

Business Driven Co-innovation during Growth of Video Solution Services Business and Technology

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Abstract

Konica Minolta aims to strengthen its market position in the manufacturing, logistics and retail sectors where 50% of its customers in Europe belong. To support this objective, the Video Solution Services (VSS) programme was built upon the close collaboration of the VSS business unit with the sales teams and Konica Minolta's Global R&D organization in Europe. The approach is to reinforce the current Mobotix cameras market through solutions based on artificial intelligence (AI) algorithms, tailored to meet the customer needs. The VSS programme execution and its customer-centric approach to innovation have already proved to be successful. Two solutions have been released to customers this year, producing profits for Konica Minolta: Box Defect Detection and Suspicious Behaviour Detection. The camera sales were increased more than tenfold over the last year in the pilot country of the VSS programme (Czech Republic). Konica Minolta will continue to grow the VSS business and replicate its success in other technological areas, such as in its Intelligent Connected Workplace.

1 Introduction

Video Solution Services (VSS) is a project born within the European Research and Development (R&D) department of Konica Minolta with the aim of quickly introducing new innovative solutions to the market, and to support the digital transformation of the company and our customers. To achieve this, the VSS project proposes a new model of collaboration between different areas of Konica Minolta, in particular between Sales, Business Units (BU) and R&D. Through this approach, the research and technological development roadmap is closely connected to the business strategy of the BUs, and the effectiveness of the new solutions can be continuously tested through a sequence of pilot projects promoted by the Sales teams towards our customers and early adopters.

The VSS programme is the union of the skills of the R&D laboratories in Brno and Rome to implement and innovate Konica Minolta's current business in the fields of imaging and Mobotix cameras. VSS's solutions are integrated into a single platform and their strengths lie in the use of artificial intelligence (AI) algorithms that are capable of recognizing people, objects, and behaviours, and through a horizontal coverage of different application domains.

Another key point of the VSS program is co-innovation as a strategic and collaborative approach to involve other companies and customers. For Konica Minolta, co-innovation means focusing on the sharing of knowledge, skills and resources to meet otherwise impossible technological challenges.

The VSS programme builds on Konica Minolta Japan-based R&D capabilities and skills gained over decades of active research and development in the area of imaging, newly transformed to machine learning-based image recognition and processing.

This paper describes the journey of the VSS programme from the pain-points which led to its creation

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to its early successes and now focuses on its full-speed advancement into the future.

2 Problem of technology and business in isolation

Konica Minolta Global R&D hosts a team of talented technologists who specialize in the areas of computer vision and machine learning. The team has been delivering brilliant research ideas and high-quality outcomes. However, they collided with two difficult realities. Firstly, many of these outcomes were mostly demonstrated on publicly available datasets of images and videos. These datasets are built for research purposes only and don't represent any real business opportunities. However, the teams strongly desired to apply their excellence to solve real problems for customers and deliver real value. They are fully aware that the secret of developing successful ground-breaking products is to have contact with customers, to be able to access their environment and data as well as understand their operations and needs. The technical team has been actively seeking ways to obtain such real insight and competitive advantage, and to directly engage with customers. This led to the realization of the second harsh reality: even when the innovative solutions were demonstrated on real customer datasets and solved the customer's problem, it still did not mean there was business for the company. Contact and cooperation with business units and sales organizations is the only way forward and the key to success.

The Video Solution Service (VSS) business organization of Konica Minolta is a department taking care of the sales of Mobotix cameras. Their KPI is the total revenues of VSS, however their primary revenue comes from the sales of camera hardware components. In recent years their sales performances have been declining steadily due to a market trend that favours video analytic solutions over cameras. The traditional video analytics market is undergoing a transformation leading to the rise of a new business model which is heavily empowered by computer vision technology. Computer vision has enabled a series of advanced capabilities, provided on different platforms, both on-premise and in the cloud, reducing the camera itself to a commodity only. This means that camera hardware manufacturers are adjusting the ratio of their hardware and software offerings, attempting to also become software producers. This new business model is the optimum, because the development-cycle and lifecycle of hardware is usually long and costly. Any changes take years to reach the

end-customer. On the contrary, software usually has a much shorter development cycle, and when offered in one combined package, a company can relatively quickly deliver different new products to the market based on the same hardware. Furthermore, for customers who do not want to renew their hardware fleet, the software services also permit to keep the sales channel always open, offering new service packages on top of cameras already sold and installed.

Therefore, the VSS business organization set a primary strategy to sell software components and associated services to generate strong monthly recurring revenue income.

For the VSS business organization, it is clear that to maintain competitive advantage, its traditional camera business needs to gear-up with intelligent video analytics solutions. There have been plenty of video analytics solutions on the market and so the fastest and perhaps simplest way to boost revenue may be to select an existing third-party solution and bundle it together with Mobotix camera. However, this approach can be very costly and can make Konica Minolta dependent on third-party maintenance, which is a clear risk. Moreover, Konica Minolta would not have any differentiation or technological uniqueness to offer to our customers. Therefore, the VSS business organization has decided to take a different approach – seeking for an internal IP from R&D Europe, an organisation with consolidated experience in computer vision, with scientific publications, submitted patents and several solutions differentiating from competitors. Although the internal development process may be slower and costly, once a solution is completed, we can use it with minimal cost and have full control over its maintenance and lifecycle.

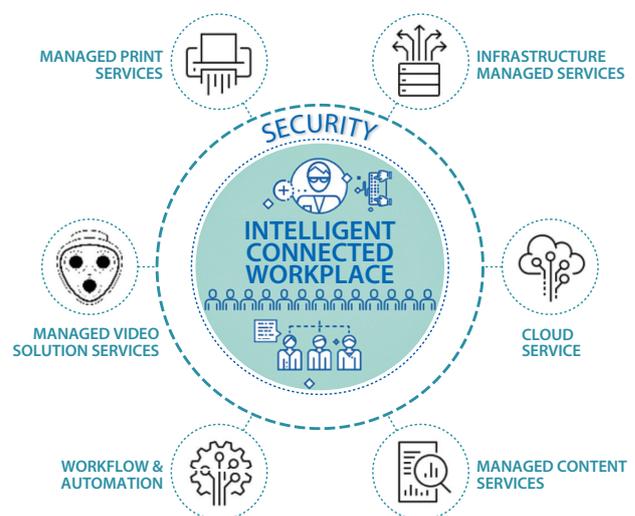


Fig.1 Konica Minolta's vision of becoming a provider of Intelligent Connected Workplace solutions.

In recent years, Konica Minolta is undergoing a digital transformation from a printer vendor to a provider of Intelligent Connected Workplace solutions (see Fig. 1). Driven by this general company strategy and the needs of both business and R&D, a collaboration started naturally, leading to the birth of the VSS programme.

3 The VSS programme

3.1 Shape the joint path

In order to roll out the joint new business, a new VSS programme was established. It extends beyond the existing VSS business organization to include also Global R&D teams for internal IP development and productization.

The VSS programme faced some strategic decisions at its outset. It is important to define which area or vertical Konica Minolta selects for building internal IP. This decision depends on the size of our existing customer base as well as potential business scalability. Manufacturing, logistics, and retail have been chosen as the first group of verticals upon which to focus (see Fig. 2), because 50% of Konica Minolta customers in Europe are from these verticals.

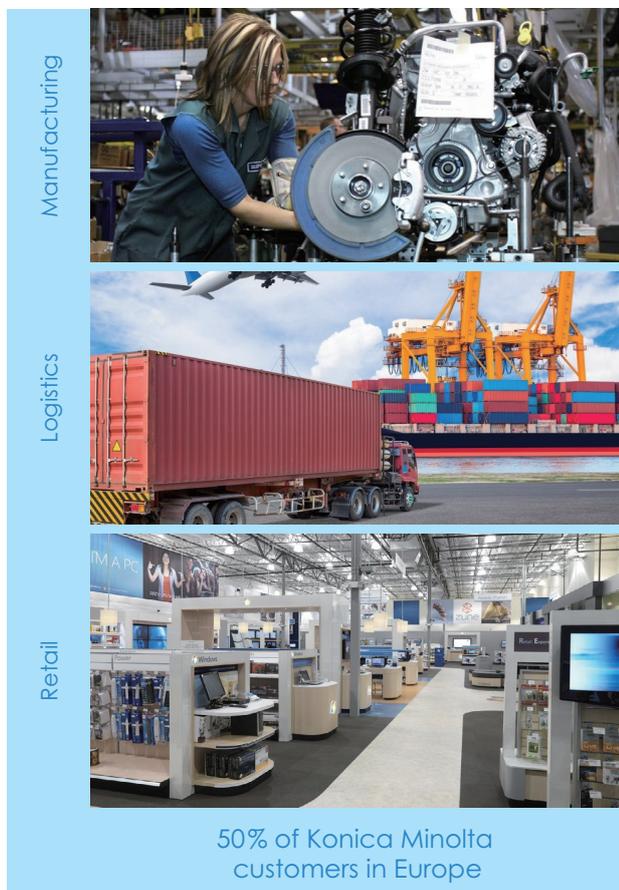


Fig. 2 Currently VSS focuses on three verticals.

When it comes to where to host the software processing, two approaches may be followed. One is to utilize the internal computing power of the new generation of Mobotix cameras. The other option is to host software processing on the server side. VSS has chosen the second option, because it allows them to cover the entire portfolio of cameras and sensors. It also provides better scalability of the software business in the future.

The VSS team soon realized that software customers are fundamentally different from their hardware counterparts, expecting more frequent product upgrades and greater support. The key to success is to shorten the time cycle of software development and meet customers' needs in a more timely manner. The new VSS organization, as well as the whole of Konica Minolta, must be ready for this. To tackle this challenge, a VSS R&D team is established within the VSS programme. This team brings internal IP into VSS business and is fully dedicated to VSS software development.

3.2 The triangle of success

The newly established VSS R&D team, together with the Business Unit and the Sales team, form a triangle of success (see Fig. 3). The business unit takes control of WHAT – what products should be developed to serve the majority of our customers, deliver impact and make profit. The Sales team takes care of WHY – why customers want our products and why our products resonate with customers' challenges and needs. The R&D team answers the HOW – how to solve customers' problem with our technology and how to develop valuable solutions. The combination of this 'golden' triangle ensures the VSS organization can deliver successful products.

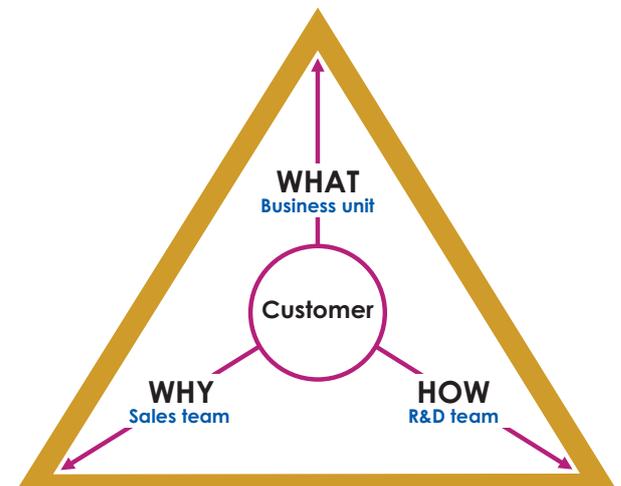


Fig. 3 VSS's triangle of success.

3.3 Building trust

Although the joint path was paved and the direction was clear, the beginning of the journey was a tough one. Trust between different parties involved had yet to be built and strengthened.

Trained through our traditional business, our Sales teams were not experienced with selling innovative software solutions. It was a brand-new battlefield for them to advocate R&D excellence to customers, identify their relevant pain-points and attract enough interest for further discussion. It was not easy at the beginning to obtain trust from customers so that they were willing to start a Proof-of-Concept (PoC) project with us.

The R&D team needed to show their capabilities to customers and obtain their trust without having any successfully completed projects in their portfolio. Even the trust between VSS sales and VSS R&D was not strongly established at the beginning.

Time has now proven that all parties in the VSS organization are able to deliver their true value in a well-coordinated manner. After the initial successful PoC projects with customers, things started to get up to speed. Sales brings more and more requests for collaboration from customers to the R&D team. The Business Unit expands the VSS Sales team from the pilot country (Czech Republic) to now 18 countries in Europe. The VSS organization has started to deliver successful products to several countries in Europe.

3.4 The customer-centric approach

Another factor which accounts for the VSS success is the customer-centric approach. All parties in the VSS organization deeply understand its importance and practise it as a guiding principle in their operations. There are many competitors in this area on the market, the true differentiator is not only the technology itself, but how well the technology can be applied to a customer's environment and how positive the customer experience is throughout the whole process.

The VSS approach closely involves the customer from the beginning to the end (see Fig. 4). After the Sales team brings in a customer, the collaboration usually starts from an innovation event where the R&D team presents their technology to the customer, discuss their pain-points and both sides agree on a list of potential topics to collaborate on. Then the R&D team pays the customer an on-site visit. They observe the customer's workflow, study the physical environment where the solution may be installed in the future, and make any necessary observations and

measurements. Based on the outcome of the on-site visit, the R&D team performs a feasibility study and generate a solution proposal. Then they return to the customer to present the proposal, they make necessary adjustments together, and then obtain the approval from the customer to proceed with the development. Throughout the whole PoC development, the R&D team regularly touch base with the customer to show them the progress and obtain feedback. This ensures that the product prototype will satisfy the customer when it is completed, and the customer will be willing to later pay for the real production of this solution. The Sales team closely follow each round of customer interaction and assist the R&D team in anything that is outside of R&D's scope.

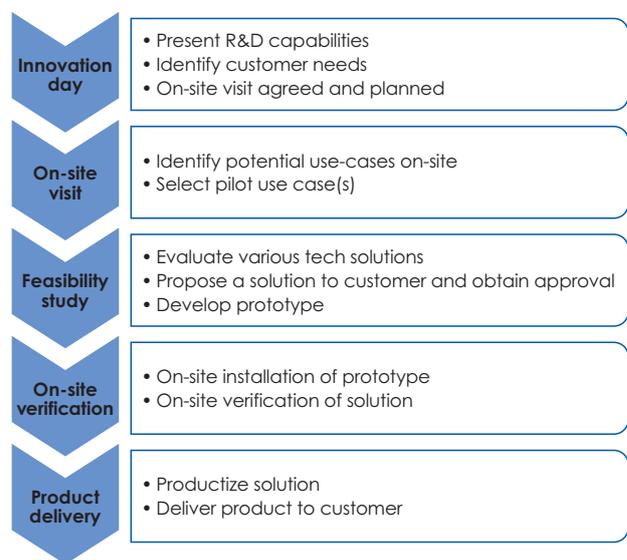


Fig. 4 VSS's process of working with customers.

Now, after many successful projects, the VSS organization deeply believe in such a customer-centric approach. They have observed that none of those customers were able to formulate the full list of requirements at the beginning of the dialogue. Requirements were always updated throughout iterations with the customers. The clear conclusion is that if we don't work sufficiently closely with our customers, it is highly likely that our solutions developed, based on only initial requirements, will not work in the real environment or will not deliver the customer value expected.

4 The VSS R&D

The VSS R&D was established in a close collaboration with three teams – two research-focused teams Advanced Data Analytics and AI Assistive Services

and a productization-focused Video Analytics System team that productizes solutions delivered by the two research teams (see Fig. 5).

With these three teams working together in a fully agile way VSS R&D, as a young organization, has already proven its value. Two pilot products in the area of Safety and Security were already successfully delivered to customers and the third product – Box Defect Detection is on its way to first customers in Poland and Croatia.

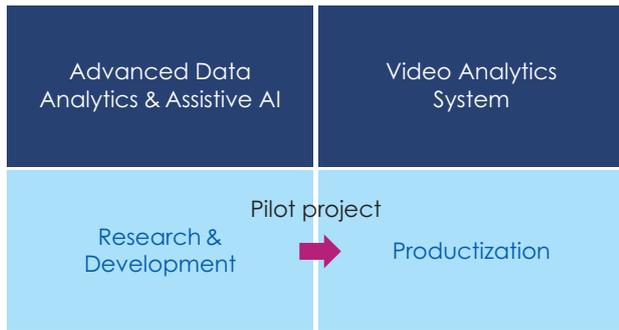


Fig. 5 From R&D to production.

4.1 Product strategy

Since the VSS R&D is fully aligned with the business insight supplied from the VSS Business Unit, the main focus has been placed on areas of manufacturing, logistics, and warehouse, all packaged in the Warehouse Management product portfolio. So far, the results have shown that it is the right strategy to focus on manufacturing and logistics, because compared to several others, these verticals are in general more willing to pay.

There are multiple other areas where the technology may be a good fit, such as retail, agriculture, healthcare, and many more, but based on acquired business insights, the business potential in these areas is not yet strong enough. Therefore, they are not in focus at this moment in order to keep VSS R&D's objectives clear and tangible.

The current product strategy sets the emphasis of the next year on Visual Quality Inspection (VQI) products with a specialization on Plane Surface Quality Inspection. The potential of this topic is almost endless, even whilst utilizing a narrow set of technologies – this coincidence provides a strong boost to solution reusability and allows for an efficient utilization of our resources (see Fig. 6).

In addition to VQI topics, the VSS R&D maintains an interest in Safety and Security applications and Visual Inventory and Process Inspections to further support the business of VSS in Europe.

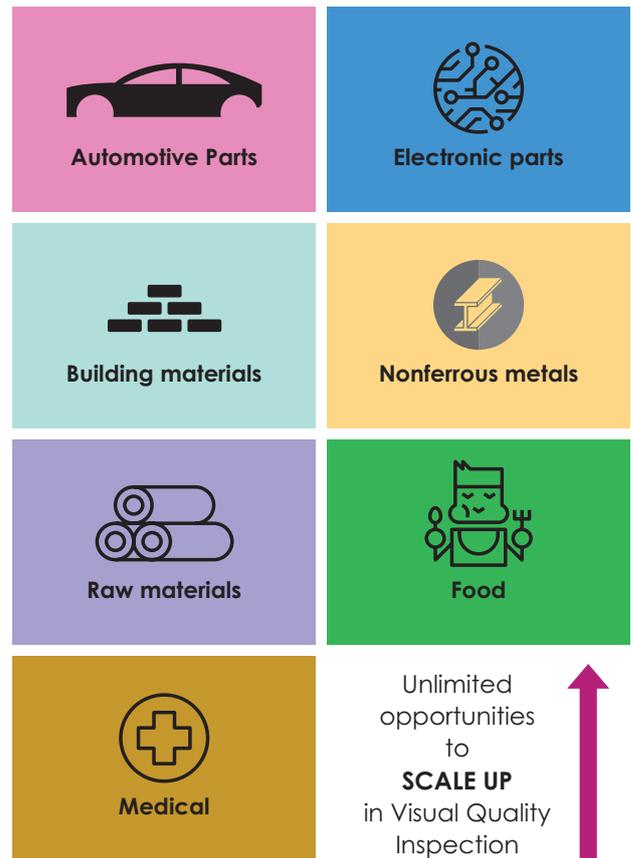


Fig. 6 Potential of Visual Quality Inspection.

4.2 Technology strategy

The technology roadmap includes several elements, namely advanced AI algorithms, technology enablers, and methodologies. Key components of VSS R&D products are Self Organizing Tree Algorithms, which are the most advanced areas of AI, Machine Learning and Deep Learning. These algorithms form the baseline of the visual quality inspection and safety and security products. The algorithms are addressing key challenges in the application domain, such as low-light conditions, occlusions, other challenges in the environment and a lack of real training data. Another key technological approach is the usage of Generative Adversarial Networks to compensate for the lack of training data by synthesizing them for the machine learning training process.

As part of the future roadmap, additional state of the art machine learning technology will be applied, such as MLOps, Federated Learning and Incremental Learning. These advanced techniques will help us to speed up iterations on model improvements and keep on the leading edge with respect to the performance and precision of the models.

Although the VSS services are coupled to the Robotix cameras, a feature of our solutions is that it is agnostic to the camera type and provider, allowing

the sale of services to be more scalable. In this context, the algorithms developed are able to analyse many different input sources, useful for different purposes, analysing data from both day and night sensors, thermal sensors and are compliant with the deployment on infrastructures of very different natures, both from KM and third parties .

4.3 Steps toward platform business

Although every product is different from the functionality point of view and requires specific algorithms, many components of the overall computer vision system are reusable among multiple product solutions. Modularization of our solutions makes it possible to reuse the components (modules). A proper design of the components and the overall architecture leads to quicker and more efficient deliveries of products, which, in the best case means it may only be necessary to switch one component, such as a machine learning model. This also makes the maintenance and support of all VSS products easier.

Modularization of our solutions also enables VSS to move towards a platform business model. A Video Analytics platform (VAS) has been built by VSS R&D to host a catalogue of all reusable components. This platform also makes the building, deployment, and maintenance of various video analytics applications simple, fast, and reliable. It also offers the ‘Do It Yourself’ approach, which means that a technician (third-party on the customer side) will be able to build their own solution from a library of available products. Then it will be possible to deploy it according to the requirements of the customer’s edge device, cloud service, or to create a hybrid solution. Fig. 7 shows the position of VAS team in the overall VSS organizational composition.

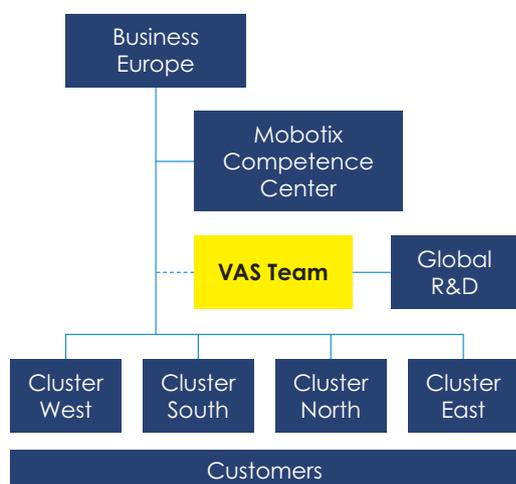


Fig. 7 The organization placement of VAS platform.

4.4 Organization setup

In VSS R&D, the research-focused teams have two technical roles: research specialist, responsible for research in the area of computer vision and machine learning algorithms and engineers, responsible for integration of algorithms, SW development and HW-related activities (cameras, sensors, networking, etc.). The combination of these roles enables VSS R&D to execute from feasibility to PoC and also deliver pilot products when needed. The deliveries of VSS R&D usually consist of algorithms of product-level quality and a working software system in prototype-level quality.

The productization-focused team has members with greater specialization in product quality software development, architecture and solution deployment. The purpose of this team ranges from pilot product delivery to actual production.

Teams work agile, divided into scrum teams with related ceremonies, where the Product Owner and Scrum Master come into play. Although the technical research teams have two roles, the variety of experience, and background, allows one to tackle the different challenges by combining the best team, forming matrix teams best suited to the problem at hand.

The flow that leads from the conception of the idea to its realization and deployment and testing at the customer, is governed by a process, called TML (technology maturity level), which through appropriate inputs, outputs and definition of completed, sanctions the passage from one state to another in the development flow. Each step has well-defined business and technical deliverables, following software Q&A best practices, and introduces appropriate Q&A checks for the machine learning and computer vision algorithms, in order to ensure the accuracy, reproducibility and reliability of the results produced.

Although the VSS R&D team is relatively small, it can deliver a big impact, because it is self-contained, integrated into one organization which includes business, sales, technology and delivery.

5 VSS Success stories

Thanks to the outstanding performance of VSS, Konica Minolta’s camera sales in Czech Republic (VSS’s pilot country) has increased more than tenfold over the last year. In manufacturing and logistics, VSS solutions have helped the control of operations in customer production lines, the movement of materials and goods around the premises, or with the

efficiency of storage processes. In conjunction with thermal imaging, the VSS monitoring system has helped to control processes for handling frozen or chilled food and to ensure compliance with relevant standards. In the field of workplace safety, VSS solutions help detect whether employees are using protective equipment in the right way, and evaluate workers' behaviours: for example, by monitoring their fatigue when working with dangerous machines. This section elaborates on two successfully delivered use cases.

5.1 Visual Quality Inspection

To ensure that delivery boxes meet quality requirement, VSS has successfully delivered a Box Defect Detection solution to be installed on production lines. The Box Defect Detection system locates all defects and anomalies of the delivery boxes running on a production line, identifies their size and severity and issues commands to the separator on the production line to send the defective box to the washer or out of the line instantly. Detectable defects include cracks, foreign objects and contamination. The solution also provides a real-time dashboard for human controllers to adjust detection thresholds and long-term statistics on processed items to make the production more predictable. Fig. 8 and Fig. 9 shows the software interface and hardware setup of Box Defect Detection solution.

The Box Defect Detection solution has been installed at pharmaceutical company Phoenix in Czech Republic. This customer has reported their satisfaction with the performance and have appreciated the added value it delivered: 1) 24/7 unattended service to avoid idle time; 2) reduced human labour to save production cost and 3) minimized human error to raise production quality. Several other pharmaceutical companies have started the collaboration process, such as Phoenix in Serbia, Hurtap in Poland and Oktal Pharm in Croatia.

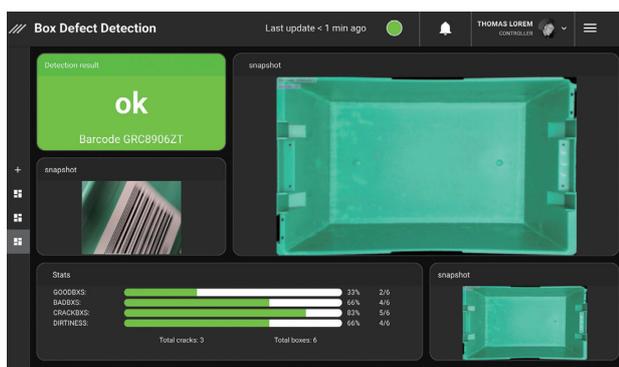


Fig. 8 Software interface of Box Defect Detection.

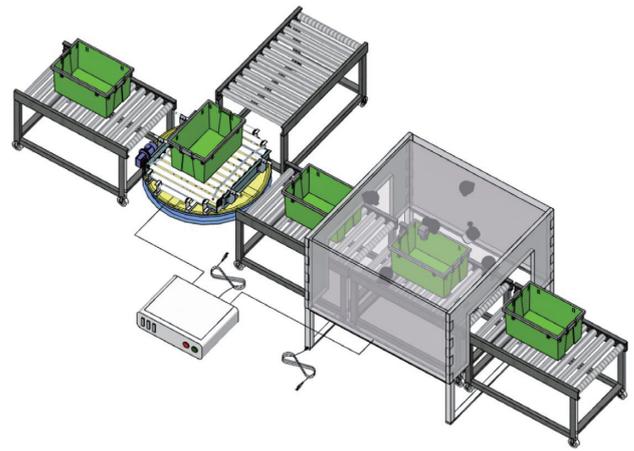


Fig. 9 Box Defect Detection setup on production line.

5.2 Suspicious Behaviour Detection

Konica Minolta's Smart camera system helps the Centre for Learning Results Detection – CERMAT to avoid unauthorized access to confidential information when printing documents and to increase the level of security and overall efficiency of its printing operations. The solution constantly monitors all person movements in the printing area and raises an alert in case of suspicious activity (see Fig. 10). For example, if an operator has been standing next to the printer for more than a specified time (such as, for more than exactly 17 seconds) while printing documents that have been identified as confidential, the system will detect it and notify the administrator immediately. According to the director of CERMAT, before using Konica Minolta's solutions, they used a standard camera system to record videos and security control officers had to go through hours of recording to identify potentially suspicious behaviour. Now, AI solutions automate the process and lead to great savings in labour costs. The security control officers see on the dashboard a list of suspicious events with associated segments of video recording. They only need to go through each item in the list to assess whether it is a false alarm or a real potential risk.



Fig. 10 Suspicious behaviour detection at a printer.

6 Conclusion and future development

Konica Minolta VSS will continue to seek opportunities and strengthen its position in manufacturing, logistics and retail areas. It will also actively work on establishing its VAS platform business. Any organization that is interested in using VSS solutions or in becoming a partner is welcome to reach out to our VSS Business Unit in our various National Operation Centres.

Konica Minolta has identified the following list of key factors, which, all together lead to the success of VSS business.

- 1) Active KPI-driven support of the sales organizations. Sales bring R&D closer to their operations, such as their Innovation Competence Programme (making innovation with customers).
- 2) Mutual understanding and transparent sharing between R&D and sales organization (e.g. technical capabilities, product plan, market plan, business plan, etc.).
- 3) Top management of R&D and sales organization support to prioritize and ensure the execution of mutually agreed commitment and to meet all KPIs.
- 4) Top-down incentives to invest in R&D projects, so that they can prove benefits and build trust both internally and externally.
- 5) R&D is committed to sales organization by actively developing their products and services.
- 6) Grow capabilities on the R&D side, such as product delivery, professional services, user experience and co-innovation customer driven approach.
- 7) On R&D side, product delivery resources and development operation capabilities exist within a shared product roadmap and under a single Product Ownership.

Konica Minolta is endeavouring to replicate the success of VSS business model in other areas such as the Intelligent Connected Workplace, and several others. This approach will surely lead to a faster and more effective digital transformation.