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| --- | --- | --- | --- |
|  | Timespan | Content | Speaker |
| 1 | 0:11.7 - 2:05.2 | Okay So nice to meet you, well we already have met and thank you very much for being here today I will start by giving you an information sheet, what I have already done, regarding the project and a consent form, that you have already signed. Eh I have already introduced myself and Interviewer B and what we are doing so as you may know, in some applications Additive Manufacturing is becoming increasingly attractive and competitive compared to traditional manufacturing processes such for instance injection moulding. In this project, we are trying to investigate how components produced using additive manufacturing are designed and which design guidelines or rules have to be followed in order to design a good component for Additive Manufacturing. This interview aims to explore your experience in design for additive manufacturing. In order to do so we will ask you to describe the experiences you had in designing a component or a product, which has then been produced with Additive Manufacturing. First, we are going to ask you about your expertise of AM, some general ideas on that. Then, we will look at some specific examples to understand how and why they were designed the way they were. And finally, we would like some background information about your work, your education, etc. During the interview, we may repeat what you say in order to check that we understood you correctly, and whether anything has been left out. If you have any questions please don’t hesitate to interrupt us.  Okay great.  So I would like to know a little bit about your general experience in designing for Additive Manufacturing.  I mean roughly, how many products or components have you designed for additive? | Interviewer A |
| 2 | 2:06.0 - 2:13.3 | For me I would say probably -- maybe twenty to twenty-five components. | ID01 |
| 3 | 2:18.0 - 2:21.9 | And how often -- how frequently have they come up? | Interviewer A |
| 4 | 2:22.5 - 2:45.1 | I am tending to use additive for a -- for components probably every couple of months or so now -- so is getting very regular -- so is becoming a route to getting parts just the same as any other manufacturing method, for me. | ID01 |
| 5 | 2:46.2 - 2:59.4 | Now we will ask you what proportion of your projects with additive are series production of end-user products and components as opposed to tooling, prototypes or one-offs? | Interviewer A |
| 6 | 3:01.0 - 3:14.0 | Eh well, most of mine are tooling based. They are not -- they are not components or such but they are functional tooling that's used in eh -- into the programs that we are working on. | ID01 |
| 7 | 3:16.0 - 3:27.0 | Eh well this is probably a little bit eh out but. Is this changing? So, because you are focusing on tooling probably this is not changing but do you think? | Interviewer A |
| 8 | 3:29.0 - 3:49.0 | I think for tooling is definitely getting more prominent. Eh for actual (seeing) components is not really anything that I have been exposed to recently to actually manufacture components additively in polymer but tooling definitely, tooling, fixturing. | ID01 |
| 9 | 3:49.5 - 3:53.7 | but what about Ted that he is got any? | ID02 |
| 10 | 3:53.6 - 4:12.0 | I mean -- I mean manufacturing components for eh trying things out definitely so there is that one fixture there is. For prototyping and improving our concepts then definitely, eh, but, for long term production I haven't see anything as it yet. | ID01 |
| 11 | 4:05.9 - 4:31.5 | On the metal side is all being demonstrated, all the stuff that we have done so companies interested in, they have an existing product and they say -- they generally say can we make it lighter than existing one by using, you know, topology or lattice or something and then we demonstrated that with redesign and then they got something that they can then test as feasibility. | ID02 |
| 12 | 4:31.4 - 4:37.2 | As any of the project you have made come into production? | Interviewer A |
| 13 | 4:37.2 - 4:44.9 | Eh no the once we have done no. There is one (in my group of pressure) but it will be a few years because it needs qualification and all the rest. | ID02 |
| 14 | 4:44.9 - 4:56.7 | So in our email I asked you if you could identify some components of products you have designed which have been produced with additive. Can you show us some of..? | Interviewer A |
| 15 | 4:56.7 - 7:48.2 | I can do. Ah I got two on CAD at the moment, I have to make, I will have to check whether or not I can send you images but before the first one I got here is a -- So basically what this is -- is the green bit you are looking at. It is an additive component eh we got a part of the machine and we got a laser scanner and we have an attachment and because of the way the machine works there was there was a problem with getting the laser to actually run along the right path through scanning what it was supposed to scan. So we needed an extension but in a limited time so this was designed for, basically designed with additive in mind. First, because of speed of getting the component ready, so we actually do the testing; but also because all the loadings and the forces involved in this, this is very light duty, there is not real loads, there is not real force and it is not moving a particularly high speed, the environment in it is clean and fairly temperature stable environment, it just additive component was just -- just made sense and the price of manufacturing this compared to actually making something from aluminium or steel it's -- it's so much cheaper, so much quicker. so basically it is -- it is a three-hundred (millimetres) long component. And the design process behind it, at the moment, it is fairly intuitive based on experience eh, experience in design and experience in using the additive manufacturing in polymers. Eh, I managed to come out with a design that I am very, very confident will do what it meant to do. So first bolt it components on and I know or I can guess to make how big tapping drill hole I should leave in the component, depending on the material that I am using eh how big I need to make that hole so I can actually tap the material to get some ((purges)) on it or whether I am going to leave an eight (scam) hole on it so I can put a nut in and screw through. On this particular -- on this is -- this is actually going to be tapped in a number of places so you can actually attach it on the machine and the actual features in there are for lighting the component, are not lighting the component but reducing the amount of material in there, because the support material is about a third of the cost of the built material so get rid of any of the -- anything you don't need. | ID02 |
| 16 | 7:48.2 - 7:52.6 | How did you decide to make that component in additive? | Interviewer A |
| 17 | 7:52.5 - 9:12.7 | The reason was: firstly -- the two main constrains on the were -- the main constrain was time. I needed a component. We had a problem and we needed a solution and it needed to be rapid, I mean. We could have potentially machined this in a couple of days but I needed something very urgently. Eh and secondly price. For what I was doing, for the functionality of the part, for the time and money that it cost to actually design it and have it made, it is so much more economical then actually manufacturing out of aluminium, steel or actually making it -- machining it out of plastic. So you have got your economy, you have got your speed but -- it allows me, to do things that traditional machining would -- you can do, but it becomes very restrictive and very expensive. So where a bulk of this would be a turned component but then we got a deep bore, we got a milling operations, we got flat, we got a lot of swarf removal, if you are going to make it out of anything other than additive. You are wasting a huge amount of material, when you don't need too. You can just. | ID02 |
| 18 | 9:15.0 - 9:22.7 | And which additive manufacturing technology like FDM, selective laser sintering did you use? | Interviewer A |
| 19 | 9:22.7 - 9:27.8 | Ah this one is being made on our FDM machine. | ID01 |
| 20 | 9:27.7 - 9:29.3 | FDM? | Interviewer A |
| 21 | 9:29.2 - 9:49.2 | Yeah. So this is being made in Nylon on FDM. And material selection was done -- it was either the two choices are, I was going to use was gonna be in the ABS-similar which was going to a Polyjet or the Nylon in the FDM. | ID01 |
| 22 | 9:49.2 - 9:53.4 | How did you choose FDM? | Interviewer A |
| 23 | 9:53.4 - 10:09.0 | The reason -- FDM for this one was chosen because the machine had the availability. It would’ve either been the ABS on Polyjet or the FDM on -- Nylon and FDM. Eh so. | ID01 |
| 24 | 10:08.9 - 10:12.1 | So those are the two technologies we got in house | ID02 |
| 25 | 10:12.1 - 10:59.9 | Yeah the two technologies we got but they were the materials out. It depends which machine was ready to go with which material so this one because the FDM was ready with Nylon that's why we made it in Nylon. The design is -- for what this is the actual design isn't, does not change that much between a way you are going for a Polyjet or a FDM. For me with the loading and having experience with the materials I didn't have to worry too much about any delamination with the parts because of knowing the load cases and knowing how the material react. So some intuition in how parts are made. | ID01 |
| 26 | 11:00.6 - 11:04.9 | And did you consider? Well you considered machining? | Interviewer A |
| 27 | 11:04.8 - 11:08.9 | I did consider machining but it just wasn't viable. | ID01 |
| 28 | 11:08.8 - 11:12.0 | Did you consider any other conventional process? | Interviewer A |
| 29 | 11:12.0 - 11:26.5 | No not really Eh I mean for me it always was a -- an additive part, there was no reason for me to really consider anything other | ID01 |
| 30 | 11:26.5 - 11:29.4 | Because is not series production, is it? so is not, you don't have to think about any other options really. | ID02 |
| 31 | 11:29.3 - 12:00.4 | Because is a one off. Because it was something needed rapidly eh it wasn't -- I mean there was no real eh issues in paying for something. I mean if I needed to I could have very easily pay for something to be manufactured very rapidly in a traditional sense but there was no need. It is just the technology is available. The thought was there to design right from the start for an additive component. | ID01 |
| 32 | 12:00.3 - 12:06.9 | But you are asking in the contest when to use additive compared to other manufacturing processes, aren't you so? But this example does not really apply. | ID02 |
| 33 | 12:06.8 - 12:08.0 | Yeah, yeah because is | Interviewer A |
| 34 | 12:08.0 - 12:10.0 | it is a one-off. | ID01 |
| 35 | 12:10.0 - 12:15.2 | Which FDM system did you use? | Interviewer B |
| 36 | 12:15.2 - 12:17.6 | This is on a Stratasys Fortus | ID01 |
| 37 | 12:17.5 - 12:19.8 | I mean if it was for a series production I’d guess you | ID02 |
| 38 | 12:19.7 - 12:58.3 | Eh if I was going to do that in a series production then depending on the volume, you can potentially use the machines, the additive machines (straight course) but you can use an investment casting or you create an injection mould which we have done here before as well so we had low volume production, not production, but low volume in the couple of hundreds where we actually created an injection moulding, moulds for low melt resins. So | ID01 |
| 39 | 12:58.2 - 12:59.6 | How are they made? Are they made | ID02 |
| 40 | 12:59.5 - 13:02.7 | They are made on the | ID01 |
| 41 | 13:02.6 - 13:03.8 | On the Object? | ID02 |
| 42 | 13:03.8 - 13:05.7 | Yeah no they are on the Fortus | ID01 |
| 43 | 13:05.6 - 13:07.7 | On the Fortus so there was a tooling. | ID02 |
| 44 | 13:07.6 - 13:14.6 | So we created an injection moulding tooling on the Fortus that was getting back probably eighteen months. | ID01 |
| 45 | 13:14.6 - 13:20.0 | En. | ID02 |
| 46 | 13:20.0 - 13:54.1 | But the majority of some other things I do tend to be end effectors for robots. the things where it is a very functional part but it is just -- it allows you to have so much more eh freedom. (We had to) design something that you wouldn't if traditionally -- you don't have to worry about cutting depths and cutting fluid lengths, tool cheap rate and things like that and time to -- to machine because you can just build it overnight. | ID01 |
| 47 | 13:54.1 - 14:29.0 | Now I try to ask you just that. So I am going to use a metaphor and ask you to immerse yourself in the experience of designing this component. Let's imagine that your development so -- all the things you did in order to design that had been video recorded and now we are taking the DVD and we are viewing again what happened when you were designing -- when you were designing that component. So how did you come about with that, that shape? | Interviewer A |
| 48 | 14:29.0 - 16:13.8 | Okay so the shape itself is -- for me is partially functional so I got the tubular shape with the cut-out in it, so. And tubular shape is for the deflection, to stop it from. It gives a little bit of rigidity. Eh the holes and the slots to take out material because it’s -- just adds cost and it does not need to be there. The other aspects of it. So when I am thinking design something, I am always -- I am thinking about how the machine place the polymer up, so I am always thinking in direction of where the forces are going, to see what I can do to stop any potential delamination and I mean that more comes in to how. When it comes to do the build and how you instruct the people to build it. But it is always something that I am thinking about where is potential delamination. So that's an aspect but then also -- I try to make any transitions, a little bit more smoother. So you don't suddenly just get a stop of transition so you don't get. So all your parts, I suppose you may look at it as -- your parts are a bit more organic. So instead of just having a corner you have just a nice blending radius eh whether that’s is needed or not I don't know but | ID01 |
| 49 | 16:14.6 - 16:28.7 | And so do you remember what actually happened. So you, someone came to you -- why did you have to design this component? If I can ask you? | Interviewer A |
| 50 | 16:28.7 - 17:38.2 | Yeah basically we were working on some tooling eh -- is fairly eh -- is all experimental. All things we were doing is very experimental. And it turned out that the people who were supplying the laser scanner hadn't account for a certain part of tooling; so there was a clash. We could not actually get what we needed to do. The actual tooling that we had at the moment clashed; so we needed to put an extension on it. We needed basically to try two different ways of doing it. One which was on axis and one which was an angle of fit rise off axis; so we needed to basically either adapt or design and manufacture something to extend and create the orientations that we needed; and that where this came about. So it was asked: we need to extend this laser, this laser scanner, a certain amount away from the actual head of the machine and that was it, that's the only -- the brief that I had. | ID01 |
| 51 | 17:38.2 - 17:44.0 | and the black component that is there, is something that was already there? | Interviewer A |
| 52 | 17:44.0 - 17:45.2 | That's a metallic component. | ID01 |
| 53 | 17:45.2 - 17:46.1 | It was already there. | Interviewer A |
| 54 | 17:46.1 - 18:11.5 | It was already on the machine.  So it is quite -- for me there is quite a lot of pulling back on things I have done previously and it is supposed is like an intuition on how to -- but for me straight away there was no real other option than additive. It's just -- it made pure sense to me to make this part out of additive. | ID01 |
| 55 | 18:11.5 - 18:17.1 | Are you interested in like the concept design stage and how that is different with additive compared to other manufacturing methods? | ID02 |
| 56 | 18:17.1 - 18:23.9 | Yeah that's the point, here we have three questions about the concept stage, the embodiment, the | Interviewer A |
| 57 | 18:23.8 - 18:24.3 | Ah right. Okay. Is this about the concept, is it? | ID02 |
| 58 | 18:24.2 - 18:35.5 | Yeah instead of asking the three questions I try like to -- because this is a little bit different than maybe a product design process. | Interviewer A |
| 59 | 18:35.5 - 18:41.5 | But we can give you an example of one that had more concept design. Would that help or? | ID02 |
| 60 | 18:42.2 - 18:43.7 | Yeah if you have but | ID01 |
| 61 | 18:43.7 - 18:51.9 | Because I think, what ID01 is saying is that he knew the solution pretty much right from the go and he just made a model that fit that solution. Is that a fair statement? | ID02 |
| 62 | 18:51.8 - 19:20.0 | Yeah I suppose -- I envisioned in my head how is going a be. So the concept stage -- I mean when it comes to designing a (part of additive) I would say that - when it comes to concepting eh it wouldn't be any different if we would have designed a component for normal manufacture. I mean, concepting to start with, is just blue sky thinking. | ID01 |
| 63 | 19:20.0 - 19:21.9 | You are not thinking at the manufacturing method | ID02 |
| 64 | 19:21.8 - 19:59.4 | It is when you start to come to the detailing that the additive side -- that's when is very different. When you are detailing the component for additive as opposed to detailing a component for traditional machining. That's when you don't have to worry about (joules) depths, and cutting fluids lengths, and radiuses, and things like that. You don't have to worry about the most efficient way of removing material because you are not removing anything, you are just building a component. That's where the biggest chance is. So for me, I mean, for the most part the conceptual stage would be the same. | ID01 |
| 65 | 20:01.0 - 20:02.3 | For me, I would say would be different so. | ID02 |
| 66 | 20:02.3 - 20:03.3 | For you yeah | ID01 |
| 67 | 20:03.2 - 20:07.7 | I would say it would be different from how the way we do it, but I mean it is just a different point of view | ID02 |
| 68 | 20:07.6 - 20:10.9 | Because you work more with topology optimization and this kind of things | Interviewer A |
| 69 | 20:11.2 - 20:48.1 | Yeah, yeah so you (start) thinking just, just something crazy and think about lattice structures and (fuzzy straights of hair holding things up) and you know, completely crazy stuff, without even thinking about CAD, so, you know, and then when you get to the damn selection stage (stop -- stop) when you, you know, when you -- in any design process you come out with hundred of what, ten ideas and you kind of compare them somehow and end up with your three top ideas. At that point you start thinking about actually can additive I make this, or are they just too crazy and then once you got the ones you think additive could make then you start down selecting to something can -- the availability. Slightly different. | ID02 |
| 70 | 20:48.3 - 22:00.9 | Yeah the only thing that is -- there's (strange) things is that the layering so when you do -- finish your concepts you start looking at the detailing. The layering of additive can be, for polymer, can be a bit, it can hold you back a little bit because where were with the metal is fully fused, isn't it? where with this is still, is still layered manufacturing you, you still can see pronounced layers although they are bonded very well you still get layers and still is a potential failure. You have to be very mindful and fairly knowledgeable in order to make sure that the design you are doing is -- is going to work. Because simulating a component that is build-up of two-and-half thousands layers would be very difficult specially if you are drilling and tapping and then applying forces to other components. So, you have to use a bit of intuition but there is a little bit of trial and error in some stuff that we are doing. We try things and see if things work. | ID01 |
| 71 | 22:00.9 - 22:04.4 | So you try, you make and you put them in the machine | Interviewer A |
| 72 | 22:04.4 - 22:05.1 | Yeah | ID01 |
| 73 | 22:05.0 - 22:07.1 | and you try to see if they work | Interviewer A |
| 74 | 22:07.1 - 22:55.5 | Yeah. So for instance ah on screw threads for instance we’ve been doing a lot of work on -- on firstly trying to print screw threads to see what tolerances we need to apply to get a good running fit on a screw thread. We’ve been looking at different tolerances ah ways of applying threaded inserts into polymer components so we can actually use the same sort of inserts that they would in injection moulding but within the polymer. So we build up this sort of information that we can use and then we can disseminate to the rest of the company to -- basically build up design rules to help people in the company use additive as a normal manufacturing method rather than a -- you know the prototype method. | ID01 |
| 75 | 22:55.7 - 23:17.4 | It is interesting I think. When you come into plastics you sort of kind make an iterate, can you? They quickly say like -- is an extension of the prototyping, isn't it? You are prototyping but for end-use. What on a metal side of it was, spend a lot of time doing CAE, a lot of time. To see if it is a viable thing because the build is so expensive, you know, it is a different -- a different focus. I haven’t thought about that before. | ID02 |
| 76 | 23:17.5 - 24:55.0 | Because polymer is, I mean. I imagine if you compare polymer to a traditional manufacturing you end up with -- it is a very cheap, very quick process. because I can send something at night and come back in the morning I will have got it to test. Where with traditional manufacturing you send something to the machine shop at four o'clock they are not gonna start it until the next day. See you are already, you know, massively ahead, but we can iterate, I mean, I got an example here, I have to find out if we can send it to you. I did have an example, so basically. So yeah, we spent a bit of time looking at inserts, so these are Tapex inserts. So because polymer is cheap we built up a lot of test pieces with different size holes, we had the hole size of the manufacturer says that you need and then we started looking at all the different variations of hole size. Ah just to work out what would be the actual best hole size to fit this Tapex inserts, so we did it, you know, a fair bit of work on that. Using our (distil) ABS on the polymer. This is (forges) the time to build something that we can test, we can be very iterative and if does not work we are only a day away from having something that might work. | ID01 |
| 77 | 24:55.0 - 24:57.0 | And also you do it yourself, don't you? | ID02 |
| 78 | 24:57.0 - 24:57.5 | Yeah | ID01 |
| 79 | 24:57.4 - 25:12.8 | Where with additive metal, you know, the part goes off the machine. Someone has to operate the machine. It is not so straight forward. When the part comes off, you have to take all the supports off, must be powder blasted. There is all set of post-processes operations before you actually get the end part. So it is quite different to plastic. | ID02 |
| 80 | 25:12.8 - 25:26.1 | Yeah plastic is, I mean, is such a -- it gives you such a freedom to -- to try and test, to actually work on prototyping and understanding. | ID01 |
| 81 | 25:26.1 - 25:42.5 | Now I am going to ask you basically what you said before but in a more structured way. So, when you were designing this product or components, did you follow any specific design rules or guidelines, when you were designing that... | Interviewer A |
| 82 | 25:42.5 - 25:44.2 | Not at the moment so | ID01 |
| 83 | 25:44.2 - 25:47.9 | That arm for the laser scanner? | Interviewer A |
| 84 | 25:47.8 - 27:28.5 | It is following -- , ah obviously there is, there is -- previous knowledge and understanding of having in design in the past, but also my experience of polymer as it stands at the moment. It’s not documented; but it is something that we are working on documenting, we are working on internal design rules for polymer, what to look for, what to -- different ways of doing things, what pitfalls might be. We are building up a quite large understanding by people designing and making things and testing, so people might want something for -- a part for their vacuum cleaner for instance. We can make that in additive as long as we understand the duty cycle, how often is used etc., what sort of media is going through it, then we can start building up a -- a very broad database of different materials with different designs, how much they cost, how they worked, all that sort of information that, that can build an understanding of polymer additive. So we tend to be very free with it. We are making end use parts not necessary full production parts, in production -- in production volumes but definitely end-use parts for all manner of applications. | ID01 |
| 85 | 27:28.5 - 27:50.3 | And well you already answered this question but I am just asking you for the sake. How did learn this rules? So you said you are applying these rules which are (()) your personal rules which are not formalised anyway but how did you learn them? You told me from my previous knowledge | Interviewer A |
| 86 | 27:50.2 - 29:27.1 | Just trial and error. Just basically building something and seeing if it works and if it didn't work why did it fail, how did it fail, is anything we can do in the design, is anything we can do with the build to change it. Is it a case of screw thread inside failed so do we need to put an insert in it, do we need to do it in a different way. So, it's -- it is being afforded the time to trial and error things, because there are no rules for this, you know, traditional manufacture there is so much data on how you cut this part with this cutter, this material, this coolant, you got all that information available to you, but with this, with the polymer side of it, there really isn't anything out there to tell you, this is what you need to do if you are going to make a part, you have to do this, so it is just, at the moment, trial and error, but that is iterative so the more -- the more you try and the more you start understanding how these parts do function and what effects of orientation of build, how and all sizes and all the things like that. What affect that has on your design, you start just becoming naturally -- is that -- is that unseen, is that the sort of tacit knowledge that you get, so when you design a component and you can look at it and you know without -- without looking or investigating too deeply that your guys in workshop can manufacture that on a milling machine, on a lathe is just, it is an unwritten knowledge. | ID01 |
| 87 | 29:28.3 - 29:39.0 | Did eh, Did the introduction to additive manufacturing knowledge change the way you design components? | Interviewer A |
| 88 | 29:39.0 - 30:15.9 | It definitely changes the opportunities that I can see with components. I do remember right from the back that the original -- what we called rapid prototypes for many years ago eh which were not very good, they were good at look at but you couldn’t do anything with them. So what we’ve got now and this definitely gives you another route to end products. It’s always there as an option. | ID01 |
| 89 | 30:15.9 - 30:23.6 | And do you think changed something in the actual design of the product itself or the component itself? | Interviewer A |
| 90 | 30:23.6 - 32:00.4 | It can do yes. It can make you or it can give you the chance to design something that you might have to make out of two components or possibly more. So you could incorporate things into a design that you wouldn't do if you are traditionally manufacturing. So, for instance on the component here if I -- So, for instance a bore there, the bore in the middle, this is an old model, but the bore in the middle there is no cone on the drill, so I was going drill that traditionally, I’d either have to drill it a lot smaller and then run another cutter down there and interpolate or put a big cutter down. Eh but this would just allow you to -- you can do anything with it really, I mean this little bit here on traditional would more than likely, you have to weld it on really, so you can turn this and then mill that and weld it and you are just cutting out operations in the assembly or the manufacturing process for component. And for me it just -- it just gives you that, you know, that sudden -- I can just make this I don't have to worry about where my cutters are long enough or where we got the cutters in house or, you know, where we got the material, because we got the materials, because is (saying) two and a half kilo sacks in liquid. | ID01 |
| 91 | 32:00.9 - 32:13.3 | Can I ask you a specific question about this design? This is my curiosity, is not on the -- Why -- so this is, this is a kind of a tube shape, why do you have two different diameters? | Interviewer A |
| 92 | 32:13.3 - 32:18.5 | So this one, This is for location over | ID01 |
| 93 | 32:18.5 - 32:19.9 | Over the other component | Interviewer A |
| 94 | 32:19.9 - 33:13.4 | Over the other component, so there is (no put down on that) because it gives me a little bit of -- it stops it from dropping. It just gives me a little bit of engagement on the other component so other than put it face to face, because I can, because it is, I mean -- this, this bit here would be -- you are talking a couple of pounds for that amount of material. So I put it on there to give me, first a little bit of positive engagement, but it also gives me a bit of support and it just -- it just supports the all component and is that sort of thing that you can do, you can give yourself that little bit of support and I know that -- with the accuracy of the machine, knowing the accuracy of the component that is made I know I can make that, a nice sliding fit, so it is not, you know, it is not press fit and it is not a loose; but it is just nice, it is probably a bad way of describing a fit, isn't it? But it is just, it's just, you know, it is just a | ID01 |
| 95 | 33:13.3 - 33:14.8 | ((Snoke)) | ID02 |
| 96 | 33:14.7 - 33:28.6 | Yeah it is a good running fit and it is because you can do that sort of thing, you know, if you are going to machine this traditionally, there is a lot of work in that, there is a lot of work in creating that, that fit. | ID01 |
| 97 | 33:28.6 - 33:37.6 | It is fair to say that, that shape is coming up basically because of the modelling tool, isn't it? It encourages you to make geometric shapes and add them together rather then, it is not a free form modelling tool. | ID02 |
| 98 | 33:37.6 - 33:40.5 | It is not a free form, this is just, no this is | ID01 |
| 99 | 33:40.4 - 33:41.7 | So it encourages using geometric features | ID02 |
| 100 | 33:41.7 - 33:42.5 | Yeah | ID01 |
| 101 | 33:42.5 - 33:46.2 | And it’s just like making it like that, you know, why bother remodelling and smoother and like that | ID02 |
| 102 | 33:46.2 - 34:32.6 | I mean, I would not show you the history tree on this, because, because it is quite a mess but what it does allow to do is, you can just try something, because you haven't -- you are not restricted -- you are not restricted by traditional manufacturing techniques, so you can just do things that you wouldn't normally do. Which then allows you to do something, test it, see how it works, if it does not work, why does it not work and you are always, with this, you are always building and if this doesn’t work, which I mean it will and it does. Ah we can do something different and make it again very, very quickly. | ID01 |
| 103 | 34:32.5 - 34:46.9 | Now I am going to ask you, in this particular component are there any drawbacks or limitations as a result of being designed for additive, compared to being made with another? | Interviewer A |
| 104 | 34:46.9 - 35:35.5 | The disadvantages for this being designed for additive are -- you are very relying on, when you build it, the person who builds it, builds in the right orientation. Doing any FEA on this becomes a lot harder. If I were to machine this out of Aluminium, doing this on F E A would be particularly, fairly simple. With additive, because it builds up on layers, it becomes very difficult, very complex level of modelling. Because you have to account for thousands of layers potentially. And then if you want to change the orientation, it's a long job. Other than that, I wouldn't say any limitations. | ID01 |
| 105 | 35:36.2 - 35:37.3 | What the durability of the material then? | ID02 |
| 106 | 35:37.3 - 35:49.4 | The durability of the material, I mean, first thing, the most of the materials in Polyjet are only similar to materials that are ABS. But the ABS isn't really ABS, is simliar of ABS | ID01 |
| 107 | 35:49.4 - 35:50.1 | That's the equivalent of. | ID02 |
| 108 | 35:50.1 - 38:22.3 | But there is not a lot of data at the moment, really on how these materials do operate over a long period of time. We know the materials creep, we know that they can potentially degrade in UV or if the temperatures cycle. But that’s something else we are building up our knowledge on. So we are working…building parts up and we are running series of tests. So we will run duty circle on components. There is some work being done where we are building a number of identical components in (secondary) different environments. We measure them before, we measure them afterwards. So test whether how () they are, how the dimensions change through heat cycling or whatever the environment they are in. So the only downside is, when you traditionally manufacturing something, there is lots of information about the materials on how they react, how they creep. This is the reason, really. So, at the moment, for high accuracy parts, we have used F D M. So we used the F D M with O10 or Nylon for components that have been around, and actually the machine must’ve been around for about a year now. So they are not exposed to huge temperature changes because they aren’t outside. But We’ve got components that have been additive manufactured. They are working on a test rig. They have been working for over a year now. So I suppose that’s the only disadvantage, the unknown about the materials. The materials are constantly changing and updating then it’s quite difficult, at the moment, to pin anything down because by the time you've done a lot of work on one material in (absolute then you've got the next grade thing out). So for high accuracy parts, I don’t know yet. I don’t know if I could use it for high accuracy parts unless you metalize it, to stop any creep. But then, we still don’t know enough about it yet whether metalizing it really reduces the creep, though. Does it really stabilise it? For me, really don’t know yet. | ID01 |
| 109 | 38:21.3 - 38:39.1 | Thank you. OK, so now some questions about general views on additive. So what is your general view of additive manufacturing as production process for end-user components? | Interviewer A |
| 110 | 38:39.0 - 39:10.3 | I think the right materials, the right design and testing of components. I think it’s just () as any other manufacturing method. I’m trying to stop people from calling it rapid prototyping because it isn’t rapid prototyping. It is another manufacturing method. So for me, it is a very very viable alternative to traditional manufacturing. | ID01 |
| 111 | 39:10.3 - 39:14.0 | Yeah we (really have to find) the quantities, isn't it? | ID02 |
| 112 | 39:14.0 - 39:51.9 | Yes, I mean, you’ve got your economic scale, of course. But if you were light volume or complicated components, then, definitely. If you wanted to make tens of thousands of components, you have to go back to injection moulding or machining or something like that. But depending on where your price breaks up, it is definitely viable. It’s only, I mean, the machines are getting quicker and they are getting cheaper, materials are getting better. So give it another ten years, it is gonna be anywhere, it will be, it will be something that people use all the time. | ID01 |
| 113 | 39:51.9 - 39:58.1 | And what do you think designers need to know for designing effective parts for additive? | Interviewer A |
| 114 | 39:58.0 - 40:16.5 | Well, for me, I think FEA, simulation the side of it is something that needs to be worked on. It needs to be, it needs to be easier for an average designer to be able to FEA analyse…[interrupted by AT] | ID01 |
| 115 | 40:16.4 - 40:17.5 | That is the material properties? | ID02 |
| 116 | 40:17.5 - 40:22.7 | It’s the material properties and (dimensions) because the eh…layer. | ID01 |
| 117 | 40:22.7 - 40:25.5 | You wanna do F E A on these layers? | ID02 |
| 118 | 40:25.5 - 40:27.5 | I think you have to FEA as layer components. | ID01 |
| 119 | 40:27.5 - 40:28.6 | We don't. | ID02 |
| 120 | 40:28.6 - 40:33.1 | Yours are bonded though, aren’t they? The metal stuff is all… | ID01 |
| 121 | 40:33.1 - 40:38.6 | Choose the layer property at which direction and use that as the property all around. | ID02 |
| 122 | 40:38.5 - 41:19.8 | OK, but (there are) things like that. So…but also people understanding the build process and how they understanding the overall process, the way the materials aren’t, actually, they aren’t an ABS. It’s ABS similar. It’s very very similar to ABS but it isn’t ABS. It’s not like how (margin) the structure you get in injection moulding, it is still a layered component. Bonded, but it’s still layered. So you’re always gonna get a weaker part between the layers. Always gonna get that with this at the moment. | ID01 |
| 123 | 41:19.8 - 41:29.5 | Have you got any software then, doesn’t, you know, from the software, in terms of tools, design tools, () like a freeform modelling capability with that? | ID02 |
| 124 | 41:29.4 - 41:56.4 | (Within NX) is a very good freeform modelling. So, I mean, it is the uptake people are still seeing it as a rapid prototyping rather than as a manufacturing tool. Given as the new generations come through, we will definitely see it as a viable production. | ID01 |
| 125 | 41:56.4 - 41:58.3 | Just as another method to me. | ID02 |
| 126 | 41:58.3 - 42:09.1 | Yeah. At the moment, it’s a viable low volume. I’d imagine, in the near future, it will be a very viable low to medium volume (). | ID01 |
| 127 | 42:09.1 - 42:22.8 | Can I just add customisation, which is an enabler? (The process has), so you know, that changes things. If you think about product design, you can stop thinking design (quantity) for one, even though it might be for thousands of people. | ID02 |
| 128 | 42:22.8 - 42:24.8 | Yeah of course. | ID01 |
| 129 | 42:24.8 - 42:29.0 | And that’s a new way of thinking about design. | ID02 |
| 130 | 42:29.0 - 42:40.4 | Are you aware of any F E A models that can be capable of simulating the process very well? | Interviewer B |
| 131 | 42:40.4 - 42:41.8 | I’m not, no | ID01 |
| 132 | 42:41.8 - 42:43.6 | Simulating what? What part of the process? | ID02 |
| 133 | 42:43.6 - 42:50.7 | The material properties or the overall FDM or Polyjet process | Interviewer B |
| 134 | 42:50.6 - 42:57.4 | Not in plastic, I know ones that do metals but not plastic. | ID02 |
| 135 | 42:57.4 - 43:15.0 | Now there are questions about well something you’ve already said in the interview. So how did you learn to design for additive manufacturing? Somehow you told us that you learned about try and error. Did you use anything else? | Interviewer A |
| 136 | 43:14.9 - 43:42.6 | Oh, I mean, not just my own try and error, other people. So we group our knowledge together. So anyone that’s done some work in polymer tends to allow everyone, they shared the information, how it worked, why it didn’t work, or why it worked, good things and bad things. But there is a lot of try and error at the moment and there is a fair intuition. | ID01 |
| 137 | 43:42.6 - 43:47.5 | How do you share the information? Literature review? | Interviewer A |
| 138 | 43:47.4 - 44:24.0 | We’ve got an internal wiki that we use. So we have a lot of information we’ve got in there. But we’ve also got a very good understanding of who uses the machine the most, who is very forward thinking when it comes to additive. So we’ve almost got like a, I suppose, additive champions really, if you like. People that are very keen on pushing polymer additive into the company. | ID01 |
| 139 | 44:23.9 - 44:25.8 | And did you talk with them? | Interviewer A |
| 140 | 44:25.8 - 44:26.4 | Yes. | ID01 |
| 141 | 44:26.4 - 44:29.1 | So the Wiki is just. | Interviewer A |
| 142 | 44:29.1 - 44:37.2 | Yes. The work is repository of information, but there is a lot of communication amongst the people that are keen on it. | ID01 |
| 143 | 44:37.2 - 44:42.9 | And is it just an informal chat, so you pop in and you say well how can do this? | Interviewer A |
| 144 | 44:42.8 - 44:56.8 | It’s uh talk about it, and then it’s recorded, but also people talked about what’s good, what’s bad, what’s happened, what hasn’t happened. But the knowledge is all stored on the Wiki. | ID01 |
| 145 | 44:56.8 - 45:01.6 | I think it’s the smallest company we could just sort of (photograph), you know, have a chat with them. | ID02 |
| 146 | 45:01.6 - 45:15.3 | So we know when it comes to additive, who’s talk to at the moment. Because the company is still small enough (interrupted by people flipping papers over). But we are working on better ways of sharing knowledge. | ID01 |
| 147 | 45:15.3 - 45:38.9 | Ok, so, well, this is also, how did you come up with your own rules? You already told us about try and error, and you showed us very nice images about the experience and experiments you were running. You told us also that you were also working on (self-optimise) rules but at the moment, you don’t have any? | Interviewer A |
| 148 | 45:38.9 - 45:47.5 | We don't have any company rules on design for polymer additive but we are looking at. | ID01 |
| 149 | 45:47.5 - 45:56.1 | There is a work-in-progress, there is a draft document in the (). We are now developing, there is an internal project, the (IN) project is starting to do that | ID02 |
| 150 | 45:56.0 - 45:59.8 | So if I ask you if you can show us those rules, you cannot? | Interviewer A |
| 151 | 45:59.8 - 47:07.1 | Well it is a draft. We got one for metal, which is ready. I’ll show you that. It’ll be equivalent to this, but this is for metal. [then ID02 was trying to find and open the file on his laptop] | ID02 |
| 152 | 47:07.1 - 47:28.9 | Since we are waiting, I’d like to ask ID01 about the internal wiki and rules you are developing. Do you look at scientific, uh, research papers and try to do the test on the, yeah? | Interviewer B |
| 153 | 47:28.9 - 47:44.5 | Yeah, so not only do we do the try and errors based on what we’ve done in house, we do, I mean, we are research organisation, so we do look at the papers, we look at the things other papers are doing, so. | ID01 |
| 154 | 47:44.5 - 47:46.8 | And then you do the tests again to verify? | Interviewer B |
| 155 | 47:46.8 - 48:09.9 | Sometimes, sometimes we might do a small scale. But we don’t, as of yet, we haven’t actually tried to repeat any tests that people have done. But whether, if these is information in there, the information that could be useful to us, then we will record it, and maybe we will run a trial, but we don’t repeat tests to see if we get the same data. | ID01 |
| 156 | 48:09.9 - 50:35.4 | So, there are basically three documents. So one is the general () AM process and how and what you can do with it. The other one is looking at software tools that are available. The third one is the comparison of some of those tools, so. [ID02 was opening and showing the documents].  So the first one describes the processes and it’s 70 pages. It talks about what additive is, what the machines are, why to use it, when and what the drivers are to choose the process, what the costs come from, pros and cons. And then looking at detail designs, supports, holes, features will build, features will (worn), some other things you can gain. So (some reasons…), weight optimisation, threads stuck in the chamber. So all sorts of guides for designer to actually create, start designing for this process and come up with something that is feasible. And then there are a few case studies, so, I mean, I won’t go through this whole report, but this flow diagram pictures some examples of good and bad design, what and how the processes work, what builds and angles are and what they aren’t, what materials are available, what (sorts of) machines from different manufacturers, so which one you can try using, the cost curve, when you’ve got a good return of investment, things not to make, lots of examples like light weighting, using cost effect to create cost effective parts. So these are examples of when you should use it, that sort of down (slept) processes that, say, as this process is a good for, I want to design. And some examples of design rules. We’ve also got the reference to online design guides that are available, so crucibles design is a good one. There is another design guide as well. So what the online resources are. And examples of recoat and direction. And general design rules. So the idea here is the designer can read this and have, uh, make a first () when designing something and where to look online for buildability rules, stuff like that. | ID02 |
| 157 | 50:35.4 - 50:39.0 | Are these design rules available? | Interviewer A |
| 158 | 50:39.0 - 51:59.1 | This specific document is available internally to members at Company A. And then you’ve got the online resources which obviously are available to everybody. We’ve been involved in a couple of projects as well, () projects, TSB projects. So that’s got a website, you can go and have a look at. So that’s the first document. And the second one is specifically looking at the tools because the tools are () at the moment. So the tools, I mean, the software, as you know, if you wanted to, I mean, what ID01’s described, using polymer design (), you design your CAD model, you export it as STL, you set it in the machine, you finish. But this’s looking more into the case of when you try to get the value out of metal additive, which is an expensive process, you need to be doing optimised design, using topology tools, lattices tools or generative complex forms. So you’re kind of looking at software that is a bit more, a bit different than conventional CAD. Then you also need to (file and fix it in) software, like Magics, then you need to be creating sliced files and hatchbacks, stuff like that. When you are doing polymer design, you generally don’t bother to think about these things. | ID02 |
| 159 | 51:55.0 - 52:13.4 | Polymer is almost like printing in a document, so uh that’s it. You don’t. Unless you printing on some of machines that have got multi-material, which is slightly a different way of printing. It is very simple. | ID01 |
| 160 | 52:13.8 - 56:09.3 | So the whole document is built around those sort of processes there. You’ve got your ideas, you’ve got the machine, these are the translation stages and data to go through. So the machine needs G-Code, and you need to get from the idea to the CAD model to the G-Code. Then you have to go through these several stages and it looks different software does different things. So it's quite a detailed document. All the pros and cons, and different routes of making things, how to optimise, what the work flow is, software packages, pros and cons, which one, uh, optmisation. So the idea is, by reading this, designers have a good idea of. Let's say, you are in a company, your boss says let's make some stuff out of additive. You then, ok, you can do that, but you are gonna need to invest the software, this sort of software you need, these are some examples good investment for. So that's really what the whole report is about. And at the end, it looks a bit about designers, how, designers, decisions also affect post-processing because in metal design, post-processing is a big cost factor. So if you design just for the bills, you may be creating cost downstream and making (manufactive) designs. So this is an attempt to explain that. We've started to have a bit look at engineering drawings. So metal parts tend to need to be machined afterwards to make them usable with interface or, you know, dimentionally accurate features. So you need to make manufacturing drawings. So how to do that, what information needs to go in them, and that's what ID01 talked about the thoughts build orientation is important, how to specify that in the drawing. So we've come up with a system of drawings to go to process engineer who sets up the bill. So the part is oriented correctly, support any place where () to be, the correct layer thickness is used, the orientation of part that recoded is set correctly. So you've got a control of the way the build process will happen. And then, when that comes out, the drawing for the machine shows, we have a set of drawings that show the support removal process, the machining and inspection, how that will be done for an additive part because that's a completely different work for them. That's sort of part of this documentation. So that's the second one. And then the third one, we had a go with the comparison of software tools. That's this one here. So there are several software packages. And then we took a component and did some optimisation. So these are the steps of the workflow and these are the different software packages that you can use. We just tried to compare how they were in each stage of the redesigns. So if you want to make STLs from different software packages, what you can get out of them. Not all software pacakges will create the same quality for STL file. And so, we did a comparison there. When you're doing pre-processing optimisation using various software packages, what's the difference in the output between those packages, what capabilities they have, you know, are there any problems with them, how ease they are to use, what's the learning curve like, again another alternative version which opitmisation using struts. And then re-modelling, once the optmisation is done, you get to optmise the part, then what happens to remodelling. Again that's another big thing needs doing if you are doing optmised parts. So just to look at all the software that you might need to use to do that, at least optimisation. Scanning, importing scans, can you reverse engineer something, and then have a nice, from the scan code, can you get a B-rep model of that part that you can work as an engineer. (What, why is there are doing that.) So it's like an overview of all the ways of working in the design process using the software that is relevant. So that's the metal. That's a big project. We're starting the one to look at polymers. So what ID01, as end users, has been developing with other guys, we're gonna try to formalise it now to get it into a formal design document that ties in with the wiki. | ID02 |
| 161 | 56:09.3 - 56:13.0 | How do you compare different software packages? | Interviewer B |
| 162 | 56:12.7 - 56:40.9 | So we had a sort of base component that we needed making, basically optimising. So if you have a base component to optimise, then you re-model it, you fix it by S T L fixing software. At each stage, there are various optimisation software packages so we (optimise) and compare all the packages and see what the app looks like. Then we get the app (implement) fix the triangles in all the fixing packages and see which one does best. That’s kind of comparison. | ID02 |
| 163 | 56:40.9 - 56:49.9 | Right, ok. Also because ID02 you mentioned ‘redesign’ a few times, how do you define ‘redesign’? | Interviewer B |
| 164 | 56:49.8 - 57:18.2 | How define ‘redesign’? Well, I guess there are two types. One is completely redesign, where you are just giving it proper specification, which this component needs to meet, and then you just go and design it. Or you are given an existing component, and it has to be redesigned to be buildable in the additive process. And usually they want you to do with light-weighting at the same time. So basically there are two types. | ID02 |
| 165 | 57:18.2 - 57:27.0 | How do you develop these documents? Based on your experience? | Interviewer A |
| 166 | 57:26.5 - 57:33.8 | Based on the experience of the people in the team and doing research, literature review as well, to see if there is information out there. | ID02 |
| 167 | 57:33.8 - 57:38.4 | Did you do any experiments or sort of [interrupted by ID02]? | Interviewer A |
| 168 | 57:38.4 - 57:48.8 | For the actual design guides I’m showing you, the only experiments were the virtual ones where we optimised parts in different software to see what the results were. | ID02 |
| 169 | 57:48.0 - 57:53.3 | So you didn't do any physical experiments? | Interviewer A |
| 170 | 57:53.3 - 58:06.5 | No physical builds on that project now. But we have done, uh, we built benchmarks. We’ve got another project, the () project I mentioned earlier that we built lots of benchmarks in there. | ID02 |
| 171 | 58:06.4 - 58:22.6 | Thank you. Now I want to ask you in the next ten to five years, how do you think additive manufacturing as a production process will influence design? | Interviewer A |
| 172 | 58:22.5 - 59:09.2 | Influence design? That depends, doesn't it? Well, I think in the next five to ten years, it will be seen as a viable niche manufacturing process, which means it will be taught at school or university. As that, so therefore the design will come out and they will be able to design for it. Therefore, there is different mind-set for designing for additive processes (down) to conventional. You need to be sort of thinking of, really, away from the constraints of your CAD model, and the tooling constraints. That mind-set would be given to the people coming out of university and school. And therefore they will design differently for the process. So I think that's our dreams. | ID02 |
| 173 | 59:09.2 - 59:56.4 | I think so. I think it will become, uh, it will be most more viable because people in school now have already been taught, what they call it 3D printing on Magicbox or Makerbot something like that. The mind-set is already there. It's already been pointed into the pre-industry. So anyone coming out through school or college, university, 3D polymer additive is something already there. It's already something that is instilled in them. They already have an understanding of what it can and it can't do before they even do start engineering design. | ID01 |
| 174 | 59:56.9 - 1:00:32.3 | I think there is another sort of extra bit there, we sort of tend to design for mass production now. So you can design for mass production with additive as well, although for low quantities. But again, it's already customisation, so designing for one personal, the democratisation of design. That's a process only now become viable, that just doesn't exist before. So that will be a new way of designing. And in the future, you will have interface for customer to help input the design. I see that coming on line in the next 5 years as well. | ID02 |
| 175 | 1:00:32.3 - 1:00:57.3 | Thank you so much for your time. We are coming towards to the end. You've been very helpful. Very interesting actually to listen to you. Now before we go, I'd like to ask you if you could tell me some details about your background, like what is your education background? | Interviewer A |
| 176 | 1:00:57.2 - 1:01:45.3 | I've got masters in additive manufacturing effectively, it's called rapid product development, but it looks around the additive processes to develop products. So I did that masters about, I finished that 4 years ago. Then I came onto here since I've been working on additive manufacturing. And before that, I did an engineering apprenticeship at Rolls Royce, a long time ago, Bristol. So I was a development engineer there. I left the engineering profession and got into modelling so I've done modelling at rendering for architecture firms, furniture design and interior design, a bit for construction so that's all before moving back into engineering and doing additive. | ID02 |
| 177 | 1:01:44.5 - 1:02:23.2 | Uh, my background, apprenticeship specialising in product design. I spent most of mine years as a product designer. I have also worked in powder production, in terms of carbide powder production. Automotive design, bespoke engineering, one-off design. Education, I've got a bachelor of engineering, a bachelor mechanical engineering. | ID01 |
| 178 | 1:02:23.1 - 1:02:25.3 | OK, where did you study? | Interviewer A |
| 179 | 1:02:25.2 - 1:02:31.2 | My degree was at Birmingham City University. | ID01 |
| 180 | 1:02:31.1 - 1:02:39.6 | Mine was a De Montfort University in Leicester. | ID02 |
| 181 | 1:02:39.5 - 1:02:42.7 | How long have you been working as professional designers? | Interviewer A |
| 182 | 1:02:42.7 - 1:02:48.7 | I've been 24 years. | ID01 |
| 183 | 1:02:48.7 - 1:02:54.7 | So on and off I have been about 15 years. | ID02 |
| 184 | 1:02:53.7 - 1:03:10.9 | Ok, now I'm asking you. Can I confirm if it is ok for me, for us to take some pictures and have copies of the drawings so we may have print-screens of the drawing you showed us? | Interviewer A |
| 185 | 1:03:10.9 - 1:03:20.0 | I would have to find out. I will have to get some permission to send you printshots of these parts plus some others we might have done. | ID01 |
| 186 | 1:03:19.9 - 1:03:29.5 | Are we gonna have a quick look at the workshop now? And then, if you sort of say ''oh that looks good, can we have a photo of that?'' Then we just ask them. | ID02 |
| 187 | 1:03:29.4 - 1:03:33.6 | Is the project you showed me in the public domain? | Interviewer A |
| 188 | 1:03:33.5 - 1:04:09.6 | Uh, this project is, but those parts might not necessarily be. As part of that project, the one wasn't in public domain. There was some additive in there where they were looking at additive - polymer additive, or printing shoes to go into an aircraft. (So the aircraft was built for shipping out). Sections of wings and things like that. | ID01 |
| 189 | 1:04:09.6 - 1:04:11.9 | Can we use this project as a case study? | Interviewer A |
| 190 | 1:04:11.9 - 1:04:19.8 | Uh, well, if, whatever is in the public domain, I don't see why not. | ID01 |
| 191 | 1:04:19.7 - 1:04:30.5 | When do you need the case study for?  If it is after six months as well, we can give you, I can give you one in six months, so. | ID02 |
| 192 | 1:04:30.5 - 1:04:35.4 | Six months should be OK. | Interviewer A |
| 193 | 1:04:35.3 - 1:04:51.5 | I can send you the website, the one, large project. It was a large (BOA) project, whether they've loaded the information yet, I don't know. But I can definitely send you that, that link. | ID01 |
| 194 | 1:04:51.4 - 1:05:08.7 | Ok, so, in the following weeks, we will transcribe the interview and send you a copy in order to see if we have understood correctly what you told us. Just one last question, would you be happy to be named or do you prefer to be anonymised? | Interviewer A |
| 195 | 1:05:08.7 - 1:05:09.7 | I don't mind being named. | ID01 |
| 196 | 1:05:09.6 - 1:05:16.0 | Don't you? Didn't say anything stupid? | ID02 |
| 197 | 1:05:15.9 - 1:05:17.0 | I'm not, haha. | ID01 |
| 198 | 1:05:16.9 - 1:05:25.5 | Ok that's it. Thank you very much.  [then chatting] | ID01 |