficient complexity for training requirements**
- 3. Action scenario as the focus of didactic planning**
- 4. Self-organized learning and process orientation**
- 5. Structuring of the learning project**
- 6. Formulation of a guiding text**
- 7. Use of digital learning sequences**
- 8. Empowerment of training staff**
- 9. Learning process support**
- 10. General conditions**

The explanations on the development and support of learning projects as well as the individual project results (intellectual outputs and learning teaching and training activities) provide impulses for practical implementation. VACIDE presents appropriate materials with the work process-oriented learning projects and enable their use at the learning locations mentioned. Since it is not a fixed recipe, the individual design is important: an adaptation to the respective environment of the learning location and the transfer to the individual learner.

The importance of cooperation between learning venues will continue to increase. After all, the decreasing number of trainees not only makes it necessary for learning venues to cooperate more closely in recruiting the next generation of skilled workers. With the advancing digitalization and the growing demands on education and training, the points of contact between the different places of learning are necessarily increasing. IT and media skills are becoming increasingly important in all professions – a challenge that all places of learning have to face equally. However, this can only be achieved in close coordination with each other, in which they complement each other with their particular strengths.

7. Appendix

- **Survey setting 1: Guideline-based interview project team**
- **Survey setting 2: Online survey of trainers/trainers**
- **Survey setting 3: Online survey of trainees/apprentices**
- **Results of the evaluation**
- **Observation sheet**