|  |  |  |  |
| --- | --- | --- | --- |
|  | Timespan | Content | Speaker |
| 1 | 0:00.0 - 0:20.1 | It is almost like an handwork that it covers design properties of 3D print materials. I don't know whether is specific to anyone material or probably Nylon is the most interesting of those. | ID03 |
| 2 | 0:20.0 - 2:33.3 | Yeah, I so tried to go a little bit more in detail about the project just give you a little background So in this project we are trying to look a to additive manufacturing as a production process comparable to traditional manufacturing processes, which means that we kind of see at it as one of the alternatives designers have when they have to choose which process to use to produce the project. So we are specifically looking in this project at plastics only and considering all the different technologies. Since we are focusing on production we are mainly looking only at two technologies FDM and selective laser sintering. Then what we are trying to do, we are trying to collect and understand what designers do when they to design components for additive or what they should do when they have to do that. We are trying to...[introduction of the D4AM project] | Interviewer A |
| 3 | 2:33.3 - 2:46.1 | We don't design very much ourselves but we have a lot of contact with people who are designing for it and provide advice on the basis of that. | ID03 |
| 4 | 2:46.0 - 2:56.7 | I would like to ask you something different in the meanwhile, how does this process work, I mean you produce for designers right? | Interviewer A |
| 5 | 2:56.6 - 2:59.4 | Yeah we are a bureau. | ID03 |
| 6 | 2:59.3 - 3:07.5 | So if a designer comes to you with a new design he wants to make with additive, what happens? | Interviewer A |
| 7 | 3:07.4 - 6:37.7 | Ah well in touch with this initially, almost always they already have a file, they already have a design and that can be difficult because they have already spent time on, they already have invested personally in it, they already believe that it’s going to be, you know, a purposeful thing for them and very often based on that and experience, it's not going to work for them for any number of reasons and that's very difficult because, you know, half of those kinds of potential customers disappear and they are disillusioned about the technology because it is not what they’d hoped. Fifty percent of them have the patience, the energy or the inclination to actually understand why they have presented is not working for them and prepare to listen to some advice about how to change it, sometimes not very dramatically, but to change it to make it work. So, this exercise in the long run would be very useful for us because the trouble is, that there is an awful lot of people who read a lot about what (AM) might be able to do for them, they get very excited but because of their fundamental lack of understanding. Their first go at it could be very difficult and can turn a lot of people off. So you know it is tricky; that's why as a bureau we are not one of these ones where you automatically upload a file and you get a price and you can pay for it, you know, we can work in that kind of way, but we want to understand what they are trying to do so that we can look at your file and not just make a judgement about whether it is a printable file, but make a judgement about whether it’s going to actually work for whatever your purpose is. So we are very keen to speak to people about what they are trying to do so that we can, you know, throw a little bit of advice that it will make work for them and, you know, yes, that it takes a lot more time, but in the long run, if it works for people, they will do it again, and again, and again, and then we are in business. Whereas with, you know, these kind of online interfaces where you don't talk to anybody, you just throw shapes at a calculator, people are not learning anything and people are probably not gonna order anything because it’s too expensive and they don't understand why it’s so expensive and the whole thing falls apart. In additive, which when we talk to people about what they are trying to do, we learn more therefore there is more for us to pass onto the next person, so, you know, it is an absolutely key part of the way that we work is trying to understand what you want to do so that we can help you get a good result which encourages you to do more and, you know, again, and again, and again. | ID03 |
| 8 | 6:37.7 - 6:47.1 | If I may ask, what are the main reasons why designers, after that they come to you and they submit the design to you, they run away? | Interviewer A |
| 9 | 6:47.1 - 7:37.6 | Too expensive. Very simple. Doesn't add up and you know it might, of course, I understand not everybody can afford, you know, certain prices but the bottom line is that they are not designing with an understanding that makes their shape, whatever it is, valuable enough to them, you know, if it was valuable enough than the price it would be worth paying and, you know, they are trying to produce a lot of not-very-valuable things in a technology that isn't necessarily cheap and that's a big problem. | ID03 |
| 10 | 7:37.5 - 8:52.1 | Sorry I go a little bit back.... [introduction to the interview]  ... So as you said before you don't design components for designer, right? | Interviewer A |
| 11 | 8:52.1 - 8:58.6 | We do CAD, you know, we will design with people, you know, we can produce CAD, but we. | ID03 |
| 12 | 8:58.6 - 9:07.4 | Can you show us a couple of projects, one or two projects in which you have done this process of designing a component with the designer? | Interviewer A |
| 13 | 9:07.4 - 9:10.9 | Yeah, I’ll come back. Bearing with me a minute. | ID03 |
| 14 | 9:10.8 - 10:43.9 | Yes.  Okay great.  Now I start a little bit more formally the interview. So first... [introduction about the next questions]  .. so I would like to ask you something about your general experience in design for additive, roughly how many products or components have you designed for additive? | Interviewer A |
| 15 | 10:43.8 - 11:07.0 | Personally, none. Well I mean that's a very difficult question, you know, I have given, provided an awful lot of input into a lot of designs but, you know, in terms of any that's entirely my own, then none. | ID03 |
| 16 | 11:07.0 - 11:09.8 | How many projects you provided an input? | Interviewer A |
| 17 | 11:09.8 - 11:15.7 | Hundreds. Sorry that's different to none. | ID03 |
| 18 | 11:15.6 - 11:32.7 | And how often these projects came up and I am taking about for-production, for series production because I may imagine you have a lot of projects which came up for prototyping. | Interviewer A |
| 19 | 11:32.7 - 11:38.1 | Yeah I’d say probably a couple a month. Two a month. | ID03 |
| 20 | 11:38.1 - 11:49.6 | And roughly do you know which volumes are? | Interviewer A |
| 21 | 11:49.6 - 11:58.9 | They vary dramatically. Some people want to make hundreds of thousands, some people want to make a hundred. | ID03 |
| 22 | 11:58.9 - 12:20.5 | And if you have to divide in proportion all your projects between projects for production, prototyping/model making and projects for tooling, what is the different percentage? | Interviewer A |
| 23 | 12:20.5 - 13:35.4 | So maybe fifteen to twenty percent of production parts. It is in the nature of running a bureau is that, you know, despite what I said about always wanting to have a conversation and understand what people are doing, sometimes we do not have a conversation, we just print things and we don't really know what they are. (less alone) what people are doing that thing. So it is very hard to be very specific, because a lot of people are just doing things and they don't talk about it, you know, just coming back for more or different things or whatever. So that's the slightly frustrating thing, I’ve talked about one of our pricing mechanisms a bit later maybe and unfortunately, although that’s very efficient, it makes what people are doing very anonymous. So it's kind of hard, you know, but off the top of my head, I would say fifteen to twenty percent of production. | ID03 |
| 24 | 13:35.4 - 13:38.7 | Do you think this percentage is going to change? | Interviewer A |
| 25 | 13:38.7 - 14:32.4 | I hope so. I am counting on it. Because, you know, it is what you want to do in the heaven, in the bureau environment is regular stream of the same components, repeat prints of the same file. You know forever, that way you are not -- the customer is happy with them, there is no question about dimensions and tolerances or any of these things. They have established that it works and they want more of it. So, you know, that's the end. You know, at the same time, sort of nurturing people through the initial process but the aim is always to take them through to that stage. | ID03 |
| 26 | 14:32.4 - 14:37.7 | Have you seen this percentage change in the last few years? | Interviewer A |
| 27 | 14:37.7 - 14:45.0 | Yeah, it is growing. The effort is starting to pay off a little bit. | ID03 |
| 28 | 14:45.0 - 14:54.9 | In my email I asked you to identify some components or products you have designed or you helped to design, which products have you chosen? | Interviewer A |
| 29 | 14:54.9 - 21:04.0 | This is for a bird box. Now this is a classic example of somebody being inspired by everything that they have heard about 3D printing and how it would enable them to became manufacturers of objects and makes everything easy. This person came to us with a file, that was just like this, the only difference being that it had a smooth roof and it was all in one piece. You know, in his head, people like birds, 3D printing is cool, therefore he would be able to sell lots, and lots, and lots of 3D printed bird-boxes. So his immediate question was, here is my file how much is it going to cost to print one of them and then can you tell what the kind of volume discount is going to be on that if I produce hundreds of them. So, you know, I wrote back to him and said one of those is probably about three-hundred pounds. If I can fit one, two, three, four, five, six into the build chamber, each of them will cost two hundred and twenty-five pounds. Now at the time, that was the biggest volume we had and so therefore beyond that, six at the time, that's the best price, you know, reduction you are gonna get for volume. Because what we will do is the same built again, and again, and again, we are not -- there is no tooling or anything that then gets amortised over that period of time. It’s just that's your box and that's what we do again, and again, and again. And he was angry, I mean, most people don't even like that but he wrote back an angry email, saying what is this? If that what this costs then, you know, the technology is a waste of time, why is it so expensive? So, you know, I called him up and explained that what he is paying to print is fresh air, he is paying to print space, you know, has the machine goes through that layer, it is printing the walls, it is also no printing the internal space, and you are buying for not to print as well as paying for it to print, because it is all built up over time. And he kind of -- he sort of understood that and then I said, I explained to him, that because Nylon isn't just a 3D print technology that is a shape maker, it is not just a technology that you feed it a shape and it gives you a shape back. Because it's got material properties, you can design the shapes with an understanding of the material properties to make them do something and so, you know, I speculated that, you know, that maybe a way of producing this much more efficiently when you are not printing (infinite) shape, you are printing components that then transform to give you the shape that you want and that would be much more affordable. So, you know, we agreed that, you now, we’d do a little, we would redesign this for him as a paper model effectively, like a cardboard model and we agreed that if it works, then he will pay us for the CAD time. We were confident that we would do this. We hadn't printed anything flat and then bend it at that point but we were quite confident that it might work. So we spent time, you know, designing it like a paper model, very simple, from bottom back, just like you would design a card model, you know, we designed a grove into the file edge just like you would score a piece of card to make it bent. So that was a good start. The really challenging thing was to produce, we had to produce that height, because that’s the height that is causing the worst problem. So this was the difficult piece and you know, we hoped if you printed a thin sheet of Nylon it would bend and, you know, that bends really nicely. That is a consistent bend and, you know, then we corrugated it to make it stiffer for when it comes together and what's nice about that bend is not just the quality of it, but the fact that it confirms a sort of a design instinct. If you print, produce a thin sheet of plastic, it may well bend and that bends as you would expect it to. Now this isn't a material for another planet, this is kind of behaving in a way a designer would instinctively expected to behave. So you don't have to learn anything wildly new about the properties of this material, you can make assumptions and it will perform in the way that you hope.  So we printed the two parts and then just designed two holes on the corners of the roof, four (pegs) on there and so it’s designed just to push on. I won’t attach it because once it is connected it is quite hard to disconnect. You know and then there is a track which the corrugations will onto to position the front and the backwards. Then you push it all together and that’s what you get. So, printing these two components flat, it's stacking them up in the build, you can get sixty pairs in there. So the two parts they cost about fifteen pounds to produce. Now that's not cheap but, you know, but it is much closer than two-hundred and twenty five pounds for a finish thing. | ID03 |
| 30 | 21:04.0 - 21:04.6 | Fifteen right? | Interviewer A |
| 31 | 21:06.3 - 23:28.8 | Fifteen pounds for the two parts.  You know the other benefit is that he could then, if he sells them, he could send them out in an envelop, he didn’t have to send them out in box. So packaging, postage all of these things become so much cheaper and you know it is actually much more elegant object. It is a more sophisticated object. Your customer engages with it in terms of doing a little bit of simple assembly, they engage in the elegance of that process and what starts to transcend the technology if he was printing those in a finished form, he would have to sell that very, very hard as a 3D printed bird-box otherwise it is just a plastic box, and you know who cares about it, you have to invest some value in it, like telling whatever you are trying to sell to, it’s 3D printed. With this, it transcends the technology. The technology has enabled him to produce two components that come together to make what it wants and he doesn’t have to talk about 3D printing which is just an elegant little thing. So not only it is more affordable but, you know, it has got a much longer sales life, because I would say that already today no one is interested in buying anything because it’s 3D printed. If you can take that out of it and just producing, you know, a nice quality elegant object, you don't have to talk about 3D printing and therefore you are not dependent on the media and hype and all of these things. You are selling to people beyond the demographic that thinks 3D printing is exciting and that's beneficial. So I hope that's a reasonable example of how to design beyond the shape making. That's shape making, that's not designing, that's just shape making. This is designing, this is understanding the material you are working with and exploiting to produce what you want and that's the way it needs to be. | ID03 |
| 32 | 23:28.7 - 23:35.3 | I would like to ask you, do you still have the paper model you used? | Interviewer A |
| 33 | 23:35.3 - 23:37.4 | we didn't, we have never made a paper model | ID03 |
| 34 | 23:37.3 - 23:38.6 | He made a paper model? | Interviewer A |
| 35 | 23:38.5 - 23:43.5 | No, there was never a paper model; we just designed it as if it was a paper model. | ID03 |
| 36 | 23:43.4 - 23:45.1 | Ah okay so you never made a paper model. | Interviewer A |
| 37 | 23:45.0 - 23:45.1 | No, no | ID03 |
| 38 | 23:45.2 - 23:46.6 | You just designed it on CAD. | Interviewer A |
| 39 | 23:46.5 - 24:02.1 | Okay, No point otherwise he would have then just made a paper model. It would have been even better as a cardboard model probably. Although the corrugation is a little bit difficult. | ID03 |
| 40 | 24:02.0 - 24:08.5 | Yeah I think all the details (()) | Interviewer A |
| 41 | 24:08.5 - 27:38.8 | But I mean the thing is that he didn't want to do hundreds of thousands of these and make them forever. He wanted, I don't know we did about a thousand of these, he sold them, it’s fine, and he moved on to his next thing. I mean you could injection mould this, I think, I don't understand all that much about injection moulding, but if he wanted to then take it onto a much bigger scale of operation, he could get moulds made of this and you know, and injected with a suitable plastic that would bend and fold and all of that; and that's fine but I mean that's also something that when you are starting to design with it like this, you need to bear in mind, you know, is all very well saying that this technology is brilliant because you can produce parts that cannot be made in any other way. If you are doing that, if you are making a part that is only suitable for additive manufacturing then you got to be very careful that you don't need hundreds of thousands of them, every week, because that’s going to be very, very hard to produce that many. So of course it’s nice to design and consider parts that are absolutely additive manufacturing specific, but they have to be very, very valuable and you have to consider how you are going to produce quantities of them if they have that kind of demand, because it's going to be very difficult. You are gonna have to engage, probably people in that situation would have to invest in technology themselves, you know, they have to buy, you know, the printers, set up that all infrastructure with people to run it all of that stuff and run it all day, every day. If you are not in the situation when you want to do that, then you gonna have to farm it out to any number of other facilities to do it and then you start getting into difficulties about consistency, about powder rations, about layer thicknesses, all of the stuff that is -- if it is not coming from a single source and Nylon is not always the same, we never with play layer thicknesses, we never mess around with powder ratios. You will always get the same, you start sending it out to different people, what are you getting? Does it matter? Maybe it does not matter, but things that you have to think about. So you know with this, this is not something that could only have ever been done with 3D printing. If you wanted to do hundreds of thousands of these it could go to tooling. So that’s actually worth bearing in mind when you are designing it that you be able to take a step back into traditional manufacturing if it becomes necessary. Because you are making a big problem of yourself, if your design is exclusively 3D printable and unique and all of a sudden you need (deep) demand goes crazy. That's a problem. | ID03 |
| 42 | 27:38.7 - 27:55.3 | Thank you. So know this is probably a question I should not ask it to you but, you said that the designer decided to produce this in series in additive just because it was cool? | Interviewer A |
| 43 | 27:55.3 - 29:12.7 | Well he wanted to use 3D printing as part of his, as part of the selling of it, you know, as been an awful lot of that. People trying to sell things because they are 3D printed and, you know, they are really struggling because people aren't that stupid. If something is being sold to you because it’s 3D printed or additive manufacture has been used you want to look very hard at it, because if that is what is going for it, it’s probably going to be very limited in other areas. So yes 3D printing was part of his story. That's what was selling it primarily. It was a 3D printed bird-box, it was not just a bird-box. | ID03 |
| 44 | 29:12.6 - 29:52.9 | [Recap and introduction] | All |
| 45 | 29:52.8 - 30:03.5 | Which technologies do you have in house? Which additive manufacturing technology do you have? | Interviewer A |
| 46 | 30:03.5 - 30:33.3 | Nylon SLS. We’ve got multi-colour plaster, I don't really consider it additive manufacturing, that's not good to make any product and a small, well a couple of small SLA machines, one specifically for jewellery and the other one just producing resins, but that's mainly for prototyping, people aren’t doing production objects, but the jewellery is producing production objects, you know, after the casting process. | ID03 |
| 47 | 30:33.3 - 30:53.9 | Because my question will be -- okay that was made in selective laser sintering. You also kind of answered about considering conventional manufacturing processes so your client came to you and he didn't consider any other manufacturing processes, right? | Interviewer A |
| 48 | 30:53.9 - 31:18.0 | For this client? Yeah no he knew, he didn't want to spend, you know, whatever it takes to injection mould it to make that. It wasn't the story. He wanted -- it had to be 3D printed. That was his selling point. | ID03 |
| 49 | 31:18.0 - 31:43.0 | Do you remember what where the main considerations for using additive manufacturing in this specific project. | Interviewer A |
| He expected it to be cheap, quick and easy. | ID03 |
| Did he think about the fixed cost, variable cost, the mechanical properties, the appearance, precision/accuracy, manufacturing speed, material properties? | Interviewer A |
| No. | ID03 |
| 50 | 31:43.0 - 32:04.3 | He didn't even know which technology he wanted. That file I came with, can I have a quote for you to 3D print this. He didn't know the difference between FDM and SLS. He didn’t, he knew nothing. 3D printing was just 3D printing. How much would it cost to 3D print my bird-box? | ID03 |
| 51 | 32:04.3 - 32:09.1 | But did he know what injection moulding was? | Interviewer B |
| 52 | 32:09.2 - 32:17.0 | Sort of. He knew that was expensive and that's what 3D printing was going to free him from. | ID03 |
| 53 | 32:17.0 - 32:26.0 | So he didn't have a clue what capabilities of 3D printing had. | Interviewer B |
| 54 | 32:26.0 - 33:18.4 | Nothing really, no. He just thought it was going to be cheap and lovely.  I don't think he actually falls into your category of designers looking to use this technology. He was really a pretty much a novice. You know he produced a fairly sophisticated STL for that box and it’s finished form and it was fine, but he wasn't a designer. He was a start-up entrepreneur type basically. | ID03 |
| 55 | 33:18.4 - 33:41.4 | I am going to ask you if you can immerse yourself again in this experience of helping him develop this specific product. So how did the design come about the way it is now? I mean what did you do? You received that CAD file, it’s ok, and what did you think? How did you do to come to that design? | Interviewer A |
| 56 | 33:50.5 - 38:01.6 | Well, I mean, very quickly, working at a bureau, you've got a very good instinct from the first email about the type of person you are dealing with. You know, straightaway, as soon as you look at that file and match it to the email, it was, he introduced himself as a start-up, you know, entrepreneur, this was gonna be a business, wanted to use 3D printing, it's gonna be parts of the story. You know, you already know before you look at the file, it's somebody presenting an S T L, if you like that, but it's not gonna be very promising. Because you can tell that they've learnt to a certain amount about the technology, they've believed everything they've heard and think it's going to be easy. So, you know, I straightaway knew when I quoted for that whole object that he was going to be shocked and disappointed. And, you know, at the end of the email like that, you always put in, you know, there may be other ways of producing this, if you'd like to discuss is further, please give me a call. And you know, not everybody does but, you know, thankfully he did. We had an opportunity talking through that. But you know, looking at that shape, you know, this presents a problem that we see very often, is that people are printing fresh air, they are printing space. A lot of people seem to think, a lot of people want to make enclosures, enclosures automatically include space, and that's not a very economically efficient work to make things easy. It's enclosures, it's through additive manufacturing. If it's in FDM, both spaces are gonna be full of support, one way or another. If it's in SLS, you are just wasting powder, you are not getting the most out of the technology, the material. So it doesn't take much to look at something like that, understanding S L S as something that performs, to suggest that there are other ways of making it. You know, very often that people are doing enclosures; we suggest that they break them down. The box, for example, you know, if it's some kind of special box, just print it as six flat panels and design it to come together so that you are not printing the space. So it's just, specifically what we find is that people who are using this best are the people who always know how to make things. They understand how to make things, they understand how things go together. They have a sensitivity to that. They are the people who are (given) upon this really purpose (for it). People who are supposedly being liberated by the ability to draw and print are really struggling because they don't know how to make things. They are shape makers and some shapes they get away with, most shapes they don't, it just doesn't add up. So being able to make a judgement about a file like that is very easy because, you know, everybody who works here knows how to make things. So that's the benefit to our clients. It's that their projects are passing through people who can offer advice, who aren't just printing, you know, inadequate objects for them and expecting them to be happy with it because they are 3D printed. Does that answer the question? | ID03 |
| 57 | 38:01.2 - 38:21.1 | I think it does. I mean, I want to explore a little bit more, just because before you told me that you made that C A D model, give C A D model to the, can you explain a little bit more about that work? () [cannot hear. Voice was vague and weak.] | Interviewer A |
| 58 | 38:21.1 - 38:47.4 | Well, you know, instead of drawing it out from a sheet of paper and cutting it out, you would use a card model, you know, in CAD, you know, I didn't do the CAD work. My colleague, you know, produced the flat sheet and then designed the profile of this and designed in grooves, you know, just designed it, but on the card, on the flat panel, in principle. | ID03 |
| 59 | 38:47.4 - 38:53.2 | Is this the final product? | Interviewer B |
| 60 | 38:53.2 - 38:54.9 | It was, yes. | ID03 |
| 61 | 38:54.9 - 39:05.2 | So for this specific product, why was it designed in this shape, why did you not design it as one piece rather than two pieces? | Interviewer B |
| 62 | 39:05.2 - 39:10.1 | Because it's massively expensive to print it in one piece. | ID03 |
| 63 | 39:10.1 - 39:15.5 | Because you're gonna need, if you print it this way in one piece, it's gonna need a lot of powder. | Interviewer B |
| 64 | 39:15.5 - 39:53.8 | Well, I mean, you know, S L S is built in a build chamber, as a finished form, I could fit one, two, three, four, five, six into a full build, which made them about £225 each. Because you are printing fresh air, you are printing space, and that's why that's expensive and that's why it wasn't worth it. It wasn't valuable enough. It is more valuable when you can print two flat sheets and get sixty pairs of parts for £15 a piece. | ID03 |
| 65 | 39:53.8 - 39:58.3 | How many, what's the production volume for this product? | Interviewer B |
| 66 | 39:58.3 - 40:06.4 | They are about 500. | ID03 |
| 67 | 40:06.4 - 40:11.1 | Yeah, that makes more sense when you printed them separately. | Interviewer B |
| 68 | 40:11.1 - 40:27.4 | Yeah, I mean, if he wanted to do a hundred to a thousand, he would've injection mould, you know, get a die made for those and get them injection mould. | ID03 |
| 69 | 40:27.4 - 40:48.3 | So when you designed that component, that specific component, did you follow any design guidelines? | Interviewer A |
| 70 | 40:48.3 - 41:03.8 | At the time it was just instinct, really. It was, you know, how thin can we print this sheet, how thin would that groove have to be to make those (woods) bent up. | ID03 |
| 71 | 41:03.8 - 41:07.1 | So that time, you didn't have any? | Interviewer A |
| 72 | 41:07.1 - 41:10.4 | No, it's working on instinct, really. | ID03 |
| 73 | 41:10.4 - 41:13.9 | But you had previous experience of? | Interviewer A |
| 74 | 41:13.9 - 41:49.9 | Of that, yes. [ID03 was pointing a component]. Of that, no. [ID03 was pointing another component]. Different considerations. I think this is a little bit, I'm not sure, thicker or thinner than the thickness of the, you know, the depth of that groove, I think it's a little bit greater, I mean it's a little bit thicker than the overall thickness of that. Just based on being strong enough not to tear. | ID03 |
| 75 | 41:49.9 - 41:56.1 | Did you make any trial and error? | Interviewer A |
| 76 | 41:56.0 - 42:00.4 | A few, but we did them simultaneously. | ID03 |
| 77 | 42:00.4 - 42:03.6 | You tried different thicknesses? | Interviewer A |
| 78 | 42:03.5 - 43:18.1 | Yeah, with different thicknesses doing it at the same time. There is no point doing it one at a time and spend two days before you get it. And it's not printing flat, it's not too expensive and time consuming so, you know, little test prints, would work fine. You know, that's something that we encourage people to do a lot. If it's, there is any something ambitious about the form they're looking to produce, it's to do a prototype of it, but not the prototype of the whole object. We cut out the section, but you are looking to test the performance of it. You know, this really didn't matter, you know, the sheet like that isn't more expensive or take particularly longer than a sheet like that. But in principle, I'd suggest cutting out that section around that hinge and you just print that in your test. You get that right and apply it to the file and then do the whole thing. So it's about identifying what you are testing and doing, you know, not prototype of the whole thing if it's not necessary. | ID03 |
| 79 | 43:18.1 - 43:26.3 | So having done the trials, the tests, did you summarise some design rules? | Interviewer B |
| 80 | 43:26.5 - 45:09.7 | No, really. I mean, it's on the website, there are, I mean, it's very, very difficult because people always call in, saying how thin can you make an element to print in SLS. Now the thickness of that corrugated sheet, that's 0.3mm. And you tell people 0.3, which is 0.3mm layer thickness. You tell people that, then they send you a file which's got, you know, something that's 0.3mm strand and they're asking you to print hair. And you say sorry that's too thin, they say yeah but I called you and you said 0.3 was good enough. You know, you've got a sheet that's 0.3 thick, you know, that's fine. If you've got a hair that is 0.3mm thick, it's not even gonna come out of the machine. So those kinds of guidelines are very, very difficult to convey to people in a clear way because it absolutely depends on the geometry of the part. Ok, might be, that thick in one dimension, but what's like around it. It's very hard. That's why we always look at files; so we see what the relative geometries are. So that kind of catalogue of data is very difficult, it would be go on forever [the grammar doesn't sound right]. | ID03 |
| 81 | 45:09.2 - 45:14.1 | How did you learn your knowledge about additive manufacturing? | Interviewer A |
| 82 | 45:14.1 - 46:56.1 | By doing it. And from, we are quite lucky in that, the vast majority of our clients based professional designers, which is great because you are already CAD proficient, providing good files which is a drawing. When I started out, most of them had more experience with it than I did, but you know. Then when you are doing it all day every day, your experience evolves. When you have that kind of conversation with people about what they are doing, you understand why they design things in certain ways and that builds up your knowledge of understanding of how, what it can and it can't do, very, very quickly. And you are building on that all of the time, passing it on, getting it back, it's amazing how quickly you learn about it. But I mean it also about having an attitude that you want to understand what people are doing. A lot of people involved in 3D printing, they don't care at all about what their customers' shapes are. They just want to print shapes and get the money from them to do it. Because we are actually interested in engaging what people are doing and first of all, they kind of appreciate that, and secondly, you'll learn on which is really important. | ID03 |
| 83 | 46:56.1 - 47:12.3 | Well, this is a component, do you think there are any drawbacks or limitations as a result of this component being designed for additive? | Interviewer A |
| 84 | 47:12.3 - 47:55.1 | Well, I don't think it's probably an ideal material to be outside for very long. It is designed to be made onto a (tree), it's not (designed to a house). I don't think, you know, I don't have any feedback on how these things perform in the wild, but my instinct is that they are probably not very nice in terms of the material choice, it's not an ideal material for that kind of environment. | ID03 |
| 85 | 47:55.1 - 48:27.8 | Now, this question is a little bit, I think, maybe not completely appropriate for you as you are a bureau, but do you think that your way of designing components changes, are there you understood (back there) what (are) the additive manufacturing is? | Interviewer A |
| 86 | 48:27.8 - 49:31.1 | Yeah, certainly, I also see that with a lot of our customers. They are modifying their designs, not dramatically, but quite suddenly, once they understand how it works, how to design with the budget of 3D printing in mind, because that's the other huge problem, is that a lot of people have got an idea what is going to cost and that's no way to design something. You don't want to design for additive manufacturing without any idea of what it's gonna cost, because you can spend a lot of time, you know, wasting a lot of time designing something that is never going to be economically viable to produce that way. So once people understand the properties and the economics of it, they are starting to modify their designs so that they get more from it whether it's more in terms of material properties, or more in terms of economy. | ID03 |
| 87 | 49:31.1 - 49:38.8 | Do you think also the design process is changing or changed? | Interviewer A |
| 88 | 49:38.8 - 51:57.6 | I think so. I mean it's quite interesting when I met Richard and Abbey at New Designers. We had a whole range of objects (out) to display. And you know, they are all quite normal for us because their things that we worked on with our clients, they're just their work. And there were a lot of people, you know, it's nice they were very impressed with some of what people are achieving. And their immediate reaction was, oh my god, the technology's moved on so much, you know, the technology must've been improved so dramatically for them to get in producing things like this one. But the truth is, the technology hasn't improved, you know, you are using the same S L S that we used five years ago, nothing has changed. What has changed is people's understanding and experience and subsequent exploitation of the technology to make better things. And that's great, because what it means is, you know, so much people when they're understanding the reality of 3D printing and what it is today, they are quite disappointed. And you know, the thing that they claim onto is that albeit very soon the materials will improve, it'll get cheaper, it'll get faster, you know, they claim onto this (), you know, all of the sudden, it'll become everything they've ever dreamed of. Uh, what it gives you, is the opportunity to stretch the real technology today. If you understand it, you can start to do some very ambitious things today, and you are not a hostage to protect the technological advancements. They may or may not come, I don't know. If they come, that's great. If they don't, you've still got something workable today. You don't have to wait for science fiction to catch up and it's not necessary. It's just about experience. So as for the question, did that cover? | ID03 |
| 89 | 51:57.6 - 52:19.3 | It has been covered. So, now, if you agree, we can move on to general reflections on additive manufacturing and design for additive. So what are your views on additive manufacturing as a production process for end user products or components? | Interviewer A |
| 90 | 52:19.3 - 54:33.0 | I think for some specific objects, it can be very, very good. But as a universal technology, I mean, I've got a real problem with the whole idea that this additive manufacturing will never be disruptive in terms of it making whole (sways) of traditional manufacturing redundant. It will not, never. But, you know, once people start to understand what it's good for, they will choose that and choose it from the position of knowledge and understanding and it's just been an automatic decision because it can make a very, very good sense but you know, I just don't subscribe to the whole disruptive ideal. You know, a lot of things are produced very, very successfully today and they will always remain. And that's the problem, and also lots of people are trying to do, is that they are trying to produce conventionally manufactured objects, same shapes, same things, using totally different technology and you know, 9 times out of 10, they get totally inadequate reproduction of what traditional technology is producing, inadequate in terms of performance, inadequate in terms of price, inadequate in terms of how quickly you can make it, and they are fine, they are just technical exercises, you know, demonstrate that a 3D printer can make a spanner. But is it a good spanner? No, it's not. It's significantly worse than a traditional spanner that is mimicked. And it's when people start to produce new objects designed specifically for the use of additive manufacturing, then things get more successful. But it's not a replication technology. It just isn't. | ID03 |
| 91 | 54:33.1 - 54:45.9 | So, (according) to this, what do you think designers need to know for designing effective parts for additive? | Interviewer A |
| 92 | 54:45.8 - 55:42.5 | Number one, they need to know what is going to cost, 'cause if it's not going to work for them economically, then they should just leave it alone. And then secondly, they should understand, with the specific emphasis on Nylon S L S, they need to start to understand how it performs, 'cause it's a 3D print material that has properties. And an awful lot of people just ignoring or taking it all away of the properties. They're just using it as a shape maker. And that's fine, it makes very nice quality shapes. But if you understand those shapes can perform, then you know, the possibilities are much, much greater. | ID03 |
| 93 | 55:42.5 - 55:47.0 | Now, this question is a little bit repetitive, but uh. | Interviewer A |
| 94 | 55:47.0 - 55:51.8 | It's alright; I can be repetitive as well. | ID03 |
| 95 | 55:51.8 - 55:56.4 | How did you learn how to design for additive? | Interviewer A |
| 96 | 55:56.4 - 56:28.9 | Never did. My background is architecture; I was an architect for 20 years on designing. I don't look at it as something new and something special, it's just understanding how things work and how things go together. Designers get it, they understand the potential of it, you know, the designing for specifically, is just experience. | ID03 |
| 97 | 56:28.9 - 56:35.7 | So you said before that you didn't come up with your own rules, right, for additive? | Interviewer A |
| 98 | 56:35.7 - 56:40.6 | No, but we have instincts. | ID03 |
| 99 | 56:40.6 - 56:44.0 | You have instincts, but you have something on the website. | Interviewer A |
| 100 | 56:44.0 - 57:24.2 | Yeah, but very generic. Thicknesses and stuff, it's not very advanced. It's really predicated, just to get people to produce something successful in terms of the shape. It's not about performance, really. That's a different thing. As I said, you can't really formalise that because it all depends on the geometry and thicknesses and all of that, thick and wide, thin and another, it's not gonna bend. [ID03 was showing the corrugated part]. So it's all about individual shapes, it's tricky. | ID03 |
| 101 | 57:24.2 - 57:39.3 | So apart from the thicknesses, do you have any experience on, for example, light, reducing weight, light-weight design? | Interviewer B |
| 102 | 57:39.3 - 57:58.6 | Uh, not really. I mean, some of our customers are using algorithms that take, you know, all the (extreme) material out of the shape. We don't get into that. That's the bit of software they are using to do that. | ID03 |
| 103 | 57:58.5 - 58:10.9 | Right, when you are looking at a C A D model your customer sent, what specific geometry would you look at? You mentioned the thickness is one of them, and? | Interviewer B |
| 104 | 58:10.9 - 59:13.3 | We look at the form of it and then match that to what they tell us it is. And then in form of view to whether it is likely to function, you know, for whatever their purpose is. It's only at the end of a fairly long conversation, do we then get into thicknesses and real material adjustments. Starts off a much more general conversation about, I can see you drew a shape because that's the way that these things are always shaped but it's not gonna do what you want it to do in that form. There might be much more general conversation about changing the overall shape of it, before you get into function and thicknesses, hinges and things like that. | ID03 |
| 105 | 59:13.3 - 59:28.2 | There are actually () [voice too vague and weak to identify] to tell them what to change? | Interviewer B |
| 106 | 59:28.1 - 1:01:51.5 | It's instinctive. It's like anybody who works with the material, you build up your experience and you know, will it might work, like a blacksmith or something. A joint, you understand wood and know how thin you can make it before it can snap, you know, of what point something that becomes so big that you can't pick it up because it becomes so heavy. It's really difficult because this is digital design and digital manufacturing. When you start out, you are not dealing with very tangible things, you are not drawing with a pencil on a piece of paper and you are not working on material by hand. People think there has to be some a set of magic rules that you need to follow to get something to work. It's not, it's about, it is experience of going through the process and then handling the finished object and you learn from it. So virtually all our clients who are producing any kind of production object, have prototypes. We can give as much as advice, and comments about tolerances and thicknesses as we like. But when it comes out, it will only be closer than what they wanted. There is always, you know, you look at it, you see how it works, and then you make some adjustments to that, so, and that's fine, because this is a very good prototyping technology as well. At the end of the conversation and the prototype, it doesn't take much to modify that prototype into something that works. But those kinds of magic rules will only take you so far. You still have to look at an object and modify it. | ID03 |
| 107 | 1:01:51.5 - 1:04:18.4 | That's what we do a lot of CAD. When we first started, we didn't do, we didn't provide CAD, we didn't have anybody who could draw anything for anybody. We were just receiving files and printing. The difficult thing there is that you are absolutely at the mercy of your customers having something decent to print. We've now got three or four members of staff who are designing, you know, very skilled at a range of different professional CAD software. So we can draw virtually anything in the right software. That costs money and a lot of people, when they hear how much it costs, would say ''oh, don't worry, I've got a friend who knows how to use sketch-up, I'll get them to do it''. And that's fine and they come back two months later with the file produced by the friend who knows how to use sketch-up, and you know, it's not printable. It's taken two months, and what they've drawn isn't in anyway suitable to be printed in whichever material they have in mind. So it's about getting people to understand CAD is the key, without it, none of this happens. So the data is the important thing and that needs to be produced by somebody using the appropriate software for the geometry that they are looking to make and have an understanding of the material that they are gonna get it back from. So very often these people are totally the force of the economy, they may have cost them nothing to get their friends to make it in sketch-up but it's taken two months and what they've brought us doesn't work. Then it may just waste everyone's time whereas we can produce CAD very quickly that's in the right software and everyone's designing with the view to make it printable in whatever material you want. That's very important as well. | ID03 |
| 108 | 1:04:18.4 - 1:04:29.1 | In the next 5-10 years, how do you thin additive manufacturing as a production process will influence design? | Interviewer A |
| 109 | 1:04:29.1 - 1:06:27.7 | Uh, I don't know. I'm not very good at speculating about the future. It's not what we do. What we do is we understand what it can do today and we help people make it work for themselves today. And you know, of course you keep an eye on the future with whatever the technological improvements there are. But I really don't know. All I expect is that there would be more, and more, and more additive manufactured components in everyday objects. And you'd be surprised how many there are already. We've got customers who are producing production parts. I asked them ''do you mind if we take some pictures of your pieces and put them on the website to talk about''. They don't want to know. They are not interested. It's just the technology they've identified that makes purposeful things for them and they are building it into what they make. There is an awful, there is not a lot, but there is, it's getting more and more and more. It's absolutely silently slipping into the making of things. That's great because in the end who cares about whether it is additive or not, you know, it's just got to work. And more people understand how to make it work, they will get (fed) into things. So I don't know whether it's going to dramatically affect the design, and appearance, and performance of things but it's gonna have an impact on components that come together that make all sorts of things. To answer the question, I don't know but there would be more of it. | ID03 |
| 110 | 1:06:27.7 - 1:06:38.5 | Thank you. Now we can move to the last bit. Ok, so, can we ask what your educational background is? | Interviewer A |
| 111 | 1:06:38.4 - 1:06:41.9 | I'm an architect. | ID03 |
| 112 | 1:06:41.8 - 1:06:45.0 | And where did you study? | Interviewer A |
| 113 | 1:06:45.0 - 1:06:49.0 | At University College. | ID03 |
| 114 | 1:06:48.9 - 1:06:53.0 | How long have you been working as a professional designer? | Interviewer A |
| 115 | 1:06:52.9 - 1:06:58.3 | For about 25 years. | ID03 |
| 116 | 1:06:58.3 - 1:07:09.6 | Ok, would it be ok for you if I can take pictures of these objects and use it as a case study? | Interviewer A |
| 117 | 1:07:09.6 - 1:07:11.4 | Yeah. | ID03 |
| 118 | 1:07:11.4 - 1:07:16.0 | Is this project in the public domain? | Interviewer A |
| 119 | 1:07:16.0 - 1:07:24.9 | Yes. It's quite old now, it's about three years old, four years old. | ID03 |
| 120 | 1:07:24.9 - 1:07:40.6 | Now, just one last question. Generally speaking, we will try to anonymise all our participants. Although we ask if you prefer to be anonymised or be named? | Interviewer A |
| 121 | 1:07:40.6 - 1:07:46.8 | I don't mind to be named. | ID03 |
| 122 | 1:07:46.8 - 1:08:19.5 | [Finishing up] | Everyone |