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|  | Timespan | Content | Speaker |
| 1 | 0:00.0 - 4:25.8 | As you may know in some ... [introduction to the interview] | Interviewer A |
| 2 | 4:25.7 - 4:31.6 | Roughly how many products have you designed for additive? | Interviewer A |
| 3 | 4:31.5 - 4:32.6 | About four | ID07 |
| 4 | 4:32.5 - 4:38.2 | How often, frequently, did they come up? | Interviewer A |
| 5 | 4:38.2 - 6:07.6 | The first project that I used to design for additive manufacturing was the first time I started with 3D printing. I brought that project with me and that’s still ongoing. What I did with that project was, it was a bespoke designed handle for my mum walking stick. Mum had a stroke and she used to complain about using the stick. It made her feel stigmatized. You know it took away her youth (for an after) she had a stroke and she didn't like using it. So we were looking at. It didn't feel comfortable in her hand so I made a… I had an idea to make the handle bespoke to her particular grip and what it did is it taught me how to scan, how to print, how to use Meshmixer and a lot of design skills that I just didn't have. So it was a really good exercise to sort of get me off the ground. The major project that I am working on at the moment which is this piece of wearable tech. That's an ongoing project that is going into short volume production. | ID07 |
| 6 | 6:07.6 - 6:20.6 | What proportion of your projects with additive are series production of end-user products as oppose to tooling, prototypes or one-off? | Interviewer A |
| 7 | 6:20.6 - 6:41.8 | Okay, this is about the early version at the moment that is more towards series production. It is pretty much in the realm of rapid prototyping. The projects that I’m looking at the moment will be more towards metals in terms of series production. | ID07 |
| 8 | 6:41.8 - 6:45.4 | Do you think this is changing? | Interviewer A |
| 9 | 6:45.4 - 7:54.8 | Very much so. I do think it is changing. I think we are now getting towards an era where industrialization is becoming to the (for). I think what we’ve got to do; we have not seen the best of what is yet to come in terms of the machines. We are getting a lot closer, but I don't think we are quite there yet where companies can realise their return on investment and understand the total costs is quite expensive for them. So we’ve got a situation where existing machining is still the cheaper alternative. I think we will struggle to get people to adopt additive manufacturing until those costs become apparent. You know because at the end of the day that's what -- How much is the money? How can we get a return on investment as quickly as possible? | ID07 |
| 10 | 7:54.8 - 8:05.8 | In my email I asked you to identify some components or products you’ve designed and now they are made with additive. What components did you choose? | Interviewer A |
| 11 | 8:05.8 - 9:32.8 | That one that I brought today to show you is a piece of wearable tech that is designed -- The project came about -- A good friend of mine is involved in 2D printing, has got a project that he had been approached to supply wristband. He was in the business of providing wristbands and what this project is about is childcare nurseries. What they wanted to do is to attach a tracking device to the child so that they knew where they were within the nursery. The reason being was that one of the children had managed to get out of the nursery and that was like, this can't happen again ever in our state of the art [nursery]. They just built a new state of the art nursery, which has got a system in place that will be able to track the children with this piece of wearable tech which I can show you how the system works later. So the challenge there was to -- One of the challenges was to get the size of the hardware into a wristband that will be small enough to go onto two to four year-old. | ID07 |
| 12 | 9:32.8 - 9:41.0 | Can you show me some of the material you used to develop the project? | Interviewer A |
| 13 | 9:41.0 - 24:58.9 | Sure absolutely. So what we got here is -- The challenge was, the brief was given to me in [change the microphone position] January this year, on January the seventh this years and the brief was to create a wristband which house two pieces of tech. One of which was an AM tag, which I am showing you now and that is what is inside that little pill; and this is a Bluetooth low energy chipset, which has got a battery in there. So the challenge was then to -- the initial brief was to create a wristband that both the teacher and the child could wear, because they wanted to understand, they wanted to have everybody on their database. And then the challenge was then to make it, obviously functional, attractive and then small enough to fit a two to four year-old; challenge then being the different sizes of wrists. So that was the initial sketches that I did to go back to the client and sort of say, after the brief they’d given me -- originally was just a Bluetooth low energy chipset that I had to house. One of the problems that they realised in the building was that they had no way of being able to recognise when the child could actually left the main part of the building. They could track them within the building with this Bluetooth low energy chipset but the major bit which is if they got out then they needed to set up an alarm or stuff like that. So this is where this came in. So the challenge was obviously to sort of pack all that into something that was quite compact. So I did some plasticine modelling and I did some concept sketches and also downloaded some statistics from the ASTM website to get to the parameters right for the child’s wrists and made some mock-ups along those lines to get some feedback from the client that's just some information there about the -- that gives you an idea. So we got to seat an hour forty-two battery within the chipset and that's the chipset there. The technology went to the wearables tech show to have a look and see if there were some smaller technology available and that is evolving and we have got some second generation, third generation ideas coming along at the moment, but we needed to get this up and running because his nursery is now open and so this is generation one, which is out there and functional. So we had a look at some of the products that are on the marketplace at the moment. So they should have said that was the one that we want to make it like, make it like that and the client would be happy, sort of thing. The challenge being that's the chipset that is in this one and that's what we are up again to house those two as you can see somewhat bigger. So we looked at trimming this down, how can we make this smaller, some original concept designs were to stuck it, one on top of each other, which is this version prototype. So as I say the brief was delivered on the seventh of January, I had access to FabLab London at the time, so we had an Ultimaker, a machine that I am quite familiar with. So just knot up some quick prototypes, chose the material that's a made solid material. So I made an original one in just PLA and then I chose this flexible material which is called "Made solid" to give it the flexibility. So I could actually put it on a child's wrist and get some idea of what it was like. Obviously the quality is pretty rough, it was the first time I actually print it with this material, but it was good because it was a proof of concept. I also made a nice render because the feedback that I was getting from my client directly was that the nursery was very aesthetically orientated, it had to look cool so I made a nice render, sort of sell it to them, which I did using a piece of software called Fusion360 and also could collaborate with the client using a cloud based piece of software that (piggy backs on that) called 8360 which is a great tool, I thought, to be able to keep the client up-to-date and to be able to share these renders over the internet. So they didn't need any software, they just needed access to the cloud basically, which is pretty good. So there is some initial prototyping that I did. So this was the first version that I did in white PLA just to check for form and function to ensure that I got the dimensions right and then what we were looking at -- because this -- They were talking about battery life and how long it will last. The idea was to be able to then remove the chipset and change the batteries over. This was all given to the client to get some feedback from them. The good thing was by about mid-January they got the prototype. We could then actually -- The first prototype. The feedback from the nursery was that they said: "we want it like this, this is what we want, so we want it in silicone and we want it smaller." Okay so we were sort of struggling then how to make it smaller. They didn't like this sort of dome idea, I thought that was the best idea to stack it, to compress the hardware. So they wanted silicone and I was not familiar with the manufacturing of silicone, so I did some research into silicone moulding. How to produce silicone. Who could do it. How to then look at over moulding. Because the good thing was that, because the client had given us a lot of feedback because we could put a prototype on the table. They could then start feeding back the design ideas. Because originally the brief was pretty, you know, just make it typical sort of design brief, I want one just like that sort of thing and not very specific. So it is up to me as a designer to sort of come back to them and with some concepts. But obviously I gave them a few to choose from. When we were looking at the complexities to put the faces into it and to look at manufacturing and designing that. That was really pushing my design skills to the limit in terms of being able to do the T-splines. And the complexity of that got quite hard for me as a designer. So I simplified it to get the functionality back and make it more simple. I spoke to a company called Protolabs about liquid silicone rubber moulding which they could do, but Protolabs could not provide the service of over moulding with their Arburg liquid silicone rubber machine. So they would have taken out of the equation. There were companies that could do this in China, but we were not ready to go into that volume of production and that volume of commitment in terms of tooling. And then, I was spoke to Digits2Widgets, working with them on another project and they suggested I speak with this lady called Mandy who was an expert in silicone moulding - Mandy maker. So I met with Mandy. She came to FabLab in London which was great and it was good because we both learned from the experience. She didn't know much about CAD. She was intrigued of what was going on in FabLabs and she was willing to share her processes. I learned a lot more about silicone moulding and materials and stuff like that. So it was a good collaboration and we both learned. Very quickly by the eighteenth of January we were in a position to give them the first version in silicone rubber. So this was once again a (stack) idea, a click design that we borrowed from the Fitbit and a bit of a combination of this style of design of fastening to get this wristband together. We also collaborated with the client and looked at moving the AM tag away from combining the two together and put it on the end of the wearable to then use it as a fastening device, which was quite a cleaver design, I thought. Some of the challenges that we had with the silicone moulding the challenges that we had were actually getting it out of the mould. The first one we got out of the mould, this is a silicone rubber, was not a problem. So other things that we needed to consider which was learning from me, was the wall thickness consistency. As you can see there, we’ve got a little bit of a tearing problem. What Mandy could not offer me was small volume production. The client originally wanted ten wristbands. It wasn't viable in terms of cost, to use her as a -- because it was a prototype method not a production method. The other learning from that exercise was that, in terms of surface finish, the master that I was producing was on an Ultimaker. So there was a lot of post-processing to get the surface finish down because obviously what you see is what you get in your silicone mould. I was looking at using Digits2Widgets and using there SLS machine, which unfortunately broken down at that time and so we ended up just doing some filling and polishing and lots of post-processing work to get them the master to a suitable standard. The good thing was then we supplied the clients with that version. They came back to us and they said they didn't like that height of the prototype. They said it is too tall although I thought the foot print was a lot smaller. Anyway that was their feedback. And the other thing was that we had some issues with tearing in terms of the retention within the mould. So some good learning there for me and both Mandy and then sort of feeding back to them. What we did manage to do though, I came up with this version of the design which they liked and they committed to and they then looked to doing some branding and there was a commitment from the client to get the go ahead. So this is all within three weeks of the initial brief. So we ended up with the final version generation one. One of things that we then went to find a company that could do series production, short volume production and the client or the manufacturer didn't like the original design idea of using a cap. The idea of that was going to be glued onto the chipset, right, to act as a seal, because these kids do wet-play. So we were looking at trying to make it, what did they say, weather-proofed not water-proofed. Understanding that to get it to a weather-proofed status is going to take a lot more time and investment in terms of the project itself. So Lewis at PD models didn't like the idea of this cap, because he saw it as a potential swallow hazard. So we came up with, this was Lewis’ idea to do a split. We did a couple of split designs in terms of getting that Bluetooth chipset in and out because the battery only lasts for probably a couple of days, a week at best, before it needs to be changed. Because it is constantly sending a signal back. The software that I used was Autodesk Fusion 360 and that was good for me, it was a great learning. The timeline was a great time saver for me and the fact that I could use interface the designs with A360, it was a great communication tool I thought, very good. That is probably jumping ahead a bit, I’m assuming that you are going to ask me questions about. | ID07 |
| 14 | 24:59.1 - 25:08.6 | Yes, How did you decided to produce in series this product or component using additive? | Interviewer A |
| 15 | 25:08.5 - 26:12.1 | So silicone moulding was out in terms of over moulding because of the fact that we could not find a machine or a process that was available to us in terms of series production. The series production aspect of it is still, I think, that is debatable in this particular project because of the fact that the master was then produced on a Projet 3000DH but what the PD Models [bureau involved in the production of the mould] then did, was to make a mould that then could be injected with a material called Proflex which is a polyurethane material. | ID07 |
| 16 | 26:12.1 - 26:25.0 | Which AM technology was used to produce this component? | Interviewer A |
| 17 | 26:25.0 - 26:45.2 | So FDM. FDM originally for the initial prototypes and then the Projet 3000DH machine which is | ID07 |
| 18 | 26:45.1 - 26:47.3 | Polyjet | Interviewer B |
| 19 | 26:47.2 - 26:49.0 | Projet, yeah | ID07 |
| 20 | 26:49.0 - 26:51.6 | Is it a Polyjet machine? | Interviewer B |
| 21 | 26:51.6 - 26:55.5 | It is a Polyjet machine correct yes. Polyjet | ID07 |
| 22 | 26:55.6 - 27:07.0 | Did you consider any conventional processes? | Interviewer A |
| 23 | 27:06.9 - 28:16.7 | Yes. Well, one of the questions to the client was what kind of volume that you were looking at. Initially they were looking at to get the project, they were committed to... The nursery offered a number of alternatives of products that were available on the market in terms of clip-on, badges and things like that and the nursery directors were quite specific that they wanted a wristband. So the wristband had to be produced to meet the deadline of the nursery opening so the minimum order quantity requirement was a hundred pieces. So we could look at almost like a repeat rapid prototyping but knowing for well that we are going for different versions of the design, moving quickly forward. That was a reason for considering this type of production method. | ID07 |
| 24 | 28:16.7 - 28:19.7 | And do you remember what the main considerations were? | Interviewer A |
| 25 | 28:19.7 - 30:44.8 | Okay, yeah. Some of the main considerations for me were stretch allowance in terms of design. Obviously support structure was a consideration. Tolerances and understanding that. One thing that I would have liked more information on, which would have been a benefit to me and I was a bit sort of stubbing in the dark a bit here, was we didn't have time or budget to do any testing which concerned me. There was a lack of -- there was initial material data sheets on the Proflex material that we ended up using, but it was trial and error, in terms of shore hardness to determine the elasticity versus strength. So that was a consideration. Over-moulding was a big concern because we were actually impregnating the AM tag into the wristband itself. And also the removal of the Bluetooth chipset, that was a consideration how to make that as effective as possible. We were considering a decal to go over this. But one of the problems is that they had to find this material that would stick adequate, stick to this Proflex material. So that's come back to not enough data, being able to understand some of these materials and what they are capable of doing. There are other considerations: not too much to do with additive manufacturing but gating and venting in terms of ensuring adequate aesthetics in terms of venting if you can see the venting is underneath here of the design. So we've got a nice top surface finish. | ID07 |
| 2 | 30:44.8 - 31:09.1 | Now, you did a very great description of your design process. The presentation really helps, with some great images. Now I would like to ask you to, well you've already kind of explained, but how did you come with that design, how did you come with the design as today's now? | Interviewer A |
| 3 | 31:09.1 - 35:35.9 | Having had previous experience in design was a benefit to me. But this was the first time that I'd really done wearables design. So there was a lot of learning for me. I think what I did do to the drawing of the most inspiration; I was looking at the existing wearables technology that was available. And almost getting the best of each piece of wearable tech and then making a (hack) of those designs to come up with the design solution.  We changed the material shore hardness to make it a lot stronger and then did some very simplest testing. But that then created a challenge for me in terms of the design because the design parameter didn't change, the material hardness did, ok, and the consequence, which was that the wristband broke. It's too hard. It was too rigid and it didn't have the elasticity required. So we then played around with material shore hardness. I twit the design a little bit here so we could get the retainer to actually snap into that groove. We've come with a workable solution. | ID07 |
| 4 | 35:35.9 - 35:53.6 | So when you were designing this product for additive manufacturing, did you follow any specific design rules and design guidelines? | Interviewer A |
| 5 | 35:53.6 - 38:49.7 | Ok, so, what I've done, I did the best of my ability. I researched whatever available information that I could find on design for additive manufacturing. And there's not a lot of information out there. So I used a lot of my previous production experience, right, to assist me in this design. It's quite difficult to quantify that because I've got many many years of experience as an automotive engineer. If somebody is starting from scratch, I think the speed and challenges would be a lot higher because of the lack of knowledge in how to design, not only how to be an industrial designer, but also how to design for additive manufacturing. So I was looking at, mainly the amount of the information that I could find was surrounding support materials, right. That's what I managed to find. I have since started to build a file on design for additive manufacturing and continue to look for information. Crucible, it's got some useful information there with some case studies. I did also come across; there was another piece of information that was quite useful. This was design for additive manufacturing, it was done by. (XXX) had posted this and it was design for Ultimaker. Design for additive manufacturing using an Ultimaker. So that was some really good information there. I can send that to you, I can give you a screenshot or whatever, no problem. | ID07 |
| 6 | 38:49.6 - 38:53.6 | Can you find this on the internet? | Interviewer A |
| 7 | 38:53.6 - 40:26.0 | I just found that on the internet, yeah.  Also Autodesk, Fusion 360, the resources are available and the support that I had from Autodesk has been amazing. | ID07 |
| 8 | 40:25.9 - 40:51.6 | This question is a little bit, how we jump directly to the drawbacks and limitation? So, do you think in this product, are there any drawbacks or limitation as a result of this being designed for additive? | Interviewer A |
| 9 | 40:51.6 - 43:51.8 | Would be to be able to pause the additive print, to be able to position the hardware within the print and then continue the printing, right. I think we could look at using that as a series production method, whether that's achievable with the type of material and the machine processes, which is available to us at the moment. I didn't have enough time to research that. I think, looking forward, whether we end up going down. I'm relatively confident with multi-jet fusion, that would be able to significantly reduce or actually design within the wearable tech itself, the technology to be able to do this within the print itself. I think we are way off there, alright. But when we get to that point, we'll then definitely be able to reduce the size of these products, to be able to produce them to demand, alright, and also as the technology and the speed improves, and the demanding increases, it would be able to bring down the production costs, I think. Other limitations, surface finish, obviously, alright.  Perhaps looking at Fortus machines and materials that are available there. I think there is a possibility of using that as a series production method, because we could pause the print. What we then got to look at is whether or not the technology is capable of withstanding the build environment temperatures. So a lot more testing, bigger budgets required. But I'm confident that there's ways and means forward. | ID07 |
| 10 | 43:51.8 - 43:56.4 | Did the use of additive manufacturing change your design process? | Interviewer A |
| 11 | 43:56.3 - 45:08.2 | Absolutely. Just in terms of speed to market. I mean, if I had to look at this from traditional manufacturing methods, we'll be looking at doing injection moulding. Then it wouldn't have got off the ground 'cause the tooling costs. I went through 12 design iterations on this, right, which I could do very, very rapidly without any tooling costs. If we had to look at that and we did that with tooling, we would spend a lot of money and not go very far. And this project wouldn't have got off the ground. This project's been done incredibly quickly. It's been done very cost effectively. | ID07 |
| 12 | 45:08.5 - 45:24.7 | So I'm going to ask you some general reflections about additive manufacturing as a production process and design for additive manufacturing. So what are your views on additive manufacturing as a production process for end user products or components? | Interviewer A |
| 13 | 45:24.7 - 47:11.8 | I can see certainly from aerospace prospective, the buy-to-fly ratios make it a viable proposition for additive because the significant savings in weight and the (knock on effect) for that is savings in aviation fuel. I think the automotive industry as we move forward in terms of car design and bespoke design, we'll see increase in smaller volume production. And the one that really excites me is digital supply chain. If we can get that moving forward, and get the confidence back to the I P, right, being able to share data files and ensure the protection of security, then I think we will have a lot more people in industry prepare to adopt. At this moment in time, they are not confident in the safety. Their products and design I think is still very much behind a locked closed doors. | ID07 |
| 14 | 47:11.8 - 47:22.5 | In general, what do you think designers need to know for designing effective parts for additive manufacturing? | Interviewer A |
| 15 | 47:22.5 - 48:57.1 | Standards. If we can get the A S T M, I S O, and British Standards, the sooner we can get those standards sorted out, we'll document it and ease the access the better.  There is not data to lean on.  I think what we are seeing at the moment, we are seeing an adoption in non-critical items, right, but until standards are in place. I mean the additive manufacturing metal workshop that I ran in London, that was the feedback: when are we gonna see standards. | ID07 |
| 16 | 48:57.1 - 49:17.5 | Now, you told before that you learned design for additive manufacturing, that was mainly based on experience but also some materials that you found online. Now you told us that you had a folder, did you come up with your own rules for design for additive? | Interviewer A |
| 17 | 49:17.5 - 50:20.4 | Yeah, definitely, I mean, that year I spent in Fablab, by running the 3D Hubs, and looking at that as a viable business.  The first year was to understand the machine, so polymer machines and parts, building the machines from scratch, understanding the maximum you can get out of the machine.  What is this machine capable of doing, and then designing with those limitations in mind of the machine. | ID07 |
| 18 | 50:20.4 - 50:24.9 | Can you show me those rules? | Interviewer A |
| 19 | 50:24.9 - 50:32.1 | To a certain degree, yes, I can. Yeah, I'm happy to share anything that I've learned. | ID07 |
| 20 | 50:32.1 - 50:34.7 | How did you develop them? | Interviewer A |
| 21 | 50:34.7 - 53:58.7 | A guy XXX, used to work in XXX. We just talked about designs, we worked (through) experience, we looked at work around.  Then we looked at the design of the product and looked at it differently. You know, can it be sliced, can it be assembled differently, can it be orientated in a different way, what's the function of the product. Is it just to sit on the desk and look pretty? Or does it need to be functional? There is more information coming now, Stratasys just pull out a white paper, which I haven't had a chance to read fully. But it's a lot more information about the materials and the machine processes which are then suitable for applications. So I think we need a lot more case studies available, a library of case studies where people are willing to share their information in a more open forum.  We need a bit more industry orientated approaches to that as well. | ID07 |
| 22 | 53:58.7 - 54:08.1 | So in the next 5-10 years, how do you think additive is going to influence design with taking all these trends? | Interviewer A |
| 23 | 54:08.3 - 55:18.2 | I think it's gonna continue to increase it on a daily basis. More and more people are becoming aware of it. I think we had a high bubble, 2013, we need to educate, I think it's really important to educate. There are two strengths of education as far as I concern, we gotta educate seed level of management about the methods and total cost of ownership of additive manufacturing machines from industrial perspective. We also then got to educate school children in 3D printing. | ID07 |
| 24 | 55:18.2 - 55:31.5 | Ok, thank you very much. That's been very very helpful. Now we are going to towards the end of the interview. So I'm gonna ask you some background. For instance, what is your educational background? | Interviewer A |
| 25 | 55:31.0 - 56:33.0 | My educational background, I'm a production engineer trained apprentice. Did that many many months ago, which fortunate enough to get a career in motive sport, which took me around Euro and off to Asia Pacific. I have designed and made breaking systems, automotive components. The thing that really excites me is assisted devices, making people to live more independent lives through clever design. | ID07 |
| 26 | 56:33.0 - 56:35.3 | Where did you study? | Interviewer A |
| 27 | 56:35.3 - 58:04.5 | I studied at the (XXX) College further education with my apprenticeship. Now I study everyday as a life-long learner, finding whatever information I can find. I would be very keen to do, I believe there is a Masters in Additive Manufacturing that has just been released at (XXX). It is an opportunity to participate or collaborate in any way shape or form. I'd be very interested to do this. This is a major career change for me in terms of, not too much turning my back on the automotive industry but looking at it from the perspective of, this really excites me. I had a really exciting career in motive sport and this makes me want to jump out of bed in the morning. | ID07 |
| 28 | 58:04.5 - 58:09.3 | How long have you been working as a professional designer? | Interviewer A |
| 29 | 58:09.3 - 58:15.4 | Two years, as a freelance designer. | ID07 |
| 30 | 58:15.4 - 58:31.3 | Ok, so, can I confirm that it is ok to take some pictures and have some copies of your presentation? | Interviewer A |
| 31 | 58:31.3 - 58:34.4 | By all means. | ID07 |
| 32 | 58:34.4 - 58:36.5 | Is this project in the public domain? | Interviewer A |
| 33 | 58:36.5 - 59:03.0 | I will be blogging on the wristband design. There is an aspect of the Projet in relation to the software, which is restricted access. There is some information that I can share with you, which is included in the presentation. | ID07 |
| 34 | 59:03.0 - 59:05.9 | Can we use this as a case study? | Interviewer A |
| 35 | 59:05.9 - 59:08.5 | Please, too. | ID07 |
| 36 | 59:08.5 - 59:54.0 | Ok, now, in the following weeks, we will transcribe this interview, it will take roughly a month, when we finish everything and check everything, and then we will send a copy to you. If you want the audio files, we can send you the audio files, and also the transcript. Whatever thing you want to change, just let us know. If you change your mind, say - yes, I said that in the interview but actually I mean this, the word - everything can be changed. You can withdraw at any moment from the study. As the last question, I just want to ask, I would like to ask you to do, you want to be named or anonymised in the case...? | Interviewer A |
| 37 | 59:54.0 - 59:55.6 | Happy to be named. | ID07 |
| 38 | 59:55.6 - 1:00:07.1 | Ok, so this takes us towards the end of the interview. | Interviewer A |
| 39 | 1:00:07.0 - 1:00:21.0 | [chatting] |  |