DOCUMENT TITLE:

GOOD PRACTICE REPORT FOR SLOVAKIA

Project: Improving RD and business policy conditions for transnational cooperation in the manufacturing industry

Acronym: Smart Factory Hub

Work package	WP4: Improving Knowledge Base
Activity	A 4.2: Good practice handbook tool
Deliverable	D 4.2.2: Regional good practice report
Date of issue	20.12.2017
Document issued by	Slovak Chamber of Commerce and Industry (SOPK/SCCI-PP06)
Contributors	NA
Version	A1.0
Number of Pages	119

Dissemination level		
PU	Public	
PP	Restricted to other Programme participants	
RE	Restricted to a group specified by the consortium	X
CO	Confidential, only for members of the consortium	

Contents

1 INTRODUCTION

Regional Good Practice Report for Slovakia contains nine good practices collected using the Good Practice Template developed in D4.2.1.
The data in this report was collected during October – November 2017 as part of the project entitled "*Improving RD and Business Policy for Transnational Cooperation in the Manufacturing Industry – Smart Factory Hub (SFH)"*.

These nine examples are the basis of the regional report, the Handbook tool report and the Good Practice Handbook, which together with the Mapping tool will allow project partners to present and promote specific smart manufacturing solutions. Based on the collected data, the Handbook tool report will be prepared by the UTC-N, WP4 leader.

The handbook will be available in electronic format on the web portal, while, for disseminating the work package, also 250 handbooks will be printed, which will be available to the participants at the closing dissemination event.

The data collected during this period will also be used for ex-ante evaluation.

SCCI collected the following good practices cases:

No.	Name of the Good Practice	Classification[1]
1	Computer vision using deep neural networks NEURONIT in industrial production	Data analytics, Intelligent sensors/ actuators, Intelligent products, Next-gen manufacturing systems
2	Using deep neural networks NEURONIT with advanced Computer vision in industrial production	Data analytics, Intelligent sensors/ actuators, Intelligent products, Next-gen manufacturing systems
3	The Digital Twin of an industrial production line within the Industry 4.0 concept	Data analytics, Cyber physical systems, Responsive manufacturing, Next-gen manufacturing systems
4	Digital internal Logistics verification throughout the plant	Data analytics, Responsive manufacturing, Next-gen manufacturing systems

[1] According GOOD PRACTICE GUIDELINES

5	Collaborative robot integrated in industrial environment of Smart Factory	Next-gen manufacturing systems, Cyber physical systems, Self-driving vehicles, Robotics
6	Bin picking	Next-gen manufacturing systems, Robotics, Intelligent sensors /actuators
7	Volumetric measurements by UAV	Smart maintenance, Robotics
8	Smallest passive contactless sensors of physical quantities in the world	Advanced materials
9	Orange Box	Next-gen manufacturing systems, Data analytics, Cyber physical systems

1 GP1: COMPUTER VISION USING DEEP NEURAL NETWORKS NEURONIT IN INDUSTRIAL PRODUCTION

ANEXT a.s., BRATISLAVA
Contact person: Juraj Smutný
Address: Hurbanovo nám. 3,
811 06 Bratislava, Slovakia
Phone: +421 2 38 105 760; +421 917 566 566
E-mail: info@anext.sk
Website: www.anext.sk

Keywords : *D*eep neural network, Advanced industrial computer vision, AI
Good practice applied in: (NACE code) : Manufacture of bodies (coachwork) for motor vehicles; (NACE: C29.2).

VOLKSWAGEN SLOVAKIA, a. s., Bratislava in its production of specially glued body parts to check their quality experimentally deploys deep neural networks from Anext. The intention is to limit the impact of the human factor in the automotive industry in the spirit of the concept Industry 4.0.

1.1 GOOD PRACTICE DESCRIPTION

VOLKSWAGEN SLOVAKIA, a. s., Bratislava, started cooperation with the company Anext in late 2017. This year was successful finished development deep neural network NEURONIT for different application industrial outputs. One of them is deployment in the area advanced industrial computer vision with elements of AI.

This solution is strongly tied with the “Smart Factory” concept, as a novel technology, advanced industrial computer vision with elements of AI were incorporated directly and contributed to the production of a specific product.

The innovative nature of this solution is that it provides fully automatic quality control of the robotically applied layer of adhesive glues. The proposed workstation is completely unattended and guarantees the quality of the finished parts in production.

1.2 OBJECTIVE AND TARGET AUDIENCE

The solution described previously was applied in VOLKSWAGEN SLOVAKIA, a. s., Bratislava, the Manufacturer of cars and parts of the Volkswagen brands, factory situated in Bratislava-Devínska Nová Ves, Slovakia.

Solution can be applied by other companies that are willing to integrate deep neural network advanced industrial computer vision with elements of AI into their manufacturing process, especially those that have operators involved in product assembly activities. The practice has a high degree of portability and can be adapted to companies operating in various industry branches. The solution can be used on any type of SME or large company.

1.3 METHODOLOGICAL APPROACH

From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only background to analysis in form required neural network and maintenance and software updates) and further investments after implementation are not needed.

The solution led to a significant decrease in faulty and non-conforming products reported by customers, which, in turn, increased customer satisfaction.

The methodology for implementing this solution comprised of the following steps:

1. Feasibility study (establish whether the solution can be implemented – interviews with operators, budget analysis, potential benefits and weak points);
2. Acquire hardware part of the solution (computing servers, high-precision cameras);
3. Develop software part of the solution (containing wire-harness assembly steps and additional information, both auditive and visual);
4. Implement the solution into the assembly process (train neural network for properly using the equipment);
5. Verify the impact (% in errors or scrap reduction, assembly duration shortening, etc.) compared to previous data.

For future successful implementation, companies should follow the steps described in the “Methodological approach” section and should appoint a project manager who will oversee the acquisition of equipment, software development contracting and the training of selected operators. Companies should also commit resources for the following aspects:

1. conducting an initial feasibility study for determining if or how the solution can be applied specifically in case of each company and what will be its impact (can be carried out internally or by contracting specialized consultancy companies);
2. acquiring equipment computing servers, high-precision cameras);
3. developing a custom application, specific to each company’s assembly process, which will be installed on the production line;
4. selecting and training the operators which will be using this solution;
5. The timespan for fully implementing the solution stretched over a period of 6 months.

1.4 VALIDATION PROCESS

The validation process was completed within the customer factory and comprised in the analysis and comparison of the error / scrap rates and the assembly time needed by operators before and after implementation.

1.5 RESULTS / IMPACT

The impact of the solution was highly positive, as the scrap rates were reduced to almost 0% and the assembly time was reduced with an average too. These led to an increase in productivity and customer satisfaction.

1.6 SUCCESS FACTORS AND CONSTRAINTS

The quality of advanced computer vision strongly depends on the quality of learning deep neural network based on the quality of the data provided.

This solution was the first of its kind, as not any other company made use of this type of practice, especially in its assembly process. As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.

The system performs better if the component devices have better technical specifications (e.g. computing servers, high-precision cameras) and the quality of the data provided to deep neural network must be as good as possible

1.7 LESSON LEARNED & SUSTAINABILITY

The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. The reliability and performance of the system is directly related to the initial investment, as hardware and devices with lower technical specifications function at a reduced performance.

Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.

1.8 REPLICABILITY AND UP SCALING

This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a medium financial commitment and the organizational culture should be open to the use of new technologies.

Currently, the remote assistance feature of this system is under development, for assuring guided support for even more complex tasks.

1.9 FINAL REMARKS

The solution requires a medium financial commitment, however, compared to the benefits it offers (scrap reduction almost 0%, time needed for assembly reduced increased productivity, increased

customer satisfaction, elimination of printed documentation, making operators' activities more efficient) it can easily be supported by any company. Moreover, the implementation of these types of solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted under "Industrie 4.0".

Disclaimer / Acknowledgements

The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

At the same time the company agrees with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

Attachment 1: Good Practice Presentation: http://default.sopk.sk/downloads/SFH/Neuronit.pptx

2 GP2: USING DEEP NEURAL NETWORKS NEURONIT WITH ADVANCED COMPUTER VISION IN INDUSTRIAL PRODUCTION

ANEXT a.s., BRATISLAVA
Contact person: Juraj Smutný
Address: Hurbanovo nám. 3,
811 06 Bratislava, Slovakia
Phone: +421 2 38 105 760; +421 917 566 566
E-mail: info@anext.sk
Website: www.anext.sk

Keywords : Deep neural network, Advanced industrial computer vision, AI.
Good practice applied in: (NACE code) : Manufacture of other parts and accessories for motor vehicles (NACE C29.32).

Plastic Omnium Auto Exteriors, s. r. o. (Ltd.) in its production of automotive bumpers to check their quality experimentally deploys deep neural networks from Anext. The intention is to limit the impact of the human factor in the automotive industry in the spirit of the concept Industry 4.0.

2.1 GOOD PRACTICE DESCRIPTION

Plastic Omnium Auto Exteriors, s. r. o. (Ltd.) started cooperation with the company Anext in late 2017. This year was successful finished development deep neural network NEURONIT for different application industrial outputs. One of them is deployment in the area advanced industrial computer vision with elements of AI.

This solution is strongly tied with the “Smart Factory” concept, as a novel technology, advanced industrial computer vision with elements of AI were incorporated directly and contributed to the production of a specific product.

The innovative nature of this solution is that it provides fully automatic quality control of the robotically applied layer of adhesive glues. The proposed workstation is completely unattended and guarantees the quality of the finished parts in production.

2.2 OBJECTIVE AND TARGET AUDIENCE

The solution described previously was applied in Plastic Omnium Auto Exteriors, s.r.o. (Ltd.), the Manufacturer of plastic parts for automotive industry, factory situated in Lozorno, Slovakia.

Solution can be applied by other companies that are willing to integrate deep neural network advanced industrial computer vision with elements of AI into their manufacturing process, especially those that have operators involved in product assembly activities. The practice has a high degree of portability and can be adapted to companies operating in various industry branches. The solution can be used on any type of SME or large company.

2.3 METHODOLOGICAL APPROACH

From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only background to analysis in form required neural network and maintenance and software updates) and further investments after implementation are not needed.

The solution led to a significant decrease in faulty and non-conforming products reported by customers, which, in turn, increased customer satisfaction.

The methodology for implementing this solution comprised of the following steps:

1. Feasibility study (establish whether the solution can be implemented – interviews with operators, budget analysis, potential benefits and weak points);
2. Acquire hardware part of the solution (computing servers, high-precision cameras);
3. Develop software part of the solution (containing wire-harness assembly steps and additional information, both auditive and visual);
4. Implement the solution into the assembly process (train neural network for properly using the equipment);
5. Verify the impact (% in errors or scrap reduction, assembly duration shortening, etc.) compared to previous data.

For future successful implementation, companies should follow the steps described in the “Methodological approach” section and should appoint a project manager who will oversee the acquisition of equipment, software development contracting and the training of selected operators.
Companies should also commit resources for the following aspects:

1. conducting an initial feasibility study for determining if or how the solution can be applied specifically in case of each company and what will be its impact (can be carried out internally or by contracting specialized consultancy companies);
2. acquiring equipment computing servers, high-precision cameras);
3. developing a custom application, specific to each company’s assembly process, which will be installed on the production line;
4. selecting and training the operators which will be using this solution
5. The timespan for fully implementing the solution stretched over a period of 6 months.

2.4 VALIDATION PROCESS

The validation process was completed within the customer factory and comprised in the analysis and comparison of the error / scrap rates and the assembly time needed by operators before and after implementation.

2.5 RESULTS / IMPACT

The impact of the solution was highly positive, as the scrap rates were reduced to almost 0% and the assembly time was reduced with an average too. These led to an increase in productivity and customer satisfaction.

2.6 SUCCESS FACTORS AND CONSTRAINTS

The quality of advanced computer vision strongly depends on the quality of learning deep neural network based on the quality of the data provided.

This solution was the first of its kind, as not any other company made use of this type of practice, especially in its assembly process. As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.

The system performs better if the component devices have better technical specifications (e.g. computing servers, high-precision cameras) and the quality of the data provided to deep neural network must be as good as possible.

2.7 LESSON LEARNED & SUSTAINABILITY

The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. The reliability and performance of the system is directly related to the initial investment, as hardware and devices with lower technical specifications function at a reduced performance.

Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.

2.8 REPLICABILITY AND UP SCALING

This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a medium financial commitment and the organizational culture should be open to the use of new technologies.

Currently, the remote assistance feature of this system is under development, for assuring guided support for even more complex tasks.

2.9 FINAL REMARKS

The solution requires a medium financial commitment, however, compared to the benefits it offers (scrap reduction almost 0%, time needed for assembly reduced increased productivity, increased customer satisfaction, elimination of printed documentation, making operators' activities more efficient) it can easily be supported by any company. Moreover, the implementation of these types of solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted under "Industrie 4.0".

Disclaimer / Acknowledgements

The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

At the same time the company agrees with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

Attachment 1: Good Practice Presentation: http://default.sopk.sk/downloads/SFH/Neuronit.pptx

3 GP3: THE DIGITAL TWIN OF AN INDUSTRIAL PRODUCTION LINE WITHIN THE INDUSTRY 4.0 CONCEPT

SOVA DIGITAL
Product Lifecycle Management

Sova Digital, a.s., Bratislava
Contact person: Milan Lokšík
Address: Bojnická 3, 831 04 Bratislava, Slovakia
Phone: +421 2 4333 0643, +421 2 4333 0372
Fax: +421 2 4333 9505
E-mail: info@sova.sk, info@industry4.sk;
Website: www.sova.sk, http://industry4.sk/

Keywords : Digital twin, Optimization of production, Genetic algorithm, Data collection
Good practice applied in: (NACE code) : Manufacture of other pumps and compressors (NACE C28.13).

In Embraco Slovakia s.r.o. (Ltd.), Sova Digital focusing on the continuous optimization of production processes, proactive maintenance, and continuous processing of process data. Basic goal is to support the existing production structures within the automotive industry and the most efficient use of resources by augmented production and planning strategies, such as the digital twin.

3.1 GOOD PRACTICE DESCRIPTION

Embraco Slovakia s.r.o. started cooperation with the company Sova Digital a.s. in late 2016. Sova Digital offered integration of the digital twin (DT). A DT is essentially a functional system of continuous process optimization, which is formed by the cooperation of physical production lines with a digital “copy. It creates the digital factory environment, in which the company can optimize the operation directly through the production chain, manipulate parameters and production processes; adapting the product to market requirements.

This solution is strongly tied with the “Smart Factory” concept, as a novel technology. Digital twin collects and evaluates the information continuously, allowing, among other things, to shorten and streamline the production cycle, reduce the rise time of introducing new products, detecting inefficient settings of the underlying processes. The concept of the digital twin, therefore, is built on the principle known today as Industry 4.0.

The digital twin is formed by the physical production line and its digital “copy”. The major feature of this arrangement is the interface, through which data exchange takes place. The digital part is

based on the simulation tool called Plant Simulation (PS) made by SIEMENS. The digital simulation model of the production line was created in this environment. This model was a detailed virtual copy of the physical process.

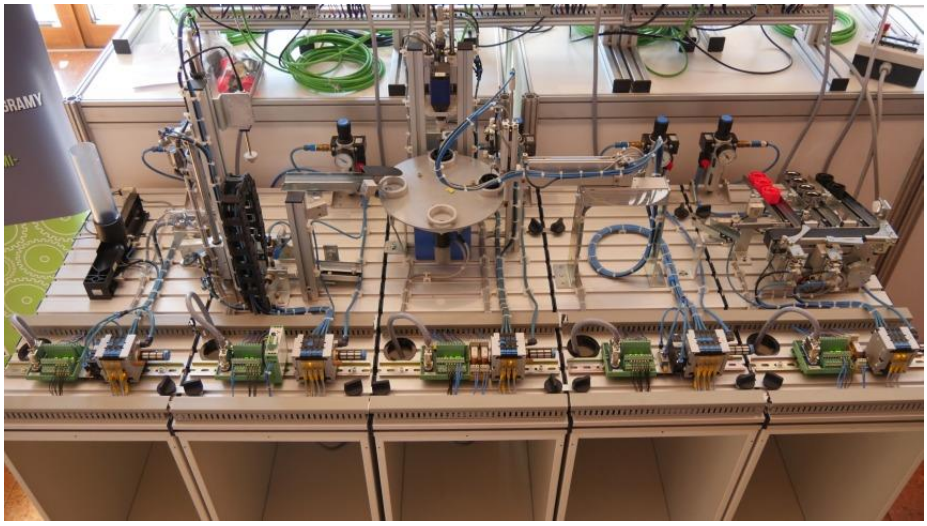


Fig. 1 – Digital Twin

3.2 OBJECTIVE AND TARGET AUDIENCE

The solution described previously was applied in EMBRACO SLOVAKIA s.r.o. (Ltd.), a Manufacturer of a full range of condensing units using R134a, R404A, R290 and R600 refrigerants in low and high torque versions and a wide range of refrigeration, freezing and air conditioning applications, factory situated in Spišská Nová Ves, Slovakia. The solution can be used on any type of SME or large company.

3.3 METHODOLOGICAL APPROACH

From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only software and extra sensors when they needed) and further investments after implementation are not needed.
The solution led to a significant decrease in faulty and non-conforming products reported by customers, which, in turn, increased customer satisfaction.
Solution can be applied by other companies that are willing to integrate digital twin and the digital simulation model of the production line for continuous process optimization.The practice has a high degree of portability and can be adapted to companies operating in various industry branches.

3.4 VALIDATION PROCESS

The validation process was completed within the customer factory and comprised in the analysis and comparison of the error / scrap rates and the assembly time needed by operators before and after implementation.

3.5 RESULTS / IMPACT

The impact of the solution was highly positive, as the scrap rates were reduced and the assembly time was reduced with an average too. These led to an increase in productivity and customer satisfaction.

3.6 SUCCESS FACTORS AND CONSTRAINTS

The quality of DT of the plant is strongly based on the quality of the data provided. Based on this, we can build a high quality simulation model for software needs (Siemens Technomatix PS).

This solution was the first of its kind, as not any other company made use of this type of practice, especially in its assembly process. As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.

The system performs better if the component devices have better technical specifications (e.g. data servers, high-precision sensors) and the quality of the data provided to Siemens Technomatix PS software.

3.7 LESSON LEARNED & SUSTAINABILITY

The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. The reliability and performance of the system is directly related to the initial investment, as hardware and devices with lower technical specifications function at a reduced performance.

Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.

3.8 REPLICABILITY AND UP SCALING

This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a medium financial commitment and the organizational culture should be open to the use of new technologies.

Currently, the remote assistance feature of this system is under development, for assuring guided support for even more complex tasks.

3.9 FINAL REMARKS

The solution requires a medium financial commitment, however, compared to the benefits it offers (scrap reduction, time needed for assembly reduced increased productivity, increased customer satisfaction. Moreover, the implementation of these types of solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted under "Industrie 4.0".

Disclaimer / Acknowledgements

The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

At the same time the company agrees with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

Attachment 1: Good Practice Presentation: http://default.sopk.sk/downloads/SFH/DD_milo.pptx

4 GP4: DIGITAL INTERNAL LOGISTICS VERIFICATION THROUGHOUT THE PLANT

Sova Digital, a.s., Bratislava
Contact person: Milan Lokšík
Address: Bojnická 3, 831 04 Bratislava, Slovakia
Phone: +421 2 4333 0643, +421 2 4333 0372
Fax: +421 2 4333 9505
E-mail: info@sova.sk, info@industry4.sk;
Website: www.sova.sk, http://industry4.sk/

Keywords : Digital, Logistics, Optimization of production, Genetic algorithm, Data collection

Good practice applied in: (NACE code) :	Manufacture of other parts and accessories for motor vehicles (NACE: C29.32).

In Honeywell Turbo s. r. o. (Ltd.), Sova Digital focusing on the continuous optimization of production processes, proactive maintenance, and continuous processing of process data. Basic goal is to support the existing production structures within the industry and the most efficient use of resources by augmented production and planning strategies, such as the digital twin.

4.1 GOOD PRACTICE DESCRIPTION

Honeywell Turbo s. r. o. (Ltd.), started cooperation with the company Sova Digital a.s. in late 2016. Sova Digital offered integration of the digital internal logistics verification throughout the plant this is essentially for a functional system of continuous process optimization, which is formed by the cooperation of physical production lines with a digital “copy. It creates the digital factory environment, in which the company can optimize the operation directly through the production chain, manipulate parameters and production processes; adapting the product to market requirements.

This solution is strongly tied with the “Smart Factory” concept, as a novel technology. Digital internal logistics verification throughout the plant collects and evaluates the information continuously, allowing, among other things, to shorten and streamline the production cycle, reduce the rise time of introducing new products, detecting inefficient settings of the underlying processes. The concept of the digital twin, therefore, is built on the principle known today as Industry 4.0.

The Digital internal logistics verification throughout the plant is formed by the physical production line and its digital "copy". The major feature of this arrangement is the interface, through which data exchange takes place. The digital part is based on the simulation tool called Plant Simulation (PS) made by SIEMENS. The digital simulation model of the production line was created in this environment. This model was a detailed virtual copy of the physical process.

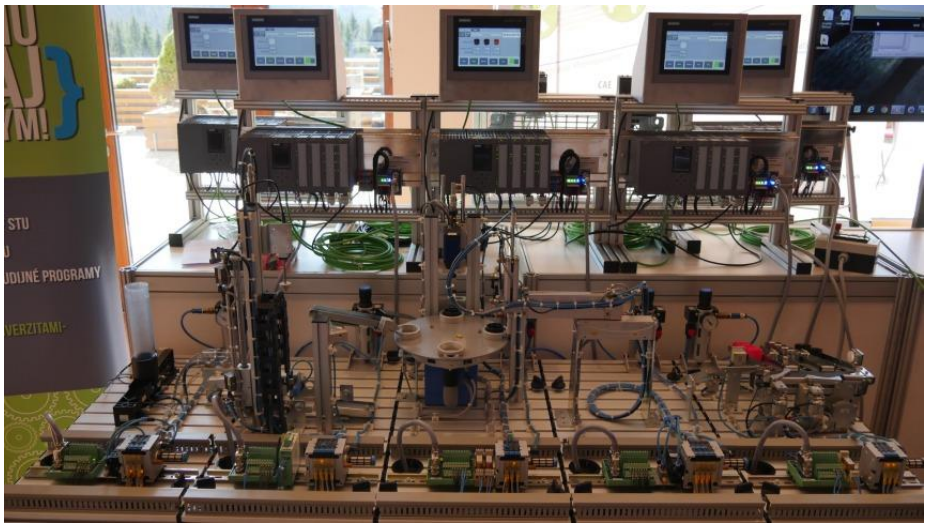


Fig. 2 – Digital Twin

(Reminder: The pictures in 3.1 and 4.1 are the same because it just an illustration of principle in 3D model. In fact, the physical production lines are different.)

4.2 OBJECTIVE AND TARGET AUDIENCE

The solution described previously was applied in Honeywell Turbo s. r. o. (Ltd), a Manufacturer of motor vehicles, engines, vehicles, parts and accessories for motor vehicles and other means of transport, the factory situated in Záborská (district Prešov), Slovakia.

Solution can be applied by other companies that are willing to integrate digital internal logistics verification throughout the plant into their manufacturing process, especially those that have operators involved in product assembly activities. The practice has a high degree of portability and can be adapted to companies operating in various industry branches. The solution can be used on any type of SME or large company.

4.3 METHODOLOGICAL APPROACH

From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only software and extra sensors when they needed) and further investments after implementation are not needed.

The solution led to a significant decrease in faulty and non-conforming products reported by customers, which, in turn, increased customer satisfaction.

Solution can be applied by other companies that are willing to integrate digital twin and the digital simulation model of the production line for continuous process optimization. The practice has a high degree of portability and can be adapted to companies operating in various industry branches.

4.4 VALIDATION PROCESS

The validation process was completed within the customer factory and comprised in the analysis and comparison of the error / scrap rates and the assembly time needed by operators before and after implementation.

4.5 RESULTS / IMPACT

The impact of the solution was highly positive, as the scrap rates were reduced and the assembly time was reduced with an average too. These led to an increase in productivity and customer satisfaction.

4.6 SUCCESS FACTORS AND CONSTRAINTS

The quality of Digital internal logistics verification throughout the plant is strongly based on the quality of the data provided. Based on this, we can build a high quality simulation model for software needs (Siemens Technomatix PS).

This solution was the first of its kind, as not any other company made use of this type of practice, especially in its assembly process. As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.

The system performs better if the component devices have better technical specifications (e.g. data servers, high-precision sensors) and the quality of the data provided to Siemens Technomatix PS software.

4.7 LESSON LEARNED & SUSTAINABILITY

The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. The reliability and performance of the system is directly related to the initial investment, as hardware and devices with lower technical specifications function at a reduced performance.

Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.

4.8 REPLICABILITY AND UP SCALING

This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a medium financial commitment and the organizational culture should be open to the use of new technologies.

Currently, the remote assistance feature of this system is under development, for assuring guided support for even more complex tasks.

4.9 FINAL REMARKS

The solution requires a medium financial commitment, however, compared to the benefits it offers (scrap reduction, time needed for assembly reduced increased productivity, increased customer satisfaction. Moreover, the implementation of these types of solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted under "Industrie 4.0".

Disclaimer / Acknowledgements

The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

At the same time the company agrees with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

Attachment 1: Good Practice Presentation: http://default.sopk.sk/downloads/SFH/DD_milo.pptx

5 GP5: COLLABORATIVE ROBOT INTEGRATED IN INDUSTRIAL ENVIRONMENT OF SMART FACTORY

MATADOR Automation, s.r.o.
Contact person: Ing. Maroš Mudrák
Address: Továrenská 1, 018 41 Dubnica nad Váhom, Slovakia
Phone: +421 908 948 928
Fax:
E-mail: maros.mudrak@matador-group.eu
Website: www.matador-group.eu

Keywords : Collaborative robot

Good practice applied in: (NACE code) :	The Vrchlabí plant manufactures highly sophisticated DSG automatic transmissions for the entire Volkswagen concern. (NACE 29)

Innovative solution relate to the integration of collaborative robot into an industrial environment with the aim of removal non-ergonomic and not effective human labour. This integration and implementation of application requires high precision and accuracy, and high safety in terms of sharing the workplace between robot and humans. This solution was integrated in ŠKODA AUTO a.s. Vrchlabí (Czech Republic).

5.1 GOOD PRACTICE DESCRIPTION

In 2014 company started to focus its activities on higher degree of robotics. Trends in this field showed that one of the most important integrations will be robots capable of cooperation with humans. Our company has own development and research capacities, that is why we created this solution.

Solution is fully compatible with Smart Factory and it follows the trends in Smart Factory. It is fully integrated with other systems and it can communicate with its environment in IoT meaning, but also in communication with humans.

Design of safe workplace with multi-axis robot, which can help the human operator, eventually it can replace him within difficult operations. Important is the repeatability and full integrity between operators without the necessity of safety barriers usage.

Fig. 3 – Collaborative robot integrated in ŠKODA AUTO a.s. Vrchlabí (Czech Republic)

5.2 OBJECTIVE AND TARGET AUDIENCE

Target customers are all industrial corporations, which perform assembly tasks or manipulation with parts performed by human operator. The solution can be used on any type of SME or large company.

5.3 METHODOLOGICAL APPROACH

Quality is ensured by fully integration and repeatability of solution itself. Before implementation, very precise analysis of specific application is done. Consequently, safety risks and their elimination are evaluated and implemented.

It is needed to realize and accept the technology by the people, which will cooperate with the robot. They must accept him as a partner, not as a replacement. Every implementation is modified for specific environment and it needs full cooperation between integrator and customer, which better knows the specification of his environment.

5.4 VALIDATION PROCESS

Validation was performed by customer and on the basis of error rate and safety conditions, which correspond with technical specifications and standards in EU.

5.5 RESULTS / IMPACT

The main impact is a removal of non-ergonomic work and this increased performance of production process.

5.6 SUCCESS FACTORS AND CONSTRAINTS

If the safety risks concerning human harming are too high and these overall risks are impossible to eliminate, our solution cannot be implemented. The selling point is the integration with safety barriers and direct cooperation between robot and human. To improve the impact is to find suitable partner for wider integration and increasing acceptance between humans, which will cooperate with the robot.

5.7 LESSON LEARNED & SUSTAINABILITY

Technology is ready for implementation into production and safety risk is minimal concerning cooperation between robot and humans.

5.8 REPLICABILITY AND UP SCALING

Implementation will increase the quality of production and reduce non-ergonomic work of human workers. This solution can be used in any type of production.

5.9 FINAL REMARKS

This solution is specified by implementation of collaborative robots, which can be implemented near the human workers or they can directly cooperate their actions with humans in production process. Integration of such solution will increase the quality of production operations and repeatability of production itself.

Disclaimer / Acknowledgements

The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

At the same time the company agrees with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

Attachment 1: Matador Group website: http://www.matador-group.eu/domov/
Attachment 2: Video demonstration: https://www.youtube.com/watch?v=c3GZ2Q0QLP8

Attachment 3: The type of the collaborative robot website: https://www.kuka.com/sk-sk/produkty-a-slu%C5%BEby/robotick%C3%A9-syst%C3%A9my/industrial-robots/lbr-iiwa

6 GP6: BIN PICKING SOLUTION FOR FLEXIBLE AUTOMATION

Photoneo s.r.o.
Contact person: Ján Žižka
Address: Jamnického 3, 841 05 Bratislava, Slovakia
Phone:
E-mail: zizka@photoneo.com
Website: www.photoneo.com

Keywords : Bin picking, Robotics, Scanner
Good practice applied in: (NACE code) : NACE C.28

Photoneo's Bin picking solution works with our family of industrial grade 3D scanners PhoXi Scan. Using advanced 3D algorithms, it runs at high speed and with a high precision. It allows the user to scan object or input a CAD model, select grip points and alternative grip points. The container is scanned and objects are picked one by one.
Such solution was implemented in company ROMI Industrial Systems s.r.o.,Trnava Slovakia.

6.1 GOOD PRACTICE DESCRIPTION

Company has developed own 3D scanner called PhoXi Scan and own software for control of the robot based on ROS. Bin picking Solution is composed of these parts:

1. Robot
2. 3D scanner
3. Bin Picking SDK Software

All these parts were implemented for our customer ROMI Industrial Systems s.r.o.

Fig. 4 – Bin picking model

The demanding needs on automation require nowadays complex systems which very often can be achieved only with the help of industrial robots. Therefore we cooperate with different robot producers and integrate their robots in to our production solutions. Bin picking by Photoneo is a new technology, which leads to autonomous bin picking workplace. Such workplace is an essential part of Smart Factory. Increasing the efficiency of robotic work cells is directly connected to autonomous robot problem. Such solutions are requested in Smart Factory. The robotic vision and 3D scanning systems become more and more important for automation solutions since the need to automate even smaller production quantities and therefore create flexible automation solutions is growing.

Our solution brings new approach (technology) to bin picking by robot. We are capable to analyse 3D data in bins and compare it with CAD model of the picked part. Analysis then decides which part is sizable for the robot. By the application of such procedure the robot is able to pick all the parts in bin without any help of human. This brings very effective solutions in industries, where assemblies or similar process are needed.

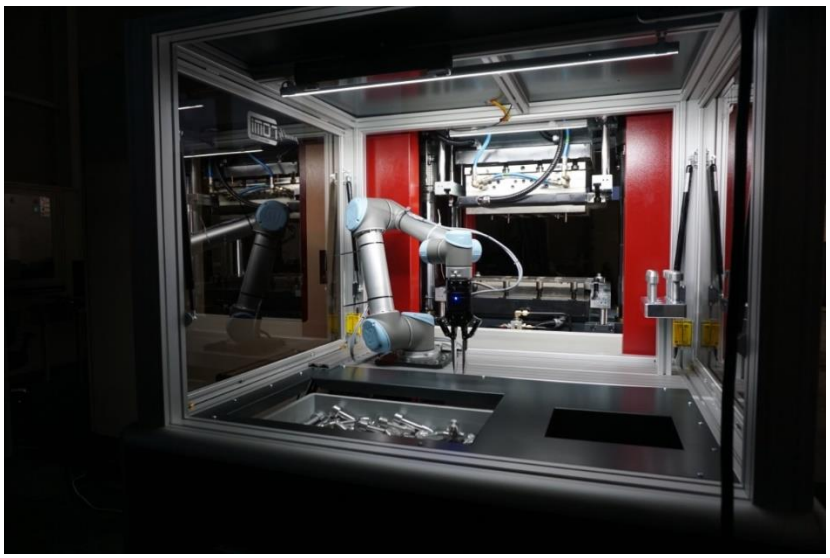


Fig. 5 – Bin picking in practice

6.2 OBJECTIVE AND TARGET AUDIENCE

Our solution is completely different to those providing by competitors. Bin picking is well known problem and robots are capable to solve this problem when the parts are placed in known positions. Our solution does need to know the precise position of the part and this is great comparative advantage in compare with our competitors.

The solution described above was applied in Slovakia in the company ROMI Industrial Systems s.r.o., and can be used on any type of SME or large company, mainly in automotive, electronics, food manufacturing process.

6.3 METHODOLOGICAL APPROACH

Solution led to more efficient production and reduction of costs for human labour. Our good practice can be applied to any customer, which requires autonomous removing of components from the bins. First we will provide primary study of the workplace and then if all aspects of the customer are redeemable, we provide also the integration of solution including various types of robots. Application of bin picking is very easy. Created software solution allows it in three steps:

1. Insert CAD model.
2. Capture 3D scene.
3. Get localized results.

As any automation device, the primary costs are higher than recruit some human labour. However, if production volumes are also higher, then the costs are also reduced. Our customer must count with several months for implementation.

6.4 VALIDATION PROCESS

Solution was validated in, and the reliability of solution is usually over 90% (i.e. from 1000 parts 900 is autonomously picked). However, this depends on the shape of part and bin. Some more complicated parts can fit into each other and this will decrease the reliability. Another interesting parameter is the time of unloading. This also depends on part and bin. However, full 3D scanning and data processing of our solution does not last longer than 1 s.

6.5 RESULTS / IMPACT

Impact of this solution is positive in the manner of more efficient autonomous production. However, there is also negative impact in taking part of people's work.

6.6 SUCCESS FACTORS AND CONSTRAINTS

System is limited as a standard robotic workplace, especially from the safety point of view. Some limitations are also defined by parts which the robotic grippers are able to pick. And other limitations are based on the kinematics of the robot. This depends on the used robot and the shape of the bin.

1. Detects 1 objects in 200 ms.
2. Allows multiple gripping points
3. Avoids obstacles, walls
4. Locates the object with a high precision of 0.5 mm
5. Smart memory (allows the robot to remember positions of all objects which are ready to be gripped after one scan. This allows a further speedup, since after first object is gripped and removed from the container; other objects are immediately queued in smart memory and are available to be picked without the need to analyze the scene.)
6. Simple to use graphical user interface for configuration of localization process
7. Robust detection and localization of occluded parts with respect to potential gripping point
8. Parallel, simultaneous localization of multiple instances, asynchronous results stream

Solution is dependent on used hardware and software. We are developing our software to be more intelligent. And we are also developing more advanced PhoXi sensor. However, our solution is dependent on robotic producers and if robot properties improve, our solution will be also improved.

6.7 LESSON LEARNED & SUSTAINABILITY

The success of implementation depends on mutual cooperation of integrator and customer. We strongly recommend using an experienced integrator. This is the basics for successful implementation.

Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.

6.8 REPLICABILITY AND UP SCALING

The solution can be implemented in a wide range of industrial companies (automotive, food, electronics). Our product can be also used as a smaller part of more complex system, when system requires:

1. 3D object recognition
2. Inspection of object placement
3. General inspection and analysis

Solution can be expanded by more appropriate software and new versions of PhoXi scanner.

6.9 FINAL REMARKS

The solution requires higher initial investment costs and skilled integrator. At the end, very effective autonomous bin picking application arises. This solution is especially characterized by unknown positions of the picked parts.

Disclaimer / Acknowledgements

The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

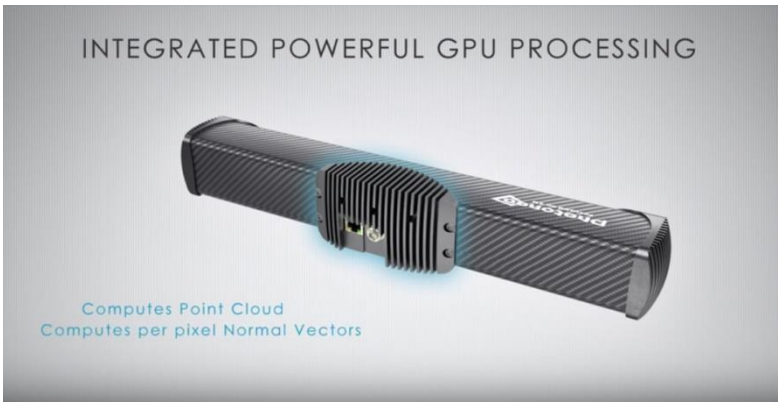
At the same time the company agrees with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

Attachment 1: Website of the good practice: http://www.romi-is.com/?page_id=42
Attachment 2: Video demonstration: https://www.youtube.com/watch?v=8aOiKJ5_QsU

Attachment 3: Video demonstration: https://www.youtube.com/watch?v=hthdcTOLkyE

Attachment 4: 3D Scanner video demonstration: https://www.youtube.com/watch?v=azsxHA2urdY



Attachment 5: Company Photoneo website and the presentation of their solution: http://www.photoneo.com

7 GP7: VOLUMETRIC MEASUREMENTS BY UAV

UAVONIC s.r.o.
Contact person: Juraj Dudáš
Address: Galvaniho 17/B, 821 04 Bratislava, Slovakia
Phone:
E-mail: dudas@uavonic.com
Website: www.uavonic.com

Keywords : Volumetric measurements, Camera, Laser scanner,
Good practice applied in: (NACE code) : NACE C.17

Volumetric measurement by UAV devices is a modern method allowing for example inspection of outdoor storage with high capacity. This method can replace employees with standard measuring devices, which have higher inaccuracies and their usage is time consuming or there is a risk of potential injury. Volumetric measurements by UAV are composed of aerial pictures created by calibrated cameras or laser scanners. This data are consequently processed in software, which creates digital 3D model of measured material. Accuracy of this process is higher than the other standard measuring methods. Such volumetric measurements were proposed and implemented in Mondi SCP a.s., Ružomberok, Slovakia

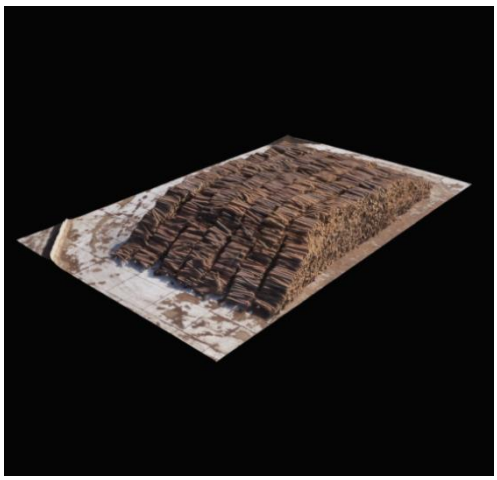
7.1 GOOD PRACTICE DESCRIPTION

Company created this solution due to intensive work of experienced and technically competent employees and also due to cooperation of segment specialist from Mondi SCP a.s. Slovakia.

Our approach is characterized by novel technologies as precise cameras or laser scanners and by intelligent software solutions. It is clear that smart factory needs smart control and smart control is characterized by smart and precise measuring. Our approach brings novel approach to volumetric measurements in any segment of the industry.
Technical solution is characterized in two ways:

1. novel hardware – precise cameras with laser scanners
2. novel software – data fusion and fast volumetric measurements of high capacity storage

Fig. 6 – Volumetric Measurements by UAV



7.2 OBJECTIVE AND TARGET AUDIENCE

The solution described previously was applied in Mondi SCP a.s. factory situated in Ružomberok, Slovakia.

The solution can be used on any type of SME or large company also in Public institutions. For example: industrial enterprises, academic sector, agriculture, forestry, construction, environmental sectors etc.

7.3 METHODOLOGICAL APPROACH

Solution led to a significant optimization of logistics in company. It depends individually on the application and request of the customers. We are able to provide basic study for the customer and then the customer decides, if he/she is able to cooperate on such solution.

At least some experts on specified problems (e.g. volumetric measurements of wood's storage will need forestry expert) are necessary to be presented during the first steps.

7.4 VALIDATION PROCESS

It is hard to validate volumetric measurements of high capacity storage. Validation can be done only by standard measuring devices, which are usually much more inaccurate than laser scanners or cameras. However, the measurement can be validated in industrial process, e.g. amount of consumed wood. Validation in Mondi SCP a.s. was performed this way.

7.5 RESULTS / IMPACT

Impact of this solution is positive in the manner of control of whole producing process. Partner exactly knows, what amount of material he has available for production and consequently he can optimize whole logistic and save the costs.

7.6 SUCCESS FACTORS AND CONSTRAINTS

System is limited by environment around the storage. If the storage is outside, our system is not able to measure when the weather is not suitable for the flight of UAV. Moreover, it is also limited in some dusty or in other ways disadvantageous for UAV technology.

Selling points – the real or perceived benefits:

1. Safety
2. High resolution
3. Costs saving
4. Time efficiency

Solution is dependent on used hardware and software. With the development of more precise sensors and more intelligent software the solution will acquire even more precise results.

7.7 LESSON LEARNED & SUSTAINABILITY

The success of implementation depends on mutual cooperation of integrator and customer. Reliability and performance of whole system is dependent on initial investment to technologies, but our company can provide such solution also as service.

Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.

7.8 REPLICABILITY AND UP SCALING

The solution can be implemented in a wide range of industrial companies (forestry, construction, metallurgy etc.), but also in agriculture or other branches.

Solution can be expanded by more efficient hardware elements (especially laser scanners and computers) and in future such systems should be autonomous. However, this is still in development.

7.9 FINAL REMARKS

The solution requires higher initial investment costs and skilled workers (UAVs, software, etc.). However, our company provides the solution as a service. So the aspects about the implementation are removed for the partners.

Disclaimer / Acknowledgements

The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

At the same time the company agrees with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

Attachment 1: Website of the good practice: https://uavonic.com/volumetric-measurements/

8 GP8: SMALLEST PASSIVE CONTACTLESS SENSORS OF PHYSICAL QUANTITIES IN THE WORLD

RVmagnetics, a.s.
Contact person: Michal Borza
Address: Hodkovce 21, 04421 Hodkovce, Slovakia
Phone: +421 918 88 55 38
E-mail: info@rvmagnetics.com
Website: www.rvmagnetics.com

Keywords : Sensors, Structural health monitoring, Non-invasive, Innovative, Magnetic, IoT, Industry 4.0.

Good practice applied in: (NACE code) :	Construction of bridges and tunels (42.13), Manufacture of instruments and appliances for measuring, testing and navigating (26.51)

The smallest passive contactless sensor of physical quantities (temperature, pressure, magnetic field, position…) was developed.
European Defence Agency (EDA) used RVmagnetics´s sensors to measure the structural health of carbon fibres composites. Czech Construction Company used RVmagnetics´s sensors to measure the forces during the construction of a train bridge. With Singapore partner RVmagnetics are creating the smart composites based on microwire technology. With partner RVmagnetics creates new generation, effective, more robust and simple railroad sensor to monitor the traffic and other parameters.

8.1 GOOD PRACTICE DESCRIPTION

EDA needed to know what the quality of composites material is used in European defence program. Goal of the project was to compare the technologies of structural health monitoring and improve the manufacture process, effectivity, etc. RVmagnetics´s microwire technology was compared with standard invasive and non-invasive techniques with excellent results. Czech Construction Company need to measure the forces during the construction of new innovative train bridge. RVmagnetics developed new non-destructive measuring system, with zero error, which shows what kind of forces are inside of concrete.

RVmagnetics bring to the market absolutely new generation of physical quantities sensors; based on microwire technology which offer to RVmagnetics´s partners create smart goods from their standard portfolio. RVmagnetics´s technology is ideal for IoT world and Industry 4.0

With RVmagnetics´s technology could be goods of our partners smarter, more effective, self-diagnosed and much more. The innovative nature of this solution is that it provides non-invasive testing, monitoring and measuring method for composites materials, which monitors the production process, application process and values from real use. With this technology partners can save the material costs, produce smarter goods and bring new added value for their partners.

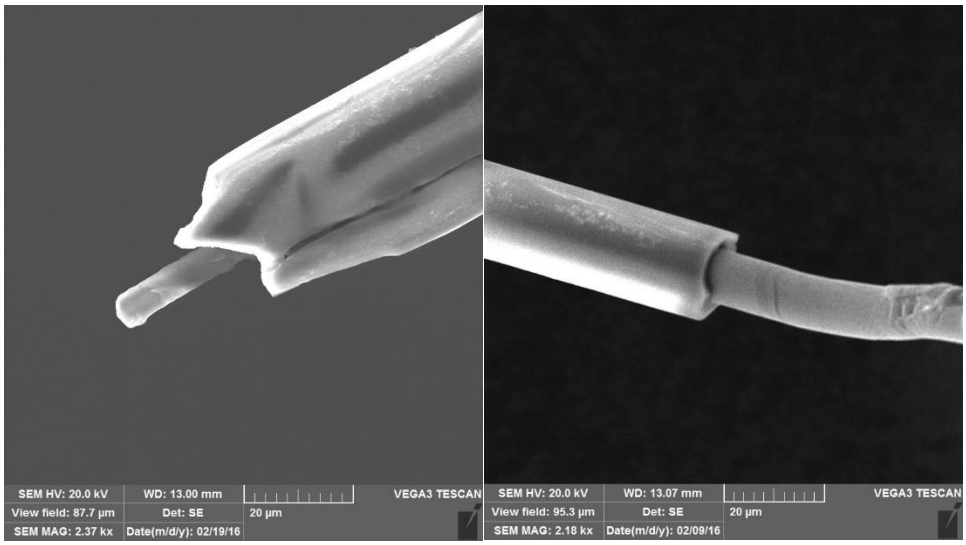


Fig. 7 – Smallest passive contactless sensor of the physical quantities

8.2 OBJECTIVE AND TARGET AUDIENCE

Solution can be applied by other companies which are looking for the innovation which brings the new high added value to their products, which can be transfer to their customers, and also by companies which are looking to solve their problems which are not possible solved by current state of technology. It can be used by the SME or large company.

8.3 METHODOLOGICAL APPROACH

RVmagnetics provides as simple as possible solution which we offer to our partners. From the costs perspective, the solution can save up to 30% of material costs for selected sectors (composites materials), or provide new and high added value with minimum initial costs.

The methodology for implementing this solution comprised of the following steps:

1. Feasibility study (establish whether the solution can be implemented – interviews with operators, budget analysis, potential benefits and weak points; information about the environment);
2. Create the HW and SW prototype.
3. Testing
4. Implementation
5. Verify the impact
6.

Companies should also commit resources for the following aspects:

1. Conducting an initial feasibility study for determining if or how the solution can be applied specifically in case of each;
2. (Technical) cooperation in production prototype process.
3. Costs of solution or exclusive license
4. Costs of sensor

The timespan for fully implementing the solution is between 6-18 months.

8.4 VALIDATION PROCESS

The validation process is done after each period of development resp. application in the external condition which was selected by partner.

8.5 RESULTS / IMPACT

From the costs perspective, the solution can save up to 30% of material costs for selected sectors (composites materials), or provide new and high added value with minimum initial costs.

8.6 SUCCESS FACTORS AND CONSTRAINTS

Technical limitations:

1. Temperature over 600 °C;
2. Depth inside the material for contactless sensing over 30 cm.

Unique solution based on revolutionary technology which brings high added value for our partner and their customers.

Benefits:

1. Small dimensions – microwires can be embedded into the various structures without changing of mechanical properties of the structure (e.g. glass- and carbon- fibre composites, polymers, Ti implants, etc.);
2. Multifunctionality – single microwires can sense temperature, stress and position at the same time

3. Glass-coating is biocompatible, protects metallic nucleus from corrosion, short-circuits etc.;
4. Contactless sensing because of magnetic nature;
5. Imperishable – when a microwire is broken, two sensors are obtained (like braking a magnet results in getting two magnets)
6. Small dimensions allow constructions of network of sensors;
7. Low energy consumptions – can be powered by little battery or photovoltaic cells;
8. Simple sensing process – no electronics is necessary inside the construction;
9. Production process allows to produce thousands of sensors in short time;
10. Real time data – 1000x/sec;

8.7 LESSON LEARNED & SUSTAINABILITY

The success of the implementation depends on the way how RVmagnetics can show the benefits of technology to our partner and how our partner has capacity to adopt new revolutionary technologies of the RVmagnetics.

Cost efficient and high added value brings the benefits which provide the sustainability of implementation of RVmagnetics´s technology.

8.8 REPLICABILITY AND UP SCALING

This solution can be implemented to a wide range of companies. It must be noted, however, that it initially requires a financial commitment and the organizational culture should be open to the use of new revolutionary technologies.

8.9 FINAL REMARKS

In the Industry 4.0 and IoT world will be necessary to have information from each part and each aspect of production process. These information could save the material costs up to 30%, increase the effectivity and deliver new added value for customers.

Disclaimer / Acknowledgements

The company describing this good practice doesn’t guarantee the successfulness of the solution and can’t be held liable for its failure in application.

At the same time the company agrees with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

Attachment 1: Good Practice Presentation, Videos and Pictures:
https://www.dropbox.com/sh/i6yqas0q7cn5i1e/AADZwFi2B_vtxps_m3hUP3rla?dl=0

9 GP9: ORANGE BOX

B+R automatizace, spol. s r.o. - organizačná zložka
Contact person: Ing.Juraj Bielesch
Address: Trenčianska 17, 915 01 Nové Mesto nad Váhom, Slovakia
Phone: +421907174055
E-mail: Juraj.Bielesch@br-automation.com
Website: www.br-automation.com

Keywords : Quick implementation, Configurability, Simplicity, Flexibility
Good practice applied in: (NACE code) : NACE C.10-C.11

There are existing production enterprises, which are equipped with machines and lines, which are not capable to communicate with superior systems. Orange Box creates a gate to ERP, MES, Edge, Fog and Cloud solutions for these older machines. It provides technologies from Industry 4.0 without the need of programming. It interprets OEE and states of machine in real time. Extension to this is an Edge system, which provides all tools for data analysis and reporting, trends tracking, etc. OrangeBox was implemented in company Nestlé Slovakia s.r.o. (Ltd.).

9.1 GOOD PRACTICE DESCRIPTION

Robust control systems B&R provided HW platform for data acquiring (productivity, quality, energy consumption, operating state, …) from machine in real time. These control systems perform data acquisition, their evaluation and display, and in consequence their transfer through communication standards as OPC UA, MQTT,…. into superior control system, where analysis and reports are created.
OrangeBox allows upgrade to Smart factory of almost any production factory. It provides new communication technology OPC UA, MQTT, even for machines without own control system.
Results of consequent data analysis have immediate impact on arrangements for increasing the productivity, effectivity, quality and energetic effectivity of machines and lines. At the same time it allows to follow the effects of changes on individual parameters, watching the trends and compering them with historical data.

OrangeBox is IIoT device, which creates the gate between the machine and analytical tool (server, cloud, edge controller). Innovation of this solution lies in its configurability without the need of

programming or IT knowledge about OPC UA or MQTT. Moreover, the knowledge of PLC programming is also not needed.

Fig. 4 – Orange Box

9.2 OBJECTIVE AND TARGET AUDIENCE

The solution can be used on any type of SME or large company in all production enterprises. It was used for example in Slovakia, Germany and Austria.

9.3 METHODOLOGICAL APPROACH

System is essential for objective analysis of productivity, effectivity, energy consumption, etc. whereby return is determined by quality and speed of established actions.

Quality monitoring, search for contexts and trends tracking are the basic elements of system. Depth of knowledge about the impact on quality is proportional to the number of monitored variables and factors.

Implementation of basic system is simple and a handy maintenance technician is sufficient for the implementation. In the case of more difficult implementations, system integrator is needed. Handy technician, necessary HW, available network infrastructure, system can be implemented in 1 hour.

9.4 VALIDATION PROCESS

N/A

9.5 RESULTS / IMPACT

After implementation of minimal configuration at a customer and after 2 days of measuring, this system was able to organizational actions, which increased overall utility of machine over 20%. Analysis brought surprising relations. Investment returns were defined on level of 3 weeks.

9.6 SUCCESS FACTORS AND CONSTRAINTS

System is dependent on analytical abilities of the customer and possibilities of accepting necessary actions.

Selling points and the real or perceived benefits:

1. User friendly
2. Data in real time
3. Mountable in any environment
4. Configurable without programming knowledge
5. OPC UA and MQTT connectivity on Edge, ERP, MES, Cloud, …

9.7 LESSON LEARNED & SUSTAINABILITY

This solution is an ideal tool for already existing production enterprises, view about OEE in real time (before once a shift or day). Frequently surprising detection of the weak places in productivity, effectivity energy consumption and other unexpected relations.
Continuous implementation of actions, and their regular evaluation with enhancing of measuring points.

9.8 REPLICABILITY AND UP SCALING

System is created for repeated usage and it is not designed only for specific enterprise, factory or technology. Extending of the solution is limited only by willingness to invest in increasing the productivity of existing enterprises.

9.9 FINAL REMARKS

OrangeBox is configurable tool for measuring and evaluating the productivity, effectivity, and energy consumption, and it is suitable for predictive maintenance. Ideal tool for already existing production enterprises, view about OEE in real time (before once a shift or day). Frequently surprising detection of weak places in productivity, effectivity energy consumption and other unexpected relations.

Disclaimer / Acknowledgements

The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

At the same time the company agrees with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

Attachment 1: Website of the good practice: https://www.br-automation.com/cs/spolecnost/tiskove-zpravy/industrial-iot-for-brownfields/

Attachment 2: Website of the good practice: https://www.br-automation.com/en/about-us/customer-magazine/striking-brownfield-gold/

Attachment 3: Brochure of the good practice Orange Box to download: https://www.br-automation.com/en/downloads/#categories=catalogues-and-brochures/products/orange-box

10 LESSON LEARNED

This section contains the learned lessons related to the good practice collection activity from the perspective of the partner and who provided the data for each good practice.

Lessons learned from the perspective of the companies who provided the good practice information

All the companies were enthusiastic about the overall idea of the Smart Factory HUB project. However, when they saw the questionnaire, they feel a little embarrassed. They were not willing to fill out so much data. Moreover, some data can be filled only by CEO, some by managers, some by technicians, etc. Most of these companies (Photoneo, Matador, UAVONIC) recommended electronic questionnaire, with simpler questions. At least some groups of answers should be prepared in advance.

The most discussed problems related to implementation of innovative solutions were financial difficulty of initial investments and misunderstanding of the need to innovate.

Lesson learned from the perspective of the partner

We think that the chosen form of questionnaire is very inappropriate. Such questionnaire should be more digital and intuitive, e.g. electronic questionnaire as web page. Moreover, some answers should be prepared beforehand. Filling out questionnaire with such long texts is not comfortable for anybody. And we also think that the evaluation of the questionnaires was not so pleasant. It is a good practice to provide a simple questionnaire with the much more intuitive system and there must be an opportunity for companies to create a product presentation in standard form, e.g. 4 slides pptx file. This is a standard way of presenting companies in EU.

Generally, the involved companies were inclined to the cooperation and willingly provided us their experiences and solutions. They are looking forward to the next collaboration regarding this project and also smart solutions. Especially from the reason that many SMEs in Slovakia are conscious about the importance of the smart solutions for increasing their competitiveness on the European Internal Market but they are still not using and applying these solutions in their production process.

1 TEMPLATE FOR GOOD PRACTICE DOCUMENTATION

Element	Guiding questions	Answers
INTRODUCTION		
Company information	*Data identification, logo, contact person, possible representative image(s).*	PERFECTION IN AUTOMATION A MEMBER OF THE ABB GROUP **B + R automatizace, spol. s r.o. - organizačná zložka** Trenčianska 17 915 01 Nové Mesto nad Váhom, Slovakia Contact person: Ing.Juraj Bielesch Phone: +421 907 174 055 Fax: - E-mail: Juraj.Bielesch@br-automation.com Web: www.br-automation.com
Name and brief description.	*Name or acronym: what is the name that captures the essence of the good practice (key words).*	**Orange BOX** Data acquisition IIoT Industrial Internet of Things OEE – evaluation of productivity and effectivity of production devices Measuring of energy consumption Predictive maintenance

Element	Guiding questions	Answers
	Provide a concise description of the good practice being addressed.	There are existing production enterprises, which are equipped with machines and lines, which are not capable to communicate with superior systems. Orange Box creates a gate to ERP, MES, Edge, Fog and Cloud solutions for these older machines. It provides technologies from Industry 4.0 without the need of programming. It interprets OEE and states of machine in real time. Extension to this is an Edge system, which provide all tools for data analysis and reporting, trends tracking, etc. OrangeBox was implemented in company Nestlé.
GOOD PRACTICE DESCRIPTION		
Detailed description	*How did the SME create good practice/new product?*	Robust control systems B&R provided HW platform for data acquiring (productivity, quality, energy consumption, operating state, …) from machine in real time. These control systems perform data acquisition, their evaluation and display, and in consequence their transfer through communication standards as OPC UA, MQTT,…. into superior control system, where analysis and reports are created.
	What is the relationship to Smart Factory (SFH) approach: novel technology, production processes, HRM or cost efficiency, quality assurance, risk management?	OrangeBox allows **upgrade to Smart factory** of almost any production factory. It provides new communication technology OPC UA, MQTT, even for machines without own control system. Results of consequent data analysis have immediate impact on arrangements for increasing the productivity, effectivity, quality and energetic effectivity of machines and lines. At the same time it allows to follow the effects of changes on individual parameters, watching the trends and compering them with historical data.
	Describe what are the technical solutions and innovations: of the good practice.	OrangeBox is IIoT device, which creates the gate between the machine and analytical tool (server , cloud, edge controller). Innovation of this solution lies in its configurability without the need of programming or IT knowledge about OPC UA or MQTT. Moreover, the knowledge of PLC programming is also not needed.

Element	Guiding questions	Answers
		
	Highlights (or keywords) of the Best Practice	Quick implementation Configurability Simplicity Flexibility Knowledge of programming is not needed
	Good practice applied in: (NACE code)	C10-C11
Benchmarking	*How does your solution related to others provided by competitors*	Unique solution on the market, which provide not only converter of protocols or signal acquisition, but also data processing and displaying in real time directly near the selected machine. It is not necessary to program OrangeBox, for the ensuring of the connectivity it is needed to know the addresses only (or signals).

Element	Guiding questions	Answers
Additional information's / materials	*Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures, videos) are encouraged to be included in this section. Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).*	

Element	Guiding questions	Answers
		https://www.br-automation.com/en/about-us/customer-magazine/striking-brownfield-gold/ https://www.br-automation.com/en/events/br-sps-ipc-drives/innovations-2017/no-more-unplanned-downtime/ https://www.br-automation.com/en/downloads/#categories=catalogues-and-brochures/products/orange-box/ https://www.br-automation.com/en/downloads/catalogues-and-brochures/products/aprol/dwldwl10000370103/
OBJECTIVE AND TARGET AUDIENCE		
Geographical coverage and target audience	*What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible*	Slovak Republic, Germany, Austria
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	All production enterprises
Targeted customers and scale of use	*Select the target group of customers:* *1. SMEs (<250 employees)* *2. Large companies* *3. Public institutions* *4. End customer (Business to Customer)* *5. Other, please specify*	1. SMEs (<250 employees) ☒ 2. Large companies ☒ 3. Public institutions ☐ 4. End customer (Business to Customer) ☐ 5. Other, (please specify) ☐:

Element	Guiding questions	Answers
METHODOLOGICAL APPROACH		
Managerial aspects	*Cost efficiency of the good practice, if applicable*	System is essential for objective analysis of productivity, effectivity, energy consumption, etc. whereby return is determined by quality and speed of established actions.
	Quality assurance aspects, if applicable	Quality monitoring, search for contexts and trends tracking are the basic elements of system. Depth of knowledge about the impact on quality is proportional to the number of monitored variables and factors.
	Risk management aspects, if applicable	N/A
Implementation guidelines	*How can the Good practice be implemented?*	Implementation of basic system is simple and a handy maintenance technician is sufficient for the implementation. In the case of more difficult implementations, system integrator is needed.
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	Handy technician, necessary HW, available network infrastructure, system can be implemented in 1 hour
VALIDATION PROCESS		
Validation	*Provide a brief description of the good practice validation process.*	N/A
RESULTS/IMPACT		
Solution impact	*What has been the impact (positive or negative) of this good practice on the beneficiaries?*	After implementation of minimal configuration at a customer and after 2 days of measuring, this system was able to organizational actions, which increased overall utility of machine over 20%. Analysis brought surprising relations. Investment returns were defined on level of 3 weeks.
SUCCESS FACTORS AND CONSTRAINTS		
Limitations and Strong points	*Describe limitations, both from the technical and implementation point of view.*	System is dependent on analytical abilities of the customer and possibilities of accepting necessary actions.

Element	Guiding questions	Answers
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands.	User friendly Data in real time Mountable in any environment Configurable without programming knowledge OPC UA and MQTT connectivity on Edge, ERP, MES, Cloud, …
Need assessment	*What else would be needed in order to improve the impact of the Good practice?*	Improvements in analysis, enhancing the number of measuring points
LESSON LEARNED		
Lessons learned	*What are the key messages and lessons learned to take away from the good practice experience*	Ideal tool for already existing production enterprises, view about OEE in real time (before once a shift or day). Frequently surprising detection of weak places in productivity, effectivity energy consumption and other unexpected relations.
SUSTAINABILITY		
Sustainability of Good Practice	*Describe aspects related to sustainability of the Good Practice, if applicable*	Continuous implementation of actions, and their regular evaluation with enhancing of measuring points.
REPLICABILITY AND UP SCALING		
Replicability and further application	*How can the solution / good practice be useful for other SMEs?*	System is created for repeated usage and it is not designed only for specific enterprise, factory or technology.
	What are the possibilities of extending the good practice more widely?	Extending of solution is limited only by willingness to invest in increasing the productivity of existing enterprises.
FINAL REMARKS		
Conclusion	*Conclude specifying / explaining the impact and usefulness of the good practice.*	OrangeBox is configurable tool for measuring and evaluating the productivity, effectivity, and energy consumption, and it is suitable for predictive maintenance. Ideal tool for already existing production enterprises, view about OEE in real time (before once a shift or day). Frequently surprising detection of weak places in productivity, effectivity energy consumption and other unexpected relations.

Element	Guiding questions	Answers
FINAL REMARKS		
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application. We agree with on-line and printed dissemination of the information from this questionnaire.

Ba/30-11-2017/SOPK-PP

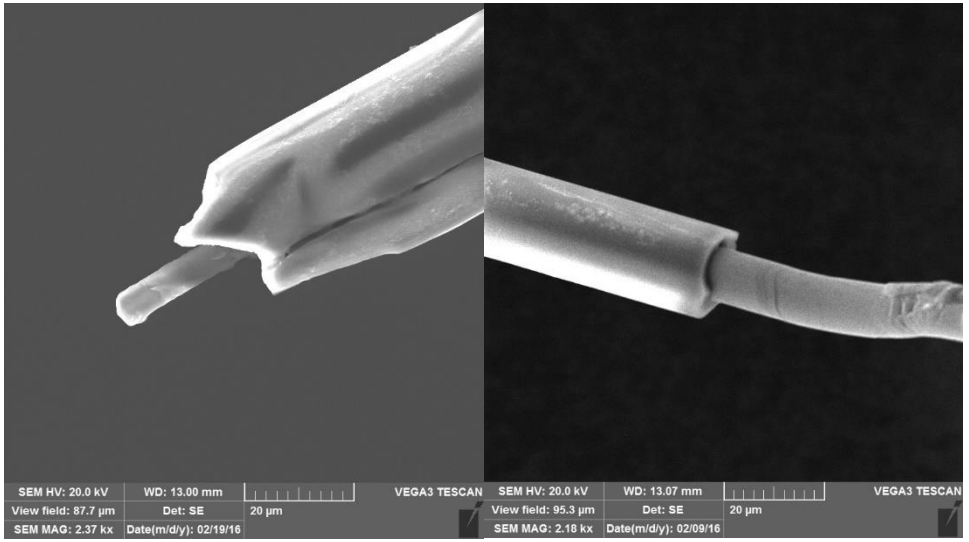
2 TEMPLATE FOR GOOD PRACTICE DOCUMENTATION

Element	Guiding questions	Answers
INTRODUCTION		
Company information	*Data identification, logo, contact person, possible representative image(s).*	Data identification : RVmagnetics, a.s., Logo: Contact person: Michal Borza – member of BoD

Element	Guiding questions	Answers
		Hodkovce 21, 04421 Hodkovce Slovakia Phone: (+421) 918 88 55 38 Fax: - E-mail: info@rvmagnetics.com Web: www.rvmagnetics.com
Name and brief description.	*Name or acronym: what is the name that captures the essence of the good practice (key words).*	Smallest passive contactless sensors of physical quantities (temperature, pressure, magnetic field, position…); in the world.
	Provide a concise description of the good practice being addressed.	European Defence Agency used RVmagnetics´s sensors to measure the structural health of carbon fibres composites. Czech construction company used RVmagnetics´s sensors to measure the forces during the construction of a train bridge. With Singapore partner RVmagnetics are creating the smart composites based on microwire technology. With partner RVmagnetics creates new generation, effective, more robust and simple railroad sensor to monitor the traffic and other parameters.
GOOD PRACTICE DESCRIPTION		
Detailed description	*How did the SME create good practice/new product?*	EDA needed to know what the quality of composites material is used in European defence program. Goal of the project was to compare the technologies of structural health monitoring and improve the manufacture process, effectivity, etc. RVmagnetics´s microwire technology was compared with standard invasive and non-invasive techniques with excellent results.

Element	Guiding questions	Answers
		Czech construction company need to measure the forces during the construction of new innovative train bridge. RVmagnetics developed new non-destructive measuring system, with zero error, which shows what kind of forces are inside of concrete.
	What is the relationship to Smart Factory (SFH) approach: novel technology, production processes, HRM or cost efficiency, quality assurance, risk management?	RVmagnetics bring to the market absolutely new generation of physical quantities sensors, based on microwire technology which offer to RVmagnetics´s partners create smart goods from their standard portfolio. RVmagnetics´s technology is ideal for IoT world and Industry 4.0
	Describe what are the technical solutions and innovations: of the good practice.	With RVmagnetics´s technology could be goods of our partners smarter, more effective, self-diagnosed and much more. The innovative nature of this solution is that it provides non-invasive testing, monitoring and measuring method for composites materials, which monitors the production process, application process and values from real use. With this technology partners can save the material costs, produce smarter goods and bring new added value for their partners.
	Highlights (or keywords) of the Best Practice	Specific keywords: sensors; structural health monitoring; non-invasive; innovative; magnetic; IoT; Industry 4.0.
	Good practice applied in: (NACE code)	Good practice applied in the field of: Construction of bridges and tunels (42.13) Manufacture of instruments and appliances for measuring, testing and navigating (26.51)

Element	Guiding questions	Answers
Benchmarking	*How does your solution related to others provided by competitors*	There is no non-invasive monitoring/testing/measuring technology for composites or any others goods, with online and real-time data. Compared other indirect competitors RVmagnetics´s technology has these benefits: 1) **Small dimensions** – microwires can be embedded into the various structures without changing of mechanical properties of the structure (e.g. glass- and carbon- fibre composites, polymers, Ti implants, etc.); 2) **Multifunctionality** – single microwires can sense temperature, stress and position at the same time 3) **Glass-coating** is biocompatible, protects metallic nucleus from corrosion, short-circuits etc.; 4) **Contactless** sensing because of magnetic nature; 5) **Imperishable** – when a microwire is broken, two sensors are obtained (like braking a magnet results in getting two magnets) 6) Small dimensions allow constructions of **network of sensors**; 7) **Low energy consumptions** – can be powered by little battery or photovoltaic cells; 8) **Simple sensing process** – no electronics is necessary inside the construction; 9) Production process allows to produce **thousands of sensors** in short time; 10) **Real time data** – 1000x/sec;
Additional information's / materials	*Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures, videos) are encouraged to be included in this section.*	At this link you can find the basic presentation, videos, onepager and also academic/scientific papers about the technology:).

Element	Guiding questions	Answers
	Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).	https://www.dropbox.com/sh/i6yqas0q7cn5i1e/AADZwFi2B_vtxps_m3hUP3rla?dl=0 
OBJECTIVE AND TARGET AUDIENCE		
Geographical coverage and target audience	*What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible*	Spain; Czech Republic; Slovakia; In negotiation process with partners from: Singapore, Japan, UK, Lithuania, USA
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	Solution can be applied by other companies which are looking for the innovation which brings the new high added value to their products, which can be transfer to their customers, and also by companies which are looking to solve their problems which are not possible solved by current state of technology.

Element	Guiding questions	Answers
Targeted customers and scale of use	*Select the target group of customers:* *6. SMEs (<250 employees)* *7. Large companies* *8. Public institutions* *9. End customer (Business to Customer)* *10. Other, please specify*	6. SMEs (<250 employees) ☒ 7. Large companies ☒ 8. Public institutions ☐ 9. End customer (Business to Customer) ☐ 10. Other, (please specify) ☐:
METHODOLOGICAL APPROACH		
Managerial aspects	*Cost efficiency of the good practice, if applicable*	RVmagnetics provides as simple as possible solution which we offer to our partners. From the costs perspective, the solution can save up to 30% of material costs for selected sectors (composites materials), or provide new and high added value with minimum initial costs.
	Quality assurance aspects, if applicable	New and high added value for products; new information of production process which could be transformed to higher profit.
	Risk management aspects, if applicable	N/A
Implementation guidelines	*How can the Good practice be implemented?*	The methodology for implementing this solution comprised of the following steps: 1. Feasibility study (establish whether the solution can be implemented – interviews with operators, budget analysis, potential benefits and weak points; information about the environment); 2. Create the HW and SW prototype. 3. Testing 4. Implementation 5. Verify the impact
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	Companies should also commit resources for the following aspects: - conducting an initial feasibility study for determining if or how the solution can be applied specifically in case of each; - (Technical) cooperation in production prototype process.

Element	Guiding questions	Answers
		- Costs of solution or exclusive license - Costs of sensor The timespan for fully implementing the solution is between 6-18 months.
VALIDATION PROCESS		
Validation	*Provide a brief description of the good practice validation process.*	The validation process is done after each period of development resp. application in the external condition which were selected by partner.
RESULTS/IMPACT		
Solution impact	*What has been the impact (positive or negative) of this good practice on the beneficiaries?*	From the costs perspective, the solution can save upto 30% of material costs for selected sectors (composites materials), or provide new and high added value with minimum initial costs.
SUCCESS FACTORS AND CONSTRAINTS		
Limitations and Strong points	*Describe limitations, both from the technical and implementation point of view.*	Technical: 1. Temperature over 600 °C; 2. Depth inside the material for contactless sensing over 30 cm.
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands.	Unique solution based on revolutionary technology which brings high added value for our partner and their customers. Benefits: 1. **Small dimensions** – microwires can be embedded into the various structures without changing of mechanical properties of the structure (e.g. glass- and carbon- fibre composites, polymers, Ti implants, etc.); 2. **Multifunctionality** – single microwires can sense temperature, stress and position at the same time 3. **Glass-coating** is biocompatible, protects metallic nucleus from corrosion, short-circuits etc.; 4. **Contactless** sensing because of magnetic nature;

Element	Guiding questions	Answers
		5. **Imperishable** – when a microwire is broken, two sensors are obtained (like braking a magnet results in getting two magnets) 6. Small dimensions allow constructions of **network of sensors**; 7. **Low energy consumptions** – can be powered by little battery or photovoltaic cells; 8. **Simple sensing process** – no electronics is necessary inside the construction; 9. Production process allows to produce **thousands of sensors** in short time; 10. **Real time data** – 1000x/sec;
Need assessment	*What else would be needed in order to improve the impact of the Good practice?*	Partners which are open to implement unique solutions based on revolutionary technology.
LESSON LEARNED		
Lessons learned	*What are the key messages and lessons learned to take away from the good practice experience*	The success of the implementation depends on on the way how RVmagnetics can show the benefits of technology to our partner and how our partner has capacity to adopt new revolutionary technologies and RVmagnetics
SUSTAINABILITY		
Sustainability of Good Practice	*Describe aspects related to sustainability of the Good Practice, if applicable*	Cost efficient and high added value bring the benefit which provide the sustainability of implementation of RVmagnetics´s technology.
REPLICABILITY AND UP SCALING		
Replicability and further application	*How can the solution / good practice be useful for other SMEs?*	This solution can be implemented to a wide range of companies, It must be noted, and however, that it initially requires a financial commitment and the organizational culture should be open to the use of new revolutionary technologies.
	What are the possibilities of extending the good practice more widely?	Partners which are looking for the innovations.
FINAL REMARKS		

Element	Guiding questions	Answers
Conclusion	*Conclude specifying / explaining the impact and usefulness of the good practice.*	In the Industry 4.0 and IoT world will be necessary to have information from each part and each aspect of production process. These information could save the material costs up to 30%, increase the effectivity and deliver new added value for customers.
FINAL REMARKS		
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application. We agree with on-line and printed dissemination of the information from this questionnaire.

Ba/30-11-2017/SOPK-PP

Element	Guiding questions	Answers
INTRODUCTION		
Company information	Data identification, logo, contact person, possible representative image(s).	Data identification**: ANEXT a.s., BRATISLAVA** Logo: ANEXT Contact person: **Juraj Smutný – Managing Partner** **Hurbanovo námestie 3, 811 06 BRATISLAVA, Slovenská republika** Phone: +421 2 38 105 760; +421 917 566 566 Fax: +421 2 321 144 266; Email: mailto:info@anext.sk

Element	Guiding questions	Answers
		Public relations: publicrelations@anext.sk Website: http://www.anext.sk/
Name and brief description.	Name or acronym: what is the name that captures the essence of the good practice	Computer vision using deep neural networks NEURONIT in industrial production
	Provide a concise description of the good practice being addressed	VW Bratislava in its production of specially glued body parts to check their quality experimentally deploys deep neural networks from Anext. The intention is to limit the impact of the human factor in the automotive industry in the spirit of the concept Industry 4.0.
GOOD PRACTICE DESCRIPTION		
Detailed description	How did the SME create good practice / new product?	**VW Bratislava** started cooperation with the company Anext in late 2017. This year was successful finished development deep neural network NEURONIT for different application industrial outputs. One of them is deployment in the area advanced industrial computer vision with elements of AI.
	What is the relationship to SFH approach: novel technology, production processes, HRM or cost efficiency, quality assurance, risk management?	This solution is strongly tied with the “Smart Factory” concept, as a novel technology, advanced industrial computer vision with elements of AI were incorporated directly and contributed to the production of a specific product.
	Describe what are the technical solutions and innovations: of the good practice	The innovative nature of this solution is that it **provides fully automatic quality control of the robotically applied layer of adhesive glues**. The proposed workstation is completely unattended and guarantees the quality of the finished parts in production.

Element	Guiding questions	Answers
	Highlights (or keywords) of the Best Practice	Specific keywords: **deep neural network advanced industrial computer vision, AI.**
	Good practice applied in : (NACE code)	Good practice applied in the field of: Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers (NACE code C29.2).
Benchmarking	How does your solution related to others provided by competitors	The application of the current technology extended over to other industry branches, but its use differed in nature from this type of application . When this solution was implemented, it was the first of its kind that made use of deep neural network advanced industrial computer vision with elements of AI. Currently used for the purpose computer vision system without elements of AI (for example Cognex). Just adding elements of AI makes the system fully autonomous in the spirit of the concept Industry 4.0.
Additional information's / materials	Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures, videos) are encouraged to be included in this section. Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).	All additional information is available at the company Anext.
OBJECTIVE AND TARGET AUDIENCE		
Geographical coverage and target audience	What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible	The solution described previously was applied in **VOLKSWAGEN SLOVAKIA, a. s., Bratislava** (further only VW Bratislava), a Manufacturer of cars and parts of the Volkswagen brands, factory situated in Bratislava-Devínska Nová Ves, Slovakia.

Element	Guiding questions	Answers
		(Website: https://www.volkswagen.sk/)
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	Solution can be applied by other companies that are willing to integrate deep neural network advanced industrial computer vision with elements of AI into their manufacturing process, especially those that have operators involved in product assembly activities. The practice has a high degree of portability and can be adapted to companies operating in various industry branches.
Targeted customers and scale of use	Select the target group of customers: 1. SMEs (<250 employees) **2. Large companies** 3. Public institutions 4. End customer (Business to Customer) Other, please specify	Large company
METHODOLOGICAL APPROACH		
Managerial aspects	Cost efficiency of the good practice, if applicable	From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only background to analysis in form required neural network and maintenance and software updates) and further investments after implementation are not needed..
	Quality assurance aspects, if applicable	The solution led to a significant decrease in faulty and non-conforming products reported by customers, which, in turn, increased customer satisfaction.
	Risk management aspects, if applicable	N/A
Implementation guidelines	How can the Good practice be implemented?	**The methodology for implementing this solution comprised of the following steps:** **1. Feasibility study (establish whether the solution can be implemented – interviews with operators, budget analysis, potential benefits and weak points);**

Element	Guiding questions	Answers
		2. Acquire hardware part of the solution (computing servers, high-precision cameras); **3. Develop software part of the solution (containing wire-harness assembly steps and additional information, both auditive and visual);** **4. Implement the solution into the assembly process (train neural network for properly using the equipment);** **5. Verify the impact (% in errors or scrap reduction, assembly duration shortening, etc.) compared to previous data.**
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	For future successful implementation, companies should follow the steps described in the "Methodological approach" section and should appoint a project manager who will oversee the acquisition of equipment, software development contracting and the training of selected operators. Companies should also commit resources for the following aspects: - conducting an initial feasibility study for determining if or how the solution can be applied specifically in case of each company and what will be its impact (can be carried out internally or by contracting specialized consultancy companies); - acquiring equipment computing servers, high-precision cameras); - developing a custom application, specific to each company's assembly process, which will be installed on the production line; - selecting and training the operators which will be using the The timespan for fully implementing the solution stretched over a period of 6 months.
VALIDATION PROCESS		
Validation	Provide a brief description of the good practice validation process.	The validation process was completed within the customer factory and comprised in the analysis and comparison of the error / scrap rates and the assembly time needed by operators before and after implementation.

Element	Guiding questions	Answers
RESULTS / IMPACT		
Solution impact	What has been the impact (positive or negative) of this good practice on the beneficiaries	The impact of the solution was highly positive, as the scrap rates were reduced to almost 0% and the assembly time was reduced with an average too. These led to an increase in productivity and customer satisfaction.
SUCCESS FACTORS AND CONSTRAINTS		
Limitations and Strong points	Describe limitations, both from the technical and implementation point of view	The quality of advanced computer vision strongly depends on the quality of learning deep neural network based on the quality of the data provided.
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands	This solution was the first of its kind, as not any other company made use of this type of practice, especially in its assembly process. As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.
Need assessment	What else would be needed in order to improve the impact of the Good practice	The system performs better if the component devices have better technical specifications (e.g. computing servers, high-precision cameras) and the quality of the data provided to deep neural network must be as good as possible
LESSON LEARNED		
Lessons learned	What are the key messages and lessons learned to take away from the good practice experience	The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. The reliability and performance of the system is directly related to the initial investment, as hardware and devices with lower technical specifications function at a reduced performance.
SUSTAINABILITY		
Sustainability of Good Practice	Describe aspects related to sustainability of the Good Practice, if applicable	Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.
REPLICABILITY AND UP SCALING		

Element	Guiding questions	Answers
Replicability and further application	How can the solution / good practice be useful for other SMEs?	This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a medium financial commitment and the organizational culture should be open to the use of new technologies.
	What are the possibilities of extending the good practice more widely?	Currently, the remote assistance feature of this system is under development, for assuring guided support for even more complex tasks.
FINAL REMARKS		
Conclusion	Conclude specifying / explaining the impact and usefulness of the good practice.	The solution requires a medium financial commitment, however, compared to the benefits it offers (scrap reduction almost 0%, time needed for assembly reduced increased productivity, increased customer satisfaction, elimination of printed documentation, making operators' activities more efficient) it can easily be supported by any company. Moreover, the implementation of these types of solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted under "Industrie 4.0".
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application. We are agree with on-line and printed dissemination of the information from this questionnaire.

Ba/21-11-2017/ Doc. Ing. Ján Vachálek, PhD./ SOPK-PP

3 TEMPLATE FOR GOOD PRACTICE DOCUMENTATION

Element	Guiding questions	Answers
INTRODUCTION		
Company information	Data identification, logo, contact person, possible representative image(s).	Data identification**: ANEXT a.s., BRATISLAVA** Logo: ANEXT Contact person: **Juraj Smutný – Managing Partner** **Hurbanovo námestie 3, 811 06 BRATISLAVA, Slovenská republika** Phone: +421 2 38 105 760; +421 917 566 566 Fax: +421 2 321 144 266; Email: mailto:info@anext.sk Public relations: publicrelations@anext.sk Website: http://www.anext.sk/
Name and brief description.	Name or acronym: what is the name that captures the essence of the good practice	Computer vision using deep neural networks NEURONIT in industrial production
	Provide a concise description of the good practice being addressed	VW Bratislava in its production of specially glued body parts to check their quality experimentally deploys deep neural networks from Anext. The intention is to limit the impact of the human factor in the automotive industry in the spirit of the concept Industry 4.0.
GOOD PRACTICE DESCRIPTION		

Element	Guiding questions	Answers
Detailed description	How did the SME create good practice / new product?	**VW Bratislava** started cooperation with the company Anext in late 2017. This year was successful finished development deep neural network NEURONIT for different application industrial outputs. One of them is deployment in the area advanced industrial computer vision with elements of AI.
	What is the relationship to SFH approach: novel technology, production processes, HRM or cost efficiency, quality assurance, risk management?	This solution is strongly tied with the “Smart Factory” concept, as a novel technology, advanced industrial computer vision with elements of AI were incorporated directly and contributed to the production of a specific product.
	Describe what are the technical solutions and innovations: of the good practice	The innovative nature of this solution is that it **provides fully automatic quality control of the robotically applied layer of adhesive glues**. The proposed workstation is completely unattended and guarantees the quality of the finished parts in production.
	Highlights (or keywords) of the Best Practice	Specific keywords: **deep neural network advanced industrial computer vision, AI.**
	Good practice applied in : (NACE code)	Good practice applied in the field of: Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers (NACE code C29.2).
Benchmarking	How does your solution related to others provided by competitors	The application of the current technology extended over to other industry branches, but its use differed in nature from this type of application . When this solution was implemented, it was the first of its kind that made use of deep neural network advanced industrial computer vision with elements of AI. Currently used for the purpose computer vision system without elements of AI (for example Cognex). Just adding elements of AI makes the system fully autonomous in the spirit of the concept Industry 4.0.
Additional information’s / materials	Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures,	All additional information is available at the company Anext.

Element	Guiding questions	Answers
	videos) are encouraged to be included in this section. Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).	
OBJECTIVE AND TARGET AUDIENCE		
Geographical coverage and target audience	What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible	The solution described previously was applied in **VOLKSWAGEN SLOVAKIA, a. s., Bratislava** (further only VW Bratislava), a Manufacturer of cars and parts of the Volkswagen brands, factory situated in Bratislava-Devínska Nová Ves, Slovakia. (Website: https://www.volkswagen.sk/)
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	Solution can be applied by other companies that are willing to integrate deep neural network advanced industrial computer vision with elements of AI into their manufacturing process, especially those that have operators involved in product assembly activities. The practice has a high degree of portability and can be adapted to companies operating in various industry branches.
Targeted customers and scale of use	Select the target group of customers: 5. SMEs (<250 employees) **6. Large companies** 7. Public institutions 8. End customer (Business to Customer) Other, please specify	Large company
METHODOLOGICAL APPROACH		

Element	Guiding questions	Answers
Managerial aspects	Cost efficiency of the good practice, if applicable	From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only background to analysis in form required neural network and maintenance and software updates) and further investments after implementation are not needed..
	Quality assurance aspects, if applicable	The solution led to a significant decrease in faulty and non-conforming products reported by customers, which, in turn, increased customer satisfaction.
	Risk management aspects, if applicable	N/A
Implementation guidelines	How can the Good practice be implemented?	**The methodology for implementing this solution comprised of the following steps:** **6. Feasibility study (establish whether the solution can be implemented – interviews with operators, budget analysis, potential benefits and weak points);** **7. Acquire hardware part of the solution (computing servers, high-precision cameras);** **8. Develop software part of the solution (containing wire-harness assembly steps and additional information, both auditive and visual);** **9. Implement the solution into the assembly process (train neural network for properly using the equipment);** **10. Verify the impact (% in errors or scrap reduction, assembly duration shortening, etc.) compared to previous data.**
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	For future successful implementation, companies should follow the steps described in the “Methodological approach” section and should appoint a project manager who will oversee the acquisition of equipment, software development contracting and the training of selected operators. Companies should also commit resources for the following aspects: - conducting an initial feasibility study for determining if or how the solution can be applied specifically in case of each company and what will be its impact

Element	Guiding questions	Answers
		(can be carried out internally or by contracting specialized consultancy companies); - acquiring equipment computing servers, high-precision cameras); - developing a custom application, specific to each company's assembly process, which will be installed on the production line; - selecting and training the operators which will be using the The timespan for fully implementing the solution stretched over a period of 6 months.
VALIDATION PROCESS		
Validation	Provide a brief description of the good practice validation process.	The validation process was completed within the customer factory and comprised in the analysis and comparison of the error / scrap rates and the assembly time needed by operators before and after implementation.
RESULTS / IMPACT		
Solution impact	What has been the impact (positive or negative) of this good practice on the beneficiaries	The impact of the solution was highly positive, as the scrap rates were reduced to almost 0% and the assembly time was reduced with an average too. These led to an increase in productivity and customer satisfaction.
SUCCESS FACTORS AND CONSTRAINTS		
Limitations and Strong points	Describe limitations, both from the technical and implementation point of view	The quality of advanced computer vision strongly depends on the quality of learning deep neural network based on the quality of the data provided.
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands	This solution was the first of its kind, as not any other company made use of this type of practice, especially in its assembly process. As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.

Element	Guiding questions	Answers
Need assessment	What else would be needed in order to improve the impact of the Good practice	The system performs better if the component devices have better technical specifications (e.g. computing servers, high-precision cameras) and the quality of the data provided to deep neural network must be as good as possible
LESSON LEARNED		
Lessons learned	What are the key messages and lessons learned to take away from the good practice experience	The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. The reliability and performance of the system is directly related to the initial investment, as hardware and devices with lower technical specifications function at a reduced performance.
SUSTAINABILITY		
Sustainability of Good Practice	Describe aspects related to sustainability of the Good Practice, if applicable	Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.
REPLICABILITY AND UP SCALING		
Replicability and further application	How can the solution / good practice be useful for other SMEs?	This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a medium financial commitment and the organizational culture should be open to the use of new technologies.
	What are the possibilities of extending the good practice more widely?	Currently, the remote assistance feature of this system is under development, for assuring guided support for even more complex tasks.
FINAL REMARKS		
Conclusion	Conclude specifying / explaining the impact and usefulness of the good practice.	The solution requires a medium financial commitment, however, compared to the benefits it offers (scrap reduction almost 0%, time needed for assembly reduced increased productivity, increased customer satisfaction, elimination of printed documentation, making operators' activities more efficient) it can easily be supported by any company. Moreover, the implementation of these types of

Element	Guiding questions	Answers
		solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted under "Industrie 4.0".
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application. We are agree with on-line and printed dissemination of the information from this questionnaire.

Ba/21-11-2017/ Doc. Ing. Ján Vachálek, PhD./ SOPK-PP

4 TEMPLATE FOR GOOD PRACTICE DOCUMENTATION

Element	Guiding questions	Answers
INTRODUCTION		
Company information	*Data identification, logo, contact person, possible representative image(s).*	MATADOR Automation, s.r.o. Matador GROUP Továrenská 1, 018 41 Dubnica nad Váhom, Slovak Republic Contact person: **Ing. Maroš Mudrák** Head of Development of special robotic applications Mobile: +421 908 948 928 E-mail: maros.mudrak@matador-group.eu I Web: www.matador-group.eu
Name and brief description.	*Name or acronym: what is the name that captures the essence of the good practice (key words).*	Collaborative robot integrated in industrial environment of Smart Factory

Element	Guiding questions	Answers
	Provide a concise description of the good practice being addressed.	Integration of collaborative robot into an industrial environment with the aim of removal non-ergonomic and not effective human labour. Integration and implementation of application, which requires high precision and accuracy, and high safety in terms of sharing the workplace between robot and humans. This solution was integrated in Škoda Vrchlabí (Czech republic).
GOOD PRACTICE DESCRIPTION		
Detailed description	*How did the SME create good practice/new product?*	In 2014 company started to focus its activities on higher degree of robotics. Trends in this field showed that one of the most important integrations will be robots capable of cooperation with humans. Our company has own development and research capacities, that is why we created this solution.
	What is the relationship to Smart Factory (SFH) approach: novel technology, production processes, HRM or cost efficiency, quality assurance, risk management?	Solution is fully compatible with Smart Factory and it follows the trends in Smart Factory. It is fully integrated with other systems and it can communicate with its environment in IoT meaning, but also in communication with humans.
	Describe what are the technical solutions and innovations: of the good practice.	Design of safe workplace with multi-axis robot, which can help the human operator, eventually it can replace him within difficult operations. Repeatability and full integrity between operators without the necessity of safety barriers usage.
	Highlights (or keywords) of the Best Practice	Collaborative robot
	Good practice applied in: (NACE code)	29
Benchmarking	*How does your solution related to others provided by competitors*	Our solution is more suitable for workplaces if there is no more place for safety elements needed for standard robotic applications.

Element	Guiding questions	Answers
Additional information's / materials	*Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures, videos) are encouraged to be included in this section. Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).*	More information can be found: http://www.matador-group.eu/domov/ Solution was integrated in ŠKODA Auto, Vrchlabí (Czech republic) as an assembly cell used for servo mechanics of automated gear. It was first integration of collaborative robotics in group Volkswage, and it was awarded as the most innovative act in 2015 in Slovak republic. Other integration was in ŠKODA Auto Mladá Boleslav (Czech republic) for tracking and inspecting the quality of products from suppliers. 
OBJECTIVE AND TARGET AUDIENCE		

Element	Guiding questions	Answers
Geographical coverage and target audience	*What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible*	Czech republic, ŠKODA Auto Vrchlabí
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	Target customers are all industrial corporations, which perform assembly tasks or manipulation with parts performed by human operator.
Targeted customers and scale of use	*Select the target group of customers:* *11. SMEs (<250 employees)* *12. Large companies* *13. Public institutions* *14. End customer (Business to Customer)* *15. Other, please specify*	11. SMEs (<250 employees) ☒ 12. Large companies ☒ 13. Public institutions ☐ 14. End customer (Business to Customer) ☐ 15. Other, (please specify) ☐:
METHODOLOGICAL APPROACH		
Managerial aspects	*Cost efficiency of the good practice, if applicable*	Removal of human operator in process of not effective production
	Quality assurance aspects, if applicable	Quality is ensured by fully integration and repeatability of solution itself.
	Risk management aspects, if applicable	N/A
Implementation guidelines	*How can the Good practice be implemented?*	Before implementation, very precise analysis of specific application is done. Consequently, safety risks and their elimination are evaluated and implemented.

Element	Guiding questions	Answers
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	It is needed to realize and accept the technology by the people, which will cooperate with the robot. They must accept him as a partner, not as a replacement. Every integration is modified for specific environment and it needs full cooperation between integrator and customer, which better knows the specification of his environment.
VALIDATION PROCESS		
Validation	*Provide a brief description of the good practice validation process.*	Validation was performed by customer and on the basis of error rate and safety conditions, which correspond with technical specifications and standards in EU.
RESULTS/IMPACT		
Solution impact	*What has been the impact (positive or negative) of this good practice on the beneficiaries?*	Removal of non-ergonomic work. This increased performance of production process.
SUCCESS FACTORS AND CONSTRAINTS		
Limitations and Strong points	*Describe limitations, both from the technical and implementation point of view.*	If the safety risks concerning human harming are too high and these overall risks are impossible to eliminate, our solution cannot be implemented.
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands.	Integration with safety barriers and direct cooperation between robot and human.
Need assessment	*What else would be needed in order to improve the impact of the Good practice?*	Find suitable partner for wider integration and increasing acceptance between humans, which will cooperate with the robot.
LESSON LEARNED		

Element	Guiding questions	Answers
Lessons learned	*What are the key messages and lessons learned to take away from the good practice experience*	Technology is ready for implementation into production and safety risk is minimal concerning cooperation between robot and humans.
SUSTAINABILITY		
Sustainability of Good Practice	*Describe aspects related to sustainability of the Good Practice, if applicable*	N/A
REPLICABILITY AND UP SCALING		
Replicability and further application	*How can the solution / good practice be useful for other SMEs?*	Implementation will increase the quality of production and reduce non-ergonomic work of human workers.
	What are the possibilities of extending the good practice more widely?	Our solution can be used in any type of production.
FINAL REMARKS		
Conclusion	*Conclude specifying / explaining the impact and usefulness of the good practice.*	Our solution is specified by implementation of collaborative robots, which can be implemented near the human workers or they can directly cooperate their actions with humans in production process. Integration of such solution will increase the quality of production operations and repeatability of production itself.
FINAL REMARKS		
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application. We agree with on-line and printed dissemination of the information from this questionnaire.

Ba/30-11-2017/ Doc. Ing. František Duchoň, PhD./ SOPK-PP

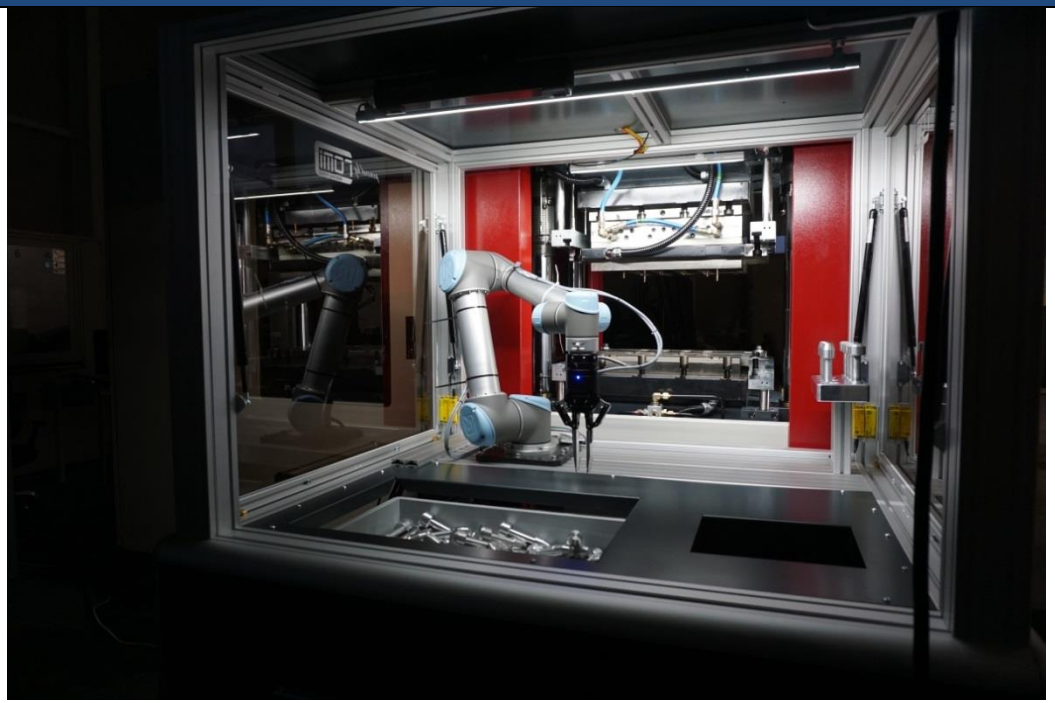
5 TEMPLATE FOR GOOD PRACTICE DOCUMENTATION

Element	Guiding questions	Answers
INTRODUCTION		
Company information	*Data identification, logo, contact person, possible representative image(s).*	Photoneo s.r.o. Jamnického 3 841 05 Bratislava Slovenská republika IČO: 47353309 Ján Žižka, zizka@photoneo.com

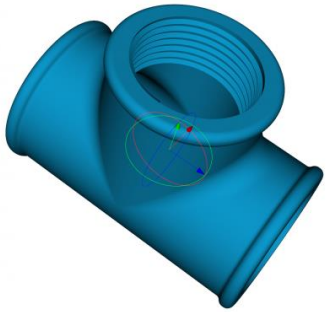
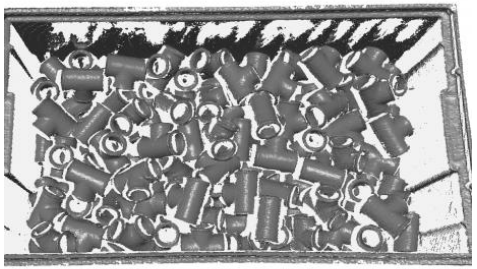
Element	Guiding questions	Answers
		Web: www.photoneo.com Photoneo focused on 3D
Name and brief description.	*Name or acronym: what is the name that captures the essence of the good practice (key words).*	Bin picking
	Provide a concise description of the good practice being addressed.	1. Photoneo's Bin picking solution works with our family of industrial grade 3D scanners PhoXi Scan. 2. Using advanced 3D algorithms, it runs at high speed and with a high precision. It allows the user to scan object or input a CAD model, select grip points and alternative grip points. The container is scanned and objects are picked one by one. Such solution was implemented in ROMI Industrial Systems s.r.o., company from Slovakia. Similar solutions are already implemented in companies ZF, Hydac, and Boge.
GOOD PRACTICE DESCRIPTION		
Detailed description	*How did the SME create good practice/new product?*	Company has developed own 3D scanner called PhoXi Scan and own software for control of the robot based on ROS. Bin picking Solution is composed of these parts: 4. Robot 5. 3D scanner 6. Bin Picking SDK Software All these parts were implemented for our customer ROMI Industrial Systems s.r.o. (more details: http://www.romi-is.com/?page_id=42).
	What is the relationship to Smart Factory (SFH) approach: novel technology, production	The demanding needs on automation require nowadays complex systems which very often can be achieved only with the help of industrial robots. Therefore we

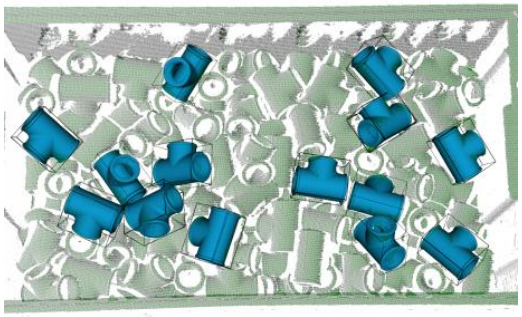
Element	Guiding questions	Answers
	processes, HRM or cost efficiency, quality assurance, risk management?	cooperate with different robot producers and integrate their robots in to our production solutions. Bin picking by Photoneo is a new technology, which leads to autonomous bin picking workplace. Such workplace is an essential part of Smart Factory. Increasing the efficiency of robotic work cells is directly connected to autonomous robot problem. Such solutions are requested in Smart Factory. The robotic vision and 3D scanning systems become more and more important for automation solutions since the need to automate even smaller production quantities and therefore create flexible automation solutions is growing.
	Describe what are the technical solutions and innovations: of the good practice.	Our solution brings new approach (technology) to bin picking by robot. We are capable to analyse 3D data in bins and compare it with CAD model of the picked part. Analysis then decides which part is seizable for the robot. By the application of such procedure the robot is able to pick all the parts in bin without any help of human. This brings very effective solutions in industries, where assemblies or similar process are needed.
	Highlights (or keywords) of the Best Practice	Bin picking
	Good practice applied in: (NACE code)	
Benchmarking	*How does your solution related to others provided by competitors*	Our solution is completely different to those providing by competitors. Bin picking is well known problem and robots are capable to solve this problem when the parts are placed in known positions. Our solution does need to know the precise position of the part and this is great comparative advantage in compare with our competitors.
Additional information's / materials	*Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures, videos) are encouraged to be included in this section.*	All other informations are available at: http://www.photoneo.com

Element	Guiding questions	Answers
	Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).	

Element	Guiding questions	Answers
		 https://www.youtube.com/watch?v=8aOiKJ5_QsU
OBJECTIVE AND TARGET AUDIENCE		
Geographical coverage and target audience	*What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible*	The solution described above was applied in Slovakia in the company ROMI Industrial Systems s.r.o.

Element	Guiding questions	Answers
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	Automotive, electronics, food etc.
Targeted customers and scale of use	*Select the target group of customers:* *16. SMEs (<250 employees)* *17. Large companies* *18. Public institutions* *19. End customer (Business to Customer)* *20. Other, please specify*	1. SMEs (<250 employees) ☒ 2. Large companies ☒ 3. Public institutions ☐ 4. End customer (Business to Customer) ☐ 5. Other, (please specify) ☐:
METHODOLOGICAL APPROACH		
Managerial aspects	*Cost efficiency of the good practice, if applicable*	N/A
	Quality assurance aspects, if applicable	Solution led to more efficient production and reduction of costs for human labour.
	Risk management aspects, if applicable	N/A
Implementation guidelines	*How can the Good practice be implemented?*	Our good practice can be applied to any customer, which requires autonomous removing of components from the bins. First we will provide primary study of the workplace and then if all aspects of the customer are redeemable, we provide also the integration of solution including various types of robots. Application of bin picking is very easy. Created software solution allows it in three steps: 1. Insert CAD model.

Element	Guiding questions	Answers
		 2. Capture 3D scene.  3. Get localized results.

Element	Guiding questions	Answers
		
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	As any automation device, the primary costs are higher than recruit some human labour. However, if production volumes are also higher, then the costs are also reduced. Our customer must count with several months for implementation.
VALIDATION PROCESS		
Validation	*Provide a brief description of the good practice validation process.*	Solution was validated in, and the reliability of solution is usually over 90% (i.e. from 1000 parts 900 is autonomously picked). However, this depends on the shape of part and bin. Some more complicated parts can fit into each other and this will decrease the reliability. Another interesting parameter is the time of unloading. This also depends on part and bin. However, full 3D scanning and data processing of our solution does not last longer than 1 s.
RESULTS/IMPACT		

Element	Guiding questions	Answers
Solution impact	*What has been the impact (positive or negative) of this good practice on the beneficiaries?*	Impact of this solution is positive in the manner of more efficient autonomous production. However, there is also negative impact in taking part of people's work.
SUCCESS FACTORS AND CONSTRAINTS		
Limitations and Strong points	*Describe limitations, both from the technical and implementation point of view.*	System is limited as a standard robotic workplace, especially from the safety point of view. Some limitations are also defined by parts which the robotic grippers are able to pick. And other limitations are based on the kinematics of the robot. This depends on the used robot and the shape of the bin.
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands.	1. detects 1 objects in 200 ms 2. allows multiple gripping points 3. avoids obstacles, walls 4. locates the object with a high precision of 0.5 mm 5. Smart memory (allows the robot to remember positions of all objects which are ready to be gripped after one scan. This allows a further speedup, since after first object is gripped and removed from the container, other objects are immediately queued in smart memory and are available to be picked without the need to analyze the scene.) 6. simple to use graphical user interface for configuration of localization process 7. robust detection and localization of occluded parts with respect to potential gripping point 8. Parallel, simultaneous localization of multiple instances, asynchronous results stream
Need assessment	*What else would be needed in order to improve the impact of the Good practice?*	Solution is dependent on used hardware and software. We are developing our software to be more intelligent. And we are also developing more advanced PhoXi sensor. However, our solution is dependent on robotic producers and if robot properties improve, our solution will be also improved.
LESSON LEARNED		

Element	Guiding questions	Answers
Lessons learned	*What are the key messages and lessons learned to take away from the good practice experience*	The success of implementation depends on mutual cooperation of integrator and customer. We strongly recommend using an experienced integrator. This is the basics for successful implementation.
SUSTAINABILITY		
Sustainability of Good Practice	*Describe aspects related to sustainability of the Good Practice, if applicable*	Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.
REPLICABILITY AND UP SCALING		
Replicability and further application	*How can the solution / good practice be useful for other SMEs?*	The solution can be implemented in a wide range of industrial companies (automotive, food, electronics). Our product can be also used as a smaller part of more complex system, when system requires: 1. 3D object recognition 2. Inspection of object placement 3. General inspection and analysis
	What are the possibilities of extending the good practice more widely?	Solution can be expanded by more appropriate software and new versions of PhoXi scanner.
FINAL REMARKS		
Conclusion	*Conclude specifying / explaining the impact and usefulness of the good practice.*	The solution requires higher initial investment costs and skilled integrator. At the end, very effective autonomous bin picking application arises. This solution is especially characterized by unknown positions of the picked parts.
FINAL REMARKS		
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

Element	Guiding questions	Answers
		We agree with on-line and printed dissemination of the information from this questionnaire.

Ba/30-11-2017/ Doc. Ing. František Duchoň, PhD./ SOPK-PP

6 TEMPLATE FOR GOOD PRACTICE DOCUMENTATION

Element	Guiding questions	Answers
INTRODUCTION		
Company information	*Data identification, logo, contact person, possible representative image(s).*	UAVONIC s.r.o. Galvaniho 17/B 821 04 Bratislava Slovak Republic

Element	Guiding questions	Answers
		IČO: 47648244 DIČ: 2024018161 IČ DPH: SK2024018161 Contact person: Ing. Juraj Dudáš, dudas@uavonic.com, WEB: www.uavonic.com UAVONIC unmanned aircraft services
Name and brief description.	*Name or acronym: what is the name that captures the essence of the good practice (key words).*	Volumetric measurements by UAV
	Provide a concise description of the good practice being addressed.	Volumetric measurement by UAV devices is a modern method allowing for example inspection of outdoor storage with high capacity. This method can replace employees with standard measuring devices, which have higher inaccuracies and their usage is time consuming or there is a risk of potential injury. Volumetric measurements by UAV are composed of aerial pictures created by calibrated cameras or laser scanners. This data are consequently processed in software, which creates digital 3D model of measured material. Accuracy of this process is higher than the other standard measuring methods. Such volumetric measurements were proposed and implemented in Mondi SCP a.s.
GOOD PRACTICE DESCRIPTION		

Element	Guiding questions	Answers
Detailed description	*How did the SME create good practice/new product?*	Company created this solution due to intensive work of experienced and technically competent employees and also due to cooperation of segment specialist from Mondi SCP a.s.
	What is the relationship to Smart Factory (SFH) approach: novel technology, production processes, HRM or cost efficiency, quality assurance, risk management?	Our approach is characterized by novel technologies as precise cameras or laser scanners and by intelligent software solutions. It is clear that smart factory needs smart control and smart control is characterized by smart and precise measuring. Our approach brings novel approach to volumetric measurements in any segment of the industry.
	Describe what are the technical solutions and innovations: of the good practice.	3. Technical solution is characterized in two ways: 4. 1. novel hardware – precise cameras with laser scanners 2. novel software – data fusion and fast volumetric measurements of high capacity storage
	Highlights (or keywords) of the Best Practice	volumetric measurements
	Good practice applied in: (NACE code)	17
Benchmarking	*How does your solution related to others provided by competitors*	Our company routinely works with current solutions and we try to add value by implementing unmanned technologies into standard industrial services. This gives us comparative benefit in compare with our competitors.
Additional information's / materials	*Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures, videos) are encouraged to be included in this section. Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).*	WWW.UAVONIC.COM, https://www.linkedin.com/company/uavonic/

Element	Guiding questions	Answers
		

Element	Guiding questions	Answers
		 

Element	Guiding questions	Answers
OBJECTIVE AND TARGET AUDIENCE		
Geographical coverage and target audience	*What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible*	The solution described previously was applied in Mondi SCP a.s. factory situated in Ružomberok, Slovakia.
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	Industrial enterprises, academic sector, agriculture, forestry, construction, environmental sectors
Targeted customers and scale of use	*Select the target group of customers:* *21. SMEs (<250 employees)* *22. Large companies* *23. Public institutions* *24. End customer (Business to Customer)* *25. Other, please specify*	1. SMEs (<250 employees) ☒ 2. Large companies ☒ 3. Public institutions ☒ 4. End customer (Business to Customer) ☐ 5. Other, (please specify) ☐:
METHODOLOGICAL APPROACH		
Managerial aspects	*Cost efficiency of the good practice, if applicable*	N/A
	Quality assurance aspects, if applicable	Solution led to a significant optimization of logistics in company.
	Risk management aspects, if applicable	N/A
Implementation guidelines	*How can the Good practice be implemented?*	Depends individually on the application and request of the customers. We are able to provide basic study for the customer and then the customer decides, if he/she is able to cooperate on such solution.

Element	Guiding questions	Answers
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	At least some experts on specified problems (e.g. volumetric measurements of wood's storage will need forestry expert) are necessary to be presented during the first steps.
VALIDATION PROCESS		
Validation	*Provide a brief description of the good practice validation process.*	It is hard to validate volumetric measurements of high capacity storage. Validation can be done only by standard measuring devices, which are usually much more inaccurate than laser scanners or cameras. However, the measurement can be validated in industrial process, e.g. amount of consumed wood. Validation in Mondi SCP a.s. was performed this way.
RESULTS/IMPACT		
Solution impact	*What has been the impact (positive or negative) of this good practice on the beneficiaries?*	Impact of this solution is positive in the manner of control of whole producing process. Partner exactly knows, what amount of material he has available for production and consequently he can optimize whole logistic and save the costs.
SUCCESS FACTORS AND CONSTRAINTS		
Limitations and Strong points	*Describe limitations, both from the technical and implementation point of view.*	System is limited by environment around the storage. If the storage is outside, our system is not able to measure when the weather is not suitable for the flight of UAV. Moreover, it is also limited in some dusty or in other ways disadvantageous for UAV technology.
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands.	1. Safety 2. High resolution 3. Costs saving 4. Time efficiency

Element	Guiding questions	Answers
Need assessment	*What else would be needed in order to improve the impact of the Good practice?*	Solution is dependent on used hardware and software. With the development of more precise sensors and more intelligent software the solution will acquire even more precise results.
LESSON LEARNED		
Lessons learned	*What are the key messages and lessons learned to take away from the good practice experience*	The success of implementation depends on mutual cooperation of integrator and customer. Reliability and performance of whole system is dependent on initial investment to technologies, but our company can provide such solution also as service.
SUSTAINABILITY		
Sustainability of Good Practice	*Describe aspects related to sustainability of the Good Practice, if applicable*	Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.
REPLICABILITY AND UP SCALING		
Replicability and further application	*How can the solution / good practice be useful for other SMEs?*	The solution can be implemented in a wide range of industrial companies (forestry, construction, metallurgy etc.), but also in agriculture or other branches.
	What are the possibilities of extending the good practice more widely?	Solution can be expanded by more efficient hardware elements (especially laser scanners and computers) and in future such systems should be autonomous. However, this is still in development.
FINAL REMARKS		
Conclusion	*Conclude specifying / explaining the impact and usefulness of the good practice.*	The solution requires higher initial investment costs and skilled workers (UAVs, software, etc.). However, our company provides the solution as a service. So the aspects about the implementation are removed for the partners.

Element	Guiding questions	Answers
FINAL REMARKS		
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application. We agree with on-line and printed dissemination of the information from this questionnaire.

Ba/30-11-2017/ Doc. Ing. František Duchoň, PhD./ SOPK-PP

7 TEMPLATE FOR GOOD PRACTICE DOCUMENTATION

Element	Guiding questions	Answers
INTRODUCTION		
Company information	Data identification, logo, contact person, possible representative image(s).	Data identification**: ANEXT a.s., BRATISLAVA** Logo: ANEXT

Element	Guiding questions	Answers
		Contact person: **Juraj Smutný – Managing Partner** **Hurbanovo námestie 3, 811 06 BRATISLAVA, Slovenská republika** Phone: +421 2 38 105 760; +421 917 566 566 Fax: +421 2 321 144 266; Email: mailto:info@anext.sk Public relations: publicrelations@anext.sk Website: http://www.anext.sk/
Name and brief description.	Name or acronym: what is the name that captures the essence of the good practice	Using **deep neural networks NEURONIT with advanced Computer vision** in industrial production
	Provide a concise description of the good practice being addressed	**Plastic Omnium** in its production of automotive bumpers to check their quality experimentally deploys deep neural networks from Anext. The intention is to limit the impact of the human factor in the automotive industry in the spirit of the concept Industry 4.0.
GOOD PRACTICE DESCRIPTION		
Detailed description	How did the SME create good practice / new product?	**Plastic Omnium** started cooperation with the company Anext in late 2017. This year was successful finished development **deep neural network NEURONIT** for different application industrial outputs. One of them is deployment in the area **advanced industrial computer vision with elements of AI**.
	What is the relationship to SFH approach: novel technology, production processes, HRM or cost efficiency, quality assurance, risk management?	This solution is strongly tied with the “Smart Factory” concept, as a novel technology, **advanced industrial computer vision with elements of AI** were incorporated directly and contributed to the production of a specific product.
	Describe what are the technical solutions and innovations: of the good practice	The innovative nature of this solution is that it provides fully automatic quality control of the robotically applied layer of adhesive glues. The proposed

Element	Guiding questions	Answers
		workstation is completely unattended and guarantees the quality of the finished parts in production.
	Highlights (or keywords) of the Best Practice	Specific keywords: **deep neural network advanced industrial computer vision, AI.**
	Good practice applied in : (NACE code)	Good practice applied in the field of: Manufacture of other parts and accessories for motor vehicles (NACE code C29.32).
Benchmarking	How does your solution related to others provided by competitors	The application of the current technology extended over to other industry branches, but its use differed in nature from this type of application . When this solution was implemented, it was the first of its kind that made use of deep neural network advanced industrial computer vision with elements of AI. Currently used for the purpose computer vision system without elements of AI (for example Cognex). Just adding elements of AI makes the system fully autonomous in the spirit of the concept Industry 4.0.
Additional information's / materials	Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures, videos) are encouraged to be included in this section. Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).	All additional information is available at the company Anext.
OBJECTIVE AND TARGET AUDIENCE		
Geographical coverage and target audience	What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible	The solution described previously was applied in **Plastic Omnium Auto Exteriors, s.r.o. (Ltd.) , a** Manufacturer of plastic parts for automotive industry, factory situated in Lozorno, Slovakia. (Web: http://www.plasticomnium.com)

Element	Guiding questions	Answers
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	Solution can be applied by other companies that are willing to integrate deep neural network advanced industrial computer vision with elements of AI into their manufacturing process, especially those that have **operators involved in product assembly activities.** The practice has a high degree of portability and can be adapted to companies operating in various industry branches.
Targeted customers and scale of use	Select the target group of customers: **9. SMEs (<250 employees)** 10. Large companies 11. Public institutions 12. End customer (Business to Customer) Other, please specify	**1. SMEs (<250 employees)** **2. Large companies**
METHODOLOGICAL APPROACH		
Managerial aspects	Cost efficiency of the good practice, if applicable	From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only background to analysis in form required neural network and maintenance and software updates) and **further investments after implementation are not needed..**
	Quality assurance aspects, if applicable	The solution led to a significant decrease in faulty and non-conforming products reported by customers, which, in turn, increased customer satisfaction.
	Risk management aspects, if applicable	N/A
Implementation guidelines	How can the Good practice be implemented?	**The methodology for implementing this solution comprised of the following steps:**

Element	Guiding questions	Answers
		11. Feasibility study (establish whether the solution can be implemented – interviews with operators, budget analysis, potential benefits and weak points); **12. Acquire hardware part of the solution (computing servers, high-precision cameras);** **13. Develop software part of the solution (containing wire-harness assembly steps and additional information, both auditive and visual);** **14. Implement the solution into the assembly process (train neural network for properly using the equipment);** **15. Verify the impact (% in errors or scrap reduction, assembly duration shortening, etc.) compared to previous data.**
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	For future successful implementation, companies should follow the steps described in the "Methodological approach" section and should appoint a project manager who will oversee the acquisition of equipment, software development contracting and the training of selected operators. Companies should also commit resources for the following aspects: - conducting an initial feasibility study for determining if or how the solution can be applied specifically in case of each company and what will be its impact (can be carried out internally or by contracting specialized consultancy companies); - acquiring equipment computing servers, high-precision cameras); - developing a custom application, specific to each company's assembly process, which will be installed on the production line; - selecting and training the operators which will be using the The timespan for fully implementing the solution stretched over a period of 6 months.
VALIDATION PROCESS		

Element	Guiding questions	Answers
Validation	Provide a brief description of the good practice validation process.	The validation process was completed within the customer factory and comprised in the analysis and comparison of the error / scrap rates and the assembly time needed by operators before and after implementation.
RESULTS / IMPACT		
Solution impact	What has been the impact (positive or negative) of this good practice on the beneficiaries	The impact of the solution was highly positive, as the scrap rates were reduced to almost 0% and the assembly time was reduced with an average too. These led to an increase in productivity and customer satisfaction.
SUCCESS FACTORS AND CONSTRAINTS		
Limitations and Strong points	Describe limitations, both from the technical and implementation point of view	The quality of advanced computer vision strongly depends on the quality of learning deep neural network based on the quality of the data provided.
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands	This solution was the first of its kind, as not any other company made use of this type of practice, especially in its assembly process. As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.
Need assessment	What else would be needed in order to improve the impact of the Good practice	The system performs better if the component devices have better technical specifications (e.g. computing servers, high-precision cameras) and the quality of the data provided to deep neural network must be as good as possible
LESSON LEARNED		
Lessons learned	What are the key messages and lessons learned to take away from the good practice experience	The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. The reliability and performance of the system is directly related to the initial investment, as hardware and devices with lower technical specifications function at a reduced performance.
SUSTAINABILITY		

Element	Guiding questions	Answers
Sustainability of Good Practice	Describe aspects related to sustainability of the Good Practice, if applicable	Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.
REPLICABILITY AND UP SCALING		
Replicability and further application	How can the solution / good practice be useful for other SMEs?	This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a medium financial commitment and the organizational culture should be open to the use of new technologies.
	What are the possibilities of extending the good practice more widely?	Currently, the remote assistance feature of this system is under development, for assuring guided support for even more complex tasks.
FINAL REMARKS		
Conclusion	Conclude specifying / explaining the impact and usefulness of the good practice.	The solution requires a medium financial commitment, however, compared to the benefits it offers (scrap reduction almost 0%, time needed for assembly reduced increased productivity, increased customer satisfaction, elimination of printed documentation, making operators' activities more efficient) it can easily be supported by any company. Moreover, the implementation of these types of solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted under "Industrie 4.0".
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application. We are agree with on-line and printed dissemination of the information from this questionnaire.

Ba/22-11-2017/ Doc. Ing. Ján Vachálek, PhD./ SOPK-PP

8 TEMPLATE FOR GOOD PRACTICE DOCUMENTATION

Element	Guiding questions	Answers
INTRODUCTION		
Company information	Data identification, logo, contact person, possible representative image(s).	Data identification : Sova Digital a.s., Logo: SOVA DIGITAL Product Lifecycle Management Contact person: **Milan Lokšík – Managing Partner** **Bojnická 3, 831 04 Bratislava,Slovak Republic (SK)** tel.: 00421/ 2/ 4333 0643, 4333 0372 fax: 00421/ 2/ 4333 9505 Email: info@sova.sk, info@industry4.sk; Website: www.sova.sk, http://industry4.sk/
Name and brief description.	Name or acronym: what is the name that captures the essence of the good practice	**THE DIGITAL TWIN OF AN INDUSTRIAL PRODUCTION LINE WITHIN THE INDUSTRY 4.0 CONCEPT**
	Provide a concise description of the good practice being addressed	In **Embraco Slovakia s.r.o.,** Sova Digital focusing on the continuous optimization of production processes, proactive maintenance, and continuous processing of process data. Basic goal is to support the existing production structures within the automotive industry and the most efficient use of resources by augmented production and planning strategies, such as the digital twin.

Element	Guiding questions	Answers
GOOD PRACTICE DESCRIPTION		
Detailed description	How did the SME create good practice / new product?	**Embraco Slovakia s.r.o** started cooperation with the company Sova Digital a.s. in late 2016. Sova Digital offered integration of the digital twin (DT). A DT is essentially a functional system of continuous process optimization, which is formed by the cooperation of physical production lines with a digital "copy. It creates the digital factory environment, in which the company can optimize the operation directly through the production chain, manipulate parameters and production processes; adapting the product to market requirements.
	What is the relationship to SFH approach: novel technology, production processes, HRM or cost efficiency, quality assurance, risk management?	This solution is strongly tied with the "Smart Factory" concept, as a novel technology. Digital twin collects and evaluates the information continuously, allowing, among other things, to shorten and streamline the production cycle, reduce the rise time of introducing new products, detecting inefficient settings of the underlying processes. The concept of the digital twin, therefore, is built on the principle known today as Industry 4.0.
	Describe what are the technical solutions and innovations: of the good practice	The digital twin is formed by the physical production line and its digital "copy". The major feature of this arrangement is the interface, through which data exchange takes place. **The digital part is based on the simulation tool called Plant Simulation (PS)** made by SIEMENS. The digital simulation model of the production line was created in this environment. This model was a detailed virtual copy of the physical process.
	Highlights (or keywords) of the Best Practice	Specific keywords: **digital twin, optimization of production, genetic algorithm, data collection**
	Good practice applied in : (NACE code)	**Manufacture of other pumps and compressors (NACE code C28.13).**

Element	Guiding questions	Answers
Benchmarking	How does your solution related to others provided by competitors	The application of the current technology extended over to other industry branches, but its use differed in nature from this type of application . When this solution was implemented, it was the first of its kind that made use integration of the digital twin.
Additional information's / materials	Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures, videos) are encouraged to be included in this section. Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).	All additional information are available at the company Sova Digital.
OBJECTIVE AND TARGET AUDIENCE		
Geographical coverage and target audience	What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible	The solution described previously was applied in **EMBRACO SLOVAKIA s.r.o. (Ltd.),** a Manufacturer of a full range of condensing units using R134a, R404A, R290 and R600 refrigerants in low and high torque versions and a wide range of refrigeration, freezing and air conditioning applications, factory situated in Spišská Nová Ves, Slovakia. (Webside: http://www.embraco.sk/)
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	
Targeted customers and scale of use	Select the target group of customers: 13. SMEs (<250 employees) 14. Large companies 15. Public institutions	**1. SMEs (<250 employees)** **2. Large companies**

Element	Guiding questions	Answers
	16. End customer (Business to Customer) Other, please specify	
METHODOLOGICAL APPROACH		
Managerial aspects	Cost efficiency of the good practice, if applicable	From the costs perspective, the solution proved to be highly efficient, as it requires **minimum intervention** (only software and extra sensors when they needed) **and further investments after implementation are not needed..**
	Quality assurance aspects, if applicable	The solution led to a significant decrease in faulty and non-conforming products reported by customers, which, in turn, increased customer satisfaction.
	Risk management aspects, if applicable	N/A
Implementation guidelines	How can the Good practice be implemented?	16. Solution can be applied by other companies that are willing to integrate digital twin and the digital simulation model of the production line for continuous process optimization.The practice has a high degree of portability and can be adapted to companies operating in various industry branches.
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	SMEs (<250 employees)
VALIDATION PROCESS		
Validation	Provide a brief description of the good practice validation process.	The validation process was completed within the customer factory and comprised in the analysis and comparison of the error / scrap rates and the assembly time needed by operators before and after implementation.
RESULTS / IMPACT		
Solution impact	What has been the impact (positive or negative) of this good practice on the beneficiaries	The impact of the solution was highly positive, as the scrap rates were reduced and the assembly time was reduced with an average too. **These led to an increase in productivity and customer satisfaction.**
SUCCESS FACTORS AND CONSTRAINTS		

Element	Guiding questions	Answers
Limitations and Strong points	Describe limitations, both from the technical and implementation point of view	The quality of DT of the plant is strongly based on the quality of the data provided. Based on this, we can build a **high quality simulation model** for software needs (Siemens Technomatix PS).
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands	This solution was the first of its kind, as not any other company made use of this type of practice, especially in its assembly process. As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.
Need assessment	What else would be needed in order to improve the impact of the Good practice	The system performs better if the component devices have better technical specifications (e.g. data servers, high-precision sensors) and the quality of the data provided to Siemens Technomatix PS software.
LESSON LEARNED		
Lessons learned	What are the key messages and lessons learned to take away from the good practice experience	The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. The reliability and performance of the system is directly related to the initial investment, as hardware and devices with lower technical specifications function at a reduced performance.
SUSTAINABILITY		
Sustainability of Good Practice	Describe aspects related to sustainability of the Good Practice, if applicable	Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.
REPLICABILITY AND UP SCALING		
Replicability and further application	How can the solution / good practice be useful for other SMEs?	This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a medium financial commitment and the organizational culture should be open to the use of new technologies.

Element	Guiding questions	Answers
	What are the possibilities of extending the good practice more widely?	Currently, the remote assistance feature of this system is under development, for assuring guided support for even more complex tasks.
FINAL REMARKS		
Conclusion	Conclude specifying / explaining the impact and usefulness of the good practice.	The solution requires a medium financial commitment, however, compared to the benefits it offers (scrap reduction, time needed for assembly reduced increased productivity, increased customer satisfaction. Moreover, the implementation of these types of solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted under "Industrie 4.0".
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application. We agree with on-line and printed dissemination of the information from this questionnaire.

Ba/23-11-2017/ Doc. Ing. Ján Vachálek, PhD./ SOPK-PP

9 TEMPLATE FOR GOOD PRACTICE DOCUMENTATION

Element	Guiding questions	Answers
INTRODUCTION		
Company information	Data identification, logo, contact person, possible representative image(s).	Data identification : Sova Digital a.s., Logo: SOVA DIGITAL Product Lifecycle Management Contact person: **Milan Lokšík – Managing Partner** **Bojnická 3, 831 04 Bratislava,Slovak Republic (SK)** tel.: 00421/ 2/ 4333 0643, 4333 0372

Element	Guiding questions	Answers
		fax: 00421/ 2/ 4333 9505 Email: info@sova.sk, info@industry4.sk; Website: www.sova.sk, http://industry4.sk/
Name and brief description.	Name or acronym: what is the name that captures the essence of the good practice	**DIGITAL INTERNAL LOGISTICS VERIFICATION THROUGHOUT THE PLANT**
	Provide a concise description of the good practice being addressed	In **Honeywell Turbo s. r. o.,** Sova Digital focusing on the continuous optimization of production processes, proactive maintenance, and continuous processing of process data. Basic goal is to support the existing production structures within the industry and the most efficient use of resources by augmented production and planning strategies, such as the digital twin.
GOOD PRACTICE DESCRIPTION		
Detailed description	How did the SME create good practice / new product?	Honeywell Turbo s. r. o., started cooperation with the company Sova Digital a.s. in late 2016. Sova Digital offered integration of the digital internal logistics verification throughout the plant this is essentially for a functional system of continuous process optimization, which is formed by the cooperation of physical production lines with a digital “copy. It creates the digital factory environment, in which the company can optimize the operation directly through the production chain, manipulate parameters and production processes; adapting the product to market requirements.
	What is the relationship to SFH approach: novel technology, production processes, HRM or cost efficiency, quality assurance, risk management?	This solution is strongly tied with the “Smart Factory” concept, as a novel technology. Digital internal logistics verification throughout the plant collects and evaluates the information continuously, allowing, among other things, to shorten and streamline the production cycle, reduce the rise time of introducing new products, detecting inefficient settings of the underlying processes. The concept of the digital twin, therefore, is built on the principle known today as Industry 4.0.
	Describe what are the technical solutions and innovations: of the good practice	The Digital internal logistics verification throughout the plant is formed by the physical production line and its digital “copy”. The major feature of this arrangement is the interface, through which data exchange takes place. The

Element	Guiding questions	Answers
		digital part is based on the simulation tool called Plant Simulation (PS) made by SIEMENS. The digital simulation model of the production line was created in this environment. This model was a detailed virtual copy of the physical process.
	Highlights (or keywords) of the Best Practice	Specific keywords: **digital, logistics, optimization of production, genetic algorithm, data collection**
	Good practice applied in : (NACE code)	**Manufacture of other parts and accessories for motor vehicles** (Branche code NACE: C29.32).
Benchmarking	How does your solution related to others provided by competitors	The application of the current technology extended over to other industry branches, but its use differed in nature from this type of application . When this solution was implemented, it was the first of its kind that made use integration of the digital twin.
Additional information's / materials	Provide additional information if existing such as case studies, datasheets, whitepapers, awards and other relevant information. Electronic sources (websites, social media, pictures, videos) are encouraged to be included in this section. Training manuals, guidelines, technical fact sheets, posters, pictures, video animations, audio documents, 3D files, and/or other material about the Good practice implementation (if existing).	All additional information are available at the company Sova Digital.
OBJECTIVE AND TARGET AUDIENCE		
Geographical coverage and target audience	What is the geographical range where the good practice has been used / tested / validated: country, region, Danube Region if is relevant and possible	The solution described previously was applied in **Honeywell Turbo s. r. o.** (Ltd), a Manufacturer of motor vehicles, engines, vehicles, parts and accessories for motor vehicles and other means of transport, the factory situated in **Záborská (district Prešov), Slovakia.** (Webside: http://turbo.honeywell.com/)

Element	Guiding questions	Answers
	Specify also the target audience/potential customers and stakeholders (stakeholders can affect or be affected)	Solution can be applied by other companies that are willing to integrate digital internal logistics verification throughout the plant into their manufacturing process, especially those that have operators involved in product assembly activities. The practice has a high degree of portability and can be adapted to companies operating in various industry branches.
Targeted customers and scale of use	Select the target group of customers: 17. SMEs (<250 employees) 18. Large companies 19. Public institutions 20. End customer (Business to Customer) Other, please specify	**1. SMEs (<250 employees)** **2. Large companies**
METHODOLOGICAL APPROACH		
Managerial aspects	Cost efficiency of the good practice, if applicable	From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only software and extra sensors when they needed) and further investments after implementation are not needed..
	Quality assurance aspects, if applicable	The solution led to a significant decrease in faulty and non-conforming products reported by customers, which, in turn, increased customer satisfaction.
	Risk management aspects, if applicable	N/A
Implementation guidelines	How can the Good practice be implemented?	17. Solution can be applied by other companies that are willing **to integrate digital twin and the digital simulation model of the production line for continuous process optimization**.The practice has a high degree of portability and can be adapted to companies operating in various industry branches.

Element	Guiding questions	Answers
	What resources are necessary for implementation (personnel, finance, infrastructure and timespan)?	SMEs (<250 employees)
VALIDATION PROCESS		
Validation	Provide a brief description of the good practice validation process.	The validation process was completed within the customer factory and comprised in the analysis and comparison of the error / scrap rates and the assembly time needed by operators before and after implementation.
RESULTS / IMPACT		
Solution impact	What has been the impact (positive or negative) of this good practice on the beneficiaries	The impact of the solution was highly positive, as the scrap rates were reduced and the assembly time was reduced with an average too. These led to an increase in productivity and customer satisfaction.
SUCCESS FACTORS AND CONSTRAINTS		
Limitations and Strong points	Describe limitations, both from the technical and implementation point of view	The quality of Digital internal logistics verification throughout the plant is strongly based on the quality of the data provided. Based on this, we can build **a high quality simulation model for software needs** (Siemens Technomatix PS)
	Selling points – list the real or perceived benefit of a good practice that differentiates it from the competing brands and gives its client a logical reason to prefer it over other brands	This solution was the first of its kind, as not any other company made use of this type of practice, especially in its assembly process. As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.
Need assessment	What else would be needed in order to improve the impact of the Good practice	The system performs better if the component devices have better technical specifications (e.g. data servers, high-precision sensors) and the quality of the data provided to Siemens Technomatix PS software.
LESSON LEARNED		

Element	Guiding questions	Answers
Lessons learned	What are the key messages and lessons learned to take away from the good practice experience	The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. The reliability and performance of the system is directly related to the initial investment, as hardware and devices with lower technical specifications function at a reduced performance.
SUSTAINABILITY		
Sustainability of Good Practice	Describe aspects related to sustainability of the Good Practice, if applicable	Currently the price of the solutions can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.
REPLICABILITY AND UP SCALING		
Replicability and further application	How can the solution / good practice be useful for other SMEs?	This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a medium financial commitment and the organizational culture should be open to the use of new technologies.
	What are the possibilities of extending the good practice more widely?	Currently, the remote assistance feature of this system is under development, for assuring guided support for even more complex tasks.
FINAL REMARKS		
Conclusion	Conclude specifying / explaining the impact and usefulness of the good practice.	The solution requires a medium financial commitment, however, compared to the benefits it offers (scrap reduction, time needed for assembly reduced increased productivity, increased customer satisfaction. Moreover, the implementation of these types of solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted under "Industrie 4.0".
Disclaimer / Acknowledgements	Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	The company describing this good practice doesn't guarantee the successfulness of the solution and can't be held liable for its failure in application.

Element	Guiding questions	Answers
		We are agree with on-line and printed dissemination of the information from this questionnaire.

Ba/24-11-2017/ Doc. Ing. Ján Vachálek, PhD./ SOPK-PP