FMCG fulfilment

Automation opportunities for the ‘20s and beyond

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Trends in online shopping

Over the last 20 years, the world has been transitioning to e-commerce, and this transition has been gathering pace. While e-commerce currently accounts for less than 20% of all retail sales, the number of online sales is growing three times faster than retail sales. To highlight this trend, consider the e-commerce behemoth Amazon, which quintupled their sales between 2010 and 2016, from US$16B to US$80B.

Not only are consumers buying more online than in bricks-and-mortar stores, they are also demanding faster delivery – when the customer clicks that ‘buy’ button, they expect their product to arrive on their doorstep, as described, soon after! This is particularly true of fast-moving consumer goods (FMCG), such as groceries. Consumers want fast, cheap, high-quality goods. The challenge of satisfying these three consumer needs is known as ‘The Triangle of Pain’!

These demanding consumer expectations are pushing every inch of the supply chain to its limit, and driving innovation in warehouse design, fulfilment and logistics. These changing expectations are thus driving the development of new paradigms in goods-to-consumer delivery, such as drone delivery and robotic automation.

Add a pinch of pandemic

The events of 2020 have further accelerated the push towards online solutions, and more than ever people are turning to online shopping. The distribution centres that fulfil these online orders are under pressure. Not only has the demand for e-commerce fulfilment increased, but the COVID-19 pandemic has shown us that it is unsafe to have thousands of workers in a facility without risk of transmission. This is increasing the complexity and cost of achieving workplace health and safety, and furthermore decreasing workforce productivity. It is unlikely that any strict new health and safety measures will relax anytime soon.

The world of FMCG

Consider your local supermarket with online ordering. How many different products do they stock? This might be difficult to imagine, so let me help.... If you were to search on a supermarket website for something simple like “milk”, how many results do you get? I got over 150 results. What about cheese, eggs, bread, flour, toilet paper, laundry detergent? According to the Food Marketing Institute, a traditional supermarket has, depending on its size, anywhere from 15,000 to 60,000 SKUs. And all these products have different shapes, sizes, weights, textures, and softness. Some of these products are very robust, while others are delicate and can be easily damaged.

Fulfilling orders made up of a diverse range of items, and doing it quickly, is a daunting challenge for any retailer. There are a few approaches to addressing this challenge:

- In-store fulfilment
- Person-to-goods warehouse fulfilment
- Goods-to-person warehouse fulfilment
- Micro- or nano-fulfilment

In-store fulfilment

If you've shopped in a bricks-and-mortar store in recent months, you may have seen an interesting shift in staff behaviour. Instead of restocking shelves or helping customers find goods, some staff are on the floor picking inventory themselves, filling carts with items for e-commerce orders.

There are certainly advantages to filling online orders from store shelves. Retailers can save money by offering a choice of pickup or same-day delivery to consumers who live nearby, instead of shipping those orders from distant warehouses. There are also potentially major cost savings to be made by serving both in-store and online customers from a common inventory.

However, there are also drawbacks to in-store fulfilment. There are inefficiencies when you consider that store workers must spend time packing the shelves, which they then subsequently unpack to fulfil online orders, rather than picking straight off the pallet. There's the potential for traffic jams when consumers and employees are all trying to pick from the same inventory at once – this is now especially problematic given the risk of viral transmission. There's also the risk of alienating shoppers who may find themselves competing with staff for items that are in short supply. It is also important to consider the cost of devoting expensive urban real estate to tasks usually performed in warehouses in low-rent areas, as well as the cost of (re)training workers for specialized shipping operations.

Person-to-goods fulfilment in a distribution centre

The traditional method of filling orders in a warehouse is similar to in-store fulfilment, except that it takes place in a dedicated warehouse consisting of rows of shelves filled with inventory. Person-to-goods fulfilment typically involves sending workers to different zones in the warehouse to find products that the worker picks off the shelf and takes to another area of the warehouse for packing. Repeated walks by staff between picking and packing zones is inefficient.

Newer solutions assign workers to one zone to cut down on both foot and equipment traffic, which results in some productivity gains, but does not go far enough to meet the needs of today's customer expectations and warehouse operation productivity goals.

Workers run back and forth pushing manual carts to retrieve items among potentially dangerous heavy machinery such as forklifts; and put their bodies under a lot of stress, often twisting and stretching to retrieve products from difficult-to-access storage areas.

Goods-to-person fulfilment in a distribution centre

Goods-to-person fulfilment involves removing incoming goods from pallets, either manually or automatically, and placing cartons of goods and/or pieces into totes (for smaller goods) or into trays (for larger goods) and stored in high-density automated storage and retrieval systems (ASRS), carousels, or robotic systems. The autonomous system brings the totes and trays containing the products to be picked to the picker.

Goods-to-person fulfilment enables the picker to continuously pick rather than spending time walking around the warehouse among potentially dangerous machinery. The belief is that replacing these intense labour tasks with automated systems will reduce the risk of workplace injury and improve productivity. Most goods-to-person workstations are ergonomically designed to ensure that employee movements are within a normal range of motion. But the goods-to-person concept does not eliminate all walking, and introduces the risk and discomfort associated with extended periods of standing still which has negative impacts on health.

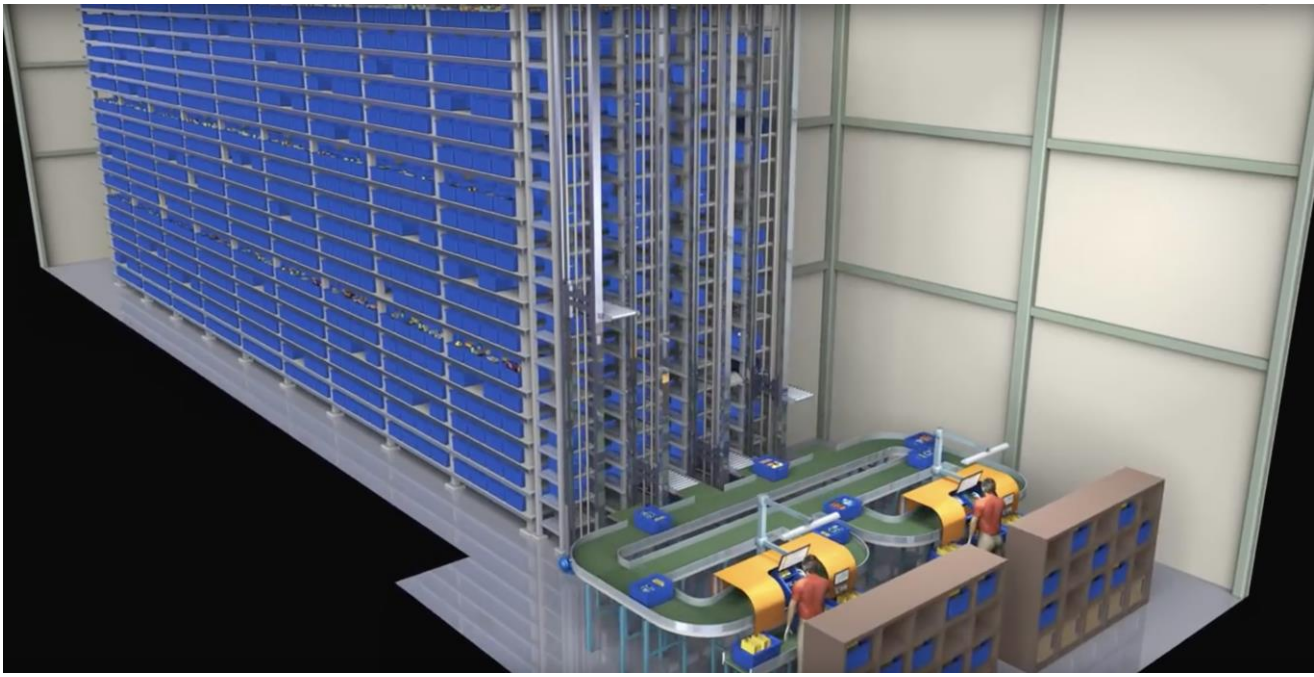
Goods-to-person fulfilment improves the efficiency and accuracy of the picking process. It is also easily scalable and uses a smaller footprint than person-to-goods fulfilment.

Micro- or nano-fulfilment

Micro- or nano-fulfilment is a way for retailers to minimise real estate costs and fulfil orders in hours. They combine the proximity of brick-and-mortar stores with the productivity gains of an automated warehouse. The idea behind micro-fulfillment is to leverage adaptable automation and robotics to process orders and returns as close to the customer as possible.

In micro-fulfilment, a micro-automated system is placed in the backroom of an existing retail location, that processes online orders for pick-up or delivery. The system features high-density storage leveraging physical height, narrow aisles and automated shuttle cars which brings totes and trays containing the products to be picked to the picker - just like goods-to-person automated fulfilment in a distribution centre, but on a much smaller scale.

While the concept of micro-fulfilment certainly has the potential to reduce delivery times (and therefore improve customer experience), as well as minimise costs by maximising utilisation of existing real estate, it does not solve any of the health-related issues of goods-to-person fulfilment in a warehouse as the human picker does the exact same task in both – repeatedly picks individual items from the totes and adds these items to the customer orders.



The individual pick requires a human touch

Whether the fulfilment model is in-store, person-to-goods, goods-to-person, or in a micro-fulfilment facility, you'll notice that the final stage of picking the order – i.e., the individual pick where a single item is picked off the shelf or out of a tote – is performed by a person. Why? People are good with their hands!

The human hand is an extremely versatile tool for object manipulation. It is gentle enough pick a raspberry without squashing it and hold an egg without breaking it or dropping it. Our hands are also quite strong, allowing us to hold and operate heavy tools, such as an axe. We can also easily move from one manipulation task to another. When we pick up an object, we apply a grip force to it. Intuitively, we know that a heavier object requires a stronger grip force, and a more slippery object also requires a stronger grip force. But we rarely apply less grip force than is required to prevent the object from slipping from our grasp and we rarely apply an excessive grip force which may damage our hand or the object. It's through our exquisite sense of touch that we can determine the optimal grip force for holding an object irrespective of its size, shape, weight, surface material, texture and softness. So, the human hand is perfectly suited to a task like the individual product picking in e-commerce fulfilment.

But there are several reasons why people shouldn't be doing these picking tasks. There are workplace health and safety issues associated with the individual pick. In the person-to-goods model, the picker is walking around a warehouse among potentially dangerous heavy machinery, such as forklifts, and reaching for stock in tight and awkward places. In the goods-to-person model, the picker is standing still for long periods of time. And in a COVID-19 world, there are additional concerns related to physical distancing in a warehouse that often houses over a thousand workers.

An obvious solution to these issues is automation of the individual pick. But this is easier said than done.

Challenges of automating the individual pick

Tasks that have little-to-no variability and are highly repetitive (i.e., low-mix, high-volume) are relatively easy and cost-effective to automate. In the case of picking a single product – for example, an upright can of baked beans of a particular size and weight - over and over again, we could customise a robotic end-effector like a two-finger gripper, such that the finger shape matches that of the can, and we can fine-tune the grip force applied by the gripper to pick up the can. This is a common approach to automating material handling tasks.

In an online supermarket, however, orders contain more than just cans of baked beans – there are tens of thousands of products of different shapes, sizes, weights, textures and softness, and any one order can contain a number of these products (high-mix, low-volume). The same custom end-effector we used for our can of baked beans is unlikely to be able to pick a pack of toilet paper rolls, or a box of cereal. A product-specific solution is not going to get the job done.

An alternative approach is to use a more general end-effector such as a vacuum suction cup. However, this requires that a seal can be formed between the suction cup and the object, which will depend on the surface material of the object, the shape of the object and the size of the suction cup, and therefore it is not a viable solution for all products. Soft pneumatic grippers are another more general approach to the individual pick. However, there are limits to the weight of the object that can be grasped. Additionally, these grippers cannot determine whether the object has been successfully grasped or not. A final approach is to use grippers with force/torque sensing on the fingertips. This enables the gripper to apply different grip forces to different objects, but requires that the grip force be pre-programmed for every one of the tens of thousands unique products.

In e-commerce fulfilment, not only are the products different, but even a single product could be presented in different orientations in a tray – for example, the can of baked beans could be standing upright, or it could be lying on its side. Furthermore, products could be stacked tightly side-by-side, like books on a bookshelf. For example, an apple in a tray of apples could be touching each of its neighbouring apples, limiting the surface area with which an end-effector can make contact with the apple and establish a firm grasp.

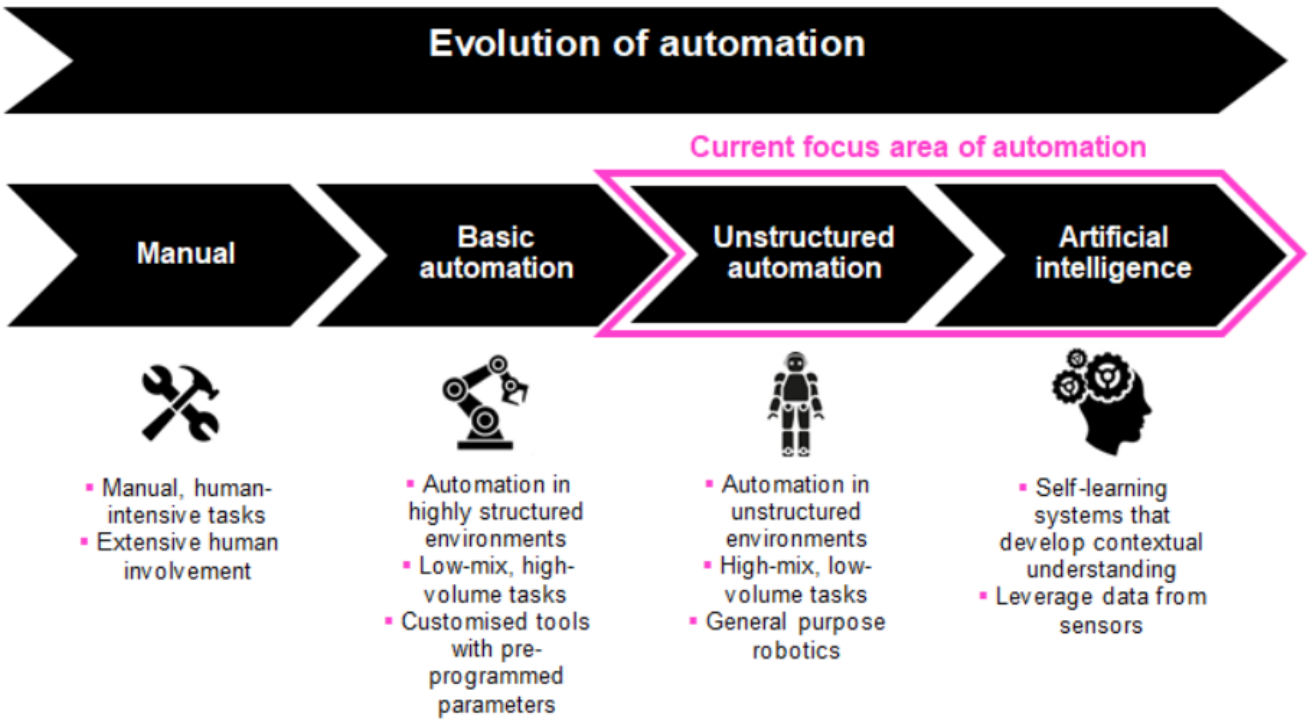
To automate the individual pick and other high-mix low volume material handling tasks, a versatile and flexible end-effector is required. An end-effector that can handle as large a range of products as the human hand.

Why does Contactile have the right technology?

Taking our inspiration from the human hand, we at Contactile believe that tactile sensing will play a critical role in endowing robots with human-like dexterity.

Contactile have developed an industry-leading capability in tactile sensing and grip force control – we are giving robots a human sense of touch and enabling them to use their 'hands' just like people do. Just like human touch, our tactile sensors measure all the parameters that are essential for dexterity. Our sensors provide real-time feedback and tell the robotic hand how firmly to grip to prevent an object from slipping from the grasp. With Contactile sensors, a gripper can grip objects of different size, weight and surface material without any pre-programming of the grip parameters, unlike grippers with simple force/torque sensing for which the grip force must be pre-programmed for each new object

Our three founders are the co-inventors of the sensor technology and have a unique combination of technical expertise spanning electrical, software, and biomedical engineering, with a strong association with UNSW Sydney. Together, the founders hold more degrees than you can poke a stick at - 4 Bachelor's (3 Honours), 1 Master's, and 2 PhD degrees among the three of us - and we're using all our smarts and hard work to bring about a tactile revolution in robotics and automation through bio-inspired, research-led technology development.



Conclusion

It is clear that new technologies, like tactile sensing, have a big part to pay in the future success of high-mix FMCG e-commerce fulfilment. Such technologies are required to address critical issues of:

- Worker safety
- Accuracy and speed
- Profitability
- Competitive pressure
- Growing consumer expectations
- User experiences

Tactile sensing technologies are an essential component for any operators in FMCG and e-commerce fulfilment in the ‘20s and beyond.

Speak with Contactile

As we scale our IP and capability we are looking to collaborate and partner with companies working at the cutting edge of automation – whether you are a supplier of automation systems, or you are a business looking for an automation solution for your material handling processes.

Please feel welcome to book a meeting by emailing **info@contactile.com**

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