Interreg North-West Europe COTEMACO
European Regional Development Fund

Success Story

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 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 1. 300L jacketed jam/marmalade cooking kettle

Figure 2. Stove top chutney cooking

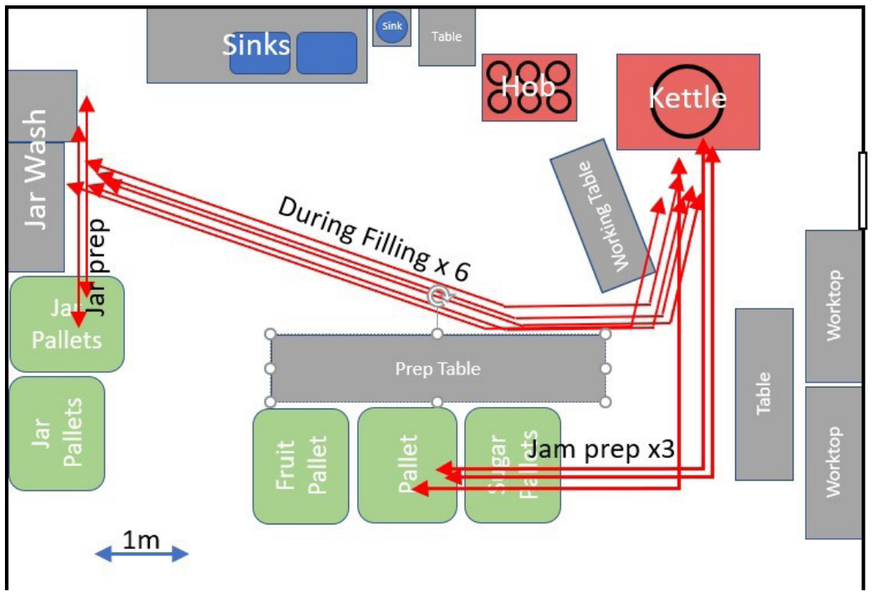

Figure 3. Process layout and movements for each batch

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.

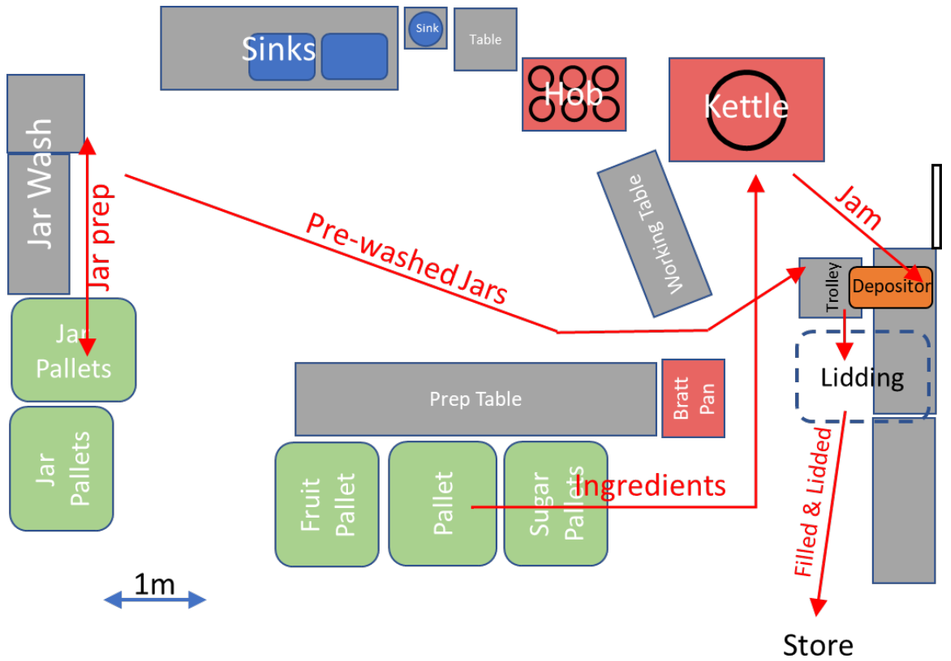

Figure 4. Revised layout with depositor

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.

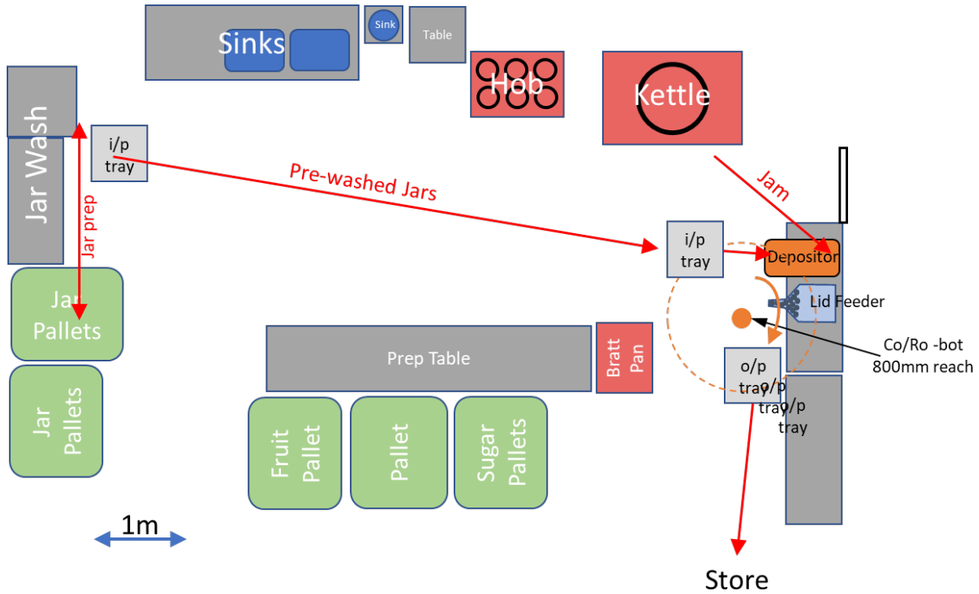

Figure 5. Cobotic cell for jar lidding

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.

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

Implementation partner:

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National Centre for Food Manufacturing

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