QUALITY CONTROL IN INDUSTRIAL PRODUCTION
Handouts for trainers

Introductory instructions for trainers

We have prepared materials for trainers to follow. They include

- Introduction
- The complete texts as read by the machine voice. The trainer can choose what to say, for example by highlighting certain sentences or concepts.
- Recommendations on where to turn the sound on or off

The presentation can run in two modes

- With audio on
- Without audio on

Presentation with audio on

- In this mode, a machine voice is heard explaining the displayed texts, diagrams and animations.
- This mode is suitable for self-learning.
- The trainer is not recommended to go through the entire content in this way. The trainee's attention may be lost, and the trainee may not focus on what is most important in the content.
- We recommend using this mode no more than 2 times during the presentation.

Presentation with audio off

- If the presenter turns off the sound, they can give the participants an abbreviated version of what the machine voice is saying in the background.
- They can also highlight what is most important about the content being shown.
- The trainer needs to go through the course several times.
- This is because the background machine voice is running all the time, and until the narration is finished, the trainer has no opportunity to move on to the next step in the presentation.

The trainer can either

- do the content switching and scrolling on their own (recommended for online webinars)
- **or** their partner can do it, but it has to be well coordinated with them (recommended for larger audiences)

Link to the course

https://paitool.eu/courses/paitool-course/lessons/quality-control-in-industrial-production/

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Educational objectives

Each presenter must understand their educational objectives. In the case of AI, participants should gain the following knowledge:

- Understand artificial intelligence as an information system that is capable of learning,
- Know how to identify those processes where it makes sense to use artificial intelligence or machine learning,
- Know the prerequisites for deploying AI in the conditions of a specific company, such as the need for data, the personnel required, etc,
- Recognize the benefits of implementing AI and the risks associated with implementing the project.

Course of training

Introduction

Hello, today I would like to give you an insight into how artificial intelligence can play a key role in the visual inspection of products. We will present examples, solutions and assumptions that are associated with this technology. At the end of the presentation, we will look at the benefits and risks associated with the deployment of AI in industrial manufacturing.

I will now play you a presentation whose voice belongs to artificial intelligence, as a demonstration of one of its capabilities.

START THE PRESENTATION

Slide 1 - Introduction

Use of artificial intelligence in visual inspection of products

Slide 2 -Introductory example

Slide 3 - Output quality control

Artificial intelligence machine learning is increasingly used in output control and laboratory analysis. Here is an example from a Czech plant of a leading manufacturer of bearings and bearings components

Pressure to minimize faulty pieces

- The company is facing hard pressure from customers to reduce the occurrence of defective pieces.

Visual inspection by trained operators

- It produces 14 different types of products on one of the lines. Trained operators perform visual quality control. The inspection is subject to fluctuations, and the result is complaints from the customer.

The need to increase the consistency of control

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- The management of the plant identified the need to increase the consistency of control.

The need to reduce costs

- At the same time, they decided to reduce costs.

Traceability of defective pieces

- In addition, they need to improve the traceability of faulty pieces to support communication with the client. Can artificial intelligence help?

Slide 4 - Solution using artificial intelligence

The combined control instead of the manual control.

- The company replaced fully manual control with combined control.

Integrated automatic visual quality control station

- The supplier has created and integrated an automatic visual quality control station into the production line, which scans the entire surface of the product and automatically discards defective and marginal pieces.

Sorting of marginal pieces by the operator

- Instead of constantly deploying the operator, their presence is only needed at the end of the shift when their task is to additionally re-sort the sorted marginal pieces.

Reducing the number of complaints

- The system has a consistent, continuous operation, and its deployment helps reduce the number of complaints.

Photo documentation of products

- The system also creates photo documentation of each manufactured piece. Together with the inspection results, it is available for the quality management department, and customer relationship needs.

STOP THE SOUND OF THE PRESENTATION

The text will be retold by the speaker in their own words:

Slide 5 - How it all works

Product entry into the visual inspection station

- The product enters the visual inspection station.

Scanning the surface of the product

- The station uses manipulators and an optical system to scan the product's surface.

AI identifies defects

- Artificial intelligence identifies defects in the images.

Sorting of faulty pieces

- Defective pieces are discarded, flawless pieces continue the process.

Continuous AI adaptation

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- Artificial intelligence is constantly adapting to changing conditions in production; it is also possible to train it to inspect new types of products or detect new defects.

STOP THE PRESENTATION

Discussion 1

1. *Have you registered an increased interest in smart solutions for quality control lately or let's say since Covid?*
2. *If so, what types of companies are involved? Larger or smaller businesses? Can the most active sectors be identified? Does this apply to your business as well?*
3. *To what extent is your company also dealing with the idea of becoming producers as well as consumers? So-called PROSUMERS?*
4. *Do companies have clarity on the topic of energy management? Are they clear about what all Smart Energy solutions encompass?*
5. *Do customers also directly express a demand for the introduction of artificial intelligence? At least indirectly, e.g., by requesting the generation of predictions or the processing of unstructured data or similar?*
6. *How long does it typically take you to negotiate with suppliers from first contact to contract and project start?*

START THE PRESENTATION

START THE PRESENTATION SOUND

Slide 6 - Presumptions

Slide 7 - Process

The purpose of deploying this solution and the target process is

Visual inspection of products or samples

- visual inspection of products or samples. Full automation using a machine vision artificial intelligence system is possible where a purely visual inspection is sufficient to detect a defect or analyse a piece without additional, such as tactile analysis.

Human factor supplementation or elimination

- adding or replacing optical inspection staff, which may be today at a higher cost and less efficient

Recommended conditions of deployment - in terms of cost, it is appropriate.

Inspection of not too complex products

- deployment to control not too complex products, for example, those whose relevant areas can be captured with few camera positions.

Insufficient reliability and consistency of human visual quality control

- it is suitable for use in series production, especially where the reliability and consistency of human visual quality control are insufficient or the work is too tedious and monotonous. In

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these cases, the use of artificial intelligence contributes to reducing the volume of complaints.

STOP THE SOUND OF THE PRESENTATION

The text will be retold by the speaker in their own words:

Slide 8 - Data

Data taken from product samples

The company must provide sufficient samples according to the type of solution - either physical copies of the product or digital images.

- Flawless pieces
- Faulty pieces with all expected defect types

Samples must contain both correct and defective pieces, including all common types of defects and all product variations

Estimated numbers of samples

The required number of pieces of samples varies depending on their complexity.

- From tens to thousands of specimens

START THE PRESENTATION SOUND

Slide 9 - Information systems

The quality control information system must include software components, user interface, and sample evaluation. At the same time, it ensures communication with information systems in their area.

Control system:

The superior system is usually the production line control system

Connected information systems:

Outputs are presented in user interfaces and stored in various corporate information systems.

Slide 10 - Infrastructure

The critical elements of the infrastructure are

- **vision system** with installed cameras
- **powerful computer** running a quality management application.
- **high-quality network infrastructure** is also recommended so that the transmission of scanned samples and their evaluation does not slow down the production process.

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STOP THE SOUND OF THE PRESENTATION

The text will be retold by the speaker in their own words:

Slide 11 – People 1

We need the following team on the client's side for a successful project.

On the client's side:

Sponsor, the owner of the process, the person who has the resources to finance the project and the competence to enforce change

- The top position on the customer side is the project sponsor, who is responsible for its financing and, at the same time, ensures the necessary cooperation

Production manager, specifies the required quality parameters

- The production manager and staff responsible for setting quality parameters. They work with the supplier's consultants to identify problems and goals.

Output control staff, participating in AI systems training

- Output control staff who participate in the training of artificial intelligence systems

Technicians operate a camera system and other equipment

- Technicians are responsible for setting up and operating cameras, manipulators, communications infrastructure, and other equipment.

IT experts operate computing infrastructure

- IT experts are responsible for the operation of the computing infrastructure.

START THE PRESENTATION SOUND

Slide 12 - People 2

It is essential to have available on the supplier's side:

Architect - design of the necessary infrastructure, integration specialist

- Architect, providing the design of the necessary infrastructure and integration with cooperating applications.

Consultant - data processing expert

- Consultant, who actively communicates with the production manager and their team and, according to their instructions, configures the method of data processing and evaluation, or the process of machine learning.

Computer programmer - deployment of algorithms needed for automation

- It is necessary to have a programmer in the team to create machine learning algorithms and the entire data processing life cycle.

Technician/designer - initial setup of cameras and mechanical components

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- Equally important is the technician or designer responsible for setting up the cameras and mechanical components.

Slide 13 - Organization

Practical cooperation of the professional teams of the supplier and the contracting authority is essential for the success of the project. Fundamental factors, in this case, are a project plan with appropriately set milestones, a communication model defining the system of project meetings, but mainly sufficient allocation of professional teams, and a flexible process model supporting the proactive definition of requirements and timely response to suggestions of the implementation team.

Project plan

- appropriately set milestones and sub-objectives of the project

Communication model

- interaction of professional teams
- regular meetings
- formulation of requirements
- responding to suggestions from the implementation team

Human capacity

- sufficient allocation of the experts
- flexible process model

STOP THE SOUND OF THE PRESENTATION

STOP THE PRESENTATION

Discussion 2

1. *Building an IT environment is a gradual process; it starts with simpler solutions and can progress to artificial intelligence. What does this evolution look like in the cases you have personally encountered?*
2. *In your opinion, is the customer willing to pay for the analysis of their needs as well, or are they trying to take on this role themselves? When you come into contact with supplier companies, to what extent do you have clarity on what you need?*
3. *What problems do you encounter in getting data? Do we mean both technical problems (fragmented and distributed data) and, say, organisational or competency problems?*
4. *How much of your projects are about integrating your solution to third-party systems? How did it work, was it necessary to involve the suppliers of these solutions or did you as a client manage it with your own staff?*
5. *How long does the project probably take?*
6. *Did you experience any problems in getting sufficiently skilled staff? Did you have trouble freeing them up in sufficient numbers for the project?*
7. *What has been your experience supporting management? Are they aware of their role in the project?*

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STOP THE SOUND OF THE PRESENTATION

The text will be retold by the speaker in their own words:

Slide 14 -Benefits and risks

Slide 15 - Benefits

Several essential benefits can be expected after deploying a vision system based on artificial intelligence. Among the most important are.

Increasing the consistency of visual inspection

- Increase in the consistency of visual control thanks to eliminating the human factor - no fluctuations depending on time, work change, the conditions in the workplace, or other factors.

The high and stable success of the control

- High and stable success in finding faulty products, increased accuracy, precision, and detailed resolution

A more precise inspection process

- More precise control process, data for further product development, for consistent improvement of production or quality control itself

Resilience against faults

- Increase the resilience of the production process, tracking errors, and transparently processed complaints.

START THE PRESENTATION SOUND

Slide 16 - What we should be careful about

The following scenarios, which lead to the failure of the quality management system and can negatively impact the company's financial result and reputation, must be included among the risks.

Failure of artificial intelligence training caused by insufficient support of the professional team in the pilot operation.

An unexpected change in production conditions with a significant impact on the database of prepared samples.

Vision system damage due to unprofessional manual intervention caused by an insufficiently trained team.

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STOP THE PRESENTATION

Discussion 3

1. *Do you have a solid business plan and payback calculation at the beginning of the project? If so, to what extent are these realistic cost-benefit calculations?*
2. *Have you been able to frame the cost of the project in past cases? What might the price be based on?*
3. *What are the most common false expectations you have registered in your projects?*
4. *How long after project deployment did you contact the contractor for assistance? Did they provide it under warranty, or was it for services beyond warranty?*
5. *Is there an ex-post cost-benefit evaluation after the project is completed in the company?*

START THE PRESENTATION

Slide 17 - This course was created in collaboration

STOP THE PRESENTATION

Conclusion:

Finally, I would like to point out that the use of artificial intelligence in industrial production opens up new possibilities for product quality control. This technology contributes to an increase in the consistency of visual inspection, a high percentage of success in identifying defects and a more exact inspection process. At the same time, it increases the robustness of the production process and enables transparent processing of complaints.

However, despite the multiple benefits, we must not forget the risks such as unexpected changes in production conditions, damage to the vision system and lack of support from the expert team in the pilot plant. It is essential that experts from both the supplier and the customer work together on the solution developed.

Finally, I would like to thank all participants for their attention and openness in listening. I hope you were inspired by our presentation and if you have any questions or need more information, we are here to help.

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