Interreg
North-West Europe
COTEMACO
European Regional Development Fund
EUROPEAN UNION

Success Stories

Collection of success stories from the EU funded Interreg COTEMACO project

10 successful implementations as a result of the project from 2018-2021

Table of content

Project Partners

Flanders Make

Flanders Make is the Flemish strategic research centre for the manufacturing industry. With our research we support the Flemish industry with both product and production innovation. Flanders Make performs pre-competitive, industry driven research in the fields of vehicles, machines and factories of tomorrow. As such we stimulate the digital transformation of companies, big and small. This research initially leads to concrete applications in the companies which participate in the research projects. Next, Flanders Make also shares the research results with the innovation followers so that they can make the transition to Industry 4.0 as well. Our expertise is focused around 4 competence clusters: "Decision and Control", "Design and Optimization", "Flexible Assembly" and "Motion Products" In addition, we attach great importance to international cooperation in the field of innovation and to participation in European research projects. Today Flanders Make counts over 700 researchers who work full-time as a unique research community on a joint industrial research agenda

University of Lincoln

The National Centre for Food Manufacturing (NCFM) is based in the heart of Food Valley in Lincolnshire and a satellite campus of the University of Lincoln. NCFM progress high impact food sector focused research designed to advance the industry at all points in the supply chain.
Current initiatives include: digitalisation of the food sector to optimise productivity and advance quality assurance; industry focused carbon net zero and sustainability agendas; application of analytical techniques that unlock specific challenges of food quality, safety and nutritional performance.
NCFM have the expertise, laboratory & factory facilities, and extensive industry and academic networks, to engage at all Technology Readiness Levels (TRLs) from fundamental / basic research through to full scale commercialisation. Research is typically supported by funding sources such as UKRI (particularly Innovate UK, EPSRC and BBSRC), private business, and a range of EU, National and Regional funding initiatives. Projects can be specific work for one client, through to large scale multi-partner collaborative projects. There are also a range of Masters and PhD researchers advancing food sector science and technologies.
Digitisation, Automation, and Robotics have the potential to significantly change how food is manufactured. NCFM progresses process automation-related research and development, which will serve to increase sector productivity and greatly enhance process control.
NCFM works with the food sector to develop the next generation of food processing systems, from concept through to full commercial research and development trials in our dedicated food manufacturing halls and process laboratories.

ZeMA – Zentrum für Mechatronik und Automatisierungstechnik

The Center for Mechatronics and Automation Technology gGmbH (ZeMA) operates in the application-oriented research and in the industry-oriented development in the fields of sensor and actuator technology, production and assembly processes and their automation. With these areas, ZeMA covers a broad research spectrum with the aim of industrialisation and transfer of research and development results to the industry and to the industrial floor. The work priorities are mechatronic systems, innovative production technologies and industry 4.0 applications.
ZeMA focuses on laboratories and demonstrator environments for the industry-oriented development of products, processes and resources. These are used in industry and research projects and are constantly being further or newly developed. Due to their practical relevance, they make an important contribution to the work with industry partners and the transfer of the results to the industry. The ZeMA makes an important contribution to strengthening innovation and progress in the region and acts in a complementary manner to the digitization strategy of the Saarland.

Foodtech Brainport

North-East Brabant (Brainport Region) is the leading agri-food region in the Netherlands, and one that is known for its pioneering mindset, collaborative spirit, enterprising mentality, high-impact innovations. In close connection with Brainport Development, Food Tech Brainport is part of the Brainport Region agenda as strategic research centre for the sustainable food production industry. The economic development agency Brainport Development cooperates with many partners on strengthening Brainport Region. Close collaboration, sharing knowledge and smart entrepreneurship characterize the open innovation culture which makes the Brainport region a growth accelerator of the Dutch economy.
With the Food Tech Brainport network of technology providers, food processing companies and knowledge and research institutes, we work on a future proof food industry. We connect the food processing industry to innovative technologies, talent, research, and funding. We develop smart regional solutions for global agri-food challenges. Together we are creating a smarter, healthier, and more sustainable world for tomorrow.
Our research supports the North-East Brabant food production industry with both product and production innovation. Food Tech Brainport performs pre-competitive, industry driven research in the fields of sustainable food production systems. As such we stimulate the digital transformation of companies, big and small. This research initially leads to concrete applications in the companies which participate in the research projects. Next, Food Tech Brainport also shares the research results with the innovation followers so that they can make the transition to Handsfree Food processing and digitalization as well.

Implementation partner:

FLANDERS MAKE
DRIVING INNOVATION IN MANUFACTURING

Success Story 1

Cobot cell design for Aminolabs

Flexible assembly work-cell to automate scoop insertion

Automated Feeding Station

Company description

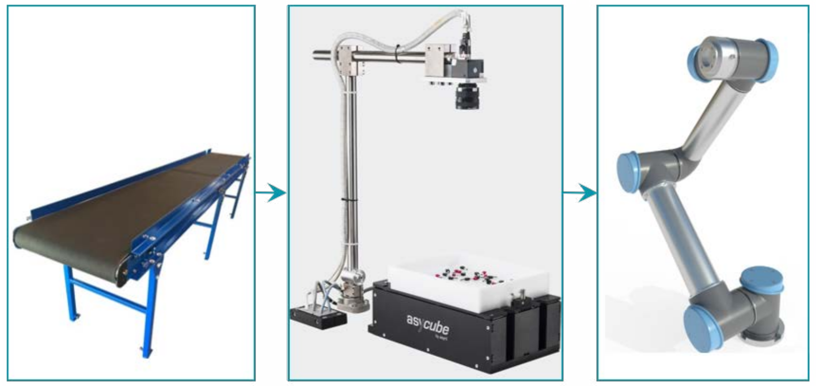
Aminolabs is a Belgian company with production facilities in Hasselt (Belgium) and Bleckede (Germany); its headquarter is located in Hasselt. They produce **sports nutrition, dietary nutrition** and **health nutrition** products, with an aim to be innovation leader in Europe. In addition to the production facilities, they have innovation centre with research facilities where they constantly study new applications at concept, product and production level in tight partnerships with customers, research institutes and universities.

Motivation an challenges

Aminolabs applied to the SME support programme with the aim of finding an automated solution for a manual assembly step of their current production line. In the current processing, the automated filling of the jar with nutritional powder is followed by manual insertion of scoops, before screwing on of the lid. This manual process needs an operator to perform a repetitive, tedious and not ergonomic task for long hours. This motivated Amoinoilabs to consider exploring automated systems, in order to not only solve the mentioned issue, but also freeing up the operator for other tasks.
This was quite challenging since any proposed solutions required to be **flexible** to handle a large variance of **scoop sizes**, **shapes** and **colors**, and also the production line needed to be easily switchable to a different product few times daily, with easy and **intuitive reprogramming**.
Moreover, the work-cell needed to provide a safe environment for an operator to work close to it. The minimal assembly rate considered to be 20 jars/min.

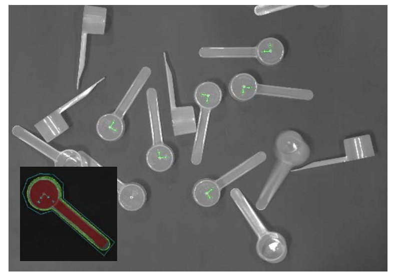
Technical solution

Based on the project requirements, a **conveyor** combined with a **vibrator feeder** was selected as a flexible scoop feeding system, a **smart vision** for scoop detection, and a **cobot** for the automatic scoop insertion. The specification of each subsystem was identified based on the performed feasibility studies.
In the proposed solution, the conveyor is responsible to fill the vibrator feeder with an optimum number of scoops. This is performed using the smart camera mounted on top of the vibrator platform in order to keep track of the number of available scoops on the vibrator surface.
The scoops on the vibrator feeder are distributed over the surface, and are arranged properly to be picked up by the robot in the right way using the 3-axis vibration technology. Smart camera also helps the cobot to know where the scoops are for picking purposes. A cobot equipped with two grippers are selected to meet the minimal required assembly rate.



Result

The performed feasibility studies showed that the 3-axis vibration technology (with right selection of the size) can successfully separate and arrange the large variety of scoop sizes and shapes considered in the project.
The experimental tests also revealed that a smart vision (with right specification) equipped with front and backlight can maximize the detection performance. A structured plate (pyramid like patter) as a vibrator platform observed to be necessary to minimize the stability timing of the scoops. Additionally, a cobot with two grippers was selected to increase the assembly rate.



Based on the feasibility studies, the maximum achievable cycle time with the proposed work-cell is estimated to be 35 scoops/min which meets the required assembly rate (20 scoops/min). The proposed work-cell also offers a safe environment for the operators to work close to it; thanks to the safety laser scanner, and the safety features of the cobot.

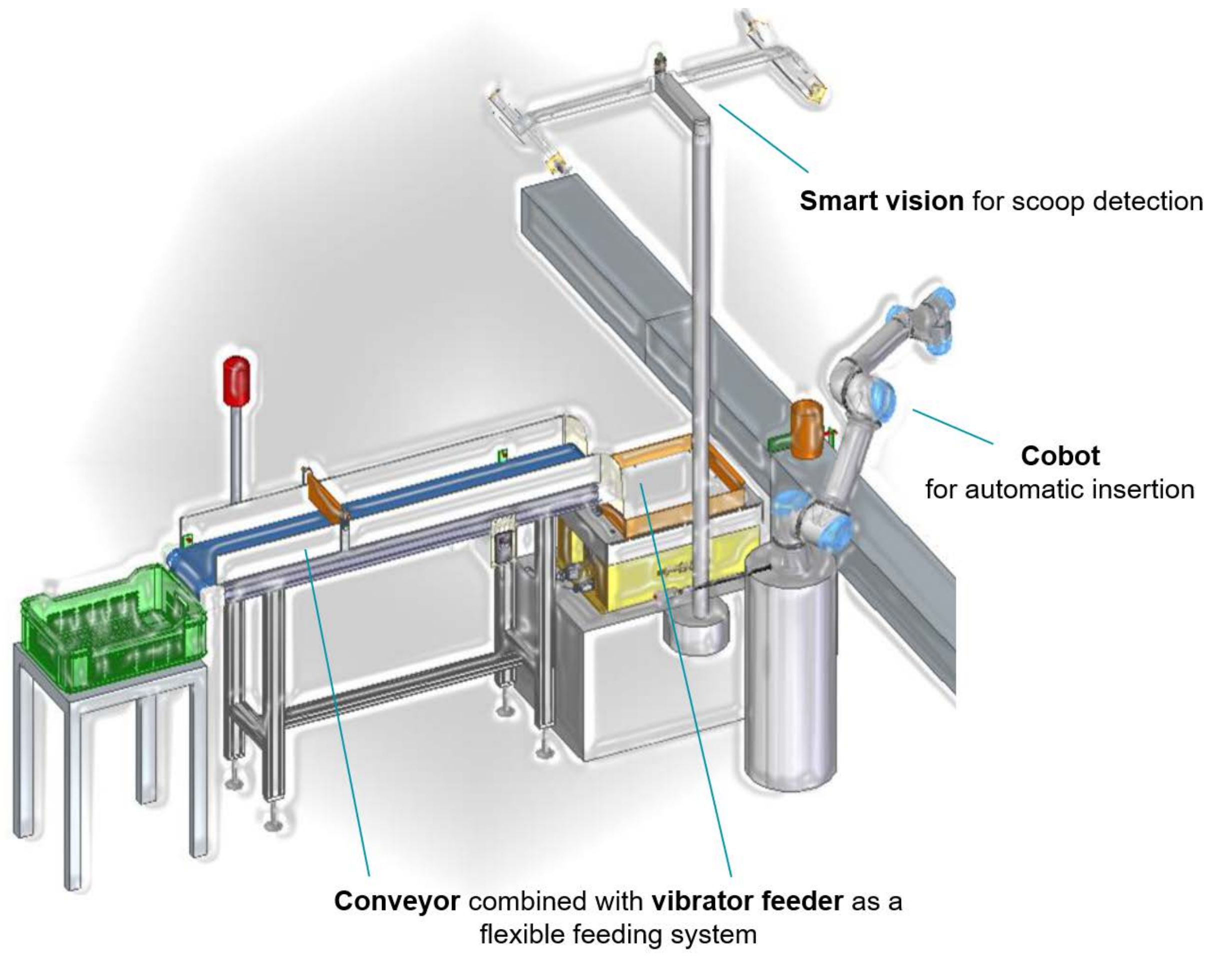
Interview

How could COTEMACO support you?

Via the SME support programme, COTEMACO engages with SMEs from the automotive and food sectors through field labs. These regional field labs in the Netherlands, the UK, Belgium and Germany are showcasing key production steps in the automotive and food industries, in order to tackle current low sectorial awareness and knowledge gaps. The field labs will exchange knowledge on different manufacturing tasks, such as handling and (un)loading.
With the COTEMACO programme, manufacturing SMEs are guided through the process of adopting collaborative robotic and shop floor digitalisation technologies, from the exploration of technological opportunities to the detailed definition of a business plan.

What was implemented and what are the benefits?

Within the COTAMACO program a potential technical solution for the Aminolabs case was identified in order to automate their current manual step for the scoop insertion. The identified solution was based on employing a smart vision for scoop detection, a cobot for automatic insertion and a conveyor combined with a vibrator feeder as a flexible scoop feeding system.
The proposed solution is flexible enough to handle the variance of the scoops with a variety in sizes, colors and the shapes. The cobot safety features combined with the laser scanner makes the work-cell a safe environment for the operators to work in the same area when needed. The intuitive robot programming of the proposed cobot and the intrinsic features of the work-cell minimizes the product changeover and makes it possible easily to switch to a different product.
A feasibility study on the proposed solution was performed; this includes the conceptual design of the work-cell, technical feasibility with validation testing, cycle time estimation, an overview of the estimated costs, and a list of potential subcontractors and suppliers.



Were your expectations fulfilled - technical implementation and support through COTEMACO?

Bert Aerts, Production Manager, Aminolabs:

“Thanks to the elaborate research with practical tests by the team of Flanders Make in the frame of Cotemaco project, today we have the necessary certainty that a robot automatization at our filling station meets all requirements.
We are extremely satisfied with the extent to which they think along about a solution that works in practice, thoroughly test and clearly report, and also provide all the necessary input for the concrete elaboration of our business case.“

Implementation partner:

ZeMA
Zentrum für Mechatronik
und Automatisierungstechnik

Success Story 2

Conceptual design of a (partial) automation of the filling process of laboratory chemicals for Bernd Kraft GmbH

(Partially) automated handling of containers in a filling station where customer-specific chemical solutions are filled

(Partially) automated handling of containers in a filling station

Company description

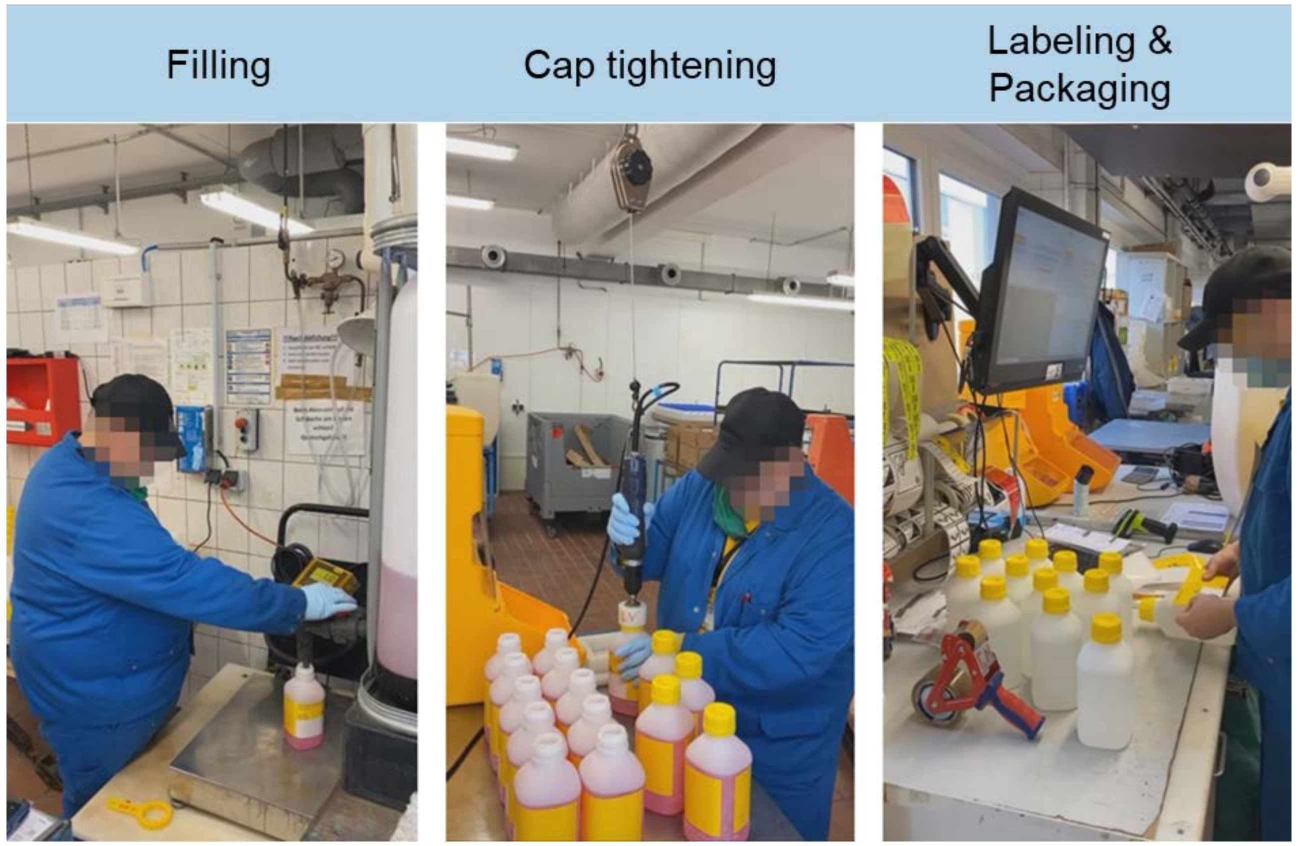
Bernd Kraft was founded in 1974 and is specialized in the production of individual solutions and reagents from very small to large batches (a few milliliters up to 1000 liter containers). Bernd Kraft offers ready-to-use solutions, reagents and salts according to the ready-to-use concept. This specialization has given Bernd Kraft a unique selling proposition at its German site, and it is particularly committed to the continuous improvement of processes in the areas of environmental protection, health and safety.

Motivation/Starting Point

Production is set up almost exclusively manually in order to be able to guarantee flexibility with the existing large variance in batch sizes and product range. Together with the successively grown company structure, the „filling“, „labeling“ and „packaging“ stations are often locally separated from each other or only loosely linked. Thus, transport routes and intermediate steps are necessary, which lead to additional workloads for resources and employees. With the help of the COTEMACO project, employees are supposed to be relieved and resources/capacities are expected to be used better in the future by more efficient division and optimized process flows. Results of this restructuring as well as a (partial) automation of individual processes should bring the following advantages:

- More efficient use of resources and improvement of processing times
- Increase in productivity, especially for „high runner“ variants
- Reduction of stress on employees during monotonous tasks
- Reduction of rework and errors

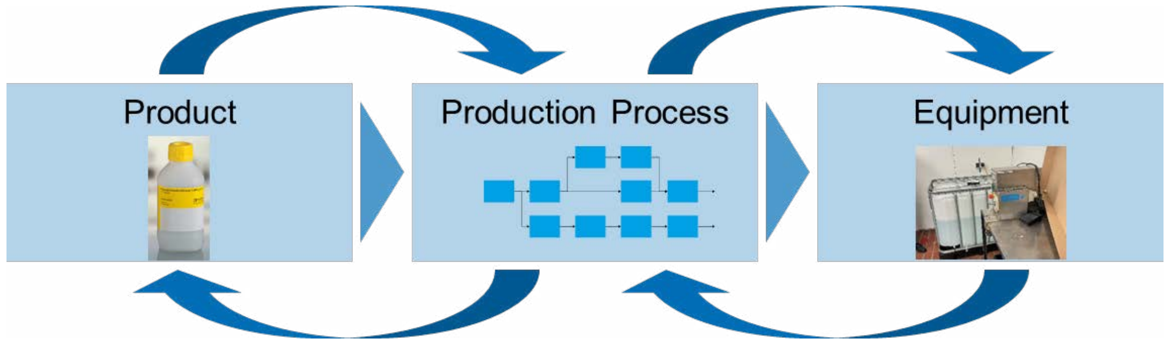
In the future, the part of the production with the „high runner“ variants (key production line for 1 L and 5 L containers of frequently requested ready-to-use solutions, reagents and salts) is to be separated to a new production area from the variant-rich special solutions. This will result in optimized and more efficient use of space. It is planned to integrate a (partially) automated „high runner“ line into the existing infrastructure from labelling to filling and packaging of the containers (brown field).



Analysis

As in all COTEMACO implementation projects, the project started with an analysis of the product, process and operating resources. In the first step, the individual work steps of the use case were documented and placed in the overall context of the production. In particular, „high-runner“ variants in the 1 L and 5 L container gradations were taken into account and the handling of the product was analysed. Considering parameters were, for example, container dimensions, process times (value-adding and non-value-adding activities), and batch sizes.
A key finding of the process analysis was the finely detailed division of labour in which the containers currently have to be picked up and handled several times. Furthermore, the percentage of non-value-adding activities is relatively high, for example, set-up and cleaning processes at the workstations and the transport of empty containers or mixed solutions. Particularly in the case of very small batches and frequent batch changes, non-value-adding activities increase and add up.
With the help of the analysis of process times as well as quantities and production

orders, the cycle time of the production was determined in order to later derive the concept of the implementation project. This shows that non-value-adding activities can be reduced, processes can be parallelized and productivity can be increased by optimizing the workplace (interlinking) and, in particular, by optimizing logistics and work organization.



Technical realization

When designing the new production areas for the „high runner“ variants, flexibility should be maintained despite the concatenation (labelling, filling and packaging). This means that the process stations can still be used separately from the line for manual tasks. Accordingly, continuous accessibility of all individual stations must be ensured in the conceptual design. Within the scope of the implementation project, the COTEMACO team focused on the 1 L & 5 L containers and considered other sizes in a scalable concept.
A significant percentage of the process time is caused by the set-up during a product changeover. In the COTEMACO implementation project, a „backpack“-system was designed to minimize set-up times by providing a solution and a material kit for filling the containers. In this way, all the necessary components for filling the next order are prepared and provided in sequence in the form of a „ready-packed backpack“. The reorganization and improved linking of production steps significantly reduces non-value-adding activities at the workplace, allowing employees to concentrate on the core processes of labelling (automated) and filling (partially automated). Furthermore, the multiple picking of partial products from e.g. empty containers as well as solutions to be filled is reduced and the intermediate storage of components is streamlined.

Result

The developed concept for optimizing the processes and production of the „High-Runner“ variants includes a new workplace/station concept (layout) and an adjustment of the internal processes. On the basis of the existing and forecast number of annual orders and process times, a layout and workstation concept was developed which provides for linking of labelling, filling and packaging for the „high runner“ variants and parallelizes processes. The use of a cobot (for handling tasks) can reduce the workload for employees, although based on the currently available data, the use of a cobot does not have any direct added value in terms of process times and output. The interlinking and proximity of the workstations to each other reduces manual handling and/or

the transfer of material and/or containers for the next process step. In addition, with the introduction of a „backpack“ system, the concept includes preparing the mixed chemical solution together with a material kit for filling and staging it in the logistics area of the workstation in sequence. This significantly reduces the setup times at the actual workstation, as a changeover from one solution to the next is much faster. In addition to the workstations, a corresponding (smaller) logistics area is therefore also provided for stocking and smooth changeover from one filling to the next. In the first stage of expansion and based on the prognosticated annual data, only labelling will be automated, while filling will be partially automated. The employee takes over the necessary actions for providing the container, starting & stopping the filling process, and (partially automated) closing of the container.

View from the employee perspective

Bernd Kraft is aiming to take a big step from manual to partially automated production in order to get positioned for the future together with the employees. During restructuring and especially during the introduction of new technologies, particularly when these are planned for cooperation with the employees, the involvement of the employees is extremely important. Whether a production change goes smoothly depends largely on employee acceptance of the new technology. Accordingly, Bernd Kraft plans to involve employees in the planning, design and implementation of the decision-making process from the very beginning. Specific training and workshops on working with the technology for employees help catalyse a successful rollout.

Interview

How could COTEMACO support you?

COTEMACO helped us to define the process steps down to the individual steps and to represent them by sequential or parallel work steps. From this, a concept was created, which is now the basis for a specification sheet for us.

What was implemented and what are the benefits?

Benefits: COTEMACO recorded the cycle times and sub-processes and combined them into one concept. Currently, the areas of filling, labelling and internal logistics for the material flow are not combined in one system. Implementation has not yet taken place because we still have to build up the infrastructure first. Another benefit is the reduction of personnel resources for recurring filling processes. Thus, more free space was created for the personnel resources to process the customer-related production.

Were your expectations fulfilled - technical implementation?

Partly because we assumed a higher degree of automation. However, the process analysis showed that this effort was not necessary. This was one of the most important points of expectation, which was thus fulfilled → Evaluation of the necessary degree of automation.

Implementation partner:

Success Story 3

In-House Production Automation & Co/Robot Opportunities for Clever Sweets, UK

Planning and implementation of automated equipment, and identification of future opportunities for cobot tasks

In-House Production Automation & Co/Robot Opportunities

Company description

Clever Sweets is a small confectionary business run by a single individual with a background in food science and technology having previously worked in product development for a major multifaceted food PLC. This background NPD expertise has led to the formulation of the LouLou's Lollies; a 'guilt free' lollipop. Every LouLou Lolly is sugar free, contains 100% of the recommended daily allowance of Vitamin C, and uses only natural flavourings and colours. The product was launched in 2013 after several years of research, with sales channels online and through a growing number of retailers. Currently production of LouLou Lollies is subcontracted out, and Clever Sweets are now wishing to gain more direct control over the process(es) by bringing production in-house to their premises in South Lincolnshire.

SME Support Activities

As sales volumes increase, Clever Sweets have engaged with the COTEMACO SME support programme to assist with basic automated equipment layouts in the new facility, and identify how to support further sales growth with the minimum of staff.
The basic production stages are:

1. Ingredients blending and heating.
2. Deposit blended mixture to moulds.
3. Add sticks before mixture hardens.
4. Cooling.
5. Demoulding.
6. Wrapping.
7. Boxing.

Clever Sweets desire to keep ingredients blending and heating (step 1) as a manual process for the present time for 'artisanal' control over the process, and further development of the precise temperature protocols required for product texture, and to avoid heat damage to sensitive ingredients.
Although flavours vary, the format for all LouLou Lollies are a standard 9g, 23mm ball on a 4mm diameter, 89mm long bio-degradable round stick. This allows for dedicated automation to be implemented for deposition into moulds (step 2), and wrapping (step 3). The selected depositor (Figure 1) can be readily adapted with different nozzle plates and piston configurations to accept a range of different moulds and is capable of depositing outer and inner product parts separately for two-colour or two-component products. These capabilities allow for an increase in Clever Sweets product range at a later stage. An Indexing mechanism will take moulds through the machine and make the deposit. Initially moulds are fed to the machine and removed manually to be set aside for cooling. The depositor is capable of 30kg/h, representing a production rate of

Figure 1. Depositer (Loynds Mini)

c.3300 lollies/h. The selected dedicated bunch wrapper (Figure 2) can operate at up to 115 lollies per minute (6,900 lolly/h) and would be able to wrap the maximum output rate from the depositor, and additionally be able to also support a 2nd depositor added at later stages when production throughput grows beyond the capacity of the single depositor.

Figure 2. Bunch Wrapper (Loynds BL-04).

The initial production layout incorporating the desired manual blending and heating and utilising the dedicated depositing and wrapping automation is shown in Figure 3. This configuration for continuous production would require 3 staff;

- operator A for blending loading product and moulds into the depositor,
- operator B for collecting moulds from depositor output, adding sticks and placing onto cooling tables,
- operator C for demoulding, and filling the wrapper infeed hopper, and returning empty moulds to the depositor infeed.

Since the wrapper outputs to a tote bin holding approximately 1h of production this is a process buffer and does not need continual attendance. Totes of wrapped lollies can be accumulated in the boxing area until end of the production batch and all staff can combine to execute the boxing.
Alternatively, the system could be run on a batch basis with one operator performing activities A, B C in sequence.

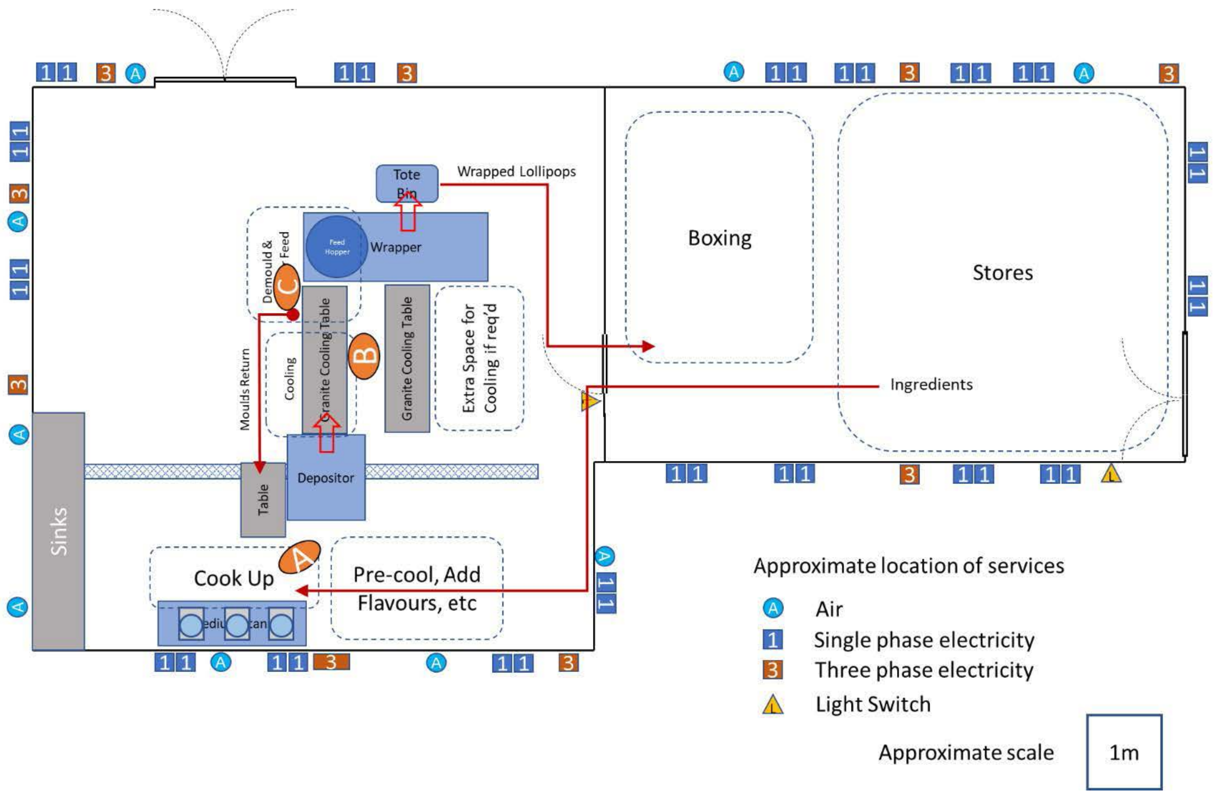


Figure 3. Initial Layout

Opportunity for Cobotic Automation

The initial inhouse production line will use manual operatives for flexibility and ease of refining process. As operations become more standardised there is good scope to introduce cobotic automation.
The lolly production stages are:

1. Ingredients blending and heating.
2. Deposit blended mixture to moulds.
3. Add sticks before mixture hardens.
4. Cooling.
5. Demoulding.
6. Wrapping.
7. Boxing.

Step 1 will be kept manual for process control reasons, and this operative (A) can also feed moulds and product to the depositor. Steps 2 and 6 have dedicated automation in place. The remaining operations, 3, 4, 5 and 7 between the output from the depositor and input to the wrapper are repetitive yet well-structured and thus are candidates for cobotic automation.

Potential Station 1 – Stick Placement

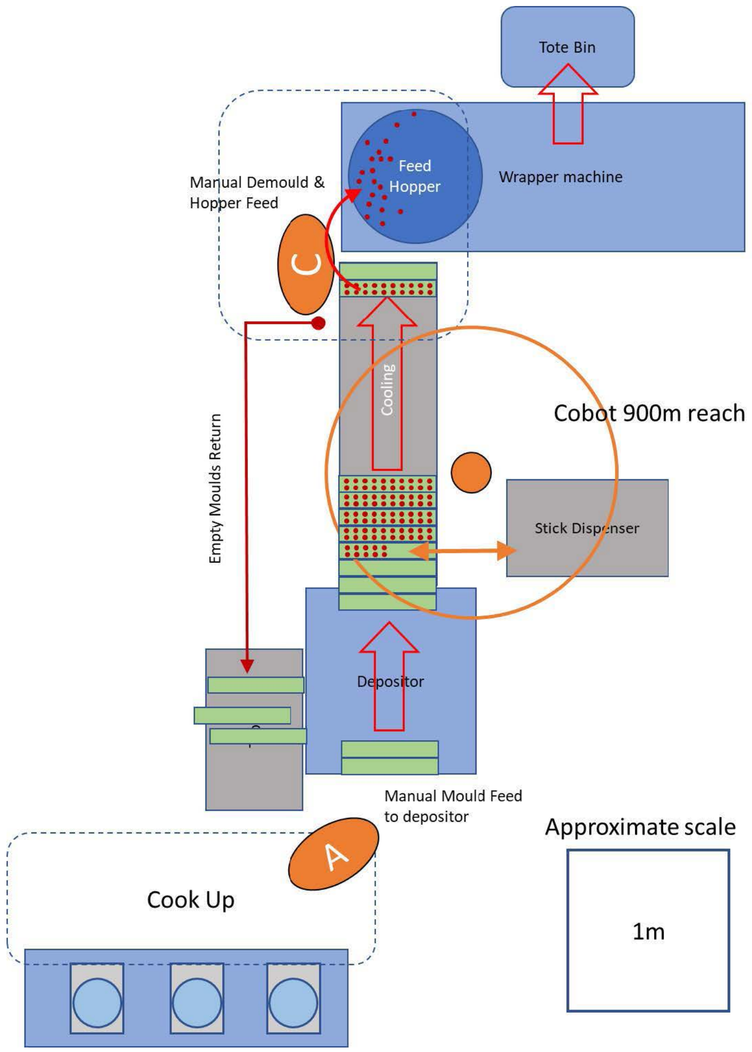


Figure 4. Stick placement cell

There are 20 lolly recesses in each mould and at maximum throughput of 21.6 s/mould, a stick would need to be placed every 1.08s. Very little (if any) process sensing is required as moulds output from the depositor are at known locations, the recesses (stick destinations) are at fixed geometry within each mould, and cooling rack (station output) is at a fixed location.
In the proposed basic cell (Figure 4) the robot would collect several sticks at a time using a multiple jawed gripper tool capable of holding 5, 10 or 20 sticks from a stick dispenser. Transferring several sticks at once reduces travel time within the cobot cycle. Depending on whether the sticks are supplied predominantly aligned or randomised (Figure 5), the dispenser could be as simple as a feed wheel, or require a vibratory feed or other mechanism to align sticks before grasping. Once gripped the cobot would then travel to the known fixed recess locations to place sticks into the setting

lolly bodies. There is a trade-off between size, weight and unwieldiness of gripper, and the number of travel motions required in the cycle for one mould.

Predominantly aligned *Random*

Figure 5. Variations in stick supply format

Potential Station 2 – Mould marshalling

Assuming moulds are 100mm wide and cooling time (step 4) is 10 minutes, c.3m of cooling table is required at the maximum depositor throughput rate. If racks are 150mm and cooling time is 20 minutes this increases to c.8.3m. This could be accommodated along a cooling conveyor, however as space within the Clever Sweets production facility is limited. An alternative would be to use a cobot to marshal moulds to and from cooling racks (Figure 6) to reduce footprint of the cooling process. There is a structured environment and little (if any) process sensing is needed. A marshalling cobot would collect moulds after stick placing and deliver them to a rack where they would reside for the required cooling time. After placing a warm mould on the rack, a cooled rack would be collected and delivered to the demoulding station. The stick placing and demoulding processes could be either manual or automated.

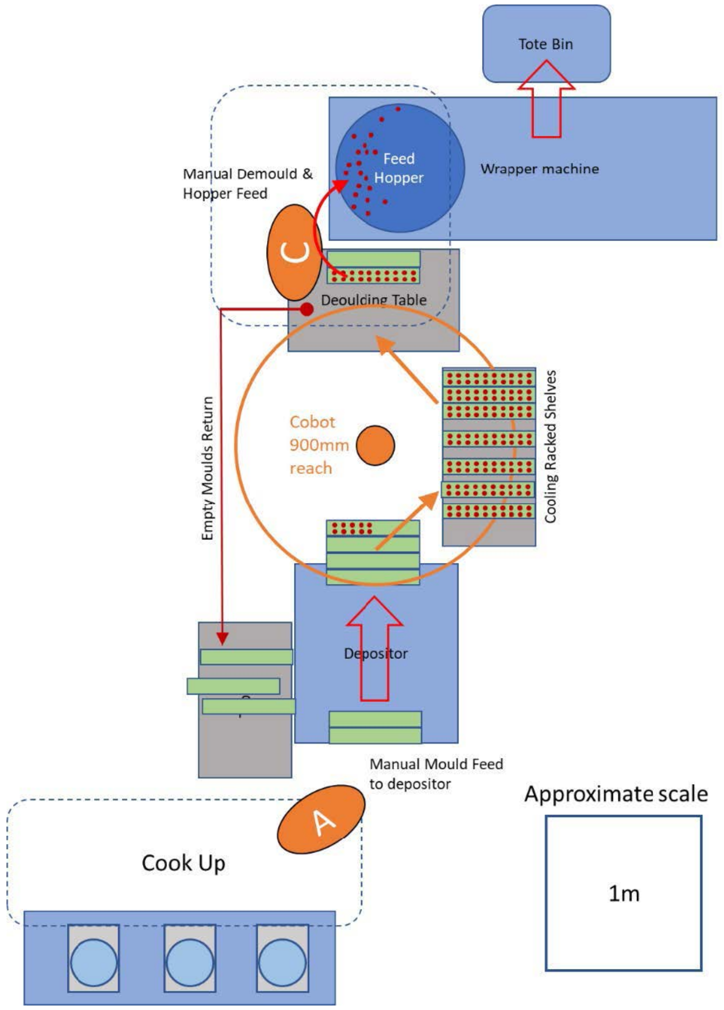


Figure 6. Mould marshalling cell

Potential Station 3 – Demoulding

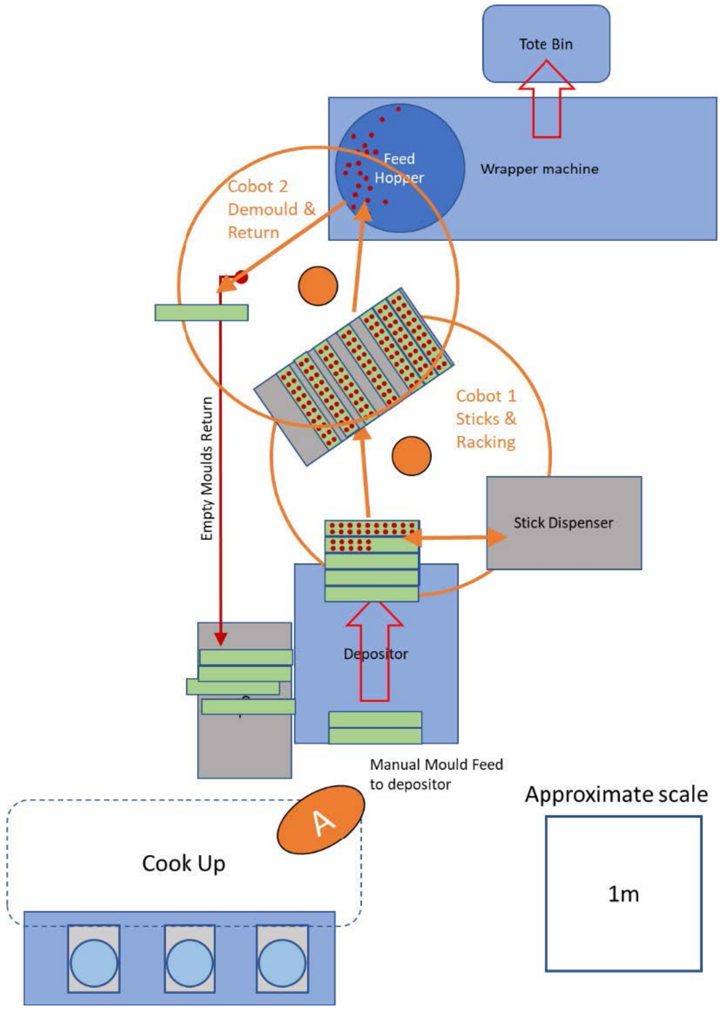


Figure 7. Demoulding cell

The demoulding process is repetitive and requires repeated manual exertion of forces to deform the moulds to eject the lollies. The demoulded lollies than have to be lifted to tip into the infeed hopper of the dedicated wrapping automation. This task could be usefully automated for long-term worker health and safety as well as process benefit. The cobot would collect moulds with set lollies from either the end of a cooling conveyor, or from cooling rack - these locations would be fixed and not require any positional sensing. The moulds would be pushed against a fixture to deform the mould and release the lollies directly into the infeed hopper. This application would require a higher payload cobot due to the need to resolve the demoulding forces through the cobot arm. Emptied moulds would be placed onto an inclined chute to return them to the start of the process ready for manual inspection and infeed to depositor. This demoulding could be combined with the stick placement cobot to completely automate the processes between depositor and wrapper (Figure 7).

Figure 8. Box

Potential Station 4 – Boxing

The current boxing format for LouLou's Lollies is a 10-piece outer box (Figure 8).
The output from the bunch wrapper is up to 6,900/h (1.9 lollies/s) in a random orientation from an outfeed chute. It is not feasible to individually identify, grasp and pack lollies at these speeds and cobotic boxing will need to accept this as an input.
Whilst not an ideal starting presentation, machine vision identification of the sticks is possible as they are the only straight parts in the view and are relatively long compared to the ball parts of the lollies. This machine vision generated positional data would define grasping locations and bin-picking algorithms could be employed. A basic pinch grip on the end of the stick would be used with jaws shaped to stick diameter to accommodate any slight sensing misalignments. This grip would allow lollies to be placed specifically into one of the slots in the box.

Implementation

At the time of writing, the depositor and wrapper have arrived on site and have been positioned according to the layout drawing in Figure 3. The majority of other equipment has been purchased and is available. Clever Sweets are currently in a funding round for investment to engage operational staff, once in place the initial manual line will be commissioned and production started. Once business has grown to sufficient levels, the cobotic roadmap plans will be revisited to confirm they still meet business needs.

Impact of COTEMACO support on the Business

The MD of Clever Sweets commented on engagement with the COTEMACO programme saying...
"COTEMACO enabled the detailed planning of the layout for a new manufacturing operation, optimising the workflow and accounting for the outputs of each machine. This gives a sound foundation for the next step, which on investment will be the creation of a fully automatic process. This is key to the mid-term success of the business".

Interview

How could COTEMACO support you?

Via the SME support programme, COTEMACO engages with SMEs from the automotive and food sectors through field labs. These regional field labs in the UK, the Netherlands, Belgium and Germany are showcasing key production steps in the automotive and food industries, in
Page 10 of 11
order to tackle current low sectorial awareness and knowledge gaps. The field labs will exchange knowledge on different manufacturing tasks, such as handling and (un) loading.
With the COTEMACO programme, manufacturing SMEs are guided through the process of adopting collaborative robotic and shop floor digitalisation technologies, from the exploration of technological opportunities to the detailed definition of a business plan.

Implementation partner:

ZeMA
Zentrum für Mechatronik
und Automatisierungstechnik

Success Story 4

Awareness-raising in the field of light-weight-robots and company digitalization for the Hasborner Mühle e. K.

Filling process and shopfloor layout optimization for flour sacks handling

Filling process and shopfloor layout optimization for flour sacks handling

Company description

Hasborn Mill started as a family business in 1702. The products are purely mechanically produced natural products: Flours, grist and bran. The grain is sourced locally within a radius of 50 km. Small to medium quantities are produced for direct sale as well as for bakeries, which are also supplied.

Motivation/Starting Point

The goal of the collaboration is to identify and analyze the challenges to the company in order to develop recommendations for action and a solution concept. The focus of the improvement process in the company is a more efficient use of the existing personnel, ergonomic improvements, as well as a higher economic efficiency through semi-automation. Two processes were considered as the main focus of the project:

1. the transfer of know-how throughout the entire production process

2. the packing of the flour into 25 kg bags, as well as the further transport under ergonomic and economical aspects

Analysis

1. Focus: provide a quick overview of the production tasks and equipment to enable new employees a short familiarization period. In addition, the process recording serves as quality assurance. Recommendation for action: digital documentation via tablet for on-site documentation; challenge/boundary conditions: Dusty environment, simple implementation through app support; to add images; transfer and storage of results also on PC.
2. Focus: mainly manual work with high physical load. Procedure: Process analysis of the filling into flour sacks, storage and further transport to trucks as well as the further transport chain were considered. Implicit and explicit restrictions were worked out, e.g. is it possible to change storage to pallets, space requirements, transport guidelines. Taking these points into account, a concept was developed.

Technical realization

1. Exchange of experiences: industrial tablets, different possibilities for documentation e.g. management apps were presented.
2. Awareness raising in the field of robotics but also automation, what are the advantages and disadvantages of new technologies. Concepts were worked out to step by step go forward with (semi-) automation. Improvements

in ergonomics can be realized, for example, with a changeover from completely manual to partially automated handling of the 25 kg flour bags by using a vacuum gripper. In a next step, this can also be completely automated with the help of a robot.

Result

Through the intensive engagement with the production process and challenges, some potential improvement points were identified, and internal processes were initiated and mapped out. Cotemaco was able to successfully set impulses and educate about new techniques in the areas of robotics and digitalization.

1. Process documentation is introduced step by step. Knowledge management is being set up and documented.By using a tablet, it is possible to train new employees faster and to plan capacities better. In this way, a changeover to other product segments can be planned in a better and more holistic way. This results in an improved competitive situation through gaining new target groups - the company is planning a small sale to local markets.
2. The company is currently not ready for the implementation of the semi-automated filling process. A detailed cost calculation and concept has been developed and is available. Because a new sales strategy is probably being pursued, it remains to be determined whether the concept fits the new product range.

Implementation partner:

University of Lincoln
National Centre for Food Manufacturing

Lincolnshire
County Council

FRPERC
Food Refrigeration and Process Engineering Research Centre

Success Story 5

Process Automation Opportunities for Jenny's Jams, UK

Assessing the current production processes and providing an automation roadmap to underpin future business growth

Automation Roadmap

Company description

Jenny's Jams is a small food business making jams, marmalade and chutneys from their premises in Lincoln, UK. The business has grown from a home kitchen producing products for sale at local car boot fares, to the current premises making c.1000 jars each week. These are distributed through local multiple retailers, farm shops, delicatessens, restaurants, cafes, and hotels. There is also a growing online sales channel direct to customers. Recipes use no additives or preservatives with ingredients sourced from local produce or from local suppliers wherever possible.
Currently the vast majority of production processes at Jenny's Jams are predominately manual and as sales growth increases this is becoming impractical for the volumes required.

Current processes

As sales volumes increase, Jenny's Jams have engaged with the COTEMACO SME support programme to improve production capacity and efficiency and reduce physical efforts. The current weekly production is c.1000 units/week, split approximately 75% jams and marmalades, and 25% chutneys. The majority of production is packaged in 3 sizes of glass jars (340g, 220g, 40g) along with small numbers of bulk catering buckets (1 - 2 litre) to order as required.
Current production is a manual batch process. Machinery is used for jar washing, and cooking, but all other processes and manual handling are performed by hand.
The basic production stages are:

1. Fruit/Ingredients preparation (washing, peeling, coring, cutting, etc).
2. Combine ingredients & heat whilst stirring. Jams and marmalades manufactured in 30-50kg batches in a 300L kettle (Figure 1). Chutneys are produced on a stove top in 10L pans (Figure 2).
3. Whilst cooking is proceeding, machine wash enough jars for the batch.
4. Manually hot fill jars, by dipping a jug into the hot (60°C) products and pouring the contents into jars.
5. Manual lidding of jars
6. Machine wash filled jars to remove any spills from the external surfaces.
7. Allow to cool in store.
8. Manually apply product and BBE labels.
9. Store ready for dispatch.

The jam/marmalade cook up process takes 45-60 minutes per 50kg batch and once ingredients are added the cooking process is automatic with the kettle control system performing stirring and temperature control. Jars are pre-washed in trays of 40-42 taking 2- 3 minutes for each tray. A tray of pre-washed jars is brought to a working table close to the kettle and the operative reaches into the kettle with a jug to scoop out hot product and manually fill each jar. Lids are screwed on manually and this is

Figure 1. 300L jacketed jam/marmalade cooking kettle

Figure 2. Stove top chutney cooking

repeated until all jars in the tray are filled. The filling and lidding takes between 9.2s – 12.3s per jar, with a mean of 10.7s. The tray of lidded filled jars is carried to machine wash the outsides and fresh tray of prewashed jars is collected. This cycle is repeated until the entire production batch in the kettle has been jarred, lidded and externally washed. These processes require substantial staff movement around the production space (Figure 3).
The chutney jarring process is similar, but batch sizes c.10kg are substantially smaller.

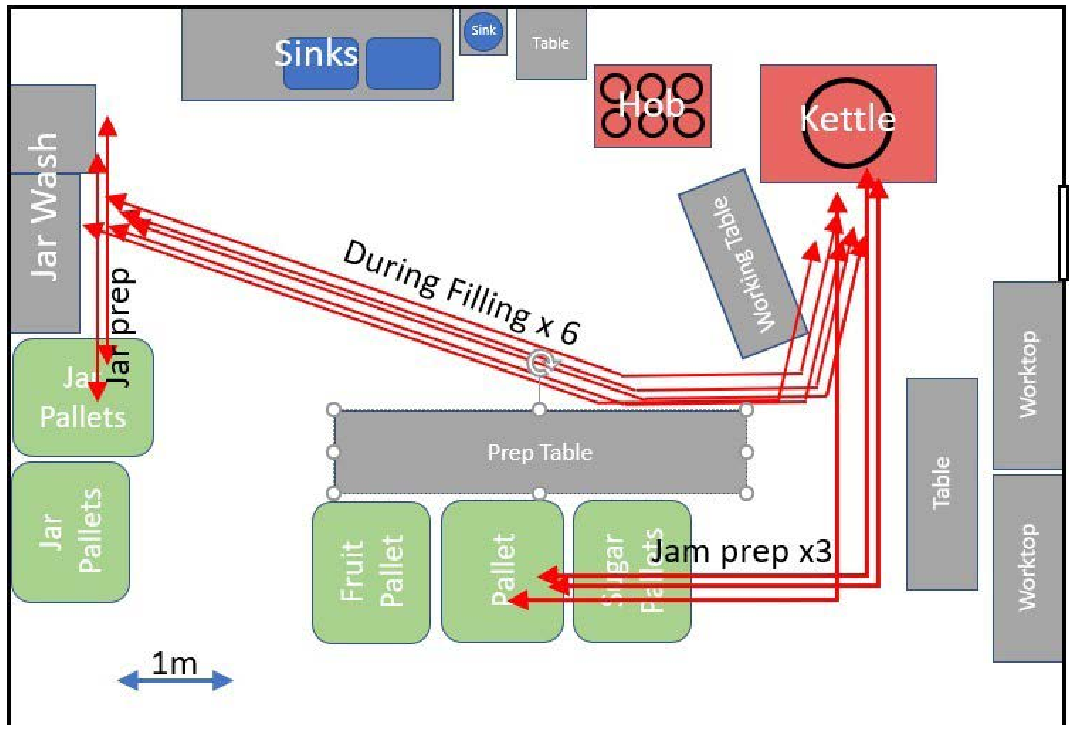


Figure 3. Process layout and movements for each batch

SME Support Activities

It was clear from the outset that a step change immediately to a cobotic / robotic automation manufacturing solution would not be suitable for this small enterprise at this point in time. There were no technical automation skills within the business, capital investment funding was limited, and beneficial gains could be achieved with simpler, lower cost interventions as initial stages of a phased automation roadmap.

An initial assessment of the production operations was carried out to identify bottlenecks, effort intensive operations, and process flow issues where automation could provide business benefit. Based on these findings a series of options were produced, along with associated projected cost-benefits. These proposals were discussed and honed with the business and formed the basis for the actions briefly described below to bring beneficial automation into the process.

Initial Steps

Initial process observations showed substantial movement around the production area (Figure 3). Currently during the filling process, once a tray of jars has been filled the operator delivers this tray of jars to the outside wash and collects the next tray of pre-washed jars. This happens 3 or 4 times per batch. These movement times could be reduced by re-positioning the washer closer to the hob and kettle, however they should make up only 2.7% of the total batch process time. In the process observed, this non-value adding operation was taking 6.8% of the batch time because jars had to be transferred to crates to free up washer trays for use. Purchasing additional washer trays would enable all jars for a batch to be pre-washed during the cooking time, thus avoiding delays seen during the filling time waiting for trays to pass through the washer and be available for the next group of jars. This would save a calculated 4.1% of batch time for expenditure of c.£60.

Larger batch sizes are inherently more efficient as the relatively fixed prep and cook up times are spread over a greater number of jars. Currently with 10kg Chutney batches it would take c.1h to cookup and fill 28 (340g) jars, a mean time of 2m06s per jar. Preparing a 30kg batch and allowing for a 25% longer prep and cook time the time per jar approximately halves to 57s per jar. Chutneys cannot be made in the jam kettle for reasons of taint. Purchase of a second kettle or bratt pan (c.£1.5k-£5k) for chutneys could increase production rate for chutneys by c.100%.

The same rationale applies to the large 300L kettle for jams where currently a 50kg batch has a mean overall rate of 34s / jar. Using batch sizes of 100kg, 200kg, and 300kg and allowing for a 25% increase in prep and cook times would give mean overall rates per jar of 24s, 20s and 19s respectively. However, the physical stresses of manually filling each jar by jug and hand screwing of caps would increase substantially with larger batches. The use of depositor automation would decrease the repeated stresses of reaching into the kettle for each jug-full, produce faster fill times, and potentially reduce splashes on the outside of jars potentially removing the need for the jar outside washing process.

A benchtop depositor is the most appropriate size for current production. This would be mounted to allow a trolley to pass under the nozzle outlet. The jars would be kept in the dishwasher trays (or the smaller blue crates) to move many at once and reduce handling. The weight of the tray of jars during filling would be supported by the trolley and moved manually to place jars sequentially beneath the nozzle and then triggering each fill with a foot switch. This is expected to reduce mean fill time per jar from c.10.7s to c.5s, resulting in a c.52% increase in filling rate per jar, and a c.16% improvement in overall rate per jar taken across an entire 50kg batch. Investment cost for depositor would be c.£4k to c.£12k. The particulates of fruit in the products poses an additional challenge and practical trials will be required to determine if a specific depositor can deal effectively with the full range of products. A revised layout with depositor is shown in Figure 4.

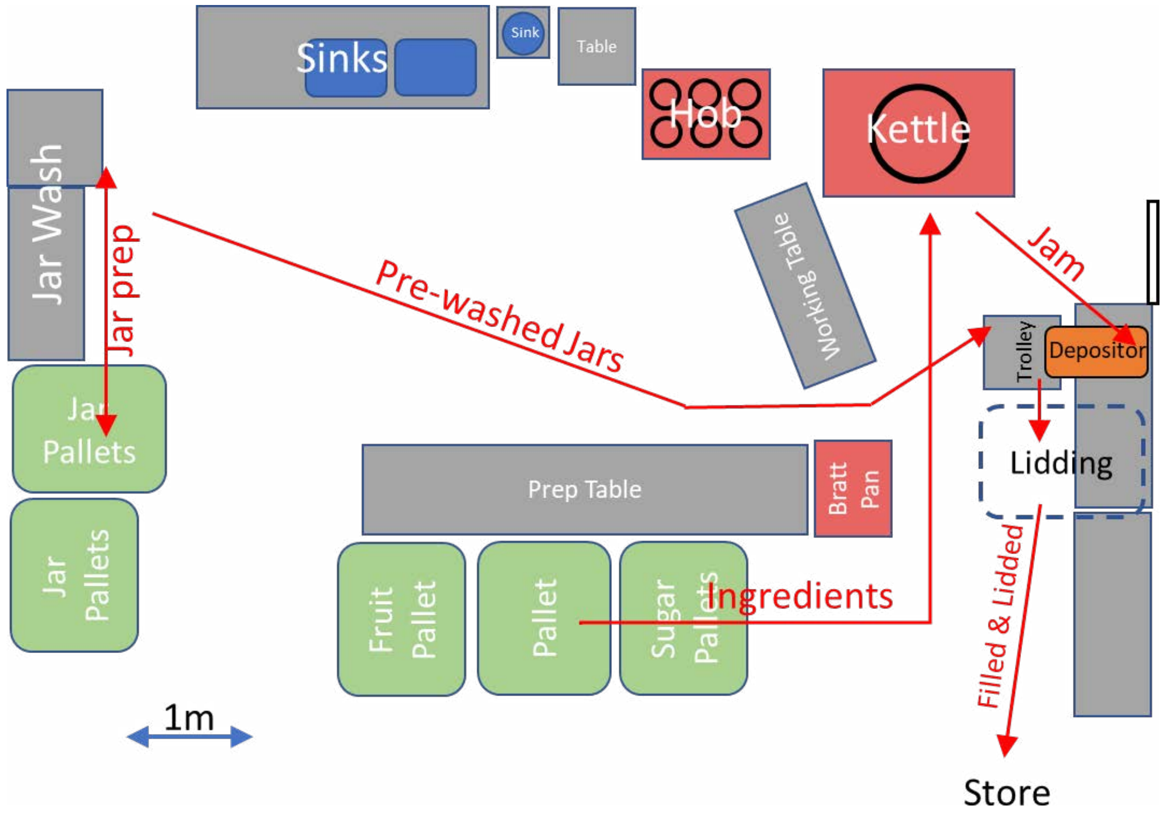


Figure 4. Revised layout with depositor

A handheld pneumatic lid tightener could be used to reduce repetitive strain injury (RSI) risk to wrists with the increased numbers of lids needing tightening. Whilst there are no direct speed improvements, the cost (c.£900) could be justified under health and safety as RSI risks are reduced.

Alongside the depositor itself is the challenge of safely getting hot product from the kettle into the depositor hopper. In the short term a large jug could be used but this requires reaching into kettle and lifting to tip into the hopper. At later stages using a transfer pump to ease this process however to cope with the particulates in the jams/ marmalades/chutney process start at c.£11k.

Subsequent Steps with Cobot

As business grows there is a key decision to be made on how to increase production further; this could be achieved by employing staff or investment in cobotics to perform the handling of jars between processes on the existing equipment that was previously performed manually. Using the cobot would free up staff time from the tedious repetitive jar transfers, whilst avoiding the costs and complexities of employing staff. A cell layout for this latter option is given in Figure 5.

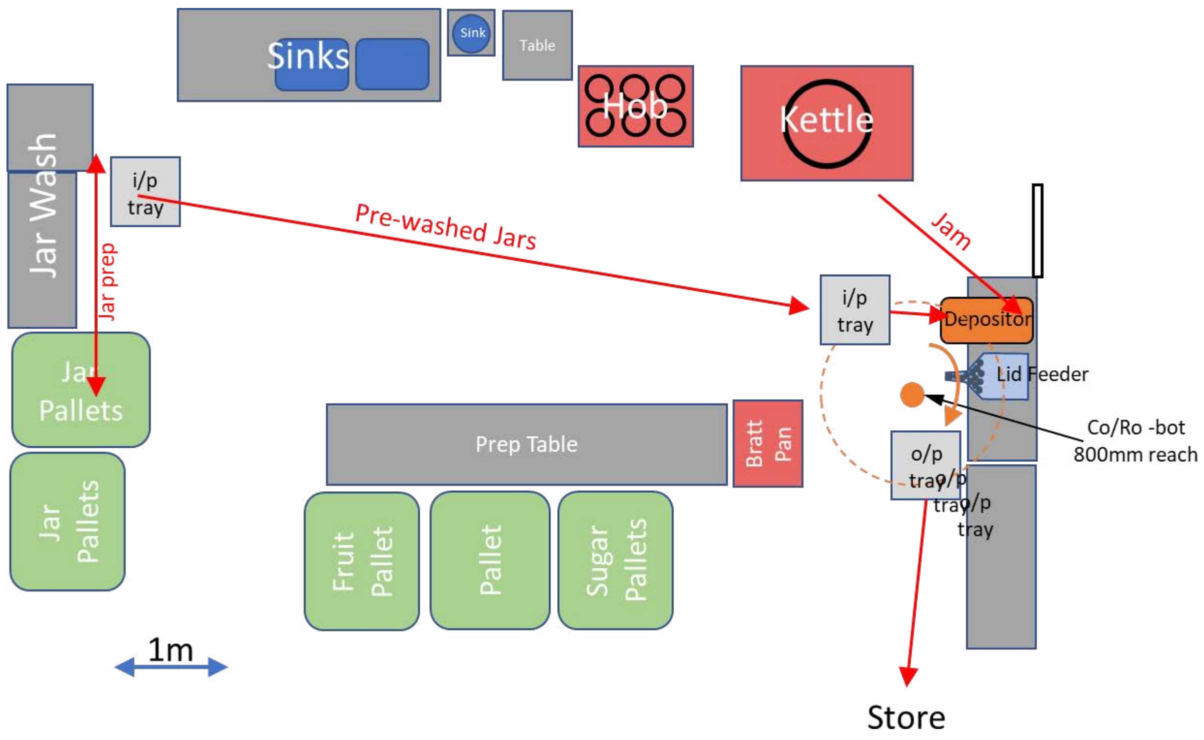


Figure 5. Cobotic cell for jar lidding

Manual ingredients preparation and automated kettle cook up would be as with the current process. Jars would be pre-washed and brought to the depositor within the cobot cell envelope. Jars would be placed manually under the depositor nozzle, and either the operator would press a button, or the jar presence could be automatically detected initiate the sequence. Once the sequence is triggered, the deposit would be started and the cobot would collect a lid while filling is taking place. Presentation of lids for picking will pose some challenges as these are supplied loose and will be in random orientations and positions. A vibratory feeder should be able to orient the lids for pick up, but trials would be required to confirm this. A bin-picking algorithm to pick individual lids from a loose pile could be used, but this would be a substantially more complex and costly approach. The collected lid would be placed on top of the jar in the known location at the depositor, and the jar then transferred to the lid tightener tool previously used manually. The jar would then be placed into the output tray and the cobot wait for the next jar to be input at the depositor.
This configuration is not fully autonomous and still would require an operator to load jars. Empty jars could be collected directly from the tray by the cobot but this would require additional sensing, and prevent the inherent inspection of jars for integrity and cleanliness that is possible if the infeed from the tray is manual.

Implementation

At the time of writing, Jenny's Jams are considering the automation roadmap and preparing to implement initial stages. Further steps will be reviewed and implemented as time progresses and the enterprise grows. Business growth will be both the driver and financial enabler for adoption of further automation including cobotics.
The main opportunity for cobotics occurs later in the automation roadmap to remove the tedious and repetitive jar handling operations between process stations. This approach integrates with previously implemented process units that were manually loaded and unloaded in earlier automated process configurations.

Interview

Impact of COTEMACO support on the Business

Jenny Smith, MD of Jenny's Jams commented on the engagement with COTEMACO programme: "I found the process interesting and useful. In particular we would like to progress with the suggestions for auto filling and lidding once our finances permit. Whilst a bratt pan for the chutneys would make control of uniformity of cooking easier, we have decided instead to invest in a second kettle as this would be OK for chutneys, but more importantly give a backup in case of breakdowns on the current jam kettle."

How could COTEMACO support you?

Via the SME support programme, COTEMACO engages with SMEs from the automotive and food sectors through field labs. These regional field labs in the UK, the Netherlands, Belgium and Germany are showcasing key production steps in the automotive and food industries, in order to tackle current low sectorial awareness and knowledge gaps. The field labs will exchange knowledge on different manufacturing tasks, such as handling and (un)loading.
With the COTEMACO programme, manufacturing SMEs are guided through the process of adopting collaborative robotic and shop floor digitalisation technologies, from the exploration of technological opportunities to the detailed definition of a business plan.

Implementation partner:

Zentrum für Mechatronik und Automatisierungstechnik

Success Story 6

Automated blasting test for K.-H. Müller Präzisionswerkzeuge GmbH

Feasibility study of a surface treatment method with a UR robot

Automated blasting test

Figure 1: first test of different handling principles (Photographer: Lisa Kopp, Umwelt-Campus Birkenfeld)

Company description

Müller Präzisionswerkzeuge is engaged in the development, design, production and reconditioning of innovative high-performance tools made of solid carbide. In close cooperation with universities and research institutes, ever better tools and reconditioning processes are developed in order to continuously maximize the cutting forces, cutting speed and tool life.

Motivation/Starting Point

The company has a very innovative surface treatment step for cutting tools, which is currently carried out manually in a blasting booth. The aim is now to investigate whether this step cannot also be automated with the help of an industrial robot. Due to the environment, the variety of variants and the quality requirements, this is a challenging task.

Analysis

The analysis of the product range under consideration showed that, from an economic point of view, it makes sense to focus on the tools that are most requested by customers. However, the resulting product spectrum is still very extensive, especially since such features as diameter and tool length are not discrete but continuously pronounced. The swirl angles present on the tools, which also play a major role in machining, are not necessarily known before machining, so these must also be measured before machining. For technical reasons, the blasting material used in this process is used in a blasting cabin under negative pressure. Therefore, the corresponding robot must also be equipped with a hood and a transfer station.

Technical realization

In a first step, a detailed process analysis was carried out. Due to the large number of variants and the partly complex process, it quickly became clear that only a first prototype could be created within the scope of this COTEMACO project. After the analysis, different robots, gripping concepts and measuring methods were evaluated and a sealing of the robot was tested in order to find suitable modules for the implementation. After this concept phase, combinations for different budgets were created, one of which was then procured after close coordination.

Result

Through the analysis and evaluation within the framework of this COTEMACO project, it was possible to find an initial solution for the individual functional components of an automated blasting system and thus to prove its feasibility in principle.
In the project it also became clear how important a good as-is analysis is and the understanding of the background of the partners, so that all participants have the same basis and can work together on the goals.
In the next steps, the solutions found are now to be further improved and combined into an overall solution, which can then also be used at the Müller company in the future.

View from the employee perspective

When there are many similar parts to be handled, the manual processing of the parts is a physically and mentally very monotonous and exhausting task. Therefore, the employees at this point are glad to be relieved of this work. Special parts that are not included in the automated spectrum are still processed manually in the blast cabinet. However, these are now only diversified individual parts and small batches.

Interview

How could COTEMACO support you?

COTEMACO helped us to assess the current shot blasting process from the outside and to identify and leverage potential for improvement. Therefore, we have carried out a detailed as-is analysis together in order to obtain as comprehensive an overview as possible in the individual sub-areas of the process. Subsequently, an improved or automated solution was found for many sub-problems and evaluated as a prototype in a first step.

What was implemented and what are the benefits?

Following the analysis of the current situation, various scenarios were examined to determine what an automated solution might look like. Of particular interest were the sub-problems of automatic workpiece guidance within the blast cabinet and the measurement of the geometries and parameters required for this. These initial prototypical approaches to these problems already significantly reduce the consumption of the very cost-intensive blasting medium and ensure improved quality through uniform application. Furthermore, it can be assumed that a later implementation within a plant through the use of robots can also significantly reduce the series dispersion induced by the previously manual activities.

Were your expectations fulfilled - technical implementation?

Our expectations were fully met. The automated approach now opens up completely new possibilities for influencing the process and quality can at least be maintained at the current high level, if not increased further. The time that follows will show how the results can be turned into a plant for productive operation and what additional advantages this will then bring.

Were your expectations fulfilled - Support through COTEMACO?

The support from the COTEMACO partner was very good at all times. The employees are able to empathize well with the customer's problems and, after a process analysis and definition of partial problems and goals, work very focused on an objective overall solution.

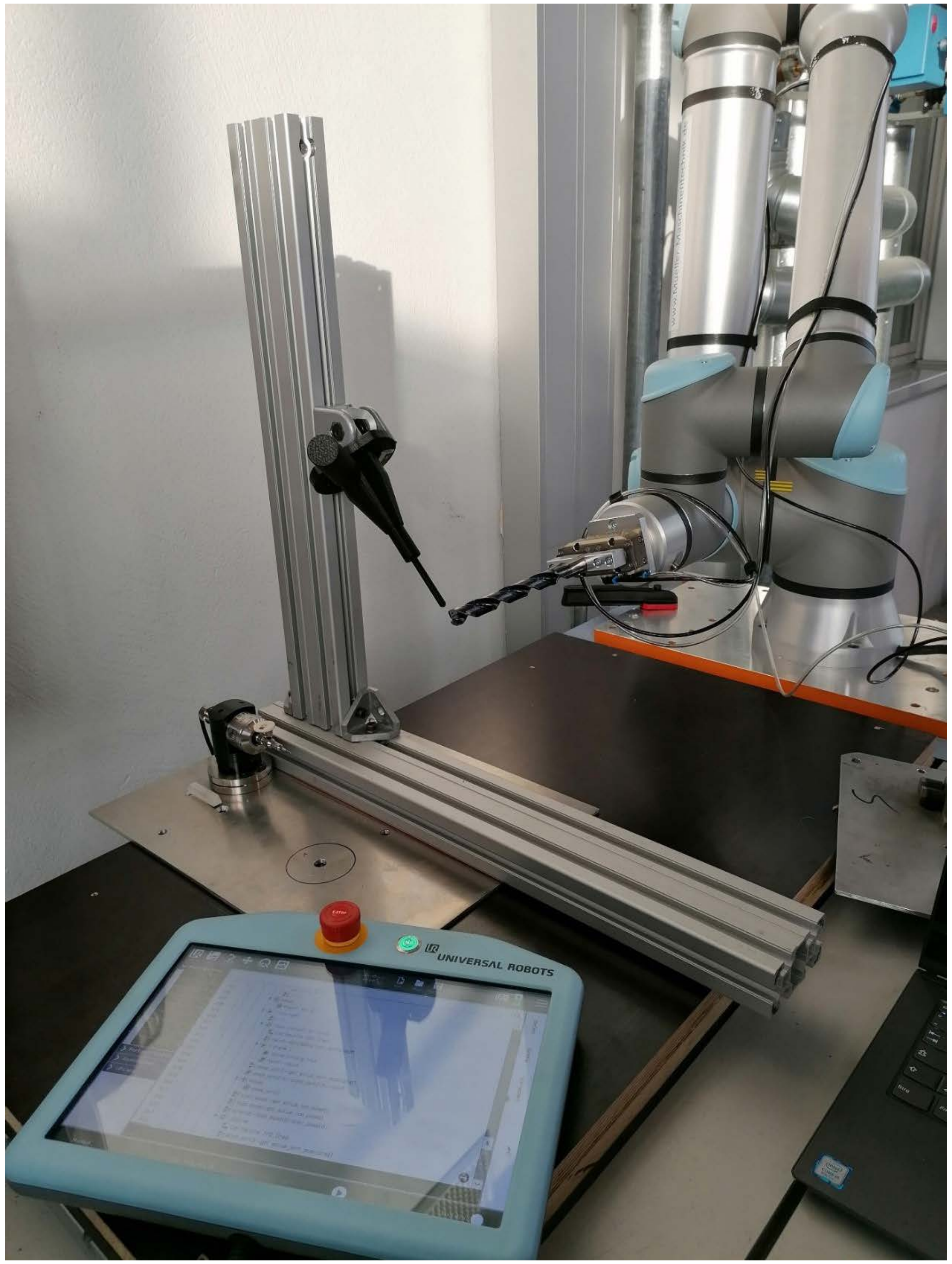


Figure 2: Test the suitability of a particular robot system (Photographer: Lisa Kopp, Umwelt-Campus Birkenfeld)

Implementation partner:

ZeMA
Zentrum für Mechatronik
und Automatisierungstechnik

Success Story 7

Assembly of clamping rings with a cobot for KMH - Kammann Metallbau GmbH

Feasibility study for a semi-automated production line for assembling clamping rings.

Assembly of clamping rings with a cobot

Company description

KMH is one of the leading manufacturers in Europe of clamping rings or flange connected pipes, components and systems for aspiration and bulk materials of all kinds. The specialties are individual pipe systems and tailor-made special products of all kinds in order to be able to react quickly and flexibly to the individual requirements of the customers.

Motivation/Starting Point

Currently, the rings are assembled completely manually. This is a monotonous and ergonomically unfavourable task that the worker has to do for 8 hours straight. In addition, some of the rings have to be assembled externally to achieve the required volume. By automating the process, KMH hopes to be able to assemble the rings

completely in-house again and at the same time achieve a higher production quantity and quality. They also hope that this first robotic application will be the foundation for more automation in the future.

Analysis

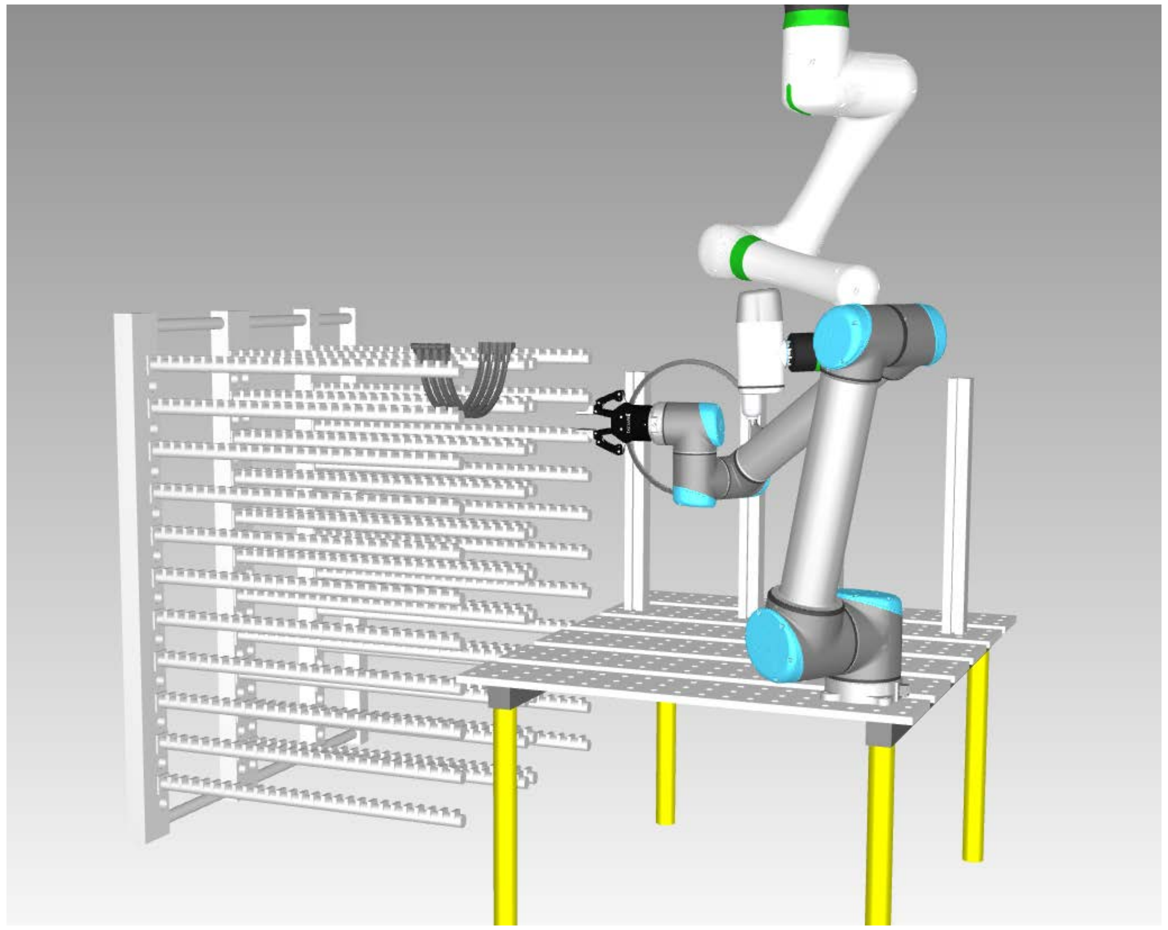
Due to the many different diameters of the rings, the line must be very flexible. At the beginning of the project, two challenges were identified that had to be overcome. The ring halves cannot be provided in a lattice box as before, because separating them with a robot would otherwise be too complex and time-consuming due to the geometry of the parts. The second challenge is to align rotating threaded inserts in the rings so that a bolt can be inserted through both. At the end of the project, the line should achieve a cycle time of one ring per minute.

Technical realization

To implement the project, a system with two cobots is planned. The first robot removes the ring halves from a material chute and positions them in a holding device. This robot also removes the assembled rings and places them in a grid box. The second cobot is equipped with a bolt-tightening tool and is responsible for assembling the rings.

Result

The feasibility study has shown that it is necessary to load two fixtures at the same time in order to achieve the desired cycle time. In the tests, the material slide proved to be a good solution for feeding material (provided you choose the right angle).



Interview

How could COTEMACO support you?

The COTEMACO initiative and the cooperation between the project partners gave us the opportunity to find a solution for a more efficient assembly process. Realising this concept could secure the production and assembly for the product in a cost efficient manner. The project work with the university and the supplier combined made the concept forward-looking but also actionable. The initiative gave us a good platform for an open and cooperative project execution.

Implementation partner:

UNIVERSITY OF LINCOLN

Success Story 8

Automation Roadmap for Lincolnshire Drizzle Company, UK

Assessing the current production processes and providing an automation roadmap to underpin future business growth

Automation Roadmap

Company description

The Lincolnshire Drizzle Company produce a range of dressings, marinades, and pestos from a small manufacturing facility in Grantham in the UK. All products use locally produced extra virgin cold pressed rapeseed oil to maximise the health benefits of Omega oils 3,6, & 9 and plant sterols, and provide a rich source of vitamin E, an antioxidant that contributes to the protection of cells from oxidative stress.
The core outlets for the products are through farm shops, garden centres, the Lincolnshire Co-operative stores, and a small amount of direct online sales.
All sales channels are growing and the business is looking to ramp up production from the current 'large kitchen scale' to small scale industrial production. The Lincolnshire Drizzle Company currently has 1 fulltime operative covering all aspects of the business: purchasing, production, marketing, sales, and distribution.

Current processes

As sales volumes increase, The Lincolnshire Drizzle Company have engaged with the COTEMACO SME support programme to improve production capacity, efficiency and productivity. The currently weekly production is c.500 units/week, with a projected need for 5,000 units/week with 2 years.
Current production is a predominantly manual batch process. Blending, Filling (Figure 1), BBE and cap labelling are performed manually, with 2 benchtop semi-automated machines for capping and side labelling (Figure 2).

Figure 1. Current manual blending and filling processes

The baseline process line configuration (Figure 3) has buffers between each operation and several double handling transfers where bottles are moved from the output of one process to input buffer of the next (rather than a common single buffer between processes). For ease of manual filling, products are mixed in sub-batches of c.3.5 Litres.

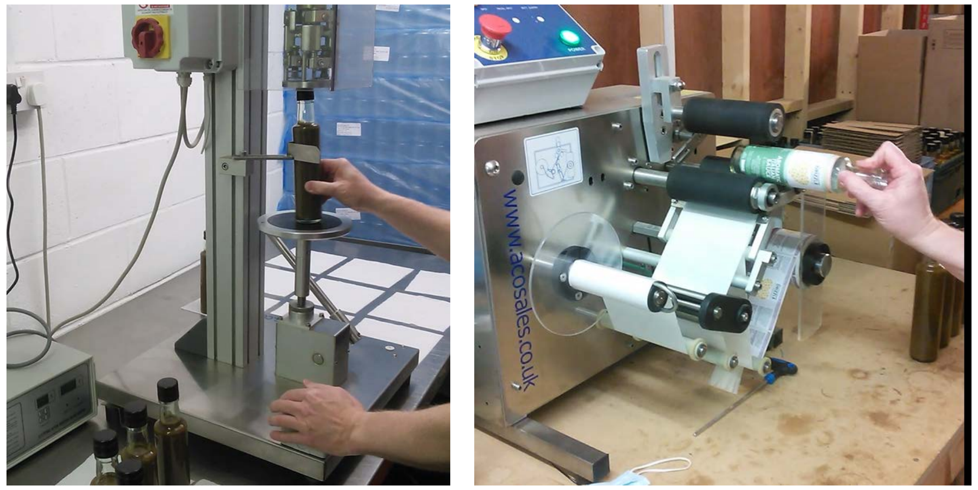


Figure 2. Current semi-automated benchtop capping and side labelling

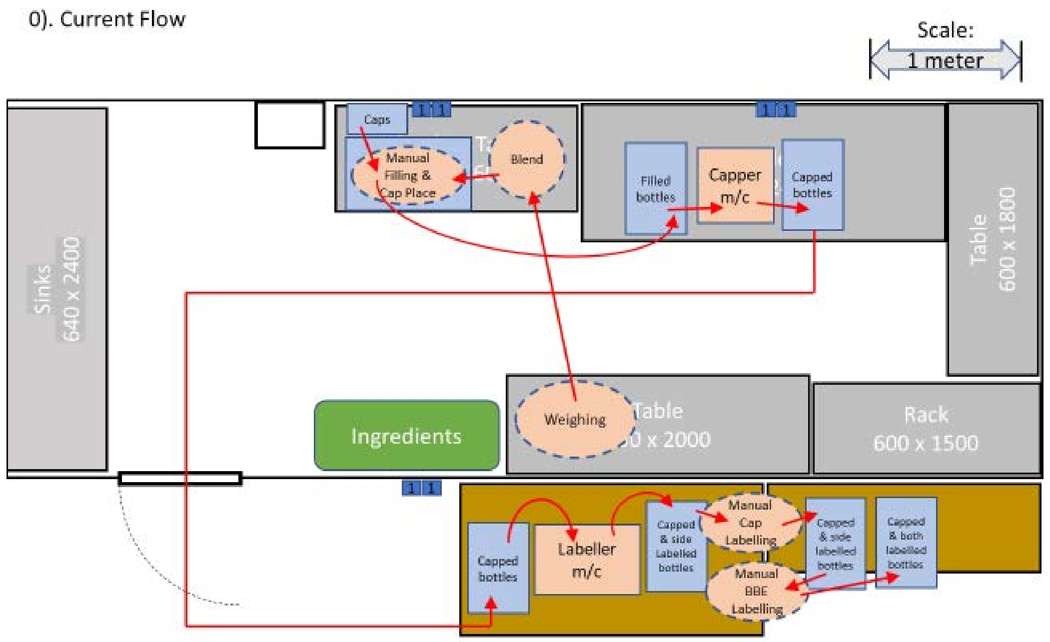


Figure 3. Current Process flow

Total process times with this baseline setup for a 50 bottle (12.5L) batch are c.319s per bottle (excluding resting time in buffers). The operations taking the most time over an entire batch are weighing and mixing (30%), filling (24%) and BBE labelling (13%).

SME Support Activities

It was clear from the outset that a step change immediately to a cobotic / robotic automation manufacturing solution would not be suitable for this 1-man SME at this point in time. There were restricted technical automation skills within the business, capital investment funding was limited, and beneficial gains could be achieved with simpler, lower cost interventions as initial phases of a staged automation roadmap.

An initial assessment of the production operations was carried out to identify bottlenecks, effort intensive operations, and process flow issues where automation would provide business benefit. Based on these findings a series of options were produced, along with associated projected cost-benefit. These proposals were discussed and honed with the business and a priority sequence agreed. This formed the basis for the sequenced automation roadmap and is briefly described below. The baseline process flow is shown in Figure 3. The operations taking the most time over an entire batch are weighing and mixing (30%), filling (24%) and BBE labelling (13%).

To address the largest of these, working with larger sub-batches spreads the weighing and blending time over more bottles. The precise amount of improvement varies with batch and sub-batch sizing, but an outline model for a 50 bottle (12.5L) batch moving from a 3.5L to 5L sub-batch would reduce process to 221s per bottle (31% improvement). The effects for different batch and sub-batch sizes can be experimented with in the simple spreadsheet model developed as part of the business support.

Small gains can be made at little capital cost by modifying the process layout to effectively bring operations closer together to reduce non-value adding transfer times. These are:

- Smooth the process flow to capper by filling bottles at the pick-up location for the capping operation (Figure 4). This avoids the transfer from filling area to capper and reduces process time by 3% for a 50 bottle (12.5L) batch with 3.5L sub-batch.
- Move the labelling operation into the production space (Figure 5). This avoids the transfer from capper output to outer room and reduces process time by 4% for a 50 bottle (12.5L) batch with 3.5L sub-batch.
- Transfer each bottle directly from output of one process to input of next (Figure 5). This avoids the double handling times in putting bottles down and then picking them up again and reduces process time by 7% for a 50 bottle (12.5L) batch with 3.5L sub-batch. However, the operator would need to move with every bottle through the processes.

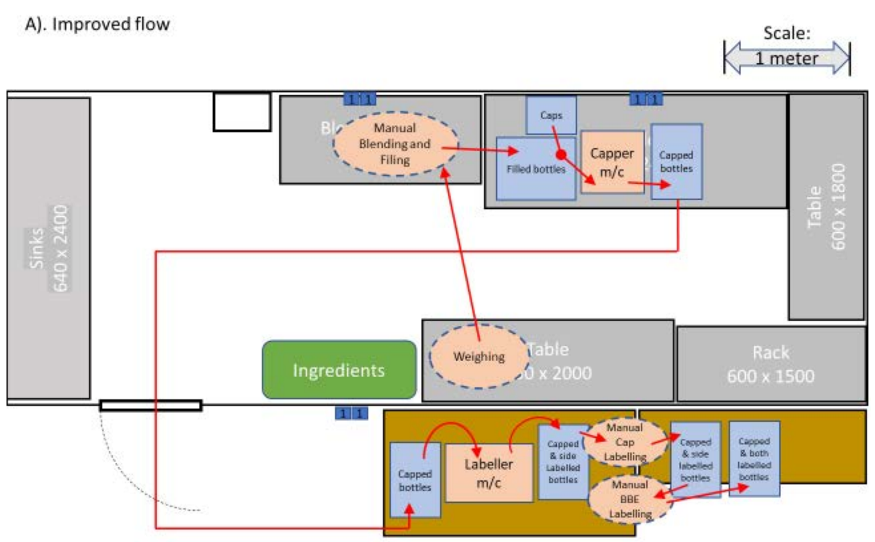


Figure 4. Revised layout with depositor

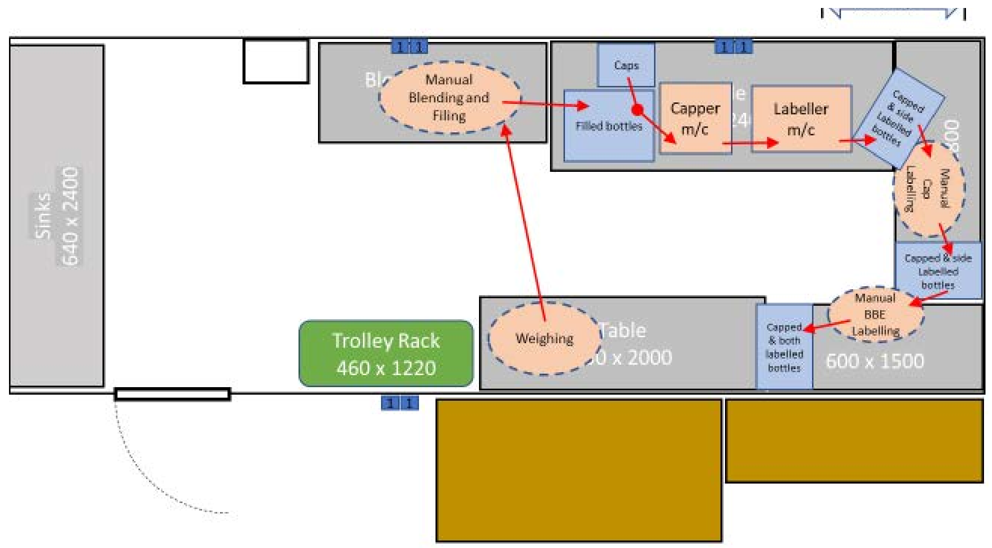


Figure 5. Labelling moved into production space.

At higher capital cost, equipment to address the bottle necks at filling and BBE labelling can be brought in.

- Incorporating a benchtop depositor (Figure 6) is projected to reduce mean filling time per bottle from 19s to 4s, resulting in an overall reduction in process time by 19% for a 50 bottle (12.5L) batch with 3.5L sub-batch. Estimated costs £6k-8k, including compressor to drive the depositor. An agitator in the supply hopper is required because of the propensity of the product to naturally separate.
- Purchasing a handheld printer to print BBE dates directly onto the label is projected to reduce mean BBE labelling time per bottle from 10s to 3s, resulting in an overall reduction in process time by 9% for a 50 bottle

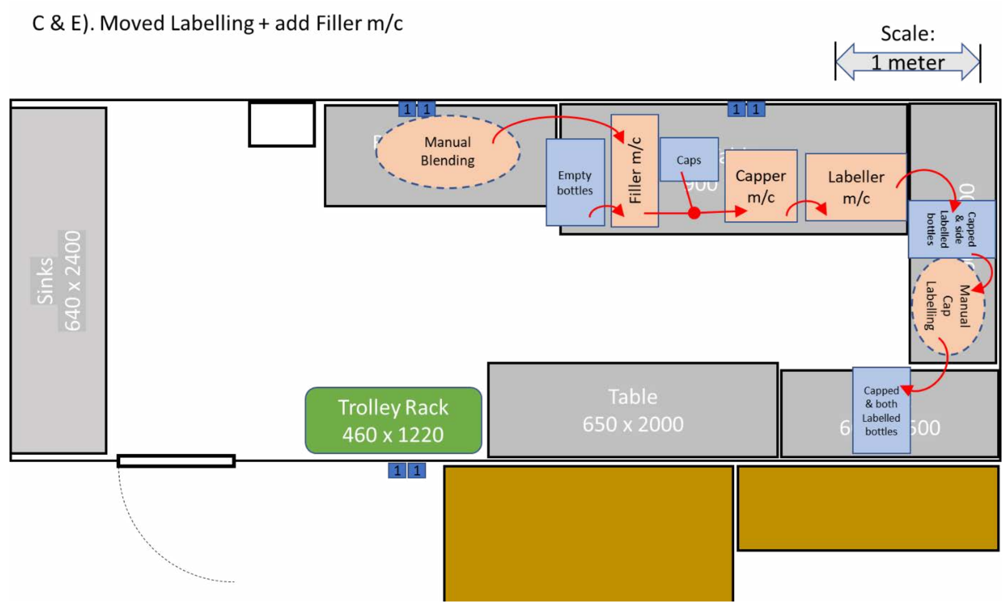


Figure 6. Layout with depositor for filling

- (12.5L) batch with 3.5L sub-batch. Estimated costs £800-£1,000.

As business grows there is a key decision to be made on how to increase production time available; this could be achieved by employing staff or investment in co/robotics to perform the manual handling of bottles between processes on the existing equipment. Using the cobot would free up staff time from the tedious repetitive bottle transfers, whilst avoiding the costs and complexities of employing a first staff member. A cell layout for this latter option is given in Figure 7.

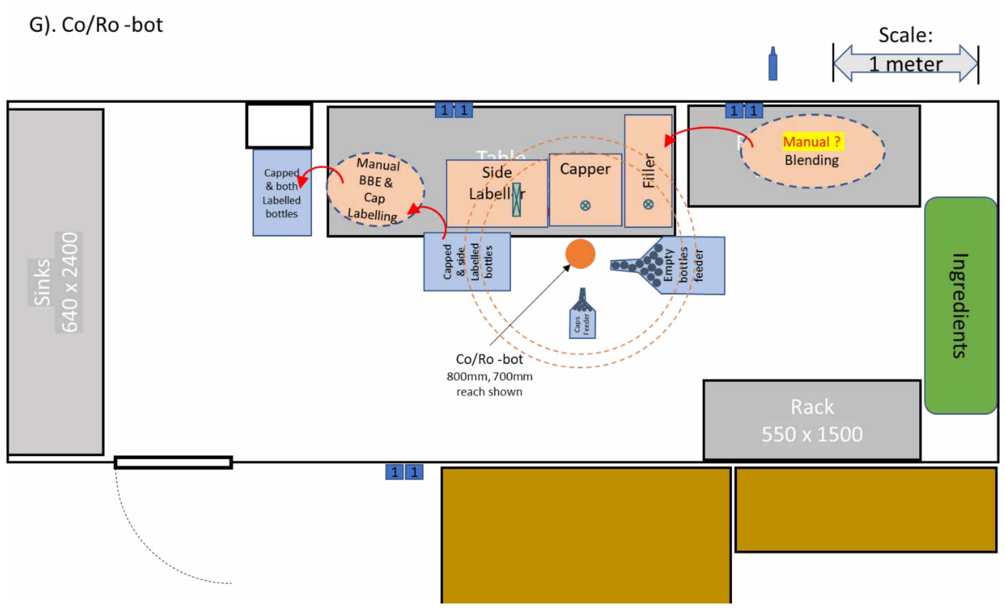


Figure 7. Co/Robotic cell for bottle handling

Blending can remain manual (although mechanisation would aid adoption of the beneficial increases in sub-batch sizes). Empty bottles would be collected and delivered under the fill nozzle of the depositor. Ideally, they would be collected directly from the packaging in which they are supplied to the business as this would require no preparation except moving the bottles in supplied packaging into place. Alternatively, the bottle would be placed in a gravity feed dispenser, or into known locations in a crate from which the robot could collect – thus avoiding need for sensing of the bottle position before grasping.
The depositor fill would be triggered from robot I/O rather than the previous footswitch. End of fill signal would be fed to the controller from the depositor piston returned sensor signal. The robot would collect a cap while filling is taking place.
Presentation of caps for picking will pose some challenges as these are supplied loose and will be in random orientations and positions. A vibratory feeder should be able to orient the caps for pick up, but trials would be required to confirm this. A bin-picking algorithm to pick individual caps from a loose pile could be used, but this would be a substantially more complex and costly approach. The collected cap would be placed on top of the bottle in the known location at the depositor, and the bottle then transferred to the ROPP capper machine.
At the capper, the signal to rotate the capping head would be sent by the robot controller, and the robot used to insert the bottle/cap up into the head (rather than the current lever operated platform).
The capped bottle would then be placed into the side-labeller, where operation is

triggered as in manual use, by the presence of the bottle. The final action of the robot would be to transfer the capped and side-labelled bottle to an output location, where a human would inspect and apply BBE and cap labels.
It is estimated that the robotic cell option would reduce production time by 23% compared with the baseline manual process with a 50 bottle (12.5L) batch with 3.5L sub-batch. In addition, the system would operate autonomously and an operator would not be required through all processes. Estimated costs £25k - 35k.

Implementation

To date (August 2021) a handheld unit for direct BBE printing onto labels has been trialled and then implemented, reducing the BBE labelling time from c.10s to c.3s.
Further steps will be reviewed and implemented as time progresses and the enterprise grows. Business growth will be both the driver and financial enabler for adoption of further automation including co/robotic cells.
The main opportunity for co/robotics at The Lincolnshire Drizzle Company occurs later in the automation roadmap to remove the tedious and repetitive bottle handling operations between process stations. This approach integrates with previously implemented process units that were manually loaded and unloaded in earlier automated process configurations.

Interview

Impact of COTEMACO support on the Business

The key benefits of automating for The Lincolnshire Drizzle Company are in the reduction of time spent producing the product. In such a small organisation, time is valuable and any less time used in production can be spent on sales and marketing - the key enabler for business growth. The first implemented recommendation of direct BBE printing to labels saves c.7s per bottle, amounting to almost 1 hour every week that can be spent on other activities. The planned implementation of semi-automated filling would gain approximately an additional 2 hours per week. Not only is the extra time valuable to the business, a tedious repetitive task is removed giving a more satisfying and stimulating experience.

How could COTEMACO support you?

Via the SME support programme, COTEMACO engages with SMEs from the automotive and food sectors through field labs. These regional field labs in the UK, the Netherlands, Belgium and Germany are showcasing key production steps in the automotive and food industries, in order to tackle current low sectorial awareness and knowledge gaps. The field labs will exchange knowledge on different manufacturing tasks, such as handling and (un)loading.
With the COTEMACO programme, manufacturing SMEs are guided through the process of adopting collaborative robotic and shop floor digitalisation technologies, from the exploration of technological opportunities to the detailed definition of a business plan.

Implementation partner:

FOODTECHBRAINPORT

Success Story 9

Mobile cobots at the bakery Mariën Bakkerij

Feasibility of implementation of mobile cobots at a bakery

Implement mobile cobots

Company description

Mariën Bakkerij Producten, with its production plant located in Balen, Belgium, is a SME with 18 own bakery shops in Belgium, and deliveries to an additional 20 retailers. The bakery, founded in 1958, produces all sorts of breads, varying in size and composition, once or twice a day. Next to bread, the bakery also produces various cakes and tarts in small series. The company has a turnover of over Euro 8 Mio, and 55 employees.

Motivation/Starting Point

The company is facing a growing difficulty in finding staff to work the early hours in the bakery plant, performing monotonous, repetitive heavy (strengthening) tasks, such as lifting trays of dough of a cart into the oven, and taking trays of the various bread out of the oven. Especially taking and placing the trays in the lower and higher part of the cart is heavy work. Their work also involves carving the dough before it goes in the ovens, which is monotonous as well and thus potentially hazardous.
Marieën is aware that further digitisation and automation is needed to maintain the business, but would also offer the possibility to further grow the business, including employability.

Analysis

A complex obstacle however, is that the bakery produces many different products in relative small series at various production machines, for only one or a few hours per day for each product. Dedicated automation of each of these processes would not be economically feasible. Therefor, the board of Marieën asked Cotemaco to investigate if it would be feasible to use mobile cobots, moving between te various production machines, to solve their challenges of improved working environment for their staff and more controllable and increased output for their business.

Technical realization

The Cotemaco Support program for Marieën was conducted by the Technology Providers of Food Tech Brainport in The Netherlands. The support consisted of a feasibility study with regards to technical and economical feasibility, as well as feasibility of financing. The technical and economical feasibility were assessed by Technology Providers Van Wees Waalwijk and Producon, whereas the financing feasibility was assessed by TechNet, all members of the Cotemaco Support team of Food Tech Brainport.

Result

From April 2020 – July 2020 the Technology Providers conducted the feasibility studies in close contact with Marieën. Various technical available solutions were evaluated, and optimised in iterations, meeting the processing requirements at the plant. Special attention was given to safety requirements for staff, hygienic and health issues related to food products, ease and flexibility of operation and integration to other digital platforms such as the company's ERP.

At the last phase of the project, when technical and economic feasibility had been established, the Cotemaco Support team was able to arrange a grand of € 120.000,00 to facilitate the development and integration of mobile cobots in the plant of Marieën. This implementation started on in September 2020 and is planned to be finished by September 2021.

Implementation partner:

UNIVERSITY OF LINCOLN

Success Story 10

Automation Roadmap for One Planet Pizza, UK

Assess production methods and provide an automation roadmap to underpin future sales growth

Automation Roadmap

Company description

One Planet Pizza produce frozen plant-based pizzas from a small manufacturing facility near Norwich in the UK. The One Planet Pizza ethos is to "help create better planet" and this is reflected in business practices such as the choice of plant-based ingredients with lower environmental impact, a tree planting scheme, waste upcycling, recyclable or compostable packaging, etc. Currently there is a product range of 11 pizzas, with new recipes constantly in development. The family owned and run business started in 2014 and has 10 staff. The core customers are individuals who order directly online, however other online retailers, and in store retailers are also supplied. Business is growing and larger volumes are required to meet demand. The business needs to retain its bespoke and agile supply chain but ensure that it is cost effective and profitable.

Motivation/Starting Point

Historically One Planet Pizza production has been manually performed as a batch process. Pizza bases are laid out on worktables and the toppings are added sequentially with staff members following round the room each placing one topping component on successive pizzas (Figure 1). The daily production is 350-600 pizzas per day dependent on the pizza type.
As sales volumes increase, One Planet Pizza engaged with the COTEMACO SME support programme with the aim to improve production capacity, efficiency and productivity.
The COTEMACO support has assessed the current production processes and provided an automation roadmap to support the growth of the enterprise.

Figure 1: Manual sequential pizza topping process

Automating the entire pizza process poses substantial technical challenges;

- removal of interleaves from between supplied bases,
- consistently applying sauce topping to within 15mm of edge pizza bases that are not consistently round
- the inconsistent, soft, pliable, delicate nature of the toppings. This manifests in:
    - ◊ identification of topping components in supply bins
    - ◊ determination of bin picking order
    - ◊ grasping
    - ◊ accurate placement and release of toppings once grasped
- swapping between pizza types.

SME Support Activities

It was clear from the outset that a step change immediately to a cobotic / robotic automation manufacturing solution would not be suitable for this SME at this point in time. There were restricted technical automation skills within the business, capital investment funding was limited, and beneficial automation gains could be achieved with simpler lower cost equipment as initial phases of a staged automation roadmap.

An initial assessment of the production operations at One Planet Pizza was carried out to identify bottlenecks, common processes, effort intensive operations, and process flow issues where automation would provide business benefit. These assessments determined;

- A common process for all pizzas was the initial preparation before the specific toppings were applied. Automation to remove the of base interleaves, apply tomato sauce and grated cheese could give benefits to all pizzas produced. Taken together the removal of interleaf, laying the base on the worktable, then sauce and cheese applications took 20.6s (SD=0.5s) and accounted for an overall mean of 22% of the production time for each pizza. Use of dedicated automation; a depositor (potentially with showerhead nozzle) for applying the tomato sauce, and a recirculating cheese waterfall for the cheese, would be better solutions than co/robotic automation for this task. However, a cobotic solution for removal of interleaves could save staff from a tedious and repetitive task, with risk of RSI. However, with a mean operation time for interleaf removal of 2.7s (SD=0.2s) accounting for a mean of only 3% of the production time per pizza this operation was not be an effective use of resource for an initial automation target.

- Once bases were prepared, application of toppings was performed by staff moving around the production space applying the topping to stationary pizzas. This could lead to 'traffic jams' and 'dead' corners of the workspace where access to pizzas was difficult. Introduction of a simple conveyor to move pizzas to the topping staff would reduce the distance walked, keep production flowing, and improve access to all pizzas for ease and consistency of applying toppings manually. Whilst cobotic automation of the toppings application would be an interesting project (due to the challenges mentioned in the previous section) and once completed, be a prime example of what could be possible with technology, the timescales to develop and costs involved were not attractive to the owners for an initial foray in automation. Furthermore, the hand applied toppings were deemed a distinctive aspect of the finished pizzas and One planet were keen to retain this feature.

- Manually wrapping each pizza in film was the major operation in the production, occurring for every pizza and taking a mean of 34.3s (SD=2.1s). This occupied a mean of 38% of the total production time across the range of pizza types produced. As this was a common operation for every pizza, speeding this with automation would be of benefit for all production.

- The final boxing operation was another potential target for robotic type automation accounting for a mean 14.8s (SD=5.5s), and 16% of production time.

Based on these findings a series of options were produced (Figure 2), along with associated projected cost-benefit (Figure 3). These proposals were discussed and honed with One Planet Pizza and a priority sequence agreed. This formed the basis for the sequenced automation roadmap.

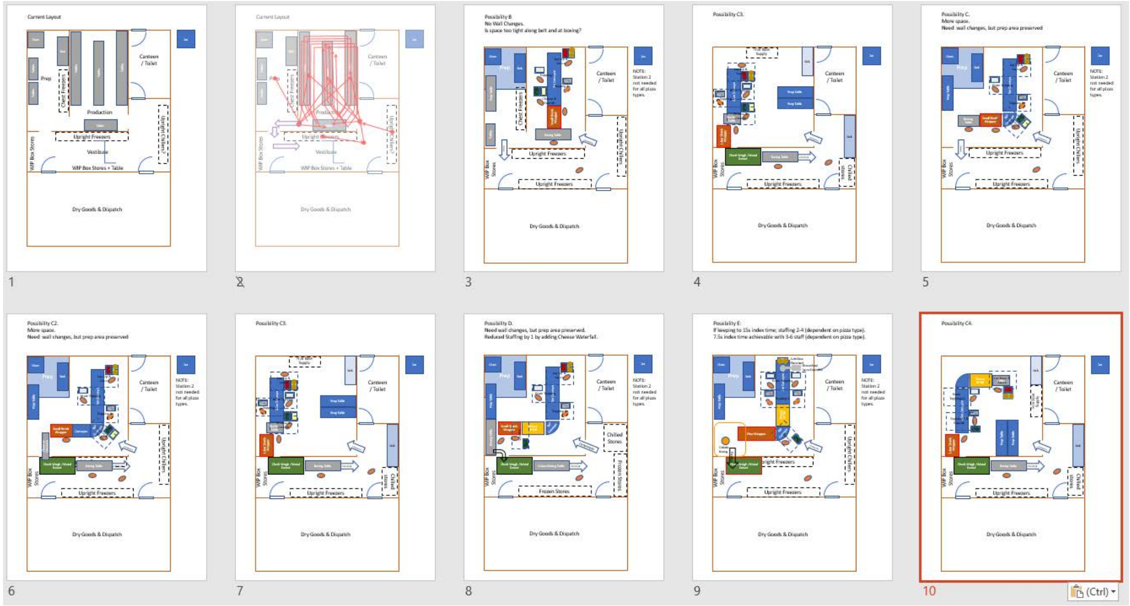


Figure 2: Layout Options

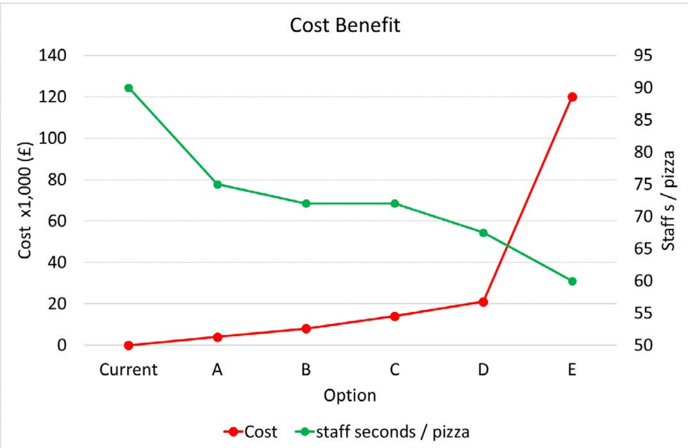


Figure 3: Cost Benefit Relationship

Implementation

As can be seen from the roadmap cost benefit relationship (Figure 3) there are substantial productivity rate improvements to be gained with relatively small investments in the early steps of the automation roadmap. One Planet Pizza have implemented the initial stages and will subsequently progress to the later stages involving co/robotic automation in due course.

To date (June 2021) the first steps along the roadmap have been taken with a reorganisation of the workflow and the introduction of a conveyor and semi-automated shrink wrapper machine to address the primary bottleneck(s). These simple measures have already resulted in a >30% improvement in productivity dependent on pizza type. Further steps will be reviewed and implemented as time progresses and the enterprise

grows. One Planet Pizza business growth will be both the driver and financial enabler for adoption of further automation including co/robotic cells.

The main opportunity for co/robotics at One Planet Pizza occurs later in the automation roadmap for the boxing of individual pizzas. This is the 2nd most time-consuming operation after the wrapping. Shrink wrapped pizzas are aligned and slid edgewise into a preformed box. The operation takes place after the final checkweigher and metal detect process. In the automated system, pizzas would travel into the boxing area on the outfeed conveyor from the checkweigher, and be guided into a single lane, thus avoiding the complexity and cost of visual identification of pizza position on the belt. A simple light beam sensor would trigger action on pizza arrival. A flat scoop end effector would collect the pizza from this fixed location and transfer it into a waiting box in known location. Some practical trials would be required to identify whether pizzas could be loaded into boxes already in the outer case as this would remove the need for the subsequent operation to stack 10 boxes into each outer case.

Result

The initial steps along the road map taken so far has more than halved the mean time spent wrapping pizzas from c.34s to <15s and this removes a tedious part of the process for the production staff. This allows for productivity increases, and frees up more time for the value adding parts of the process... applying the toppings. This can now be done with more care and the need for rework/adjustments is reduced.

Interview

Were your expectations fulfilled – technical implementation and support through COTEMACO?

Mike Hill, Managing Director, One Planet Pizza

"With COTEMACO's help, we've redesigned our kitchen, knocked down a dividing wall and reorganised the production flow. With the new conveyor belt system and simple wrap machine we've already improved our productivity by 30%."

How could COTEMACO support you?

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What is COTEMACO?

The project, which is an initiative of Interreg North-West Europe, aims to support around 60 SMEs in the automotive and food manufacturing industries with so-called „test environments“ and to encourage them to integrate collaborative robotic systems and digital technologies into their business. Accordingly, in addition to increasing production flexibility, the relocation of production abroad will be curbed and the number of jobs in manufacturing increased, which will generally lead to an improvement in the competitiveness of the companies involved.
In the project new technologies are implemented in application examples - the aim is to move from the prototype in the laboratory environment to the transfer to production, taking into account the legal situation and certifications.

Do you want to support SMEs in the implementation of automation and digitization issues?
Become part of the COTEMACO network and benefit from the advantages as a project partner!

Or are you interested in further Success Stories?

Visit our website at:
www.robot-hub.org/cotemaco

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