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|  | Timespan | Content | Speaker |
| 1 | 0:02.5 - 5:15.9 | [Introduction to the interview] ... Roughly how many products or components have you designed for additive? | Interviewer A |
| 2 | 5:15.9 - 6:26.1 | Okay so, so I do more research nowadays. I did work as design engineer in industry in two thousand and one [2001], two thousand and three [2003] I suppose. It would’ve been less than five. I worked in an aluminium casting company so I designed, we designed -- we would have used additive manufacturing for tooling basically. So we would have created a component sometimes for example emergency door handles on trains, that are going to be cast and then I would create that in the CAD software, get the 3D prototype done in SLA epoxy resin and then we would then give that to pattern makers to tool off. So that's where I really designed for it, but then I moved into research more. So as I say that why I might not have specific examples that's where Grahame or someone probably has more. But in terms of, recently, I have been working on a project, I cannot say huge amount about, but it's a patient specific device. So I can design an interface for the body that fits the body's form by using additive manufacturing. | ID10 |
| 3 | 6:26.0 - 6:31.9 | Using Additive manufacturing for designing or do you think that you would use additive also for the final production? | Interviewer A |
| 4 | 6:31.9 - 6:51.2 | I have been -- well yeah for designing actually because of the complex nature of the part of the body that interfaces with. I am using scan data and because of the complexity of the shape I am using additive manufacturing. Try to think -- can I do it any other way? | ID10 |
| 5 | 6:51.2 - 6:55.1 | But the final product will be made with another technology. | Interviewer A |
| 6 | 6:55.1 - 7:32.9 | Hm well because it is a research and development process at the moment, we are going to test some prototypes in a few weeks’ time in a hospital. So it is very early stages. I think it’s feasible but the end product, if we find the hypothesis that a product that fits the body at this point will be more comfortable. If we prove that hypothesis then feasibly yes, it could be an end-product in additive manufacturing, but at this stage it’s probably a bit early, because we are still in the testing. But it could be a solution potentially. | ID10 |
| 7 | 7:32.8 - 7:39.6 | When you were working in industry how often did projects related to additive manufacturing came up? | Interviewer A |
| 8 | 7:39.6 - 8:53.2 | So because I was working in that aluminium casting industry so I was working -- when I started due to history of the company, is a small company, fifty employees; but they didn't have any sort of CAD software or not sort of decent CAD software. They didn't have CAM software. It didn't really use additive manufacturing so my role was to set up a design department. So I guess the fact that I sort of set that up, enabled us to then explore additive manufacturing for products. So when there was an urgent job that came in; to say for example there are castings for mechanical castings for -- you have been on the tube in London yeah, so tube trains -- metal castings on the (coving) and things like that and I say that model came in quickly, then they might want us to manufacture that in sort of a week. So what we would do is, rather than get a pattern maker to manual make it, I would take the CAD model, I would edit that for the additive manufacturing process, also the casting process. Get that made and then we would create tooling from that. So when we need to do urgent projects I guess, products. | ID10 |
| 9 | 8:53.2 - 9:12.5 | Considering your all projects. Considering as one hundred percent that all the projects you have been working on, how many in percentage did you use additive for prototyping, producing the components or for tooling or for one-off? | Interviewer A |
| 10 | 9:12.5 - 10:10.2 | It was always for tooling actually. Yeah it was always tooling. We did mainly for smaller, I’d say smaller aluminium cast tools, I am sort of saying about half of -- four hundred mil by a hundred mil I suppose sixty whatever; like cast components, but we did do some very large SLA models for driver communication units. So in the cab of the train in this big sort of unit, imagine (monosis) going to, like a big display unit; so we had that 3D printed -- we had that additively manufactured and we did soft tooling of that for a resin, glass fibre, phenolic moulding, a long time ago. But we phenolically moulded in a close mould, so we used for that for tooling. | ID10 |
| 11 | 10:10.2 - 10:15.5 | Do you think this percentage is changing? | Interviewer A |
| 12 | 10:15.5 - 11:24.5 | I would say depends, again for my experience, it depends on the company, the application and the market. What's the end product if it is. Could be quite a big answer to this. I think is changing, but I think it depends on the end product. If it is like something that someone’s designed for, like a bespoke product, like a, I don't know, they have gone to Shapeways online and they have downloaded or edited a new phone case for them or something that is not as demanding in terms of quality. The sort of stuff, then I think that is increasing, that's model is there; but if is something that is part of a turbine blade for an engine, then obviously that’s a different -- I know they are starting to do stuff in the aerospace; but there are higher quality and there are higher demanding parts still, in my view, being made in traditional manufacturing processes because of the rigour and the quality that is required at the moment. | ID10 |
| 13 | 11:24.5 - 11:36.3 | In our email, ... [introduction to case to present] what products or components have you chosen? | Interviewer A |
| 14 | 11:36.3 - 12:26.6 | So like I said in the email, I am not designing, you know, I am a researcher like yourself really now, so I am kind of; but one of the projects I can talk a little bit about, bear with me, because I cannot talk too specifically because is under NDA and stuff. But these products are bespoke medical interface. So I am using the complexity that you can get from additive manufacturing to make something that would fit onto the body as an interface for a medical device and that has been designed for additive manufacturing. And I always -- when I designed it, it was always to be additively manufactured, it was not meant to be -- I have never thought it would be injection moulding or something, because of the complexity and the small volume. It will be one-off per person. | ID10 |
| 15 | 12:26.6 - 12:35.2 | Can you show us some of the material you used for developing this product? | Interviewer A |
| 16 | 12:35.2 - 12:55.8 | Give me a minute.  You may guess which one of the body fits on; but if you could, in terms of confidentiality not, you won’t be talking about this with anybody else, will you? | ID10 |
| 17 | 12:55.8 - 13:02.5 | No at the end we will ask you. We will not take any picture. | Interviewer A |
| 18 | 13:02.5 - 14:08.3 | No that's fine. Okay good. It is the application (that I am worried). So this is going to fit onto the body. Actually I 3D printed this one on a Printerbot at home. I've got a little Printerbot at home. I made one at home as a test piece to see how it would fit with other components; Okay? So that is using PLA, yes it is PLA actually. Okay so that is an example but that was to try and get a fit and sort of function before moving onto a more expensive material, okay. And that one is just another example there and there. So this is where my design is changed; so that is using epoxy resin. That is the Stereolithography photopolymer, it is a (Accura) clear, a (Accura ClearVue) I think it’s called. So yeah. | ID10 |
| 19 | 14:08.3 - 14:15.9 | Can I ask you which part of the body this interface fits? | Interviewer A |
| 20 | 14:15.9 - 14:21.4 | Yeah if you don’t tell anyone. | ID10 |
| 21 | 14:21.4 - 14:40.0 | How did you decide to or how will you decide to produce in series this component in additive? | Interviewer A |
| 22 | 14:40.0 - 15:48.7 | It is an R&D project at the minute; so we are still trying to prove if it works. You know, if there is a need for it as such. So but if it went into series production, I mean this is hypothetical. I’d imagine -- it is going to be batch production anyway, so it would not be tens of thousands, it would be sort of, I don’t know, maybe ten a go for a number of users; but the way we are designing a product. This fits to another part of a product which could be mass produced. So there is another part that is plastic that could be mass produced that it fits to and then this part, because of using the additive manufacturing to get the contours, the complex contours; I would like to see that being used for the end product if it was strong enough after testing and so on. A combination of traditional and AM. | ID10 |
| 23 | 15:48.7 - 15:56.2 | Which additive manufacturing technology do you think would be used for the final production? | Interviewer A |
| 24 | 15:56.2 - 16:04.3 | For this one would be the photopolymer, so the SLA at this stage. | ID10 |
| 25 | 16:04.3 - 16:08.1 | Did you consider any other conventional processes? | Interviewer A |
| 26 | 16:08.0 - 17:11.2 | I did consider, again in combination, I CNC machined some polyurethane board with the contours of that part of the face, to look at creating a different kind of material interface with the edge. So you can put it in the material then bond into it, to follow the contour. So in conjunction with but for actually making the parts, I am only exploring the additive manufacturing for the main component; however there was an extrusion as well, so a silicone extrusion that I was looking at as well that can fit into some recesses here. So it is combination really, so traditional technology as well as additive manufacturing. | ID10 |
| 27 | 17:11.2 - 17:23.1 | Will this product in your idea be personalized with anthropometric data of the final user? | Interviewer A |
| 28 | 17:23.1 - 17:50.7 | That's the idea. Yeah. That's the idea. The personalized element will be using scan data. So it could be. So easy to do that now. To take that data and then the personalized bit in theory would fit into a modular component which could well be produced using sort of injection moulding or something else to make it more viable and stronger and whatever. | ID10 |
| 29 | 17:50.7 - 17:54.5 | What are the main consideration of using additive manufacturing for this product? | Interviewer A |
| 30 | 17:54.7 - 19:55.1 | So orientation. So things like build orientation. It is not a bad print actually for a three hundred quid machine. Orientation, post-processing, so for example on this early model I am showing you, you've got, it was made of PLA on a very low quality or low cost FDM machine and you can see there is a something build over, there is a honeycomb structure that has to be removed. So that was obviously an issue. So for that process that was (fiddly) taking that off. The same with the other examples I’ve got here. The epoxy ones on the higher end machine - the SLA. They had to be post- processed; so they need a sort of honeycomb support structure. So there would have been support structure for any overhanging surfaces had to be removed; so there was a side of it. Wall thickness as well. So I do go quite thin on this component here because of one mil but again the other wall is too thick and support structure, there is still a bit of support there actually, a tiny bit on one of the edges. So again you know where I put some of the slots and have a view in future revision, it is a learning curve, better ways of designing it. In this example here, there is a little bit like a channel. The example I am showing you now has like a channel around of the edge. Obviously producing that isn't really ideal in this process because there was quite a lot cleaning-up to do. So you know, I did at the time. I think it’s pretty fair to say, I sort of did it without thinking fully what would happen with the post-processing so the next -- this was an iteration where the previous one did not so well when I made this with larger gaps in sort of -- (what habit) sort of. But yeah there are some of the things. | ID10 |
| 31 | 19:55.1 - 20:04.6 | So obviously the component was not previously made in any other technology, right? This is a completely new design? | Interviewer A |
| 32 | 20:04.6 - 20:07.6 | So this is a new design yeah. | ID10 |
| 33 | 20:07.6 - 20:43.3 | Now we are going to use a metaphor... [introduction to the question] How did you design the component as it is? | Interviewer A |
| 34 | 20:43.3 - 22:23.8 | Okay. So one of the parameters was that I had to fit into an existing component, okay? So an off-the-shelf existing C marked component. So that was one of the design restrictions if you like. And then it was a case of trying different -- having spoken with the users of the end product and haven’t [or ‘having’?] spoken with the experts of those that work with the users, it was a case of then coming up with ideas, you know, the usual kind of design process sketching, ideas, concepts and then transferring that into a CAD package, so Freeform is one of the ones we use here which is the 3D clay software. So we imported in the patient or person data and then I had to design, like a say, the standard bit, the interface bit that had to work on, that to fit with the standard component and then the other part I designed around the face; so I used the face -- so I used the organic anatomy whatever, as a cutting interface and then try different iterations basically. So I tried the first method I thought would work with like a flange and then I tried something else and then. So it is iterative design in that sense, so I try it, make it, test it, try it, make it, test it. Really. | ID10 |
| 35 | 22:23.8 - 22:31.5 | And what were the design considerations at the concept stage, I mean during the idea generation? | Interviewer A |
| 36 | 22:31.5 - 23:42.2 | So the interface with a standard component was one; creating a surface that fit the anatomy is the other part; so that is the sort of point to that; removing things like sharp edges, like any sharp edges off or anything that would be (from) the process. What else? Things like the post-process cleaning of the material. So for example the epoxy resin can be -- we have process here where we -- my colleagues have used for implants before, have you met Dominique? Have you met Dominique Eggbeer? Okay he might be someone to talk to anyway afterwards. But they make sort of guides like anatomical guides. So for example if someone had a nose removed, they’d create the guide that goes underneath and they use this material because they can sterilize it and clean it. So material cleanliness was another decision, another design (aid). So there are the key factors really at that stage. | ID10 |
| 37 | 23:42.1 - 23:55.8 | Probably you have not gotten at that point but are you thinking about the considerations for the embodiment and the detail design? | Interviewer A |
| 38 | 23:55.8 - 24:51.6 | So would have sort of final kind of. At this stage is more about proving the principle because we’ve got a kind of -- but it is a working prototype if you like or a test prototype so once we move beyond the initial testing, there might be some more redesign iterations (at the circle of design) and what happen at the very end it might be quite different maybe; but again at this stage I still foresee that we will use additive manufacturing at least for the component that fits the body, because the complexity of it and trying to create this complexity in a geometric CAD software, oh it is a pain. I’ve got colleagues here, actually Grahame before, he did some work on it as well, but. | ID10 |
| 39 | 24:51.6 - 24:54.5 | Because your moving between meshes and Nurbs? | Interviewer A |
| 40 | 24:54.4 - 25:15.4 | Well my experience of using that software, I don't use that software much, I use Freeform, like works with voxels, 3D cubes which works a lot better with this kind of data; but there are still a lot of issues like (lucan) surfaces, lost and various things and again cut from the face and I don’t know, but I don't use (the gimet) I don’t use that software much so anyway. | ID10 |
| 41 | 25:15.4 - 25:29.2 | Okay so now that you are designing this product or component, are you following any specific design rules or guidelines? | Interviewer A |
| 42 | 25:29.1 - 26:23.6 | No, not actually. No, not really. Like I say, I would not have as much experiences, as the previous interviewee, Grahame, he is a design engineer day by day; but it is from what I have learnt from working with these technologies and researching these technologies more than anything. So, you know, if you’ve got walls that are self-supporting and that kind of stuff, you are gonna need supports underneath, how the supports are gonna go on there, it is going to be easy to take away? You know, not common sense, but it is kind of what I have learnt from when I have talked about these processes and when I have actually observed people using these processes and from talking to my colleagues here. So it's kind of from experience, but from talking to my colleagues and leaning from them as well and seeing how the processes work here, we can see them, we can access them, we can try them. | ID10 |
| 43 | 26:22.4 - 26:39.6 | Did the introduction of additive manufacturing knowledge change the design of other components of the product other than that? | Interviewer A |
| 44 | 26:39.6 - 26:41.6 | Has it? I'm sorry, can you? | ID10 |
| 45 | 26:41.6 - 26:52.0 | Because you are making that in additive, then the design of other components is changing? Is the design of components changing because you are making that component in additive? | Interviewer A |
| 46 | 26:52.3 - 28:01.3 | Uh, interesting. Yes, actually, I suppose yes. First I'd say because, for example, you've got a channel where you could put silicon extrusion through, ok, to make a softer interface. We tried that, and, this might be more to do with the application though, I suppose, but because additive manufacturing and processes we were using, the channels were quite clogged to the support structure, so yes, in that case, it was hard to get the silicon in, so we looked to doing something else, that's one of the reasons. But also the other reason, because of the () [something that supports the nose?] sharp changes in the direction, because the patient of atomy, it was very difficult to get that silicon component in to do what we wanted it to do. So, yes, a bit of both because of the support structure, but also because of the application of the product. | ID10 |
| 47 | 28:01.3 - 28:09.6 | Are there any drawbacks or limitations as a result of this component being made with additive? | Interviewer A |
| 48 | 28:09.6 - 28:46.7 | The post-processing. So if you need, for example, this prototype version here, what we had the silicon running around, that needed a lot more finishing. What else? Bonding to it, can be a bit tricky. It's quite brittle as well. Can be quite brittle. So we had to design, you know, make sure that's thick enough in certain locations to carry out the function that it does. But, uh, yeah, they're the main things. | ID10 |
| 49 | 28:46.7 - 28:54.4 | Did the use of additive manufacturing change your design process or practice? | Interviewer A |
| 50 | 28:54.4 - 29:38.5 | Yeah, I suppose, in terms of, if I was trying to do this another way, how would I've done it? It would've been hand crafted or it would've been C N C machined. So I originally designed it for additive manufacturing because I knew that I could get the complexity of the shape I wanted, you know, fairly efficiently. It was sort of timewise, you know, it's a quicker way of doing it. So in that sense, I knew that I had to start off, I wanted to use additive manufacturing from the beginning. | ID10 |
| 51 | 29:38.5 - 29:52.8 | Ok, so, now we are going to ask you some general reflections on additive. So, what are your views on additive manufacturing as a production process for end user products or components? | Interviewer A |
| 52 | 29:52.8 - 31:24.1 | I don't think it's there yet. I think there's been a lot of hype about additive manufacturing and a lot of talk about 3D printing in terms, well, let's talk about the term 'interchangeable' now. I think there is a lot of hype, I think we are not at the stage where you are gonna be making end components, you know, it's gonna replace, say, injection moulding. The economies of scale and the quality of the product, doesn't make sense, at this point. I think the best application is going to be sort of one-offs or bespoke or tailored products in batches. But again, at this stage, at this point in time, I think the issue is to do with the quality of the material and the finished good that is being made. You know, you get an injection moulded part with a homogenous structure, you know, in vast that way, the quality of say a 3D printed machine, someone's done in their shed yeah, it's not there yet. I don't know if it will get there, I mean. But I can't see being end products yet. Perhaps it might be part of the process of the production line. I can imagine, maybe, when I talked about how components fit with injection moulded parts, maybe things like that. Perhaps that will be the point in the process where actually 3D printing is used, which is for one specific thing rather than making the whole product, because of the complexity, because of the nature of it. | ID10 |
| 53 | 31:24.1 - 31:26.3 | Like in the example you are showing us? | Interviewer A |
| 54 | 31:26.4 - 31:40.1 | Yes. So, one component might be, but using the properties of additive manufacturing, so like the complexity of the shape, you know, that kind of stuff really. Different type of material, whatever. | ID10 |
| 55 | 31:40.1 - 31:47.9 | In general, what do you think designers need to know for designing effective parts for additive? | Interviewer A |
| 56 | 31:47.8 - 32:58.4 | Well, the first is gonna be different type of additive manufacturing processes, because they are all different. That would be the first thing. I mean, you know, understanding it is a layer based manufacturing process, understanding that you might make something coming out of Projet, () resin, with wax structure, but actually that melts out so the post-processing is different to, if you make a SLA with a honeycomb physical structure, you have to take, you know, you got to understand the processes and the drawbacks and the positives for each of them. Material properties too. So, you know, I'll try to mimic ABS plastics or polycotyl plastics. Can you do that? You need to have a think. So, what are the limitations? So it's down to, very simply, what's available, what can you do with each technology and then how I address design for that technology, I guess. Because the one was wax support structure that can melt out, might be really good for making small intricate channels and sort of sieve components whatever or filters. What else? The one using the epoxy resin or FDM say, would be very difficult again to pour out the support structure. Ok. | ID10 |
| 57 | 32:58.4 - 33:02.6 | How did you learn how to design for additive? | Interviewer A |
| 58 | 33:02.6 - 34:36.9 | Yeah, good question. It wasn't formal. I did a product design degree and got to industries, design engineer. But my, since graduated in 2001, showing my age now, but basically, additive manufacturing wasn't really, it was around but it wasn't used as much then, you know. So I first got to introduce, I suppose, I came to, I was working as a design engineer, and for the, I mean, the aluminium company, I came to COMPANY G actually, when COMPANY G here, so COMPANY G was the first start, we got a part sub-contracted here, so we had a prototype sub-contracted that working as sub-contact, I came to collected it, looked at it, so that was my first, was introduced to it. That's a few years back. Then I guess, being a designer, I was always interested in these kind of technologies, and when I worked in industries I had my first main job, I was linked to the university, I did a KTP, it's a knowledge transfer partnership, I was working at a company but we still had a strong link with the uni. I was aware of the technologies they had here. They showed me the facilities and then I was able to say, look, why don't we try using these technologies. So I was able to bring that to the company and upskilled them if you like. So that was observation, being aware of what's there, I was so addicted I suppose. But I was lucky to observe them at the university and to see them. | ID10 |
| 59 | 34:36.9 - 34:39.8 | Did you come up with your own rules to design for additive? | Interviewer A |
| 60 | 34:39.8 - 35:44.6 | No, it's kind of try and error I suppose. In the early stages, it's try and error. I wasn't making thousands of parts, you know, one or two here and there every other month. And the parts that are being used are patterns, so the main design requirement was actually interesting was actually designing them, so you cast of them, like aluminium casting, so things like getting the draft right, making the shrinkage, such as increasing the part in certain size. So that's actually more getting the aluminium component at the end of the day. But the parts weren't the super complex, you know, they were, because that's the way that additive manufacturing processes work, they were pretty standard. I was happy that what we do with the parts wasn't super complex or, they were big enough that they could be finished, they could be added to. So that's fine. [These answers do not make too much sense to the question] | ID10 |
| 61 | 35:44.5 - 35:47.7 | So how did you learn casting? | Interviewer B |
| 62 | 35:47.7 - 35:53.1 | Aluminium casting? So, I mean, yeah, I did actually learn, we did learn that at uni. | ID10 |
| 63 | 35:53.1 - 35:58.2 | So there is a list, a checklist, the design rules? | Interviewer B |
| 64 | 35:58.2 - 36:34.5 | Yes, when I was at university, I remember learning about, we kind of learned about injection moulding, how an injection moulded part should be made, how an aluminium cast component should be made, how extrusion and also from going to textbooks myself, reading about them, you know, because they are obviously very well known processes, you got a draft there, etc. etc. But then in the company too, there was a lot of so much knowledge there, you know, I learned a lot when I actually had to start using that process. The designers were there, the engineers were there too. Ok, it needs to be this big, this draft, have this, have that. | ID10 |
| 65 | 36:34.5 - 36:46.7 | Would you think it would be useful for you if you had a textbook for the design rules for additive manufacturing rather than doing it yourself and doing try and error? | Interviewer B |
| 66 | 36:46.7 - 36:53.6 | Oh, for here. So like we could get paid money to buy our time to, what do you mean? | ID10 |
| 67 | 36:53.6 - 37:02.1 | I think Interviewer B is trying to say is that, if there was a textbook on SLA, do you think it would be useful? | Interviewer A |
| 68 | 37:02.1 - 37:09.8 | Oh, oh, sorry. I think it would, yeah, there must be some out there, there must be some out there I think, no? | ID10 |
| 69 | 37:09.8 - 37:10.9 | Do you use any? | Interviewer A |
| 70 | 37:10.9 - 37:49.0 | No, because we've got a lot of knowledge book colleagues here as well. So, you know, I'm not designing every day for the parts, so when I do, I can ask my colleagues, they've got a lot of experience because they've been using that technology 20 years or whatever, 10 years whatever. But I know the textbook thing, actually, I'm not sure it'll go out of date too quickly. Maybe wouldn't. I don't know. Maybe online courses would be better or some sort of things that can be updated. I like a textbook but may be the generation below may be don't. | ID10 |
| 71 | 37:49.0 - 38:03.9 | Did you change the design when you, so this is the first generation [Interviewer A is talking about the example ID10 showed], did you change the design when you moved from FDM to SLA, just because of the processes? | Interviewer A |
| 72 | 38:03.9 - 39:06.6 | I did. This was thicker, so the first one was thicker, because I was using my FDM machine at home. Because the way it was building, I wanted a thicker wall thickness to create the part to give it a surface to build on. So I did make it thicker. Because I didn't think, with that technology, that entry level basic technology, it would be [I think it should be 'wouldn't be'] able to handle a very thin wall because you are building the wall up, it's gonna be start, you know, machine of thin air, you are gonna get a big spaghetti mess. So, yes, because this was for, this first prototype was to try and see if it fits with a standard component, so it was all about form, shape, and the area, the A class surface or area if you like. I was interested in was on the outside, it didn't matter about the thickness. So, yes. | ID10 |
| 73 | 39:06.6 - 39:09.8 | You reduced the thickness? | Interviewer A |
| 74 | 39:09.8 - 39:15.7 | I did, yes. I went to a thinner one. The next iteration, 'cause I was using SLA, I used a thinner one. | ID10 |
| 75 | 39:15.7 - 39:21.1 | Is there any other thing you change because the move to SLA? | Interviewer A |
| 76 | 39:21.0 - 39:50.5 | Well, the other thing would be actually, is a hundred percent fill in terms of the wall thickness. This was about probably 60%. So again, because this was gonna be like a fit for function. Because it had a thinner wall, because of the process, I was able to make a hundred percent wall thickness. So it could be thinner. That's the porosity. | ID10 |
| 77 | 39:50.5 - 39:51.9 | Did you consider SLS as well? | Interviewer B |
| 78 | 39:51.8 - 41:11.2 | We don't have SLS here. So, OK, this is down to manufacturing constraints now. So we have certain technologies here. This goes back to the learning. I'm familiar with the epoxy resin and I'm familiar with the fact that my colleagues use, they can treat these and they can be cleaned for medical use. So I naturally went down the route of using this process. OK. There is a cost implication too. So internally, because somebody is in R&D, I can get the odd one or two made, I mean these have been made over a long period, like a year or so, not to mention the iterations. 'Cause this is not my main project to something I'm doing as day to day, so yes, could've considered SLS, didn't consider it purely because the equipment we had here and the fact that I know that we can clean this, sterilise, various things. S L S could be interesting though, not sure about sterilisation for SLS, can we sterilise it? I don't know. I don't know enough, I have to look into it but I know the nylon fit might be strong. I have to look. | ID10 |
| 79 | 41:11.2 - 41:19.2 | So basically, you have never written down your rules for SLA? | Interviewer A |
| 80 | 41:19.1 - 43:30.8 | Not for SLA. What we did do, I was part of the project with XXX University, [ID10 is introducing JOHN at XXX University and ID11]. I do have a slide set, if that's relevant, I can show you that, I can share that with you. I'm sure that'd be fine. That's what we talked about different types of processes, we talked about ways to design, things like delamination, things like support structures. So if you like, it was a beginner to introduction to sort of things you need to consider when 3D printing or additive manufacturing. | ID10 |
| 81 | 43:30.8 - 43:33.5 | How did you develop these rules? | Interviewer A |
| 82 | 43:33.5 - 44:59.7 | So they would've developed from our experience again. So JOHN, XXX University, has done a lot of production for additive manufacturing, he did a PhD in that area. It's quite intangible, isn't it really? It's from having worked around the people who do this, who talking about it. In my first role here, I worked as a knowledge transfer role, I was talking about the medical guy, the surgery guy, I wasn't designing them but I understood how they worked through my colleagues explaining it to me, from seeing that technology, from my background in design. There is no form. This is how you design for additive. But those rules came from our experience, all three of us, so we sat down and put the slides together. And also from what's out there as well, what other experts, for example, XXX, I had him come and present to us and do a presentation about 4 years ago to and a big seminar. So we learn from talking to experts, from peers and from searching for a guide on internet, so we pull that information and put it together in the presentation for the audience. | ID10 |
| 83 | 44:59.5 - 45:15.9 | How did you prove these rules? Or test them? You got these rules, you tell people these rules, have you ever tried to run any experiments to check if they were? | Interviewer A |
| 84 | 45:15.9 - 46:09.8 | No, I hope, I'd like to. No, it's more like every day when you are designing, you need to think about the support, you need to think about the type of the material, so it's more to get them asking the questions before they design the product. So you got to think about the scale, wall thickness, it's all kind of very standard stuff that a designer you would hope, would think of. Testing the rules though, we didn't sort of get them come back to us to say this worked, this didn't work, you told me the wrong rule. So in that sense, we didn't test it. It's the project that was more about knowledge transfer and engaging people. So we weren't actually trying to create a set of rules or toolkit at the end. But that's a good point. | ID10 |
| 85 | 46:09.7 - 46:20.9 | In the next five to ten years, how do you think additive manufacturing as a production process will influence design? | Interviewer A |
| 86 | 46:20.8 - 48:03.0 | For the first five to ten years, I think there is a trend towards, and this is what I know best I suppose, the trend towards person specific design. So designing things tailored to individual, be it fitting to them, because they move a few sliders on the Shapeways interface, they think they've designed it because it's a bit wide there and short there, they changed the pattern because they moved the slide. Maybe the user is gonna feel a more like a designer in a sense that they've altered the online part, it's not the designers, we would know it potentially, I'm guessing from a theoretical design. There might be more of that where the public feel like they are designing products and that might happen, maybe. So they might go to Shapeways and get an end product. In terms of standard designers, this complexity of, instead of having 15 parts, you can do it in one. That's when materials get better. And that's the quality get better. Then it's gonna open up options for designers to create complex parts in one. So I think that will increase, but as soon as the quality is better. That's from designer's point of view. | ID10 |
| 87 | 48:03.0 - 48:04.4 | For the design process? | Interviewer A |
| 88 | 48:04.4 - 49:44.2 | For the design process, what change? I suppose that depends again on the output. If you are making something that's, I mean, at this point of time, it's hard to think 10 years ahead, it's hard to know what's gonna happen with the technology. But in the last few years 3D printing has been a big hype I think maybe what you will find as manufacturers, make more specific, tailored machines for production, perhaps, rather than trying to do everything like a large SLA machine that can do everything. Maybe they make them more better in terms of quality control, things like that. If that happens, for design process, then it's gonna be, for a design engineer or a designer, it will encourage them to create more parts that can be additively manufactured because they know that they'll be able to test it, they'll be able to quality control, which is probably easier at the moment with injection moulded parts per se. But in theory, design process should always start with the user, from the need, and work through, so I don't think it will drastically [adv] change it, I think, it's more of awareness for designers of what's out there. | ID10 |
| 89 | 49:44.2 - 49:55.7 | Ok, thank you very much for your time and your observations. They are really interesting. So before we go, I would just like to ask about some background information. What is your education background? | Interviewer A |
| 90 | 49:55.7 - 50:04.0 | So I've got a BSc in product design and manufacture, BSc hons. | ID10 |
| 91 | 50:04.0 - 50:06.7 | Where did you study? | Interviewer A |
| 92 | 50:06.6 - 50:12.3 | Here, actually, at Company G. | ID10 |
| 93 | 50:12.3 - 50:16.0 | How long have you been working as a designer? | Interviewer A |
| 94 | 50:16.0 - 50:33.5 | Well, I've worked as a designer for 3 years and then I moved into research, so I'm more into research area. So it depends on what you would call, this is a working design, because this is gonna be research and development, it's got a bit of design work. So it depends how strict your classification is on that. | ID10 |
| 95 | 50:33.5 - 50:36.8 | Well, personally I would classify that as a design. | Interviewer A |
| 96 | 50:36.8 - 50:47.8 | I've been doing this for about 6 years in total. Yeah, that's very fair. | ID10 |
| 97 | 50:47.8 - 50:56.7 | Ok, so, can I confirm it's ok for us to take some pictures and have copies? | Interviewer A |
| 98 | 50:56.7 - 50:57.2 | Not that there. | ID10 |
| 99 | 50:57.2 - 50:59.8 | We cannot take pictures of that, ok. | Interviewer A |
| 100 | 50:59.8 - 51:05.3 | In terms of, did you want all my background or just, so did you want all my background, qualifications and things? | ID10 |
| 101 | 51:05.3 - 51:06.8 | Yeah. | Interviewer A |
| 102 | 51:06.8 - 51:51.3 | So I've got a BSc and a MPhil in advanced design as a MPhil, in the areas of advanced design and technologies. And a MSc in research methods. A PhD and a certificate on mechanical engineering as well, so a certificate of higher education in mechanical engineering. OK. Get them all in. | ID10 |
| 103 | 51:51.3 - 51:56.5 | This project is not obviously in the public domain? | Interviewer A |
| 104 | 51:56.5 - 52:00.1 | No, no. | ID10 |
| 105 | 52:00.1 - 52:02.9 | Can we use it as a case study? | Interviewer A |
| 106 | 52:02.9 - 52:04.9 | No, sorry. | ID10 |
| 107 | 52:04.9 - 52:23.9 | In the following weeks, we will transcribe the interview and we will send a copy to you. So at that time, well, always, you'll be able to change and add anything you want. Our last question is, do you prefer to be named or anonymised? | Interviewer A |
| 108 | 52:23.8 - 52:29.1 | I don't mind being named, that's fine. Absolutely. Yeah. | ID10 |
| 109 | 52:29.1 - 52:42.2 | I mean, some of the comments when I talked about, you know, personalised interfaces and things. I'm happy you talk about that. It's just the application of this, that's all. | ID10 |
| 110 | 52:42.1 - 53:20.7 | [chatting] | ID10 |