Interreg North-West Europe
COTEMACO
European Regional Development Fund

# Success Story

## Automation Roadmap for

Pour and Ice Cocktails Ltd, UK

# Opportunity for Cobotics

## Company description

Pour and Ice Cocktails Ltd. produce a signature range of hand-crafted cocktails from a small facility in Cleethorpes in the UK. The main business is production of bottled cocktails for distribution through a home delivery service. However, as the business expands, Pour and Ice Cocktails are looking towards wholesale and supermarket retail options which will demand a substantial increase in production volumes.
Pour and Ice Cocktails offer a selection of 9 cocktail flavours all year-round, with seasonal additions. Sales into the home delivery market are for a customer defined mix of flavours, in quantities of 5, 10, 20, 30, or 40 bottles, with 250ml and 500ml bottles offered.
With the potential for substantial sales growth in the near future, the business is looking for opportunities to ramp up production and optimise the current process with the potential addition of some automated equipment to enable the business to meet demand without significant hiring. Pour and Ice currently has 1 fulltime operative covering all aspects of the business: purchasing, production, marketing, sales, and distribution.

## Goal

The aim of this COTEMACO support is to assess the current production process for improvement opportunities at Pour and Ice Cocktails Ltd and provide an automation roadmap to underpin future business growth.
As sales volumes increase, Pour and Ice Cocktails have engaged with the COTEMACO SME support programme to improve production capacity, efficiency, and productivity. The currently weekly production peak is c.100-150 bottles/week, with a potential need for rapid increase if wholesale/supermarket sales aspirations are achieved. As this is a market that could expand extremely quickly, Pour and Ice are looking to be ready and ahead of the game in terms of investment in optimisation of process, be it technological or otherwise.

## Current Production

Current production is entirely a manual batch process, comprising mixing (including sugar syrup production) and shaking, filling (Figure 1), lidding, labelling, and packing. Bottle labelling is a process that is done “off-line,” and whilst time is currently not a problem, it could become so in the future. For this reason, labelling times are included in timing calculations. Furthermore, a simple bottle labeller has been tested but the square bottles the business use make things more difficult, and a more complex piece of equipment would be necessary to do this task consistently.

*Figure 1. Current filling process from 10l storage containers*

A simple production timing model was constructed to help the business understand the entire process.
Initially, baseline production timings for a current standard 5l batch size Pour and Ice Cocktail mix (5 ingredients: juice, 2 alcohols, sugar syrup, and a fruit purée) were calculated for the current fully manual process. The total times to make, fill, and label an entire 5l batch is 1143s with 250ml bottles and 753s with 500ml bottles. Thus, the time needed to produce each bottle are 57s per 250ml bottle and 75s per 500ml bottle. The operations taking the greatest proportion of the times for 250ml and 500ml bottles respectively being filling (30.3% and 34.1%), labelling (35.0% and 26.6%), and lidding (17.5% and 13.3%) – see Table 1.

*Table 1. A summary of time taken in each operation for 250ml and 500ml bottles based on the current manual 5 litre batch process.*

| | **250ml Bottles** | **500ml Bottles** |
|---|---|---|
| **Total Time per bottle (s)** | 57 | 75 |
| **Total Time per litre (s)** | 229 | 151 |
| **Mixing Time (s per bottle (%))** | 3.5 (6.1%) | 7 (9.3%) |
| **Shaking Time (s per bottle (%))** | 1.5 (2.6%) | 3 (4.0%) |
| **Filling Time (s per bottle (%))** | 17.3 (30.3%) | 25.7 (34.1%) |
| **Lidding Time (s per bottle (%))** | 10 (17.5%) | 10 (13.3%) |
| **Labelling Time (s per bottle (%))** | 20 (35.0%) | 20 (26.6%) |
| **Sugar Syrup Production (s per bottle (%))** | 4.8 (8.4%) | 9.6 (12.8%) |
| **Maximum bottles/week** | 630 | 478 |

As one person is currently covering all aspects of the business, purchasing, marketing, sales, delivery, etc in addition to production, maximum bottle production in a week (based on 10 hours available for production) is 630 and 478 for 250ml and 500ml bottles respectively. This number is likely to be substantially higher than in practice as this assumes all ingredients/bottles etc. are in position and ready to be utilised. All comparative bottle/week numbers also make these assumptions.

## 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.

From an initial assessment of the production operations and the process timings model, process bottlenecks, effort intensive operations, and process flow issues were identified. Based on these findings a series of options were produced, along with an associated projected cost-benefit. This formed the basis for the proposed sequenced automation roadmap and is briefly described below. The operations taking the most time are filling (30.3% and 34.1%), labelling (35.0% and 26.6%), and lidding (17.5% and 13.3%).

The most efficient bottling lines use dedicated automation; however, this is beyond the means of Pour & Ice at this business evolution stage – particularly as 9 separate flavours are produced. The process model was used to identify pragmatic approaches of small gains at lower cost. These included: the following:

- If sugar syrup was made in 3l batches instead of 1.5l batches, an output of 656 (4.1% increase) and 510 (6.7% increase) bottles for 250ml and 500ml respectively would be possible in the same production time.
- If sugar syrup was bought instead of made, albeit this would cause a higher input cost per bottle, an output of 688 (9.2% increase) and 548 (14.6% increase) bottles for 250ml and 500ml respectively would be possible in the same production time.
- If 10l batches were made instead of 5l, an output of 644 (2.2% increase) and 494 (3.3% increase) bottles for 250ml and 500ml respectively would be possible in the same production time.
- If the current shaking operation was performed using an automatic stirrer (pan stirrer or similar c.£40 per stirrer), other tasks could be done at the same time and thus the shaking time would be effectively removed. This would create an output of 647 (2.7% increase) and 498 (4.1% increase) bottles for 250ml and 500ml respectively in the same production time.
- Combining bought sugar syrup, an automatic stirrer, and 10l batches would create an output of 715 (13.5% increase) and 584 (22.2% increase) bottles for 250ml and 500ml respectively in the same production time.

All further increases in production will assume that the low-cost recommendations described above have been implemented.

At higher capital cost, equipment to alleviate the bottlenecks at filling, labelling, and lidding can be brought in.

- Incorporating a benchtop depositor is projected to reduce mean filling time per bottle from 17s to between 4s and 10s, dependent upon capital investment (see Figure 2), resulting in an output of 837-973 (38.6-54.4% overall increase) and 783-900 (63.8-88.2% overall increase) bottles for 250ml and 500ml respectively. Estimated costs c.£500-8k per depositor, including a compressor to drive the more complex depositors. It should also be noted that much larger batches would be required to make a single depositor worthwhile for this business to avoid multiple clean downs between different cocktails. For this case to be worthwhile, cocktail sales would need to be substantially higher, or the business would have to build a significant stock. Multiple cheaper (c.£500), mostly manual depositors are likely to be a better investment as a substantial portion of the time saving can still be achieved without having excess cleaning or a substantial capital outlay. Similarly, a hand depositing nozzle (i.e. Unifiller) could save substantial time and do the job but is aimed more for depositing a lot of a single substance rather than smaller quantities of different substances dependent upon orders.

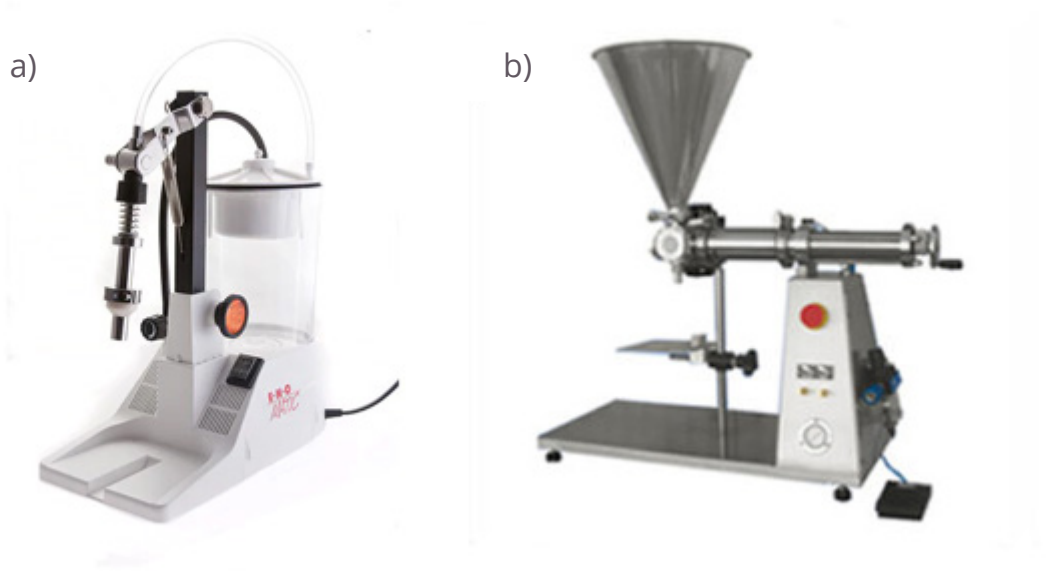


*Figure 2. a) A simple, manual single head vacuum filler c.£435 per filler;*
*b) A more complex semi-automatic piston filling machine c. £6,000 (including required compressor).*

- Purchasing a handheld electric lidder could reduce mean capping time from c.10s per bottle to c.2s per bottle. This alone would result in an output of 850 (34.9% overall increase) and 670 (40.1% overall increase) bottles for 250ml and 500ml respectively. Estimate of cost is c.£60-100.


*Figure 3. Manual electric lidder for plastic bottles*

- There are two main options to increase labelling speed; these can either be implemented in tandem or individually:
    1. Changing the bottles to circular instead of square will substantially de-skill the labelling operation as the alignment of the label to a flat side will no longer be an issue. This is likely to halve the manual labelling time from c.20s per bottle to c.10s per bottle resulting in an output of 892 (41.6% overall increase) and 697 bottles (45.8% overall increase) for 250ml and 500ml respectively. This would require no substantial investment in equipment from the business, but may require re-designing bottles and marketing materials accordingly which does have a cost.
    2. Implementation of a bottle labeller would likely reduce the labelling time even further to c.5s. For square bottles, this would require a more complex piece of equipment than for a circular bottle and would thus be reflected in the price (c. £185 for a manual labeller (circular bottles), £1.4k for a more automated labeller (circular bottles), and £6k (square and circular bottles) (see Figure 4). The output from this intervention would be c.1019 (61.7% overall increase) and c.771 (61.3% overall increase) bottles for 250ml and 500ml respectively.

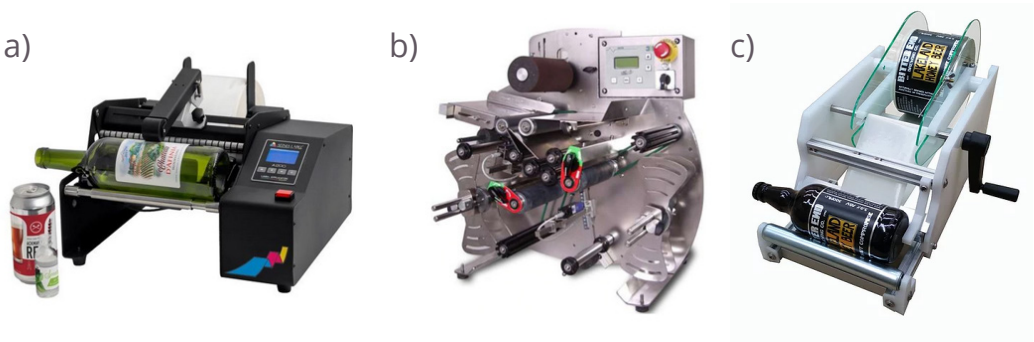


*Figure 4. a) Simple bottle labeller for circular bottles, capable of c.600 bottles per hour, c. £1,400; b) A more complex bottle labeller for circular and square bottles, capable of c.700 bottles per hour, c. £6,000; c) A simple manual bottle labeller for circular bottles, capable of c.500 bottles per hour, c. £200.*

## Combining all interventions

If batches were increased to 10l, an auto stirrer was purchased, syrup was bought instead of made, a depositor, labeller, and lidder were introduced, output could be increased to 2,880 and 2,000 bottles for 250ml and 500ml bottles respectively – an increase of 300-400%. Table 2 shows the time taken for each operation if all interventions were combined. Table 3 summarises each individual intervention discussed in this document, comparing cost of the intervention with the increase in production capacity that is associated with that intervention.

*Table 2. A summary of time taken in each operation for 250ml and 500ml bottles based on combining all interventions discussed above.*

| | 250ml Bottles | 500ml Bottles |
|---|---|---|
| **Total Time per bottle (s)** | 13 | 18 |
| **Total Time per litre (s)** | 50 | 36 |
| **Mixing Time (s per bottle (%))** | 3 (24%) | 6 (33.3%) |
| **Shaking Time (%)** | 0 (0%) | 0 (0%) |
| **Filling Time (s per bottle (%))** | 2.5 (20%) | 5 (27.8%) |
| **Lidding Time (s per bottle (%))** | 2 (16%) | 2 (11.1%) |
| **Labelling Time (s per bottle (%))** | 5 (40%) | 5 (27.8%) |
| **Sugar Syrup Production (s per bottle (%))** | 0 (0%) | 0 (0%) |
| **Maximum bottles/week** | 2,880 | 2,000 |

*Table 3. A summary of the interventions discussed in detail throughout this document comparing the cost of the intervention with the associated increase in production capacity.*

| Intervention | Cost of Intervention | % Increase in production capacity | |
|---|---|---|---|
| | | 250ml bottles | 500ml bottles |
| Larger Sugar syrup batches | 0 | 4.1% | 6.7% |
| Bought sugar syrup | c. £0.20 per bottle | 9.2% | 14.6% |
| 10l batches | 0 | 2.2% | 3.3% |
| Automated stirring | c. £40 per stirrer | 2.7% | 4.1% |
| **Bought sugar syrup, automated stirring, 10l batches** | **c. £40 + £0.20 per bottle** | **13.5%** | **22.2%** |
| Benchtop depositor | c. £435 per vacuum depositor<br>c. £6,000 per piston depositor | Up to 55.4% | Up to 88.2% |
| Handheld lidder | c. £60-100 | 34.9% | 40.1% |
| Circular bottles | Associated marketing/supplier change costs | 41.6% | 45.8% |
| Bottle labeller | c. £185 for manual labeller (circular bottles only)<br><br>c.£1.4k for a more automated bottle labeller (circular bottles only)<br><br>c. £6k for automated square bottle labeller | Up to 61.7% | Up to 61.3% |
| **10l batches, automated stirrer, bought sugar syrup, depositor, labeller, and lidder introduced** | **£6,000 - £10,000 + £0.20 per bottle** | **300%** | **300%** |

## Comparison with hiring staff

As business grows there is a key decision to be made on how to increase production, whether it is through increasing the production time available (this could be achieved by employing staff) or further investment in automation and equipment. The total cost of equipment to achieve the increases highlighted in the previous section would be approximately equivalent to the yearly outlay in hiring a new member of staff.

However, adding a new member of staff (giving increased production time from 10 hours per week to 40 hours per week) translates to a very similar increase in overall production (weekly: 2,520 and 1,912 bottles respectively for 250ml and 500ml bottles).

## Introduction of Co-/Ro-botics

An alternative to employing staff would be to implement a co/ro-bot to would free up staff time from the tedious repetitive bottle transfers between machinery, whilst avoiding the costs and business complexities of employing a first staff member.

Mixing would remain manual. The cobot would collect empty bottles and place 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 supplied units into place. Alternatively, the bottle would be placed in a gravity feed dispenser, or into known locations in a crate from which the cobot could collect – thus avoiding need for sensing of the bottle position before grasping.

The depositor fill would be triggered from cobot I/O rather than manually. End of fill would be fed to the controller from the depositor return signal. The cobot would collect a bottle lid while filling is taking place and place on top of bottle after filling is complete.

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 bottle in the known location at the depositor, and the bottle then transferred to a lid tightening station based on the same principle as the manual lid tightener.

At the lidding station, the signal to rotate the lidding head would be sent by the cobot controller, and the cobot used to insert the bottle/lid up into the head. This would be a more complex piece of equipment than suggested in the previous section but operate on exactly the same principle.

The lidded bottle would then be placed into the labeller, where operation is triggered as in manual use (though this would be dependent upon which labeller is chosen). The final action of the cobot would be to transfer the lidded and side-labelled bottle to an output location, where a human would inspect.
It is estimated that the cobotic cell option would be approximately equivalent to the manual process in terms of time taken per bottle, but the system could operate autonomously, and an operator would not be required through all processes. Estimated costs £25k - 35k.

## Implementation

At the time of writing, Pour and Ice 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.

# 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 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 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.

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