ARTIFICIAL INTELLIGENCE (AI) – QUALITY MANAGEMENT SYSTEM/DIN SPEC 92001-1:2019-04

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ABSTRACT:

Artificial Intelligence (AI) is a complex and rapidly developing field. It is a branch of computer science that covers tasks that are associated with human intelligence. The term was first coined by the American computer scientist John McCharthy in 1955. It enables systems to automatically improve their performance by observing data. Cloud-service technologies, sensors & beacons, IoT & connectivity, analytics based on Artificial Intelligence and Machine Learning, and Smart tags & labelsare only some of the technologies that are making their way into many sectors in a disruptive fashion. It is also worth mentioning that, after making a first appearance in FinTech, blockchain technology has grown to branch out into almost every other sector, including the food & beverage industry. Blockchain, a new data storage technique, allows users to make a "chain" of relevant information on, effectively, anything. This "chain" cannot be changed once information has been stored – it isincorruptible. For this reason, blockchain is being touted as a revolutionary technology with far-reaching implications. DIN SPEC 92001-1:2019-04 is a first step and creates the basis for robust, traceable, safe and trustworthy AI applications.

1. INTRODUCTION

The world population will grow from 7.7 billion people (2019) to 9.7 billion people (2050). Climate change will have a strong impact on agriculture. New approaches are needed to guarantee food security for the world's population. In the next ten years, the food industry will change radically. Accordingly, two thirds of the companies (68 percent) forecast 100% traceability back to the origin of the goods thanks to digital technologies such as Big Data or Blockchain. Two thirds (65 percent) also see food in batch size 1, i.e. individually produced for the consumer, as a common scenario in 2030. Almost every second company believes that consumers can check shelf life using intelligent food packaging (46 percent).

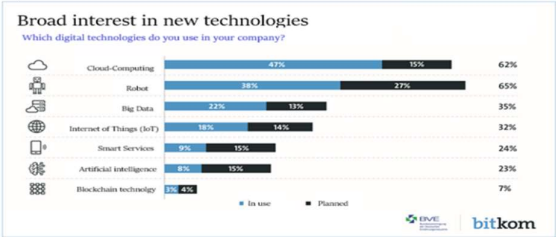


Figure 1. Representative survey among more than 300 companies of the food industry [1]

The world's food industry is already at the cutting edge of technology. With robotics, big data or blockchain, the industry will not only continue to optimize its processes, it is also facing a real revolution. Digitization in food production will not stop with agriculture, because it will bring completely new dimensions to companies along the entire production and processing chain and also

to consumers, for example in terms of food safety. It is now important that digital processes from field to plate are interlinked and that they are valid and applicable worldwide with newly defined quality standards. This brings the greatest benefits for food safety, companies, the supply chain and consumers.

2. EXAMPLES

2.1. AI-Farming

The MARS experiment aims at the development of small and stream-lined mobile agricultural robot units to fuel a paradigm shift in farming practices.

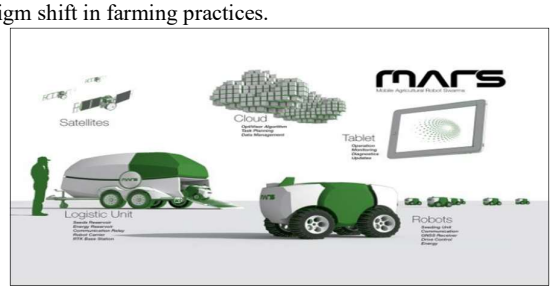


Figure 2. http:euchord/eu/mars and http://www.fendt.com/int/11649.asp

The concept addresses looming challenges of today's large and constantly growing tractor-implement combinations with mainly three aspects. First: to optimize plant specific precision farming, leading to reduced input of seeds, fertilizer and pesticides and to increased yields. Second: to reduce the massive soil compaction as well as energy consumption of heavy machinery. Third: to meet the increasing demand for flexible to use, highly automated and simple to operate systems, anticipating challenges arising from climate change as well as shortage of skilled labour.

The robots will cooperate as a group, similar to swarm principles. MARS will focus on the seeding process for corn performed by two robots as an example. The key strategy of this approach is on the one hand the radical reduction of weight and size compared to conventional farming equipment, which also allows for a fundamental simplification of safety tasks. On the other hand it is the essential simplification compared to known agricultural robot prototypes, especially by minimized use of on-board sensors. This will be realized by transferring control algorithms, process optimizing and supervising intelligence to **cloud services** and utilizing precise GPS-Real Time Kinematic technology. All these measures are intended to lead to a significant cost reduction of the overall system paving the way towards robots as a true alternative in the agricultural domain [2].

2.2. Digital Farming

Artificial Intelligence is part of the Bosch Plantect solution, which was developed specifically for agriculture. It is a data-based early warning system for plant infections.

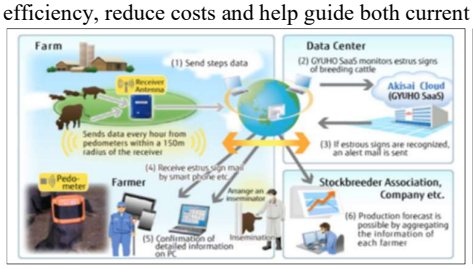
Figure 3. https://www.bosch.com/de/stories/plantect-kuenstliche-intelligenz-landwirtschaft

Artificial Intelligence is part of the Bosch Plantect solution, which was developed specifically for agriculture. It is a data-based early warning system for plant infections. The Plantect hardware

consists of wireless sensors that measure, among other things, the temperature and humidity in the greenhouse.
Plantect adds up to 100 additional agricultural parameters, such as plant age, disease history and weather forecast. So that the AI can draw the right conclusions from the data.
These parameters are crucial for the development of tomatoes and play an important role in the identification of infection risks - not only for tomatoes, but also for other greenhouse crops. The measured values are transferred to the **Bosch IoT cloud** as a data package [3].

2.3. A outline of Fujitsus AI project "Cattle breeding"

The world is moving at speed into a period where leading food companies focus on Continuous Improvement while also using deep Machine Learning and Artificial Intelligence to increase competitive advantage and proactively, assist management, predict food safety, optimize on efficiency, reduce costs and help guide both current and future decisions taken by the company.



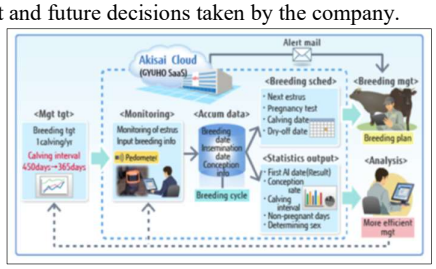


Figure 4. *Figure 5.*
https://www.foodsafe.net.nz/food-safety-intelligence.html[4]

PROCESS FLOW

1. Send steps data
2. GYUHO SaaS monitors estrus signs of breeding cattle
3. If estrous signs are recognized, an alert mail is sent
4. Receive estrus sign mail by smart phone etc.
5. Confirmation of detailed information on PC
6. Production forecast by aggregating the information of each farmer

2.4. Technology companies and farms (US)

Artificial intelligence is spreading to more industries and being applied across a wide range of applications. These companies are using AI to improve healthcare, develop autonomous vehicles, preempt cyberattacks, and more.

Figure 6. *https://www.cbinsights.com/research/artificial-intelligence/ [5]*

3. ARTIFICAL INTELLIGENCE AND QUALITY MANAGEMENT SYSTEMS

The question arises from the examples: Who is the owner of the cloud? Who is the owner of the data (BIG DATA)?

- The farmers?
- The software companies?
- Or who?

A clear legal framework is needed.

The application of Artificial Intelligence makes new quality requirements.
One part is the International Organization for Standardization with her Technical Committees. JTC 1 is the standards development environment where experts come together to develop worldwide Information and Communication Technology (ICT) standards. ISO/IEC JTC 1/SC 42 Artificial intelligence, for example: ISO/IEC 20546:2019 Information technology -- Big data -- Overview and vocabulary.
National organizations for standardization develop new quality requirements.

Germany:
DIN Deutsches Institut fuer Normung e.V.
DIN SPEC 92001-1:2019-04
Artificial Intelligence –
Life Cycle Processes and Quality Requirements –
Part 1: Quality Meta Model

This DIN SPEC has been developed according to the PAS (Publicly Available Specification) procedure. The development of a DIN SPEC according to the PAS procedure is carried out in workshops and does not require the participation of all stakeholders. DIN SPEC (PAS) are not part of the body of German Standards. A draft of this DIN SPEC (PAS) has not been published. Provision of this document free of charge as a PDF via the Beuth WebShop has been financed in advance [10].

- Especially, recent advances in the subfield Machine Learning (ML), a paradigm that enables systems to automatically improve their performance by observing data, have led to an increasing deployment of AI-based technologies by companies across almost all sectors [6].
- AI components face traditional software quality problems and new issues that occur on the system level.
- For these reasons, quality assessment of an AI module still poses a major challenge. It becomes more difficult to confirm, verify, and validate an AI module during conception, development, deployment, operation, and retirement which are wide-ranging tasks.
- The quality requirements arising from these new challenges are organized in the three quality pillars functionality & performance, robustness, and comprehensibility.
- This document introduces an AI quality metamodel to outline key aspects of AI quality including the previously mentioned AI quality pillars. For AI quality analysis, an approach for risk evaluation and a suitable software life cycle are provided. The given AI life cycle is consistent with the international standard for systems and software engineering . The second part of this specification, DIN SPEC 92001-2, provides specific AI quality requirements [10].

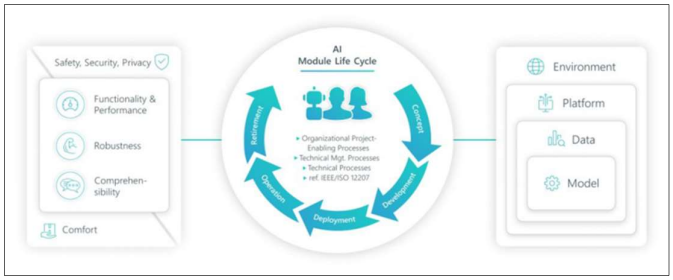


Figure 7. AI-quality metamodel [6]

How do we ensure security by design (AI moduls) in line with global best practice?

EUROPEAN DATA PROTECTION SUPERVISOR, The EU's independent data protection authority

Data Usage, Security & Compliance

- **Security inbuilt by design!**
- Confidentiality; Access control
- Transparent and responsive
- Address portability of data issues – other countries of organizations (cloud)
- Engagement of other sub-processor/s with similar rigour
- Data on Project End: Delete / Return
- Contribute to audits, including inspections, conducted by a client or another auditor

4. FOOD SAFETY INTELLIGENCE

Connecting the current quality management systems (ISO 9001), Food safety (ISO 22000:2018, FSSC 22000-Vers. 4,), customer-oriented standards BRC (British Retail-Consortium), IFS (International Food Standard, new: International Featured Standard) as well as national standards such as the "HACCP Code" in the Netherlands or the American "Safe Quality Food (SQF) 2000 Code and EU regulations and ISO 28001 (Security management systems for the supply chain), ISO 25000 (System and Software-Engineering) with the new AI modules (BIG DATA, information technology, Block chain, computer security, IoT, IIoT).

Deming Cycle – Basic quality improvement model

The Deming Cycle, or PDCA Cycle (also known as PDSA Cycle), is a continuous quality improvement model consisting out of a logical sequence of four repetitive steps for continuous improvement and learning: Plan, Do, Check (Study) and Act. [8] Wikipedia

Figure 8. Demming Cycle [7]

Deming Cycle – machine learning

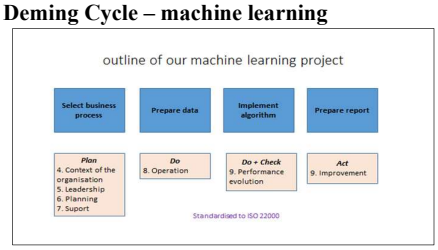


Figure 9. Outline of our learning project [4]

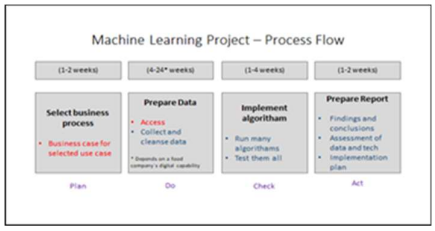


Figure 10. Machine Learning Project – Process Flow [4]

5. CONCLUSION

In recent years, the topic of artificial intelligence (AI) has gained great importance and is spreading in many different industries. From manufacturing to the automotive industry, you can certainly see an AI used for many different purposes. One of the most exciting sectors in AI is agriculture. Agriculture is an important branch of industry and plays a major role in the foundation of our economy. As the climate changes and the population increases, AI becomes a technological innovation that improves and protects crop yields. Possibilities how the AI contributes to the agro-industry: robotics, Image-based aspects for grain and soil health by means of drone technology, Precision Farming.

How can new technologies in ensuring food safety?
The trustgap is best bridged by the incorruptible blockchain data storage system, as well as being verified by an independent party. Blockchain allows each products' tracking history to be traced "from farm to table" with timestamped information at every stage of their creation process. The unique way blockchain stores data means that the information cannot be tampered with nor falsified.
Data analysis has a long tradition in quality management. However, it rarely goes beyond random sample-based incoming and outgoing controls or simple statistical characteristic values. With Big Data, artificial intelligence and machine learning, possibilities are now available that allow a significantly higher level of analysis-supported quality management. Continuous quality monitoring through artificial intelligence, algorithm-based fault cause analysis and early detection of rejects with the aid of machine learning methods. For AI-supported production come AI functions, Industrial IoT and advanced analytical methods for use in order to optimize manufacturing processes in unprecedented ways to optimize. Prerequisite is the infrastructure (5G), skilled workers and the e-learning platforms.

6. REFERENCES

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