DOCUMENT TITLE:

HANDBOOK OF GOOD PRACTICE

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

Acronym: Smart Factory Hub

Work package	WP4: Improving Knowledge Base
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Dissemination level		
PU	Public	
PP	Restricted to other Programme participants	
RE	Restricted to a group specified by the consortium	
CO	Confidential, only for members of the consortium	X

Project co-funded by European Union funds (ERDF, IPA)

TARGET GROUP ASSESSMENT

Has this deliverable addressed any of the target group indicated in the application form?

Yes / No

If yes, please describe the involvement of each individual target group in the table below.

Target group	Number reached by the deliverable	Description of target group involvement
SME	*5x*	SME which provide data for good practice
Regional public authority		
National public authority		
Higher education and research		
Business support organisation		

CONTENT

1 Introduction

Manufacturing industry represents a generator of Research and Development, innovation, growth and employment. Based upon increasing pressure on manufacturers (increased production capacity in low-cost economies and increased level of sophistication of supply chains in high-cost economies), the manufacturers need to embrace novel technologies, principles and approaches.

In other words, manufacturers need to digitize their production, while taking into consideration also improvement in processes and human resource management.

The main objective of the Smart Factory HUB project is to improve framework conditions for innovation in the area of "smart factory".

Therefore, the project's goal is to develop R&D and business policy conditions for transnational cooperation in the manufacturing industry.

Result is improved cooperation between R&D and business where based on RIS3 (Research and Innovation Smart Specialization Strategy) centered model, quadruple helix partners will be oriented to find novel solutions in the following three domains: applying novel technologies, applying effective production process and applying effective human resource management system.[1]

2 About SFH Project

Within the SMART FACTORY HUB Project 10 countries (Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Romania, Serbia, Slovakia and Slovenia) have been selected to show, how they operationalized their smart specialization strategy and enhance innovation in the context of smart manufacturing.
Europe 2020' requires policy makers to consider how the different aspects of smart, sustainable and inclusive growth are interrelated. Integrated smart specialisation strategies respond to complex development challenges by adapting the policy to the regional context. This benchmark report is based on a statistical benchmark and regional mapping reports. The national smart specialization strategy and instruments from each single country give insights to funding schemes, sector trends, project and smart manufacturing solutions providers and production oriented SMEs. On the other hand, the benchmark report includes a bottom-up view on Smart manufacturing through a questionnaire, prepared in the 10 chosen countries and answered by more than 270 SMEs, showing highly interesting state-of-art in this very important sector.

[1] http://www.interreg-danube.eu/approved-projects/smart-factory-hub

Figure 1 The Danube region and SFH partner countries

3 Good Practice

The primary purpose of good practice case study findings is to introduce production-oriented companies with good practices in the field of managing Smart factories. Good practices are to be sought in three thematic areas, which are closely related - novel technologies, production processes and human resource management systems. At first a Good Practice Guidelines was prepared, under which the partners will get guidance on what actually a good practice represents and how to deal with the identification of good practice. Good practices shall essentially focus on improvements in three key areas - (1) cost efficiency, (2) quality assurance and (3) risk management, although other improvements could also be covered. After reconstitution of instructions, the partners collect good practices and conduct individual meetings with companies. Every regional partner has identify at least 5 good practices, which will be presented in a joint handbook. Since many businesses, especially smaller ones, are not familiar with possible solutions an additional handbook tool will be prepared, available for dissemination and assistance in planned investments in new smart factory solutions. Handbook will be available in electronic form on the web portal, while in the context of the dissemination work package also 250 pieces will be printed, which will be available in physical form to the participants at the closing dissemination event.

The important part of collecting good practices is to identify following topics, which will help the consortium to perform ex-ante, mid-term and post evaluation of good practices (during the A3: Developing assessment tools – D3.1.2 Monitoring toolkit development).

The areas of interest are:

- How did the SME created the good practice/new product?;
- Types of cooperation;
- Constraints and limitations in creating a good practice/new product;
- Lessons learned;
- Need assessment (what would be needed to create more, better, cheaper, faster, …).

„A good practice is not only a practice that is good, but a practice that has been proven to work well and produce good results, and is therefore recommended as a model. It is a successful experience, which has been tested and validated, in the broad sense, which has been repeated and deserves to be shared so that a greater number of people can adopt it."
(SOURCE: UN Food and Agriculture Organization, 2014)

The following set of criteria was used to determine whether a practice is a "good practice" [2] :

Effective and successful:
A "good practice" has proven its strategic relevance as the most effective way in achieving a specific objective; it has been successfully adopted and has had a positive impact on SME, is a novel technology, or have a significant impact on production process or human resources management.
Technically feasible:
Technical feasibility is the basis of a "good practice". It is easy to learn and to implement.
Replicable and adaptable:
A "good practice" should have the potential for replication and should therefore be adaptable to similar objectives in varying situations.
Environmentally, economically and socially sustainable:
A "good practice" meets current needs, in particular the essential needs of all of the global populations, without compromising the ability to address future needs.

The important part of collecting good practice is to identify following topics:

The **introduction** section will contain the company information (data identification, the logo, the contact person and a brief description.

The **good practice description** will contain a detailed description of the technical solution, managerial innovation and benchmarking of the product/service regarding existing solutions available on the market. Additional information related to case studies, whitepapers, awards and

[2] SOURCE: UN Food and Agriculture Organization, 2014

other relevant information can be provide, electronic sources are heavily encouraged to be used in this section.

The **objective and target audience** section will contain the geographical coverage and the target audience. This section can include a map of the Danube Region that will highlight the geographical location where the practice was implemented. Pain points of the good practice example should be described. The targeted customer and the scale of use should also be specified in this section.

Figure 2 Documentation of good practice[3]

The **Actors and stakeholders** section will contain information regarding the institutions and partners involved in the good practice implementation and their involvement.
The **methodological approach** section will contain the methodology used to address the initial issue and lead to the successful outcome. Managerial aspects regarding the cost efficiency, quality assurance and risk management will also be specified here. The implementation guidelines and the implementation effort that are required for the good practice system to work.
The **validation process** section will contain information regarding the validation of the good practice process with the stakeholders and final users.

[3] Adapted after Good practice template – Food and Agriculture organization of the United nations available on line : *www.fao.org/3/a-as547e.pdf*

The **results/impact** section will contain the technological focus that the product/service is addressing. The solution impact of this good practice regarding the beneficiaries will be presented. This section should contain illustrative delighters such as training manuals, guidelines, pictures, videos, audio files and 3D models.
The **success factors and constraints** section will contain the organizational prerequisites of the good practice and what are the areas and departments that will be affected. This section will contain the limitation both from the technical and implementation point of view. The strong points and the need assessment (weak points) will also be detailed in this section.
The **lessons learned** section will contain the key messages and lessons learned within the good practice experience.
The **innovations section** will present the factors that are required to have a positive effect of the outcome implementation.
The **sustainability** section will present the cost efficiency of the good practice solution and will present the factors that are required to have a positive effect of the implementation outcome.
The **replicability and up scaling** section will present the replicability of the good practice and the conditions that should be respected to ensure the optimal implementation.
The **final remarks** section will conclude the documentation process and it will explain the impact and usefulness of the good practice as well as the disclaimer and the acknowledgement.
Examples of good practices gathered within the project were classified using the schematic diagram detailed in Figure 2, starting from the suppliers and ending with the customers.

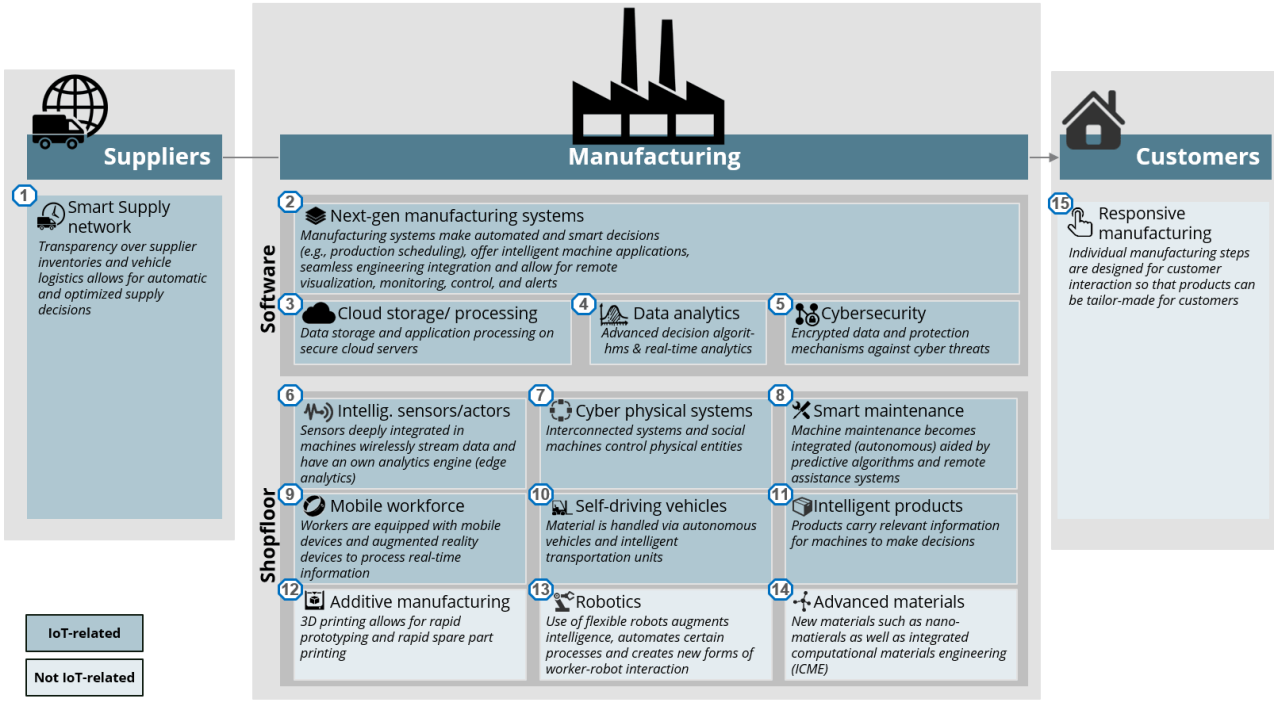

Figure 3 15 components of the smart factory of the future[4]

[4] Source https://iot-analytics.com/industrial-internet-disrupt-smart-factory/

4 SMART SUPPLY NETWORK

Industry 4.0 changes production logistics and transforms the demands regarding logistics organizations.

Logistics 4.0 and Supply Chain Management 4.0 or smart supply chain management concern the various aspects of end-to-end logistics and supply chain management in the context of Industry 4.0, the Internet of Things, cyber-physical systems, emerging technologies, advanced data analytics and (semi-)autonomous decisions enabled by AI[5].

In IBM vision there are three important components for smart supply[6]:

- **Instrumented**: Supply chains will be supported by pervasive data collection networks that provide real-time visibility; pallets will "report if the wind up in the wrong place." we are rapidly moving to a scenario where we have real-time visibility to everything all the time. How companies will best leverage this level of information will become a key competitive vector
- **Interconnected**: We will have system-to-system integration up and down the supply chain, not only to trading partners but to machines and inventory (shop floor to top floor). With Service Oriented Architecture, the web and other technology advances, it is not only easier but much less expensive than it the past to integrate systems.
- **Intelligent**: We will achieve better supply chain decision-making through advanced analytics and next generation optimization software. Supply chain complexity and lean-ness are key drivers of this trend, along with better working tools.

Figure 4 Location of Good practice

[5] Source : https://www.i-scoop.eu/industry-4-0/supply-chain-management-scm-logistics/
[6] Source: http://www.scdigest.com/ASSETS/FirstThoughts/10-08-26-1.php?cid=3701

4.1 BIN PICKING SOLUTION FOR FLEXIBLE AUTOMATION

Photoneo s.r.o.
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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.

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.

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.

Figure 5 – Bin picking model

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.

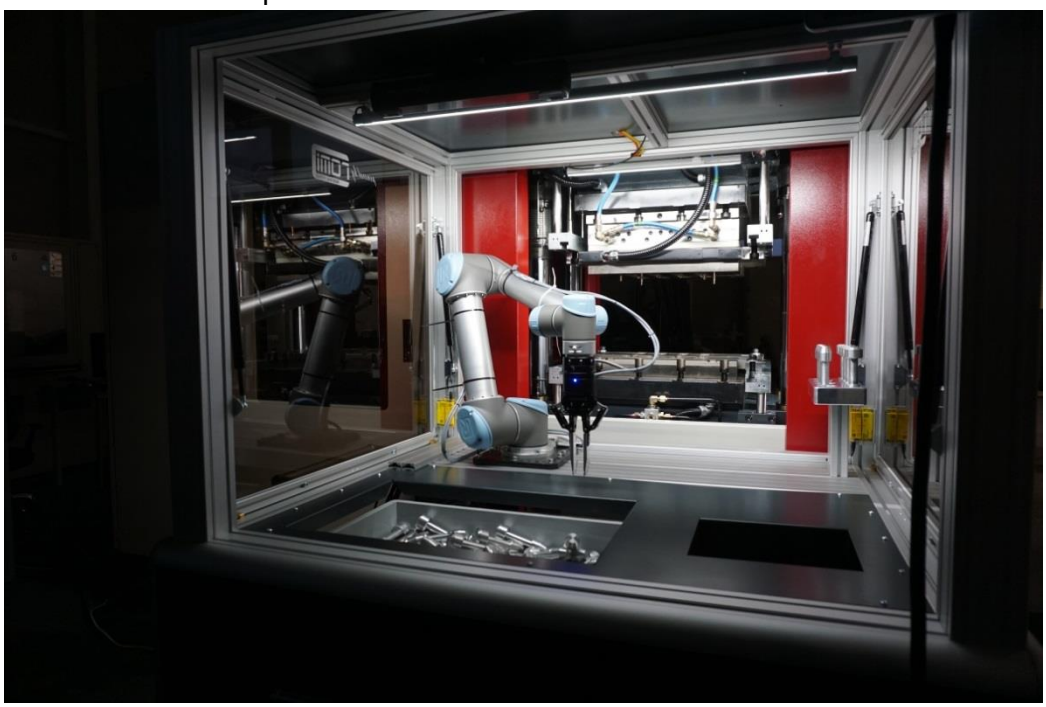


Figure 6 Bin picking in practice

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.

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.

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

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

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.

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.

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.

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.

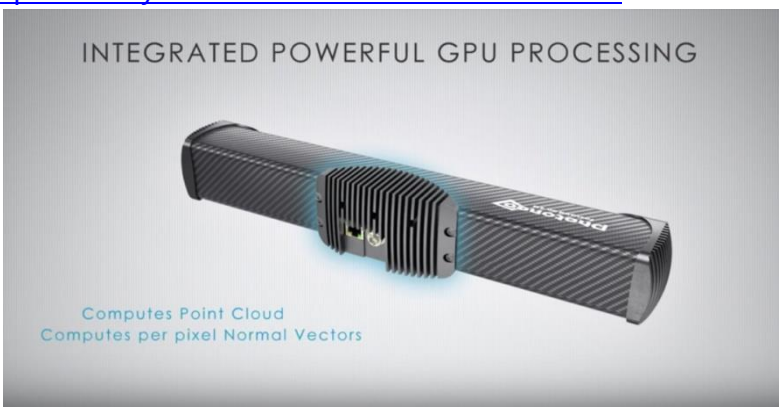
List of attachments:

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

4.2 DIGITAL INTERNAL LOGISTICS VERIFICATION THROUGHOUT THE PLANT

SOVA DIGITAL
Product Lifecycle Management

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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.

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.

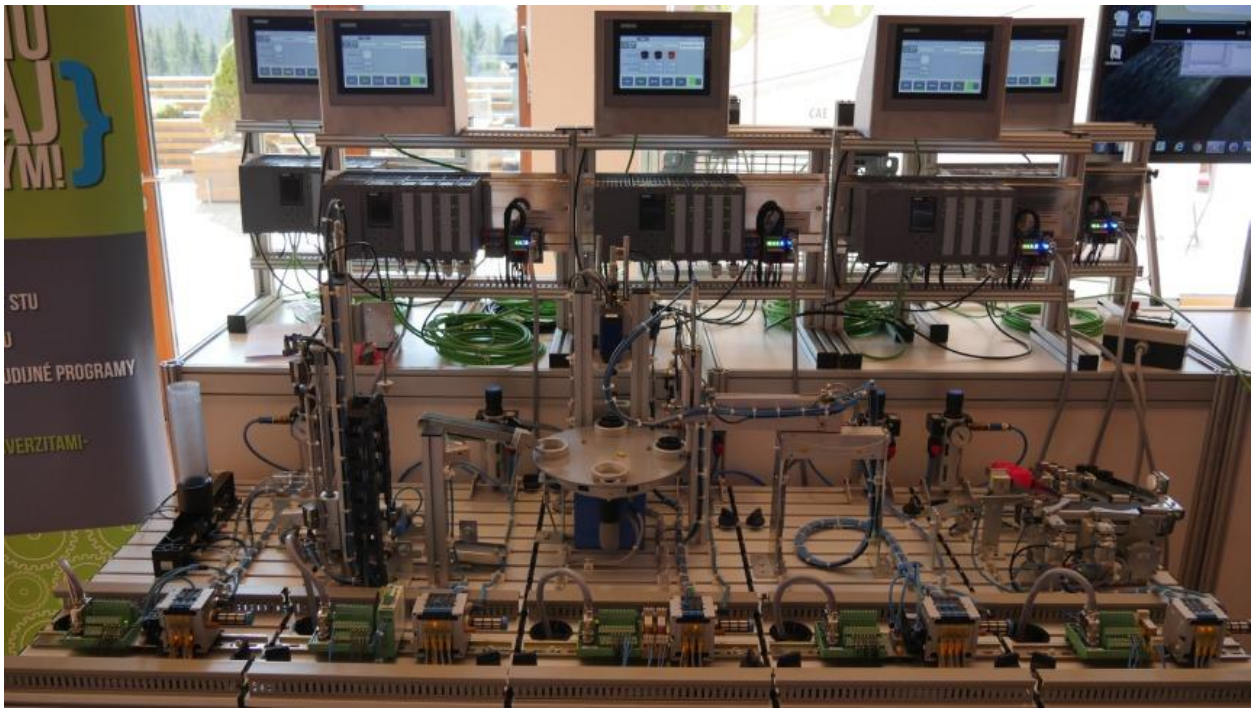

Figure 7 Digital Twin[7]

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.

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.

[7] 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.

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.

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

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

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.

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.

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.

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

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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 NEXT-GEN MANUFACTURING SYSTEMS

Advancements in ICT systems bring forward progress in almost every field. Regarding industrial production this progress was more pronounced in the late first decade of the 21st century. These improvements and the introduction of the so called “Internet of Things” (IoT) and “Internet of Services” (IoS) into production are pushing the worldwide industry towards a new technological age, towards the fourth industrial revolution.

Developments were also made for digitally empowering operators. In this regard, the mentioning of “Remote equipment control and assistance” is due, that allows the provision of specialized expertise of highly trained personnel from an onshore central location to various offshore facilities in which complex intervention is required. By doing so operation resources (both human and financial) are reduced and time-to-intervention is shortened exponentially.

An article published in the Wall Street Journal (Tita, 2015) illustrates the practical uses of the Augmented reality technology and “Smart Glasses” on the factory floor and numerous benefits that they offer. Companies such as Daimler AG, Boeing and United Parcel Service Inc. said to have increased productivity by replacing printed manuals and instructions with media that helps clarify the steps that the operator needs to follow. Moreover, Daimler went as far as using this technology even for quality control, as they implemented a system in which a check-list is readily displayed on-screen for the operator to see and when a nonconformity is detected a “voice-recorded report” and a photograph is prepared on-situ, documenting that error.

5.1 ONE BASE - MFT

Contact Data
ABF – Industrielle Automation GmbH
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mailto:christian.hiebl@abf.at

Keywords : OneBase – MFT, Material flow tracking, warehouse management system, forklift guidance system, crane control system, 3D warehouse, RTLS, Real Time Locating System, automatic load detection, hands-free, fleet management
Good practice applied in: (NACE code) : C

This industry independent intralogistics solution integrates a high-performance warehouse management system with continual material tracking for the in-plant logistics processes. With a multitude of modules, this flexible, total solution forms the basis for modern logistics. The material movements are posted automatically and the products get continuously tracked through the warehouse. Hereby the operator has an exact and complete overview where each and every piece of material is in the logistics chain at any time.
Optimization algorithms and a dynamic, adaptive set of rules automatically ensure the ongoing calculation of the necessary transport orders for quick processing of all the required in-plant material transports. This optimized real-time procedure leads to efficient usage of the available warehousing and transport capacities and assures the efficient material flow.

GOOD PRACTICE DESCRIPTION

OneBase – MFT provides innovative material tracking and control functions for the intralogistics in the industry's production processes. This solution optimizes the efficiency of the customer's intralogistics.

The solution provides a situation adaptive warehouse management, a forklift guidance system, a crane tracking system, a tight integration of the production facilities and interfaces with the existing IT infrastructure to form a complete solution for the optimization of the production and intralogistics processes. The innovation is the continuous material tracking of every movement within the intralogistics chain, by integrating RTLS on forklift trucks, cranes, milk runs and AGVs. The system determines the vehicle position precisely in a X, Y coordinate system. All movements are tracked and controlled, starting from the goods receipt, covering the work in progress movements and managing the final products.

Using a RTLS and load detection sensors the movements can be tracked fully automatic in block and high-bay warehouses although the warehouse is managed in manual operation.
OneBase – MFT, Material flow tracking, warehouse management system, forklift guidance system, crane control system, 3D warehouse, RTLS, Real Time Locating System, automatic load detection, hands-free, fleet management

The ABF intralogistics solution is probably the most modern RTLS material tracking solution including a highly optimized warehouse management system.
In comparison to warehousing solutions based on barcodes or RFID technology the RTLS based OneBase – MFT solution can be realized with very high accuracy (X, Y, Z coordinate within the warehouse) and offers by this the highest possible grade of digitalization and automation of the customer's intralogistics processes.

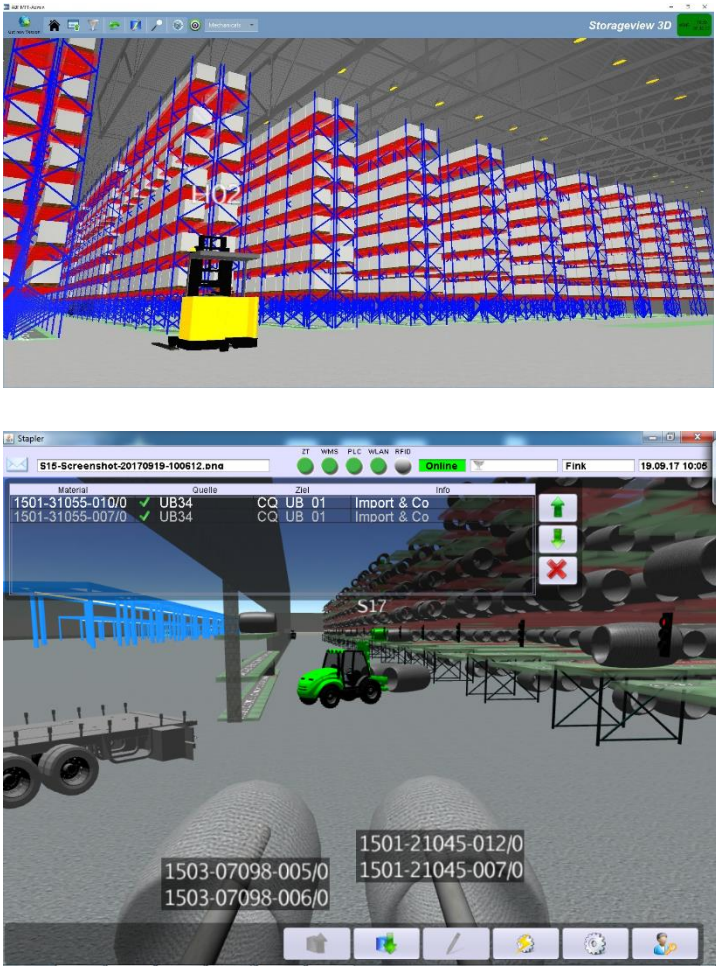


Figure 8

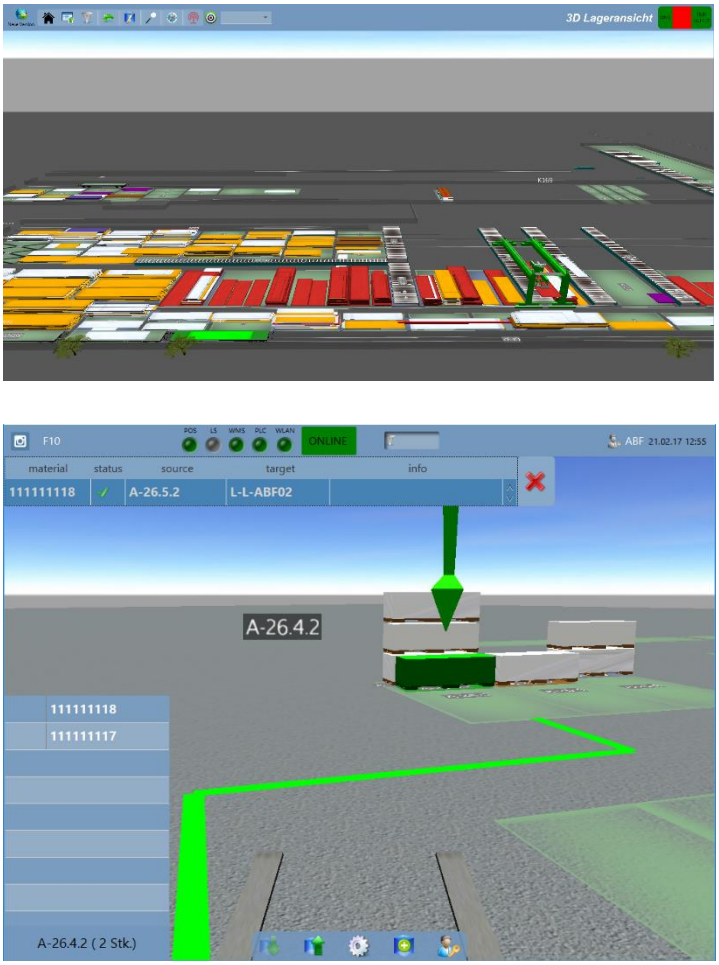
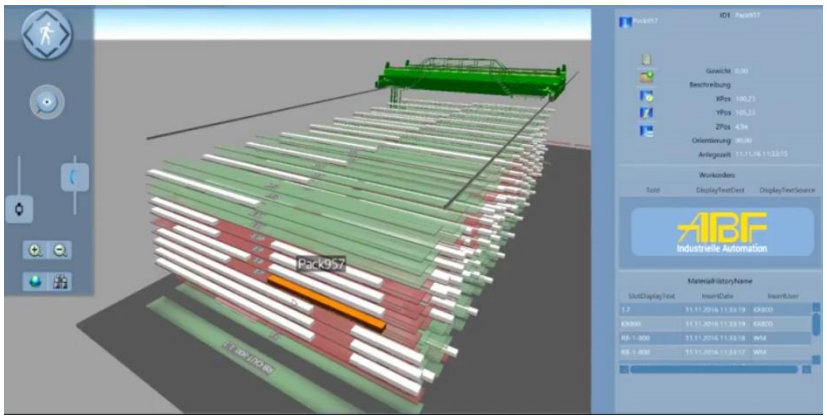


Figure 9

Award: Finalist in the Austrian logistics award
Website: www.abf.at/en/products/warehousing-solution-onebase-mft

Videos:
MFT forklift guidance system: https://www.youtube.com/watch?v=AWZAJdSPVZE

MFT for automatic cranes:
https://www.youtube.com/watch?v=awHp9qwBB68



MFT in a crane warehouse:
https://www.youtube.com/watch?v=qCnquzsHqwM

MFT in a steel wire rod production:
https://www.youtube.com/watch?v=xkJG1aGwkxc

Pictures of realization examples:

OBJECTIVE AND TARGET AUDIENCE

The target customers are industrial production facilities and logistic centres that are handling big material units (e.g. steel coils or steel heavy plates, wood products) or storing products in pallets, containers, lattice boxes

METHODOLOGICAL APPROACH

From the costs point of view:

- No time consuming search times for material
- No time consuming material identification times (scan-less material identification
- No time consuming manual warehouse bookings in the warehouse management system and ERP system
- Permanent inventory
- Optimization of the intralogistics fleet by route optimized transport order handling
- Time and cost

Regarding the quality assurance, the solution avoids manual operator mistakes in the warehousing process (wrong material in production, wrong storage location) and while shipment of final goods.
Additionally, it reduces downtimes of production aggregates by time efficient supply of materials

MFT improves the safety of used personnel and equipment resources.

VALIDATION PROCESS

Implementation of ***OneBase*** – MFT intralogistics software solution with RTLS components on the means of transport (forklifts, cranes, …) as well as the integration or mounting of additional sensors for automatic load detection. Integration of in and outbound facilities of the production aggregates and the IT systems (MES, ERP).

The impact can be validated if the results of the solution realization can be compared to an actual situation survey, which could be done in advance.

RESULTS / IMPACT

More transparency in intralogistics and enablement for automatic warehouse management by continuous material tracking and situation adaptive material flow control.

SUCCESS FACTORS AND CONSTRAINTS

The automatic load detection depends on the possible accuracy of the used RTLS. On cranes the positioning precision sometimes also depends on the used hoist. To assure a continuous and error free material tracking the accuracy of the RTLS needs to be less than the half size of the transport unit's shortest side. On forklifts the solution works fine with transport units of a size bigger than a Euro pallet.
Automatic vehicles or manipulators with a fixed hoist can achieve a higher positioning precision.

OneBase – MFT and its automated intralogistics environment introduces a high grade of innovation and significant improvement in quality and efficiency of logistics and production supply processes, because:

- The warehouse management will no longer be done in the minds of the operators
- You know where the material precisely is at any time
- Intralogistics availability around the clock
- No more barcode scanning and manual mistakes, because the automatic load detection avoids manual actions for identification (hands-free)
- Situation adaptive transport management with route optimized transport orders under consideration of the current transporter position (forklift, cranes, AGVs …)
- Fleet management and optimization
- Digitalization of the intralogistics processes
- Performance optimization for manually operated vehicles (automated load detection, guidance systems for better orientation within the warehouse by a state-of-the-art 3D environment, transport orders)
- Improvement of human and machine safety by providing location related safety function like collision avoidance and speed control

The best impact will be achieved, for customers who have a middle to big sized fleet of transport vehicles and have big warehouse areas and / or numerous production areas that need to be supplied with WIP material.

LESSON LEARNED & SUSTAINABILITY

The OneBase – MFT solution is able to optimize the intralogistics processes, efficiency and costs.

The improvement of a well automated intralogistics transportation fleet (e.g. forklift trucks) will lead to a reduction of travelled distances and to possible reduction of needed vehicles. By this there is not only a rise of efficiency in terms of costs but also in terms of energy consumption and exhaust emissions.

REPLICABILITY AND UP SCALING

The solution can be useful for any industrial production facilities and logistic centres that are handling big material units (e.g. steel coils or steel heavy plates, wood products) or storing products in pallets, containers, lattice boxes. The high grade of standardization allows to use the solution in different kind of industries. It also applies to different means of transports no matter if manually or automatically operated.

The solution has very good scalability features. Roll-out to the customer's other facilities as well as internationalization is supported.

FINAL REMARKS

Concluding, OneBase – MFT and its automated intralogistics environment introduces a high grade of innovation in the logistics and production supply processes because:

- The warehouse management will no longer be done in the minds of the operators
- You know where the material precisely is at any time
- Availability around the clock

- No more barcode scanning and manual mistakes, because the automatic load detection avoids manual actions for identification (hands-free)
- Situation adaptive transport management with route optimized transport orders under consideration of the current transporter position (forklift, cranes, AGVs …)
- Fleet management and optimization
- Digitalization of the intralogistics processes
- Performance optimization for manually operated vehicles (automated load detection, guidance systems for better orientation within the warehouse by a state-of-the-art 3D environment, transport orders)
- Improvement of human and machine safety by providing location related safety function like collision avoidance and speed control

5.2 KOMANDIR.NET - PRODUCT LIFECYCLE MANAGEMENT (PLM) SYSTEM

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Keywords : Product Lifecycle Management (PLM) System, Optimization, Management, Constant monitoring, Automated process, Remote access, Terminals, Cloud

Good practice applied in: (NACE code) :	C25 - Manufacture of fabricated metal products, except machinery and equipment

The good practice is a system for manufacturing management aiming to optimize and digitalize the manufacturing process in the factory through:
· Automate the preparation of accompanying technological documentation in accordance with ISO 9001: 2000 (order documents, complete maps, route cards, etc);
· Automated transmission of tasks from one workplace/machine to another via computer terminals;
· Permanent monitoring of the condition of the parts and the nodes;
· Timing reports for each product at every operation;
· References for workers working on each operation for each detail according to ISO 9001: 2000;
· Remote access to production data with the ability to change the priority for order execution;
Others.
The system consists of network of computer terminals, cloud based server, and computers, smartphones, tablets etc.
KOMANDIR.NET system operates using Google apps.

GOOD PRACTICE DESCRIPTION

The SME created the good practice through finding the need of optimizing the manufacturing process and prioritising the order execution.
The good practice is strongly linked to the SFH approach by implementing a smart system for optimizing the ensuring production process and cost efficiency and quality assurance.
The network of terminals ensures good digital control over the production process. Being cloud based allows the system to be accessed remotely by any type of digital device. Using google apps makes the implementation cost low and compatible with wide rage of devices.

The system is custom made so it is not known whether there is a competitor using similar system in their work process.

OBJECTIVE AND TARGET AUDIENCE

The solution described above was used in Sofia, Bulgaria, on the territory and for the benefit of the company only. However the system could be implemented in small, medium and large manufacturing companies;

Another systems that need visualisation, monitoring, control and prioritization of different kind of tasks/processes.

METHODOLOGICAL APPROACH

The good practice is targeted quality assurance of the production process.

Because of the remote use of free software on wide range of devices the system is easily implemented for the need of production lifecycle process management.

For implementing the good practice, the company needs to allocate financial resources for installing terminals on every step of the manufacturing process.

VALIDATION PROCESS

The validation process was completed in 6 months within the factory with help of some IT experts nearby, and comprised in the analysis and comparison of the work process and the before and after implementation of the system.

RESULTS / IMPACT

The implementation of the system has positive impact on company production process related to time optimization and order prioritizing.

SUCCESS FACTORS AND CONSTRAINTS

Because of low volume of data and performance needed form da system their limitations will be reached when the terminals (and relevant workplaces/machines) are more than 100, and/or the server DB/Internet connection to the cloud reach their limits, but this is subject of additional researches and tests.

The system is custom made and it could give an easy way for remote monitoring and reporting of the manufacturing process from the beginning (taking the order) to the finish (completing the order). The use of open source hardware and software reduces the cost of the system significantly.

The system could be improved with installing an audio and video connectivity on every terminal for faster and better management of the work process.

LESSON LEARNED & SUSTAINABILITY

The good practice is an example for smart remote organization of the work process in the factory that will increase the manufacturing capabilities, quality of the products and the positive feedback from the clients.

The system is sustainable because of their low cost not only for the establishing, but also for it's support and improvement, being in the same time high efficient and reliable.

REPLICABILITY AND UP SCALING

The good practice is an example for smart remote organization of the work process in the factory that will increase the manufacturing capabilities, quality of the product and the positive feedback from the clients

The good practice could be implemented in every company where there is a need of monitoring a numerous process at once and optimizing the time for completing certain tasks

FINAL REMARKS

The good practice is an example for smart remote organization of the work process in the factory that will increase the manufacturing capabilities, quality of the product and the positive feedback from the clients

Disclaimer / Acknowledgements

There are no legal loose ends or limitations for dissemination

List of attachments:

KOMANDIR.NET

www.komandir.net

Figure 10

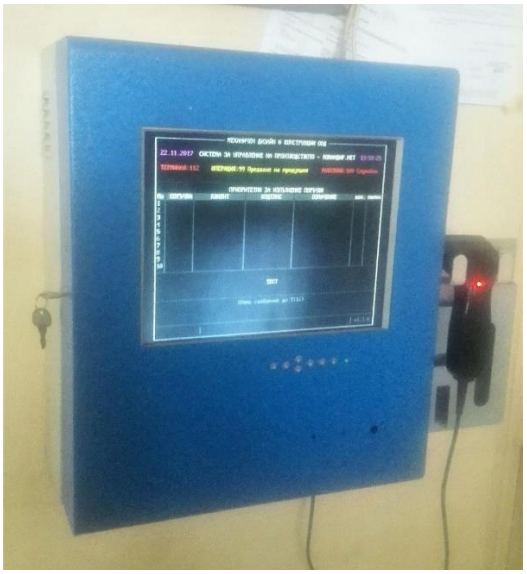

Figure 11

Figure 12

5.3 MILKRUN 4.0

WITTENSTEIN bastian GmbH
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Keywords : production planning
Good practice applied in: (NACE code): C - Manufacturing

The challenge for WITTENSTEIN bastian GmbH was to avoid a media discontinuity between the paper-based planning board for controlling order processing and IT-supported production planning. The media discontinuity resulted in long and inflexible production planning cycles. This meant that workers could not call up the information directly at the machine and digitally transfer it back to the production planning system. This has changed with the introduction of Industry 4.0 technology: In addition to increased flexibility in production planning and improved information transfer, a transparent and consistent database for extended approaches to production planning and failure analysis has been established.

GOOD PRACTICE DESCRIPTION

The relationship to SFH approach is production processes.

WITTENSTEIN bastian GmbH has further developed existing IT back-end production systems and networked them with each other. LED screens are now showing the planning status electronically. In addition, all machines and order papers were provided with a DataMatrix code, which means that identification is also carried out digitally. Tablet PCs enable mobile access to the production planning system. Problems and causes of problems that endanger the execution of the order are fully recorded in an escalation database. Problem causes can thus be methodically and analytically eliminated. The database also provides the basis for applying Big Data algorithms. In the future, it will be possible to analyse fundamental interrelationships with regard to materials, tools, setup parts, production machines and suppliers. This improves the processing of orders.

It is one of the first technologies that enables the digital monitoring and modification of the production process from start to finish.

The "Dynamic Milkrun 4.0" supply train optimally compiles orders according to demand.

Figure 13 Work instruction are projected on assembly table[8]

Figure 14 Work instruction are projected on assembly table[9]

OBJECTIVE AND TARGET AUDIENCE

The mobile assistance system was tested in real-life environments before the competition.
The target audience are all companies that want to make their logistic processes more efficient are potential customers.
The target group are SMEs (<250 employees) and large companies.

METHODOLOGICAL APPROACH

From a cost perspective, it is first of all a great effort that has to be done until the journeys of the route train are automated. However, this effort is worthwhile because it gives employees more productive time for the actual main activities of picking, shipping and warehousing.

[8] Source: https://www.elektrotechnik.vogel.de/der-milchbote-fuer-die-schaufensterfabrik-a-506312/index2.html
[9] Source: https://www.wfb-bremen.de/de/page/stories/digitalisierung-industrie40/wie-der-milchbote-der-dynamische-milkrun-40-beliefert-maschinen-in-der-fabrik-nur-bei-bedarf

Consistent quality is ensured by demonstrating the processes and making them transparent. Potential for improvement and potential sources of error can be identified and then eliminated.
To implement the solution, first of all, the route train is automated so that it only drives when necessary. A tablet is attached to the route train so that the employee always sees the current transport orders in front of him/her and can process them.
In the beginning, a large amount of money is needed because many new interfaces are created and must be networked. This results in high costs and a large expenditure of time.

VALIDATION PROCESS

The tests were carried out in the competence and transfer centre of BIBA and the prototype test in the shop window factory in the real environment.

RESULTS / IMPACT

The results are very positive, for workers and for the companies. The employees will therefore have more time for their real work as they can control everything from a central point and see directly where there is a lack of material. For the companies it is easy, to see where potentials are and where problems.

SUCCESS FACTORS AND CONSTRAINTS

The technology must be maintained regularly to prevent errors.
This production line with the nets is not unrivalled. However, each provider offers different advantages. Every company has to find the right supplier for its needs.

LESSON LEARNED & SUSTAINABILITY

Not all employees will be able to deal with it immediately, but the new technology will make their work easier. You will find this out as soon as you have tried it.
At the moment, the price for technology is very high. However, in a few years, the price will increase. In addition, with the networked logistic, resources are conserved.

REPLICABILITY AND UP SCALING

This solution is also helpful for other SMEs, as they also have logistics problems. By implementing such a system, a lot of time and money can be saved.

FINAL REMARKS

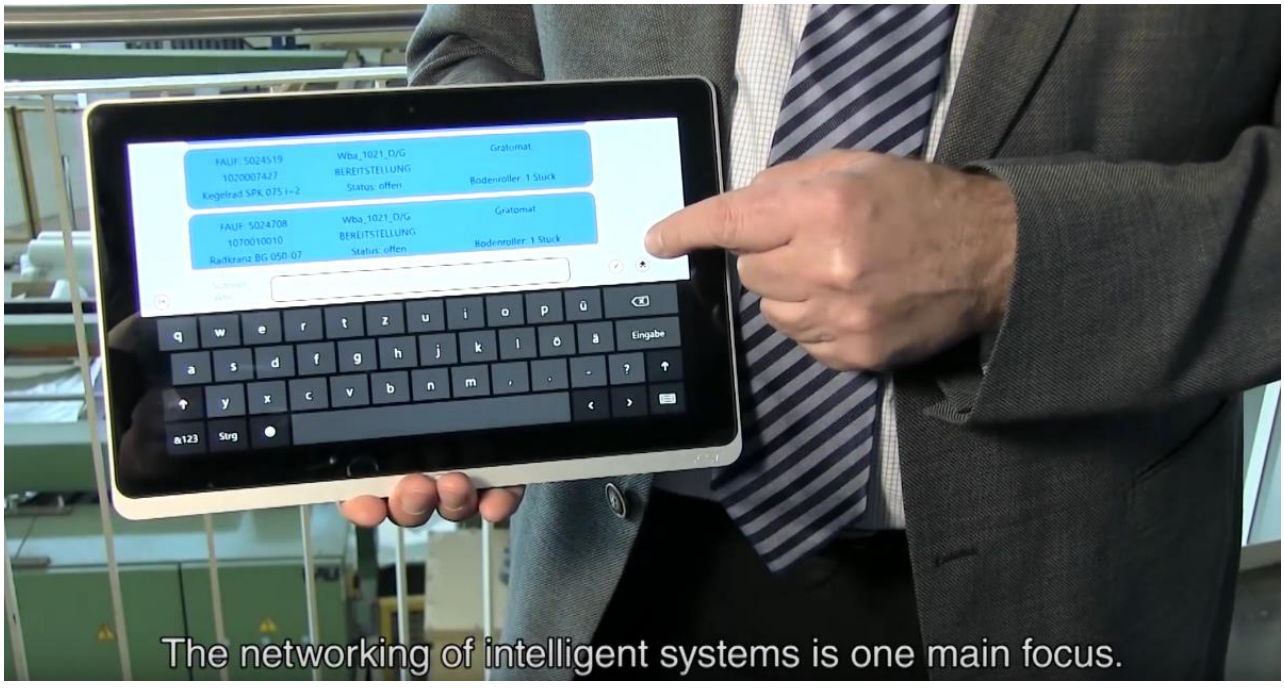
The solution requires a financial commitment at the beginning, but is a good investment for companies compared to the advantages it offers, such as shortening production time due to the always up-to-date deliveries.

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.

List of attachments:

Attachment 1: picture of a worker who gets work instruction that are projected on assembly table
Attachment 2: picture of the tablet with work instructions
Attachment 3: Video about Milkrun 4.0: https://www.youtube.com/watch?v=S_x02BX71X4



5.4 COMPUTER VISION USING DEEP NEURAL NETWORKS NEURONIT IN INDUSTRIAL PRODUCTION

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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.

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.

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.

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.

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

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

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

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.

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.

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

5.5 USING DEEP NEURAL NETWORKS NEURONIT WITH ADVANCED COMPUTER VISION IN INDUSTRIAL PRODUCTION

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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.

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.

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.

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.

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

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

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.

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.

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.

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

5.6 THE DIGITAL TWIN OF AN INDUSTRIAL PRODUCTION LINE WITHIN THE INDUSTRY 4.0 CONCEPT

SOVA DIGITAL
Product Lifecycle Management

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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.

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.

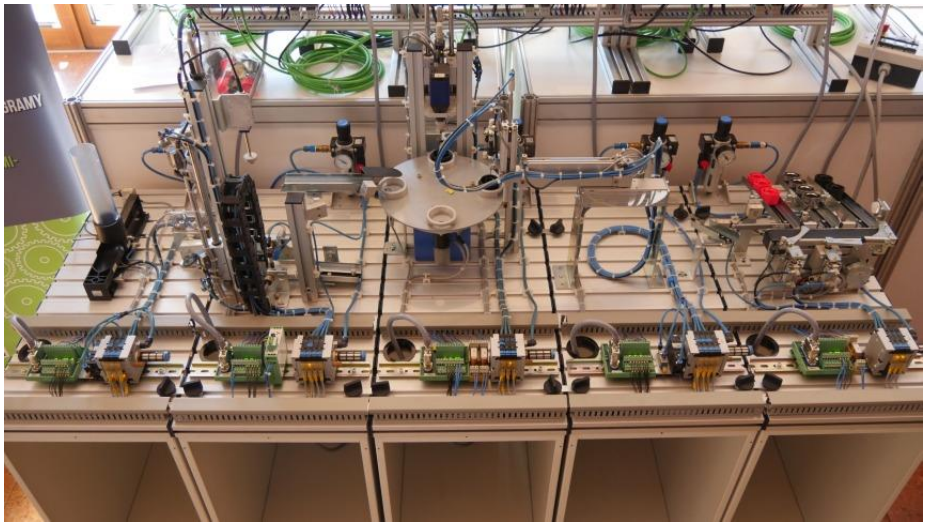

Figure 15 Digital Twin

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.

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.

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

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

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.

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.

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.

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

5.7 AUTOMATIZATION AND DIGITALIZATION OF PRODUCTION AND BUSINESS PROCESSES

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Keywords : Production process, Manufacturing software, Cost efficiency, Time tracking, Production stages, Integration
Good practice applied in: (NACE code) : C32.500 - Manufacture of medical and dental instruments and supplies

Medicop and ININ started the collaboration when ININ implemented ERP solution for managing financial and material flows IPSPlus. In the beginning of 2017 they started new project: Optimization and digitalization of production processes. Consulting services for optimized production processes and implementation of IPSPlus manufacture provided by ININ, helped Medicopachiev significant improvements.

GOOD PRACTICE DESCRIPTION

By implementing new solution, Medicop gained significant improvements on production process, purchasing process and inventory management. The solution helped company gain significant cost efficiency and higher product quality customized and automatized production and other processes. Additionally, the integration with other solution and central ERP visibly increased time efficiency and reduced administration tasks. Innovative nature of this solution is that it provides fully digitalized information and documentation flow across company. Additionally, it provides needed information and instruction directly on work station. Moreover, for each work order and task the system tracks time, which enables company to determine required resources for specific order and forecast delivery date.

Figure 16: Medicop and ININ cooperation

The advantage of the solution is that it is adjusted for the specific of company's production process and that it is integrated with other software solution. Flexibility enables company to keep its competitive advantage, while integration provides fully digitalized documentation and information flow.

Figure 17: Increasing the quality is most important for Medicop

Figure 18: Production of medical vehicles

OBJECTIVE AND TARGET AUDIENCE

The solution described previously was implemented in Medicop factory situated in Murska Sobota, Slovenia. The solution can be implemented in various manufacturing companies in need for flexible and adjustable software solution and full digitalization of production and other business processes. It is the most suitable for SMEs.

METHODOLOGICAL APPROACH

Cost efficiency related to the implementation of the good practice.

- Reduced amount of packaging due to optimized material purchasing
- Reduced surface needed for inventory due to more optimized purchasing
- Reduced number of complaints due to traceability of production process and consequently fast and easy problem identification

The methodology for implementing the solution comprised of following steps:

1. Agreed and signed collaboration
2. Blue print including detailed description of current business and production processes
3. Meetings with key employees for determining specifics and designing desired solution
4. Adjusting solution for specifics and establishing integrations with other solution
5. Implementing the solution and teaching employees
6. Maintenance, upgrades, new features and more,

Resources needed for implementation are:

- key employees for each business process to define specifics and desired features and to describe current production process
- other employees that will meet the solution at everyday operations
- timespan is determined after blueprint, when scope of required adjustment is defined, and it also depends of company's commitment
- required infrastructure includes monitors for production, identification key cards, server with Microsoft licences, barcode scanner and barcode printer

the financial aspect of implementing the solution depends on specifics required by the company, number of required integrations and implementation time, production process complexity.

VALIDATION PROCESS

The validation process was completed by measuring time and costs used before and after implementation.

RESULTS / IMPACT

The impact was highly positive since company significantly reduced time for administration, decreased number of complaints by 20% and optimized material purchasing that led to lower inventory costs. Additionally, it increased on-time deliveries by determining delivery time.

SUCCESS FACTORS AND CONSTRAINTS

The main limitation lies in employees, which are not ready for changes and are afraid of new technology. This can significantly increase implementation time. Key employees must be willing to cooperate and contribute to successful implementation.

The solution provides flexibility and adjustability, which ensures keeping competitive advantage that lies in good production process. Additionally, every customer is for us individual project to which we allocate sufficient time and effort. Finally, the solution can be easily integrated with existing software, which reduces time needed for transferring data and documents and eliminated double entry.

In next stages module for production planning and scheduling based on previously gathered data in existing solution, will be developed and implemented. In that way company will be able to organize sales team better and provide them with accurate information on possible delivery date and production occupancy. Additionally, the company will have information on required resources for specific time period.

LESSON LEARNED & SUSTAINABILITY

The success of the implementation depends on the capability of overcoming the resistance of workers regarding the new technology and different work process. Additionally, the success highly depends on clearly defined and accurately described business process.

The amount of printed documentation is almost zero, while all information is in the system and provided to workers at their work station. Additionally, all documentation is transferred digitally across company.

REPLICABILITY AND UP SCALING

The solution can be implemented to all kinds of manufacturing companies, either with series production, make to order production or combination of both. It must be noted that solution is designed for small and medium sized companies. There is possibility of extending the solution widely, especially due to new technologies for remote support and maintenance, which reduces costs. For implementation physical presence at location is required.

FINAL REMARKS

There is possibility of extending the solution widely, especially due to new technologies for remote support and maintenance, which reduces costs. For implementation physical presence at location is required.

Disclaimer / Acknowledgements

No limitations and it can be used for dissemination.

List of attachments:

NA

5.8 Solopex solo – personalized industrial intelligence tool

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Keywords : Industrial AI, IoT solution, Supply chain
Good practice applied in: (NACE code) : C22 - Manufacture of rubber and plastic products; C24 - Manufacture of basic metals; C25 - Manufacture of fabricated metal products, except machinery and equipment

IoT solution for production company operating in high-dynamic supply chain (automotive industry or similar high-demanding and fast-paced industry). It is especially applicable for those from steel, plastic and tooling industry.

GOOD PRACTICE DESCRIPTION

The founders of the Solopex have ideal set of skills to create this product and ensure success in the market. The team have following members:

- Industrial IT Specialist (Manufacturing, telecommunications,…)
- Optimization Expert (Statistics, engineering,…)
- Serial Entrepreneur (30 years of experience in tooling and founder of 9 companies)

The solution is tied to increasing the efficiency of production processes.

SOLO is the ultimate tuning add-on for industrial IT systems. It enables manufacturers to take the best planning decisions for organizing complex tasks on and off the shop floor. SOLO plans tasks like material preparation, production scheduling, workforce allocation, and warehousing optimally at the push of a button. SOLO combines the power of the cloud with a high-end decision optimization engine. SOLO is accessible as a SaaS product via REST API, integrating easily with any system infrastructure. It does not disrupt existing processes and adjusts to the current data situation.
Our solution is already taking into consideration next step of Industrial revolution (Industrial AI). It is also noted that our solution can be ready in less than a month, while it is not disrupting the manufacturing process. Another plus is also subscription based fee, which is not presenting too high investment related issue for the company.

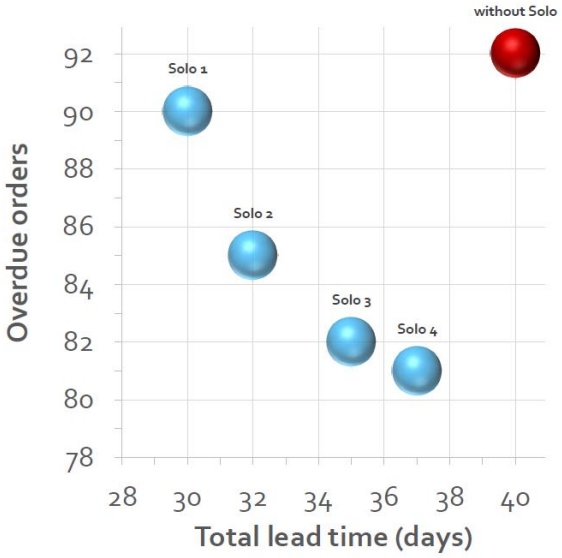

Figure 19: Measurement and increase in production with and without SOLO

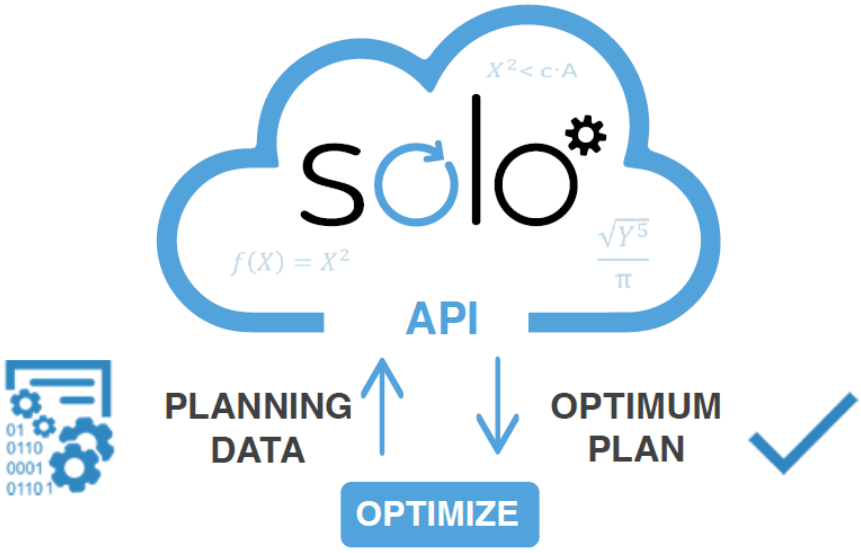

Figure 20: Solopex SOLO API

OBJECTIVE AND TARGET AUDIENCE

The good practice is in early phase of adoption, where it was first tested with 4 pilot cases in Slovenia and Croatia. The further implications were done in Slovenian and Croatian companies, while solution is actively marketed in DACH regions, where future step would be to enter the market of USA.

Figure 21: Number of target customers

Ideal customer:
Two sizes:

- Company size 1:
  - >100 employees
  - >25M annual revenue
  - Growing, ideally more than 20% annual growth during last 3-5 years
- Company size 2:
  - >500 employees
  - >100M annual revenue
  - Growing, ideally more than 5% annual growth during last 3-5 years

Targeted customer are both SMEs and Large companies.

METHODOLOGICAL APPROACH

Solopex SOLO saves manufacturers time and money: Planners save time by planning production-related tasks at the push of a button. SOLO computes plans that minimize wastage, overall production time, and space use in warehouses. Compared to manual processing, savings of 15% and more can be achieved for dedicated planning tasks. With SOLO's monthly subscription model, this leads to an immediate return on investment and a lasting increase in profit margins.

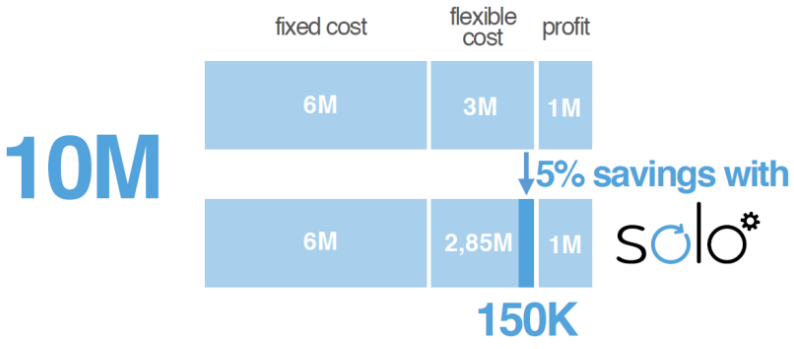

Figure 22: Solopex SOLO savings

Many industrial manufacturers organize production-related tasks in a manual or semi-automatic way. Human planners apply best-practice approaches or thumb rules and rely heavily on their experience. This works fine until the planning situation reaches a certain complexity, at which the human mind becomes unable to process all possible alternatives. Consequently, crucial

performance indicators like material yield, machinery uptime, and system throughput drop and reduce business efficiency.

Taking the best planning decisions and being able to immediately react to changes and unexpected events in daily operations allows industrial clients to manufacture their products at the highest possible speed and to utilize their resources in the most efficient way.

Following procedure is used when implementing our solution:

1. Analysis: Analysis on how the production processes are planned (5 days)
2. Packaging into SOLO: design of algorithms which finds better planning decisions and package this algorithm into SOLO (10 days)
3. Interface: Finally, the integration to the client system is done. (3 days)

By that whole process takes less than a month and it gets quicker with every new client.

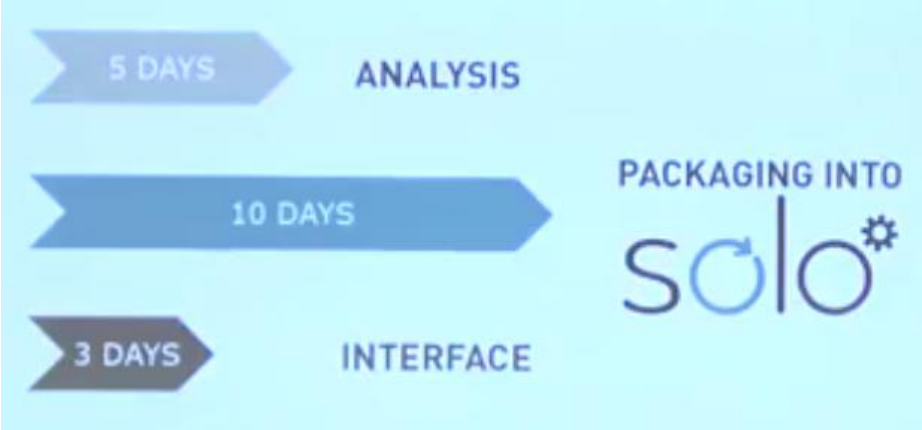

Figure 23: Implementation procedure

Resources involved:
- 3 experts who are engineers, computer scientists, and mathematicians.
-Solution can be ready to use in 3 weeks (1 week analytics, 2 weeks design and implementation)
-Analysis is for free, while implementation is based on customer requirements

VALIDATION PROCESS

The validation process was completed within the customer factory where comparison between results before and after implementation was done.

RESULTS / IMPACT

Following results can be achieved while implementing the good practice:

- Solopex Solo is providing strictly better planning decisions in a fraction of the time (1min vs 15min)
- With goal prioritization, Solo can be adapted to the client's most pressing needs
- In the overload situation that the client is in, a good strategy is to minimize lead times (Solo 1) in order to get shop floor operations back to a normal state
- In normal operations where sales are mostly within production capacity, the primary goal should be on-time delivery (Solo 3 or 4).

SUCCESS FACTORS AND CONSTRAINTS

No specific limitations were noted while implementing the solution. Specific attention should be given to the persons involved in the process of implementation, since IT knowledge is of a special importance, whereas usually processes are run by experienced experts, who lack knowledge of computer science.

Following selling points are important:

- Gain in process efficiency of 15% or more, while saving hundreds of Euros and hours of processing time
- Rapid return on investment
- Lasting increase in profit margins
- Integrates easily with existing IT infrastructure
- Does not disrupt existing processes
- Adjusts to current data situation
- Can manage unexpected events

LESSON LEARNED & SUSTAINABILITY

Solo can be adapted to the client's most pressing needs. There is always human factor involved in this process, whereas it is important that production managers are prepared for this step and are looking into same direction as management of the company.

The production all over Europe and world is moving into digitalization of processes into so called Industry 4.0, where Industrial AI, which is a basic of Solopex Solo represents the most advanced part of this transformation. This is why we see our product as a sustainable in the current market.

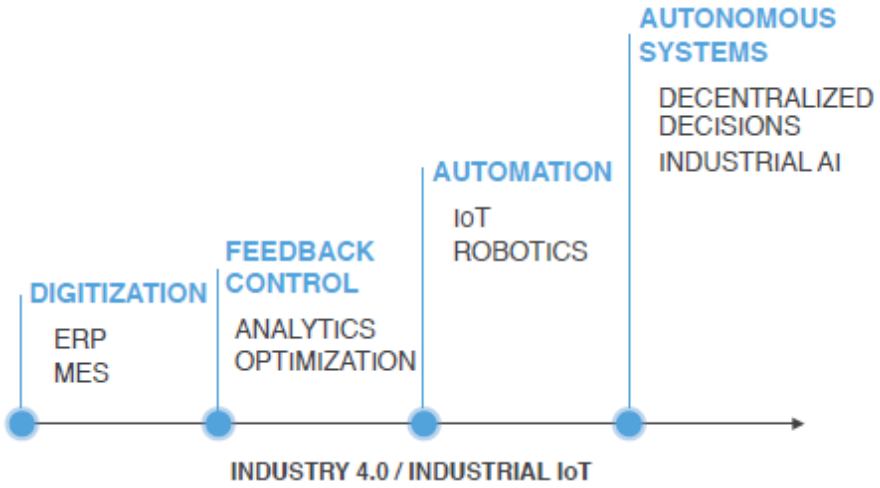

Figure 24: Industrial AI in future autonomous systems

REPLICABILITY AND UP SCALING

SOLO has been designed for manufacturing companies in steel, plastics, aluminium, tooling, chemical, and electronics industry. This is why it can be easily transferred to any of these production oriented companies. So far there are no special plans on widening the scope, as we

first want to start with implementation on a big scale, after that we will focus on further development of our solution.

FINAL REMARKS

The Solopex SOLO offers customer tailor made solution to their specific production process needs, where it integrates easily with existing IT infrastructure of the customer. While implementing the solution the process is not disrupting the existing production processes so the costumer is not facing any production loss or loss of income. The start investment is easy to carry on, as it is based on subscription fee and is not representing too much of a burden for the customer.

Disclaimer / Acknowledgements

No limitations and it can be used for dissemination.

List of attachments:

NA

5.9 DIGITALISATION OF HRM IN IMPOL GROUP

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Keywords : HRM digitalisation, Industry 4.0
Good practice applied in: (NACE code) : J63 - Information service activities; J62 - Computer programming, consultancy and related activities

In line with the guidelines of Industry 4.0, the transition to business brings a number of challenges also in the field of human resources management, where the increasing needs for knowledge management, competence development and the management of the complexity of changes are emerging. For this purpose, the human resources development field also needs agile solutions that effectively support strategic management functions with human resources.

GOOD PRACTICE DESCRIPTION

The Impol Group decided to develop the personnel information system, following the following goals: to ensure the corporate management of a complex business group, to follow the requirements of the corporate strategy of Industry 4.0 and to provide strategic management of employees.

With the help of the new information system HRM 4.0, the Impol Group has the appropriate platform for managing the complexity of human resource management. The new information system enables the development of personnel through targeted management, monitoring of activities, competence development, knowledge management, performance measurement (360-degree appraisal), monitoring of company dynamics (measurement of organizational climate, questionnaires, forums), promotion of innovation reporting of useful proposals, innovations), mastering the field of occupational safety (records, medical examinations, work accidents, incidents) and giving feedback. The IT solution also enables every employee access to the application with the help of a smartphone, thus promoting personal development, two-way communication, building affiliation and simplifying data management.

The solution was developed for dedicated requirements in IMPOL group and therefore it is not possible to directly compare the solution with competitors.

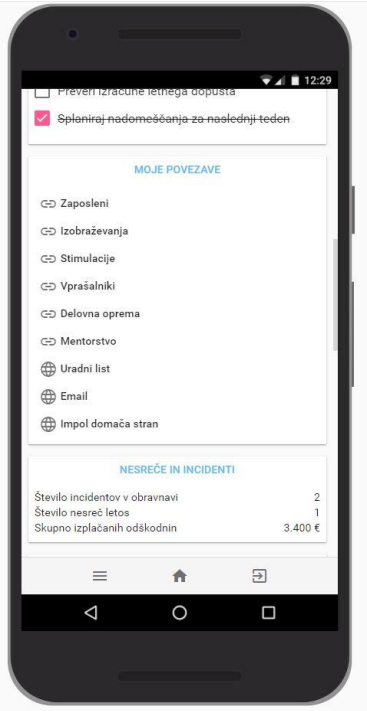

Figure 25: IT solution enables tracking via Smartphone

OBJECTIVE AND TARGET AUDIENCE

The solution where good practice has been tested and validated is Slovenia.

Advanced analytics enables the up-to-date monitoring of key personnel development indicators while at the same time the system through its interconnectivity with key institutions (Employment Service, Health Insurance Institute) greatly simplifies administrative processes and reporting processes. Target group for this good practice are SMEs, Large companies and public institutions.

METHODOLOGICAL APPROACH

The solution is software based and as such very cost effective. The solution is providing data that can be incorporated to existing quality assurance systems and existing risk management systems. To implement the solution in a company it is required to outline the functionalities to be used. The implementation itself is technically not very challenging but focus to internal training of personnel using the system in organisation is important. Implementation of IT solution does not require many resources.

VALIDATION PROCESS

The validation was done by HRM responsible persons in IMPOL GROUP. The process was performed while development of the product and several people has been involved.

RESULTS / IMPACT

The application itself will bring the following benefits:

- saving time for data processing,
- saving time for data entry,
- reduction in the number of transmission errors,
- increasing transparency of data,
- improved control of events in organizations.

Career management tools will enable employees to:

- raising the commitment of employees,
- raising the membership of employees,
- raising the productivity of employees,
- reduction of work incidents.

HRM 4.0 offers the following benefits as a smart service:

- Improves the state of knowledge and the possibility of more efficient and successful management of employees and their rewards, motivation etc...,
- supports the lean business of organizations, since it makes it easier to manage data and knowledge of employees,
- Provides added value for users with reminders, predictions and skills for future planning.

SUCCESS FACTORS AND CONSTRAINTS

No major limitations identified. Larger companies are aware of HRM processes and are searching for IT supported systems to automate data collection from employees related to satisfaction on working place, productiveness, education, trainings and other HRM related relevant data.

LESSON LEARNED & SUSTAINABILITY

With the development of the HRM 4.0 application, the following knowledge was acquired at three levels:

a) Implementation level: Process knowledge, how to approach application development,

b) content level: The application comprehensively lists the basic processes in the personnel function, with emphasis on the specifics required by the manufacturing companies,

c) Structural level: The application provides a framework within which organizations can store their knowledge.

The solution is software based and all relevant data are stored in databases. The data is collected regularly and the database will grow with time. Sustainability as such is given by the use of relevant data collected.

REPLICABILITY AND UP SCALING

The process openness of the application also enables the use in other organizations, and therefore a marketing application distribution strategy was created, which will cover the costs of development and will provide the basis for further upgrading of the functionality. In this context, we can, for example, with the application; they helped primarily small and medium-sized enterprises in the management of human resources, based on the use of smart solutions.

The solution can be further integrated to other existing systems in the company to provide more insights and better information's for taking HRM related decisions that can influence the total productivity in the company.

FINAL REMARKS

The solution described can only support the company strategy if integrated properly to existing HRM and management decision processes. The solution cannot be a substitute for required professionals that will take decisions but can support them to collect relevant information faster and take decisions based on such information in a more exact way.

Disclaimer / Acknowledgements

No legal constrains.

List of attachments:

- **Attachment1: HRM system overview**
- **Attachment2: HRM system overview**

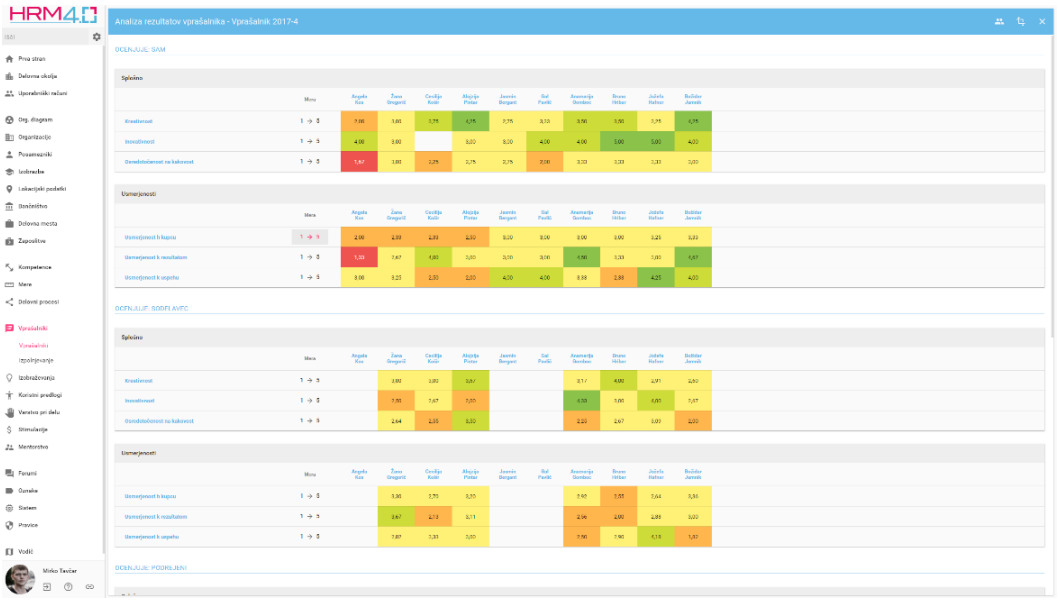

Figure 26: HRM system overview

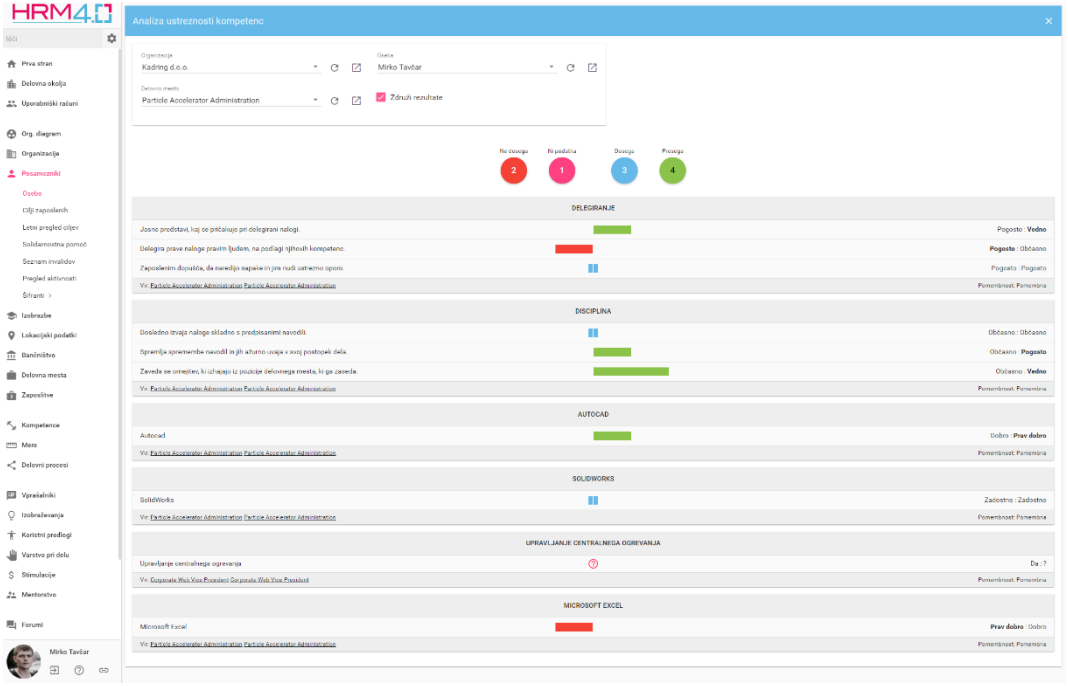

Figure 27: HRM system overview

5.10 OPTIMIZING ALL BUSINESS PROCESSES BY IMPLEMENTING A CUSTOMIZED ERP SOLUTIONS – ASiS ERP

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Keywords : Traceability, stock optimisation, production achievements, ERP IoT, integrating production devices with ERP, data driven company
Good practice applied in: (NACE code) : C - Manufacturing

Fibrex Co has implemented ASiS ERP solution for its factory of bath tubs and swimming pools manufacturing, with the main purpose of implementing ***barcode traceability regarding operations made to products in the manufacturing process****. Using mobile phones in the production hall, working operators can record operations in real time, for each product, by scanning barcode labels for each operation. This way, operations completed can be seen in ASiS database. At the end, after quality tests, a barcode is attached to the warranty certificate and if there are any flaws, by scanning this barcode, in ASiS can be seen the entire production history (operations made, people who made them, time).*

GOOD PRACTICE DESCRIPTION

Fibrex Co is one of the main manufacturers of baths tubs and swimming pools in Romania. If there is a quality problem with some of these baths tubs and swimming pools, the product and problem can be traced back to the completed operations, in no time, due to barcodes attached for each product (that confer traceability down the production chain, in ASiS ERP system).
ASiS ERP solution is strongly tied with the “Smart Factory” concept because it addresses all of the following:

1. **New technology**: it offers a personalized ERP solution, integrating barcode readers and other devices – Internet of Things (IoT)
2. **Production processes**: ASiS focuses on all economic (financial, accounting, cost calculation) and production processes (technology, operations/stages) within a manufacturing company.
3. **Cost efficiency**: ASiS ERP assures cost efficiency because it helps implement standardized production processes, with information and correlation between stocks of raw materials, customer orders, human resources and machineries.

Quality assurance: ASiS ERP assures quality for products developed in manufacturing by using mobile devices that have ASiS mobile application installed. Quality processes are validated by traceability policies defined in ASiS ERP.
At Fibrex Co, ASiS ERP solution for production comes up with a few innovative features for an integrated system: mobile application for entering production achievements that can immediately be seen in the database, barcodes scanning for completing production operations, seen directly in the ERP system, viewing stock in real-time.
Traceability, stock optimisation, production achievements, ERP IoT, integrating production devices with ERP, data driven company
ASiS ERP is a validated solution by 20 years of experience in the technology and business solutions sector, that can be used in different industries (retail, construction, distribution, utilities, HORECA), not only in production.
Updated throughout the time according to technological requirements, ASiS ERP is one of the most modern and adaptable integrated IT solution, 100% online, the first of its kind in Romania!
What makes a clear difference between ASiS ERP and other integrated solutions in Romania? The following:

- **Increased flexibility and adaptability**: ASiS has a 90% ready-made structure, the remaining 10% allows for refined adaptations in a record time and in accordance to industry and customer needs.
- **Availability from anywhere**: ASiS does not require installation on working stations (installation is done exclusively on the server) and can securely be accessed from anywhere via an Internet connection.
- **Accessibility for information from mobile devices** (IOS, Android): Any information from the ASiS database can be brought on mobile devices due to ASiSmobile (application of the ERP that works on Android or IOS)
- **SaaS solution**: ASiS ERP is a Cloud-computing solution.
- **Human Resources** in Alfa Software have more than 10 years of experience in the development and implementation of ERP solutions.

OBJECTIVE AND TARGET AUDIENCE

The production solution described earlier was implemented in the company named Fibrex Co, from Crasna, Salaj county, Transylvania, Romania. ASiS solutions can be applied to mid-sized and large companies (regardless of their field of activity) that want to optimize their processes and to become more competitive in the market.

METHODOLOGICAL APPROACH

ASiS solution for production that was implemented at Fibrex Co (implementation completed in 2015) brought an increase by 20% in the company`s turnover in 2016.
ASiS ERP came for the company as a package of licenses, implementation services, customization and development services and a monthly fee for technical assistance and support. The initial investment in production devices, server, licences and services was significant, but maintenance of the provided solution turned out to be a reasonable cost.
The validation of the solution was achieved through direct implementation into companies that use the system for managing production processes such as:
Ramira Baia Mare has as main activity the machining of mechanical parts and the production of devices for assembly lines from the automotive industry. Among the beneficiaries of this

company were huge actors from the automotive industry such as: Daimler, Nissan, Volkswagen, Audi, Peugeot-Citroën, Dacia and many others. Anvis Group is an internationally resonant name in the manufacturing, design and development of anti-vibration systems (AVS) for the automotive industry, expansion joints for various industries, including railways, as well as other fields, such as the manufacturing of rubber blends. Inteva Products has decided to implement the ASiS ERP to manage its financial and accounting activities in Romania. The American group has two factories, in Salonta and Oradea, that provide automotive parts and components to prestigious companies from the automotive industry in Europe. Traceability across the production chain assures quality in the production chain and especially for the final products. Validating operations in the system (production achievements) by operators in the manufacturing brings efficiency and reduces the mistake. The starting point in the implementation process is the **business process analysis**. Then a plan and the implementation project are completed. Usually, the preparation of an implementation project takes place with the presence and participation of both parties: Alfa Software representatives - with experience in the business verticals of the company involved, the proposed implementation team and representatives/project manager from the beneficiary.

A start date is set for the implementation and it begins with the setup and configuration of the server. Because ASiS is an online ERP, modules and standard applications are installed on the server. Application settings and user rights are also configured on the main server. When starting the implementation process, data initialization means entering data into the ERP from an existing database: suppliers, customers, balances, assets, employees, etc. If this data is available in electronic format, then it will be automatically imported in ASiS. **System configuration** is the adaptation stage and brings the system to parameters set by the client in the analysis phase by activating parameters that already exist or by programming them. **Training** involves teaching users to use the system according to their job description. This kind of training will be held throughout all the implementation process. At the end of the implementation, general trainings are organized for each department, detailing app features in use. Operational phase means that the all the departments use the ERP system on a daily basis. At this stage, data will be entered into the system: invoices, receipts, production reports, etc. Based on the data entered, reports will be extracted containing vital information for decision making. These reports are usually related to stocks, sales, production, costs, etc. At the end of a monthly financial exercise in ASiS ERP, the implementation is evaluated and a Protocol of delivery and acceptance is signed.

What is evaluated at the end of the implementation process:

- that all the client`s applications are installed and in use;
- that the system works in the parameters set in the analysis phase;

New features can be successfully developed beyond the period of implementation of the system, when new requirements arise or there is a reorganization, thus creating the basis of a long term partnership.

Every ERP implementation demands a different amount of resources from the company that is preparing to make a change, depending on field of activity, size, etc.

In order to follow the steps described above for an implementation project, a company must commit resources to:

- providing project management (a person within the company familiar with all the internal processes, responsible for the implementation project)
- offering information about the ERP change for all the employees in order for them to embrace the change and make the implementation a successful project.

- participating actively in an analysis completed with an implementation plan (that has estimated implementation phases, estimated working hours, go live moments and training sessions)
- providing equipment for hardware infrastructure, decided together with Alfa Software team (server, mobile devices – smartphones or tablets, barcode readers, scales)
- purchasing software licenses. Their price is influenced by the number of system users and by the selected ERP modules. Also, an ERP system can be purchased on premise or can be rented based on a monthly subscription (SaaS).
- accepting ERP customization services according to analysis made within the company
- accepting implementation services according to the complexity of the project
- organizing ERP training sessions for each department
- making a subscription for technical assistance - legislative adaptations and maintenance

Every implementation project takes between 3 months to 1 year, depending on the complexity of business processes.

VALIDATION PROCESS

After the operational phase, a validation process was completed at Fibrex Co. The company`s turnover increased by 20% the next year after the implementation was completed. There was an increase in the production productivity and a decrease in the error/scrap rates after the implementation. Integrating all processes significantly simplified company`s flows.

RESULTS / IMPACT

The impact of the ERP solution implemented was highly positive as the general turnover of the company increased by 20%. Scrap rates reduced from 10% to 2%. The productivity increased by 14% in the production line. The main customer of this company increased orders to the company.

SUCCESS FACTORS AND CONSTRAINTS

The limitations may appear from integrating certain devices with ASiS system. For example, ASiS has no problem working with certain scales, but for others, development for integration is needed.

The frame of the ERP system allows updates without affecting specific configuration. Errors and minor complaints are solved throughout the online support system, in no more than maximum two days. In over 20 years of existence on the Romanian market, ASiS ERP has always been an innovative system, adapting to new technologies and offering innovative solutions to its customers.

ASiS is the first Romanian integrated system to work 100% online. ASiS is very flexible. It has a 90% ready structure, the rest (10%) allowing developments and customizations according to specific needs. Using a secured Internet connection (and not local installation), ASiS is also a Cloud Computing solution and it can be accessed from anywhere via a monthly subscription (SaaS).ASiS is one of the few ERP solutions that has a mobile component (ASiSmobile) that brings data from the system on smartphones and tablets. This data refers to KPIs, project management, production achievements, retail information, and others. There are a few technical minimum requirements for ASiS ERP system to work. The first one refers to working stations capabilities that need to have running on them at least Windows 7, but Windows 10 is recommended.

The second requirement refers to the server on which ASiS needs to be installed. The recommended configuration is the following:

SISTEM EVISION Ci73.6G
Placa de baza MSI Socket LGA1151, B250 GAMING M3, Intel B250 Chipset, 4 *DDR4 2400/2133 MHz, DVI-D/HDMI/12*DirectX, 2*PCIEx16, 4*PCIEx1, 2*M.2, 6*SATAIII, GAMING LAN 10/100/1000*1, 8*USB3.1/6*USB2.0, Realtek ALC1220 Codec, ATX
Intel Core™ i7 Kaby Lake i7-7700 4C 65W 3.60G 8M LGA1151 VT-dx ITT TXT
Memorie RAM 32GB, 2133MHz, DDR4
2 x SSD Samsung, 250GB, 850 Evo, retail, SATA3, rata transfer r/w: 540/520 mb/s, 7mm
HDD intern WD, 3.5", 1TB, BLACK, SATA3, 7200rpm, 64MB
CARCASA Cooler Master fara sursa, K350, mid-tower, ATX, 1* 120mm fan (inclus), I/O panel, side window, black
Sursa FSP HEXA Plus Series HE-500+, 500W, 80 Plus White, Eff. 80%, Active PFC, ATX12V v2.4, 1x120mm fan, neagra, retail

The third requirement deals with equipment capabilities and interconnecting devices (cash-points, barcode readers, scales) with the ERP system.

LESSON LEARNED & SUSTAINABILITY

The system has better performances if the hardware infrastructure is of high quality.
Moreover, there has to be an acceptance agreement from everybody that will be working with the system in the company in order to sustain the implementation process (change of paradigm) and its success. The ERP system is “alive” and needs readjustments according to new market conditions, extensions and other features in order to give the company a competitive edge.

Direct connection between equipment and ERP system encourages performance. The number of employees reduces due to automatization and Internet of things. Throughout time, the prices for equipment decrease whereas their capabilities increase.

REPLICABILITY AND UP SCALING

Traceability in production is a must in many production fields, especially in the food and pharmaceutical industry. This production solution can be used and slightly adapted in other domains without great difficulties. Reporting production achievements from mobile devices is also a desired functionality for production companies and can be replicated to other production companies too.

ASiS solutions can be implemented to a wide range of companies: retail, distribution, construction, waste management, etc. Access to ASiS database from mobile devices can be used differently, depending on the action or the information that needs to be accessed quickly. For distribution companies, sales agents can access information about customers from their smartphones and can also place orders. For retail companies, cash-registers can be tied to a

tablet and sales can be made using that tablet. For waste management companies, consumption can be registered on the spot and bills can be paid by subscribers on the spot (if the company`s representative uses a mobile device).

FINAL REMARKS

Adopting an integrated solution could be expensive at first, but all the costs can be supported by the advantages that this solution brings: at least the increase of the company`s turnover with 3% in the year following the implementation. Other advantages are: increased productivity, stock optimization, cost control, accounting document automation, process control, increased customer satisfaction, customer orders optimization, production management.

Disclaimer / Acknowledgements

The success of an ERP implementation depends both on the involvement of the client and the provider. Thus, Alfa Software cannot guarantee the success of the solution presented before and can`t be held liable for its failure. We agree with on-line and printed dissemination of the information from the questionnaire.

List of attachments:

Attachment 1: Video presentation of ASiS: https://www.youtube.com/watch?v=RjkKjw4iOMY&t
Attachment 2: Presentation of solution: https://prezi.com/ei6bl8bh_obk/asis-erp/
Attachment 3: Presentation of solution: https://prezi.com/embed/_vnjvkekq4xk/


ASiS ERP
tica integrata, ac
Prezi


Solutia ASiS ERP dedicata firmelor din
domeniul viticulturii si vinificatiei

6 CLOUD STORAGE/ PROCESSING

“The Cloud” (online stored data pools, accessible by multiple users / applications at the same time) eliminates the use of local servers and dedicated software solutions and replaces it with online data storage and analysis capabilities, also referred to as “Cloud Computing”: “a powerful technology to perform massive-scale and complex computing” by eliminating “the need to maintain expensive computing hardware, dedicated space, and software. Massive growth in the scale of data or big data generated through cloud computing has been observed.” (Hashem, et al., 2015).

6.1 TELEVEND SMART VENDING

INTIS d.o.o.

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Keywords : smart vending, IoT showcase, planogram analysis, geo routing, cash conformity, customer mobile app, loyalty programs, prediction algorithm, offline machine management

Good practice applied in: (NACE code) : J – computer programming
C - manufacturing

Televend Smart Vending platform is a unique combination of hardware and software products which organize and optimize daily business in a vending operator company. It is the most important and most useful technical improvement in the last ten years in the vending industry. There is no need for investment in huge software modules and there is no need for internal IT specialists, because they use a Cloud platform. It is real proof that 4th industrial revolution has started.

The platform consists of:

1. Televend Box which is inserted in the vending machine and communicates with the Cloud via GSM;
2. Televend Cloud which supports vending operator's daily business using real time data;
3. Televend Mobile App which supports fillers and technicians in their daily tasks;
4. Televend Virtual bank which allows consumers to close loop payment and marketing actions and
5. T- Wallet Mobile App – consumer application for cashless payment via smartphone.

GOOD PRACTICE DESCRIPTION

They have combined many different technologies to be able to deliver a versatile and useful solution for a very challenging market. TELEVEND CLOUD is central point of modern Smart Vending Company. It is a powerful platform which could completely change vending operator business model, guiding company in the most optimal way. Benefits of TELEVEND Smart Vending concept are remarkable. It will suggest the most optimal way of organizing tomorrow's actions, saving time and money. Everything is based on real time data and historical based predictions, using advanced mathematical algorithms and methods. Connected machines are all controlled from one centre which allows them to make optimal decisions and to react immediately

in case of an error on any machine. It allows them to provide precise cash collection up to the last cent. Reports are on daily bases showing Key Performance Indicators of any machine in real time. Dynamic planogram management will adjust every machine to the best performing product choice. Expiry date management will take care of product usability proposing to move short lasting product to “faster” machines.

Experienced engineers who have been working on the complex projects in industrial automation, were assigned to design a robust hardware with GSM Internet connection which connects to a vending machine along with an efficient assembly line. It was crucial to find reliable suppliers flexible to support highly growing demands of a new product and to keep the development in-house in order to quickly react to new requirements from various customers as there are many vending machine types and many different requests to tackle in the industry.

Novel technology – the product is a state of the art IoT, Industry 4.0 example - the complex infrastructure in which hardware, associated with a vending machine, directly communicates in real-time with the Cloud web and mobile applications.

Production processes – every coffee vending machine is a small factory. Televend Cloud vending operators are able to predict the need of a visit to a vending machine which is a highest single logistical cost for the operator.

Quality assurance – every software development of complex web and mobile application goes to deep testing of their Q&A team. They also have a special team working on the testing of the firmware made to work with various vending machines. They have developed testing units for each electronic board in-house.

Risk Management & cost efficiency– they have a specialized procuring department taking care of ensuring enough stock of critical components and also constantly evaluating suppliers and watching the movement on market which is critical for optimal pricing.

Figure 28 T-BOX device

T-BOX is a small device installed into old and new vending machines. It collects all useful data from the machine and payment systems including sales, cash details and errors, and sends it in real time to the Cloud.

T-CLOUD gives online control of vending machine network in real time - sales and stock data, cashflow data, machine and payment system errors and remote machine settings. T-CLOUD also includes a mobile application for refill operators and servicers making their daily routine more productive.
T-WALLET is a closed loop mobile app for customers allowing quick payment by smartphone, using only QR code or Bluetooth. It Interacts with customers and creates customized marketing and loyalty programs.

SMART ROUTING ALGORITHM helps to drastically reduce the number of visits and optimize a planogram. T-CLOUD enables to create daily routes based on a smart mathematical model which helps to prioritize the visits. A flexible routing model allows you to choose between pre-kitting models, or live routing with mobile app based on real time stock levels from all your machines.
GEO ROUTING - optimal routes are calculated and visualized on the map, along with the time necessary to visit all machines, making daily route planning very fast and smart. Fillers get the sequence of visits shown on a map, so they can easily navigate through the intended route. Product list and machine tasks communicate on each machine.
CASHFLOW REPORT provides an exact information on how much money is left in each tube/BNA in the machine. It also gives information on how much is sold using cash/cashless system and how much was topped up to cashless devices. The most important info is how much money does the filler needs 'till the centre and how much money they need to bring to machines if the tubes are empty.
CASH CONFORMITY - Televend Cloud is connected to the counting machine, enabling cash conformity analysis and complete automation of cash handing. Fillers scan the barcode on the cash bag using Televend Mobile App. Cash bags are brought to the counting machine.

The solution includes a highly versatile and rounded up product for Vending machines management, including hardware, web application, staff mobile app, mobile app for end customers, cashless payment and ERP integration. There is an insignificant number of competitors.

Intis is a member of the biggest vending association in Europe – EVA.
Televend is actively present and exists on the biggest EU vending fairs for already four consecutive years – EU Vend Koln, Venditalia Milano. Also they present on Evex, Vendiberica (spain), UK vending fair etc.

Televend Wallet is a mobile payment and marketing solution tailored for vending. End consumers use mobile application to pay or recharge. Vending operators use web application to track consumer payments, feedbacks and activities in real time and create loyalty and rewarding programs. Operators can configure mobile application "look and feel" and that way create their own vending payment service. Solution is based on Televend Box hardware which provides vending operators with most advanced Smart Vending Operations features to optimize and improve their daily business. One hardware, two solutions.

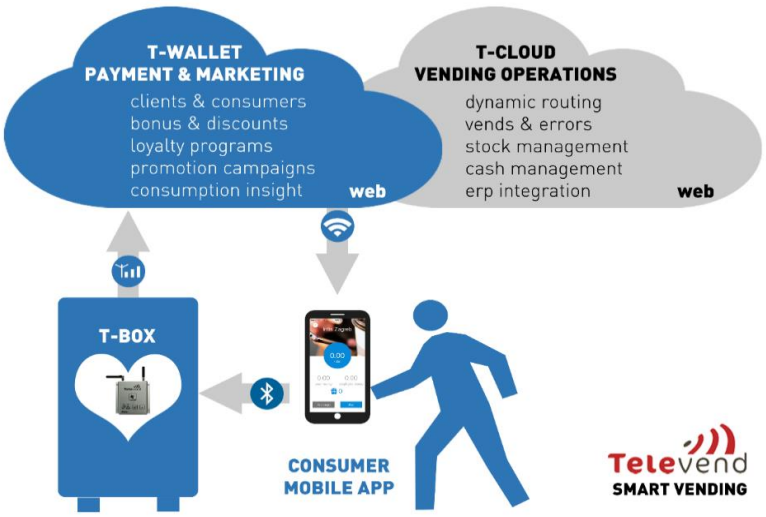

Figure 29 How it works

OBJECTIVE AND TARGET AUDIENCE

The product is designed and produced in their headquarters in Zagreb, Croatia. The product is sold in more than 40 countries in EU, and distributed by specialized partners from Germany, Austria, Spain, Portugal, UK, Slovenia and Hungary. Their customers are the biggest vending operators in EU and vending machine producers (SMEs and large companies). Their product enables their customers to communicate with end consumers through Televend Wallet mobile application.

METHODOLOGICAL APPROACH

The key of the solution is increasing logistical efficiency of the vending operator:

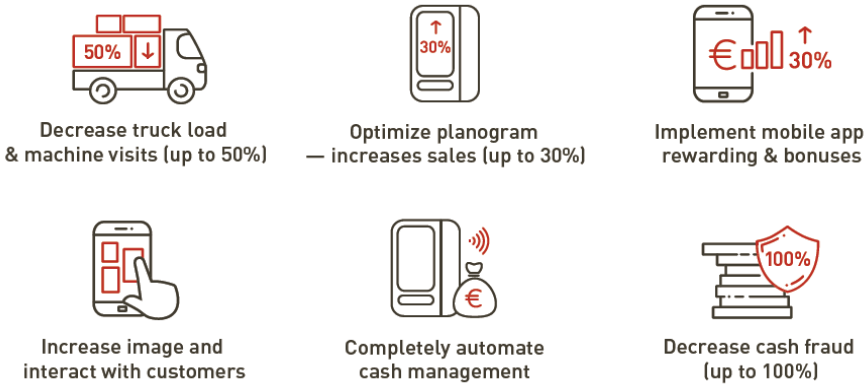

Figure 30 Why it works

All software and hardware components are tested by their QA team and product possess all quality certificates which ensures sales on the global market. Solution is implemented by their key account managers who work closely with the clients, educating them on the software and hardware implementation, and they also have customer support in daily communication with the customers.

The team for this project consists of 50 people working in the following departments:

- cloud development team
- basic infrastructure development team
- IT system support
- mobile application development team
- firmware development team
- hardware development team
- wallet development team
- testers team,
- product management team,
- customer support team,
- production management
- sales
- procurement,
- QA team
- management

VALIDATION PROCESS

Every development is done according to the best development practice. After every development cycle, QA team is responsible that the improvements and new developments are delivered to the customers

RESULTS / IMPACT

Case studies show massive improvement in cost efficiency of vending operators in many areas. Following table shows a measured case study with one customer who owns 3200 vending machines whit a solution for all of the mentioned areas which proved that following savings are possible:

Recalculation of 3200 machines during a 6-month period (230 snack & cold drink machines, 3 fillings)

Reason	Annual cost
unnecessary visits	2.030.191,30 EUR
expired products	85.176,57 EUR
working capital cost	24.192,00 EUR
failed vend	378.657,39 EUR
price incorrect	10.685,22 EUR
cashless malfunction	584.000,00 EUR
coin changer fail	467.200,00 EUR
planogram	583.680,00 EUR
Total:	**4.163.781,91 EUR**

Figure 31 Measured case study

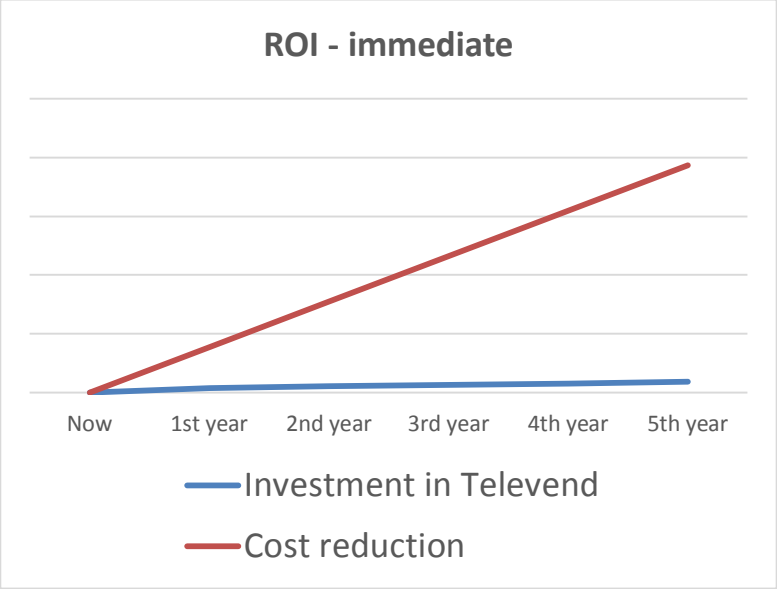

Figure 32 Cost reduction in 5 years

SUCCESS FACTORS AND CONSTRAINTS

Compatibility is one of the main challenges on the market with almost thousand different machine types. Different communication protocols are required: EXECUTIVE, MDB, BDV, EVA DTS, CSI etc. Low cost and industrial design are needed as much as an easy installation. There are also a lot of requirements for small electronic devices.

Other biggest challenge is the slow speed of implementation and a need for employees' education:

- real time sales and stock level monitoring
- real time errors & event lists – alarm management
- cash collection management
- smart Route optimization – by urgency factor calculation
- expiry date management
- dynamic planogram analysis & optimal product placements
- rentability analysis - per machine, customer, product...
- user role based concept – restrictions on widgets per users
- reporting editor with detailed filtering and export possibilities
- remote configuration
- third party systems data integration
- one device which is cashless at the same time
- cashless payment and virtual bank

In order to improve the impact of the Good practice there is a need for creation of Smart Vending Academy for distributors and vending operator's education.

LESSON LEARNED & SUSTAINABILITY

Big customers are key for success.

It is important to be very careful with filtering all of the development requests – there are many customers and many different requirements. Listening to all of them at once would be impossible, but there is a need to prioritize development with extreme care.

Monthly fee per connected machine is the key to the long term sustainability of the product.

REPLICABILITY AND UP SCALING

Besides key selling points and their customer benefits, a positive market response is beneficial to many suppliers as the company has many different hardware components for assembly and often assigns different technology consultants. Present the product on the global market – not only EU. This requires a lot of effort in establishing a worldwide distribution and partner networking.

FINAL REMARKS

In recent years, the most important change in the sales industry has occurred. Industry 4.0 or IoT (Internet of Things) is here. Vending sector will become “smarter” and activities of vending operators will become optimized and coordinated. Old term “telemetry” is outdated. Transmitting of data from vending machines is not enough. New term is - Smart Vending which is based on smart bidirectional communication between vending machines and business intelligence in the Cloud. It brings unimagined possibilities and new business models in vending. It will change this sector completely - like Interned did in other sectors.

Disclaimer / Acknowledgements

This information can be disseminated by printing material and online release.

List of attachments:

Attachment 1: Screenshot from the application
Attachment 2: Screenshot from the application
Attachment 3: Screenshot from the application
Attachment 4: Screenshot from the application
Attachment 5: Screenshot from the application
Attachment 6: Installation tutorial http://bit.ly/2Bc0BtQ


Televend
Installation Tutorial
INTIS

6.2 OSICE - OPTIMIZATION AS A SERVICE IN CLOUD ENVIRONMENT

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Keywords: OSICE - Optimization as a Service in Cloud environment
Good practice applied in: (NACE code): Software Development Services (NACE code 62.0)

OSICE is a Cloud service intended for solving complex optimization problems in the distributed computing environment. It provides all interested third parties, especially low resources stakeholders like SMEs, with the effective tool for the problem solving and decision making. This goal is achieved through the implementation of the optimization procedures based on evolutionary algorithms (EA) in Cloud computing environment and through the development of simple and intuitive application programming interface (API).

GOOD PRACTICE DESCRIPTION

Vodena is an innovative ICT company established as a research spin-off from the Faculty of Science, University of Kragujevac, Serbia. Our enterprise offers university-strength research, modeling, simulation and data analysis, all integrated through flexible and efficient software applications. After years of experience in solving various optimization problems we have developed a web service for solving optimization problems on supercomputers using evolutionary algorithms. Finally, we have decided to offer the service to the market as a Cloud service.

OSICE is an innovative ICT concept which will disrupt existing markets of optimization software and create new ones by enabling SMEs to utilize immense computational power of the Cloud for optimization problem solving and decision making, regardless their financial, technological and knowledge level.

Technical solutions and innovations of the good practice are:

- Service Oriented Architecture (SOA) approach to the optimization software, which allows the optimization methods to be exposed as an Internet service.

- Fully automatic allocation of the computing resources on HPC or Cloud infrastructure, which provides enough computing power hiding the implementation details from the user.
- Frugal utilization of the computing resources in accordance with the current service load, resulting in financial savings and minimal energy consumption.

According to company's best knowledge, direct competition in the field of cloud-based optimization service does not exist at the moment. Currently, commercially available solutions available on the market (IBM, SAS, Lindo Systems Inc., AIMMS B.V., AMPL Optimization Inc., ...), although robust and reliable, are often very expensive and do not offer proper HPC support. On the other hand, open source solutions such as jMetal, OptaPlanner, Scilab, HeuristicLab HIVE, and others are publicly available, but their application requires significant expertise in the field of software development and optimization. Nevertheless, these solutions are still not comprehensive enough. For instance, OptaPlanner does not support multi-core execution, while HeuristicLab HIVE requires that the user establishes computing infrastructure on his own. The necessity of possessing expertise can be partially overcome by employing a consulting company specialized in solving certain types of optimization problems. Unfortunately, the services offered by these companies are often very expensive and unavailable to SMEs, due to engagement of highly qualified and scarce experts.

OSICE is a modular system that consists of:

- **WoBinGO** - the framework for parallel execution of the evolutionary algorithms
  - **JARE** - evolutionary algorithms library
  - **Work Binder** - the component in charge of elastic allocation of the distributed HPC/Cloud resources
- **JARE Service** - the optimization service which exposes functionalities of JARE library.
- **JARE Manager** - user exposed web application for optimization management and monitoring. Intended for both experts and users.

Binder Manager - web application for administration, monitoring and management of Work Binder service. Intended for HPC/IaaS admins.

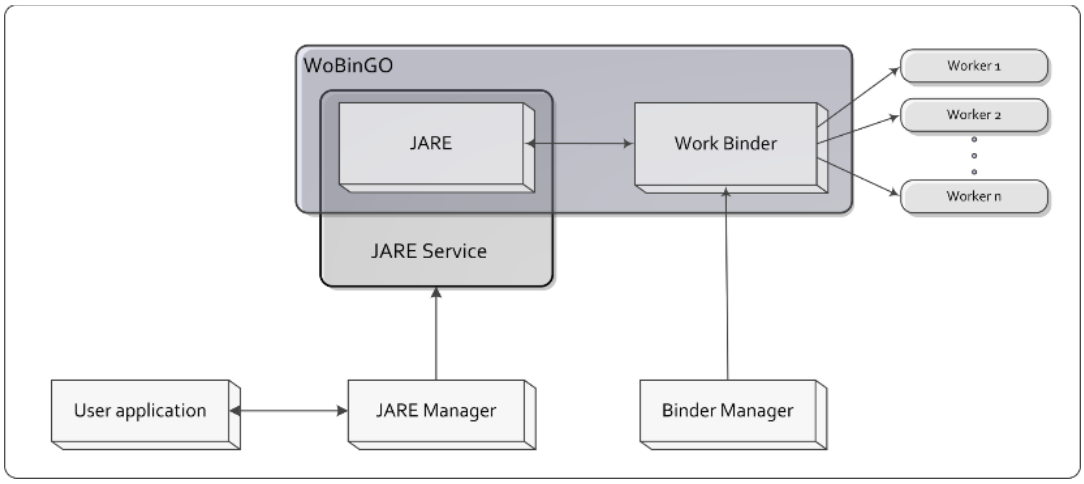

Figure 33 Logical architecture of OSICE - component view

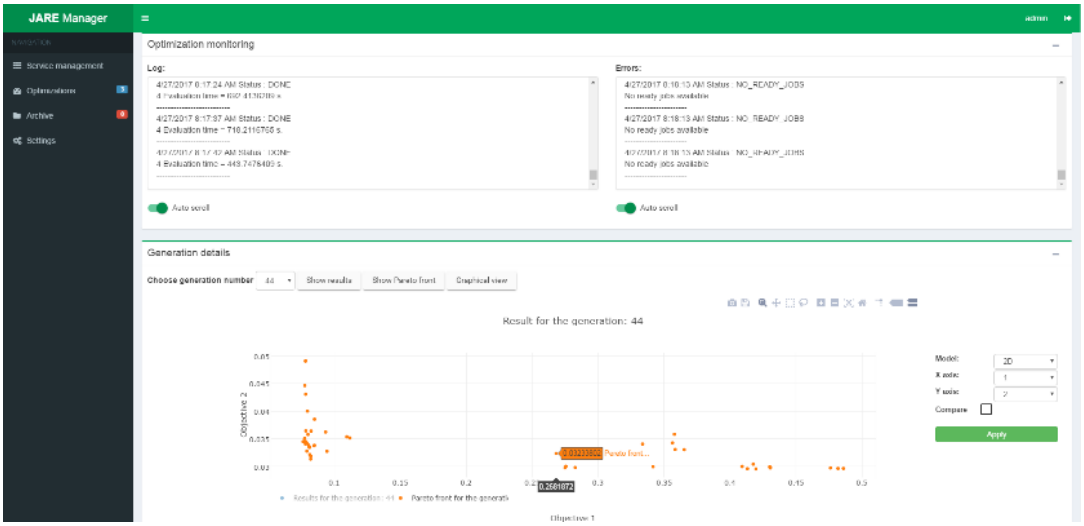

Figure 34 JARE Manager, user view. Monitoring the objectives in real time

OBJECTIVE AND TARGET AUDIENCE

Company's greatest achievement so far is the development and deployment of comprehensive data analysis and optimization solution employed at "Iron Gate" hydropower plant on Danube river. The solution uses OSICE as an underlying optimization engine.

The key segment of our identified users are European SMEs, with 50-250 employees, in high-tech manufacturing sector and high-tech knowledge-intensive services sector, especially telecommunications, computer programming, consultancy and related activities, information service activities and scientific research and development. These companies are already familiar with the benefits of business processes optimization, or optimization in design of products and services, and they are in the need for comprehensive, cost-effective and easy-to use optimization solution, or cost-effective alternative to existing in-house optimization solutions.

METHODOLOGICAL APPROACH

Implementation of our cloud-based optimization solution eliminates need for initial investment in HPC equipment, which ranges from 100,000 to 500,000 EUR. Development of HPC based optimization solutions demands interdisciplinary team, which include domain expert, optimization expert, expert for parallel programing and system administrator. Cost of this team is 200,000 EUR annually. Usage of our product require only domain expert, thus reducing the personnel costs up to 80%.

A crucial business novelty that OSICE brings to the global market is the offer of the optimization in the form of service that can be accessed over Internet. It is achieved through the technological innovation that combines state-of-the-art distributed evolutionary algorithms, cloud-based computational environment and easy-to-use universal API. This combination overcomes two main obstacles for broader usage of optimization, knowledge gap and technology gap.

Due to different internal and external factors, there is a risk of delay in different phases of the project, which can lead to insufficient funding for project completion or market takeover by the

competition. Measures to mitigate these risks involve timely assessment of complexity of every activity and provision of sufficient human resources.
In spite of invested effort to expose optimization methods as easy-to-use API, there is a standing risk that resulting interface will still be too complex for the user who is not sufficiently familiar with the optimization techniques. This risk will be diminished by increased understanding of technological level and needs of our potential users.
There is also commercial risk that we will not succeed to reach our key customers. Mitigation measures will involve increased marketing activities.

By accessing **JARE Manager** instance, the expert defines the optimization problem, including the number and types of decision variables, their ranges, optimization goal(s), the algorithm to be used, etc. Moreover, the expert has to supply the evaluator whose role is to assess quality of the potential solution. The evaluator is given in the form of Docker/LXD container or ordinary ZIP that contains the executable(s) and necessary data for the solution fitness evaluation. The evaluator package has to comply to the standardized interface.
The execution of the optimization task itself is left to the **WoBinGO** framework, which hides the complexities of the optimization method and underlying computing infrastructure. The user has the ability to follow the progress of the optimization process within **JARE Manager,** through its common numerical and graphical elements expressing the current status.
The web application **Binder Manager** is aimed at computing infrastructure administrators. Its main purpose is to enable fine-grain control of the distributed evaluation process. It plays a role of a bridge between the evaluation requests posed by **JARE** and underlying HPC/IaaS infrastructure controlled by **Work Binder**. The **Binder Manager** largely facilitates a number of common admin tasks like monitoring IaaS instances, cleanup, specifying users' Quality of Service (QoS) requests, etc.

We offer the solution for two, not necessarily distinct, user categories: experts and users. **Experts** encounter optimization problems in their domain (i.e. in production, computer science or hydrology) and try to get a viable solution. For them, OSICE provides tools for specifying optimization parameters, goals, algorithm to be applied, evaluator, etc. **Users** of the optimization service are not as familiar with the problem domain as experts are. They only use the provided optimization scenario of the service. Since typical optimization tasks take hours to days, users need control to start, pause, resume and stop such runs.

VALIDATION PROCESS
The solution has been validated as an underlying engine of several decision support software in hydrology, power production, finance, etc. The most comprehensive and demanding software that uses OSICE is the power production optimization tool employed at "Iron Gate" hydropower plant on Danube river.

RESULTS / IMPACT
OSICE provides a comprehensive solution comparable to in-house optimization solutions **without need for investment in HPC infrastructure** and **reducing the costs of expert stuff by 80%**. In addition, it provides ease-of-use of available commercial solutions, but with possibility to optimize large real-world problems in Cloud-based environment.

SUCCESS FACTORS AND CONSTRAINTS

In spite of invested effort to expose optimization methods as easy-to-use API, there is a standing risk that resulting interface will still be too complex for the user who is not sufficiently familiar with the optimization techniques. This risk will be diminished by increased understanding of technological level and needs of our potential users.

	No initial investment	No need for expert knowledge	Ease of use	Generality	Distributed computation	Price
In-house solutions	✗	✗	✓	✓	✓	High
Commercial solutions	✓	✓	✓	✗	✗	Low
OSICE	✓	✓	✓	✓	✓	Low

- **Better IaaS support**. In its current incarnation, OSICE is fully tested within a pure HPC and HPC-in-the-Cloud infrastructure. Although the first alpha version, which uses cloud IaaS, has been built, this approach needs more thorough testing.
- **Accounting and Billing**. Although OSICE logs all events, the accounting and billing feature has to be implemented more seriously. The service has also to provide an easy to use cost estimator.
- **Service Level Agreements (SLAs)**. Since users may have versatile QoS requirements, service level agreements play an important role for the optimization service.
- **Implementation of security standards and data governing procedures** in relation to administering data transfer, storage and backup. Trust and confidentiality can be critical factors in deciding whether to use the services of an HPC/Cloud provider.
- Further improvements of user and admin front ends.

LESSON LEARNED & SUSTAINABILITY

According to INFORMS, winners of Franz Edelman Award for Achievements in Operations Research and Management Science made a cumulative financial impact of $240 billion in last 40 years through optimization of business processes. Some of this companies are Syngenta, TNT Express, MISO, HP, GM etc. However, SMEs, which contribute two-thirds of total employment and 57% of value added in the EU, **rarely use large scale optimization of real-world problems**, due to the following obstacles:

- **Knowledge gap**
  Knowledge required for real-world optimization problems can be separated in three main areas:
  - **Modeling of the problem**, which requires domain knowledge of processes in question and expert knowledge in modeling of these processes.
  - **Development of the optimization procedures**, which requires expert knowledge from the area of the optimization methods.
  - **Execution of the optimization procedures on HPC infrastructure**, which requires expert knowledge in distributed computing and HPC system administration.
    Required human resources with an adequate level of expertise in any of these domains are scarcely available and expensive.
- **Technological gap**
  Potential users of the advanced ICT solutions for optimization mostly lack the appropriate hardware and ICT infrastructure to fully benefit from its use. For most low resources users,

like SMEs, costs related to the investment in equipment and constant need for its maintenance act as a financial barrier.

Mentioned gaps drive away the potential users from investment in the optimization tools, and consequently reduces their potential to compete in today's markets.

REPLICABILITY AND UP SCALING

OSICE is an innovative ICT concept which will disrupt existing markets of optimization software and create new ones by enabling SMEs to utilize immense computational power of the Cloud for problem solving and decision making, regardless their financial, technological and knowledge level. It will provide comprehensive, cost-effective and easy-to-use HPC-Cloud-based optimization service.

Optimization as a service in HPC-Cloud based environment is a new concept, and there is no developed market for it. However it is closely related to the cloud computing market, Platform as a Service (PaaS) market, and operational analytics market. Increasing adoption of cloud-based services and IoT technology among SMEs, growing demand of application development platforms, and technological improvement in PaaS services are the major driving factor for PaaS market. Hence the market for PaaS is expected to grow at US $12 billion with CAGR of 26% between the years 2016 to 2022. Globally the market for operational analytics is valued at €3.3 billion in 2016, with CAGR of 18% and it is expected to reach €9 billion by 2022.

The key driver for the growth of this market is the increasing number of IoT-enabled smart connected devices and sensors, which releases a large amount of heterogeneous data simultaneously. Furthermore, the shifting interests towards cloud deployment, predictive analytics for business, end-to-end automation, and consumer-friendly IoT analytics platform are additional factors driving this market and creating value in the market. Global cloud service market is expected to reach €249 billion by 2022, at 4% of CAGR between 2016 and 2022.

FINAL REMARKS

Most of real-world optimization problems require computing resources that largely exceed the capacity of modern personal computers. Solving such optimization problems has so far been a privilege of large companies and research institutions, which can afford specialized expert teams and necessary computing infrastructure. Due to inability to provide adequate human and hardware resources, smaller companies and institutions are forced to avoid optimization of their business procedures, or to rely on commercially available solutions.

OSICE is an innovative ICT concept which will disrupt existing markets of optimization software and create new ones by enabling SMEs to utilize immense computational power of the Cloud for problem solving and decision making, regardless their financial, technological and knowledge level. It will provide comprehensive, cost-effective and easy-to-use HPC-Cloud-based optimization service.

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.

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

6.3 VIRTUAL ENVIRONMENTS TO CREATE SUSTAINABLE INNOVATIONS

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Keywords : KoBP: digital manufacturing, production optimization, data collection, manufacturing capabilities simulation, material flow, customer feedback in the early stages of product development, delivery just in time
Good practice applied in: (NACE code) : Manufacture of metal forming machinery (2841)

Operational excellence requires harmony across design, production, distribution, people and processes. In MAGIC ENGINEERING organization, the innovation is driven by current technological needs coming from various industries: Aerospace & Defence, Transportation & Mobility, Engineering & Construction, Consumer Goods & Retail, Industrial Equipment, High-Tech.
Our software products portfolio, from Dassault Systemes, enables our technical team to transform operations, designing and testing in a simulated production environment. Once completed, our customers that are using our technology can efficiently plan, produce, and manage all resources from staff to production and later to customer delivery.

GOOD PRACTICE DESCRIPTION

In EMSIL SRL, we provide a platform embedding continuous process optimization algorithms, collecting real-time data from the physical production lines linked to the factory's virtual digital 3D model. The company can optimize direct operations through production chain, setting the parameters and production processes, adapting the product to the customer's requirements.
Our solution is strongly tied with the "Smart Factory" concept, as a collaborative platform technology. With our software solutions the engineers can evaluate the simulation results in the early phase of product creation - shorten and streamline the production cycle, reducing the time-to-market, detecting inefficient settings of the underlying processes. Therefore, the concept of Digital Manufacturing is built on the principle known today as Industry 4.0.

The digital simulation model of the production line was created in 3DEXPERIENCE platform modelling global production processes. This model was a detailed virtual copy of the physical processes.
Digital Manufacturing drives manufacturing innovation and efficiency by planning, simulating, and modelling global production processes. DELMIA allows manufacturers to virtually experience their entire factory production from the impact of design to determining how to meet global demand. These simulation activities allow manufacturers to better address and shift processes so as to quickly respond to competition, or to take advantage of new market opportunities.

Figure 35 3D experience architecture[10]

OBJECTIVE AND TARGET AUDIENCE

The solution was tested in Transylvania region from Romania. We will focus on the Automotive Industry, especially on small medium businesses (SMB).

METHODOLOGICAL APPROACH

From the costs perspective, the solution proved to be highly efficient with a good rate of return on investment (ROI), as it requires minimum intervention after installation/customization, further investments after implementation are not needed – good scalability.
The solution being developed for the automotive and aerospace industry led to a significant decrease in faulty and non-conforming products reported by customers, which in turn, increased customer satisfaction. Managing traceability and impact analysis of requirements across different systems, our solution can manage the risks capturing data from any source (file, database) of any vendor in a wide variety of data and file formats. The solution has a high degree of portability and can be adapted to companies operating in various industry branches

[10] Source : https://academy.3ds.com/en/software/3dexperience-for-academia

(https://www.3ds.com/industries/). Dedicated for mid-size SMEs (<250 employees) and big companies, the implementation needs 4 – 5 high skilled internal engineers and IT specialist to support our team during the implementation, the infrastructure costs around 30 KEUR, including databases.

VALIDATION PROCESS

The validation process was completed within customer's facility 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

The impact of the solution was positive, scrap rates were reduced and the assembly time was also reduced.

SUCCESS FACTORS AND CONSTRAINTS

The solution being highly scalable, practically we have no limitation on the deployment size.
This solution was the first of its kind in Romania, as no any other company made use of this type of practice, especially in its CNC machining and assembly processes with robots. As mentioned previously, direct results of the implementation significantly increased productivity and customer satisfaction was obtained. The platform returns better results if the input data accuracy is higher and the Robots & CNCs are better documented with technical specifications.

LESSON LEARNED & SUSTAINABILITY

The success of the implementation depends on the capability of overcoming the resistance of employees regarding the technological change. The reliability and performance of the system is directly related to the initial investment in mid-level hardware (ENOVIA servers). Currently the price of the solutions can be prohibitive mainly because of hardware infrastructure, however, due to future technological progress, their price will decrease and the cost of next implementations will be reduced.

REPLICABILITY AND UP SCALING

3DEXPERIENCE software platform can be implemented to a wide range of companies from different industries, 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. The on premise solution is costly because of IT infrastructure, but we can also deliver the cloud based solution, therefore avoiding any investment in servers.

FINAL REMARKS

The implementation of these types of solutions increases a company's readiness to adopt the new industrial revolution's principles, promoted in Europe under Industrie 4.0 (Germany)
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.

List of attachments:

Attachment 1: Video Understanding the 3DEXPERIENCE Platform in under 5 minutes: https://www.youtube.com/watch?v=hk-KiV35yeo

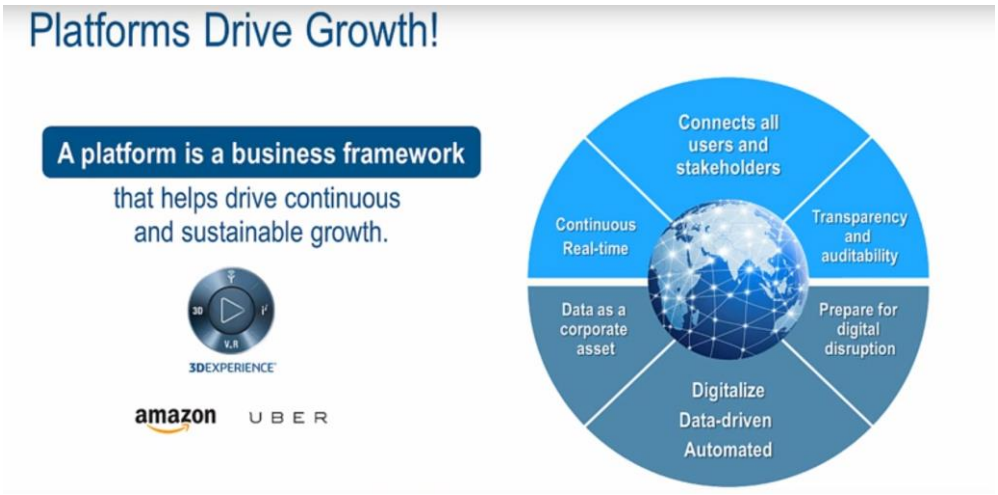

Figure 36 Understanding the 3DEXPERIENCE Platform in under 5 minutes

7 Data Analytics

Statistical Process Control (SPC) relies heavily on interpreting collected process data, which, in the context of CPS and “Big Data”, there is in no shortage and with the help of dedicated digital solutions real-time decisions can be made. This led to the development of the “Real-time SPC” (Costantino, Di Gravio, Shaban, & Tronci, 2015), (Urban & Landryová, 2015) and the concept of “Inline Metrology” (or “Inline Monitoring”), which unlike the traditional, offline approach that measures values only at the end of the production process, this one establishes short control loops throughout the fabrication cycle for “evaluating measured data close to each process step” (Schmitt & Moenning, 2006). Basically, from the measured / collected values information is obtained about the process’ functioning and its control is done accordingly. They function under an “Integrated Factory Information System” that uses local or online servers for storing and analyzing data.

7.1 FIT (Factory Incident Tracker)

). CDI, Cooperation Development Innovation

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Keywords : efficiency and effectiveness production planning for SMEs,
Good practice applied in: (NACE code) :

FIT (Factory Incident Tracker): Problem Analysis in productive environments for long term failure preventation

Small and Medium Enterprises are lacking of ERP / MES Software that is in fact to big for their scale. Furthermore producing companies focus on fast solution of any incidents that may occur and then pass the further analysis.
The good practise of said solution is to track, analysis and avoid often occurring failures in the long run. This might as well shorten the expenditures of maintainance, could lead to easily keep delivery goals and in long run give SME the possibility to do efficiency and effectness planning with a low level technique.

GOOD PRACTICE DESCRIPTION

Small and Medium Enterprises are lacking of ERP / MES Software that is in fact to big for their scale. Furthermore producing companies focus on fast solution of any incidents that may occur and then pass the further analysis.
The good practise of said solution is to track, analysis and avoid often occurring failures in the long run. This might as well shorten the expenditures of maintenance, could lead to easily keep delivery goals and in long run give SME the possibility to do efficiency and effectiveness planning with a low level technique.
The solution is a very handy easy to use web application that is combined with a short eye to eye customizing with IT and Production consultants.

In Figure 37 are present a crop of the dashboard, that provides data to the customer; blue line is a technical process (here the production output of a bunch of machines). Blue orange and olive boxes represent Incidents of said process. These incidents later have to be analysed.

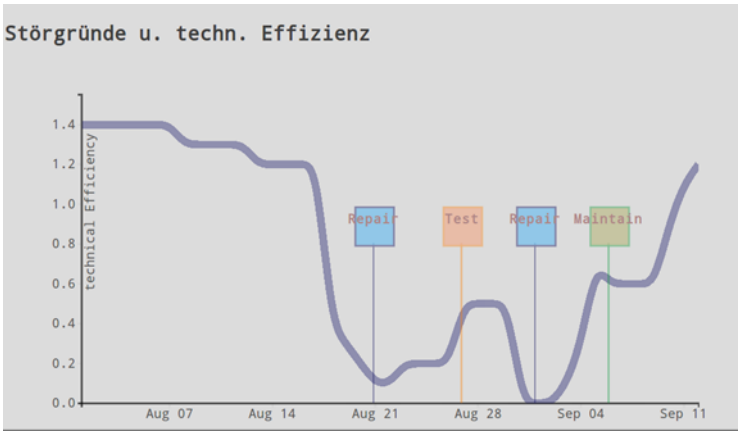

Figure 37 Crop of the dashboard

OBJECTIVE AND TARGET AUDIENCE

Target groups are:

SMEs (below 150 Employees) that have rather none or few IT Systems yet implemented or not using data for long term Problem Analysis

METHODOLOGICAL APPROACH

From the costs point of view:

- Cost Cuts by process analysis, critical / longest path meth.

Related quality assurance and risk management:

- New method set combined of: FMEA, functional description, asset management, risk evaluation and mitigation

The tool can be implemented by (BI, KPI, Data) workshop, small adaption of dashboard, review from time to time HTML Browser, eventually data base or some kind of standard data format that can be read through a browser

VALIDATION PROCESS

RESULTS / IMPACT

SUCCESS FACTORS AND CONSTRAINTS

Benefit is that improvement potential is discovered at all, which cannot be detected without problem analysis via FIT.

LESSON LEARNED & SUSTAINABILITY

Many SMEs react to incidents only, i. e. accidents or if necessary exchange something in advance on suspicion. Very few SMEs think about it closely what kind of malfunctions you are experiencing all the time.

SME (below 150 Employees) that have rather none or few IT Systems yet implemented and SME are not using data for long term problem analysis.

REPLICABILITY AND UP SCALING

FINAL REMARKS

7.2 CHARME

Pickert & Partner GmbH
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Keywords : Industry cockpit
Good practice applied in: (NACE code) : C26- Manufacture of computer, electronic and optical products

The industrial cockpit RQM. CHARM is an easy-to-use tool for individual and dynamic cockpits to monitor production, reaction and alerting in real time as well as for decision support.

GOOD PRACTICE DESCRIPTION

The relationship to SFH approach is die production process and the cost efficiency. The technical solution is that the data, which are important during production, can be clearly displayed with CHARM. The innovation is that all data is displayed in a bundled form, thus saving unnecessary searching.This is the only tool that bundles these parts. Other technologies also represent cockpits. However, they do not display exactly the same tools.A mobile version for smartphones and tablets is available, too. All required information is displayed on the CHARME interface. These are displayed in diagrams, displays and many other graphic representations.

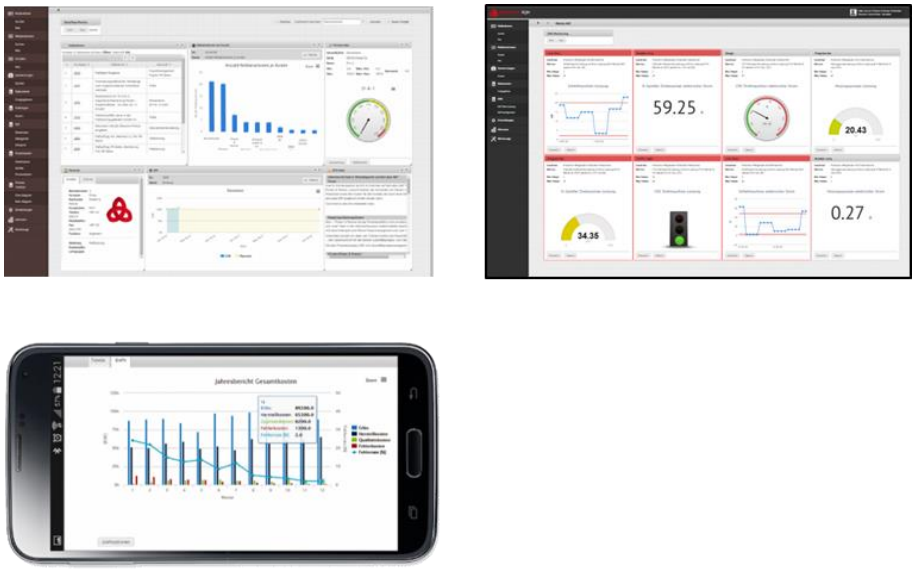

Figure 38 Work instruction are projected on assembly table[11]

[11] Source: http://www.pickert.de/caq-mes/information/industriecockpit-charm/

OBJECTIVE AND TARGET AUDIENCE

CHARME was tested at the Pickert & Partner GmbH and at the Industrial Automation Show 2017, too.

For all companies that have a high amount of data and that want to show each employee the data that is relevant for him/her with regard to the order being processed, is CHARME a possibility to do that.

The target group are SMEs (<250 employees) and large companies.

METHODOLOGICAL APPROACH

From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only for initial commissioning, maintenance and software updates) and further investments after implementation are not needed, except in the case of training newly employed operators.

From quality assurance aspects, CHARME is very helpful. The employee receives information for the process and thus reduces the susceptibility to errors. The solution led to a significant decrease in the number of faulty and defective products reported by customers, which in turn increased customer satisfaction.

The implementation is simple through standardization and the use of plugins. A step-by-step demand-oriented expansion is possible through the approach configuration instead of programming.

At the start, capital is needed to install the new technologies.

VALIDATION PROCESS

The validation process compares the time it takes to get the necessary information with CHARM, with the time it takes without getting the plug-in to get the information it needs.

RESULTS / IMPACT

Employees save valuable time by seeing all important information instantly without having to search for it. Unimportant information is also hidden.

SUCCESS FACTORS AND CONSTRAINTS

A technical limitation is that the plug-ins must be updated regularly. The hardware must also be kept up to date. As already mentioned, CHARME supports the worker with exactly the information that is important for him. These vary from person to person and from order to order. This ability to provide the right information to the right person at the right time is one of CHARME's most important tasks.

LESSON LEARNED & SUSTAINABILITY

This program is something new that many employees have to arrange with, because they are not used to this kind of information provision.

This good practice saves resources, as all information is displayed on the screen and therefore no printed documentation is required.

REPLICABILITY AND UP SCALING

This solution can be implemented for a wide range of companies without any industry-specific ties. It should be noted, however, that it requires a financial commitment and that the organisational culture should be open to the use of new technologies.
The system is currently undergoing further development in order to provide guided support even for more complex tasks.

FINAL REMARKS

The solution requires a financial commitment at the beginning, but the new technology can save a lot of time and effort. This makes it worthwhile for companies with a huge amount of information.

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.

List of attachments:

Attachment 1: Screenshots of the cockpit CHARME

7.3 InFrame SYNAPSE MES: EFFECTIVE ENTRY INTO IT-BASED MANUFACTURING

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Keywords : Production and process data acquisition, direct entry in tracking & tracing
Good practice applied in: (NACE code) : J63 - Information service activities

Digitization and computerization of business processes through the implementation of dedicated information systems and automated data acquisition and processes is today key to maintaining and increasing competitiveness. The project gave the experience of the 4th industrial revolution of first hand and a tangible experience of how digitalization has a direct impact on production.

GOOD PRACTICE DESCRIPTION

Own development together with partner companies.

In the first step functional specification of software solution based on client's expectations, requests and analysis of the situation is written. Functional specification includes listing all functionalities and defining data model of the new software solution. We offer support of our experts' wide range of knowledge and experience in fields of business, industry and energetics when designing content of the solution.

In the second step code planning and development is executed. We use modern and up-to-date business application software architecture and Microsoft (.NET and MS SQL) environment. Outcome of code development is web-based application that can be hosted in the cloud which guarantees high level of reliability and data security or hosting can be set up on client's server.

In the last step of information systems' development cycle, software implementation at the customer is done. To ease the transition to new information system, educational workshops are organised. While the system is up and running clients are provided constant maintenance and application support. Successfully finished project follows phase of maintenance and possible upgrades where we offer content and technical assistance.

Complete data collection at a surprisingly low price. The solution is modular, scalable, and tailored. It scales with needs of production. The InFrameSynapse MES mini can grow with customer requirements. It can be scaled to a mature InFrame Synapse MES if needed. As an easily embedded solution for Tracking and Tracing needs, the InFrame Synapse MES mini certainly is a worthwhile investment.

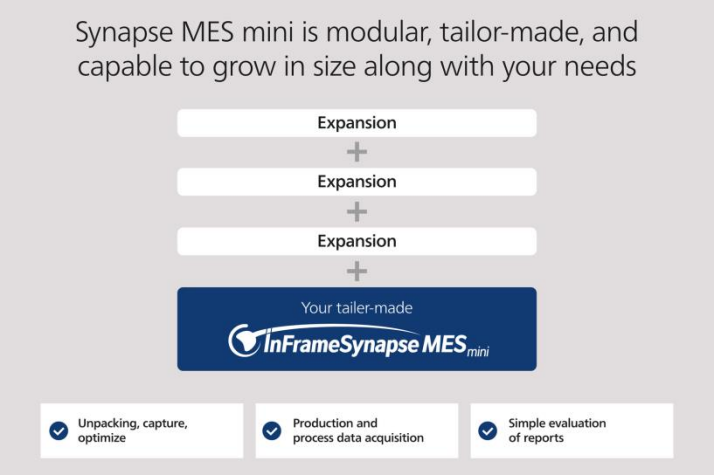

Figure 39: Synapse MES mini solution

The solution is better than competition because it developed in the giant semiconductor industry, the white goods industry and the automotive industry, which had clear demands and a vision for the future. These are today completely digital factories and part of their solution is also our solution. The solution is designed to be updated every 14 days - as a result, the solution always complies with the latest guidelines.

OBJECTIVE AND TARGET AUDIENCE

The target group of good practice are all companies that have discrete production in their establishments. The size of companies that are suitable for the implementation of good practice or solution starts with 30 to 50 employees in production.

METHODOLOGICAL APPROACH

Small and medium-sized manufacturers benefit from a production, which is consistently IT-based to be controllable and schedulable. In the past, the introduction and maintenance of such Manufacturing Execution Systems (MES) have been associated with great effort. With InFrame Synapse MES mini, the SMEs can get the transparent and process-oriented view onto their production. Production data are processed and available for further process optimization.

Better overview of production process and available data are supporting existing quality management systems and quality assurance by providing relevant information for further decisions and actions. Better overview of production process and available data are reducing the potential risk and in general supporting the risk management process.

If a business considers data collection and analysis to be most important, a mature high-volume MES would be too complex and expensive. InFrame had these thoughts in mind and came out with InFrame Synapse MES mini which is a “stripped down” MES for SMEs and their entry into the IT-based process optimization. This version is simply a Manufacturing Execution System without the “Execution”. Nevertheless, the InFrame Synapse MES mini offers complete production and process data collection, plus a cost-effective entry into productive tracking and tracing.
The implementation requires a person from customer who is capable of describing all production process and is actively involved in scaling up the solution. The whole process is usually done within a month, while the finances are not of a big scale as we are usually preparing the solution for specific customer needs, so also the finances are being discussed with customers from case to case.

VALIDATION PROCESS
Validation of implemented solution is done by existing team in the company that was responsible for production already before implementation. More sophisticated information and details provided are critically evaluated and validated to get an approval from customer top management.

RESULTS / IMPACT
Through control and greater transparency of production, bottlenecks, deviations from the predicted quality levels (through monitoring of parameters) can be identified, error types and analysis are monitored, real-time alarms are sent to the responsible person on smart devices (also the possibility of analysing alarms, frequency ranges, depending on a particular machine or operator, etc.), through various industrial indicators (most often, indicators such as the total efficiency of devices or OEE for monitoring the performance of devices are exposed). It is possible to obtain an additional dimension of production, to control material consumption and consequent reduction in waste, which helps to reduce costs directly. It is also possible to control the operators in production. Added value is flexibility, control and visualization of events in production.

SUCCESS FACTORS AND CONSTRAINTS
There are no major limitations. The implementation of the system is possible in all productions but the collection of data is based on used and available sensors and data collection systems that are the input for production optimisation.

With InFrame Synapse MES mini, camLine presents a lean, cost-effective, and easy to install solution. This allows SMEs the transparent and process-oriented view onto their production. Production data are processed and available for further process optimization.

The more data can be collected, more optimisations can be performed.

LESSON LEARNED & SUSTAINABILITY
It is possible to improve every production process and in every production, it is possible to produce faster, more efficient and with better quality. Good control and overview of production system is a prerequisite for

the future and will be even more important in the future. Described solution will be even improved in the future therefore sustainability is assured.

REPLICABILITY AND UP SCALING

The application solution can be transferred to all sectors of the manufacturing industry. In the implementation of such complex systems, there are always special requirements that must be fulfilled.

All the positive effects of the implementation can be transferred or repeated, but the approach and the way in which they are carried out due to the different organization of production, age of equipment, employees, management (which may be unprepared for changes), the prepared infrastructure are different. The list of requirements to be fulfilled is individual on a case-by-case basis.

FINAL REMARKS

The good practice is useful for production oriented SMEs in order to allow them to digitize their production processes and increase their efficiency. In today's worlds, the digitalization is playing an important part, and if SMEs will not jump on this train of so called Industry 4.0, they will face a big gap between the leaders of this new industry era, which will cause them to not be competitive enough.

By implementing solution as this one, they will make the first and concrete steps into digitalization.

Disclaimer / Acknowledgements

No limitations and it can be used for dissemination.

List of attachments:

Attachment1: Youtube video presentation **(**https://youtu.be/8CxCWIx3kLA)

Attachment2; Good practice datasheet (http://inden.si/en/pdf/Datasheet%20InFrame%20Synapse%20MES%20mini%20Release%205.0%20EN%20v03.pdf)

7.4 APPLIED FMEA FOR MANUFACTURING PLASTIC COMPONENTS IN THE AUTOMOTIVE INDUSTRY

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Keywords : Failure prevention; Risk analysis; PFMEA

Good practice applied in: (NACE code) :	Manufacture of other plastic products: C2229

The FMEA method was applied within Thomas Romania Plastic, a mold injection manufacturing company, which produces plastic components for the automotive industry. In this particular case, the method was used for identifying risks related to the functioning of the manufacturing process, before starting the serial production, in the product validation stage. This risk analysis was adjusted to the main stages of the process, in accordance with its flow chart, among which, worth mentioning are: material reception, components incoming check, mold injection (initial setup, startup confirmation, serial production), packaging, storage, delivery.

GOOD PRACTICE DESCRIPTION

The company implemented the IATF certification in 2017 and one requirement of the standard (IATF 16949:2016) is the inclusion of risk analysis activities for all manufacturing processes. The FMEA method is a proper tool for conducting such analyses because it helps in the detection and prevention of diverse potential failures and in containing their negative effects. PFMEA respects the guidelines from the AIAG manual. When the company starts the manufacturing of a new product, all related processes must be planned before committing any resources. By deploying FMEA and including it in the planning stage, potential process failures are identified here, which leads to minimum failures that need to be corrected after they appeared in the manufacturing cycle. This means that failures are prevented before they psychically appear, or at least the risk of their occurrence is lowered, all of which translates to exponentially lowered quality costs. In Thomas-Tontec process FMEA is used as a preventive tool and includes both product and manufacturing process risk analysis. The results are used to develop the work instructions for production operators and quality inspectors. Checking methods include: appearance check, dimensional check (with measuring instruments – CMM caliper, micrometer, control gauges), verifying incoming documentation (quality certification, checklists)

OBJECTIVE AND TARGET AUDIENCE

The instrument is successfully used within the Thomas Romania Plastic manufacturing company, a division of the Thomas Tontec group, operating in Cluj-Napoca, Romania. Target audience/potential customers and stakeholders : Mass production, Production with limited series, Manufacturing of customizable products.

METHODOLOGICAL APPROACH

The costs associated with the implementation and use of this method are minimum, it only needs human resources trained in applying the method correctly and financial resources for conducting periodic trainings of the designated personnel. The use of the FMEA method helps in identifying non-conforming parts, before reaching the customer. This way, the customer satisfaction is increased, the complaints are decreased, and by keeping the processes under control, from this perspective, the overall quality of the manufactured product is also increased. The FMEA is a convenient and simple method for evaluating the risk of potential failures from the perspective of severity, occurrence and detection. The product of the three indicators provides the so-called Risk Priority Number (RPN). Acceptable risks failures are those that have a RPN value lower than 125. In case this value is superseded improvement actions have to be proposed and implemented to lower either the occurrence or detection of potential failures. Severity can be lowered only by change I product design. The implementation of this method is done by creating the necessary functional instructions and training of operators. In case of this company it assures training for the following employees: operators for checking and package the workpiece, technician for mounting the mold and for starting the process – loading or setting process parameters. For each process and phase there are clearly described instructions for applying the method and the operators are trained to conduct their activities corresponding to their own job description. Corresponding to the stages of implementation, the resources needed here are comprised of appointing a multidepartment team, that will be responsible for the implementation and further correct use of the method. Moreover, a plan containing periodic training of involved personnel is also advised.

VALIDATION PROCESS

The validation is achieved by creating a working matrix that certifies the training of operators and that they are aware of all potential risks related to the manufacturing process.

RESULTS / IMPACT

The impact of the FMEA method is that it reduces non-conforming workpieces, it significantly reduces costs of poor quality and it is also useful for making process forecasts.

SUCCESS FACTORS AND CONSTRAINTS

The method is well documented and established, it is simple to use and doesn't require significant financial commitment for its implementation.
To improve the impact of process FMEA is always recommended to use a multidisciplinary team with competence in different fields: engineering, production, quality, logistics, human resources.

LESSON LEARNED & SUSTAINABILITY

The FMEA is a very useful tool if used properly, before the start of serial production, during the product and process development phase. A lot of inconveniences and costs could be eliminated/ avoided.

REPLICABILITY AND UP SCALING

Any SME, regardless of its field of activity, can implement this method for analysing risks associated to potential failures and/or for containing their negative impact.

The FMEA is used 100% in all the manufacturing processes. The risk-based thinking could be introduced in all the processes, even in the non-manufacturing ones (quality management systems processes).

FINAL REMARKS

The FMEA is a very useful tool if used properly, before the start of serial production, during the product and process development phase. A lot of inconveniences and costs could be eliminated/ avoided. 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 agreeing with on-line and printed dissemination of the information from this questionnaire.

List of attachments:

NA

7.5 Process improvements using simulation software

TURBOCAM ROMANIA SRL
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E-mail: flavius.stroia@turbocam.com
Web: www.turbocam.com

Keywords : Process simulation; improvement through simulation;

Good practice applied in: (NACE code) :	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines: 28.1.1.

This good practice demonstrates the usefulness of simulation software, through which manufacturing processes are recreated in the virtual environment, for the purpose of better understanding their functioning and contributing to their optimization by reducing redundancies, eliminating unproductive times and avoiding blockages in the overall manufacturing flow.

GOOD PRACTICE DESCRIPTION

S.C. Turbocam Romania, a division of Turbocam International (with 10 locations in 8 countries and 3 continents), "is a global turbomachinery development and manufacturing company that specializes in 5-axis machining of flowpath components" (Turbocam International, 2017). As a concern for continuously improving their fabrication processes, Turbocam Romania searched for innovative ways for addressing this issue. The Technical University of Cluj-Napoca offered a potential solution in this sense and proposed to simulate their existing processes with the purpose of conducting an in-depth analysis for identifying potential improvement possibilities. The solution offers detailed tracking of the manufacturing flow and in-depth study with robust tools at the level of each process, which facilitates advanced scientific corrective intervention, leading to greater performance, if the company implements measures according to the results thus obtained.

From a technical perspective the solution provides:

- Balancing the component processes of the production system by sequentially correlating inputs and outputs throughout the product manufacturing flow;
- Determining the optimal mechanisms for increasing labor productivity, considering at the same time a moderate workload level of the simulated operations;
- Designing, testing and installing performance metrics based on available simulation information;
- Implementing improvement tools and techniques and comparing the results achieved across the entire system;

- Introducing intermediary buffer zones into the manufacturing stream, that allow self-regulation and avoid bottlenecks.

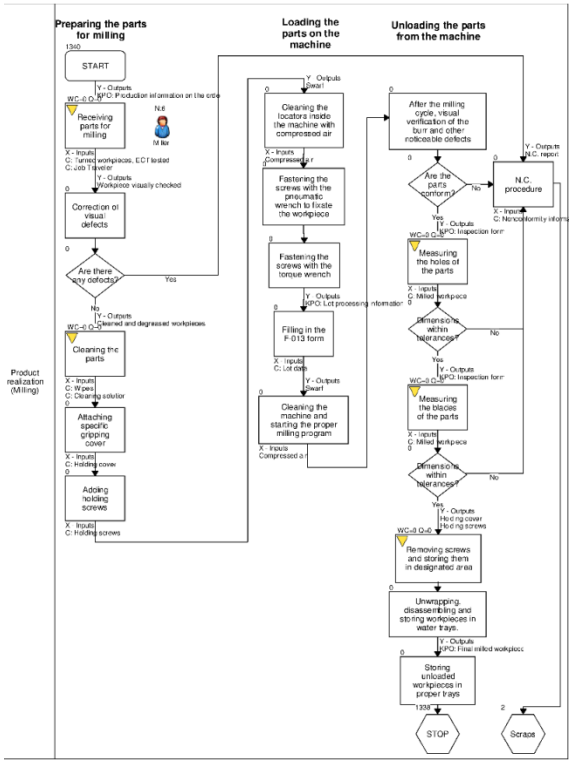


Figure 40 The figures above represent the functioning of a real-life and its corresponding simulated process.

OBJECTIVE AND TARGET AUDIENCE

The solution was tested and implemented in Turbocam Romania, with headquarters in Târgu-Mureș, in Romania's Transylvania region. The target audience/potential customers are: mass production; production with limited series; manufacturing of customizable products, any type of SME, which documented and structured its activities into processes, or large enterprise.

METHODOLOGICAL APPROACH

The simulations are completed using the Sigma Flow Modeler software, which includes process analysis instruments, statistical tools, Lean Six Sigma, and many more, which help in observing how existing processes work or what is the impact of the changes made to them, before they are put into practice. This way, resources (time, financial, human) are saved, because unexpected issues that are identified in simulations can be remedied before implementing changes in process operation. This solution supports both the older version of ISO 9001:2008 Quality Management Standard approach, the process approach, and the philosophy promoted by the newest ISO 9001:2015 standard, in which evidence of risk-based thinking is necessary. Applying this solution, management decisions can be taken in such a way that there is minimal risk, it is possible to analyse the manufacturing flow and process capacities, even before allocating the resources necessary for their operation, and the interventions are done only in those areas where it is need.

The implementation of this good practice begins with the observation and recording of how the existing processes function within the organization. In this case, the organization's quality manual was the first document that was consulted, in which the process map illustrates all processes within the company, as well as their interaction and material flow. Next, data collection about all activities must be completed with respect to the following important aspects: working times, allocated human and material resources as well as specific working instructions. Finally, all collected data is entered in the simulation program, which provides mathematical data about how the processes function and helps identify how they can be improved. Various scenarios can be tested, and the best solution can then be selected, which will be implemented into the manufacturing flow. As a safety measure, it is recommended to document and record how the changes affected real-life processes.
The implementation of this solution can be completed with minimum resources:

- appointing a multi-departmental team that will collect all the necessary data about the process;
- acquiring Sigma Flow Modeler simulation program license (about 2000 $);
- training the personnel for using the software (about 1000$ - 1 week);
- running the simulations, identifying improvement measures and testing scenarios (about 1-2 weeks, depending on the process' complexity);
- implementing best scenarios into real-life processes (1-2 weeks, depending on the process' complexity).

VALIDATION PROCESS

The validation of this good practice comprised in observing the effects that the improvement measures had on real-life processes, namely observing indicators such as scrap reduction rate, working times reduction rate, personnel workload rate, process bottlenecks, etc., over an established period of time (depending on the process complexity between 1 to 2 weeks) and if these indicators were improved the changes to real-life processes were adopted permanently. Otherwise, if the measures provided same or worse results the data entered into simulations was rechecked to determine what went wrong or why were these results obtained.

RESULTS / IMPACT

The simulations increased the overall manufacturing flow's fluidity, the personnel workloads were reduced between 10-15%, certain redundant activities were identified and eliminated from the fabrication process and most importantly the scrap rate was reduced significantly. As a direct result of these measures the company received positive feedback from clients for shorter execution and delivery times and for the increase of the quality of products.

SUCCESS FACTORS AND CONSTRAINTS

Special attention must be given to the data collection process and when inputting them into the simulation program. If the data is entered incorrectly, the identified improvement measures (obtained based on knowledge from the simulations) can affect real-life processes in a negative way. The advantage of such a solution is that each manufacturing process can be observed palpably, and after simulations, the additional quality instruments provided by the Sigma Flow Modeler program offer the possibility of intervening on areas where bottlenecks and/or problems are identified, which can be improved by reallocation of resources; or by other means. Moreover, infinite scenarios can be tested without committing any resources for setting up and starting rea-

life processes, which translates to minimum risks and reduced costs for managing and maintaining this solution. Currently, the simulation software offers clues about the areas where improvements can be made, and the end-user is the one that decides what are the conclusions that can be drawn from the simulations and which are the measures that have to be taken. If the solution could offer punctual measures on what to change/ eliminate or reduce from the manufacturing flow it would increase its impact.

LESSON LEARNED & SUSTAINABILITY

Turbocam Romania, after implementing the measures proposed by the simulation team, was very satisfied with the obtained results, as not only the functioning of processes was improved, but also the workload of personnel was reduced, leading to a positive impact both internally and externally.

REPLICABILITY AND UP SCALING

The solution is readily available to all SMEs, which are open for relying on the computational power of modern devices and the increased performance of innovative software programs for improving their processes Raising the awareness between SMEs regarding the benefits of simulation software could result in the wide-scale adoption of this solution, as currently only a few companies understand its utility.

FINAL REMARKS

The solution presented in this good practice, through the data obtained from simulations, demonstrated the utility and great benefits of specialized software programs for improving the functioning of processes and optimizing their time and other type of resources necessary for their operation. Turbocam Romania recommends this practice to other SMEs as well, which are preoccupied for objectively (based on empirical data) increasing the performance and functionality of their processes. 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.

List of attachments:

NA

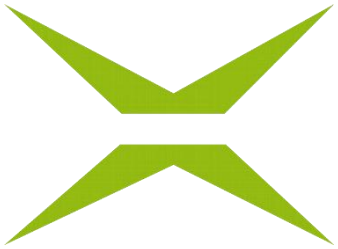
8 CYBERSECURITY

All collected data used by an Integrated Factory Information System must be protected from external threats, that can undermine the functioning or trigger unwanted errors in the manufacturing process. Cybersecurity solutions comprise of programs, processes and practices the assure the protection of the data flow within a network and prevent the attack, damage or unauthorized access. According to the author (Rouse, 2016), cybersecurity includes the following protection elements:

- Application security;
- Information security;
- Network security;
- Disaster recovery / business continuity planning;
- Operational security;
- End-user education.

8.1 XiTrust - Secure QR-Code (sQR)

Photo of the contact person



XiTrust is your provider for all services concerning electronic signatures. For more than 15 years, we have been advising clients seeking tailored solutions for business processes without cross-media conversion. Our innovative products grow with the requirements that your company places on them now and in the future.

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Keywords : Signed and encrypted QR code
Good practice applied in: (NACE code) :

The sQR features another level of security and offers new possibilities regarding the use of QR codes with respect to authentication. Basically, the sQR contains information such as the ID, name of a person or machine, respectively. This information is electronically signed to ensure data integrity. An APP which is able to check the validity of this signature has been developed. Additionally, it is also possible to encrypt the information of the QR Code and to decrypt it with the corresponding public key within the APP. After the information is decrypted and the signature is validated, the APP provides a possibility to verify the real identity of a person or a machine. In case of a person, there is the additional possibility to compare a photo and in case of a machine, additional information regarding the location of the machine can be provided

GOOD PRACTICE DESCRIPTION

The sQR features another level of security and offers new possibilities regarding the use of QR codes with respect to authentication. Basically, the sQR contains information such as the ID, name of a person or machine, respectively. This information is electronically signed to ensure data integrity. An APP which is able to check the validity of this signature has been developed. Additionally, it is also possible to encrypt the information of the QR Code and to decrypt it with the corresponding public key within the APP. After the information is decrypted and the signature is validated, the APP provides a possibility to verify the real identity of a person or a machine. In

case of a person, there is the additional possibility to compare a photo and in case of a machine, additional information regarding the location of the machine can be provided
The fact that the information within the QR code can be signed and/or encrypted represents a novel approach regarding authentication.

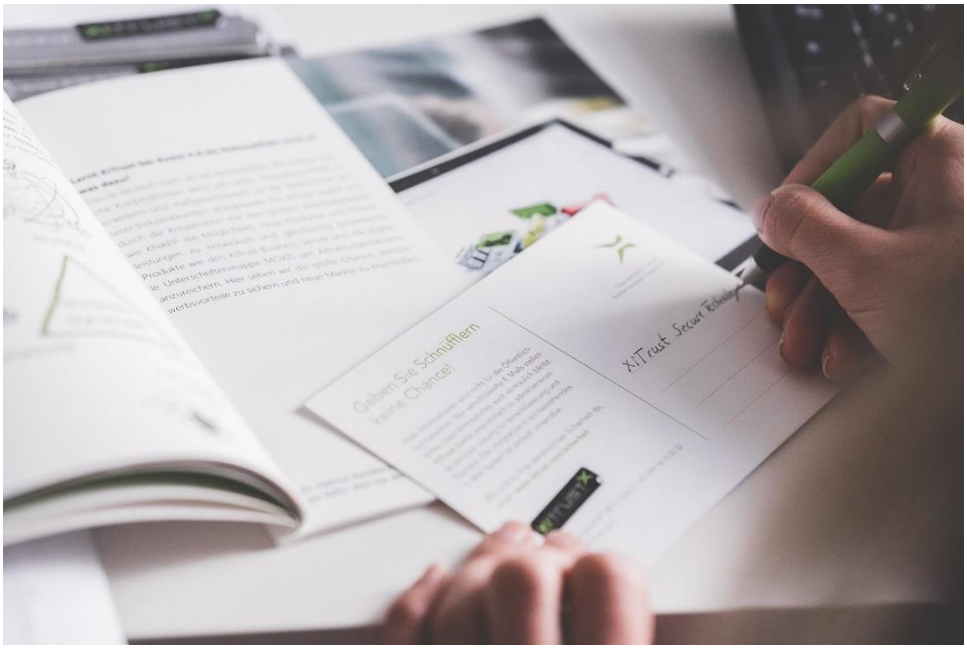

Figure 41

OBJECTIVE AND TARGET AUDIENCE
Worldwide
All institutions that issue a secure identification card for a person and all big production/logistic companies with many locations over the world. Additionally, the sQR-Code can also be used for instructions for a specific machine

METHODOLOGICAL APPROACH
Quaity Assurance:
All the information within the QR code cannot be read or changed.

There is no additional device needed for the identification card and there is also no specific device needed for the APP, which also works offline.

This depends on the amount of QR codes that need to be issued. The process of issuing such codes is not very time consuming and then just the process of handing out these codes is left. Generally speaking, the implementation of these QR code can be easily integrated into existing workflows.

VALIDATION PROCESS
The sQR was part of a research project and customer project.

The keys for decrypting the information are available within the APP and for validating the signature one needs the public keys.

RESULTS / IMPACT

Proof of identity of the person/machine can be ensured by easy means.

SUCCESS FACTORS AND CONSTRAINTS

Only a limited amount of data can be stored within a QR code. In case of machines, the QR code itself has to be applied in a way that malpractice is prevented. Furthermore, it has to be ensured that the camera of the device where the APP is installed (e.g., mobile phone, virtual reality glasses) is capable of scanning the QR code properly.
The use of QR codes which contain signed and/or encrypted information features a fast and easy solution for strong authentication of a person/machine.

LESSON LEARNED & SUSTAINABILITY

The described solution represents a great possibility to connect the analogue world with the digital world, however, the user acceptance strongly correlates with the level of experience concerning the technologies involved.

REPLICABILITY AND UP SCALING

They can use the secure QR Code for strong authentication of persons or machines, e.g. if they are a production/logistic company.
This solution can be easily transferred to basically every use case where QR codes come into play, such as vouchers or e-tickets.

FINAL REMARKS

This solution can be implemented very easy and ensures the integrity, authenticity and confidentiality of the information within the QR Code. For this reason, it is the ideal tool to authenticate a person or machine and to provide important instructions of a machine in order to activate or repair it. This secure QR Code in conjunction with the APP perfectly connects the analog world with the digital world in a secure manner as the information is signed and encrypted.

9 INTELLIGENT SENSORS/ACTORS

The last couple of years an even newer trend started being associated with “The cloud”, called “Edge Computing”. The idea behind this approach was to increase even more the efficiency of “The cloud” by migrating some data analysis to the “edge” of the network, where, the actual source of the data is (Shi, Cao, Zhang, Li, & Xu, 2016). Traditional sensors designated with collecting data from processes were replaced by semi-smart sensors, which are capable, to a certain degree, of deciding what data is or isn’t relevant to be relayed to “The cloud”. By doing so, the computations carried out within the cloud were reduced to only essential ones.

9.1 MONARCO HAT

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Website: www.rexcontrols.cz
Product website: www.monarco.io

Keywords: Monitoring of machines, Monarco HAT, Raspberry Pi, REX control system.
Good practice applied in: (NACE code) : Manufacturing (NACE code C)

Monarco HAT is an add-on board which provides input-output interfaces following industrial automation standards for the Raspberry Pi (B+ and newer) minicomputer. It is designed according to the HAT (Hardware Attached on Top) specification. It enables collection of data from machines for its visualisation or evaluation.

GOOD PRACTICE DESCRIPTION

This product was created in response to the demand of SMEs for upgrading or retrofitting existing control systems of machines. Monarco HAT is based around ARM Cortex-M3 microcontroller (MCU) which provides a wide set of embedded peripherals missing on the Raspberry Pi itself. It offers PWMs for all digital outputs, versatile counters including quadrature encoder signal decoders, digital-to-analog and analog-to-digital converters, and RS-485 communication etc. ARM MCU can also provide very deterministic IO timing compared to Raspberry Pi with Linux.

This solution is strongly tied with the “Smart Factory” concept, as a novel technology, namely intelligent sensors/actors are implemented.

Below are the applications we had in mind when we designed the add-on board which we call the Monarco HAT.

- Reading and archiving data from standard industrial sensors.
- Monitoring of machines.
- Providing communication gateway between various devices.
- Feedback control in non-critical applications.

Here are a few examples of devices whose outputs can be handled by Monarco HAT digital inputs:

- utility meters (electricity, gas, water) with pulse output,
- standard quadrature encoders for position/velocity measurement,
- gear tooth sensors for position/velocity measurement,
- motor controllers with pulse/direction or quadrature position output,

- various industrial sensors (temperature, pressure, distance) with frequency output.

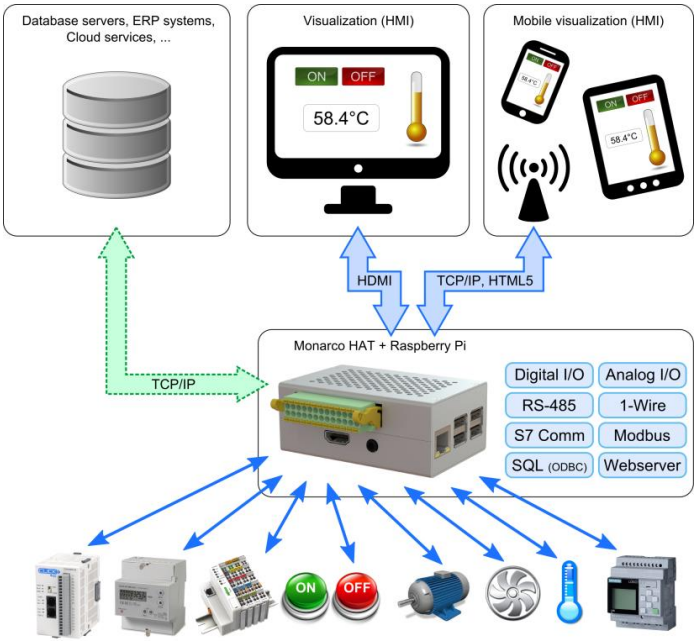


Figure 42 Visualisation of product peripherals, inputs and outputs

The first choice for programming is the REX Control System, which is best described by the following features:

- Graphical programming without hand-coding.
- Programming control units on a standard PC or laptop.
- User interface for desktop, tablet and smartphone (HMI).
- Wide family of supported devices and input-output units (including Monarco HAT).
- Industry-proven control algorithms.
- Easy integration into business IT infrastructure (ERP/BMS).
- REST API for seamless integration into Industry 4.0 and (I) IoT solutions.

Figure 43Monarco HAT plain board and with housin

OBJECTIVE AND TARGET AUDIENCE

The solution described previously was developed, tested and validated in Czech Republic. The utilisation is worldwide.
Monarco HAT with its REX Control System can be applied in various scenarios in various industry fields. Its versatility ensures its uses in large as well as in small and medium size companies.

METHODOLOGICAL APPROACH

There are indirect cost savings connected with describes solution. The data which is being collected and evaluated influence the overall productivity by well-timed decision making. Furthermore the purchase cost of Monarco HAT is quite low which ensures that this solution is also affordable for SMEs.
Clear visualisation and electronical data transfer eliminates mistakes which may occur if the data was processed manually (pen and paper) by workers.
Data Security Measures have to be applied.

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

1. Feasibility study (establish whether the solution can be implemented – checking electrical compatibility at signal level, checking availability of sensors and actuators, studying the programming tools, budget analysis, potential benefits and weak points);
2. Acquire the hardware platform and programming tools;
3. Develop software based on the solution (programming the mini PLC to collect the required data, perform the requested operations and);
4. Deploy the resulting controller/data logger/communication gateway at floor level of the factory;
5. Verify the impact (compared to historical data and/or evaluate benefits of collecting new data).

Below are the resources which are necessary for successful implementation.
Personnel: IT, PLC programmers
Finance: Plain board with optional housing – 129 €, Automation kit with RexCore Plus – 279 €, Automation kit with RexCore Pro – 359 €
Infrastructure: IT Hardware, LAN
Timespan: Delivery time is about 3-5 business days within Europe and 10-12 days outside Europe. Realization on the spot in one day for single implementation.

VALIDATION PROCESS

The good practise was validated with industrial clients worldwide. (USA, Australia, Taiwan, Republic of South Africa, Germany, Austria, Belgium, Norway, etc.)

RESULTS / IMPACT

The impact of the solution was highly positive, the new collected data and interconnection between individual machines led to an increase in productivity and lowering failure rates in final quality tests on production lines.

SUCCESS FACTORS AND CONSTRAINTS

The solution cannot be directly mounted on moving parts of machines. The reason is the memory card holder, which is not designed for use in vibrating environments.
Monarco HAT was developed by control engineers for control engineers. So far it is the only board aimed at industrial automation and following the HAT standard. Years of experience in automation domain and electronics design were put into the product design. Although Monarco HAT is a very young product, our records indicate very low failure rates. Hundreds of satisfied customers are enjoying the benefits of using the solution. The device is universal and can be used for all tasks in automation and cybernetics. Low entry costs make it attractive also for SMEs and even end customers.

LESSON LEARNED & SUSTAINABILITY

Operating temperature and vibrations are known to be the most critical. What happens when the Raspberry Pi fails? Not having real-time data on displays at floor level can hurt, but certainly not as much as stopping the whole production line. If necessary, will it be possible to switch to another hardware platform without starting software development from scratch? Those are the types of questions you should be asking before deploying the solution in the field. In short, using this platform gives you freedom, but keep in mind that freedom comes with responsibilities.

REPLICABILITY AND UP SCALING

This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch.
The Monarco HAT is upgraded continuously in its functions regarding the needs of industrial practice. The upgrades are mainly on software basis.

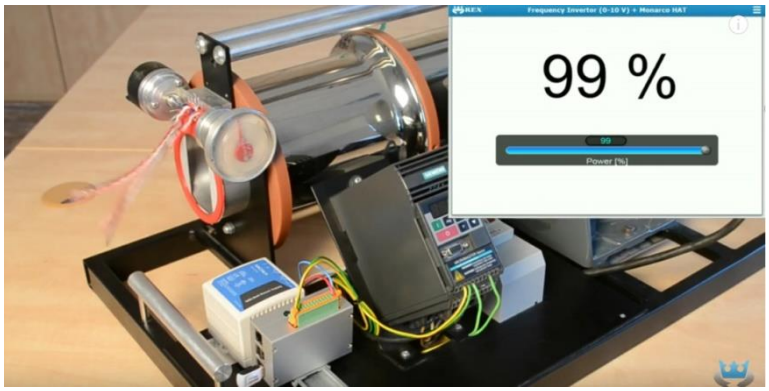
FINAL REMARKS

The use of Raspberry Pi and the Monarco HAT in industrial automation opens new possibilities for IoT and Industry 4.0 projects. This platform has proven to work well in symbiosis with existing control systems and controllers, providing additional CPU power, memory, storage and communication capabilities, which the traditional platforms are missing.

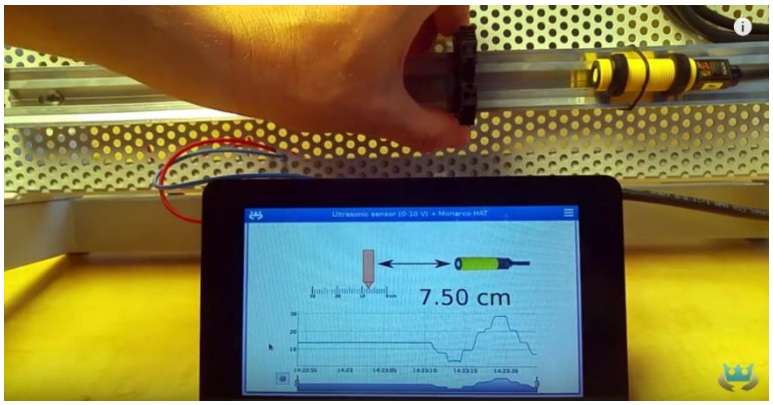
List of attachments:

Attachment 1: Video demonstration: Raspberry Pi as a 1-Wire data bridge for Siemens LOGO
https://www.youtube.com/watch?v=rdosVtdxJac

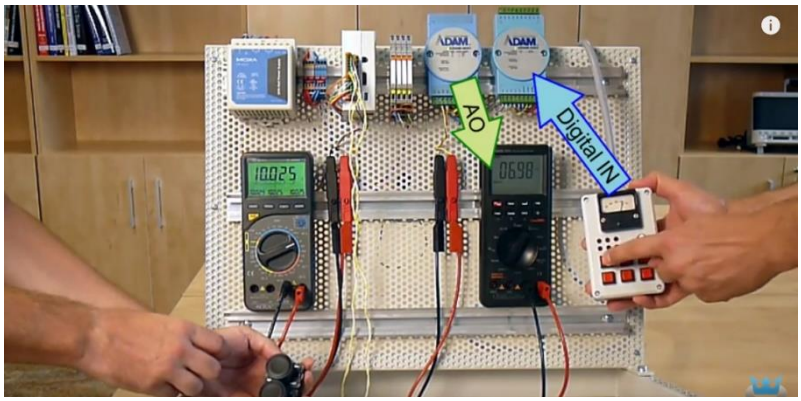
Attachment 2: Video demonstration: Raspberry Pi controlling a frequency inverter
https://www.youtube.com/watch?time_continue=74&v=APXEFQKF5Tw



Attachment 3: Video demonstration: Raspberry Pi reading a 0-10 V ultrasonic sensor
https://www.youtube.com/watch?time_continue=45&v=oXTaTk1jbEY



Attachment 4: Video demonstration: Extending I/O of the Monarco HAT via RS-485
https://www.youtube.com/watch?v=3G5M0xRgNss



9.2 VESKI d.o.o.

Veski d.o.o.

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Keywords : machine condition monitoring, algorithms
Good practice applied in: (NACE code) : C - manufacturing

Veski d.o.o. has been established in 1990 in Zagreb. Their field of expertise is vibration and online advanced machine condition monitoring. Their specialty is also measurement and signal processing. Their services include advanced signal analysis, design, manufacturing and installation of in-house solutions for online machine condition monitoring and protection systems on hydro power plants. This also implies better asset management by the end user. CoDiS Online monitoring is a product that is developed and suited for future usage within “smart power plants” and is ready for Industry 4.0. Data collection, smart sensors, IoT, and consequently Big Data Analysis is what will be the base of future industry.

GOOD PRACTICE DESCRIPTION

Constant development of new ideas and implementation of industry trends combined with experience of their founders resulted with good product. They try to implement new ideas using new technologies available. Being a small company gives them a competitive edge in implementing and testing those ideas in real environment so their development and testing process is much shorter than the one of the large competitors.

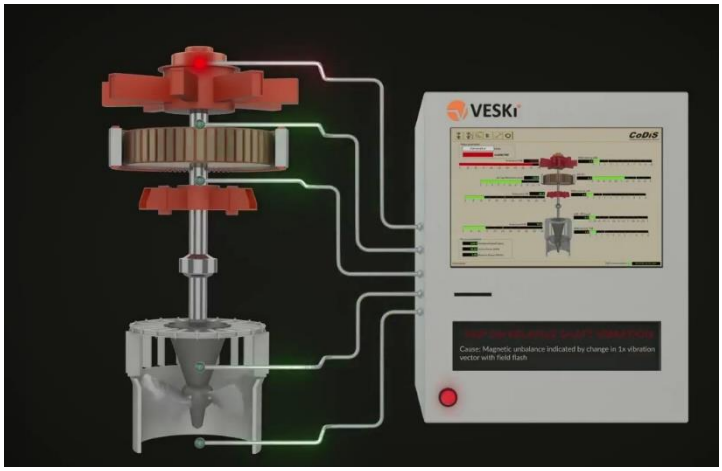


Figure 44 Veski product

Their solution is based on National Instruments PAC (CompactRIO) technology. It is an open platform that allows them to implement smart and advanced algorithms in CoDiS platform which they use for machine condition prediction. Algorithms include mathematical models of generators that can be used to predict different faults and create failure mode signatures. Their solution is mostly different as their final product is a hardware (measurement device) that is completely software-reconfigurable, meaning it can accommodate any type of signal from any type of sensors installed on hydro-generator or in the plant, whereas their competitors have dedicated hardware modules that can't be used for different measurements. That gives them a flexibility to completely custom tailor the solution and implement algorithms dedicated for each machine.

Figure 45 Veski machine

OBJECTIVE AND TARGET AUDIENCE

The geographical range where the good practice has been used is Croatia, Bosnia and Herzegovina, Macedonia, Hungary, Slovenia, USA, Canada, Australia, New Zealand and etc…
The target audience and stakeholders are power plant personnel (maintenance and reliability engineers), plant and utility owners.

METHODOLOGICAL APPROACH

Their system is used to provide information to plan management which users use to have cost effective maintenance and to plan the activities. This is proven to save the maintenance costs by 30% and more. But more importantly it makes machines more available for production which can sometimes mean more than hundreds of thousands of USD annually. System provides better quality assurance to the end user as they have an insight in their machine condition and can act

accordingly, and it reduces the end-user risk of machine failures and all risk consequently. Their products are implemented within the end-user power facilities. Usually it implies sensor installation, cabling and instrument installation. In the end, software is configured and installed in the end-user's operation centre. The resources necessary for implementation are skilled personnel (electricians and engineers) and planned machine outage.

VALIDATION PROCESS

Their products are usually validated by the end-user as a result of more efficient maintenance or as direct savings by early fault detection which stops larger fault from occurring and thus directly saves assets.

RESULTS / IMPACT

Using their products, their customers have managed to reduce their maintenance and plan the activities. Also they have helped in preventing the malfunctions by predicting the critical situations and alerting the customer. This has been done automatically from their device.

SUCCESS FACTORS AND CONSTRAINTS

Their product is very specific and it requires specific skills to be able to implement and use it. Limitations would be inadequate knowledge of end-users and consequently their reluctance to implement and embrace new technologies in their day to day activities.
Key selling points are:

- flexibility
- end to end solution (complete package all in one)
- custom tailoring of GUI to every end-user
- advanced algorithms

In order to improve the impact of the Good practice they need more marketing resources to improve visibility, and implementation of AI to improve the software capabilities.

LESSON LEARNED & SUSTAINABILITY

Cooperation and outsourcing of specific sub-components is the key to faster results when developing and implementing new ideas. The key to sustainability of the Good Practice is constant improvements and implementation of cutting edge technologies which keeps you ahead of competitors, and also proper and thorough training of every employee, from basic to more advanced subjects.

REPLICABILITY AND UP SCALING

To design and develop new product it is essential to have know-how but also know-why. Other step is to identify uniqueness of product and how it will find its way to the market. Today, in IoT and Industry 4.0, it is impossible to have a standalone product so the key is how to integrate into the big picture and contribute. The product(s) can be used in any type of industry, with modifications applied to target specific demands and challenges.

FINAL REMARKS

Their products are used for predictive maintenance, asset management and machine protection.

The base is online data collection, analysis and use of smart algorithms that are able to predict and detect small changes that would point to irregular behaviour. On hydro-machines the biggest challenge is how to integrate signals from various and different parts of machine and how to correlate them properly. With that capability end-users can benefit from using and implementing new technologies in maintenance process in many aspects:

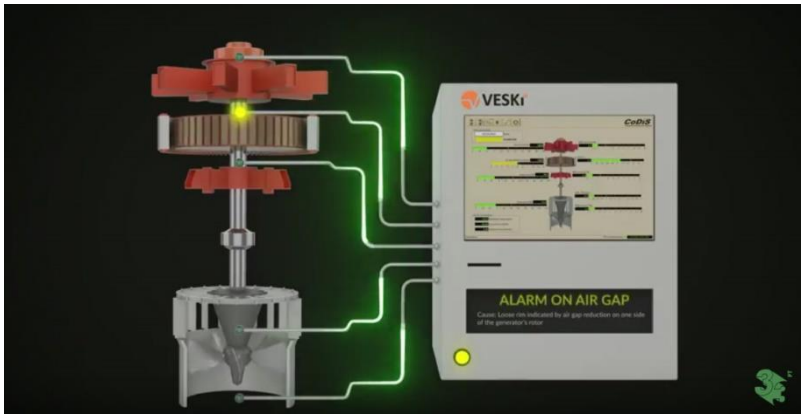
- safety – direct impact on safety of asset and people
- costs – cutting unnecessary maintenance costs
- better machine availability – shorten the maintenance period and put the machine into more operation – earn more money
- learn more about the real machine behaviour in exploitation where different and sometimes unexpected situations occur

Disclaimer / Acknowledgements

This information can be disseminated by printing material and online release.

List of attachments:

Attachment 1: Screenshot from the application
Attachment 2: Screenshot from the application
Attachment 3: Case studies, Application notes, papers:
http://veski.hr/index.php?page=library#application-notes
Attachment 4: How Veski product works



9.3 SMART SENSE – SMART CITY AirQ ENVIRONMENTAL MONITORING SYSTEM

SMART SENSE d.o.o.

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Keywords : Smart Sense – Smart City AirQ Environmental Monitoring System
Good practice applied in: (NACE code) : J – computer programming

Station for air quality monitoring (Smart Sense AirQ) is based on flexible Smart Sense platform, making it suitable for deployment in various measurement applications. This platform can be upgraded with different sensor technologies and it can implement different communication protocols. System enables remote control, monitoring and configuration of AirQ system and OTA software upgrades managed by Smart Sense server. Monitoring station uses very sensitive electrochemical gas sensors. Each gas sensor is factory calibrated and lasts for up to 24 months, depending on air pollution. Gas sensors can be easily exchanged on the field without a need for deinstallation of monitoring station. For monitoring particles, the laser optical sensing module is used.

Smart Sense is a Croatian IT company consisting of both tech magicians and business savants, on a mission of closing the gap between physical and cyber world with innovative state-of-the-art IoT solutions. Their strong suit is Smart sensor development with a main interests in a Smart Home and Smart City solutions, infrastructure and human body monitoring. Their ultimate goal is to enable a more delightful everyday life for the end users so they can relax and enjoy the Smart sense complete home/life solutions. Their focus of interest is Internet of Things, the idea of *techtopia* where all things around us are connected, communicating and working in perfect harmony. This task is distant, expensive and not easily achievable so for this purpose only, they write their own software, create their own hardware and tread bravely towards the interconnected reality and the Holy Grail of networking: The Internet of Everything. Smart Sense core team has successfully implemented numerous projects in cooperation with industry and Faculty of electrical engineering and computing within EU framework program. Smart City AirQ monitoring station collects and sends data to Smart Sense cloud server. Server application (Smart Sense AirQ central cloud application) collects, analyses and saves measuring data and according to customer request presents them through AirQ WEB application. On the other hand, server

application enables control and configuration of AirQ station. AirQ station can be configured to send data not only to Smart Sense cloud server but also to any other IoT system. Software platform can be extended in a way to be able to support all current and future application protocols. Comparing to competitors, their solution uses European standard for presenting air pollution in the area (CAQI-Common Air quality index). Therefore they are monitoring five types of gases and three types of particles which are important for calculation of AQI. These gases have been validated in cooperation with *Andrija Štampar Teaching Institute of Public Health* which differentiate the company from their competitors and brings them additional value in monitoring air quality. Solution is white labelled.

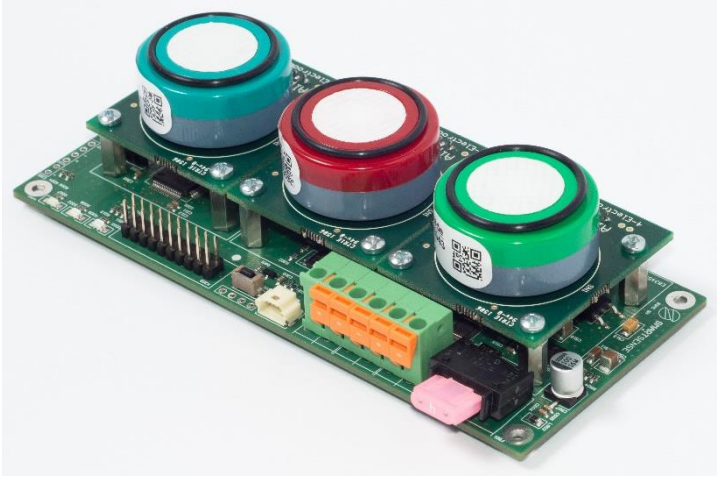

Figure 46 Smart Sense product

OBJECTIVE AND TARGET AUDIENCE

The geographical range where the good practice is being used is:

- Smart City pilot project in Dubrovnik, Croatia
- Andrija Štampar Teaching Institute of Public Health, Zagreb
- Smart City pilot project in Bonn
- Baud Telecom Company – Riyadh
- Croatian Telecom – Zagreb
- Smart City Koprivnica, Croatia
- OTE group, Chalkida, Greece

Smart Sense is using service provider (Deutsche Telekom, Croatian Telekom, Nokia, Huawei, Ericsson…) sales and marketing strength to sell Smart Sense – Smart City AirQ Environmental Monitoring System. Target audiences are Smart Cities and various city institutions using air quality data. Target group of customers are public institutions through service provider sales channel.

METHODOLOGICAL APPROACH

Good practice can be implemented by making initial business research regarding market potential and product development, using processes that have been effective in previous projects, using qualitative materials and components used in product development, and reliable partners who can help them in development and production processes. Resources necessary for implementation are

HW, SW and business experts, financial support, infrastructure and reliable production partners.

VALIDATION PROCESS

Good practice is validated by the result of product research and development which is AirQ solution created within certain time, money and scope with developed all upfront defined functionalities. This solution is tested and verified before commercializing.

RESULTS / IMPACT

Instead of buying very expensive fixed measurement stations (around 150.000-200.000 EUR), according to EU directive 2008/50/EC, cities are allowed to supplement existing fix measurements with indicative measurements. This enables them to cut down costs and to get better overview of air quality around the city. Collected data (Indicative measurements) can be shared/sold to health and environment agencies who can then use this data for making modelling techniques, air quality assessment throughout the city and air quality predictions. Better overview of city air quality provides health and environmental agencies with exact information on worst pollutants in certain locations. Action plan based on this information can help cities in reducing air pollution on critical points to a level acceptable for living. This would directly lower medical and economic costs. Places with good air quality can put this information on a display and make it available to citizens and tourists, especially in places like national parks, city centres, beaches… Better overview of air quality enables better traffic management, e.g. redirect traffic in order to reduce air pollution on critical points, avoid closing whole City centre for cars because of the lack of relevant information on air quality.

Actions:

Real-time traffic surveillance and control – i.e. dynamically modifying speed limit, traffic light period or closing off critical areas for general traffic.
Real time pollution incident detection and location, identification of safe evacuation routes, precise alarming.
Conduct pollution characterization research – long term improvement actions.
Comprehensive pollution maps, influence travel advice, weather forecasts for joggers, children and sensitive population.
Parking management and pricing depending on air pollution; e.g. bigger prices for parking in the centre of town when pollution is rising.

SUCCESS FACTORS AND CONSTRAINTS

Limitations are big development and production costs and limited number of suppliers who are critical for production process. Smart Sense – Smart City AirQ Environmental Monitoring System best-selling points are:

- collaboration with Andrija Štampar Teaching Institute of Public Health in Croatia in validating Smart Sense AirQ Monitoring Station data with professional environmental station data,
- solution is “white-label” conceived so service providers could sell it as their own,
- easy scaling and adjustments to customer requirements.

In order to improve the impact of the Good practice they need employee education, larger production series and more field tests in different environments. Using benefits of Smart Sense – Smart City AirQ Environmental Monitoring System, and taking actions like:

- real-time traffic surveillance and control
- real time pollution incident detection and location
- conduct pollution characterization research
- comprehensive pollution maps
- parking management

LESSON LEARNED & SUSTAINABILITY

Each development process and solution is unique and you have to adjust certain parts of good practice to a specific element of each project. By each development process, they are improving good practice and are adjusting this good practice to their needs. In that context good practise will be used in future development processes and further in putting their solutions on the market and selling them to end customers.

REPLICABILITY AND UP SCALING

Using data from Smart Sense – Smart City AirQ Environmental Monitoring System other SME could develop new solutions for:

- real-time traffic surveillance and control
- real time pollution incident detection and location
- conduct pollution characterization research
- comprehensive pollution maps
- parking management

Wider Smart City Initiatives and approach to other service provider in Smart City Initiatives worldwide

FINAL REMARKS

Smart Sense – Smart City AirQ Environmental Monitoring System:

- promote City as a place to live in
- promote City as a tourist destination
- help in problems with traffic management and regulations
- ensures better model for Air Quality index in urban area

Disclaimer / Acknowledgements

This information can be disseminated by printing material and online release.

List of attachments:

Attachment 1: Screenshot from the application
Attachment 2: Green Light for Smart City Bonn: http://bit.ly/2Bz7K4n


VERSALIFT
SMART LIGHTING
UP TO 60% COST REDUCTION WITH
INTELLIGENT SENSORS

9.4 ORANGE BOX

B+R automatizace, spol. s r.o. - organizačná zložka

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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.).

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.

Figure 47 Orange Box

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.

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.

VALIDATION PROCESS

N/A

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.

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, …

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.

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.

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

9.5 SMALLEST PASSIVE CONTACTLESS SENSORS OF PHYSICAL QUANTITIES IN THE WORLD

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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.

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.

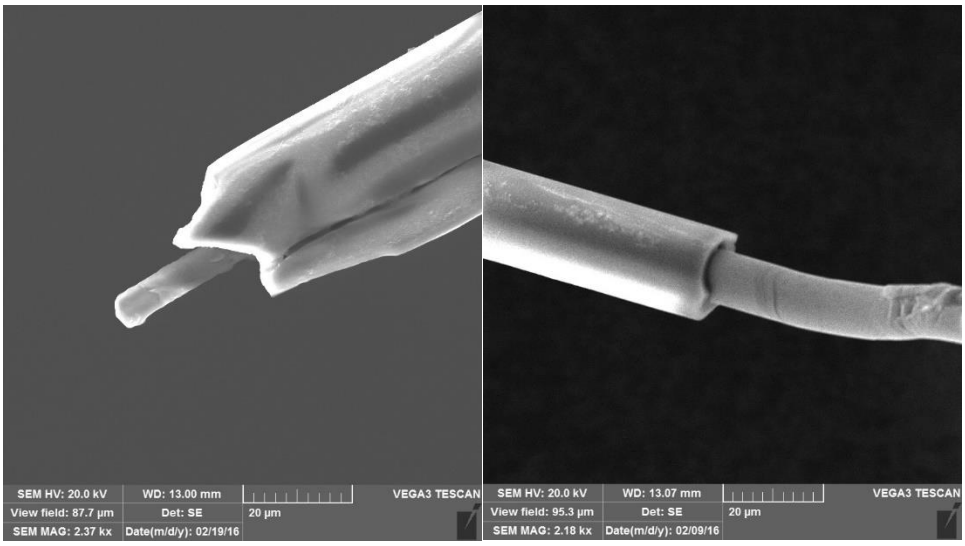

Figure 48 Smallest passive contactless sensor of the physical quantities

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.

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.

VALIDATION PROCESS

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

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.

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;

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.

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.

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

9.6 E-VINEYARD – Vineyard management software

Elmitel d.o.o..
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Tel. +386 40 811 465
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Keywords : Vineyard management, Internet of Things, Production management, SaaS
Good practice applied in: (NACE code) : A1.2.1 - Growing of grapes

Evineyard helps you with paperwork and crucial decisions – to save time, improve sustainability and performance. Evineyard matches the latest technology and science with the real needs of the winegrowers.

GOOD PRACTICE DESCRIPTION

Elmitel is software based company, which is employing young engineers who are interested in new technologies and innovations. While working with some new ideas the team started to "play" with sensor technology and their application into real life. After initial testing and development, the idea of Evineyard was born and also other possible applications of software based solution into real life scenarios. The solution is introducing new technology in form of sensor technology, while it is also helping to improve the production processes of companies.

23. There are following features available within the solution:
    - Turn regulative records into value: Fill your work evidences from the tractor, in the vineyard, from any device - phone, tablet or computer
    - Regulate irrigation. Achieve superior quality
    - Avoid disease outbreaks. Spray with confidence
    - Reduce vineyard manager's administration.
    - Integration = power, simplicity and safety.
    - No installation. No training. All yours.

Figure 49: eVineyard in a glance

Built with winegrowers, eVineyard is designed with simplicity of use in mind from the ground up. eVineyard is the only fully integrated, complete vineyard management system, on the market. It combines sensor data with data about your activities and vineyard parameters, to give you punctual decision support about when to spray.

Figure 50: eVineyard real case implementation

OBJECTIVE AND TARGET AUDIENCE

The solution has been implemented in various regions in the world, starting in Europe and Australia, while last applications were done also in North and South America.

The target customers are vine growers, typically those are the ones who have at least 20 Ha of vineyards. But also smaller ones are the target since solution has two options for implementation. Mainly they are SMEs, while also Large companies are the target. We want to develop smaller systems which would be also attractive to end customers which have smaller vineyards.

Figure 51: Implementations worldwide

METHODOLOGICAL APPROACH

Cost efficiency is important aspect of the solution, and is applicable due to following reasons:

- irrigation management saves water and by this also money
- Spraying just in time and when needed saves investment
- Save up to 80% of time on administration

All in all saves money related to investment into OPEX which can be used differently or transferred into direct income of the company.

By implementing the solution company is increasing the quality of products and increase the production. The solution is taking away the risk of losing the entire crop due to disease outbreak or climate changes and also the risk of losing any data, since they are always stored on the safe in the cloud.

The good practice can be implemented in two ways:

1. Small scale: Implementation of software solution into daily operation of vine grower. Showcase and training for the customer.
2. Large scale: Implementation of sensors in the vineyard, testing their work, implementation of software solution into daily operation of vine grower and connection with field sensors, showcase and training for the customer

In most cases one person is needed who will work with the software with addition to the computer and Smartphone, which are currently not presenting too much of a burden as this is present in everyday life already. In case of large scale there is also a need for investment into sensors on the field.

VALIDATION PROCESS

The validation is still an ongoing process as we are validating almost each implementation separately.

The first validation took part with our local wine grower, which has its vineyards next to our offices. With his help we were also developing the solution and its functionalities.

RESULTS / IMPACT

The impact is very good as all the customers are very satisfied with our solution, as it has saved their crop and by that also their expenses many times.

SUCCESS FACTORS AND CONSTRAINTS

The limitation is usually connected to the specific limitations of the wine grower, as there are different obstacles when implementing the solution. Either the terrain is difficult and there are difficulties with implementation or on other hand person working with the solution does not have basic skills in computer science.

eVineyard is the only fully integrated, complete vineyard management system, on the market. It combines sensor data with data about your activities and vineyard parameters, to give you punctual decision support about when to spray. By that wine growers get full solution from one supplier, not needing to go to one supplier for software and to other for hardware.

There are some specifics in each of the markets. While we are familiar with environment and limits in Europe, we are lacking this knowledge in other continents like Australia and North-South America. This is why we are often looking for partnership in these new markets in order to get more familiar with specialties there.

LESSON LEARNED & SUSTAINABILITY

It is important to be opened for new things, as this solution was developed in a process of open thinking and “playing” with sensors. Other thing is that every economic area could be transformed into digital. We were acting as pioneers in the area of Agriculture and want to move forward also to other areas. Since there is an upcoming trend of “smart” applications in Agriculture, we are more than sure that the solution will be sustainable throughout next years. As we are in continuous process of simplification of our solution we are making sure that it will be available and understandable for all the wine growers in the region.

REPLICABILITY AND UP SCALING

The possibility to extend the good practice is huge, as sensors together with developed software can be implemented in different areas of Agriculture, but on other hand not only Agriculture but also economic areas, such as manufacturing and other.

So far we are focusing only into Agriculture, where we are already developing solution also for vegetable growing.

FINAL REMARKS

The impact of the good practice is very important, as the solution is directly influencing the production of food, which will be an important aspect in future years.

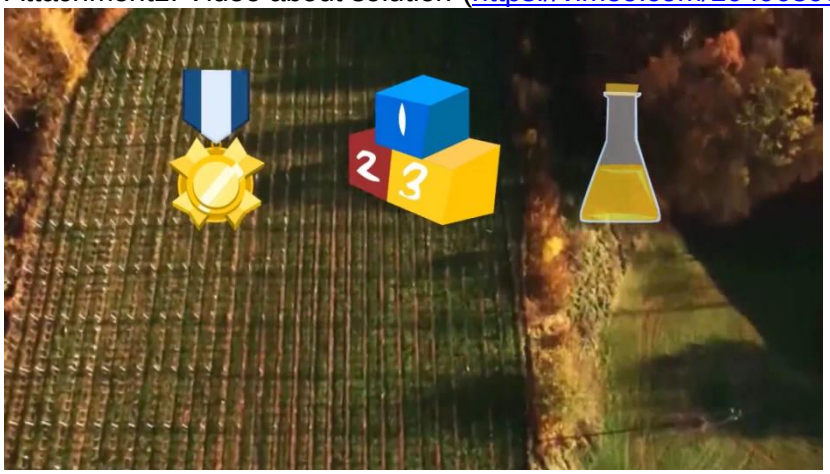
On other hand digitalization is happening in each step of our lives, this is why it is important to implement solutions like ours as this will help the humanity and all the actors included.

Disclaimer / Acknowledgements

No limitations and it can be used for dissemination.

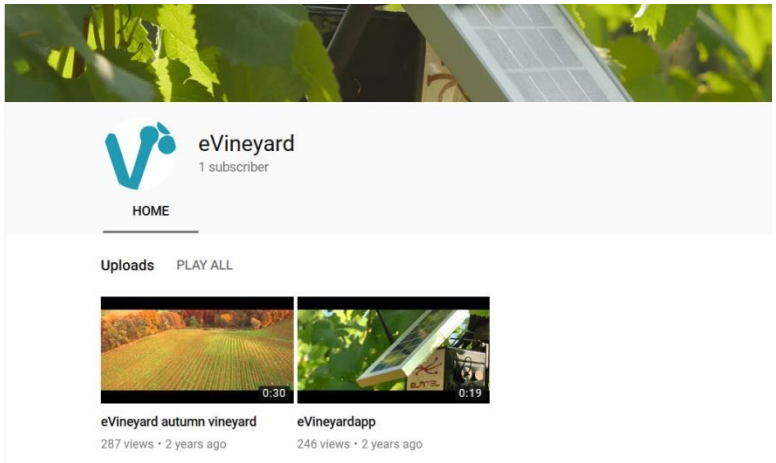
List of attachments:

Attachment1: Video about solution (https://vimeo.com/164903966)



Attachment2: Company website (http://www.elmitel.si/)

Attachment3: eVineyard youtube channel (https://www.youtube.com/channel/UCOEKL8Lea5qTPQUemTLO9fw)



10 CYBER PHYSICAL SYSTEMS

Although in product life cycle (PLC) stages, such as planning, design and development, the influence and use of digital / virtual instruments and techniques used to be more pronounced, the breakthrough of the IoT – Internet of Things (key enabler of the 4th industrial revolution) shifted this aspect by contributing to the creation of the Cyber-Physical Systems (CPS) (Baheti & Gill, 2011). These are networks that connect every physical object that comes in contact with the manufacturing cycle facilitating the exchange of information between them, thus increasing the level of autonomy, self-awareness and performance of the whole fabrication process. The information collected from this network are stored as “Big Data”, upon which real-time analyses are carried out and consequent actions are taken such as: “Automated smart maintenance” (machine / equipment information is analyzed for predicting and preventing potential failures related to their functioning), (Alexandru, et al., 2016) “Automated real-time process optimization” (calculating and implementing optimal process parameters for increasing efficiency) (D'Addona & Teti, 2013), “Automated process control” (automatically monitors process descriptors and, if discrepancies are detected, sends information to control mechanisms) (Oditis & Bicevskis, 2010) and others that drastically reduce disturbances within the manufacturing cycle.

10.1 Production Cell 4.0

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Keywords: Continuous measurement and adjustment, predictive diagnosis, integrated robotics, augmented reality, Edge Node, cloud processing.
Good practice applied in: (NACE code) : Machining (NACE code C25.6.2)

Production Cell 4.0 is being developed as a base unit of future smart factories. The cell is formed by interconnected devices that are involved in the partial steps of the production of metal workpieces. The motivation is to prepare a cell for easy adaptation of production for SMEs. The cell is used to test principles and develop new industry-related technologies in connection with Industry 4.0.

GOOD PRACTICE DESCRIPTION

Several subjects participated on the development of production cell 4.0. The machine was provided by TAJMAC-ZPS, measuring station by Renishaw, B + R Automation developed an open platform, a robot for the demonstration of integrated robotics was borrowed by COMAU, SMC delivered clamping elements, and thanks to Sewio Networks the movement of people around the cell can be tracked.

This solution is strongly tied with the “Smart Factory” concept, as several novel technologies (namely cyber physical systems, intelligent sensors, robotics and cloud processing) were incorporated directly and contributed to the production of a specific product. The benefits can be seen in the area of quality assurance.

The cell forms a functional production unit linking a CNC machine, a robot and a measuring station. The uniform system solves proprietary communication with each device and communicates externally with open protocols. Thanks to modular architecture the device can be easily modified and the system can be supplemented by other software applications.

The so-called production control process remains the basis of the production cell - the measuring station in the cell checks the quality of each workpiece after finishing. When a deviation is detected, the workpiece, including the necessary corrections, is sent back to the machine for repair. This greatly reduces the need of the operator to interfere with machine settings during the manufacturing process.

Key capabilities include horizontal and vertical connectivity of the cell with other manufacturing systems. For the cell, the so-called edge node connection into the cloud platform was prepared where the data mining is being conducted to search for deeper connections. The cell is controlled

by a system opened for user applications and the third-party applications. The data are displayed in augmented reality, monitoring of people movement is being done, condition monitoring of CNC machine and, last but not least, quality control of production process.

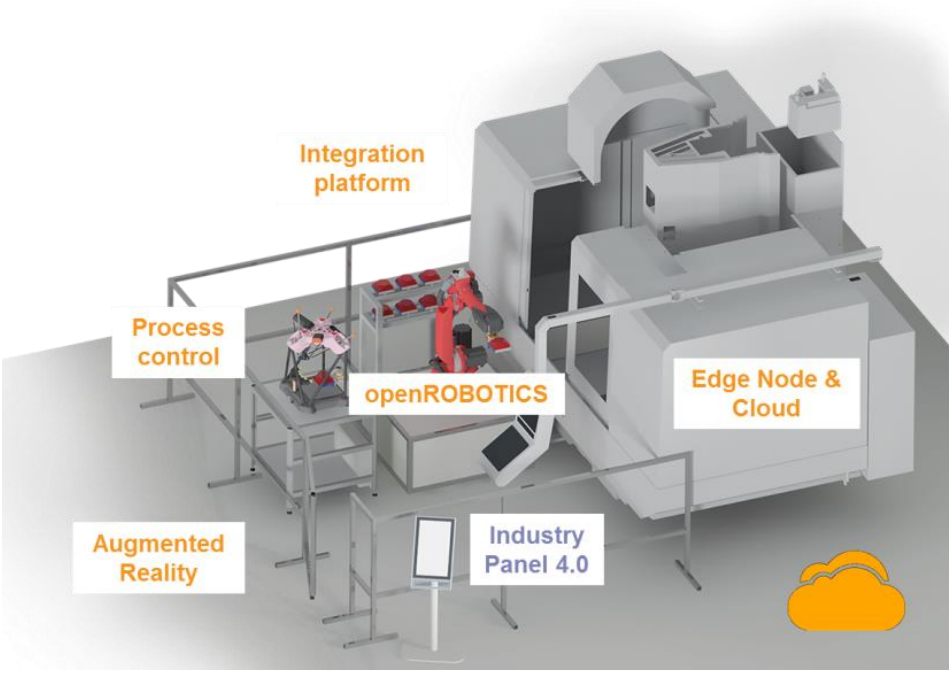


Figure 52 Features of Production cell 4.0

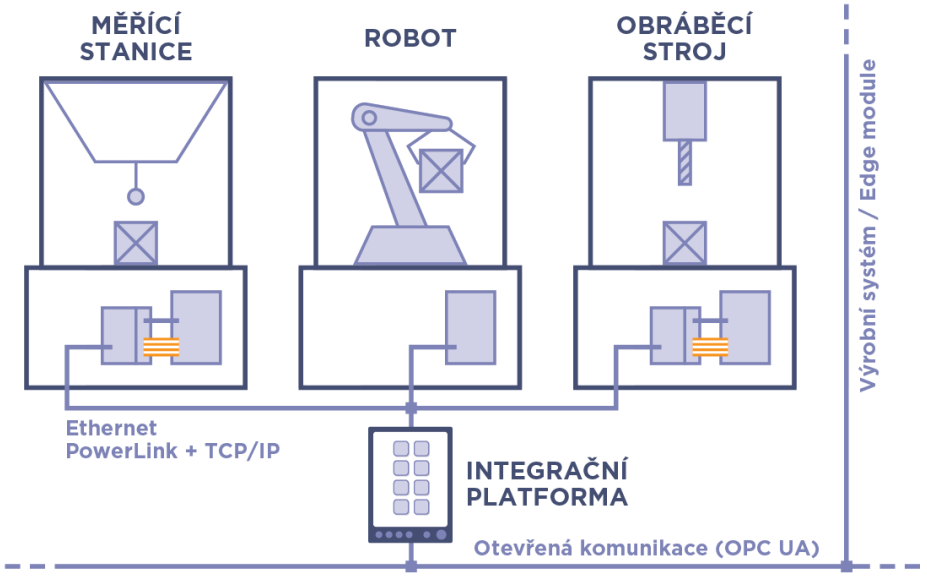


Figure 53 Visualization of communication and integration platform principle

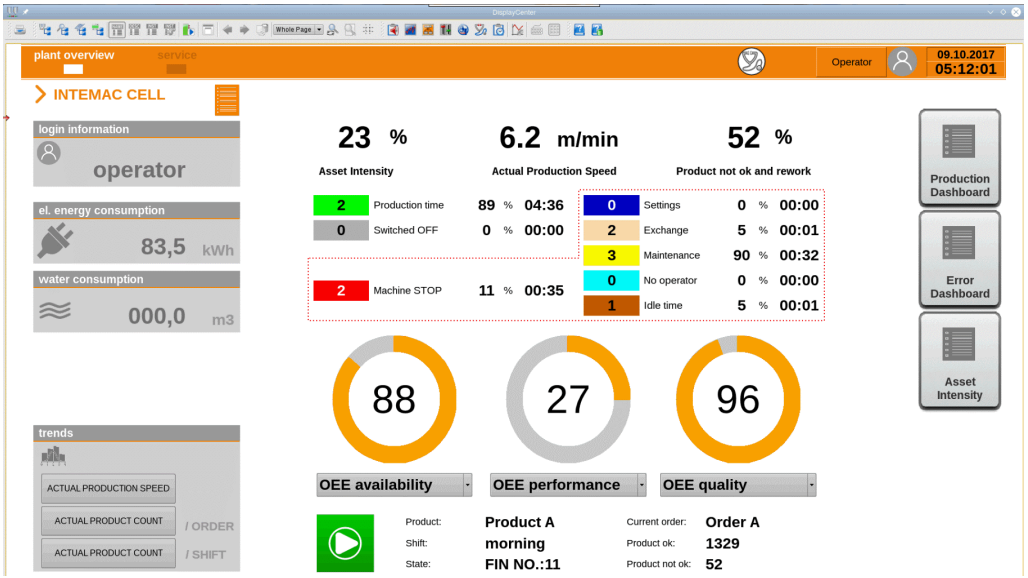


Figure 54 Edge Node – visualization and data processing

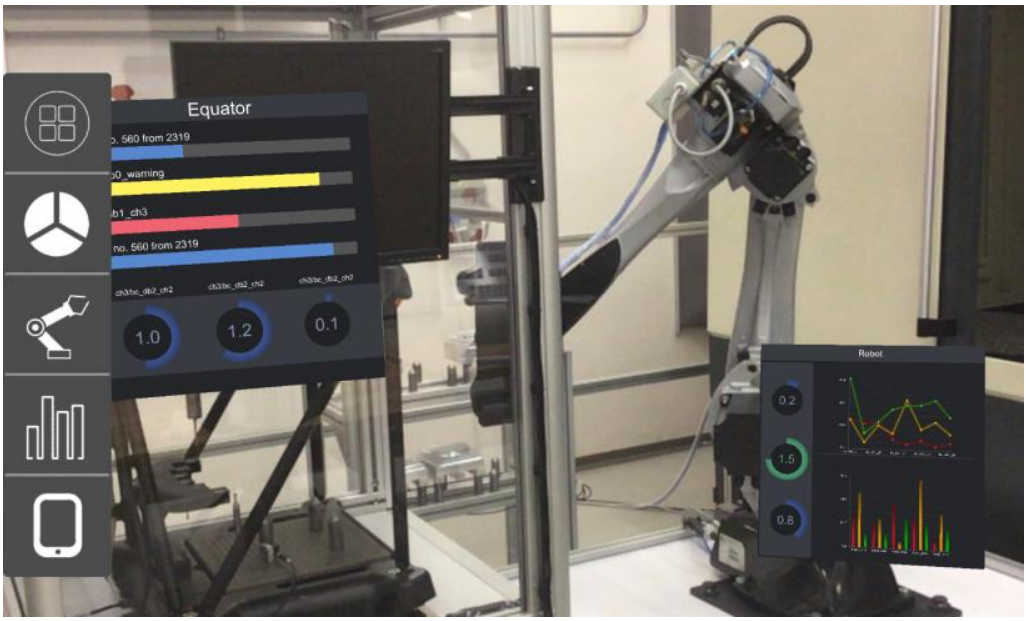


Figure 55 Augmented reality - all important information in one device, quick managerial reports.

Uniqueness consist in interconnection of a whole range of new technologies to a functional concept that is ready for deployment in production. Operation od the production cell is built on the principles of the so-called Testbed. The cell is opened to other industrial partners.

OBJECTIVE AND TARGET AUDIENCE

The solution described previously was developed, tested and validated in Czech Republic.
The production cell 4.0 is usable in small and medium-sized companies as well as in large companies which are focused on machining operations.

METHODOLOGICAL APPROACH

The solution minimize on-site presence of experts, reduce changing time, increase machine availability, predictive maintenance will detect a possible failure on time.
Avoid human interaction and thus human faults. Quality is further ensured by following measures.

- Control of the machining process by workpiece probe.
- Process control by the control system Renishaw Equator.
- Calibration of each manufactured part.
- The parts carry correction data and are automatically sent back for repair.

Data Security Measures have to be applied.

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

1. Analysis of the production system – mapping of customer requirements on the resulting functionality, mapping of control systems and compatibility options.
2. Creating a concept for the operation of the production cell with customer approval.
3. If necessary, purchase and installation of missing devices.
4. Modification of the uniform system for mutual communication of all devices - programming of specific functions.
5. System testing and validation - functionality, accuracy, speed, data processing and visualization.

Below are the resources which are necessary for successful implementation.
Personnel: IT, technology and process department
Finance: very variable, can't be predicted
Infrastructure: machines, IT hardware, LAN
Timespan: Realization depends on complexity. It may vary for 3 to 6 months.

VALIDATION PROCESS

The good practise was validated with industrial clients.

RESULTS / IMPACT

The impact of the good practise is highly positive, as the scrap rates are reduced to almost 0% and the process of self-adjustment is fully automatic. Data about the machining process are displayed virtually and in time so the customer has all the necessary information for decision making.

SUCCESS FACTORS AND CONSTRAINTS

The benefit of Production Cell 4.0 is based on the interconnection of new technologies into a functional unit and in the same time openness to the technologies of other industrial partners. Those interested can even engage their devices (such as the material transport system or 3D printer), use it to test their own technologies or develop features that they would like to prefer in their business.
Thanks to the open platform the production cell is prepared also for new technology advances and thus can serve as a testbed.

LESSON LEARNED & SUSTAINABILITY

The described solution represents a great possibility to interconnect devices in one fully automated manufacturing cell however the user acceptance strongly correlates with the level of experience concerning the technologies involved. Customizing is an important requirement for user acceptance.

REPLICABILITY AND UP SCALING

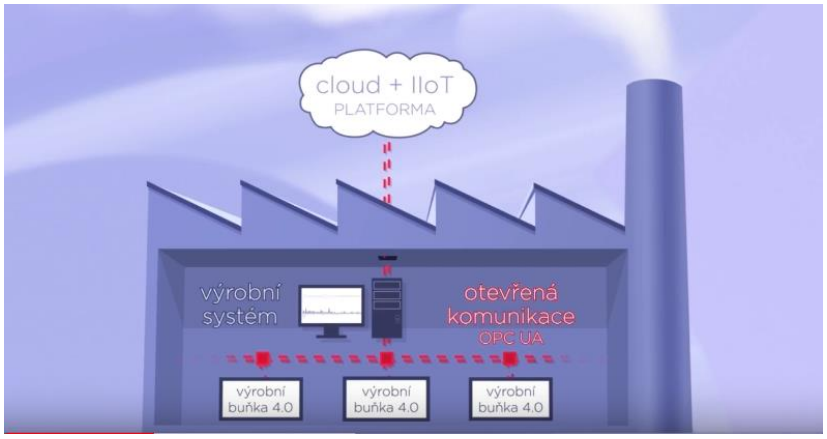
This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. It must be noted, however, that it initially requires a high financial commitment and the organizational culture should be open to the use of new technologies.
The benefit of Production Cell 4.0 is based on the interconnection of new technologies into a functional unit and in the same time openness to the technologies of other industrial partners. Those interested can even engage their devices (such as the material transport system or 3D printer), use it to test their own technologies or develop features that they would like to prefer in their business.

FINAL REMARKS

The core of the Production cell 4.0. is formed by a platform linking a machine with a handling robot and a measuring station. The cell enables the so-called adaptive process of production - the measuring station can evaluate the workpiece quality after completing the machining process and, when finding the imperfections, send information to the machine that will repair the workpiece.
The system can work completely automatically without human intervention, which eliminates errors. Reports and data from machines are instantly available in various display formats thanks to cloud computing.
The cell with a uniform system demonstrates the advantages of automation combined with the needs of small-scale production where one of the key requirements is the need to change the input of production several times a day.

List of attachments:

Attachment 1: Video demonstration: https://www.youtube.com/watch?v=IQJph5c7xo0



10.2 SEW-EURODRIVE

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Phone: +49 681 959 3110
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Keywords :
Good practice applied in: (NACE code) : C26 – Manufacture of computer, electronic and optical products

A production line of the future, the Smart Factory, is presented in the smallest possible space. In order to make them functional, various systems are used: autonomous transport and assembly vehicles (AGVs) are combined and the most advanced industrial robots are coupled with state-of-the-art user interfaces. These support the user with gesture control, 3D real-time visualization and augmented reality.

GOOD PRACTICE DESCRIPTION

Together with the world market leader in drive technology, Centigrade worked on an exhibit for Hannover Messe 2015.
The relationship to SFH approach is the production process.
The control panel brings together all the information necessary for a quick decision by the user. He thus has an intelligent, permanently up-to-date schedule in front of him. He hardly has to modify it any more - but if he wants to, he only needs a single, fingers-fast tap.
Cameras on the ceiling track the movement of the storage containers with the product.
Thanks to Augmented Reality, users can see where their goods are located at any time on the control panel of the intralogistics station - 3D models and additional information are rendered live into the video stream of the cameras on the ceiling.
Users can easily drag live data to their smartphones or tablets via Touch Live. Maintenance workers in the factory no longer have to run to every device for simple maintenance steps.
It is one of the first technologies that enables the digital monitoring and modification of the production process from start to finish.
SEW EURODRIVE received a few awards, for example the German Design Award Special 2017 or the Industrie Preis 2016 Best of.
All necessary information is brought together on the control panel. The employee thus has an intelligent, permanently up-to-date schedule in front of him.

Figure 56 Work instruction are projected on assembly table[12]

OBJECTIVE AND TARGET AUDIENCE

SEW EURODRIVE was tested at the Hannover Messe 2015.
Every manufacturing company is a potential user, since the production process has several work steps that can be digitally monitored and controlled by SEW-EURODRIVEs.
Target groups for the SEW EURODRIVE are SMEs (<250 employees) and large companies.

METHODOLOGICAL APPROACH

From a cost perspective, it is initially a very large effort, since all parts of the production process have to be connected, and tablets have to be purchased to control the processes.
From the quality assurance aspects, it is very helpful because everything is networked with each other, it is easy to locate an fix an error.
To implement the solution, the existing structures are analysed and a detailed plan is drawn up as to how everything can be linked.
In the beginning, a large amount of money is needed because many new interfaces are created and must be networked. This results in high costs and a large expenditure of time.

VALIDATION PROCESS

The production line was validated at the Hannover Messe 2015

RESULTS / IMPACT

The results are very positive, for workers and for the companies. The employees will therefore have less work, as they can control everything from a central point and see directly where there may be problems. For the companies it is easy, to see where potentials are and where problems.

SUCCESS FACTORS AND CONSTRAINTS

The technology must be maintained regularly to prevent errors.

[12] Source: https://www.centigrade.de/de/referenzen/portfolio/sew-industrie-4-0

This production line with the nets is not unrivalled. However, each provider offers different advantages. Every company has to find the right supplier for its needs.

LESSON LEARNED & SUSTAINABILITY

Everyone does not directly accept a fully networked production line, as they do not know this. However, the user-friendliness makes every day work much easier. The more people involved, the greater the acceptance of new technologies will be.

At the moment, the price for technology is very high. However, in a few years, the price will increase. In addition, with the networked production line, resources are conserved, as some parts of the production will be eliminated.

REPLICABILITY AND UP SCALING

The production line makes work easier and clearer for employees. Errors can also be assigned and rectified directly.

An example how to extend the solution more widely is to show production lines at trade fairs and reach new customers.

FINAL REMARKS

The solution requires a financial commitment at the beginning, but compared to the advantages it offers, such as shortening the production time, it is a good investment for companies.

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.

List of attachments:

Attachment 1: Picture of the control panel while using SEW EURODRIVE

Attachment 2: Video about SEW EURODRIVE https://www.youtube.com/watch?v=tfsM6pHEICM

11 SMART MAINTENANCE

Due to new technologies and easy access to the Internet or working in the Cloud, accessing and remotely monitoring machines can be done anytime and anyplace. This asks for reliable remote monitoring and access. Safety issues also play a big role in adopting new technologies using the Cloud or Internet connections. Depending on the criticality of equipment, some equipment needs near to real-time condition monitoring to ensure it will not fail causing great losses or production stops. Critical equipment has a risk profile indicating that the consequences of failure are severe. Condition monitoring, diagnostics and remote access require an intelligent system to bring together the extended amount of data and analysis that is needed in this next level of maintenance management. The aggregation of data collection, storage, analysis and decision making for smart maintenance is called an intelligent maintenance system. Monitoring and analyzing the behaviour of machines and components of machines has become possible by means of advanced sensors, vibration analyses and other smart technologies. (Smart Maintenance Management, 2016)

12 MOBILE WORKFORCE

Among other digital support instruments, related to inspection of products and monitoring processes, the increased use of mobile device applications and smart wearables can also be mentioned. A survey conducted by (Hughes, 2016) found that devices such as tablets, mobile phones, smart glasses, wearable bar code scanners and other devices using Bluetooth technology are being used on the factory floor for various inspection-type purposes and displaying process related data in real-time.

12.1 Impact of a live-video-assistance-system on the problem-solving-competence of service and maintenance employees

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Keywords : WebRTC solution, audio-visual support, reduced repair time, reduced on-site presence, positive influenced problem-solving process
Good practice applied in: (NACE code) : C33

By using the EVOLARIS Live-Video-Assistance-System named EVOCALL, the problem-solving process can be influenced positively. EVOCALL is able to replace non-effective communication channels. Besides, in combination with a "work-shadowing" approach, the on-site presence of experts as well as the repair times can be reduced.

GOOD PRACTICE DESCRIPTION

The system was created based on research work conducted within the COMET Centre of Excellence Programme and knowledge gained from a project funded by the Austrian Research promotion Agency (FFG). Building on these outcomes, a first prototype was created in the course of a master thesis and then iteratively improved with lead customers.

eAWARD Winner 2017; https://evocall.evolaris.net/

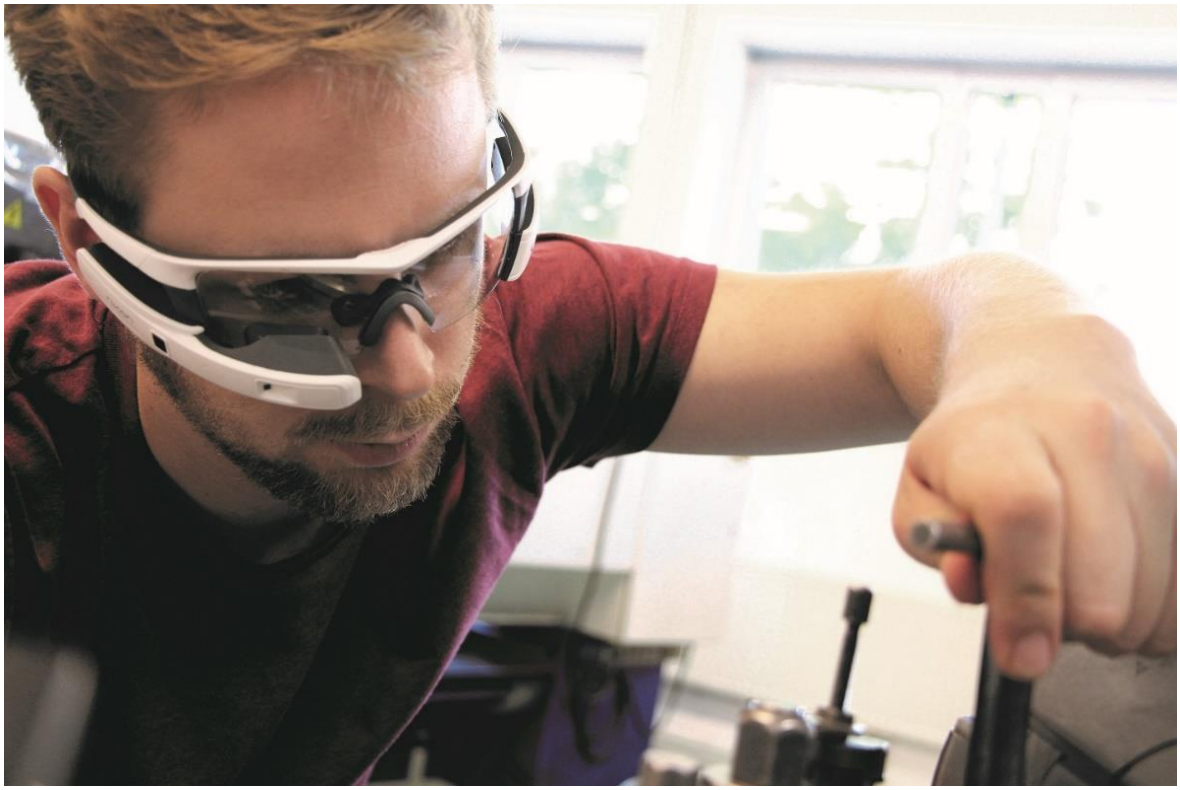

Figure 57: EVO-Call Data googles

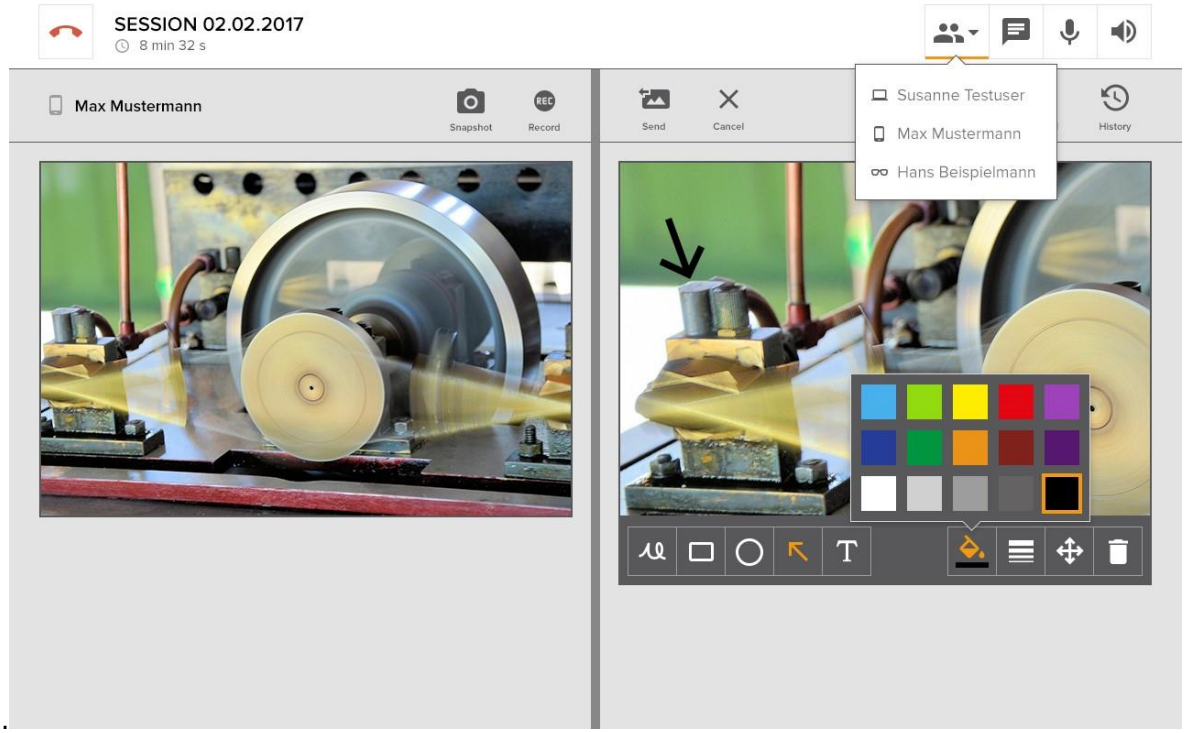

Figure 58: Visualisation of EVO-CALL Session

OBJECTIVE AND TARGET AUDIENCE

Geographical range where the good practice has been used / tested / validated was:

Primarily Austrian HQ and internationally operating companies.
Countries they used EVOCALL: USA, China, Bulgaria, Hungary, Spain, UK,…
Target audience/potential customers are:
Service and maintenance employees and the head of departments, After Sales, IT Support, …

Target group of customers is:
Beginning from SMEs less than 40 employees, up to large companies (more than 2500 employees) to public institutes (university)

METHODOLOGICAL APPROACH
From the costs point of view, the solution minimizes on-site presence of experts, minimize travelling cost, reduce repair time, increase plant availability

The starting point for the implementation of EVOCAll for a company interested would be a proof of concept with EVOLARIS consisting of: an initial workshop to identify the processes and stakeholders with the highest impact potential, training and hands-on experience of the smartglass-based solution; assistance for integrating the solution into the internal IT environment; 3 monthly test licenses

Resources necessary for implementation are:
EVOCALL WebApplication – Computer for Expert, Smartphone for Fieldclient, Chrome Browser on both devices (minimum resources). Timespan incl. Kick-off Workshop less than one day.
Financial resources: costs for concurrent licence – 460€ per licence per month

VALIDATION PROCESS
The solution was implemented with two lead customers, TGW logistics and AVL List. After a first trail with a single device at each site, a test phase with approx.. 10 devices took place, evaluating the solution regarding the stability and performance (e.g. by testing it in a live-like setting between AVL HQ in Graz, Austria, and a AVL subsidiary in the US) and regarding the acceptance of the solution by various employees, which was measured via qualitative interviews.

RESULTS / IMPACT
Reduce the response time. Before between 24h – 36h worldwide, in combination with EVOCALL round about 30 Minutes.

SUCCESS FACTORS AND CONSTRAINTS
Limitations are network shares and network (WLAN) infrastructure constraints (e.g. firewall ports needed to be opened)
Benefits are placed in data centre, high secured communication, in combination with smart glass hands free;
Minimize on-site presence of experts, minimize travelling cost, reduce repair time, increase plant availability
Important factor to improve the impact of the good practice is the user acceptance

LESSON LEARNED & SUSTAINABILITY

Even if the companies are working in the same field, there are often quite different processes that need to be reflected and supported by the solution. Customizing is an important requirement for user acceptance.

The example minimizes travelling of experts

REPLICABILITY AND UP SCALING

The solution requires only the WebApp license, a browser and smartphone and can thus be easily deployed. For hands-free operations, smartglasses are advisable, which cost about 1.500 EUR each.

FINAL REMARKS

Concluding, the good practice example EVO-Call minimize on-site presence of experts, minimize travelling cost, reduce repair time, increase plant availability

12.2 WorkHeld VOICE ASSISTANT

WorkHeld

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Keywords : AI, Artificial Intelligence, Voice Assistant, NLP, NLU, Speech Recognition.
Good practice applied in: (NACE code) : C, Manufacturing,
Plant Equipment Engineering, Field Services

WorkHeld seamlessly connects field technicians with their project coordinators in the head office. Construction plans, checklists and work orders are continuously updated and defects can be reported immediately. WorkHeld enables all involved parties to always be up to date on the project progress.

GOOD PRACTICE DESCRIPTION

We developed a new form of interaction for workers and technicians with low IT skills. WorkHeld seamlessly connects field technicians with their project coordinators in the head office. Construction plans, checklists and work orders are continuously updated and defects can be reported immediately. WorkHeld enables all involved parties to always be up to date on the project progress.
Novel Technology: AI based voice assistant similar to Amazon Alexa or Apple Siri build with NLP (natural language processing) and Speech to Text Technologies.
Voice Assistant that runs on smartphones and tablets and can be connected to headsets.

Awards:

- DBS Award,
- Handelsblatt Industriegipfel - vielversprechendsten Start-Up Lösung
- Born Global Champion

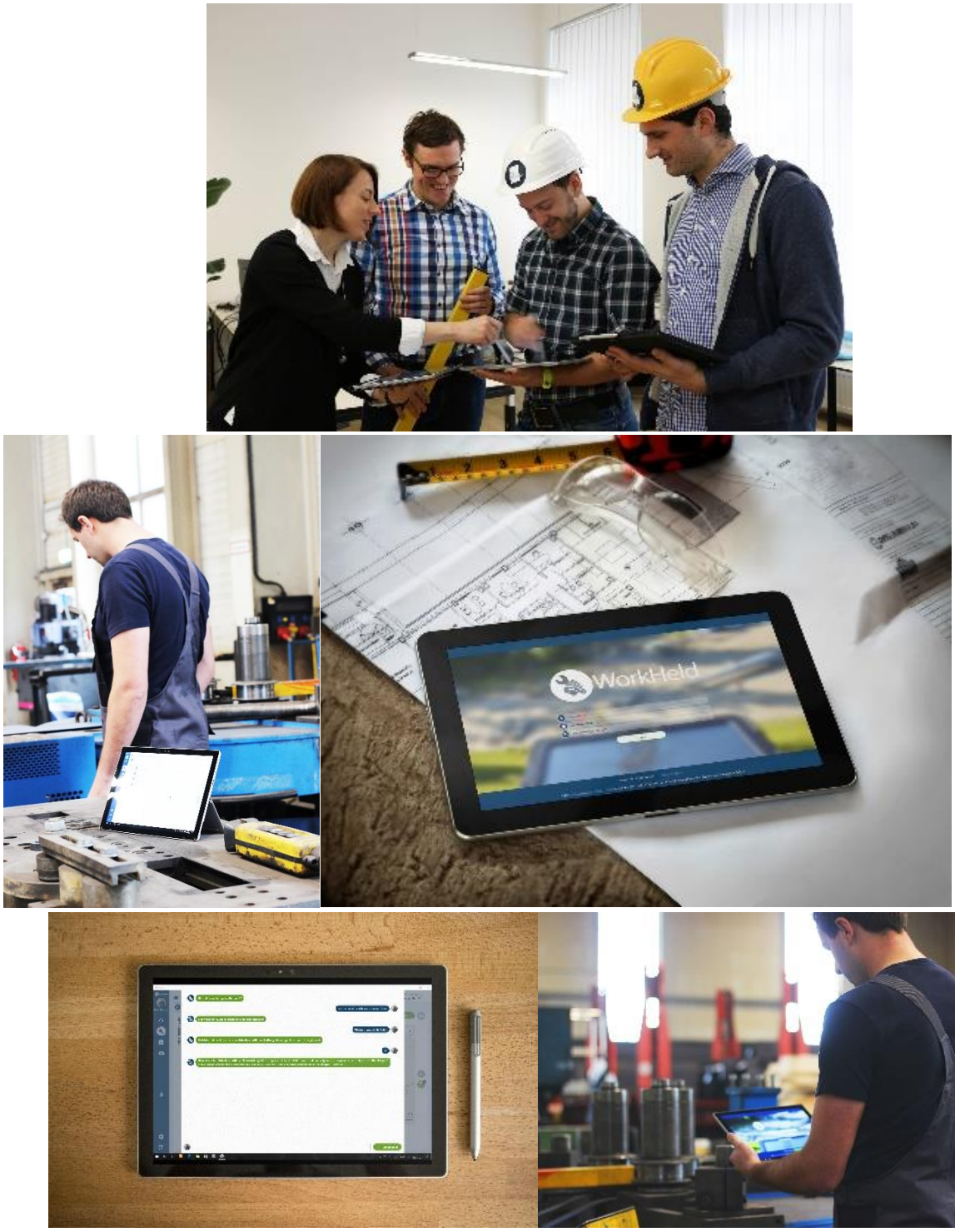

Figure 59

OBJECTIVE AND TARGET AUDIENCE

Geographical range where the good practice has been used / tested / validated, is:
Austria and the DACH region

Target group:

SME's and Large companies

METHODOLOGICAL APPROACH

Design a good conversational interface for specific use cases before you start with implementation.
Conversational User Interfaces are the future of human machine interaction but have to be designed to feel natural. Than build on top of existing NLP Frameworks.

From the costs point of view:

- 20-30 % (estimated)

VALIDATION PROCESS

VALIDATION PROCESS with industrial partners

RESULTS / IMPACT

They are more motivated to document their work and have access to data an information even though they are not highly skilled in IT.

SUCCESS FACTORS AND CONSTRAINTS

Dialects can be problematic. Voice Assistants open up completely new forms of interaction with IT systems and can be applied to all sorts of Use-cases.

LESSON LEARNED & SUSTAINABILITY

Good conversation design is essential.

REPLICABILITY AND UP SCALING

Easy Access and Interaction with complex IT systems
Can be applied to almost all business processes.

FINAL REMARKS

Voice Recognition is expected to have a major impact on all industries in the next 1-3 years. Lets make sure the manufacturing industry is a technology leader this time!

Disclaimer / Acknowledgements

12.3 VIRTUAL REALITY WORK INSTRUCTIONS

FACULTY OF MECHANICAL ENGINEERING UNIVERSITY OF WEST BOHEMIA
REGIONAL TECHNOLOGICAL INSTITUTE

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Keywords: Virtual work instructions, augmented reality, assistive technology, operator empowerment.

Good practice applied in: (NACE code) : Manufacture of consumer electronics (NACE code C26.4.0)

The goal was to create a virtual work instructions that will shorten the time needed to train new employees to improve work performance, reduce mistakes, and ease work by eliminating inappropriate assembly and further disassembly of parts. The shorter the training of new employees is, the sooner they will be able to perform their work and produce flawless products. These instructions are also useful if the operator gets into an unfamiliar situation and if he have to do some work for the first time.

GOOD PRACTICE DESCRIPTION

A first prototype was created in the course of a master thesis. The system was further developed within the research work conducted in the RoRTI project from National Sustainability Programme funded by the Ministry of education and then validated and improved with lead customers.
This solution is strongly tied with the “Smart Factory” concept in concrete with mobile workforce. The workers are provided with virtual working instruction presented on LCD display.
The innovative nature of this solution is that it provides animated instructions for the operators training and work which makes their activities more efficient. The instruction can be performed as fully virtual or in mixed reality (augmenter reality). The visualisation with smart glasses (Vuzix) was tested however the satisfaction was very low. Thus the simple visualisation on LCD display – tablet, smartphone was provided. The system was developed with aid of Unity 3D software package.

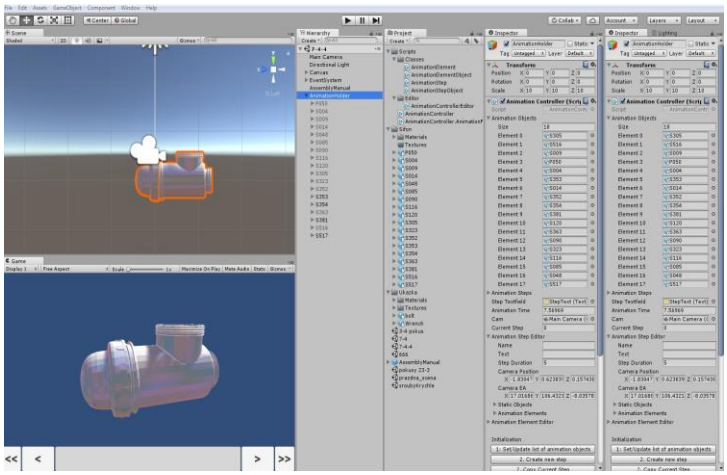

Figure 60 Preparation of virtual assembly in Unity 3D

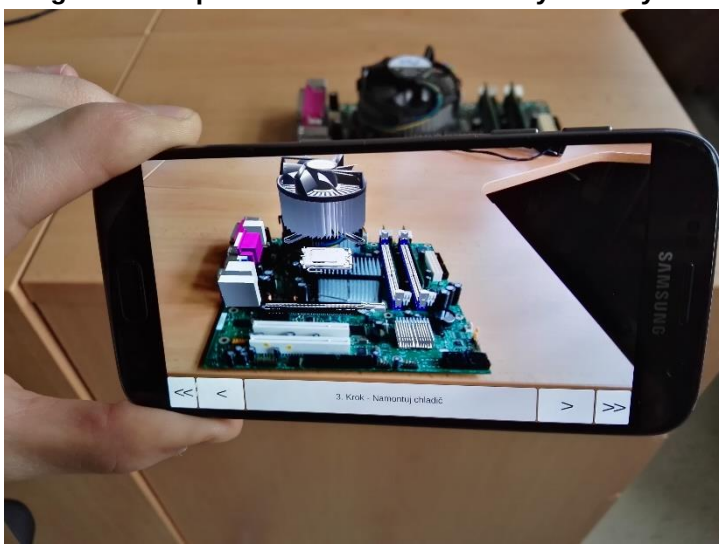

Figure 61 Augmented reality work instruction

The application of the current technology extended over to other industry branches, but its use differed in nature from this type of application (e.g. Daimler applied Vuzix glasses for quality-control and other type of product inspection activities, while UPS (United Parcel Service Inc.) used it for reducing labelling on packages). In both of these cases the AR glasses are required however the comfort by using the AR glasses is not very high. The technology has still its limitation. For our solution we choose simple visualisation on display.

OBJECTIVE AND TARGET AUDIENCE

The solution described previously was developed, tested and validated in Czech Republic.
Solution can be applied by other companies that are willing to integrate virtual reality or augmented reality technology 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.

METHODOLOGICAL APPROACH

If a company recruits new workers, they have to be trained and the faster they learn, the sooner they can effectively perform the necessary tasks. Virtual guides are not only suitable for training of new employees, but they can be effectively used if there is a wide range of products in the company. If the employees don't perform these processes daily, they do not need to remember the exact procedures and steps.
In addition to promptly training of new employees and thus increasing their performance, the errors are reduced or completely eliminated, and the resulting ease of work due to inappropriately mounted parts and subsequent removal of faulty components occurs. Virtual working instructions can be easily done in language versions and therefore are also suitable for foreign agency workers. There is also no possibility for operators when using virtual instructions to skip a step and thus create a scrap. In the case of virtual instructions, every step after completion has to be confirmed by pressing the button and therefore can't be omitted by mistake.

The methodology for implementing this solution comprised of the following steps:
1. Analysis phase – decision about form of work instruction (VR or AR), selection of work instructions and products to be processed, budget analysis, mapping of company's IT infrastructure and databases;
2. Development phase – digitisation of products and its components (creation of 3D models), creation of animations, in case of AR mapping the 3D models on real object;
3. Implementation phase – upload to company's database, fine-tune the visualisation, train the operators.

Below are the resources which are necessary for successful implementation.
Personnel: IT department, technology and process department
Finance: Depends on no. of products and thus number of work instruction to be prepared, also on the complexity of the products and finally the type of work instruction (VR, AR). One working instruction costs around 550 €. If more instruction are being prepared than the costs for one instruction is being lowered as the 3D components may be interchangeable.
Infrastructure: IT Hardware, LAN, database entry.
Timespan: Time also depend on the complexity of the project. Timeframe is usually around 1-3 months also with implementation on the spot.

VALIDATION PROCESS
Twelve workers (6 males and 6 females) tested the assembly of two complex products of a similar type, of which they had previously no information. The product was assembled according to both paper and virtual instructions. They have always done four repetitions of the assembly. With every further round, work has accelerated (see chart). The results show that the virtual instruction was much more efficient than paper in the first round, and this was repeated in the following rounds also.

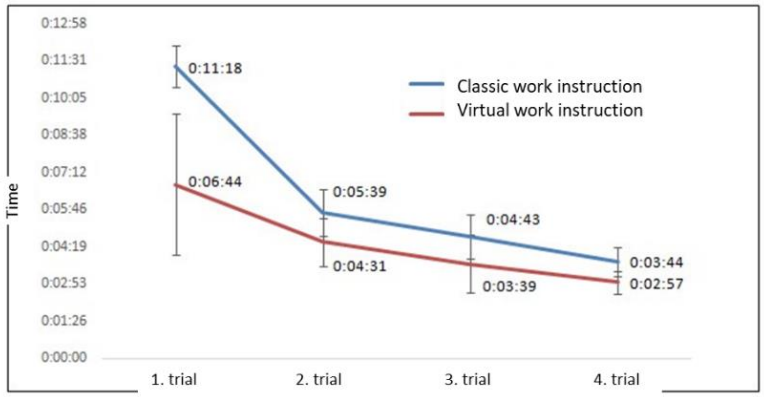

Figure 62 Results from validation of time demands

RESULTS / IMPACT

The impact of the solution was highly positive, as the assembly time was reduced by 40% in the first trial round, by 22% in the second trial round, by 23% in the third trial round and by 20% in the fourth trial round. From these results can be seen that the virtual work instructions enables around 20% faster assemblies.

Moreover as the printed documentation is reduced significantly the reduction is also in the printing costs.

SUCCESS FACTORS AND CONSTRAINTS

The technology is universal however the software is programed directly for specific products. If the product is updated or modified the same goes also for the software which needs to be updated as well. The quality of company's internal databases and also the speed of connection is essential.

The augmented reality work instructions has still many limitations. Marker technology is sensitive for the distance from marker and vison angle. The object fitting technology is limited by the size of the product which can maximally be around 30x30 cm.

The solution and technology is not brand new. The virtual reality and augmented reality work instructions are implemented also in other companies. But it is usually domain of larger companies. Our solution and its development is rather cheep a thus can be implemented also in SMEs.

LESSON LEARNED & SUSTAINABILITY

The success of the implementation depends on the capability of overcoming the resistance of workers regarding the technological change. If they give it a try usually they are more satisfied. During the testing phase most of the workers followed the animations. The accompanying text was read only when assembly was difficult or if there was another problem.

The technology has still some limitations in these days however due to future technological progress the development can be foreseen.

Moreover the system reduces the need for printed documentation and thus is environmental friendly.

REPLICABILITY AND UP SCALING

This solution can be implemented to a wide range of companies, without being tied specifically to a certain industry branch. The technology is transferable however the work instruction preparation must be taken into account which requires a medium financial commitment. Also the workers must be open to utilize new technologies.

The technology is limitation for now especially in augmented reality application. With technology development we will be able to track greater objects without markers.

FINAL REMARKS

The virtual work instructions are promising new technology of work organisation. Either the full virtual reality solution or augmented reality solution can be applied. The AR still has some technology limitation but fully VR instructions works fine. Validation showed time reduction of assembly in comparison to classical work instructions by around 20%. The costs for printing are reduced or eliminated totally. The solution can be used widely through many industrial sectors. Also it is very effective in those types of productions where high variability occurs, where the production is running in small batches or where often changes of products portfolio appears.

List of attachments:

Attachment 1: The animation of virtual assembly

12.4 SCHLAUER KLAUS

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Keywords : Intelligent image processing for industry 4.0
Good practice applied in: (NACE code): C28.2.3 Manufacture of office machinery and equipment (except computers and peripheral equipment)

The intelligent database supported image processing software "Smart Klaus" was developed as an assistance system that offers a perfect solution to these challenges. Where RFID and barcodes reach their limits, industrial image recognition plays to its strengths along the entire supply chain - sometimes in combination with existing systems - or can even replace them with intelligent feature recognition.

GOOD PRACTICE DESCRIPTION

The production process is thus facilitated.
One or more cameras record the passing products. The software checks the image for certain characteristics. Intelligent algorithms then recognize distinctive points and compare them with the database. On the basis of the stored characteristics, the "Clever Klaus" now identifies and checks the products. If the system detects an error, the "Clever Klaus" outputs a signal in the form of a tone or screen hint. The employee receives a note.
There are similar solutions which, like the clever Klaus, support the worker. However, they all have other advantages and disadvantages. But smart Klaus is the solution with the most functions and the best development.

The “schlaue Klaus” guides the employee through the process audivisually via a screen, he checks every step, he confirms that a task has been carried out correctly and he documents the results of the individual steps.

Figure 63 Work instruction are projected on assembly table[13]

Since 2015, the “schlaue Klaus” received 5 innovation awards, for example the Award “100 Orte für Industrie 4.0 in Baden-Württemberg”.

OBJECTIVE AND TARGET AUDIENCE

The “schlaue Klaus” was tested at the OPTIMUM GmbH.
The solution can also be used by other companies that are willing to integrate image processing into their manufacturing processes, especially those that have staff involved in the assembly of products. The practice has a high degree of portability and can be adapted to companies in various industries.
The target group for customers are SMEs (<250 employees) and large companies.

METHODOLOGICAL APPROACH

From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only for maintenance and software updates) and further investments after implementation are not needed, except in the case of training newly employed operators.
From the quality assurance aspects, the “schlaue Klaus” is really helpful. The employee receives information for the process and thus reduces the susceptibility to errors. The solution led to a significant decrease in the number of faulty and defective products reported by customers, which in turn increased customer satisfaction.
OPTIMUM integrates the “smart Klaus” into the existing system and process. Depending on the customer's requirements, it is equipped with one or more cameras, a computer with individually adapted software and database management. A lighting unit ensures consistent measurement results.
The companies need capital to integrate the new technologies.

[13] Source: https://www.handling.de/2--handhabung-und-montage-optimum.htm

VALIDATION PROCESS
The validation process compares the manufacturing time before and after the implementation

RESULTS / IMPACT
The solution has a positive effect for employees and the companies. The employees can fix their mistakes immediately as soon as they made it. It also makes their work easier by giving them instructions on what to do and this saves them time, what results in less cost for the companies.

SUCCESS FACTORS AND CONSTRAINTS
There is a limitation, for example, the system must have a certain technical state of art, otherwise the implementation is only possible with great effort or not at all.
As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.
Operators also welcomed this technology as it made their activities easier, faster and "worker-friendly".
At the moment the price of new technology is high, but in the future the price will decrease, so that it is really pays off.

LESSON LEARNED & SUSTAINABILITY
Human-machine interaction is very important and should be developed further, as this is an important point of Industry 4.0. The more people are confronted with it, the more acceptance increases. The "smart Klaus" can not only support you directly in the production process, but also in goods receipt, returns, quality assurance, order picking and goods issue.

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 financial commitment and the organizational culture should be open to the use of new technologies.
The system is currently undergoing further development to provide guided support for even more complex tasks.

FINAL REMARKS
The solution requires a financial commitment, but compared to the advantages it offers (increase in productivity, increase in customer satisfaction, reduction of assembly time, reduction of errors, and more efficient operation), it is worthwhile for companies.

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.

List of attachments:
Attachment 1: picture of the "schlaue Klaus"

Attachment 2: Video about the “schlaue Klaus”:
https://www.youtube.com/watch?v=S4eJH0MN1_U

12.5 SCHNAITHMANN cubu:S

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Keywords : assistive technology
Good practice applied in: (NACE code) : C28.2.3 Manufacture of office machinery and equipment (except computers and peripheral equipment)

cubu:S is an intelligent and networkable infrastructure for manual workstations, primarily for assembly, packaging and order picking. The system was developed to support the employees at the assembly station to minimize possible user errors.

GOOD PRACTICE DESCRIPTION

In a joint project with Esslingen University of Applied Sciences and the Protective Workshop in Heilbronn, an assistance system was developed that guides employees systematically through assembly and commissioning processes based on movement recognition.
The technical solution is that a motion sensor from consumer electronics was integrated into the system. By combining it with a commercially available beamer and a PC, it was possible to design a flexible system with minimal hardware requirements.
A completely new kind of human-machine interaction is realized in the system itself. The use of “intelligent” component containers opens up unimagined possibilities for flexibility along the entire value chain.

The individual work steps are projected onto the assembly table. The "Pick-by-Light" principle is used to visualize the component removal from the correct container.

Figure 64- Work instruction are projected on assembly table

Source:
https://www.schnaithmann.de/news/news-uebersicht/montage-assistenzsysteme/

OBJECTIVE AND TARGET AUDIENCE

It is used at the Schnaithmann GmbH in Germany. It was tested at the Esslingen University of Applied Sciences and the Protective Workshop in Heilbronn.
All companies that are faced with the challenge of an increasing variety of variants and at the same time a declining number of units with a constantly changing workforce, but still want to produce economically efficient and high quality products can benefit from it.
The target group of customers are SME's (<250 employees) and large companies.

METHODOLOGICAL APPROACH

From the costs perspective, the solution proved to be highly efficient, as it requires minimum intervention (only for maintenance and software updates) and further investments after implementation are not needed, except in the case of training newly employed operators.
For quality assurance aspects, the Good Practice is furthering, the employee receives information for the process and thus reduces the susceptibility to errors. The solution led to a significant decrease in the number of faulty and defective products reported by customers, which in turn increased customer satisfaction.
To implement the Good Practice the parts to be removed or picked are made available on a Kanban shelf. Necessary working information is projected directly into the working area as video, photo or instruction. Therefore, tools are needed to make this possible.
The companies need financial resources to integrate the new technologies.

VALIDATION PROCESS

The validation of the solution was achieved through testing at the Esslingen University of Applied Sciences. The validation process compares the manufacturing time before and after implementation.

RESULTS / IMPACT

The solution has a positive effect for employees and the companies. The employees can fix their mistakes immediately as soon as they made it. It also makes their work easier by giving them instructions on what to do and this saves them time, what results in less cost for the companies.

SUCCESS FACTORS AND CONSTRAINTS

There are limitations, for example, the system must have a certain technical state of art, otherwise the implementation is only possible with great effort or not at all.
As mentioned previously, as direct results of the implementation significantly increased productivity and customer satisfaction were obtained.
Operators also welcomed this technology as it made their activities easier, faster and "worker-friendly".

LESSON LEARNED & SUSTAINABILITY

Human-machine interaction is very important and should be advanced, as this is an important point of Industry 4.0. The more people are confronted with it, the more acceptance increases.
Currently the price of the technology can be prohibitive, however, due to future technological progress their price will decrease and the cost of implementation will be reduced.
Moreover, the system it reduces the need for printed documentation.

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 financial commitment and the organizational culture should be open to the use of new technologies.
The system is currently undergoing further development to provide guided support for even more complex tasks.

FINAL REMARKS

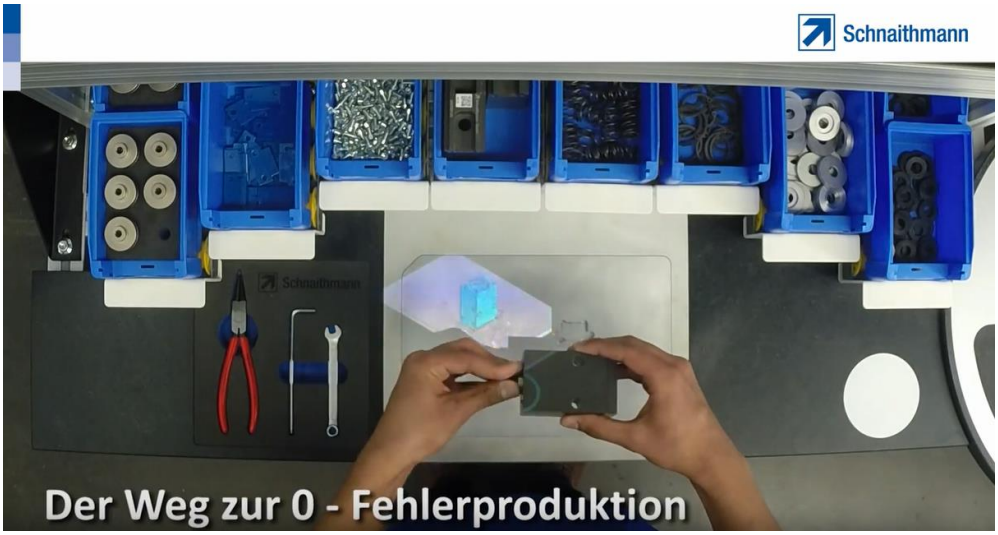
The solution requires a financial commitment, but compared to the advantages it offers (increase in productivity, increase in customer satisfaction, reduction of assembly time, reduction of errors, and more efficient operation), it is worthwhile for companies.

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.

List of attachments:

Attachment 1: Picture of the cubu:S
Attachment 2: Video demonstration https://www.youtube.com/watch?v=tVTme30L_DM



13 SELF-DRIVING VEHICLES

13.1 VOLUMETRIC MEASUREMENTS BY UAV

UAVONIC
unmanned aircraft services

UAVONIC s.r.o.
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E-mail: dudas@uavonic.com
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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

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

Figure 65 Volumetric Measurements by UAV

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.

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.

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

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

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.

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.

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.

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/

14 INTELLIGENT PRODUCTS

According to (Wellsandt, Hribernik, & Thoben, 2014) the majority of tools and techniques employed for obtaining information related to product use are subjective, newly developed ones, such as “product-embedded sensors” prove to be more objective, because they function “unobtrusively and therefore facilitate authentic user behavior”. Not disregarding user privacy, collected data can be further processed and integrated into the design of future products. They also proposed a set of eight techniques for collecting use information, which were rated according to established criteria and offered a qualitative evaluation of them. Their findings prove that “product-embedded sensors” are highly compatible with the “Industrie 4.0” model.

14.1 QUALITY ASSURANCE SOLUTIONS FOR AUTOMATED PRODUCTION PROCESSES AND ADDITIVE MANUFACTURING APPLICATIONS

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Keywords : Quality Assurance, Process Control, Process Monitoring, AM
Good practice applied in: (NACE code) : 25620

plasmo offers quality assurance solutions that enable our customers to implement a secure, efficient and cost-optimized production mainly in automated metal working industry. plasmo has a large clientele of top global companies established in different industries (automotive, steel, mobility, aerospace industry, suppliers etc.).

GOOD PRACTICE DESCRIPTION

plasmo systems inspect the quality of components of i.e. vehicles, aircraft, ships, turbines, furnaces, household appliances, windows or steel structures to make these and many other products safer and more efficient. Our solutions capture all relevant data for process optimization (errors, defects, process deviations, tracking of component data) and visualisation adopted to the relevant user level.
plasmo solutions enable a fault-free production and documentation of produced components as well as a visualisation of deviations in the production process. To produce 100% quality and avoid call back actions as well as produce as efficient as possible is our customers' goal and our purpose.

plasmo contributes to these goals by providing absolute transparency of the respective production process and considering customisation requirements. This transparency supports the worker in optimization of all steps and starting the necessary measures in case of detection of failures or process deteriorations. This means, that the investment in monitoring systems and training activities helps to reduce the risk of defective parts or components which may have been returned by the customer of our customers. Plasmo solutions are often installed in combination with other non-destructive technologies like eddy current tests or ultrasonic inspection methods just to be sure that all produced components fulfil all internal and external specifications.

The plasmo portfolio ranges from monitoring of welding and laser brazing processes, control of weld seams, geometric shapes and surfaces up to tailored solutions in the field of machine vision and analysis software. Plasmo has an own business field for AM monitoring activities.
In addition plasmo plasmo builds on know-how including the following disciplines: hardware development, software development, optical sensors, laser technique, machine and computer vision, mechatronics, physics and mathematical algorithms as well as deep learning. All solutions and customisation procedures are implemented at plasmo. For all solutions plasmo provides a global service and training network.

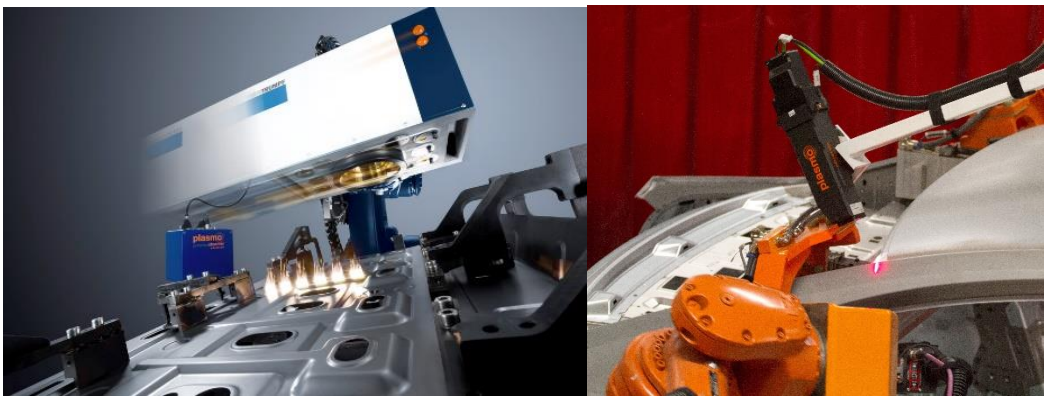

Figure 66

OBJECTIVE AND TARGET AUDIENCE

METHODOLOGICAL APPROACH

The expert team assists its customers from the moment the control task is defined until implementation of the control system. Starting with support from the decision phase, if and how and which technology can be implemented in automated production and what is needed for implementation including relevant expertise (planning phase), training and accompanied services and consulting. All relevant internal or external standards are considered in the technology selection and implementation of the monitoring systems as well as intercultural issues.
Resources needed are:
Production manager, quality representative, production staff, service & maintenance department, electrical and control engineering department. Production line should produce first trial parts. Also old production lines can be upgraded by a retro-fit package.
Time span: from planning to implementation incl. training (about 16 weeks)

From the costs point of view:
The solutions minimize the number and costs of rejects and claims by 50%; Optimization of cycle time by 20%, process optimisation by 20%, reduction of machine stand stills or interruptions nearly to zero, efficient tool to plan predictive maintenance activities.

Increase the quality of produced parts, optimization of the production process in general, consider safety and optical aspects. Plasmo solutions make quality visible.

Our solutions capture all relevant data for process optimization (errors, defects, process deviations including full traceability etc.) to keep the quality of our customer´s products at the highest possible level. Plasmo provides additional technical consulting services for interpretation and further use of production data, individualised illustration by dashboards and implementation of process optimisation measures. Plasmo solutions are monitoring solutions contributing to minimisation of production failures.

VALIDATION PROCESS

plasmo gathers all relevant process data, correlates and evaluates this data. This evaluation enables identifying the real cause of a defect and provides visualisation tools serving for continuous improvement of the process.

RESULTS / IMPACT

Customers have told us that plasmo quality assurance solutions make their production process significantly more efficient (by optimization of the production process and further reducing costs created by new insights due to the implementation of monitoring systems – “customers know their production processes better” and use the existing information for defined measures).

SUCCESS FACTORS AND CONSTRAINTS

Limitations are:

resources and know-how in various disciplines (mechatronic, electronic, measurement and control systems, laser material processing, plant construction & engineering, industrial automation), awareness and trust in the new technology, misunderstanding of benefits of the system, lack of knowledge of best practices from our customers (use cases)

Benefits are:

Flexibility: Our solutions are independent from the integrator or laser manufacturer.

Customized solutions: the plasmo quality platform offers solutions adoptable to individual requirements of production processes.

Expertise: plasmo aggregates all necessary disciplines for the implementation of quality assurance systems in house, in the headquarter in Vienna. Plasmo works cooperates with research institutes and industrial partners to focus all expertise optimally on plasmo’s core topic: quality assurance and monitoring of production processes. All plasmo systems are industrialised and accepted in automotive, steel and aerospace industry as well as in electro mobility.

To improve the impact of the good practice:

gain experience with the provided technology during tests in laboratory and industrial circumstances, adequate training and additional technology consulting, involvement of production and quality manager as well as purchasing and maintenance department to understand the benefits, limited rental time with possibility to return the product, offering a proof of concept phase to confirm covering the most important individual requirements. Success stories of best practice cases highlight the needs and provide an impression how customers use plasmo solutions.

LESSON LEARNED & SUSTAINABILITY

With plasmo solutions, our customers are able to produce the highest quality as possible and to better understand their production process. It is necessary to provide use cases and highlight benefits and possibilities of plasmo systems, make additional use of generated information by data created during the production process. Adequate trainings adopted to the know-how level of the trained organization and remote & hotline services are necessary to increase the awareness for the new technology, provide demonstration facilities. Expected benefits need to be illustrated explain to companies' stakeholders, especially the champions.

plasmo hardware-independent solutions offer the opportunity to plan quality assurance in your production flexibly. This ensures sustainability

REPLICABILITY AND UP SCALING

The provided solutions are also relevant for SMEs, especially job shops. plasmo contributes to making quality visible and gaining more information about the production process.
At corporation level: In addition plasmo provides a detailed track record for all components produced (long-term archive) which can be used in case of call back actions or process comparisons (i.e. comparison of the same applications in different locations and plants.
Dissemination of good practice more widely: reference business cases and use cases published at congresses or journals, illustrate a list of reference customers to visit reference installations.

FINAL REMARKS

plasmo offers tailor made quality assurance solutions that enable our customers to implement a secure, efficient and cost-optimized production.

Disclaimer / Acknowledgements

NDA (non-disclosure agreement) for new customers as well as agreement on data hosting and security, agreement on use of photos and videos (if required)
All information illustrated in this tab can be published and disseminated online and printed.

14.2 HSTec, High Speed Technique

HSTec
HIGH SPEED TECHNIQUE

HSTec – High Speed Technique

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Keywords : high speed technology, engineering, robotic automation, motor spindle
Good practice applied in: (NACE code) : C - Manufacturing

HSTec is specialized in the development, design and manufacture of high speed motorized spindles, direct drives and other high speed technologies, as well as engineering, design and automation of special machine tools and systems.

GOOD PRACTICE DESCRIPTION

The company was founded in 1997 by SAS Zadar, a company specializing in the field of production of special machine tools and the German company Bosch-Rexroth (formerly INDRAMAT), a world famous company in the production of electric drives and control systems. Since its founding, HSTEC has developed a wide range of motorized spindles and electric drives for direct application in machining centres and machine tools. A flexible team of highly skilled mechanical and electrical engineers with great working experience in development, design and production of special machine tools and implementation of industrial robots offers creative solutions in industrial automation. HSTec's R&D team is focused on individualized production offering development, design, calculations and optimization, production and assembly of machine tool components according to customer requests. The high standard of product quality control continues after the implementation of the product at the customer, thus managing the product's lifecycle. The company incorporates novel technologies in the production processes, such as:

- machines for the production of high efficiency and low energy consumption;
- dynamic sampling of the product lifecycle;
- incorporation of digital and ICT systems into production processes,
- lean management guidelines,
- a high level of product quality assurance and control provided by the strict standards (ISO 9001:2015) and top quality devices and machines;
- production of smart products with the monitoring sensors and the ability to communicate and network via the monitoring signals;
- ERP (Enterprise Resource Planning) integrated management system;
- HRM includes continuous monitoring and upgrading of the ICT system and overall work environment, continuous investment in education of employees and work tools, such as software and hardware, continuous work evaluation and appropriate awards and/or advancement opportunities, providing additional health insurance;

- risk management principles and guidelines are incorporated into management decisions.

Technical solutions and innovations arise from the continuous involvement in novel technologies, creating products that are not only innovative, but are also the solutions to the unsolved problems in production processes, such as energy efficiency, digital machine networking, implementing solutions in hazardous environment and thus eliminating possible personal injuries in the production process.

Figure 67 Machine part

All innovative technical solutions have been discovered through the present situation in their environment and in consultations with partners and potential customers. As a manufacturer of prototype solutions, in order to remain competitive, they must pay attention to all possible customer requirements and on the global strategy and guidelines for future development, such as Industry 4.0.

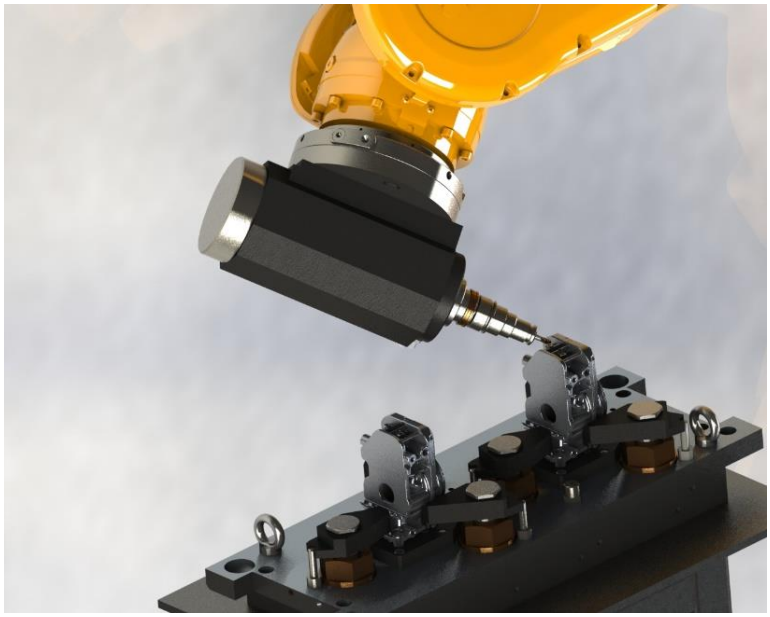


Figure 68 Machine tool

Awards:
Platinum key for continuity in company excellence HSTEC d.d. (http://www.hstec.hr/novosti/platinasti-kljuc-za-kontinuitet-u-izvrsnosti-tvrtki-hstec-dd/51.html),
Annual reward of Zadar County to HSTEC d.d. (http://www.hstec.hr/novosti/godisnja-nagrada-zadarske-zupanije-tvrtki-hstec-dd/49.html),
Zlatna kuna 2016 and 2012 for the most successful SME in the Zadar County.
Website: www.hstec.hr

OBJECTIVE AND TARGET AUDIENCE

HSTec is an export oriented company with the following geographical coverage:
Germany 50%, Croatia 28%, Slovenia 10%, Austria 5%, USA 5% and other countries 2%.
Target audience and potential customers are companies mainly from the automotive industry, and in a small percentage, glassworks and plastic mould industry, that is SMEs, large companies and universities.

METHODOLOGICAL APPROACH

Efficiency of the good practice impacts investment, process, resource and energy consumption, and the quality assurance aspects are quality assurance of the product and services, continuous improvement of the product, services and processes and key process indicators of efficiency. However, the main tool for quality assurance is the efficient quality management and awareness of all employees striving to develop the best possible product and service. Risk management aspects are strengths, weaknesses, opportunities and threats regarding the future development and they are incorporated into managerial decisions. The solution can be implemented if all necessary resources are available, however it can depend on the environment (i.e. if the environment is productive and all necessary suppliers are nearby, it can be a very positive start). The resources necessary for implementation are: highly qualified and educated personnel, finance, infrastructure (production plant, top quality production machinery, devices and ICT system, adequate software tools), and timespan of ca. 1 year.

VALIDATION PROCESS

The good practice has been validated by every satisfied customer. The customer satisfaction survey is being continuously monitored, which is one of the main starting points where products and services are being improved. All products and services are monitored even after the delivery, using the Product Lifecycle Management. Thus they are able to witness the lifespan of products as well as some possible aspects of the product needed to be improved.

RESULTS / IMPACT

Satisfied customers, product improvement, taking part in development of future smart factories by improving their product according to the guidelines of Industry 4.0 strategy. Their employees are continuously improving their skills and knowledge, the company's employment rate is continuously rising which is being positively affected on the development of Zadar County.

SUCCESS FACTORS AND CONSTRAINTS

Limitations are mainly in the ability to find skilled professionals who are willing to work in small towns. The educational system needs to be upgraded so the company continuously invests time

and money to improve the level of knowledge of its employees. Limitations are found in the local area where there is a minor percentage of suppliers. Almost all suppliers are located at least 300 km from the company location which negatively affects the time management and transportation costs. The products and services are made according to customer requests and are mainly prototypes. The company's know-how is a great sales point, where they consult their customers on what solution to choose. Their ability to produce only one prototype product for a reasonable price differentiates them from the competing brands that only sell standard products. The company also differentiates from other companies in having all the necessary departments at the same location: development and design department, production and assembly department, quality control department, product testing department, logistics department, after sales, service department etc., and thus is able to offer a competitive solution incorporating knowledge, high-quality product, product monitoring and servicing. In order to improve the impact of the Good practice they need more highly qualified and trained personnel and an improved industrial environment where most suppliers would be located and thus easily connected with the company.

LESSON LEARNED & SUSTAINABILITY

Always strive to be ahead of your competitors through knowledge and quality. Work continuously on improvement of your business processes, resources, personnel, products and services.

REPLICABILITY AND UP SCALING

A good practice can be useful for other SMEs in regard to implementing the solutions for energy efficiency, production efficiency and production process automation by incorporation of digital and ICT systems, HR management and continuous investment in education of employees, risk management that is efficient and prospective and process organization according to lean management principles and guidelines. Opportunities are in growth of companies that have the best practice or merging several companies which leads to an increase and spread of the good practice.

FINAL REMARKS

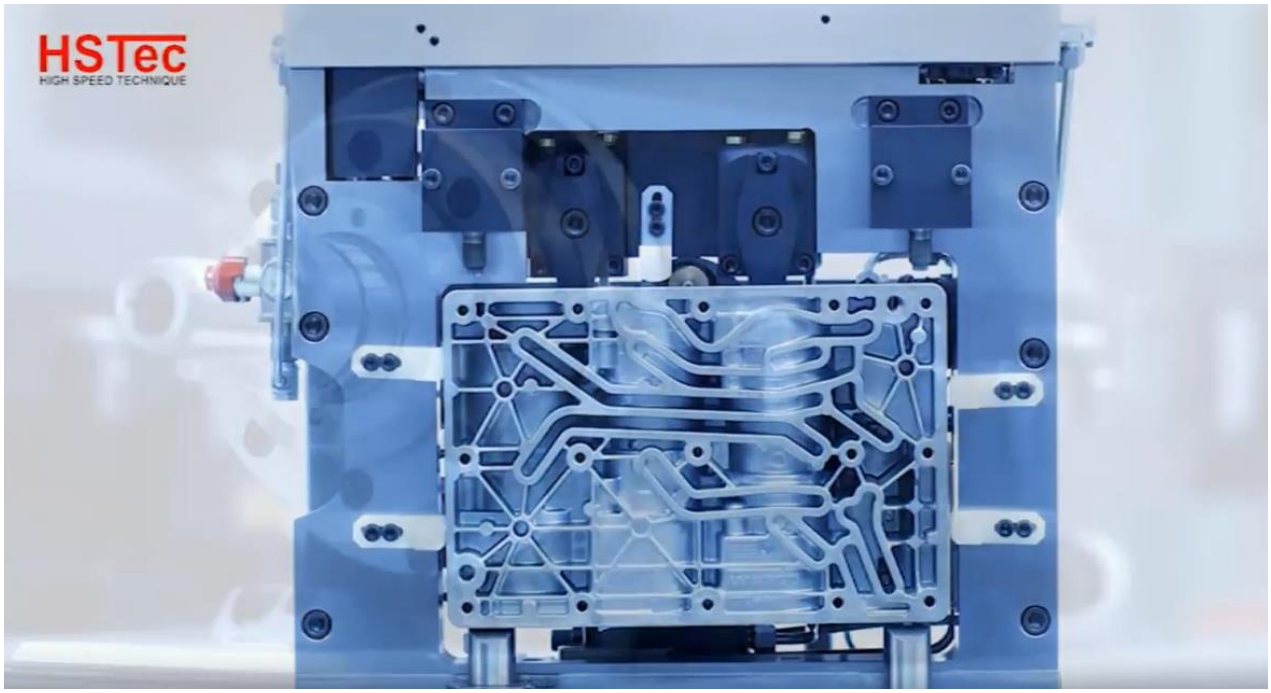
The impact is global and irreversible: future demands are based not only on automation of processes and products, but also on digitalisation and implementation of monitoring sensors in order to communicate throughout the network and between several smart factories.

Disclaimer / Acknowledgements

This information can be disseminated by printing material and online release.

List of attachments:

Attachment 1: Screenshot from the application
Attachment 2: Screenshot from the application
Attachment 3: Video presentation of the company: http://bit.ly/2yhQY6K


HSTec
HIGH SPEED TECHNIQUE

14.3 HEATING UNDER GLOVE FOR WORK IN EXTREME ENVIRONMENTS

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Keywords : Textile, temperature sensors, heated wires, embroidery technology
Good practice applied in: (NACE code) : C13 - Manufacture of textiles

Heating under glove can be used as a simple working glove (cool environment), combined with the additional outer layer (cold environment) or with strong insulated outer layer (extreme cold environment). Into textile are integrated temperature sensors, embroider isolative Braids on upper side and heating places over fingertips and electronic control unit, which can regulate different temperature range. Heating elements are heated wires. These are sewn on textiles using embroidery technology.

GOOD PRACTICE DESCRIPTION

TITERA bridges the gap between small sized companies and large-scale industry. It explores the everyday needs of people related with the textiles and its use. To every project we bring industry knowledge and of the best technical solution for the first batch production. We work large scale companies to produce innovative content, solutions and demonstrators by means of combining materials and technologies.

A lot of innovative products developed in the research organization are usually not developed to the stage of commercialization. This often happens because of the necessary investments in the development of usable prototype, due to poorly conducted market analysis or because of the necessary knowledge needed for the positioning of the product on the market. There are also usually ill-prepared maintenance protocols, the evaluation by end-users is not designed or the knowledge to commercialize is highly inadequate. TITERA has tight collaboration with their end users, for who it develops the smart wearable products and smart composites.

Novel technology is related to combining the wearable technology with the traditional textile technologies processes.

Heating under glove can be used as a simple working glove (cool environment), combined with the additional outer layer (cold environment) or with strong insulated outer layer (extreme cold environment).
This is specifically used in extreme environments where temperature is very low, for example cold store or regions where the winter is very harsh, with very low degrees. Production oriented companies faces the difficulties on how to equip workers in order to provide them decent workplace, which is why heating gloves together with heating clothes present perfect solution.

Following specifications are known for low temperature heating materials:

- Voltage range of 1.5 V to 230 V
- Temperature range of 10°C to 100°C
- Heat output can be adapted according to the customer's preferences
- Advantages: rapid surface heating and energy-efficient heating compared with conventional wire heating systems

Heating textiles can be manufactured with various textile manufacturing technologies.

Energy supplies two batteries with 7,4 V and power 15 W. Booth gloves can be charged at the same time.
Glove-electronic is made in two options:
- With integrated temperature sensors for control and regulation.
- Option ON/OFF – without integrated temperature sensors.

Figure 69: Heating under glove presentation

Figure 70: Thermal measurements

Existing products for heating elements are mostly integrated into the outer garment. Carbon fibres are replacing embedded heating wires, which are rigid and heavy, break easily, and require more energy. Making use of low voltages for safety, electrically heated clothing comes with a button on the outside which enables the regulation of the heating system. Heating is achieved through the integration of the heating pads based on metal wires weaved into the surface. At the moment such heating kits have to be taken out of the garment item while washing. Our heating elements can be washed.

OBJECTIVE AND TARGET AUDIENCE

The good practice has been tested in Slovenia (Prekmurje) and Germany (Thüringen). The target customers are all the workers in a cold environment. This is why target group are varying from SMEs and large companies to End customers.

METHODOLOGICAL APPROACH

Product can positive impact the human health. Workers can work longer while exposed to cold environment. While feeling comfortable in cold environment, the work efficiency will be higher. There are no special implementation rules, as product is ready to use. So it is just a matter of reading the instructions on how to use it. There is a need for appropriate sewing equipment which needs to be implemented into traditional manufacturing facilities.

VALIDATION PROCESS

Validation in our case can be performed through quality check process in a final step of production. Positive feedback from end users.

RESULTS / IMPACT

The big advantage for people who work or play outdoors is that heated clothing keeps them warm during breaks in activity, when body temperature can decrease quickly. They will feel comfortable.

SUCCESS FACTORS AND CONSTRAINTS

Today's technical limitations are related to the lack of appropriate sewing machines needed for placing a metal wires over textile layer. Automatization process is required, but not possible yet. The presented heating glove is the only one that kind of type. It consists of two layers. It can also be washed. The product is developed and ready for market, but there is lack of promotion about "smart" textiles. So there still needs to be some work done in order to present the benefits of such best practices.

LESSON LEARNED & SUSTAINABILITY

Being innovative on every step is needed in all industrial environments. The cooperation between research, business support organizations and end-users (production companies) is needed in order to develop the product which is ready for the market and acceptable by the market. The market of "smart" textile is being developed rapidly and it is just a matter of time, when each of the production line will be using one or another implication of those kind of materials.

REPLICABILITY AND UP SCALING

Once the technology can be adopted in serial production of heating gloves, also other protective garment items can be produced by the same technology. Transfer the technology on other type of products is welcome.

Researching, developing, creating and demonstrating innovative solutions in the field of the smart textile and wearable electronics, personal protection equipment, thermoregulation and human thermal comfort will bring more and more possible applications. By spreading the technology on other products for personal protection.

FINAL REMARKS

The heated gloves play an important role in the tough environments, where the temperature is very low. In order to ensure the healthy environment and workers satisfaction and by that also the production efficiency with added value it is important to implement such smart products, which are already on the market and are changing the everyday of workers.

Disclaimer / Acknowledgements

No limitations and it can be used for dissemination.

List of attachments:

NA

15 ADDITIVE MANUFACTURING

Three-dimensional printers not only hold the promise of achieving high quality at volumes as low as a single unit, but also of opening the door to entirely new designs and material structures and combinations. Printers have been developed that can print over 1,000 materials, including hard plastic, flexible plastic, ceramics and metals. One German manufacturer has developed a process that deposits layers of wood pulp; a San Diego company called Organovo is 3D printing human tissue for use in labs. Some printers can now layer more than one material and can enable smart components to be fabricated with embedded sensors and circuitry, such as hearing aids or motion-sensing gloves. There even is something called a Replicator on the market. It's a system made by Cybaman Technologies, a British firm, that starts by layering a basic shape and then machines the rough object into its final precise and polished form. (Koten, 2013)

16 ROBOTICS

Industrial robots can operate 24 hours a day, seven days a week, with repeatable and increasingly fine precision—to hundredths of a second and in less space than is detectable by the human eye. They report accurately on their progress, improve when their performance is tested for efficiency and become more dextrous when they're fitted with advanced sensor systems. (They also rarely complain.) As robots become ever more widespread, they're becoming more economical, too: The expense associated with industrial robots has fallen as much as 50% compared with human labor since 1990, according to a report by the McKinsey Global Institute. And, with advances in biotechnology and nanotechology, robots are expected to become capable of doing ever more intricate things, like drug processing and growing full-blown human organs. (Koten, 2013)

16.1 PROFACTOR – X Rob - easy robot configuration

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Robotics & Assistiv Systems

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www.profactor.at
ATU 38420507

Keywords : Flexible robotics
Human machine interaction
One interface
Easy-to-use features
Automatic path planning
Fast configuration of complex processes
Good practice applied in: (NACE code) : C - Manufacturing

ONE ROBOT. ONE AUTOMATION-SOFTWARE.
CHANGE PROCESSES EASILY
WITHIN A FEW MINUTES.

With XRob users with minimal training experiences are able to create robotic processes in a new and effective way. The system is designed to be cost effective also for small companies.

The benefits are
» Easy & fast configuration – no programming skills required
» Fast retooling for a high number of variants
» Intuitive process setup within few minutes
» Easy integration into existing environment and processes
» Versatile and expandable
» Supports all popular robot brands

GOOD PRACTICE DESCRIPTION

The software system XRob allows the creation of complex robot applications within a few minutes. With unique and easy-to-use features significant speed up will be accomplished during ramp up. This makes the operation more efficient and flexible than common programming

methods. The novel software architecture allows easy and intuitive creation of processes and configuration of the components of a robot system by only one single user interface.
Onboard key technologies are:

- On-board 3D modeling of work spaces for automatic collision model
- Process simulator with automatic path planning
- Inline 2D/3D position recognition
- Object recognition in real-time
- Mobile user interface

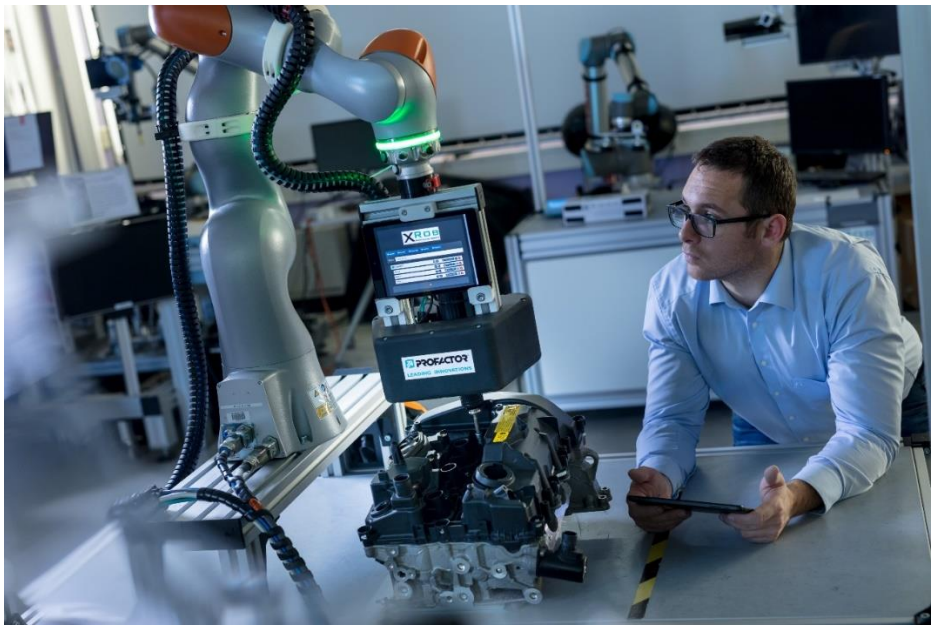

Figure 71

https://www.youtube.com/watch?v=RnLznMFj5Y8&t=2s

https://www.profactor.at/en/solutions/flexible-robotic/

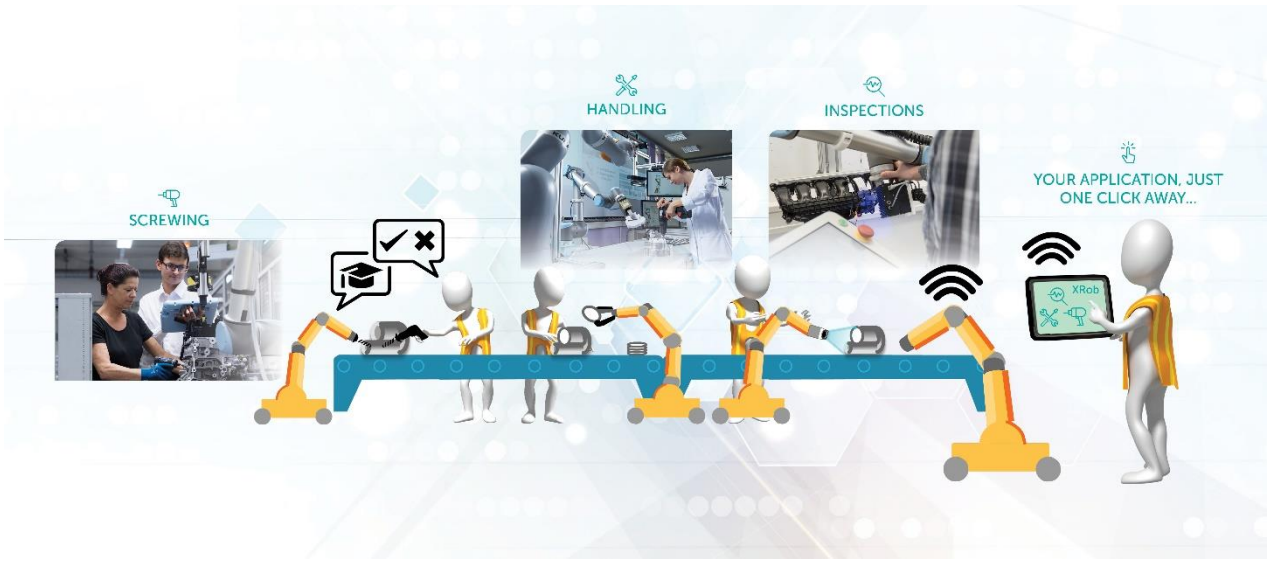

Figure 72: Your Application one Click away, make robot usage simple

OBJECTIVE AND TARGET AUDIENCE

Main application fields

» Pin picking
» Handling
» Assembling
» Inspection
» Screwing

Key references

» 3-D inspection of engines parts
» Screwing Assistant for engine assembly
» Automatic crankshaft picking
» Automotive: Acoustics inspection
» Flexible screwing station

Target Audience:

Production oriented SMEs (<250 employees)
Large companies

METHODOLOGICAL APPROACH

With its partners, PROFACTOR develops customized pilot plants and prototypical plants for the evaluation of the latest robotic technologies. The range extends from feasibility studies to real systems – which are implemented and realized together with experienced system integrators.

VALIDATION PROCESS

Amongst others, the following were tested at the project partner
: Haptic Technologies (Forced Feedback),
Image Processing Techniques Spatial Augmented Reality and a Tangibles User interfaces (TUI) were used.
Here balls or hoppers mark the positions that the robot must approach.
The technologies were evaluated in a three-step user study with assemblers aged 20-60 years. The persons did not have any previous knowledge of robotics, their requirements to the Interaction could therefore describe them without bias.
At the beginning, the robot only had one operator panel. The system has been made more and more flexible by various sensors.
Ultimately, it was equipped with a combination of projection, 3D and gesture detection. The interaction time could thus be reduced to less than half of the time required for the interaction.
The results showed that even complex systems, the are suitable for batch size 1, can be operated efficiently by non-professionals
This requires automatic service functions in the background that the user does not perceive.

The teaching duration was extracted by video recordings. The average teaching time decreased from 6:25 to 3:36. The usage of physical guidance increased from 0% to 71,57%. This shift to physical robot guidance was also measureable in two dimensions of user experience Usablilty (SUS System Usability Scale) and Performance Expectancy (PE). PE describes one's belief that using the system will help to attain gain in job performance, and was measured using two items which were derived from.

The implemented XRob programming system supports a linear programming approach, robot motion commands, sensorics-data handling, Computer Vision algorithms and software-templates. XRob supports more possibilities like vision-based, automated compensation of position deviations. This fact led to increased duration for the whole parametrization process from 13 to 20 minutes caused by the additional functions (Computer Vision).

RESULTS / IMPACT

The Impact of X-Rob is manly for SMEs. If the system is integrated after a common definition phase, processes which were done manually today could be done by / with a robot and it is easy to reconfigure. This enables the SME to be faster, more accurate and deliver a better quality.

SUCCESS FACTORS AND CONSTRAINTS

The benefits are
» Easy & fast configuration – no programming skills required
» Fast retooling for a high number of variants
» Intuitive process setup within few minutes
» Easy integration into existing environment and processes
» Versatile and expandable
» Supports all popular robot brands

Limitations may result through user acceptance.

LESSON LEARNED & SUSTAINABILITY

A “universal system” does not exist, even if you have such a flexible and easy to “configurate and instalate” system like X-Rob. A careful definition of the tasks the SME expects from the system is strictly necessary

REPLICABILITY AND UP SCALING

The system can be replicability after a first feasibility study at each organisation, also until lot size

FINAL REMARKS

Attachments

Folder: XRob

16.2 Automatic Laser Engraving System

Mechanic Design and Construction
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email: info@mdc-bg.com

Keywords : Laser, Stepper motor, Arduino, Automation

Good practice applied in: (NACE code) :	C25 - Manufacture of fabricated metal products, except machinery and equipment

The system is a good practice for implementing automatic technologies in a hand process in order to optimize the process and increase the productivity of the company. The good practice consist of a laser, a metal disc with slots for placing the metal plates, which is rotated by a stepper motor, controlled by an Arduino computer.

GOOD PRACTICE DESCRIPTION

The idea and the creation of the good practice came with the need of the factory to be competitive on the market. The automation of the process increase the productivity and reduce the production cost.

Implementing computer in the manufacturing and automation of the production process is the base of the SFH approach. Self-operating system improves the production process, cost efficiency as well as the risk management.

The technical solution if the good practice is simple, but effective. Arduino computer controls the stepper motor rotating the metal disc allowing the laser to brand higher number of products in smaller amount of time.

The system is custom made so it is not known whether there is a competitor using similar solution for the process production.

OBJECTIVE AND TARGET AUDIENCE

The solution described above was used in Sofia, Bulgaria, on the territory and for the benefit of the company in order to increase the productivity and optimize the production process. The system is applicable for SMEs and Large companies.

METHODOLOGICAL APPROACH

The automation of the production process increase the productivity and lowers cost for manufacturing.

The consistency of the stepper motor ensures the quality of the laser engraving.
The automation of the production require human intervention only when the process is finished. This ensures the safety of the worker since the laser is harmful for the human sight.
The simplicity of the system allows easy implementation.
The needed resources for implementation are financial for buying the necessary technologies and personnel for programming the functionality and calibrating the laser with the motor.

VALIDATION PROCESS
The validation process was completed within the work process in the factory and comprised in the analysis and comparison of the productivity before and after implementation of the good practice.

RESULTS / IMPACT
With the implementation of the good practice the increase of the production is nearly 200% as well the automation process saves the personnel time.

SUCCESS FACTORS AND CONSTRAINTS
The limitations from technical point are the size of the metal product and placing it in horizontal position for engraving. No limitation in implementation.
Since the system is custom made there is no other known system for this type of production. The system is easy to work with and the automation process has low power consumption.
The system have been improved with a visual and sound signal indicating the finishing of the process. The further automation of the whole process will be a good way for improving the impact of the good practice – automatic unload of the finished products and setting the metal plates for the next batch.

LESSON LEARNED & SUSTAINABILITY
The automation of the process because of the good practice saves time, less personnel needed, increases productivity with all that the factory has increased its competitiveness.

REPLICABILITY AND UP SCALING
The solution is a good example of implementing smart technologies in order to increase the productivity and save time in the work process.

FINAL REMARKS
Creating and implementing the good practice in the work process increased the productivity and the competitiveness of the manufacturer.

Disclaimer / Acknowledgements
There are no legal loose ends or limitations for dissemination.

List of attachments:

Figure 73

16.3 AUTOMATED PRODUCTION LINE WITH INDUSTRIAL ROBOTS FOR MANUFACTURING CARDBOARD PALLETS

INNO ROBOTICS SRL
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Keywords : Automated production line; Assembling and palletizing; Flexible system; Cardboard products.

Good practice applied in: (NACE code) :	C17.2.1 - Manufacture of corrugated paper and paperboard and of containers of paper and paperboard

Our solution regarding the manufacture of cardboard pallets is fully automated and flexible and can be used to manufacture standard pallets or custom special size. Our solution supports Romanian exporters to implement and comply with the International Standards for Phytosanitary Measures No.15 (ISPM 15).

GOOD PRACTICE DESCRIPTION

Inno Robotics provides to its customers fully automated solutions with industrial robots for various production processes:

- loading / unloading parts from mold injection machines, CNCs or presses;
- machining of non-metallic and metallic materials, as well as their engraving;
- different manufacturing processes: grinding, deburring, gluing
- assembling parts from the electronic industry
- handling, sorting and transfer of raw materials and processed materials
- painting or varnishing
- electric arc welding

The company has set out to meet the most varied and specific automation needs in the field of production by offering complete services as follows:

- Defining the technical solution;
- Mechanical and electrical design;
- Software developments for robots and PLCs;
- Robot cell assembly;
- Validation and testing;
- Training;
- Warranty and post-warranty services.

The automatic cardboard production line has been designed to meet the needs of products exporters and carriers such that they can implement and comply with ISPM 15.

The solution is fully reconfigurable and adaptable to the needs of any company and to any existing budget. The line has been fully developed within Inno Robotics and it was implemented at a supplier for a multinational corporation operating in the furniture industry.

Figure 74 Inno Robotics solution for cardboard pallets manufacturing

The solution is completely automated and fits within the smart manufacturing concept. Its integration into any manual and automated manufacturing system is simple and easy, offering flexibility in terms of speed and types of customized assembled pallets.

The solution is fully automated and uses 6R robots for the line feed and final product palletizing and Fanuc Delta robots for the bottom feet-frame assembly of the main cardboard pallet. Using these robots, the speed of the pallet assembling is increased as well as the flexibility of the positioning of the cardboard bottom feet-frame. The automation of the manufacturing process for the cardboard pallets has proved to be a complex project in which various equipment has been introduced: different types of conveyor belts, different robot models, linear axes, grippers adapted to each operation in the process, presses. The first operation for the production of cardboard pallets is completed by a linear axis system provided with a vacuum gripper that picks up the cardboard base to which the pallet's feet are attached and places it on a conveyor. At the same time, a Fanuc serial robot feeds another conveyor belt with cardboard feet frames which, after applying the adhesive paste, are moved by the Delta robots and positioned on the base plate according to a particular pattern. The pallets thus fabricated are transported to a press, and then they are picked up by another Fanuc robot, which palletizes them. The line is much more compact than other solutions for making classic and cardboard pallets. The production line combines robots (2x6R and 2x Fanuc Delta robots) with automatic raw material feeding systems. Therefore, in the case of the base cardboard, an automatic system was chosen, while a 6R robot

was mounted for feeding the feet-frames to increase the flexibility of the system. The gluing system is automatic and the arrangement of the feet-frames on the pallet's base plate is completed by two Fanuc Delta robots that offer high work speed, precision and flexibility. The brazing process is completed with a mechanical press, after which the pallets are assembled in stacks according to the model requested by the customer. If the line is directly integrated into the packaging process of the final product, the last 6R robot can be removed. The system may be equipped with a vision system with option for counting for providing real-time data about the manufactured pallets.

OBJECTIVE AND TARGET AUDIENCE

The solution can be integrated into a manufacturing process where the products are packaged on cardboard pallets or it can be used as an independent system capable of creating cardboard pallets. The solution can be used in any company at any location. Being a new concept, recently launched on the market, the project was successfully tested and implemented in a Romanian factory. Potential customers can be furniture manufacturers, plastic component manufacturers, aluminium element manufacturers, etc.

METHODOLOGICAL APPROACH

The line has been designed so that its production cost is as low as possible. Therefore, a limited number of robots have been used that have been placed at key points to offer accuracy and flexibility. For the other components, automated mechanical systems have been designed since they are a lot cheaper then robots. The entire solution is automatic after the parameters are being defined. Also, the quality of the produced pallets is constant. Optionally, the gluing system can be equipped with sensors that indicate the lack of glue in the fuel tank and vision system for online inspection of the pallet quality. Considering that the whole process is automated, the quality of the pallets is better than in the case of a manual assembling line with human operators where the quality varies based on the human operators. The implementation of the system begins with the establishment of the pallets type that will be created and the dimensions of the components that will be used for their manufacturing. Based on these data, the system, automated components and robots will be customized. Depending on the productivity and system customization, one or two Fanuc Delta robots and 1 or 2 6R robots will be used. After designing the mechanical systems, a layout of the solution is made, and the entire manufacturing process is simulated. The last step is the implementation of the line, this starts with the manufacture and assembling of the components, the mounting of the sensors and the automation of the component systems and the integration of the robots. At the programming and testing stage, the parameters for each pallet type are set, therefore changing the product is done in minutes without too many manual adjustments or attempts. Depending on the complexity of the system, the cost may be between € 150,000 and € 300,000 depending if the vision system is integrated or not. Implementation can take between 2 and 4 months, the human resource needed by the beneficiary is about 200-man hours.

VALIDATION PROCESS

The validation of the product was carried out both by the manufacturer (Inno Robotics) and the final customer. Products made on the assembly line have been analyses and tested for their quality and strength.

RESULTS / IMPACT

The beneficiary is a manufacturer of wooden furniture and by installing the line, they have internalized the production process of the cardboard pallets. This internalization has led to customer`s independence from suppliers and offer a lot of flexibility to their packing systems. By being able to produce any type of pallet size, it can save the raw material used in the manufacturing process and it can optimize the way the goods are arranged in trucks by producing pallets that are the right size for their products. Another positive aspect was the elimination of the pallet storage space, the storage space for the raw material needed to create the pallets is three times smaller than the space in which the pallets were stored.

SUCCESS FACTORS AND CONSTRAINTS

From a technical point of view, the limitations of the solution are given by the maximum width of the pallet, the conveyors used for the pallet base plates have a width determined in the design stage and it gives the maximum width of the pallet. Smaller pallets can be manufactured without any constraint. Pallet resistance is correlated with the quality of the cardboard and type of glue that was used. In terms of implementation, the line can be operated and supervised by a single operator. The line uses Fanuc robots but can also be configured with robots from other manufacturers. The line has a cardboard deburring system for the main frame and can produce pallets that are variable in length while the width remains constant. The automation, the increased productivity, the constant quality of products and the flexibility are the selling points of this production system. In the production flow of the cardboard pallets, a pallet base plate cutting system can be integrated and at the end of the process a system that can personalized the cardboard by either painting or applying stickers can be applied.

LESSON LEARNED & SUSTAINABILITY

The most important lesson learned is that the most critical stage of implementation is the identification of all the initial customer requirements. So, if all the details and technical requirements are not set at this stage, the design of the line will be a painful process because every new customer requirements can lead to major changes of the technical design.
The training process of the operators that will maintain the line is important and critical especially if they are not familiar with automated and robotic workflows. The sustainability has two aspects in the case of the cardboard line: the replacement of wooden pallets with reclaimed cardboard pallets is an action that contributes to the protection of the environment and has other social and economic implications. From a financial point of view, the sustainability of the line is ensured by the fact that once this investment is made, it will ensure the long-term manufacture of cardboard pallets even if their design will suffer minor changes.

REPLICABILITY AND UP SCALING

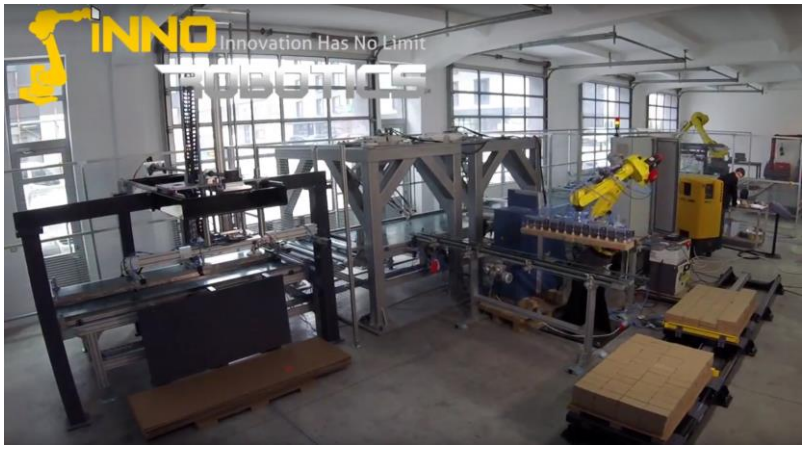
The solution can be implemented both individually and jointly by 2-3 SMEs. The solution offers an alternative to the wooden pallets.

FINAL REMARKS

The cardboard pallet manufacturing system is fully automated and it can be used in various fields. By implementing it, the costs of purchasing and using classical wooden pallets are

reduced. If products are required to be exported in compliance with the ISPM 15, this solution represents a good choice.
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.

List of attachments:
Attachment 1: Video with solution: https://www.youtube.com/watch?v=VOc5RQow86M



16.4 Computer Numerical Control (CNC) Machine –M550/M450

Photo of the contact person

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Keywords : Computer Numerical Control, CNC, Metal products, Foundry industry Automation, Precision, Productivity
Good practice applied in: (NACE code) : C28 - Manufacture of machinery and equipment n.e.c.

The CNC – machine RAIS model M550 and M450 are computer operated drilling and cutting machines designed for manufacturing metal parts for the foundry industry.

GOOD PRACTICE DESCRIPTION

Driven by the need to increase the productivity and stay competitive, the company implemented the CNC machines in the production process.
Implementing the CNC machines in the manufacturing allows faster production and quality assurance.
The Computer Numerical Control Machines are controlled by a computer. Coordinates are uploaded into the machine controller from a separate CAD program. Being controlled form a computer the machines produce consistent and high-quality work.
CNC Machine M550 has more than 50 nozzles allows wide spectre of metal processing. M550 also has automatic rotator for 3D processing.
CNC Machine M450 don't has such a high precession as M550, but has drilling with integrated cooling which reduces the time for deep drilling and increase the productivity.

OBJECTIVE AND TARGET AUDIENCE

Both machines are bought and used for the benefits of the company in Sofia, Bulgaria.
The good practice could be useful for companies in the foundry industry.

METHODOLOGICAL APPROACH

The CNC machine can produce a one-off as effectively as repeated identical production and can reduce waste, frequency of errors, and the time the finished product takes to get to market which reduces manufacturing costs
The CNC machines characterize with high precision work and improves products quality. Automation and precision are the key benefits of cnc machines. All ball screws - high precision,

class P3, Ø40 mm OD, with a double nut, pre-loaded to control backlash. High precision of positioning and smooth operation.
Fully enclosed electrical cabinet with heat exchanger, accordance to CE requirements.
The implementation of CNC machines in the factories is easy and the benefits are instantly visible
Financial resources are needed for the implementation are in regards of acquiring of the machines. The easy use of the system allows one worker per machine for operating the production process.

VALIDATION PROCESS

The CNC Machines are bought with certificate for validation form RAIS Ltd. from Pazardjik, Bulgaria.

RESULTS / IMPACT

The impact of the good practice is good with increased production and quality. The personnel for the manufacturing is reduced since the process is automated

SUCCESS FACTORS AND CONSTRAINTS

The models of the CNC machines are not the latest out on the market, however the factory is ready to implement newer models in their production.
The stability of machines manufactured by RAIS outperforms all others in this frame size. Precision linear guides and ball screws from "Bosch Rexroth" are built-in. The machines are designed and implemented in full production by the company experts. Precision in assembly, test and control means provides quality on each machine, meeting the requirements of EN ISO standard for machining centres. The Management System Quality creates all the prerequisites to meet customer requirements.
The company has already planned to acquire newer model of the CNC machines M700 for greater precision and higher quality products

LESSON LEARNED & SUSTAINABILITY

The CNC machines typically produces consistent and high-quality work and improves factory productivity. Automation and precision are the key benefits of implementing cnc machining in the production process.

REPLICABILITY AND UP SCALING

The CNC machines typically produces consistent and high-quality work and improves factory productivity. Automation and precision are the key benefits of implementing cnc machining in the production process.
The CNC machines are ready to be implemented in SMEs for producing metal components for machinery.

FINAL REMARKS

The CNC machines typically produces consistent and high-quality work and improves factory productivity. Automation and precision are the key benefits of implementing cnc machining in the production process.

Disclaimer / Acknowledgements

There are no legal loose ends or limitations for dissemination.

List of attachments:

CNC M550
http://www.raisbg.com/page.php?15

Figure 75

Figure 76

CNC M450
http://www.raisbg.com/page.php?13

Figure 77

16.5 SIGMA – MODULAR SYSTEM

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web: www.lem.com

Keywords : Microelectronics, Co-bots, Modular, Automation
Good practice applied in: (NACE code) : C26.4 - Manufacture of consumer electronics

The system Sigma is a modular printing system which consists of flexible conveyor belt and collaborative robots (co-bots)

GOOD PRACTICE DESCRIPTION

The Sigma system was developed in evolutionary way with the need of the company to increase the productivity.
The developing of a system like Sigma and integrating robots in the work process increase the production process, assure quality as well as cost efficiency.
Collaborative robots (co-bots) integrated in the production increases speed and the precision of manufacturing which is critical in microelectronics components

OBJECTIVE AND TARGET AUDIENCE

For now the system is developed and used for the benefits of the company in Sofia, Bulgaria.
The good practice could be useful for companies that need quality precise manufacturing.

METHODOLOGICAL APPROACH

The cost efficiency of the system shows in the lowering the personnel needed for production as well as the expenses for maintaining the co-bots is lower than a minimum wage.
The precision of the robots is far better than the human production which assures better quality especially in the sector electronic components.
Because of the modular character of the system the good practice could be easily implemented, and customize for the needs of the company
The main resources used for developing the good practice are financial as well as timespan of 3 years for creating testing and validation

VALIDATION PROCESS

The evolutionary way of developing Sigma system started the validation process from the beginning. The Validation methods used are lean manufacturing as well as value stream mapping.

RESULTS / IMPACT

The impact on the company has been positive. Reducing the needed personnel for the same task from 9 to 2 and at the same time increasing the production.

SUCCESS FACTORS AND CONSTRAINTS

There are no technical or implementation limitation known at this moment.
The modular characteristic of the good practice is the biggest advantage which allows the quick modification of the system and quick development of new products
The Sigma system could be improved with sensors for quality control and tracking the production process

LESSON LEARNED & SUSTAINABILITY

Sigma is a great examples how automation and implementing co-bots in production allows more precise production without slowing the production process.
Being modular system Sigma is flexible and easily customizable in order to be able for quick new product development and manufacturing. Every module of the system could be

REPLICABILITY AND UP SCALING

The system could be customize for the need of the SME and by implementing co-bots in production allows more precise production without slowing the production process
Sigma system could be implemented in every SME or Large manufacturer that need precise fast production.

FINAL REMARKS

Sigma is a great examples how automation and implementing co-bots in production allows more precise production without slowing the production process.

Disclaimer / Acknowledgements

There are no legal loose ends or limitations for dissemination.

List of attachments:

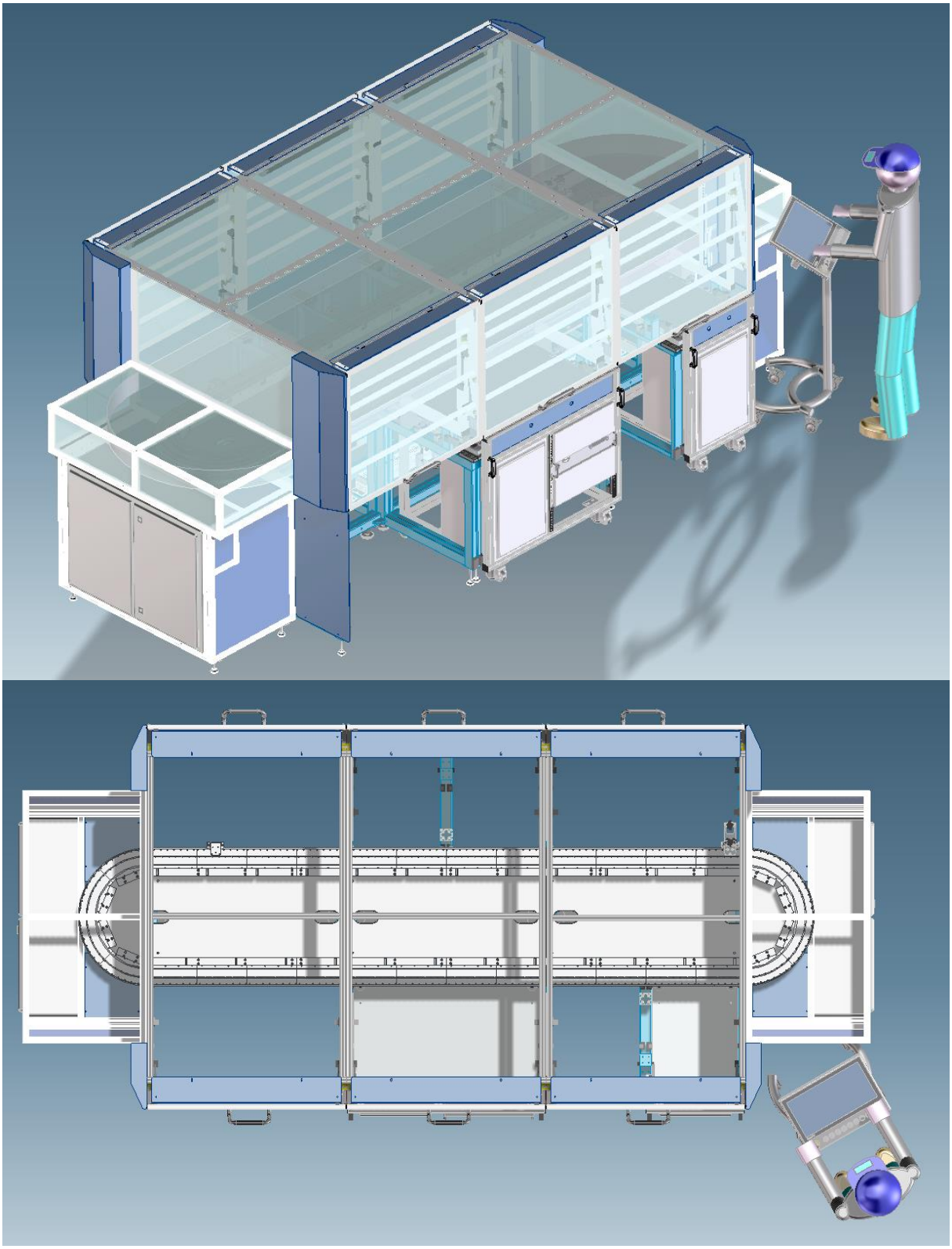

Figure 78

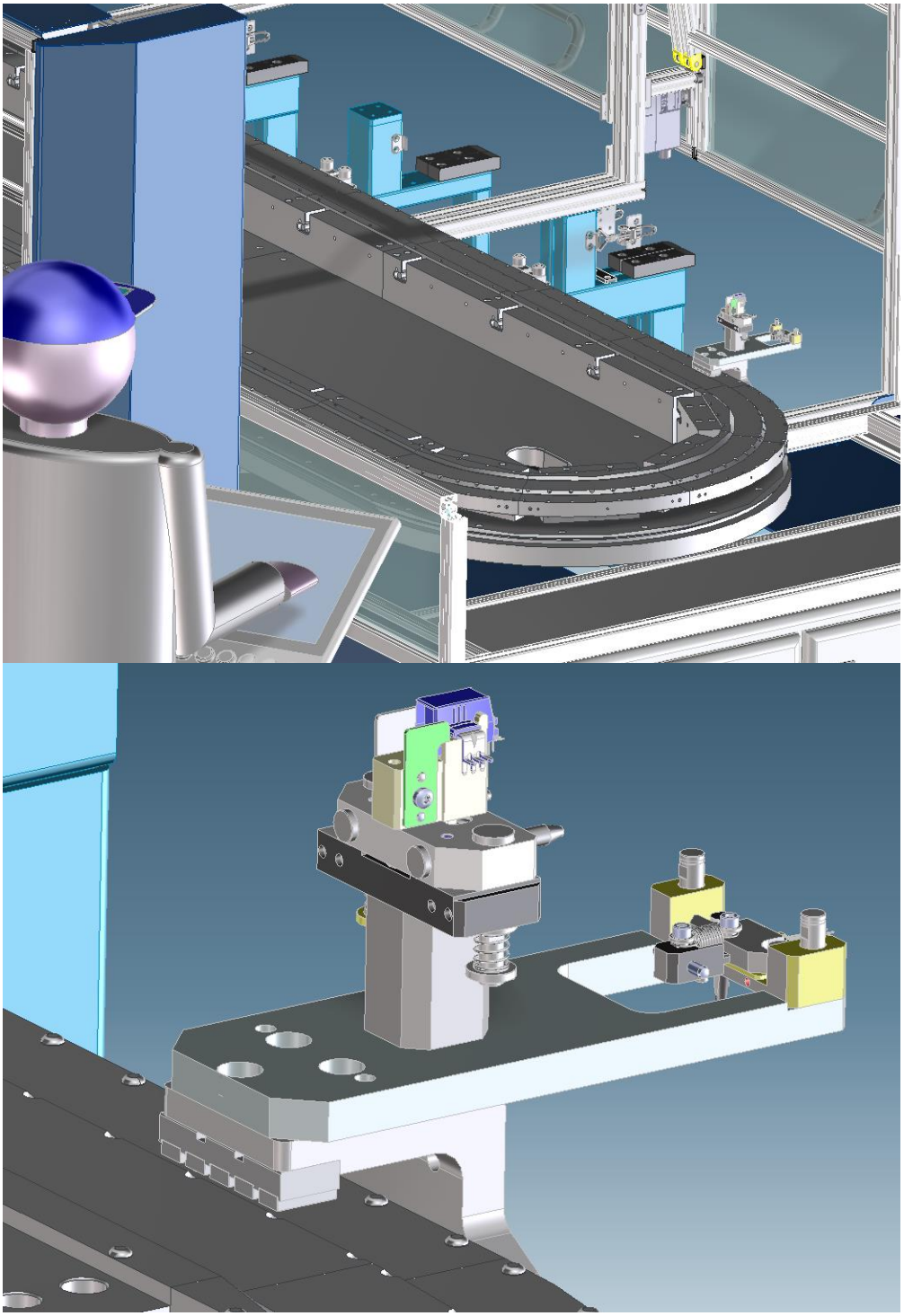

Figure 79

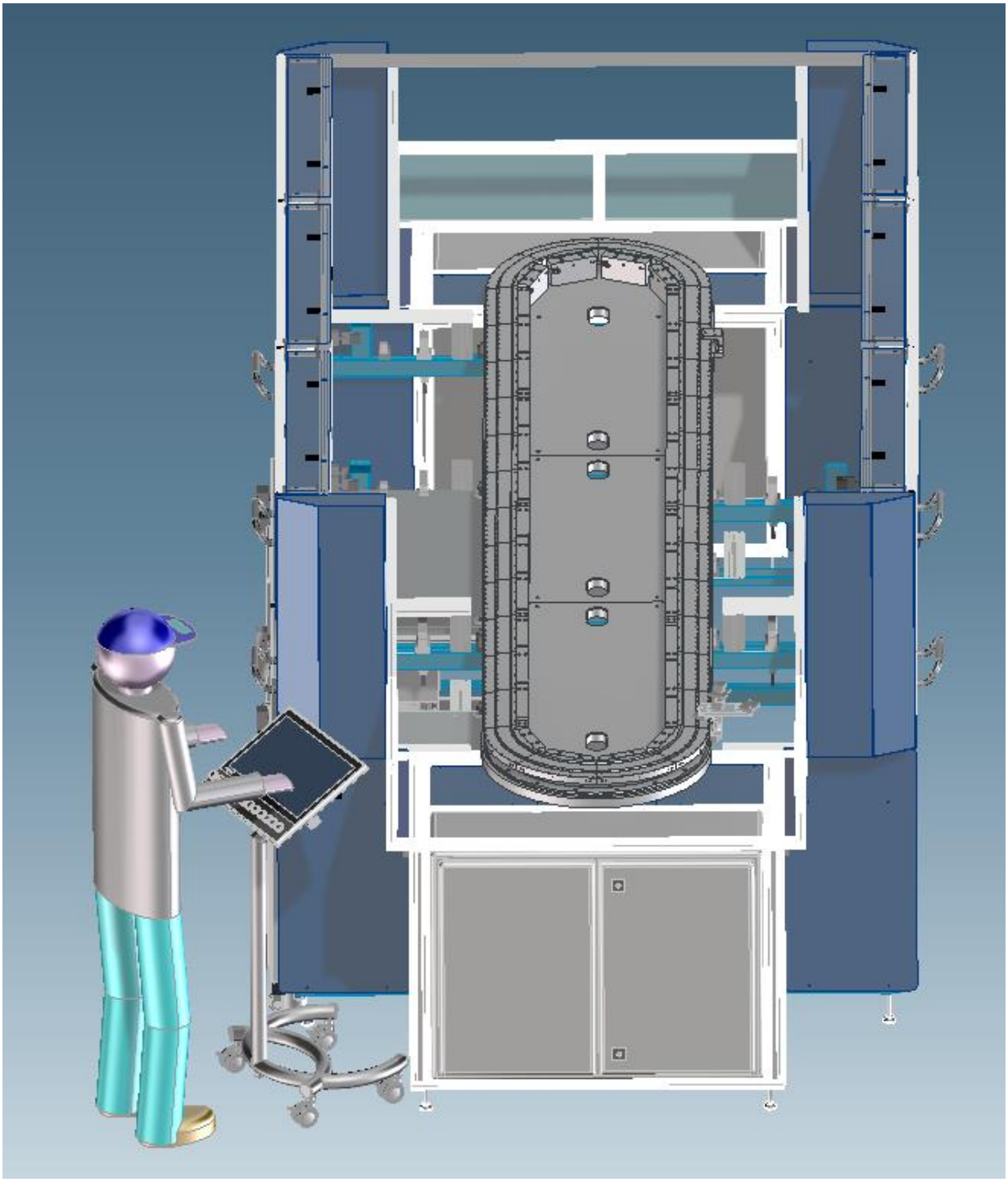

Figure 80

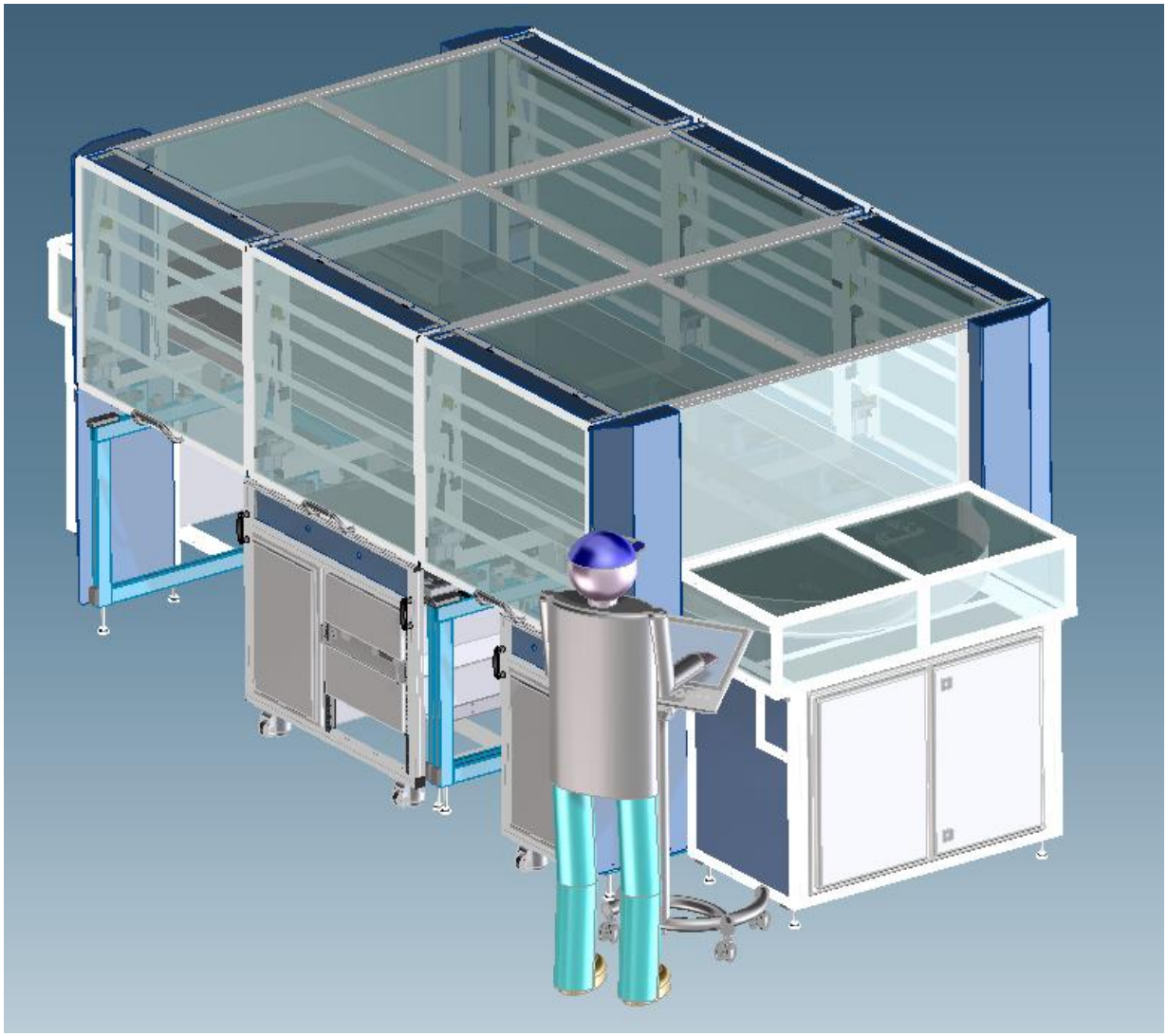

Figure 81

16.6 PRODUCTION OF FIRE DAMPERS

KLIMAOPREMA d.d.
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Keywords: one peace casing, aerodynamical design, easy installation, low weight
Good practice applied in: (NACE code) : C - manufacturing

In the production of fire dampers Klimaoprema is using smart specialization. Production process is divided into phases. Product has a QR code which is read by the camera and gives information on how much time the product has spent in which production phase and which employee was working on it. In this way they detect if and where the error occurred, they analyse the time necessary for production, control the quality, the product and the whole production process in advance.

GOOD PRACTICE DESCRIPTION

Klimaoprema developed new smart production of fire dampers by following customer needs and demands on the new markets. They developed new and innovative smart production of fire dampers by using new technologies which created cost effective production processes. Production lines are developed in cooperation between Klimaoprema's engineers and renowned European machinery manufacturers. Technical solutions and innovations in fire dampers production are: light, strong one peace casing, easy installation, unique fire performance on the market, low pressure drop, damper blade smaller than nominal size – no possible collision with air duct, EI 120S fire resistance at 500 Pa.

Figure 82 Klimaoprema's working area

Fire dampers produced in Klimaoprema have unique design, better performance and more efficient production compared to competitors.

Figure 83 Klimaoprema's production line

OBJECTIVE AND TARGET AUDIENCE

Fire dampers are distributed all over the world, but mostly in France. They are produced according to EN 15650, tested according to EN 1366-2, classified according to EN 13501-3, have certificate of Constancy of performance and Declaration of constancy of performance according to Regulation (EU) No. 305/2011. The target audience/potential customers are installers, engineering companies and wholesalers.

METHODOLOGICAL APPROACH

Cost efficiency is secured by large serial production and automated production with minimal no. of employees on the production line. Quality is ensured by controlled production according to EN 15650 and NF 264. Risk quantification is calculated by looking at the likelihood that a specific risk

factor may occur and then the impact to the organization if it does occur. Risk management is in processes and assets. Resources necessary for implementation are personnel trained to work in smart factory production, and finances to invest and upgrade the production with new technologies and solutions.

VALIDATION PROCESS

Validation process is provided by processing large amounts of data in real-time, which prevents errors. Finished product is inspected by quality control manager and gets a signature and mark that it is safe and produced according to standards, norms and guidelines.

RESULTS / IMPACT

The impact is positive and reads in exporting fire dampers into new markets, new customers, achieving profit and new employments.

SUCCESS FACTORS AND CONSTRAINTS

Limitations are in computer software to achieve some functionality. The biggest selling points are product quality and smart factory production which results in better product performance. In order to improve the impact of the Good practice there is a need for a bigger production space.

LESSON LEARNED & SUSTAINABILITY

Key messages and lessons learned are data processing and implementation of industry 4.0 with which they have achieved production efficiency with less energy consumption.

REPLICABILITY AND UP SCALING

System that they have implemented is applicable to similar production type, semi-automated with manual assembly. This production process can be implemented into other production lines, which is planned for the near future.

FINAL REMARKS

Data processing and implementation of industry 4.0 has resulted in concurring new markets, export expansion and new customers, new employments and energy efficiency.

Disclaimer / Acknowledgements

This information can be disseminated by printing material and online releases.

List of attachments:

Attachment 1: Screenshot from the application
Attachment 2: Screenshot from the application
Attachment 3: Video presentation of the company: https://youtu.be/JgMUB4j-XiY


INTEGRATED SYSTEMS_

16.7 COLLABORATIVE ROBOT INTEGRATED IN INDUSTRIAL ENVIRONMENT OF SMART FACTORY

MATADOR Automation, s.r.o.
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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).

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.

Figure 84 Collaborative robot integrated in ŠKODA AUTO a.s. Vrchlabí (Czech Republic)

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.

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.

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

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

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.

LESSON LEARNED & SUSTAINABILITY

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

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.

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

16.8 CNC ROBOTIC PACKING, PALLETIZING AND WELDING

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Keywords : Smart, fast, and easy programming of welding robots
Good practice applied in: (NACE code) :

We made a robotic welding system that is programmed through the PC and software for 3D modelling of parts. The traditional way of programming robots is with the help of a cone with which the robot learns how to move. Robot programming software reduced the programming time of the robot from several hours to a few minutes and made a robot suitable for companies that produce small series.

GOOD PRACTICE DESCRIPTION

Through conversation with customers, we realized that robotics does not pay off to many domestic companies because no one has a big series. While the robot is programmed, a person can wipe half of the parts manually. For this reason, we started developing an application that will enable the robot to be profitable and to companies that do not have a series.

This is a new technology that improves production processes in small-scale companies that can not provide welders or have problems with them.

In the computer software, the 3D model of the work to be welded is inserted. With a few clicks, the positions are marked where they need to be protected. The software automatically generates a robot program. The operator should just insert a piece on the table and load the program of robots that generated the software.

The solution is quite different because it accelerates and facilitates the robot programming process and makes the product more applicable to many customers.

OBJECTIVE AND TARGET AUDIENCE
The good practice has been used Republic of Serbia.

The solution is globally applicable, and so we will perform on the market.

Target group of customers are: SME's, large companies, end customers…

METHODOLOGICAL APPROACH
The robot, on average, replaces 9 welders. Companies that need 9 welders can return investments within a year.

It can be applied in any company that has a welding process.

Staff and finance are resources are necessary for implementation.

RESULTS / IMPACT
So far, the system has been tested only in our production.

SUCCESS FACTORS AND CONSTRAINTS
It is necessary to have 1 man who knows how to draw in 3D software.

The machine that has so far been used in companies that have a large series can also be used in companies that have small series.

REPLICABILITY AND UP SCALING
All companies that have the welding process can use this solution and solve many problems related to MHR, improve quality and speed up the production process.

FINAL REMARKS
All companies that have the welding process can use this solution and solve many problems related to MHR, improve quality and speed up the production process.

Disclaimer / Acknowledgements

There are no legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed

17 ADVANCED MATERIALS

New machines will require new materials, and new materials will enable the creation of entirely new machines. The development of coatings, composites and other materials is being accelerated through advances that break materials down to an atomic or molecular level and allow them to be manipulated virtually without the need for lengthy laboratory procedures. Borrowing a page from the widely acknowledged success of the Human Genome Initiative, the Department of Energy and other U.S. agencies launched a Materials Genome Initiative last year. The goal: halve the time it takes to identify a new material and bring it to market, a process that currently can span decades. The technology for lithium-ion batteries, for instance, was first conceived of by an Exxon employee in the 1970s, but it wasn't introduced commercially until the 1990s. Part of the effort involves getting the widely dispersed and cloistered researchers in the field to share ideas and innovations. (Koten, 2013)

17.1 IT PHOTOVOLTAIC SYSTEM - IT PS

IT Industrial Technologies
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Keywords : Photovoltaic, Solar, System, Electricity, Green, Cost Efficiency, Power Supply
Good practice applied in: (NACE code) : C26.4 - Manufacture of consumer electronics

Photovoltaic System installed on the roof and the parking lot of the factory providing electricity and lowering the company's expenses. The system is custom made from metal frames, photovoltaic panels, voltage invertors and switch, serving as both shelter and electricity provider.

GOOD PRACTICE DESCRIPTION

The high electricity expenses of the factory, made it necessary to find an alternative solution for power supply using new technologies.
The good practice is tied to the Smart factory hub's approach in relation to the cost efficiency of the production process.
The innovation is that the construction of the system is used also as a parking shelter and at the same time is a power supply provider reducing the electricity cost for the production by 50%
In Sofia region there is no other factory that is using solar electricity in the production process.

OBJECTIVE AND TARGET AUDIENCE

The solution described above was used in Sofia, Bulgaria, on the territory and for the benefit of the company only, but it could be implemented in small, medium and large manufacturing companies also in public institutions.

METHODOLOGICAL APPROACH

The good practice is targeted cost efficiency of the production process.
The good practice is easy to be implemented. The company needs to identify the added value of using solar technologies in the production process. For implementing the good practice, the company needs to allocate financial resources for building a metal structure and installing photovoltaic panels at any open space near the company. The expenses depends on the size of the company.

VALIDATION PROCESS

The validation process was completed within the factory and comprised in the analysis and comparison of the power supply expenses before and after implementation of the system.

RESULTS / IMPACT

The implementation of the system has positive impact on company production process related to decrease of production costs.

SUCCESS FACTORS AND CONSTRAINTS

The technical and implementation limitations depends on the open area that the company has. Also the use of the good practice could be limited by national legal issues. The system is custom made and the financial investment is lower than the systems offered by other brands. The system could be improved with installing an accumulator for storing the produced energy when the factory is not working.

LESSON LEARNED & SUSTAINABILITY

The good practice is an excellent example of using green energy in the manufacturing process and reducing production cost.

REPLICABILITY AND UP SCALING

The good practice is an excellent example of using green energy in the manufacturing process and reducing production cost. The good practice could be implemented by every manufacturing company.

FINAL REMARKS

The good practice is an excellent example of using green energy in the manufacturing process and reducing production cost.

Disclaimer / Acknowledgements

There are y legal loose ends or limitations for dissemination.

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List of attachments:

Figure 85

Figure 86

17.2 ECOTHERM - A SET OF COATINGS FOR THERMAL INSULATION OF WOOD HIVE

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Keywords : Thermal insulation protection of wooden hives
Good practice applied in: (NACE code) : Beekeeping

EcoTherm is a coating with a very low thermal conductivity coefficient (λ = 0.0016 W / (mk) making it an exceptional isolator in very thin coatings of 0.7-1.0 mm. When applied on a hive, it very favorably affects the microclimate within the hive , prevents the decline of societies due to great cold or heat, bees consume less energy, they are healthier (no crop formation) and bring more honey.

GOOD PRACTICE DESCRIPTION

Three years ago, the company won the production of thermal insulation coatings based on the microsphere, which is used in construction. At the Belgrade Building Fair in 2016, the product was awarded with a special award.

Our family has been in contact with beekeeping for a long time and are aware of the negative effects of extreme temperatures on the escape of society. So we came up with the idea to customize our product for that purpose and help solve this problem.
All of our products are ecological - water based. We have done health tests.
The mechanism is based on the most modern raw materials in the form of microspheres with exceptional thermal insulation characteristics.

The main thing is to keep the wood as a natural habitat of bees and to insulate from the outside significantly the thermal insulation properties of the hive. The coating is applied in a thickness of 1 mm and does not affect the dimensions and weight of the hives. This is very important because hives are transported and must be manipulated often with them.

Coatings of other manufacturers do not have thermal insulation properties and can not be compared with our coatings. There are beehives made of styrofoam and plastic that have insulation, but it is not a natural habitat of bees and as such is not widely accepted.

Figure 87

OBJECTIVE AND TARGET AUDIENCE

In the previous period, we tested the product in Serbia and countries in the region (Bosnia and Herzegovina, Montenegro, Croatia, Slovenia, Macedonia, Romania). The test results are excellent and the beekeepers are very satisfied.

In October, we successfully presented the product at the international fair for bee-keeping - Apimondia in Istanbul. There is a lot of interest from around the world, so now we send samples to twenty countries for various tests.

Target group are beekeepers from around the world! Our product positively affects bee companies in all climate zones. The coating has several positive factors on the beehive and bee company and there is no negative factor.

METHODOLOGICAL APPROACH

The investment of beekeepers in our product is not high and it is very fast to pay off. There is no deterioration of societies, healthier and stronger societies and as a result higher honey production.

The application of our products to beeswax all over the world can significantly improve beekeeping.

The product is environmentally friendly, very easy to use and does not require any expensive equipment and training.

VALIDATION PROCESS

The thermal conductivity coefficient was tested at -IMS-Belgrade λ = 0.0016 W / (m.k).

It is examined according to health safety by Jugoinspekt - Belgrade

A large number of beekeepers with comparative tests confirmed the positive effects of the coating.

RESULTS / IMPACT

We did not have negative observations.

Positive are numerous:
- Prevent the decline of the bee's society due to extreme temperatures and in winter and flying
- Prevent the occurrence of mould due to condensation on the walls of the hive
- It facilitates the maintenance of microclimate in the hive
- Reduces the disorder of bees because they provide a healthier environment
- Reduces the consumption of food needed to maintain microclimate
- We get a stronger and more numerous society
- Bees can spend more time in collecting pollen ...
- The length of the wooden hive is prolonged because the coating has a positive effect on the wood. It prevents rapid spread and shrinkage due to sudden changes in temperature and hence the cracking of wood.

-INCREASES HONEY PRODUCTION

SUCCESS FACTORS AND CONSTRAINTS

The product must be applied at a temperature of 14-30 C. The product must not freeze and should not be in direct sunlight.
Our product is unique on the market. There are no similar products for this purpose. A large number of positive factors and no negative. The product is environmentally friendly, health-minded, easy to apply.
We enable the bee's society to maintain the necessary microclimate in a wooden hive as a natural habitat.
In order for EcoTherm to have the right results, it is necessary to follow the instructions for use and apply it to a standard hive.

LESSON LEARNED & SUSTAINABILITY

Experience has shown that the best results are achieved when the finishes are of a lighter shade of colors.

Increasing demand and production would probably result in a reduction in product and its massive use.

REPLICABILITY AND UP SCALING

This type of thermal insulation coating based on microspheres already has application in construction.

Products are perfected every day and we believe that we can find even more useful applications.

FINAL REMARKS

EcoTherm - a set of coatings for thermal insulation of wooden hives is a very useful innovation for beekeeping. By its application, the following positive effects on the wooden hive as a natural habitat are achieved:

- Prevent the decline of the bee's society due to extreme temperatures and in winter and flying
- Prevent the occurrence of mold due to condensation on the walls of the hive
- It facilitates the maintenance of microclimate in the hive
- Reduces the disorder of bees because they provide a healthier environment
- Reduces the consumption of food needed to maintain microclimate
- We get a stronger and more numerous society
- Bees can spend more time in collecting pollen ...
- The length of the wooden hive is prolonged because the coating has a positive effect on the wood. It prevents rapid spread and shrinkage due to sudden changes in temperature and hence the cracking of wood.
- INCREASES HONEY PRODUCTION

Disclaimer / Acknowledgements

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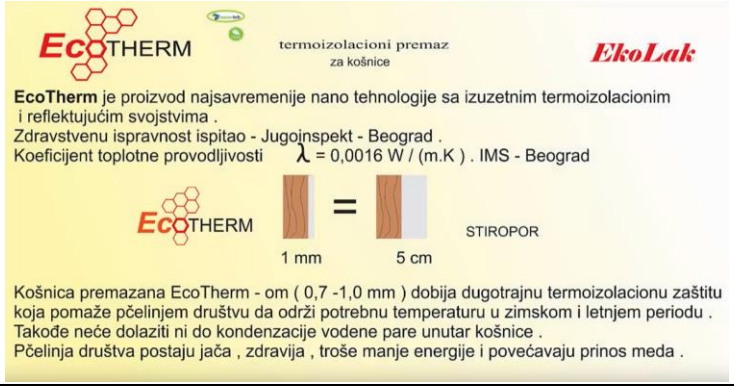
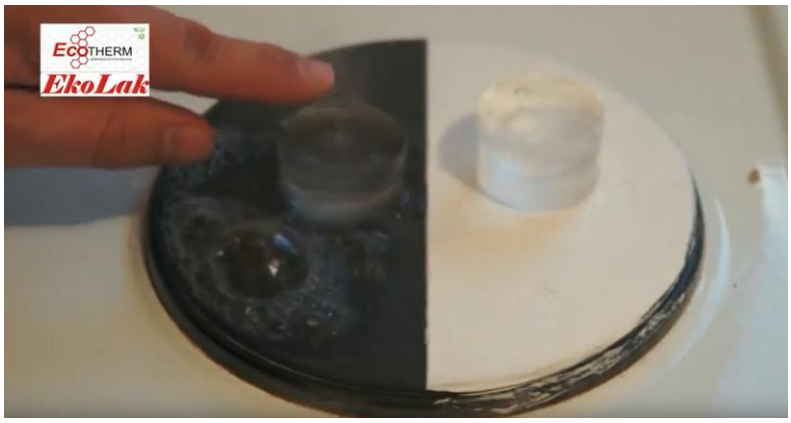
List of attachments:

Attachment 1: video presentation: https://www.youtube.com/watch?v=qphwXjKN_I8



Attachment 2: video presentation: https://www.youtube.com/watch?v=HOwlNxoyLBM



Attachment 3: video presentation: https://www.youtube.com/watch?v=Q8uApz-mjV4

Attachment 4: video presentation: https://www.youtube.com/watch?v=R0bpln6lheU

Attachment 5: declaration of conformity:

Declaration of Conformity - EcoTher

17.3 PRODUCTION OF DISINFECTANT AT THE PLACE OF CONSUMPTION

SIGMA d.o.o.

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25.230 Kula, Serbia

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tel: **+381 25 731 805**
website: **www.hlorogen.com**

Keywords : Ecologically sustainable, safe disinfection, no hazardous substances, at the place of consumption, automatically, in site…
Good practice applied in: (NACE code):
C27.9.0 - manufacture of other electrical equipment
C28.9.0 - manufacture of other special - purpose machinery

Production of disinfectant (1% sodium hypochlorite solution; and a mixed disinfectant - a mixture of sodium hypochlorite and chlorine dioxide) users expel hazardous chemicals from use in the process of disinfection of drinking and process water.

GOOD PRACTICE DESCRIPTION

First plant for the production of 1% solution of sodium hypochlorite at the place of consumption (in situ) HLOROGEN® was manufactured and installed in 1996.Since then, over 120 HLOROGEN and OksiHLOROGEN plants have been installed on the territory of Serbia and Montenegro.

HLOROGEN and OksiHLOROGEN technologies are smart solutions for automatic disinfectant production at the place of consumption that fully disclose the possibility of human error in the process of water disinfection and completely replace the use hazardous chemicals (primarily gas chlorine that is hazardous to human health and life) in water disinfection.

Technological equipment HLOROGEN at the place of consumption produces 1% solution of sodium hypochlorite in the process of electrolysing of aqueous solution of kitchen salt. To obtain a 1% solution of sodium hypochlorite, only salt, water and electricity are used.

Technological equipment OksiHLOROGEN at the place of consumption produces a mixed disinfectant - a mixture of sodium hypochlorite and chlorine dioxide it the electrolysis process of water solution of salt uses only salt, water and electricity.

Less energy consumption more cost-effective due to the use of common unheated kitchen salt, it is safer because it produces dilution solutions that are classified as safe chemicals, a complete solution that combines the production of disinfectant at the place of consumption, automatic dosing administrated by flow and / or residual user training and service.

All awards are available on www.hlorogen.com as well as all technical data.

OBJECTIVE AND TARGET AUDIENCE
Serbia, Montenegro, Romania, Bulgaria, Croatia, Bosnia and Herzegovina, Slovenia.

Water supply companies, meat industry, food industry, hospitals and spas, swimming pools.

METHODOLOGICAL APPROACH
The use of HLOROGEN and OksiHLOROGEN technology reduces the cost of water disinfection from 3 to 5 times.

The user of HLOROGEN an OksiHLOROGEN technology receives a modern plant for its own production of disinfectant, which becomes independent from the supplier of strategic chemicals for water disinfection and simultaneously throws away from the use of dangerous chemicals for the health and life of people and the environment.

The documentation of the site is necessary and it is done by our professional team of the manufacturers of technological equipment HLOROGEN and OksiHLOROGEN in the order to determine the necessary equipment capacities, space for the installation and configuration of technological equipment .After the technological equipment is produced especially for the known customer, after which it is installed and put into operation.

Necessary resources are: trained rersonnel for the basic management of the technology of SCADA software, this training is provided by the manufacturer of technological equipment, finance and existing infrastructure.

VALIDATION PROCESS
Validation is done through regular bacteriological and physico-chemical analyses of water.

RESULTS / IMPACT
Application of technological equipment HLOROGEN an OksiHLOROGEN reduces the costs of water disinfection increases the independence of user.

SUCCESS FACTORS AND CONSTRAINTS
The only limitation is the poor information of potential users about the benefits of this technology for their business process.

Use of easily available raw materials for the production of disinfectant at the place of consumption - kitchen salt, water and electricity. This eliminates the use of hazardous substances and chemicals from the process of water disinfection and ensures greater environmental safety of the water treatment plant. Using this technology users' independence from chemical suppliers for disinfectants is achieved.
Better inform potential users and more emphasis on their education in order to get acquainted with the availability of modern technologies in the field of water disinfection.

LESSON LEARNED & SUSTAINABILITY

The use of technological equipment HLOROGEN and OksiHLOROGEN prevents the use of hazardous chemicals and materials in the working environment and the contact of employees with them. The presence of hazardous materials from the production process and the environment in which a large number of people lives or works.

Use of easily available raw materials for the production of disinfectant at the place of consumption - kitchen salt, water and electricity. Using this technology users' independence from chemical suppliers for disinfectants is achieved.

REPLICABILITY AND UP SCALING

This technology can be implemented with a large number of users from different fields of production and services: water supply, food industry, hospitals and other health facilities, spas, swimming pools and bathing sites, etc.

In addition to the primary users in the field of treatment and distribution of drinking water and wastewater treatment plants, technological equipment HLOROGEN and OksiHLOROGEN is applied in the hospitals, food industry, swimming pools and wherever the sanitary safety of water is essential for the production process of service provision.

FINAL REMARKS

Use of easily available raw materials for the production of disinfectant at the place of consumption - kitchen salt, water and electricity. This eliminates the use of hazardous substances and chemicals from the process of water disinfection and ensures greater environmental safety of the water treatment plant.

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18 RESPONSIVE MANUFACTURING

A new solution mentioned increasingly often with respect to the agility and flexibility of the manufacturing process is “Virtual Cellular Manufacturing”. It evolved from the classic “Cellular Manufacturing” and it integrates the lean manufacturing ideology with the “Group Technology” philosophy, which comprises in reducing the system to sub-systems, with reconfigurable manufacturing equipment, which work together to achieve greater efficiency. Among its advantages we can mention (Khilwani, Ulutas, Islier, & Tiwari, 2011) (Nomden, 2011):

- providing increased process flow and flexibility to machining areas;
- high degree of final product customization by processing groups of similar components by non-similar machines;
- classification of CAD modeled parts, which have similar shapes, into part families;
- high flexibility for changes in product requirements.

18.1 Business Upper Austria - Industry 4.0 Maturity Model

Photo of the contact person

Contact Data
Company: Business Upper Austria – OÖ Wirtschaftsagentur GmbH;
Department: Mechatronik Cluster;
Contact person: Manuel Brunner;
Representative:

Keywords : Benchmark, maturity, implementation road map, experience in 16 cases
Good practice applied in: (NACE code) : C28, C23.42, C26.1, C31.01, C31.09, C28.15,

The Maturity Model is a structured methodology to evaluate the Industry 4.0 status quo of a company, create a tailor-made vision and derive an individual road map to get from status quo to the vision.

GOOD PRACTICE DESCRIPTION

This model is a new approach to structure the technological change process through Industry 4.0 in a company and realized as a software cloud application on license. Production processes, organizational processes, machines, software applications can be investigated with the model and the outcome will lead to cost efficiency and process optimization. Enclosed to the software tool is a benchmark database where all investigations are saved anonymous.
The maturity model is the first known approach to describe the Industry 4.0 status of an entity with 24 criteria including a derivation of a road map for implementation.

www.reifegradmodell.at

OBJECTIVE AND TARGET AUDIENCE

Upper Austria, Lower Austria, Bavaria.
Mostly producing companies but also service provider.
The model was tested in large companies as well as in SMEs

METHODOLOGICAL APPROACH

When using the model, cost efficiency could be an aim.

Attending a one day training and using the given process and software.

The training costs EUR 500,-- for a day and the licence EUR 1.000,-- in the first year and after that EUR 500,-. Or you engage a consultant. For an investigation a company can calculate with about a week and 3 days of providing staff.

VALIDATION PROCESS
Since the launch of the Model (01/2017) it was used in 16 companies and so the process is validated.

RESULTS / IMPACT
The beneficiaries get a detailed road map for implementation of Industry 4.0. Thus save money, be more flexible and getting ideas of new business models.

SUCCESS FACTORS AND CONSTRAINTS
The Model is not a tool for assessing a whole company and make general improvement suggestions. It is a specialized tool going in depth a providing an action plan.

Individuality, investigation on the spot, tailor-made implementation road map, not limited to a branch, software support.

More investigations to keep the benchmark database growing.

LESSON LEARNED & SUSTAINABILITY
Implementation of smart factory projects in companies is difficult.

REPLICABILITY AND UP SCALING
This software can be used in nearly every SME and providing them to make the first steps towards a smart factory.

Get new data for the benchmark, developed more services and also get more references for the maturity model and thus improve quality.

FINAL REMARKS
The maturity model is in use and delivers great results wherever implemented. It delivers a tailor-made road map for a company to become a smart factory

Disclaimer / Acknowledgements

Address any legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed (Yes/No)	Yes

List of attachments:

Maturity Modell

Making Advanced manufacturing measurable

18.2 INDIVIDUAL ORTHOPEDIC CARTRIDGES, CAD / CAM TECHNOLOGY

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Keywords : 3D scanning of prints, CAD / CAM technology
Good practice applied in: (NACE code) :

Taking footprint, 3D scanning of prints, computer preparation and correction, machine making

GOOD PRACTICE DESCRIPTION

Based on good years of experience in the development of individual orthopedic cartridges and modernizing technology, CAD / CAM technology has been used in the production of our orthopedic cartridges.

CAD / CAM technology speeds up the production process and improves the quality of fabrication of products, with the help of high-quality materials.

Fingerprint imaging, 3D imaging scanning, computer preparation and correction, machine manufacturing.

The solution speeds up the production process and produces a high quality product.

Figure 88

OBJECTIVE AND TARGET AUDIENCE
Serbia, end users and companies.

METHODOLOGICAL APPROACH
It can be applied in cooperation with other companies and end users.

RESULTS / IMPACT
Positive impact on users.

SUCCESS FACTORS AND CONSTRAINTS
Working in software, operator on CNC machine.

A faster production process, high-quality materials, Ottobock orthopedic cartridges reduce the effects of micro trauma and save the locomotors system.

Positive user experience, good marketing.

LESSON LEARNED & SUSTAINABILITY
Positive experiences of the users who come to create more pairs of individual orthopaedic cartridges.

FINAL REMARKS
Since the introduction of CAD / CAM technology in the production of individual orthopedic cartridges, we have three types of products that are selected in relation to the needs of users, high quality materials in application, faster process of production, which has a positive impact on both workers and users, a positive impact on end users.

Disclaimer / Acknowledgements

There are no legal loose ends or limitations for dissemination, certify the use of this information for dissemination, online and printed.

19 CONCLUSION

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