Panasonic
BUSINESS

PANASONIC: ROBOTICS & AUTOMATION IN LOGISTICS FORUM

MANUFACTURING TECHNOLOGY CENTRE, COVENTRY

Contents

Preface

After the success of our industry rail forum, Panasonic Business was pleased to host a logistics forum at the Manufacturing Technology Centre in Coventry. We featured three speakers, two from industry and one from academia, followed by a question-and-answer panel session. Afterwards attendees participated in a tour whereby they could see, touch and hear about Panasonic technology, much of it still unreleased and in development.

Organisations represented at the forum

- DHL
- DHL Supply Chain
- Fedex
- Ocado
- Sainsbury's
- Kuehe + Nagel
- TNT
- Whitbread
- SHD Logistics
- Manucore

Executive summary

Professionals from across the logistics industry gathered to hear insight from a panel of three speakers, specifically in the realm of robotics and automation, followed by an open-floor discussion.

The speakers were:

Professor Hani Hagras,
Director of the Computational Intelligence Centre at the University of Essex

Alex Harvey,
Head of Robotics and Autonomous Systems at Ocado

Ashley Hartwell,
Strategy Team at Sainsbury's

Speaker one

After a few opening words from **Panasonic Systems and Solutions Europe's John Hardy** the speakers session began with **Professor Hani Hagras, Director of the Computational Intelligence Centre at the University of Essex**.

Dr Hagras gave a background into robotics research, examining the challenges faced by the field of robotics. He made the point that robotics is not really computer science, and in fact is its own separate field, drawing on a wide array of other disciplines. Many of the things that are being done with robots were still in the realm of science fiction not too long ago, including their control using the mind and just thoughts.

Dr Hagras took a look towards the future and argued that in many ways people are living inside robots. If you take a look at a typical robot, he said, it is basically an array of sensors as well as actuators to make movement happen, along with a high level of artificial intelligence. He argued that many current building management systems, operating things like temperature and climate control, have these kinds of things built in to sense and automate operation.

Dr Hagras used an example of the work that the University of Essex has been doing for a number of years with BT. They have harnessed artificial intelligence to create real efficiency and cost savings. Logistics, he said, is all about trying to achieve as much as possible whilst moving as little as possible. The University has been working on a system for scheduling BT's remote engineers, so that jobs can be completed with the least amount of driving and time. It is estimated that the new system has been allowed BT to take hundreds of vans off the road every year and save thousands of hours of driving time, simply from intelligently assigning jobs and organising a given engineer's work more efficiently.

The way for robotics to really advance further is for them to properly converge with artificial intelligence, rather than working using a type of automation. Dr Hagras argued that much of the robotics currently in operation are based more on elements of hard-coded automation, rather than being able to properly react and change to varying environmental conditions. Many simple face-to-face interactions we do as humans on a daily basis, and take for granted, are still very difficult to replicate with a robot.

With the work with BT set out as an example, Dr Hagras concluded that there is an opportunity now for robotics to play a big part in the future of logistics.

Speaker two

The next to speak was **Alex Harvey, who is Head of Robotics and Autonomous Systems at Ocado.**

Many people are familiar with the company's public-facing online shop and delivery service, but Alex went into depth about what the company does behind the scenes in terms of technological development to make all that happen. The robotics and autonomous systems division at the Ocado Group consists of over 1000 people, split across five development centres in four different countries.

Alex explained that Ocado's smart platform is the real strategy for the business, specifically the technological systems and IT behind fulfilling the online orders. The goal is for the company to offer an end-to-end grocery management service to retailers worldwide in a pay-to-use fashion.

Alex then took a look behind logistics more broadly and the economics involved. The capital costs involved in developing what he called 'classic' sequential automation are huge, and they also require a good grasp of the data – an ability to accurately predict and then supply the volumes of orders that are expected. There's a need for sophisticated simulation and an extremely detailed understanding of the business model.

Because the initial investment with these kinds of large-scale projects are so huge, facilities need to be able to ramp up quickly and work at a certain throughput rate in order to get the payback of the capital cost that has been invested, as well as the operational cost of maintaining and staffing the place.

Alex discussed the fact that large sites need to reach an 'end game' volume as fast as possible – that is, the largest possible throughput that a facility can support. But once a facility is running at capacity, you need another one, so with this approach you are constantly stuck in a cycle of investment and then chasing the payback, before investing again. It takes a huge level of confidence in a business model that some may not be prepared to risk, and arguably is a barrier to more companies adopting robotics in their logistical operations.

With this in mind, Alex addressed what Ocado is doing to solve this problem. The key is a modular and scalable solution, rather than building out a huge facility at the start and having to rush to fill it. He showed a visualisation of a grid system solution, where boxes are stacked and robots move up and down the layers to pick out particular goods. In this way the facility can be scaled depending on what the demand is.

Ocado has been developing their own proprietary technology to achieve this. By using robots that are homogenous, they can invest into just one type of robot and keep the costs and complexity relatively low.

Alex moved onto the other challenge in logistics alongside the initial investment - the operational cost. Wages of the employees, he said, tend to be the largest part of the operational cost of a warehouse, so obviously reducing that is a key target from the company's perspective. He was keen to point out that redeploying people elsewhere, to roles where they have more of an opportunity to better use their skills, is also an opportunity for the workforce to develop themselves.

Speaker two continued

Alex laid out three main areas where operational cost plays a big factor – picking and packing, moving goods around within the warehouse and lorry and van deliveries out on the road.

For picking and assembling orders, the challenges as a grocery retailer are unique – with 50,000 different items to fulfil, all with varying weights and dimensions, using the same number of specialised robots would be unbelievably expensive and complex. Only a standardised solution would be the most cost effective. There is also the problem of the hundreds of changes to the product range that are made every week that means any automation has to constantly adapt and change to be able to work with it.

A large part of the work in the warehouse is moving palletised goods by hand – managing inbound deliveries from suppliers and putting it in storage. Here there's a lot of manipulation that humans are fantastic at doing but for robotics continues to be a huge challenge. Removing packaging without damaging the item, for instance, is something humans can easily do and is taken for granted, but is very hard to get a robot to do quickly and consistently because no two scenarios are exactly the same. Human beings are great at dealing with this – say one time a bag isn't sitting quite right and it needs resetting in a tray – a human easily sees that and can correct it, but with a classic robotics approach it's difficult to match it.

For these kinds of operations, haptic and sensory feedback is very important – with just visual surveying alone, even humans do not have the sufficient co-ordination to do many things, so asking robots to try and achieve it is a long shot.

Sensory feedback when moving goods around is extremely important – you need to be able to use the right amount of pressure to get a good grip on something, but not go too far that you end up breaking it.

Alex argued that a data-led approach, where the robotics take on board feedback from sensors and adapt, is the only way to deal with 50,000 different items with packaging that changes frequently, not to mention the items being added and removed every week.

So for now, while the eventual end goal is to be able to pick the whole range automatically using robots, Ocado does what it can now with robotics to pick a limited number of items with suction cups.

Alex concluded by saying that the classical approach – i.e. building a large automated warehouse from scratch, works if you can predict and plan sufficiently far in advance. However, it takes a large amount of investment and knowledge, and you have to ramp things up incredibly quickly.

To deal with uncertainty and flexibility, Alex advocates a more data driven approach, with a system that is modular and scalable, like the work Ocado is doing with their grid design for the warehouse.

And at its core, being able to effectively implement robotics in logistics, with all the variables that are involved, all comes down to machine learning or AI with data driven optimisation.

Speaker three

Following Alex Harvey was **Ashley Hartwell, from the Strategy Team at Sainsbury's.**

He gave a brief background into the company's experience with automation. After adopting it in a big way from 2001, things became unmanageable and Sainsbury's experienced major supply chain issues with empty shelves. The experience meant that it took a long time before the company considered moving into any kind of automation again.

It makes for quite a comparison with online-only Ocado, as Sainsbury's only has 7 fully automated sites, and 2 semi-automated out of 23 main warehouse locations.

Ashley said that the capital cost of automating is still a major reason why the company hasn't adopted it fully. With automation working best when building a new warehouse from scratch, Sainsbury's has a property portfolio that it feels works well currently and they don't want to move away from this spoke model. Getting things that scale quickly enough to pay back the investment he felt was the third reason.

Ashley felt that all of these reasons meant that if Sainsbury's or any other similar big supermarket were to build a large regional distribution centre now, there wouldn't be a big enough reason for them to automate it.

The talk was concluded by going into a little more detail about the factors involved for the company to adopt greater automation in its logistics processes.

Sainsbury's has to start every automation project from scratch, meaning there isn't a lot of knowledge being carried over from previous efforts. With a lot of the innovation being done elsewhere already, Ashley asked if there could be more standardisation and integration to bring the cost of automation projects down.

Sainsbury's use a lot of long leases on their property, with the company often getting a better deal if they extend to 25 years. As a result there's a real reluctance for the company to move to greenfield sites and throw that away. Questions also remain about lifespan – the lifespan of property often exceeds the lifespan of the automation systems, so in those buildings, what's the exit strategy to remove and replace, and yet keep running?

Panel discussion

During each speaker, the audience was invited to come up with questions and topics for debate and write them down. The panel discussion was then based on these suggestions.

Security implications

The first question regarded the risks with automation, specifically security issues. Adopting greater levels of robotics and automation in logistical processes may bring a lot of benefits, but it also attracts individuals with malicious intentions. And with things becoming increasingly more and more automated and decisions are left to computers, who is at fault when things go wrong?

Dr Hagras used the example of autonomous vehicles – with a car, who is at fault when an accident happens? It is a legal area that needs to be addressed and a clear decision made before any activity in automation can move on.

Ashley Hartwell from Sainsbury's said, meanwhile, that from their perspective they face many different site security and safety issues across both manual and automated operations. For them the weather has caused a similar impact on operations to that of a security breach – he cited flooding as being a regular and major one because of the cost of the clean-up.

As a company that is so technologically oriented and looking to get retailers on board with and trust their platform, Ocado is obviously very focused on keeping security tight. Alex Harvey said they as a company carry out regular testing, with teams trying to break into systems internally to check for weak points. Their premises themselves are also carefully designed with radio-frequency blocking to prevent outside tampering.

He also pointed out that mistakes can happen entirely innocently, using one example of a door lock that had been inaccurately linked up to the network and resulted in people being locked in. Software engineering problems can have the same effect sometimes as an intentional hack.

Meanwhile John Hardy from Panasonic said a fully incorporated, solutions-style approach was important in this area because you can have the hardware, software and firmware all controlled and managed by the same person.

Panel discussion continued

Commercialisation of automation

The next question regarded the eventual commercialisation of automation and robotics technology – innovation often comes from university laboratories, but it can often stay there - how long before it will be out into the real world?

Dr Hagras from the University of Essex, as Director of the University's Computational Intelligence Centre, was obviously in a very strong position to speak about this area having been involved in masses of research. He said thanks to hardware improvements the area has seen many advances – just 3–4 years ago autonomous cars were not on the roadmap at all, and now it's all manufacturers are talking about as the technology starts to get to the point where prototypes can be run.

Panasonic's John Hardy was very clear when he said commercial interest drives innovation. If there is demand for something, companies are strongly motivated to develop and advance the technology simply by having the chance to be the first.

For Ocado, Alex Harvey said the constant changes in the retail business mean they as a company, focused as they are on processes, need to change too, often continually. Looking ahead to the future, it is clear there is a definite need to build capability in for the increasing demands down the road, but there is the balance between this and keeping things cost effective.

To do this, the company visualises everything first so they have a high degree of certainty about the costs, timings and demands involved.

Ashley Hartwell at Sainsbury's, sharing his own personal view rather than that of the company, felt that the chain is certainly not an automation first mover. As a company, they want tried and tested solutions that have been around for five years or more, and not risking the scale of operations they currently have to run on risky, new initiatives and platforms. However, he felt that when the trade-off is made between a manual and an automated mock-up of a particular site, they have been opting for the manual one nearly every time.

First adopters?

Leading on from this the panel was then asked for their thoughts on being a first adopter as well as how they saw their company doing it. Are there any times where the company has gotten in early with a new technology or is there a tendency to be more conservative?

Alex Harvey said as a retailer Ocado is tiny in terms of market share, and that they make money through efficiency savings rather than sheer volume. Over time the company has moved more and more of its technological development in-house, after having many problems with integrators and outside consultants that they've used in the past.

For them as a smaller company that was online-only and technologically set up from the start, Alex felt there was a real challenge to bring in the kind of culture and thinking within the business that they have into older, more established retailers that are set up differently.

Ashley Hartwell from Sainsbury's made the point that the relatively small order size that an online retailer like Ocado has to deal with suits automation better than the more traditional physical store retailer. He felt that the Sainsbury's current more manual logistics model is more efficient and cost-effective.

John Hardy from Panasonic said that industries are typically bad at learning from other industries, and that the work that Panasonic is doing in both rail and logistics is actually highlighting the many similarities between the two. There are opportunities for the logistics industry to take the learning and technology from rail and redeploy it in a different way, which could be very useful.

And with older companies, there is always a history and a level of inertia that you have to overcome. He felt that for many companies, logistics is still seen as a cost rather than a service, and until that mindset changes, major adoption of new technology will be difficult to push through.

Panel discussion continued

Collaboration

The next question raised from the audience regarded collaboration. Panelists were asked about the partnerships they had made in the course of their work in robotics and automation.

Alex Harvey explained that the web infrastructure Ocado uses is all based on Amazon Web Services, meaning that their plans for international deals and expansion can be carried out very quickly because there is the capacity. But he was clear to mention that it is a double-edged sword, with Amazon launching its own retail grocery delivery. For Ocado to use Amazon technology like the Echo, for instance, and integrate it into their service would be a no-no because they would then be giving a major competitor their data – the Echo is developed by a different part of Amazon to the web services division.

Dr Hagras from Essex University said that most universities regularly collaborate with each other and with industry on projects and it is something that the government is keen on encouraging. He cited again the university's work with BT Openreach as an example. He felt that university research becomes useful to far more people than the small community in the field that read academic papers when it is applied to industry, at which point it can have a real world impact and really make a difference.

John Hardy mentioned that in many parts of Panasonic's business, they're both a competitor and a supplier, having done major work with Toyota but also significantly involved with manufacturer Tesla being the exclusive supplier for the company's batteries. He felt that as a company they have to collaborate with everyone, they can't pick and choose and put the politics first.

Standardisation of technology

After Ashley Hartwell's earlier plea during his talk for more standardisation in robotics and automation so that Sainsbury's could actually start to take advantage, the next question from the audience was about the level of standardisation the panels felt was present in automation and how, if at all, they have been able to take advantage.

John Hardy from Panasonic said that one of the biggest challenges as a company that develops a technology, is that once you've put that investment in, someone has to pay for it and recoup the costs. Giving it away is not financially feasible. There's a conflict between manufacturers that want a closed, arbitrary protocol, and users, that want an open one.

Alex Harvey used the example of Ocado's use of Direct Store Delivery software for its HGVs as a use of a standard. The software helps plan routes and vehicle inventory in order to make the best possible use of resources.

Ashley Hartwell meanwhile reiterated his opinion that as a company Sainsbury's is still having to start from scratch with every new automation project they're carrying out, costing extra time and money. There needed to be, he felt, more of a joined-up way of thinking and working and not having to spend so much time unnecessarily duplicating efforts.

Panel discussion continued

The social implications of robotics in the workplace

The next question for the panelists was about the social implications of robots in the workplace. With many of them set to take jobs away from people, how do they see companies dealing with the reaction and fallout?

Essex University's Dr Hani Hagras said that during the course of their research academics are always trying to factor in the social aspects of all that they do. Ideally, they are looking to help rather than displace people, and Alex Harvey from Ocado said much the same thing – for them as a company, he felt that automation was actually crucial to long term job security as it keeps the company competitive and responsive. He also said there are still enough manual operations throughout Ocado that they can redeploy people elsewhere and make better use of their skills. Redeployment in this way was also suggested to give people the chance to add more value to the business than they did originally.

Ashley Hartwell provided a contrasting viewpoint when he said that actually for them as a business moving location can have more of an impact on the human resource factor in some ways than automating.

Alex also perceived IT skills levels in the UK as being really poor, with Ocado having to look to Europe to find the best talent (the company has offices in Barcelona and Poland). He saw it as being a problem starting right at the school level, and said ICT teaching needs to improve to stimulate interest in programming.

Automation and flexibility – scaling up, down or more

The final question from the audience was all about flexibility – what does automation bring to the table, but also how do you integrate the day-to-day demand profile of a retailer with the automation capacity that they now have?

Ashley Hartwell believed making warehouse infrastructure more flexible often meant over-specifying and over-costing because there is a tendency to add extra capacity 'just in case'. Massive spikes in demand can also regularly happen and sometimes are hard to predict, so the question was also raised of how to deal with that without completely over-engineering and building – are there more smarter ways of dealing with big peaks in demand?

The 'classic' non-modular, typically large and complex, warehouse design, said Alex Harvey, does not have much capacity for change except for changes to the products available. He mentioned that customers can also be incentivised into adopting a particular order pattern to help flatten demand out across the week, and reducing that pressure to have everything picked and delivered at the weekend. So, for instance the cheapest Ocado delivery slots are in the evening (9pm onwards) or early in the morning (6–7am).

He argued that with marketing-led sales days like Black Friday, which in recent years has taken place in the run-up to Christmas, retailers have actually made it harder for themselves to make money because demand is so high. They end up with stock shortages and logistical problems that prevents them being able to fulfil demand properly, or have to take on significant extra temporary staff for those periods, eating into the profitability of the entire promotion.

And as much as the physical retail space is carefully designed in terms of maximising time spent in store and getting customers to look at and buy certain products, Ocado also continues to make lots of changes to their web interface to encourage clicks and orders for certain items.

John Hardy from Panasonic said that as automation takes off and the more that is implemented, the more machine learning that needs to be done, otherwise the amount of human effort needed just to analyse the vast amount of data removes much of the original benefit in terms of cost and labour efficiency savings.

Conclusion

There were a number of key messages raised from the speakers and audience. One that perhaps prompted the greatest response was the social issues and impact resulting from implementing automation, specifically the thorny issue of replacing human employees with robots. Redeployment was stressed as a means of addressing these concerns, with Alex Harvey making the argument that from a company's perspective of view retraining staff and enabling them to make use of more of their skills in other parts of the business actually enables them to add more value. The other challenge identified of replacing human workers with robotics is that people are incredibly good at dealing with uncertainties in processes – from small adjustments that might need to be made to something going wrong, people can easily spot something is wrong, correct it and move on. Machine learning and vision is not developed enough still to address the everyday challenges that arise in logistics activities.

The second challenge identified regarded barriers to adopting automation technology. Such projects typically work better in new buildings that are purpose-built to accommodate them, yet many retailers have a property portfolio on long leases that they are happy with and are reluctant to back out of. As the technology advances such systems also have a shorter useful life than the buildings that they are installed in, so the other key barrier to adopting large-scale automation is how to replace without running into huge costs or disruption to continued operations.

The third key point regarded the security of automation. Bringing network-connected technology into logistics operations brings many benefits, but there are unintentional and intentional consequences of doing so. From design flaws and bugs to deliberate malicious interference, maintaining a secure environment yet automating logistics processes is a careful balance. Rigorous ongoing internal testing needs to be scaled up as automation becomes a greater part of logistics operations globally and businesses place more risk upon the technology.

This was our first logistics-focused event and thanks to our close partnership with the Manufacturing Technology Centre took place in an ideal venue. It went extremely well, and it was great to have insight from people on the ground in logistics. In particular, the contrast between long established grocer Sainsbury's and the younger online-only Ocado. We're looking forward to setting up similar events in the logistics space in the future to get conversations started and give members of the industry a chance to learn from each other that they wouldn't otherwise have.

John Hardy, European Sales & Marketing Director,
Panasonic Systems & Solutions Europe