SMI-UTU Webinar: Artificial Intelligence for Port Applications
Answers to Questions posted during the Panel Discussion

29 July 2021

No	Question	Answer(s)
1	**What are some of the challenges in implementing AI technology into a company business processes?**	**[Mr Goh Kwong Heng]** That's a good question. In NCS, we do work with our clients to help them in their AI and analytics journey. So, I just highlight some of the challenges that I see for most of the companies that I worked with. Just to highlight probably three or four challenges. In my view, the first one would be identifying new use cases. You can't adopt AI just because everyone is doing it. Business users and IT guys must come together to identify possible use cases, which will meet the business objectives, or solve the organisation's pain point. without relevant use cases identified, it is challenging for the organisation to kickstart the analytics or AI journey. Second is about understanding the benefits of AI. Quantifying the benefits of AI projects sometimes could be difficult. Of course, some benefits could be very well defined, such as revenue increase or time save. But there may be other areas which may be difficult to quantify, for example, customer experience. Ultimately, you must be able to somehow try to quantify the benefits of AI. Third, I think probably will be the lack of strategic approach to AI adoption. To get management's support, AI initiative need to be planned at a strategic level. Lack of a strategic approach means the plan failed to meet and address the strategic business objective, and don't fit well within the organisation's overall plan. The other barrier, or challenges could be lack of AI analytic skillsets in an organisation or cultural barrier.

		[Dr Satya Murthy] I agree with what Mr Goh has said just now. I think everyone gets excited, but when it comes down to identifying exactly where the AI should intervene in the business process, I think that is one of the challenges. Appreciation of AI is something we are also focused on, because with that education, I think people get better at this. You already mentioned the need to have a good and skilled AI engineers, or data analytics professionals. On top of that, collecting and sharing good quality data, because as I mentioned earlier, AI is really built on top of data analytics or data. So, I thought that is one of the key ingredients we need to pay attention as well.
		[Dr Li Haobin] I think maybe a simple answer from me is actually the lack of data, but I will say that this will not be the root reason. I think the root cause is actually a lack of the standards for people to exchange information. Maybe we take this as an example. If we want to deploy an AI solution for industry, we need an AI engineer, and we also need an expert who have that domain knowledge. But it will be a little bit more difficult for us to identify a person who is actually an expert in both. We need a certain interface, either we let the AI person understand the industry, or we need an industry person to be able to understand the AI. If we are able to have a certain kind of standard for them to exchange information, and to describe the problems, I think this will accelerate the progress.

		[Dr Fu Xiuju] I think the industry partners have a clear view on the challenges for their business process. From my understanding, AI is a race. We need to adopt a long learning curve to be there. So, it's not immediate, where you put some data and some efforts, you will get something out. Maybe from the management, middle layer, and from the worker level, we need to learn. Definitely, as Haobin mentioned, data. Whether we have sufficient information there will allow the data to be accumulative, and allow the knowledge to build up. Don't be afraid of failure, I think then we will see the destination of the successful race in AI.
2	**How AI application to big data collected in SOMS, for example, could assist IMO's rule making process for safety, environmental protection and efficiency of navigation? Could I maybe address this question to Dr Fu Xiuju, since you are doing maritime traffic safety?**	**[Dr Fu Xiuju]** That's a great question. I think a lot of data, including AIS data is available for SOMS. So definitely, it can help us describe the traffic going through Singapore Straits, or go through Malacca Straits. Definitely we can better utilise such kind of big data for a lot of our applications, for example, traffic hotspot ahead, whether we are experiencing some dense traffic, or whether there are some risks ahead like piracy. It's a big challenge for our areas. Others like search and rescue. Even we can think a lot further, like maritime supply chain. For example, in carrying cargoes that are going to spoil, whether we can allow them to do something in the port of Singapore, or in other part of the SOMS to solve this supply chain problem. I think a lot of applications can be done. Part of that, from a safety aspect, whether virtual traffic light can be applied, or something like a warning, such as what we see in the Google map, can be applied by IMO.

3	There is a great emphasis on the Port / infrastructure AI. To have a complete eco-system, in your view, would there be a next phase of AI to be "pushed" downstream to end users such as vessels/ ship owners/ ship agents etc? So that optimisation can be further enhanced?	[Dr Satya Murthy] I think definitely there is a scope for going beyond the port operations. As a community system, Portnet has been around for many years now. This is somewhat innovative when it was first started here. We are even going beyond our local port community. Now it is really about finding our rightful place in the global supply chain. I think you can see multiple disruptions that have happened in the last 1 year or so. You can really see there is opportunity to find alternative ways of logging the cargo. A lot of times, you know, a transhipment port like Singapore, happens to be the key. I mean the way we facilitate the shipping lines, or the cargo owners, or the container operators, to find alternative ways of sending the cargo. The future is really about not just looking at disruptions, but overall, I think improving the efficiency even in good times. I think that is important because of environmental factors which I mentioned as well. I think everyone is now trying to implement some kind of a carbon calculator. They want to know how much did I add to the carbon footprint by routing this way or passing through this port. All these areas, which require a lot of data to be shared, can be trusted because if you are going to claim credit for carbon emission reduction, it must be verified. So, it's not really the AI technique which is lacking. I think it's really about finding the proper use case, and then sharing the data around that, will allow us to make the next push, which I'm very hopeful is going to happen.
		[Mr Goh Kwong Heng] I agree with Dr Satya's comment. I think this question is about how to optimise the port ecosystem. Ships are the main customers of the port. When the ship arrived, it is not just unloading and loading of cargo. You need to send a pilot on board, you need a tug boat to serve them. The ship needs to take a bunker, it needs to take ship supply and take water. So, all these service providers want to optimise their resources, but how do you optimise the resources and at the same time minimise the ship's stay? This is about sharing of data among all the key stakeholders. Everyone needs to know what is

		the change of the ETA, everyone needs to know what is the service required time for the various service providers. They then work towards the optimisation of resources. At the same time, try to give the minimum inconvenience to the ships. So, sharing of data within the stakeholders will be the first step that you need to push it through.
4	**In a real-life scenario, data come from different systems that are from different regions around the world. Synchronisation of these systems will be a challenging task. Any insights on how such a challenge can be overcome?**	**[Dr Li Haobin]** Our Centre have been looking into this issue because we want to build a port digital twin, we want our simulator to able to synchronise with a port. We have been thinking how can we define this synchronisation? For example, maybe people say you can observe what is happening in real time and just copy the data. We think this is not enough, because some of the data is related to, for example, the design configuration of the system. Such kind of data will be there for long time, no change. We maybe then can quote the static data. Some of the data is actually dynamically changing. You observe at a different time, those information change. This is another category of the data, for example, we call this dynamic data. There is maybe another portion, where we can see this actually the trigger for the change of those dynamic data. This is also pretty important. For example, the arrival of the vessel, we see the state will change and the dynamic information will change. I think one of the possible ways is that we need to carefully look into the data and classify them into different categories, so that not only a human being, but a machine is able to understand and digest. According to such kind of a standard, we zoom into the different industries, for example, into the port, into the warehouse, or at least these are the two areas our Centre is doing, and maybe also some other businesses, other industrial domains. We can then zoom into each of the industrial cluster, to say what these different aspects of the data really mean in these industrial clusters. We then get a consensus from the different stakeholders in such industrial cluster, so we can make the standard. The next time when we say we want to exchange

		the data, we want to achieve certain synchronisation, then we can just refer to a certain standard, and everyone will know, what does this mean? These are standards that can be built between the industry and maybe researcher. It can also be built between the physical system and the machine or AI algorithm. So, this is actually one of the agendas that our Centre is pursuing. This is also related to the PortML that we are doing in our Centre.
5	**An ideal situation seems to be one where every single container is identified by say IoT, like what OOCL has done for reefers. I cannot imagine how optimisation etc can be proficiently accomplished without it.**	**[Mr Goh Kwong Heng]** I agree with comments from Mr Seah. The optimal situation is that every container should have a sensor with an IoT device, so you can track the location, you can track the temperature for the reefer container, like OOCL. But I think this issue about who pay for the IoT devices, for every device that is attached to the container have been discussed for many, many years. So that's the issue. So maybe you only use IoT device for containers that are of high value or perishable goods. That is why OOCL only put in IoT device for their customers and for the reefer container. I don't think it's about technology issue, but it's a business issue. Who pay for the costs? Is it the shipper? Is it the shipping line? Or is it the port operator? This is the issue.
6	**Do port community systems play any role in AI of port operations? Also, can you explain whether this AI solution should consider external user behaviours?**	**[Dr Satya Murthy]** I'm not sure I got the question correctly, but let me try. I think definitely the port community systems should play a part because I think they facilitate the sharing of data. All the presence of the stakeholders allows the data to flow efficiently. The other part about the behaviour of the external users, I think it really depends on the context. To the extent that the behaviour of the external users impacts port operations, I think definitely we will try to do that. For example, Mr Goh had mentioned the ship suppliers. We know that they need to deliver the ship supplies to the ship, they can be ship stores or stuff for the crew. But when they come to the ship side, definitely there are operations ongoing as well, and you need to deconflict, for example. So, if they just come at any point of time, either we have to make allowance for

		them, or they have to wait for the operations to finish before they can go in. I think we do need to reckon with their behaviour. Another place where I think we deal with the behaviour is the haulier truckers who bring the containers in and out. I think definitely, we see that, for example, start of the day, a lot of them will come at the same time. This does affect port operations, because there can be congestion which will inconvenience not only the haulier truckers but also the other port users as well. So, to that extent, definitely, yes. But if you are asking about benefits to someone outside the port, I think these applications are yet to take shape or are already there.
7	Fantastic presentations on the necessary synergies. Per the speakers' perspectives, where would automated mooring solutions fit in to the picture as the technology stands today?	**[Mr Goh Kwong Heng]** Automated Mooring is certainly part of the major components in the Smart Port Transformation picture. Automated mooring system decreases the time taken for vessel mooring and release. The time saved amounts to significant reductions in fuel consumption, improved local air quality.
		[Dr Satya Murthy] Automated mooring solutions could contribute towards speeding up the start of operations after berthing, speeding up the unberthing after completion of operations, and also improve safety during the mooring process, as well as improve the productivity of mooring operations. The manual effort involved in securing the mooring lines can already be reduced using mechanical winches mounted on mobile trucks. Apart from the port operator who must equip to perform automated mooring the shipping line is also a key stakeholder here. The cost effectiveness of automated mooring is yet to be properly established. Given that some automated solutions are already in play at a couple of ports and there are also Mooring-as-a-Service solutions on offer, the available data needs to be reviewed to establish this. While I am unsure about how much variability is there in an automated mooring solution due to variances in ship sizes, cargo load and ship design, and local environmental conditions etc. from an AI/ML angle it would be worthwhile to collect data on

		the mooring process to optimize it in terms of performance and safety.
8	Do the digital twin, Port ML and other innovative tools require special IT infrastructure to integrate at the port facilities. Also, in growing need of digitisation, a crucial aspect is 'change management' that is needed at all hierarchy levels. From port side, will it be difficult to finally achieve a 'digitised ecosystem' that is essential for integration of all such advanced technologies in a truly fruitful and seamless manner.	**[Dr Li Haobin]** We are still in the midst of exploring the best IT infrastructure to implement the idea of digital twin and PortML. We are trying to adapt to the latest but common infrastructure for the deployment of the potential solution. One of the potential ways is to leverage on the cloud-native computing, and allow all AI components work as Microservices and communicate with each other via a well-defined protocol, e.g., HLA (high-level architecture). Yes, it is difficult to achieve a fully 'digitalised ecosystem', and we do not think it is realistic to do so. Therefore, we put a high emphasis on 'visualisation' and believe we must make sure that the human beings are still in control while we design the digital twin solutions. The purpose of the digital twin shall be to extend the human beings, and work in an "advisory mode", but not to replace the human decision.
9	The presentation on AI is on port operations. With regard to IMO requirements on greenhouse gas emission - what reason should a shipowner be interested to AI with regard to IMO requirement?	**[Dr Fu Xiuju]** This is a good question. There are many potentials for AI applications for reducing of emissions of greenhouse gases in maritime shipping. Give some examples here for AI applications in maritime emission reduction and that will benefit ship owners and other maritime players: AI can help describe and predict the fuel consumption of vessels for different routes considering weather forecasts to provide decision support for route planning with a reduced fuel consumption. AI could be used for predicting vessels' operation durations in a port before its arrival for better scheduling among terminals within a port to reduce the wait time and unnecessary emission during wait. With AI-based prediction of vessels' operation in a port before its arrival, vessels could carry out voyage optimization through slow

| | | steaming during its voyage to the port and achieve optimal time of arrival with reduced wait time etc.

If future emission tax is applied, all vessels may have to pay attention to their emission and AI can be used to predict/measure each vessel's emission based on their movements. |
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| | | **[Mr Goh Kwong Heng]** The IMO MARPOL regulations limit the sulphur content in fuel oil. This means ships must use fuel oil which is inherently low enough in sulphur, or install an appropriate exhaust "alternative" method such as scrubber, in order to meet IMO requirements. In this context, AI will be more relevant to the scrubber manufacturers where they can look at how machine learning and analytics can make their equipment more intelligent and efficient.

For ship owner, the incentive for exploring AI will be in areas such as optimizing fuel consumption, predictive maintenance of ship's engine and other critical machines and equipment. |