How education and industry can work together to drive innovation: Episode 05

Asif [00:00:00] Welcome to The Art of the Impossible. A podcast for the design and manufacturing industry that explores how you can leverage technology, processes and people to make the impossible possible. I'm Asif Moghal, senior industry manager at Autodesk. And each week I'll be joined by two experts from the design and manufacturing world to discuss their perspectives on the challenges our industry faces and share what they're doing to overcome them. From smart products, mass customisation, digitisation, supply chain resilience and the convergence of once diverse industries, this podcast is for anyone that runs a design and manufacturing business who's interested in making things possible. You can subscribe by following us on Apple, Spotify or via your favourite platform.

Asif [00:00:54] Harvard Business Review sometime ago wrote a paper talking about innovation, and it was really interesting. It talked about the fact there's three types of innovation. Incremental, making small regular improvements to the things that we do. Adjacent innovation, which is taking something we're already very good at and applying that technology to an adjacent market. And the Holy Grail, which is transformational or transformative innovation. And what's really interesting is, the top-performing companies tend to have a blend or a balance of those three types of innovation. But transformative innovation carries with it the biggest amount of risk, but also the greatest amount of reward. And I think that's why so many organisations are hell-bent on trying to find their next big thing, their next big transformation.

Asif [00:01:42] So, how do we enable SME manufacturers to de-risk and dilute the amount of transformative innovation they do? Is it purely that we have to train our people? Do we have to bring new people into the business? Train our thinking? Train our engineers differently? Or is it a combination of both? So to help explore that topic, I've got two very special guests with me today. I've got Paul Perrera, who's the technology manager at myMaskFit. myMaskFit works with universities to develop custom-fit reusable PPE. And Nicole Pellizzon, who's an aeronautical engineer undergraduate at Imperial College London. Nicole is focussing on additive manufacturing data science and in her own words, a bit of tinkering. And she's got some pretty transformative ideas about how we could change the aviation industry. So welcome to you both.

Paul [00:02:35] Thank you.

Nicole [00:02:37] Thank you very much.

Asif [00:02:37] All right. So let's sort of kick-off. Paul, maybe we could start with you. If you could tell us a little bit about myMaskFit, what is it? How did you get started? And if we snap our fingers and suddenly your product was on the market this afternoon, what do you think the transformative impact would be?

Paul [00:02:57] Okay, so I got started after 30 years, almost to the day, working in aerospace for the likes of Airbus, BAE Systems, Rolls-Royce and GKN Aerospace. I was the VP for technology in GKN and looking after things like additive, industry fourth industrial evolution.

And clearly, with the resilience of our supply chain, we managed to convert that supply chain with Rolls-Royce, GKN and a number of other Airbus to create ventilators. And that's when I began the journey to say, well, how can I transform things? So I set up the ventilator challenge with [00:03:27]the KLC [0.0s] and the high value manufacturing [00:03:28]catapults [0.0s] here in the UK and we generated 14000 ventilators 14 weeks later and we leveraged technology. And I thought, well, what more good can we do for the world? And given that we've still got this virus and it's still killing lots of people, unfortunately, we need to do something to stop that. And the most vulnerable people are those people in hospitals, putting themselves at risk. [00:03:49]And it's become more apparent even this week with the issues in the White House. [4.3s] Mask wearing is going to be an essential ingredient to solve the challenges we suffer. And even when we get a vaccine, I can't see that that's gonna change. So I took my learning from additive manufacturing, from industry four, developing digital twins and AI and said, well, how can I solve the world's problem around this? And we spoke to ICU nurses in hospitals who 20 percent of them by statistics, don't fit the standard size masks. And therefore, you know, we started thinking how many other people, if this goes to be a global challenge, won't be able to sit in a standard size mask? So if we roll ourselves forward, and, hopefully, in a month's time, the [00:04:36]previous [0.0s] concept we've got means that you can scan your face using a mobile app on a mobile device. Any kind will do. And then two days later, you bring yourself to the doorstep and you find a box with your mask that fits, hence the name myMaskFit. So I'm using all my learning from aerospace regulated marketplaces to create a solution to these problems. Now, I don't sit here in today thinking that's the end of it. The day after tomorrow is where the real innovation is going to come from. And so beyond the mask, we can see how we can use the same technology to do myShoesFit, myGlassesFit, myiPodPodsFits, you know, [00:05:16]anything to do with a personalisation. I think one of the challenges of this decade is more personalised products and services. And also, it means that we need to think about a distributed supply chain. [10.1s] And we know that in the midst of this pandemic, some amazing things have happened which have been transformative. I'm working with Swansea University who have partnered with us on creating this marketplace. And hopefully we will see Autodesk heavily involved in that. And what we're going to do is build off the back of their additive manufacturing server farms that they created. And they provided 14000 face shields within two weeks through this 3D printing farm distributed network. [00:05:59]So what more can we do about asset sharing? And I think that's another part of the supply chain that's going to be transformed when we actually look at distributed supply chains. And then we think about the business model. And I think these three things coming together will transform the whole of manufacturing, so the manufacturing supply chain business model could be on piece part manufacture for one good today and another tomorrow. [21.7s]

Paul [00:06:21] [00:06:21]So how do we create this flexible, agile, responsive supply chain that can take a design, develop it, move it into production and rapidly reconfigure their business overnight? That's the challenge for this transformation. [11.9s] I believe.

Asif [00:06:36] That sounds absolutely huge, Paul. I mean, so we know that there's a potential for the products to transform the lives of the people it's designed to protect. A better fitting product decreases the risk of somebody transmitting coronavirus. Then, what

you said of the process as the ability to transform, potentially there's an adjacent innovation opportunity there. Well, if you can make a mask of it, then why not shoes or your earpods, as you say.

Asif [00:07:03] And then even the sort of business transformation, you could transform your business to be able to supply custom-fit stuff to people [00:07:10]on the world. [0.2s] I mean, the potential transformation for that is absolutely huge. And I think in a really positive way. So Nicole, having kind of heard all that and thinking about your experience, I know you had this pretty big idea around how we could transform the aviation industry. Do you want to just share with us some of the work that you did? And again, asking you the same question, if we snap our fingers in this afternoon, your kind of ideas and concepts for aviation were implemented. What would the transformational impacts of those innovations be?

Nicole [00:07:47] Yeah, of course. So I looked into how we could take pretty small and insignificant parts of an aircraft and lighten them enough so that when you add it all together, you get us a significant change. So the particular products I looked at was the bracket and the table tray to the seat in front of you, which is something that it is small, it's light. But you've got two on each chair. And think of how many you've got on a single aircraft? Save a very small reduction of a few grams will eventually add up, roll out onto entire fleets all across the world. Then you've got this big change and fuel economy and CO2 emissions.

Nicole [00:08:24] And I think there's been a lot of talk about how there's very little what the individual person can do in that sort of sense. But it's these big corporations that have a lot more responsibilities. It's these little changes. And part of it as well was using [00:08:36]engineer [0.0s] to design, to make these design changes. And it's almost, having it in this very public space where people get used to seeing it, also helps sort of public vision of it as well, to be less afraid of these strange looking parts, which can hopefully mean on people become more used to seeing it. And it'll be less of a strange thing to see these strange innovations that on sort of traditional route and new changes.

Asif [00:09:03] Again, so similar... I'm trying to draw parallels between the examples Paul gave and what you just described. It seems, again, the potential for transformation is huge. Tons and tons and tons of carbon or even hundreds of tons of carbon could be taken out of the atmosphere by making these some of small things. I think that's what you talked about. [00:09:25]Lots of little changes equals a huge impact. [1.7s] And it kind of reminded me, Paul, of what you were saying in terms of, you start with this whole concept of a custom-fit mask, but then add that with something else and something else, and a supply chain, and the marketplace... [00:09:37]A lot of things that connected can be the catalyst, if you like, for this sort of big transformation. [6.0s] I'm just wondering why more people are thinking like this. Paul, what's kind of your view? What's preventing more business leaders in sort of having these sort of thoughts?

Paul [00:09:54] I'm fortunate enough to work for a very entrepreneurial people in the past. And the challenge in some large organisations is control, governance, the mechanisms for

which are often hindering the innovation, being able to be released. And I think Nicole's examples, my best analogy to this is that I worked on hydrogen-powered flight 10 years ago. I was working for a little company called Rolls-Royce and pushed that message into the big organisation that sits above it and said, look, this is the future. And it was and I was the strategy and future programmes lead for a large part of the business. But in the incumbent, inherent organisation, well, that's not a gas turbine. How do we see value in that? That's going to destroy our business, not increase our business. So you kind of got pushed to the side. Then I came to seek an aerospace where I put the message on the table. Hydrogen is the future. Now, look at today's announcements and this last week, that's a significant change in 10 years. We're now seeing Airbus saying they're going to develop by 2035 a hydrogen-powered aircraft. I'm confident it'll happen sooner than that. I'm already talking to other companies about the application of hydrogen and coming back to my myMaskFit and what we're doing there. Many of the things I'm doing there can apply to a [00:11:16]hydrogen fuel cell in the balance, a plant associated with that. [2.2s] There's a lot of space constraints, as I think Nicole was talking about. A lot of optimisation, generative design features in a hydrogen redeveloped aircraft. And we have to take weights out because the one biggest challenge about hydrogen-powered aircraft is that you're carrying huge tanks volume-wise, and they carry weight. And, of course, that's the biggest challenge in any aircraft, to carry that weight, you're carrying additional fuel for every pound or kilo of weight. So one of the things that I've been thinking about is about connecting the dots. And there are very few people who have got the luxury to be able to spend the time like I kind of do, [00:11:56]looking across different boundaries and saying, well, what could I learn from this industry and take into that industry? How can I work with universities, too, that I can accelerate my innovation? [9.4s] I had the privilege of being the lead sponsor for the Boeing ATI Aerospace Technology Institute accelerator programme. And three of those companies have actually joined me on the journey now into myMaskFit, where we brought a team that's working on distributed additive manufacturing from [00:12:25]obscenities [0.0s] and they push out manufacturing execution into machines. And we can work out exactly where in the supply chain everything is while they're building to quality, to standard and responsiveness timescales. I've also built in here features of artificial intelligence and machine learning that have come from another start-up that we're working with, and they are now redeveloping their business model and really innovative and how they've turned on a dime, and moved in a different direction. [00:12:53]Trip through [0.2s] the ventilator challenge now into this. And they're building out another feature set which will enhance the way engineers collaborate. I'm also working with universities who are creating intellectual property, whether it be University of Birmingham, King's College London, Swansea and also the national physics labs. And what we've realised is if you don't go down the road a really exploring those collaborative ecosystems, then you're missing out. I mean, it's key to me to bring industry closer to academia. I have seen that. Obviously, we've got these great big research centres now, the [00:13:28]RTOs [0.0s] of the National Composites Centre, the Manufacturing Technology Centre, the AMRC up in Sheffield and also North Wales. All great, wonderful buildings and great projects. What's difficult if you're a small company, sometimes is getting involved in that, because the overhead associated with being involved in what's become quite large organisations is not as nimble nor efficient cost-effectively for a small [00:13:52]company. So I think the network effect, working across smaller companies with universities, is the way of the future. [6.6s] Yes, leveraging some of those great

strengths of our high-value manufacturing centres, but also working with the technology providers like Autodesk and others who can bring that network together. So that to me, [00:14:15]a bit of investment from companies, a lot of investment from academia and exploitation channels into government are the ways of the new normal. And I think that's the future. [10.6s]

Asif [00:14:26] Yeah. And connecting the dots, I think you said, Paul, which some of it kind of resonated with me. One of the sort of features of the modern world is of crowdsourcing, crowdsourcing everything. You crowdsource funding with things like Kickstarter. And now [00:14:41]we're seeing an increasing push to crowdsource expertise. [3.1s] And one thing that I'm very painfully aware of is the sheer raw talent that exists inside, I think undervalued talent that exists inside universities. Students who are studying design and engineering. And Nicole, I'm kind of wondering, have you got examples where yourself and maybe some of your colleagues have just got together to solve a problem either for a company or a project where you should have crowdsourced expertise? Because it just feels like there's so much needed to design and manufacture and bring a product to market. It seems to be too big for a traditional mechanical engineering degree to encompass. You need these additional skills around it. And some of the best places to get those skills is the crowdsourcing approach. So do you have examples of where maybe you have worked in that way and the impact it's hard to connect the dots?

Nicole [00:15:34] Unfortunately, I don't. Which I think it's a real shame. And I completely agree with both of you were saying, that it's this connecting the dots, working through multidisciplines is incredibly helpful. Not only do you have this extra knowledge, this new way of thinking, but it's also building that network and finding out the different ways that different departments do things. And perhaps it's jus specific to my university. But it's something I think that really should be pushed forward and is where the sort of link between academia and industry can become really helpful. So obviously it can be quite difficult from within an academic sense to have this cross-department working. But you see it happening, and slowly, slowly getting pushed forward. For example, Sheffield with a new I think it's called, The Diamond Engineering building, where they've got all of engineering working together. It's a really great initiative. Being honest, from what I've heard, it apparently is not actually working quite as imagined. But I think it's one of those things that it will take a little bit of time to sweep in. And also just change the way that things work. And it's sort of one of those unfortunate parts of innovation that sometimes it can take a little while to get sort of picked up on before people become truly enthusiastic about it, which is a shame. But it is something that we've really got to try and push forward. And I think, taking Sheffield's example, it would be great to see that in more places because it's really this whole talking to other people, seeing how other people do things is, I think, a significant part of education and learning.

Paul [00:17:04] On that, Nicole, I just added to this thinking. I'm wondering whether the new normal doesn't position things like a building as actually a feature that we will not need in the future. You just talked about getting people together, collaborating, seeing what each other's doing, learning from that. But with digital... I'm also working with a company I just [00:17:24]founded [0.0s] in Wales to build out of gaming technology. My kids spend a lot of

time on gaming consoles and they're socially networked. They're continuing their social engagement despite lockdown, buildin new things like Minecraft or continuing with that theme. I work with Enginuity amongst the [00:17:44]non working [1.6s] panel to develop skills and [00:17:48]stem. [0.0s] And we've built something called Skills Miner, where we can bring together people's abilities and even tap into, as Asif was talking about, un-acknowledged capability. Skills Miner actually allows people from all walks of life to go in and play within an environment which is a truly engineering capability, skill set environment. It tells you where your skills are. We have a great story of a young girl who was in a deprived area around Manchester, and her teacher pretty much wrote her off. We took the skills minor tool to their school and she was playing away with this tool. Suddenly, the report came back and said to the teacher, actually, this young girl is possibly your brightest. The teacher didn't understand. I mean, she wrote her off almost. And the school realised that she had untapped capability in engineering. And since then has begun really to involve herself in start-up projects and getting involved online and making things happen. And it's a wonderful story. And she came from a very diverse background. She's hugely innovative, slightly dyslexic, maybe slightly autistic. And maybe that's part of who I am too. But the idea of bringing together people with untapped capabilities that may not rise to the surface is something I think it's fascinating. And then building on this to think about what do we do around aviation right now? I remember leaving university in a downturn. And guess what? We're in that same place some 30 years on. What can we do with this amazing talent that's coming out of universities to build the future aircraft? I now think there's probably capability sitting around, many of it idle in actual activity, but not idle in their minds. So remeber thinking about raising the platform we've created open source. Let anyone come onto it and collaborate. I'm actually working with a young lady who got a first class degree out of Bristol in aeronautical engineering, and she's created a platform called Engineer to Engineer. And it's like a peer to peer type learning setup. So engineers can connect with each other across the globe and share their learning. And she's amazing. She's now back in Dubai with her family. And we keep working on that platform. In fact yesterday we started connecting up with other universities across the globe. I think there are new models where we can bring the talent together to solve these global challenges. And I take the ventilator challenge as another example of that, where industry, with academia, with kind of scientists, brought to the table a real solution that no one would have dreamt of six months ago. So here's the possibility to solve climate change. [00:20:36]I think it's a bigger challenge than covid. [1.0s]

Asif [00:20:38] [00:20:38]There's a definite groundswell of this. [1.5s] I hear this a lot. Always in every sort of podcast we've recorded, every customer conversation I have, it comes back to collaboration. [00:20:47]Open-source, being more collaborative, being more open and not trying to manage a process, but create an environment for people to innovate and talk and work together. I suppose the challenge is the natural tendency for the commercial world. We must monetise. If we can't see how we monetise it immediately, let's kill it. [17.8s] That sort of short term thinking. And maybe what you were talking about with the Sheffield is if we created an environment, we expected to deliver results instantly. Perhaps if we took a longer term view, we just all relaxed about it. The results will come and maybe there might be difference to the results we expected. But it could still be as valuable. And it just strikes me that's the sort of that's a mental attitude, has nothing to do with

technology, has to do with human beings. So I kinda wanted to move on to explore the characteristics of innovative companies and innovative people. So Nicole lets start with yourself. Imagine with coding, DNA coding, we're going to create the ultimate innovative human being. What are some of the characteristics that you think that person would be, if we were to look at them and say there is a really innovative human? It's a tough question. I know.

Nicole [00:22:05] [00:22:05]This is outside of [0.8s] the immediate obvious of the vague intelligence idea of somebody who is capable and able to sort of create these innovative ideas, it's, [00:22:16]I think a large part of it is probably just down to being open. Open to hearing these things. Open to change in particular. [5.4s] Particularly with working from home now during the pandemic, and I think it's really spotlight on companies that are open to this new digital way of thinking. Companies that listen to their younger employees and say yes, we will implement things like Zoom from the start and Slack. Will these sort of platforms allow working from home, working from different countries? And it's made the world not smaller, but closer together. To collaborate with people from across the world so much more easily. [00:22:51]And this is being open to these new experiences, [2.0s] I think is almost the more crucial thing. A great idea means nothing if you can't implement it properly. [00:22:58]It's being willing to shift with the tide as well as things go. [3.1s] As much as I hate to say it from the sort of morality of it, Amazon has been doing fantastically now for various reasons. Part of it is just because it's sort of that far ahead of the curve at this and allowing the customer to have so much choice over the product.

Paul [00:23:23] To build on that, [00:23:24]I think the characteristics of someone who is innovative builds on other people's ideas and sees strengths in people. But they also see patterns and they see ahead of the curve in terms of trends. [14.3s] So we talk about data analytics and AI. I Think the human mind is the best day AI tool. Some people ask me, Paul, how did you see things like hydrogen coming? I mean, I saw ventilator's coming before we needed ventilators. I use many different sources. I just counted the number of books I've read since lockdown. And it's over 50 different books. And someone just asked me, well, did you get them from the library? And I just go on Amazon back to you. And I find these most amazing resources of brilliant minds across the world. But I also integrate them and join up the dots with social media. [00:24:16]So I'm not constrained by one set of themes. And I build up pictures of what could be the next trend and how do I respond to that trend? What are the challenges that I can bring to support in and develop? [13.1s] So I already see the next thing that's about to hit. [00:24:32]There won't be a vaccine any time soon as much as I want to have it in our doorsteps. The facts are even if we have a vaccine, the most likely booster time will be every two months. So, you know, we are going to be living with this virus for some time. So, you know, do we need actually to think about a distributed vaccination service where, you know, pharmacies now become vaccination points? Do we need to think about, you know, each cell vaccinating each other? [29.1s] Are we going to get to a point where there's going to be a new model for distribution of the antivirals? What does that bring to my mind? It brings to my mind a huge new logistics chain, a new way of thinking. I've talked about drones being a lastmile logistics service. I think we're going to see the deregulation of aerospace in some areas. Where drone deliveries for vaccines will be required. There are certainly people in remote areas today that can't get themselves out of

their house, particularly the vulnerable and the weak, and those that are exposed and sheltering. We need to look after them. And I think that we must think about [00:25:38]how our technology solves that humanitarian problem. [2.4s]

[00:25:42] I stood on a stage about November last year with a wonderful speaker called Gerd Leonhard, who talks about the use of technology. We can use it for all the good reasons, but there will be some people who use it for the wrong reasons. And I think it's our role in society to police those good reasons and keep building on them. Well, that's something I'd like to work with universities and construct a social enterprise around the use of [00:26:06]Amanda Evia [0.4s] cause to help support this next big challenge.

Asif [00:26:09] And so you kind of achieve that if we go back to Nicole's, she's kind of created this ultimate human being. And if I summarise what you were saying, Nicole, the person has to be creative, obviously. They're going to be open. I took a sense of adaptability. And Paul, what you were saying is they need to have the ability to spot patterns and make connections. So if that's the DNA of what a really innovative, transformative human might look like, Paul, [00:26:37]how on earth would we bring that sort of thinking into an SME? I think for large organisations that might potentially be slightly easier because you might have more resources to do it. But if you're an SME manufacturer, 200, 300 people based in the Midlands, how do you instil that into your business strategy? Your goal, your mission, your vision? [21.6s]

Paul [00:26:59] I think it's three things there. One, you need the vision in yourself to bring your employees and the capabilities up. You need, two, the confidence to go and apply it. And three, you need some resources to make it happen. If you have the ingredients for the vision, the resources and the capabilities in whatever form that might be through a distributed collaboration, whether that be in your own team. I think you've got everything that it takes. You just need that confidence to take it to the next level. I mean, this environment we live in and the way that the UK government, particularly, I think other governments around the world are looking at the challenge and building [00:27:33]back better or the green growth, [1.2s] there're so many opportunities that I can see that if you're a small company, just rub them, take the confidence and go, because no matter which way you turn, there'll be people to help you. And I think it's the first time in my life that I felt like actually being in an SME is better than being in a corporate. I think I'd rather spend my life building new solutions fast and quick, rather than sitting on a big organisation worrying about when the next 10 billion pound order is going to come through the door in aerospace. That's challenging.

Asif [00:28:06] You sort of mentioned vision, confidence, resources. I know lots of SMEs who have the beginnings of a vision. And I would say, without being disrespectful, their confidence level is really low. Is it possible to dip your toe into messing around with the resources that are available? Here, again, I'm thinking specifically about going to a university, connecting with students like Nicole and your sort of peers. Can you kind of reverse engineer confidence vision by engaging? Do you think that's possible?

Paul [00:28:37] Absolutely. I've just built so many good friends because I've just taken a step towards a university and said, look, I'm not the expert, you guys are. How would you solve this problem? And they sort of say, well, actually, you do know a bit about this already, but let me help you with what we do know. I'm plugging those gaps. I mean, I think an university, if I think about it in my career, has always been a key part of how I thought about things. I took a systems engineering approach. Doing an aeronautical engineering degree, getting a first class from Bath. And that has been probably the best thing I ever did. But at the same time, on top of that, I was also an apprentice.

Paul [00:29:14] I got my overalls on, went to the Rolls-Royce Training College in Bristol. I learnt on the trades how to mill, how to weld, how to assemble. I learnt all the basics, which I think is sometimes the vocational bit which universities need to bring to the table a little bit more. I loved the big academic powerhouses we have in the UK in particular. But if we don't integrate that with practical reality and this is the challenge we've got under lockdown and the continuation of this. [00:29:44]How do we give people the practical experience of being an engineer in the field? And I think there is a way, and I think technology helps us with that. [8.4s] I was lucky enough to be the biggest owner of HoloLenses from Microsoft in the middle of the ventilator change. We had 89 in total deployed across the UK, doing remote learning effectively. So many of the people on that programme I've still never met. We deployed HoloLens into seven different factories. We had remote assist and we were able to teach each other how to go and build ventilators. Something we've never even done before.

Paul [00:30:20] But the prerequisite for that, and this is where we have worked with Autodesk heavily, is to actually build a digital twin of the ventilator. We actually needed something physically to convert it into digital so that we could translate that into standard operating instructions, be able to reference parts. Many of the quality inspectors had never seen a ventilator part before and we're looking for fit form and function. We augmented their capabilities. And this is why I think we need to do augmented learning by providing the link to the digital and having a hybrid solution so you could pick up a part, look at that through your HoloLens and know that that part was fit form and function as per the CAD model. Now, when I think about this, when I was at university, if I hadn't had the practical experience of being on the shop floor, I could design, and I like Nicole's example of the seats, I actually have done something to use generative design to take about 20 percent of a business class seat weight out. But I needed to go and actually physically get a business class seat from a MRO shop in Cardiff. I pulled it into the office and scanned it, turned it into a digital representation to see really if I could make this work, because without it being physically in front of me, it became really difficult. Now, that was a few years ago. [00:31:45]Virtual reality has come a long, long, long way. It's going to come further and faster. We do need to think about, if you can't actually pick up these things and feel the weight, you can't actually work out the space allocation quite as easily when you're actually not sitting in the seat. You need that physical piece. And I think without having some way to blend the physical and the digital, we're losing out. [23.2s] So one of the things I'm challenging myself to do is to see how we can bring people, particularly apprentices, into the physical environment, but safely. I'm thinking about how to do that. And looking at contact tracing, looking at the ways we can use machine learning to learn whether

someone's coming through the doors with a mask on and only open the door when the mask is on. Just things that just take some of the pain away from the future. We can live with it.

Asif [00:32:33] So, Nicole, from your experience, do you think enough SMEs are approaching universities and saying, hey, I got this challenge outside of the structured placement programmes that exist? Do you think enough SMEs are knocking the door of universities and having those conversations that Paul described?

Nicole [00:32:54] From my limited experience, I would say no. I think it's something that should definitely happen more. I sort of completely agree with this whole... If an engineer hasn't got this experience, physically manufacturing some things, stop seeing that design actually come to life, they're not a very useful engineer. And it's something that I think a lot of engineering students have an issue with. Once you do enter the workplace, having to then get accustomed to actually working with a physical product. It's very different to just seeing on piece of paper, doing a lot of maths in the background. It's not quite the same thing. And Paul mentioned about augmented reality and having this sort of interactive additional experience is the first step towards that. Given the expanding population, everyone's going to university these days, it's not always feasible to have everyone in the shop floor. Particularly looking at dense cities. For example, Imperial, we're in central London. There is no way to expand. It becomes very difficult to make sure everyone has time on [00:33:51]life, [0.0s] for example. So having this digital experience is not the same, but it's certainly better than nothing, much better than seeing a video on a PowerPoint, for example. And it's enough to give you that understanding of how manufacturing works. So then make your design smarter so that you're not having to go through several iterations, talking to technicians, say, well, physically, this is impossible, why have you designed it like this? No, we need to have that information before so that when we do take it to be manufactured, [00:34:19]what sort of are there [0.0s] to make it sort of put the final touches and make sure it's actually manufactured to the best it can be, rather making these fundamental design changes. Because we have no idea what's going on. So I think having this partnership, a close partnership with SMEs, can give this opportunity to more students where they're not necessarily having to go through the university to get this experience. So they can offer a new perspective. We know nothing from the way things are manufactured. But we can offer this fresh perspective on how we think you should go based on what we've seen, based on the fact we don't have these preconceptions of how it should be, and then learn from people who have actually done it physically and said, well, this is why we didn't do it like that, or perhaps we'd never thought of that. And it's getting the synergy of two completely different backgrounds and eventually, hopefully, will roll out some better engineers.

Asif [00:35:14] It just sounds so painfully easy to do. I mean, if I was running an SME I would be kicking the door down Cardiff University saying, where are your design, manufacturing and engineering students? Because I want to talk to them. Is there anything stopping SMEs? The comment you made, Nicole, about having access to some physical, hardcore manufacturing facilities like [00:35:36]lathes, build [0.2s] that kind of stuff? Is there anything stopping a manufacturing company kind of budding up with universities saying,

look, if you want to mess around with [00:35:43]lathes [0.0s] and you want to see [00:35:44]leaves, [0.0s] I'm thinking pre-covid, obviously, is everything stopping universities and SMEs connecting?

Asif [00:35:51] So, you know, we got a specialist [00:35:52]lay, [0.0s] we got five accesses [00:35:53]mill, [0.0s] we got 3D printers, we got resourcing capability outside of your traditional capability, and sort of almost making those available to universities. Would that be something that you think is possible to do, Nicole? From a university-industry partnership point of view?

Nicole [00:36:09] I think the largest issue that would probably be from the sort of knowledge, health and safety side, you don't want a student come in and then break a really expensive machine. And it takes time to train someone to use it. But I think even from the point of view of just perhaps having this conversation about a design, taking it through the different stages, not necessarily have the student manufacturer, but at least have them on site to be able to see how it works, understand the sort of pinch points of their initial design, for example, or the things that actually perhaps turned out well. It's difficult. I think it would be fantastic for everyone to have this experience of actually manufacturing something. But I can understand that it's most likely unattainable for the majority of people.

Paul [00:36:52] I think a good thing about this conversation is that there aren't all the answers. But an SME obviously has a focus on probably a smaller portfolio than a larger corporate. The benefit of being connected with a university is looking across the different schools. We're working with the likes of the School of Manufacturing and Life Sciences and Maxillofacial Surgery unit at King's College, London. We're working with Birmingham on a medical device design. We're working with the Swansea University on scaling up manufacturing, using industry for working with Sheffield on the AMRC side, looking at how we can deliver robotics and cobotics. All of these things are amazingly interesting. [00:37:47]But the one thing that's missing from all of that, and this is something I'm trying to tackle, is to look at the social aspects of this. If you start thinking about user experience, someone trying to move themselves into digital manufacturing environment with new business models, you have to think about the impact that you're having on your people, because if you start bringing cobots into a factory and thinking about the use of technology, you then have another [26.2s] [00:38:14]SETTON [0.0s] [00:38:15]suite of issues. [0.5s] You know, all these robots are going to take my job. I think we have to think about it differently and we have to think about all these technologies complementing, augmenting our learning and our jobs. And I think one of the challenges that an SME might have is to work that bit through. And it's quite easy. I mean, let's give you the example on the ventilator challeng where one of those factories, and I'm not going to say which, but we had Rolls-Royce, GKN airbus, [00:38:43]sweet Seamans, [0.3s] Ford. We gave them HoloLens and the response was like, wow, we're just going to do this on paper. We don't want all the lenses, they're nice to have, not necessary. So we'll turn those away. The others took those HoloLennses, used them as an opportunity to try out the technology. And the benefit was that they could produce their ventilators at half the cost and at twice the rate. So immediately there was a big gain by taking the technology. [00:39:16]The problem is the barrier. It takes a courageous leader to jump into digital and say, OK, I'm going to take this on. [6.8s] And I

think in university you've got courageous people who want to do something with this technology. So how can you blend that? University, the enthusiasm, ambition together with maybe, I'm not going to say laggards, but certainly those that struggle to be the leaders? And I think that's the clever bit. The blend of the two is so important that [00:39:45]we can push each other much further and faster if we have that blend. Diversity is the key in innovation. [5.2s] And I think universities have huge diversity of minds, of schools, of thinking. The blend that comes across, and I think Nicole's touched on it. Even in these coded lockdown times, probably the collaboration across different schools within the university has been better than ever before. I would imagine now that the society groups of universities get together online and do their socials this way, with Zoom or whatever else.

Paul [00:40:27] [00:40:27]But I think that the value of this social interaction across different functions of business or across university schools is where diversity and innovation really come together and we can bring more out of everybody if we try out new things. [15.0s] And I think that the first part goes back to get your confidence that you can do something with that diversity and innovation. But to do that confidence move, and I think this is the key for most SMEs, you need a bit of help.

Paul [00:40:56] And what I can tell you now is that the government I'm working with, the Manufactory Made Smarter Commission, and Juergen Maier and Chris Courtney, who are leading that activity through government, really pushing to get SMEs interested in digital transformation. Now is the time and the place to get that government support, to go alongside your ambitions. They'll introduce you to any university that will be able to partner with you. And they'll also provide you with some of the means and mechanisms and even funding to do so. So, what a wonderful time to be in manufacturing and in a small company. I've been lucky enough to be part of the bigger companies, but some of these small companies are doing some really interesting and differential technology development. And faster than the corporate. So let's lean on that and lean in. [00:41:39]Let's work with universities. Let's find ways and means with which we can co-collaborate and co-create and reinvent the product development lifecycle. [8.5s] I think there's one thing we've not touched on and that sustainability in manufacturing.

Paul [00:41:53] I think [00:41:54]there's another piece here about the circular economy. That's going to drive us to think completely differently about how we design, manufacture and bring SMEs together. [8.2s] The example on the mask that I have right now is everything I 3D print, all the waste support material that I have, I recycle it. And it's going back into another product at another time. I need to produce a low carbon footprint. I'm looking at how do I do distributed manufacturing close to the point of use. Could we create a factory in the box that ends up on a NHS hospital car park? So the day you walk in to the factory in the box, maybe in a lorry, a bit like the blood donor, you get your face scanned the following day, you come back and get your mask printed with the components that are being assembled in that factory in the box. How do we do these things that also benefit society? The sustainability argument. Again, an SME distributed manufacturing solution is a better option than these great big towers of strength, the massive manufacturing company. [00:42:53]So today I call upon all the SMEs out there to begin to think differently and embrace the change and learn from what we've been talking about and go and get access to

the finances, work with the universities and generate your proposition that will change your business and your future of your employees. [15.8s]

Asif [00:43:10] So that brings me nicely to sort of the last part of the conversation. In a minute I'm going to ask you both, what are the three things, bits of advice you would give to the industry? So, Nicole, from your perspective, what are the three things you wish that every SME manufacturer, design and manufacturing company in the UK, would start doing tomorrow to bring industry and education closer together? What are the three bits of advice you've got? And Paul, I'll ask you the same thing in a minute.

Nicole [00:43:44] The main one for me is be brave. We've been speaking a lot today about confidence and having the confidence to push further. And I think really, once that's been tackled, everything else will fall into place a lot more easily. It's about taking these risks, shaking things up, going digital. Taking the advice of an inexperienced university student who thinks differently. These little things that once you're brave about it, these little things that will help push forward. I think, I believe. And to be honest, I can't even think of three, for me the main one is just be brave. Take these risks.

Asif [00:44:23] That's a really clear bit of advice. So Paul, from your point of view. And again, it doesn't need to be three. But what's the bit of advice you would give all the SME manufacturers out there who might be listening to this, thinking it's fine for large organisations? What about me? What could they literally do tomorrow?

Paul [00:44:40] Firstly, I mean, we know that the graduates of 2020 have got jobs to be found. The government supporting, you getting those graduates that are almost free. I'll go and grab some. What have you got to lose by taking on some of the best and brightest in the industry right now from Imperial College. And Nicole, can you work for me?

Nicole [00:44:59] We've got [00:45:00]lots of hands all the way. [0.7s]

Paul [00:45:02] And, we will take you on the journey. And, from a student's perspective, don't think of it being you're stuck in that career track because, aerospace will come back and we will find a route back. And that's why I'm doing what I'm doing. To bring people back into aviation. So, first thing is, be brave. Take some decisions now. Take the benefit of all the encouragement that the government is providing particularly in the UK and I'm sure across the world. Get manufacturing going. Bring the value back to the country by taking on your challenges and actually doing something with it. But I think if you've got a purpose and a mission, the people will follow them. You're going to get the best and brightest from university. You're going to get the best and brightest capabilities from the wider ecosystem. You're going to get the money to go with that. The investors out there don't want to be earning point five per cent to the bank. They want to be finding new sources of income. So I don't think there's a better time to create your own company as well. So go and spin out something. If you don't think you can do it within your own company, go and find someone that can and leverage that. And go and find ways and means that you may not have tackled before. So first thing is to be brave. And I think Nicole's pointed that out. And look for support. Go and find those conversations. If you have to use House Party, go into some

social environments and find a way to network in a different way. I constantly use LinkedIn and other things to get my thoughts out there. And it's really rewarding when you get the messages back saying, can you tell me more about that? Can we find out a little bit more about what you're doing there? That happens every day that I learn something from somebody and that's my guidance to everybody. We're never going to be at the top of our learning, we can always learn from somebody, so pick on that learning and turn it into action. What have I done today that's changed tomorrow? That's the question I keep asking myself. And then the final thing that we need to think about, I think, is, take that first small step on the digital journey. I don't know how small it might be for you and your company, but let's take the smallest step. Even today, I had just been advising a small company, starting up, how do you get yourself off the kind of idea of government funding, grant funding and get your first revenue? How do you put your monetisation plans down so that investors can see that you've got a route to getting your first revenues? Because that's the essential for a new business. And often it's just a case of, well, turn on that other feature on your website and get people to pay for it. Whatever it might be, but you can do minimum viable product so much easier now than ever before. I could create a new business tomorrow and see if it works within a day. That's the way that the future's going to work. We will never get it right straight away. We'll learn. We'll iterate. We'll develop. We'll learn. We'll iterate, develop. And I think we'll create the circular environment if we share that learning. So I think the benefit of us being open to failure is one of the things that this country in particular is not so rewarded for. Look at the US market. Someone who's failed in business actually probably stand up on their feet the next day and starts [00:48:06]again. In this country, we look down on failure a different way. And I think there's a cultural aspect to that. We need to change that. And I think we need to challenge that. [7.7s]

Asif [00:48:15] Fantastic. So there you have it. It sounds like the technology has the potential to achieve great things. But without the right people, the right sort of thinking and leadership behind it, it won't do it. So what I've taken from this conversation is if you run a company, if you're a SME leader, you need to have a vision. And maybe that vision has to have a sort of a social impact as well as a kind of a monetary productivity kind of impact. You have to have the confidence to take that first small step that Paul just talked about. And then you need resources and that sort of courage to go and make some decisions. Now, the resources seem to be abundantly available. It seems to me that there's a pool of creative, open, adaptable people out there who are good at spotting patterns and making connections, and they seem to exist within our university framework. So take that first step. Go and reach out to a university. Talk to a non-expert about a challenge, an opportunity, an idea you have and see where that conversation ends.

Asif [00:49:15] So I really want to thank Nicole and Paul for a great conversation today. Thank you very much for both attending me.

Nicole [00:49:24] Thank you for having me.

Paul [00:49:25] Thank you, Asif.

Asif [00:49:25] No problem. And so we had a wrap up on this amazing topic today. I will talk to you again on the next podcast. So thanks very much. See you next time.