Rolls-Royce Pro-Laser Technology

Design System Phase One Testing – Feedback form
13th June 2007

Name: *Designer A*

The Design System

Please rate the design system in terms of :
(Out of 5 whereby 1 would signify very little support and 5 a significant resource)

	1	2	3	4	5
Support provided by design system:	☐	✓	☐	☐	☐
Ease of use	☐	☐	✓	☐	☐
Content offered by design system	☐	☐	✓	☐	☐

Please detail the features most appreciated:

Pictures are good and of good quality.

Please detail features you feel you required:

Drawings.
The search interface to work well (few bugs at the moment).

Please detail the information or content you used the most:

Please detail the information or content you required, but were not available:

K factors
Standard bolt sizes

Rolls-Royce Pro-Laser Technology

Case studies supplied

Please rate the case studies in terms of :	*1*	*2*	*3*	*4*	*5*
The value of content supplied:	☐	☐	✓	☐	☐
The support provided w.r.t to the design task:	☐	☐	✓	☐	☐

Please detail the most valuable aspect of the case studies:

Please detail how you would improve the case studies:

Choose 1-2 and go through them.

Additional resources

Please detail the most valuable resource provided:

One day intro sessions

Please detail the resource most required:

A4 Crib Sheet

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Design Task

Please rate the task in terms of:	*1*	*2*	*3*	*4*	*5*
Difficulty of task presented:	☐	☐	☐	☐	✓
Interest :	☐	☐	☐	☐	✓
Degree of step change from previous experience in design:	☐	☐	☐	✓	☐

Please detail the most challenging aspect to the design task:

Considering how to build

Please detail how you would improve the design task:

More definition on what was wanted at the end.
Less CAD intensive perhaps.

Please comment on the time allocated to design:

About right.

Please comment on how different designing for Pro-Laser than previous experience:

Not too different – as long as manufacturing constraints are considered

Please detail whether you completed the task and how much time you would have liked to complete the task.

Yes, Time was about right.

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Methodology:

Please rate the methodology in terms of:	*1*	*2*	*3*	*4*	*5*
Degree of uniqueness:	☐	✓	☐	☐	☐
How well defined do you feel it is:	☐	✓	☐	☐	☐
How easy it was to follow:	☐	✓	☐	☐	☐

Please add any additional comments on the methodology you feel are relevant, in particular if you answered 1 or 2 for any of the above please detail why:

The methodology is really just a set of principles, it should never develop to more than this as every problem, customer is unique.

Experience

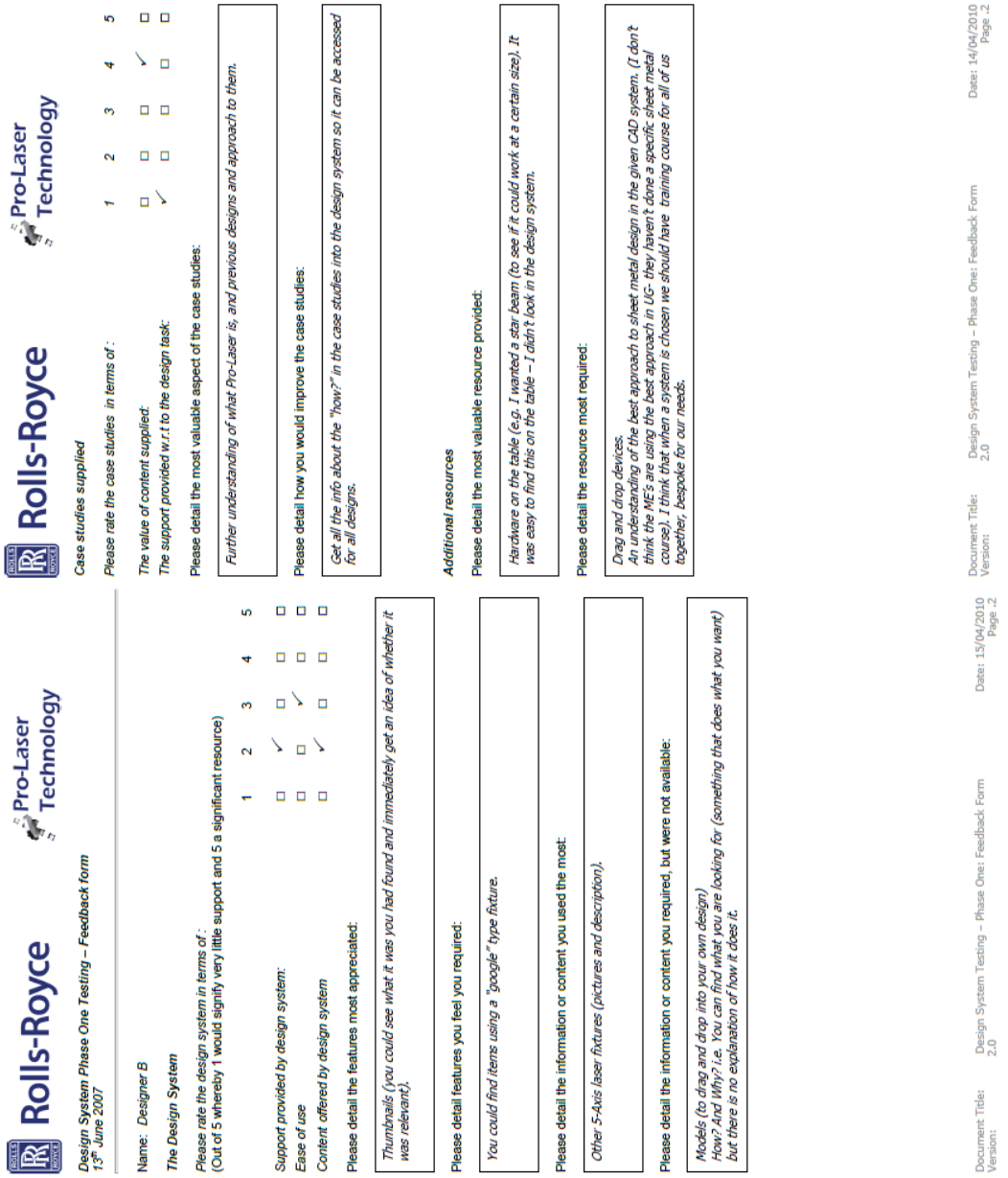
Please comment on your experiences from the week:

Really enjoyed working in a more free thinking, positive part of Rolls-Royce.

Please comment on how you would improve the week:

Closing session needs bit more work.

Designer B



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Design System Phase One Testing – Feedback form
13th June 2007

Name: *Designer B*

The Design System

Please rate the design system in terms of :
(Out of 5 whereby 1 would signify very little support and 5 a significant resource)

	1	2	3	4	5
Support provided by design system:	□	✓	□	□	□
Ease of use	□	□	✓	□	□
Content offered by design system	□	✓	□	□	□

Please detail the features most appreciated:

Thumbnails (you could see what it was you had found and immediately get an idea of whether it was relevant).

Please detail features you feel you required:

You could find items using a "google" type fixture.

Please detail the information or content you used the most:

Other 5-Axis laser fixtures (pictures and description).

Please detail the information or content you required, but were not available:

Models (to drag and drop into your own design).
How? And Why? i.e. You can find what you are looking for (something that does what you want) but there is no explanation of how it does it.

Document Title: Design System Testing – Phase One: Feedback Form Date: 15/04/2010
Version: 2.0 Page :2

Rolls-Royce

Pro-Laser Technology

Case studies supplied

Please rate the case studies in terms of :

	1	2	3	4	5
The value of content supplied:	□	□	□	✓	□
The support provided w.r.t to the design task:	✓	□	□	□	□

Please detail the most valuable aspect of the case studies:

Further understanding of what Pro-Laser is, and previous designs and approach to them.

Please detail how you would improve the case studies:

Get all the info about the "how?" in the case studies into the design system so it can be accessed for all designs.

Additional resources

Please detail the most valuable resource provided:

Hardware on the table (e.g. I wanted a star beam (to see if it could work at a certain size). It was easy to find this on the table – I didn't look in the design system.

Please detail the resource most required:

Drag and drop devices.
An understanding of the best approach to sheet metal design in the given C4D system. (I don't think the ME's are using the best approach in UG- they haven't done a specific sheet metal course). I think that when a system is chosen we should have training course for all of us together, bespoke for our needs.

Document Title: Design System Testing – Phase One: Feedback Form Date: 14/04/2010
Version: 2.0 Page :2

Rolls-Royce Pro-Laser Technology

Design Task

Please rate the task in terms of:	1	2	3	4	5
Difficulty of task presented:	□	□	□	✓	□
Interest :	□	□	□	✓	□
Degree of step change from previous experience in design:	□	✓	□	□	□

Please detail the most challenging aspect to the design task:

Recognising whether the design would provide required tolerance on final part.
Chasing between option ideas without discussion/peer review stage.

Please detail how you would improve the design task:

Realistic time scale – CAD system meant took longer time, but concepts were generated over relatively short period.
What are we testing? Concept generation? Drawing? Integration to design whilst drawing? All?

Please comment on the time allocated to design:

See above. We could probably have looked at more than one problem if we had stopped at concept generation and tested the rest at a later date.
We may want to do this if this I the bit we want to help with (I don't think we do, but this is the are a we managed to look at most this time)

Please comment on how different designing for Pro-Laser than previous experience:

Easier than expected (once we knew we were limited to sheet metal, it was quite easy to think that way only).

Please detail whether you completed the task and how much time you would have liked to complete the task.

Was distracted by CAD (NX) as was finding it difficult. Therefore the design was not completed. The CAD was needed to identify problems, but would probably have finished if had been using AutoCAD in 2D (Partly due to experience in it).

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Methodology:

Please rate the methodology in terms of:	1	2	3	4	5
Degree of uniqueness:	✓	□	□	□	□
How well defined do you feel it is:	□	✓	□	□	□
How easy it was to follow:	□	□	✓	□	□

Please add any additional comments on the methodology you feel are relevant, in particular if you answered 1 or 2 for any of the above please detail why:

Not enough emphasis on stability/ equilibrium / looking at loads and accuracy (tolerances etc.).
Prioritising mandatory requirements according to importance was both impossible and pointless (by difficulty however, was more relevant).

Experience

Please comment on your experiences from the week:

Enlightening!

Please comment on how you would improve the week:

Everything a little more crisp and well defined (training and set up for the week). (As expected as this was the first go).

Rolls-Royce Pro-Laser Technology

Design System Phase One Testing – Feedback form
13th June 2007

Name: *Designer C*

The Design System

Please rate the design system in terms of :
(Out of 5 whereby 1 would signify very little support and 5 a significant resource)

	1	2	3	4	5
Support provided by design system:	□	✓	□	□	□
Ease of use	□	✓	□	□	□
Content offered by design system	□	□	✓	□	□

Please detail the features most appreciated:

Pictures of previous designs are very useful.

Please detail features you feel you required:

Drawings of features and mechanisms.

Please detail the information or content you used the most:

Pictures

Please detail the information or content you required, but were not available:

Rolls-Royce Pro-Laser Technology

Case studies supplied

Please rate the case studies in terms of :	1	2	3	4	5
The value of content supplied:	□	□	□	✓	□
The support provided w.r.t to the design task:	□	□	□	✓	□

Please detail the most valuable aspect of the case studies:

Good simple part with enough variety to give multiple solutions.

Please detail how you would improve the case studies:

Find out what the welding requirements are (Two hemispheres).
Provide load data on the laser head (Gas loads).

Additional resources

Please detail the most valuable resource provided:

Jeff Bishop

Please detail the resource most required:

Rolls-Royce Pro-Laser Technology

Design Task

Please rate the task in terms of:	*1*	*2*	*3*	*4*	*5*
Difficulty of task presented:	☐	☐	☐	✓	☐
Interest :	☐	☐	☐	✓	☐
Degree of step change from previous experience in design:	☐	☐	☐	✓	☐

Please detail the most challenging aspect to the design task:

The balance between holding the piece with inadequate surfaces and cutting continuously, or holding on better surfaces and damaging the fixture

Please detail how you would improve the design task:

Don't use UG. [Unigraphics]

Please comment on the time allocated to design:

Adequate if you don't try and design too many versions.

Please comment on how different designing for Pro-Laser than previous experience:

No different to current practises.

Please detail whether you completed the task and how much time you would have liked to complete the task.

Completed with the exception of adding features and creating drawings.

Rolls-Royce Pro-Laser Technology

Methodology:

Please rate the methodology in terms of:	*1*	*2*	*3*	*4*	*5*
Degree of uniqueness:	☐	☐	✓	☐	☐
How well defined do you feel it is:	☐	☐	✓	☐	☐
How easy it was to follow:	☐	☐	✓	☐	☐

Please add any additional comments on the methodology you feel are relevant, in particular if you answered 1 or 2 for any of the above please detail why:

Decision making process, i.e. selecting the best option – need peer review?

Experience

Please comment on your experiences from the week:

I enjoyed the week, but battling with UG is not fun.

Please comment on how you would improve the week:

If possible have two studies, one where the study is taken thoughts to the concept stage and then peer reviewed, followed by another study learning from the above review.

Structured Interviews

Manager M:

Start @ 000

What do you feel are the main aims and objectives of capturing and storing knowledge?

They are twofold, to firstly ensure that the business as it develops is not reliant on too many technical specialists so we are dependent on having knowledge within a system rather than having knowledge embedded within specialists.

The second reason would be to continuously reduce the time it takes to develop similar solutions and also reduce the time it takes to develop new solutions by finding out key lessons learnt from previous projects.

[Business Reliance, Reduce Time, +Lessons learnt]

Do you feel that the Design System supports these aims and objectives?

I think the infrastructure supports the aims and objects absolutely, the infrastructure does, I think there are examples of information and knowledge in there that do support those objectives but it is not comprehensive enough across a full range of projects that are in the system, the information is not rich enough to satisfy those objectives and the awareness of the existing information is not strong enough across the group.

[Poorly Populated]

Do you feel there has been enough guidance given to staff on how to use the system?

Yes. I think we need to have another attempt at describing to them the other routes that they can use to capture their day to day experience and knowledge rather than relying on the predefined prescribed fields in the database, there are other means that we can use to load and retain information and knowledge and they perhaps need some more guidance and freedom to do that kind of activity.

[Poor Detail]

Can you give me an example?

Let me just think of the best example that I can give. On the 434 project there is some key knowledge on laser machining precision parts that we learnt from the 434 project and that required the use of diagrams and schematics that could have and should have been easily developed within a PowerPoint slide and supplied as an attachment to the design system, just using the fields and using a verbal description wouldn't be good enough to actually make that useful for others and it tripped us up because we've just recently found this characteristic in another high precision machining job and if we had been able to refer to a simple schematic in the system it could have saved us some time.

[Resentment of Current Practice, Poor Usage]

How often have you accessed the system?

As a program manager I access it not daily, I would access it on a weekly basis. There's never any one week when I don't access it.

How long did you typically spend using the system?

15 minutes, maybe 10/15 minutes in a session.

[High Freq, Low Depth]

Was that getting knowledge in or out?

Primarily in.

When you do get knowledge out, what was the knowledge sought?

Usually pictures, usually visual representation of a previous design, whether that is a photograph, CAD render or geometry.

[+Visual Representation]

What information and knowledge do you feel is most important to supporting the business, and its functions?

To me its lessons learnt, it's the technical lessons learnt and the articulation of those lessons learnt into best practice guides.

[+Lessons Learnt]

Do you feel the Design System captures this knowledge?

Not at the moment. Not comprehensively enough across the projects.

[Poor Population]

Do feel some projects capture this knowledge?

Some, but nowhere near enough.

Where do you believe the major bottlenecks occur during the design and manufacturing process?

In the design and make?

Yes.

Geometry creation, lack of commitment to our quality system and lack of recognition that the quality system can speed up things by reducing errors.

[Poor working practices]

How well you feel the Design System integrates with your existing workflow?

I think it has the infrastructure and the means to integrate very well, but the designers don't treat it as a, they don't treat it as a systematic point that they should be accessing on a regular basis, it should be part of their start of, lunch time and close of play activity as it is with any plm type environment . The example in case right now, we have just completed a physical trial downstairs, there is a key point of learning in the trial, the engineer should be opening up the design system entry and writing one or two lines, probably one line recording the finding. Not worrying about any detail on it, just recording the finding we've had and I don't believe that happens because they don't systematically see it as the route to recording these lessons.

[Incorrect User Perception, Poor Usage]

Has the system provided tangible benefits to your design and manufacturing activities?

Yes.

How?

I believe it has been a significant factor in attracting potential joint venture partners. I believe it has been a significant means to demonstrate to the wider senior stakeholders in the company that we have attempted to transfer people based knowledge to a system. That's all I can actually say to be honest.

[Business Image]

What effect has the use of the system had on designers' workflow and activities?

Yes. Absolutely, it impacts the type of information whether that's photographs, screenshot or cad geometry that they create. I think it levers the generation of additional information that would not otherwise be produced on one off projects.

[Facilitates Knowledge Generation]

Has the system been able to save you or the business time?

Currently I don't think it has with the current population, no. That's not through any fault with the system. It's through the fact that there is not the systematic accessing and usage of the system on a daily basis.

[Resentment of Current Practice, Poor Usage]

Do you feel the benefits of the system are worth the cost of documenting work?

100% Absolutely, if it takes an extra – where the business is at the moment – if it takes an extra 20% on a job, if it takes an extra 30% on a job to complete the information to a level where it can guarantee tangible benefits then absolutely yes it's worth the effort.

[Cost effective]

What has been the most valuable function or aspect of the Design System and why?

I think the most valuable aspect is demonstrating that we have transferred, recorded a vast amount of information from technical experts and that we have a robust infrastructure that can be

developed and used as we move forward into the Joint Venture. I think also that the awareness, the consciousness that the system develops that there is a single funnel and single guide for all the information is a positive thing for the group as a whole. I don't think anybody disagrees that it's the wrong thing to be doing.

[Business image, +Collective motivation]

The system wasn't used much prior to this summer, why do you think that is?

I think primarily, twofold, primarily a desire for our engineers and our designers to get the project delivered and move to the next job with an awareness that they are trying to do things as quickly as possible because that's what ProLaser tends to demonstrate. But probably of equal priority it didn't have the necessary pressure or influence from anybody in the business, or the focus or the priority set on it.

[Job desire, Lack of manager pressure]

Moving forward with the system: How would you improve it?

It needs a better more intuitive means to act as a log, more of an informal basis for logging. It maybe appears too rigid to our engineers, it needs something to encourage them, in the way that I described in the previous example, to routinely just use it as a bit of a logbook, as a technical logbook, but not at the expense that that log in its fairly unstructured way is then not managed into a structured input into the system.

We've created a lessons learnt at the end of the entry and that is maybe wrong, because there are lessons learnt all the way through that project, design and manufacture wise. It perhaps needs a slightly better way of managing and helping engineers control file names, it is a little bit clunky in terms of when you upload files deciding how they are named and one of the most valuable parts of the system that I thought we would have used much more, was the summary sheet and the ability to print out that summary sheet and park that in the project folder at the front which gives a straight eyeball of where the project is and I think we need to somehow understand how we can make more use of that and see more benefit of the system ability to summarise on a page and quickly print to pdf, I'm really surprised we have not made more use of that.

[Different emphasis required, Better interface required]

How would you encourage its use?

There are lots of tactics that I have used so far and I think that the group based encouragement as a team, let's make sure we improve our access and population of the system, doesn't and isn't working as far as I can see. I think with the small number of people that we've got at the moment it's going to be a more one to one directive from me in terms of what I expect them to do and my oversight of that activity and I've already started to plan this and make it clear to them that on a fairly regular basis I want to be going in and I want someone else to be going in on my behalf and providing that secondary oversight level of the information that's going in and again it's going to be formally positioned as an objective. So I think in answer to the question is more of a positive directive from myself rather than a gentle "please use the system", this is going to have to be part of their objectives and they will be monitored on that. A much more firmer approach to what they do.

[Group motivation, Manager pressure, Authority required]

How do you feel the system will influence or affect the growth of the business?

I think it has huge potential to easily demonstrate someone the scalability of the business. I think at the moment we only have a single instance of the design system on one server and I think we have a system is not rich enough in terms of the information in there. But the way in which the information is presented, stored and recorded its very easy to see that as a scalable deployable system either across a uk base or across a global base and I think it's just so easy to visualize that. So I think that's one way in which it supports the growth, the other way in which it supports the growth is got to be the re-use of the information in the system and we know, although I have cited the fact that I don't believe it's giving us real tangible benefits, the flip side to that I do know that there is information in there that if we just used and accessed and built upon it more systematically it would easily give those tangible benefits. I think it would be a good means for the JV partner to come in and test and understand if there is good information in there that could help with growth.

[Business image, Design re-use, Poorly populated]

How do you feel the business will utilise or leverage knowledge long term?
What do you mean by that?
So, you've cited that we would use past products and lessons learnt, long term as we become a more stable business and we retain more staff, so we don't have a lot of new starters, do you think feel we will still be leveraging our knowledge in the same way the
I think it will be more biased towards the geometry creation side of things and I think the system will be more focused on the techniques and the improvements and the lessons learnt on how to rapidly create geometry. I think it will make more use of parameterized models and I think, it will and it should provide a simpler gate way to the CAD tool and that's always what we always envision, the system being an integrated part of the cad tool and I think it should be an easier gateway to that.
[Different emphasis, Geometry focus]

End @ 310

Designer A:

Start @ 000

What do you feel are the main aims and objectives of capturing and storing knowledge?
So that we have a centre point from which other people can obtain that knowledge without having to go to one particular specialist to get that knowledge. In terms of the joint venture and the future of Pro-laser the idea is that it should help with up-scaling the business.
[+Business growth, Minimise expert reliance, +Central store of information]

Do you feel that the Design System supports these aims and objectives?
Yes I think a great deal of information is in there if you want to go and find it.
Do you feel you have been given enough guidance on how to use the system?
Yes I think if there is any issue I have I would ask and I haven't needed to ask, so therefore I think I have been given enough.
How would you improve this?
Well we have grown up with it to some extent, so we've learned about it as things have changed, so I'm not sure what the situation would be for someone coming in such as Designer E, whether he gets enough guidance as we've got guidance as we've gone along, where as he's in a different position and will need some sort of definite guidance.
How often do you access the system, and how long do you typically spend using the system?
I've probably only accessed it half a dozen times I suppose really, in earnest searching for something and when I have I've probably spent 20 – 30 minutes.
[Infrequent, Average depth]

What was the knowledge you sought?
Quite a bit about the OGV's at the point of handover. A bit about press tools and other bits of odd projects.
[+Project specific]

Any specific knowledge?
Generally, trying to find out how something was done, why it was done, why it was done that way and if there were any specific details and if there was any particular reason why the technical expert chose to do it in one particular way rather than another, and subtle little differences.
What information and knowledge do you need the most when working and working on a project?
Probably the first most important, which is really the design system issue, is the specification on what you've got to do. I suppose that comes into the design system in that that is an input into the design system.
[+Specification knowledge]

What about the most valuable knowledge relevant to your work?
Well past examples of things that are similar to give you an idea of how it's have been done before. I've always found valuable. The more detail you have about the problems that were encountered whatever it was when it was done before.
[Previous rationale, Previous design knowledge]

Where do you believe the major bottlenecks occur during the design and manufacturing process?
I think our bottleneck is still design resource, actually doing a design, getting the drawings done.
But for you on a single project, where do you find the main bottleneck is?
Well we can manufacture things fairly rapidly, and rarely is the laser taken up and the press brake is certainly not taken up. The Manufacturing Engineer is sometimes not free - if you need to use Him - but that really doesn't stop you from getting things made, and there is no sort of bottleneck in terms of me personally doing design work other than my time.

[Restricted design time]

How well you feel the Design System integrates with your existing workflow?
It's still a bit separate. It might be, that I've not got used to using it. Because I suspect that if I get used to using it more, it won't be so separate. I've tried to try and use it from my desk, rather than always thinking you've always got to go to the design system itself. Certainly just to drop or save a file into a directory, in a file structure perhaps feels more easy than uploading it to something and then having to save it out again if you want it. It still feels a bit like a repository, for things after the event than something you work with alongside.

[Perception of system as archive, Not concurrent with system]

Has the system provided tangible benefits to your design and manufacturing activities?
I'm slightly strange in that I've been working on the 434 project, so it's been one long project. So the number of times I've needed to reference it for that has been limited, but in the little bit of project work I have done it has been of some value in that you can look up similar projects.
How has the system provided these benefits?
Well going back to the OGV's there was lots of information in there that I had not been aware of and had I not had access to it through design system I wouldn't have. So in that case it was invaluable.

[Project specific]

But how did the actual knowledge help you?
Well I sort of wrote down a set of design rules for the first set of OGV's so those design rules were gathered from what I knew, from what I'd spoken to The technical expert about and what was in the design system and I sort of pulled it all together, that worked to help Designer B do the first set, the second set was different and we didn't realise that they were that significantly different until we found it didn't work, but certainly it was very helpful having that information and I also think Designer B went in and looked at the same sort of set of information.

[Supplementing knowledge, Initial understanding]

What effect has the use of the system had on your workflow?
I think it probably focuses you a little bit more on trying to get a very precise specification at the beginning of the project so that you can fill out the first section, rather than just getting on with the job and realising you've missed something later it focuses you attention to think, "well I need to fill that in so I need to get all the information I need"

[Focus, clarify]

When during the design process do you find you use the Design System the most?
It's probably, the beginning and the end, so it's the beginning to set up the spec and the end its more of a repository to put everything in at the end.
Has the system been able to save you time, for example suggesting ideas or helping to avoid mistakes?
If I'm honest I can't say it's really saved me much time, because I've not used it for the 434 project that much, but I'm pretty sure when I get started on some other projects and I'm looking for a bit of inspiration it will.
Do you feel the benefits of the system are worth the effort of documenting your work?
Yes, well I think we should be doing that anyway, it's a fact the work should be done and it should go in there, it shouldn't be an issue really.

[Should be done]

What has been the most valuable function or aspect of the Design System and why?

I think that, any method of storing and organising all the information and data we generate is going to be of value, even if it's not a design system whatever method you have it would be of value. But in the design system it's a much more organised and structured way of doing it.

[Organises and structures knowledge]

The system wasn't used much prior to this summer, why do you think that is?
Well we had a long period when we didn't have it there was a period when it was out of commission.
Yes, but we have had it in here since October, so from the period from October to June, why do you think it wasn't used?
Well we needed a kick, to get us started and recognise it was back and we should be doing it, having got out of the habit.

[Routine, Authority]

We still have a large number of projects, dating back prior to June that haven't been entered. Why do you think that is and is there a way we can encourage that?
From my personal position, with the 434 project there was a lot of pressure to get allot of the stuff made and done and therefore time was of the utmost importance and I sort of knew what I was doing and I just needed to get on with it, so allot of things didn't get done that should have been done and entry into the design system was one of them. I had the view that I would catch it up at the end and have a period where I got everything entered. It's not going to be as easy to do that as I thought, so I am of the view now that you do need it as you go along, but I still will try and get that information in.

[Time pressure]

So how would you improve it for other people, say if you were managing the system?
I'm not sure how you can force people to into doing it, it's just got to become part of what you think is involved of the job, it should become part of the job, as opposed to something that is an extra add on.

[Part of the job]

Would you recommend a new Chief Executive to continue using the system and why?
I would recommend using it and I think the more we use it the more it will integrate into our daily life and it won't become a separate task.

[Increase usage and integration, Reap and sow]

End @ 253

Designer B:

Start @ 000

What do you feel are the main aims and objectives of capturing and storing knowledge?
I believe that capturing knowledge will enable us to re-use that knowledge in the future and speed up our design process and our manufacturing process. And not make the same mistakes in the past. And also enable new starters to have a faster learning curve than I did.

[Speed up Design, Avoid Mistakes, Support New Starters]

Do you feel that the Design System supports these aims and objectives?
Yes it does support that. But it requires us to populate it and that's where it falls down.

[+Support, Poorly Populated]

Do you feel you have been given enough guidance on how to use the system?
Yes. It's pretty self explanatory in terms of the fields we've got to populate and what we have to populate it with. And I'll go back to the previous comment that we need to spend more time populating it.
How often do you access the system, and how long do you typically spend using the system?

Fits and spurts. Basically I think that the pressures of the job at the moment require us to get fixtures out to customers due to time scales, so when there is a lull I will access it and populate it.
It depends on how many projects I need to upload.
Per project, for a medium complexity stranger, I would say half a day. The reason I say that is, one thing I have found with that is that you want to make it as clear as possible for any user to pick up and then use. Because you have been so involved with the project, a. you start writing it and then come back to it 10 minutes later, and you re-read what you have written and you think, "no one will understand that but I perfectly understand it". You need to put it into as clear as English as possible, where my English is poor and that's what's causing it in the first place, or lack of clarity of thinking in the first place.

[-Job Pressure, Knowledge In, Need Detail, Low frequency High Duration]

What was the knowledge you sought?
I have accessed it. I can't remember what it was for, but it was for some of the design guiding documents rather than a specific project, and a few projects I accessed for TBC when I first started, kicking those off but I feel I have developed those into something new now and probably won't go back to the original documents.

[Initial Understanding]

What information and knowledge do you need the most when working and working on a project?
I suppose it depends on what stage your lifecycle is in terms of your employment at Pro-Laser. I think as a new starter, you access that design system left right and centre. However, I have been working at Pro-Laser for two years and I know a lot of the dos and don'ts in terms of design and manufacture I know what to do. That's my tacit knowledge rather than explicit that I need to reference every time I do a fixture design. For a new start though that information only comes across by reading it from a design system or from communication with a fellow colleague.

[Self Belief, For new starter]

You would then, tend to need information very project specific like the requirements, like the initial geometry for the project?
Yes.
And do you feel that the design system does capture that. So if you did a project with the same requirements we could utilize that.
At the moment, probably 50:50. I'm looking at the Gas Shields. Designer A produced a document that said how to design Gas Shields, but generally it gave you a very good overview, but didn't give you the nitty gritty the finer detail of what you had actually physically had to do and the problems you had to be aware of and just to get a few basic geometry, it was relatively straight forward, but then detailing that basic geometry up, it didn't scratch the surface. But that's not to say in the future, we will, as part of lessons learnt from the Gas Shields project that we won't populate that just do that and so for new starters.

[-Lack of Detail]

Where do you believe the major bottlenecks occur during the design and manufacturing process?
The major bottlenecks are receiving clear requirements from the customer, some concept definition and then the biggest bottleneck is the detail work, i.e. putting all your joining features and then flat patterning as well.

[Customer Interaction, Design Work]

How well you feel the Design System integrates with your existing workflow?
Yea. I think it certainly integrates well. I think if it was on a separate system and in a separate building, then you know. It's quick access, it doesn't take long to find the information you want and I think the work we are proposing in 2010, to do that, the improvements for that will just enhance that workflow.

[+Well Integrated]

Has the system provided tangible benefits to your design and manufacturing activities?
Yes. I think it has allowed me to access knowledge which would probably have been locked up inside The technical expert's head. And other people's heads. If it wasn't in the design system or a knowledge capture system I would have probably made a lot mistakes and lost a lot of time.

[+Tangible Banefits, Avoided Mistakes]

When during the design process do you find you use the Design System the most?
It's usually at the beginning. Then maybe, on rare occasions, maybe halfway through just to make sure what I am designing is still akin to what's on the design system.

[Beginning]

Do you feel the benefits of the system are worth the effort of documenting your work?
Definitely.
What has been the most valuable function or aspect of the Design System and why?
I think the most valuable thing is just having that ready source of information when your colleagues are out, you can access that information and quickly gain an understanding of the lessons learnt they went through.

[+Lessons Learnt]

The system wasn't used much prior to this summer, why do you think that is?
Yes. That's when I put allot in. I think it's primarily driven by customer deliveries. I think we as a business we are still underestimating, how long things take to design. Manufacturing, I think we have a good handle on that now, but the design side of things. It's still taking us too long to design things I think, well we haven't got the systems in place to automate allot of the repetitive tasks that we need. And that's one of the reasons why we don't populate the design system is because we are being driven by customers and then before you know it, once you get one job out the door it's on to the next.

[-Customer Pressure, Design time too long]

If you were managing the use of the system, how would you improve it? How would you encourage its use?
I would allow, get a group owner, someone like Designer A or Manager M to review, the data entry after a month. After say a month has gone by after the project delivery, to the customer, you have one month or a few weeks to populate the design system and then you will sit down with the manager to review that data entry and I think that will force people to populate it and populate it well.

[Needs Group Owner, Needs Leader, Operate Reviews]

How else would you ensure knowledge is stored and utilised?
I think with Steven's plans for doing a pro-laser handbook, I think that will be an incredibly useful asset to us. At the end of the day, there are things that are captured by the design system but there are some things that aren't and hopefully if I want to know something specifically like how to program a lasers and things like avoid small rads, I've never seen that written down really it's the tacit knowledge that each of us has. Which is passed on person to person verbally, rather than if someone can read this 500 page booklet, that will be an all encompassing design guide, manufacturing guide, assembly guide it will be an excellent asset to the design system.
I think that will put allot of the design systems knowledge into context, why people have done it, rather than just saying "I've done this because of this, this and this"

[Need context, Needs overall guide, Handbook]

End @ 222

Designer C:

Start @ 000

What do you feel are the main aims and objectives of capturing and storing knowledge?

To have an ability to log the work that we do and also transfer, knowledge transfer basically, any job we make and produce the main objective e is to allow other users and designers to access the work we've done and gain knowledge from it so they can produce fixtures.

[Archive work, Repeat products, Design Re-use]

Do you feel that the Design System supports these aims and objectives?

Yes and no, I think it's good for, I mean it's quiet hard for me at this stage as the majority of fixtures I have done are quite unique. Whereby there has not been a specific type of fixture for a specific part, so each one has been pretty different, most of them have been pretty new, so I generally have not used it for accessing knowledge as I have been starting off new projects, or for example on the splitter projects, I've really been the only person who has worked on these projects for the T1000, so because I know it, I know all the background and the nitty gritty behind it I've relied on my own experience for those group of parts.

[Self-belief, Neutral, Not-used much]

Do you feel you have been given enough guidance on how to use the system?

Yes.

How often do you access the system, and how long do you typically spend using the system?

Generally, I tend to access it for knowledge input, for inputting knowledge on fixtures and stuff I have just completed. There has been occasionally, occasionally I have a had a quick look for gaining knowledge on other fixtures and other approaches, but the vast majority for me has been inputting data on the fixtures I have just completed.

[+Knowledge Input, Low Frequency, Low Depth]

What information and knowledge do you need the most when working and working on a project?

Fundamental things I would want before starting a project are, all the definitions for the part that we are required to make, or design a tool for and the machine that it's going to be used on, or the data for that.

[Lacking Knowledge, Specification Knowledge]

Do you feel the Design System captures this knowledge?

I.e. the tool, the information about the machine being used? Well no not really. It's not something I've put in. It's something I could put in, but it's not something I've really thought about. I've always thought about, I guess I've always been focused on the fixture as opposed to the other things that surround it.

[-Project specific knowledge]

Where do you believe the major bottlenecks occur during the design and manufacturing process?

For me, it would be, allot of the fixtures or most fixtures we do have mechanisms in them like clamps and work holding clamping devices, they are something that you need to spend quite a bit of time just working out, making sure they work on paper, then transferring that into a design and just getting all the rationale behind the design of the over centre clamp, that generally is one of the most time consuming things just getting the detail bits of the design.

[Design Detail]

How well you feel the Design System integrates with your existing workflow?

As I use it currently, I think it's fantastic to be able to at the end of a project write down and consolidate your thoughts and how you went around designing this fixture because it's something you don't generally do, if you're not asked to, you just pick the next job up and it's forgot about. So

that, I enjoy doing that, you get the benefits just yourself, more than potential users that might be looking at it in the future. It's just nice to see all the data and issues.

[Not integrated, Archive function, Benefit of self documenting]

Has the system provided tangible benefits to your design and manufacturing activities?
Yes. Most of my projects have been so varied, I've not really gone back to previous projects I've done because they have been so varied. I guess, the things that I'm always interested in is the more technical things, like the clamps, they are the kind of tings I like to refer to because I know how they work, I know they did or didn't work. I like to be able refer to those things, for me those are the most important things to see, whether you can get all that information from it as it stands. I reckon it could be improved in that respect.

[-High variety, Low benefit]

In what way?
Because the design system treats the fixture as a whole, as a finished article, it can be a bit overwhelming, not misleading, but overwhelming for any designer especially someone who hasn't designed it to look at an overview of a fixture because there is lot going on, there are some fixtures that are relatively simple that you can work it out straight away from a few pictures. But the more complex ones with different devices, different work holding techniques, different bits of automation which are not obvious. They are the bits that I want to be able to see and understand and capture. I and I think most designers, don't, The technical expert always says this, don't think about the end results, try and get to it solving lots of little problems and that's an approach everyone, most people take, you think "right how am I going to hold this part, how am I going to locate it in the right position, "how am I going to make sure the structure is not wobbling everywhere, how am I cope with all the heat that's generated?" Those are like the fundamental things that, a designer or certainly I, will think of first and to see a fixture as a whole doesn't answer those questions. It could do, but I just think on the system you are forced to describe about the fundamental things like work holding positioning, structural integrity, and how you have tackled these issues.

[Lacking Detail, Forced Input, Constrictive Input]

So are all these things fundamental to all our fixtures?
I think so, certainly work holding, I can't imagine any instance, where work holding is not an issue, because that's what you are always doing, fixtures are for holding the part for an operation. So those fundamental things are I think are key for understanding, it gives you a bit of a background of what's possible, what can be done, what can be used for the new fixture you are designing.
There are the things that I specifically want to know. A few days ago, it was a very simple over centre clamp that we were designing, Designer D asked me, he wanted some help designing it, and we both must have scratched our heads for easily half an hour or an hour, thinking how does this work, just the detail, how many degrees do we want to go over centre, those bits, even though i have done millions before, it takes time to get your head into it. And just sort of model it in your head, and just capturing that kind of knowledge is the key for me I think.

[Missing knowledge, Need fundamental features, Lacking Detail]

Has the system been able to save you time, for example suggesting ideas or helping to avoid mistakes?
That's hard to say again really, I just keep coming back to all the different projects that I have been doing. I can't say at this stage that with the amount of varied fixtures I have done, but, yea, what it is doing is archiving all my information and images, thoughts.

[+Archiving, +Reflection]

Do you feel the benefits of the system are worth the effort of documenting your work?
Oh yes, definitely because I have tried to be as honest as possible, even if stuff doesn't work or is bad I want to make a note of 'don't do this again' hopefully next time when I do something similar I will

read don't do this or this didn't work well, that's as important or more important than some of the pictures. In that respect yes I think it's valuable.

[Benefit to self, Avoid repeat problems]

What has been the most valuable function or aspect of the Design System and why?
To me it's a kind of lessons learnt, for me it is, it's quite easy to get distracted by nice pictures, but the actual things that worked well, things that didn't and the rationale behind why I wanted to pick this part up in three parts or whatever or why I wanted to pick it up in more than three points, just explaining those things, for me is the most useful thing. It just helps. Pictures show a nice overview but it's the detail, the more technical detail for me is key.

[+Rationale, -Pictures only an Overview]

The system wasn't used much prior to this summer, why do you think that is?
Probably a bit of it is discipline, maybe it was relatively new and people just saw it as an extra thing they needed to do. I don't think it's any fault of the system, it's more the way people work I think. For me its discipline, I'm very disorganised and it's just getting into a routine and now, every project I've done, even the composite fan blade, is on there. It's just getting into the pattern of doing it really. And I've certainly done it at the end of each project, I always make sure it's on there.

[Lack of discipline, -Extra work, Need routine]

How would you encourage its use?
Probably similar to the way I was a few months ago, the discipline. I think you become more conscious that there's a lot of stuff you've learnt during the project that nobody will find out about unless you write it down. And the more you do it, the more you realise people won't ever get it from the fixture, just explaining your fixture is quite important to me. I think if they were aware of all the things they'd learnt and were asked to write it down they would realise they're quite an expert now and would realise its probably quite important that they should get it down.

[Discipline, Iteration, Reap and Sow]

Would you recommend a new Chief Executive to continue using the system and why?
Yes. I think, there are some changes that maybe I would want to do, or put more emphasis on particular areas, like the technical and the basic principles of the fixture design. But I think, there would be allot of information lost if we didn't log what we logging at the moment, especially stuff like time spent on the job. That's one we are so quick to estimate how long a job should take, always get it wrong, then at the end when asked how many hours did you spend building etc. it and you start putting some real honest answers in it which makes you think well, that's how long it took therefore the next one I should be looking at these kind of figures unless there are some comments saying we messed up, like, we cut it out of the wrong material. I think there is a lot of useful information in there, which any business is going to need.

[Necessary, Avoid Knowledge Loss, +Time Pressure, Business Need]

When during the design process do you find you use the Design System the most?
I'd probably want to go to it straight away, if I was doing another similar job and it's been some time, because you assume you remember everything from the last 6 months, and you sort of remember all the bits that went well, and not. But, if it's been sometime, and I was going back to a project, I'd look at it straight away to see if there were some subtleties that I forgot about, so initially straight away I'd want an overview, of what we did, and what went well and what went wrong. So, right at the start and right at the end to write up.

[Beginning and End, Repeat fixture, Self benefit]

End @ 259

Designer D:

Start @ 000

What do you feel are the main aims and objectives of capturing and storing knowledge?
To inform the design process of other engineers based on lessons learnt, based practices acquired, in a safe timely and economic way.

[Support Other Designers, Design Process]

Do you feel that the Design System supports these aims and objectives?
I think that it does very well as a database of past tasks, but I worry that I am not able to search by solutions to small design decisions which maybe hidden within a larger project such as joining technique or maybe or even something like gas flow, particularly with the project I'm doing at the moment just very simple concepts rather than overall designs.

[-Database Only, Lacking Detail, -Fundamental Features]

Do you feel you have been given enough guidance on how to use the system?
Yes. As I explained, because I haven't used it very often, I'm going to have to go back and populate it at length and that will reinforce the training and I will feel a little more comfortable with it.
Would you improve the training at all?
No, everything seemed quite all right. When I was accessing it, it was the limited search functionality I was worried about. You can find things that are similar if you know what you are looking for, but you can't put in "hinge, titanium mounting to stainless steel" for example.

[Limited Search]

How often do you access the system, and how long do you typically spend using the system?
I think about two or three times.
When I first started the project, about an hour, looking through some videos and technical documents that were attached to the gas shield project 435, I reviewed a large part of the video interview with the technical expert and other documents.

[Low Frequency, High Depth, +Videos, Project Specific use]

What was the knowledge you sought?
What I wanted to do was to try and find out the reasons why everything had been selected or done. Quite often things that seem quite an arbitrary figure or a very particular way of doing something, it's not immediately apparent why it's been chosen sometimes it's been chosen because of discussions with operators, sometimes I think some of that operator feedback is missing. That's not a criticism of the Design System itself, but maybe how we use it.

[Rationale, Lacking feedback, Poor usage]

The feedback system you mean?
Yes the feedback form is hardly ever chased up because of the short lead time on the next task.

[Poor feedback]

What information and knowledge do you need the most when working and working on a project?
I want to know if someone has done something clever which I can steal for the new design.

[Improve new design, Self benefit]

Do you feel the Design System captures this knowledge?
Overall, on a high level yes. On a small level, just things like, its concepts, the small advances in a design on each project and there might be something really relevant on a project which is completely irrelevant.

[+Cross project benefits]

Where do you believe the major bottlenecks occur during the design and manufacturing process?
For me, purchasing seems a little clunky. So say I make a decision today that I want to use 2.5 material, it's going to be a long time until I can use that material compared to the fluidity of the design and manufacturing we have. It's almost like some kind of material and fixings requirement should be logged and provided to The Manufacturing Engineer early on. The other day Designer B had to pop out to buy some bolts and at £55 per hour, they are some expensive bolts.

[-Purchasing]

How well you feel the Design System integrates with your existing workflow?
It's quite separate for me, because I am making micro decisions, rather than huge sweeping decisions. Once I've used it for an overall design strategy, I then don't return to the system, I usually go to colleagues and the technical specialist, to see if they can inform me on the small parts of the design.

[Poorly integrated, Design detail, Beginning, Colleagues for Detail]

Has the system provided tangible benefits to your design and manufacturing activities?
Yes. Certainly and especially, for example, yesterday I was talking to Designer C about a particular project and there was an example on the design system of a similar solution and he was able to pull it up and show me several photos very quickly - that just doesn't happen in a usual design office. You can describe it and you could pull up the number of the drawing.

[Facilitates Discussion, +CAD access]

What effect did the knowledge have?
It turned what would have been a very airy fairly discussion about how it worked and a rough sketch into a solid understanding of what was produced before in minutes.

[Improved Understanding]

What effect has the use of the system had on your workflow?
I think it's given me a definite start point. So the first thing to be done on any project is to go to it and review it. Like a technical library.

[Beginning, Review, Initial Understanding]

Has the system been able to save you time, for example suggesting ideas or helping to avoid mistakes?
Yes. See previous answer! There are a lot of times where discussions between engineers, you can point them in the right direction. The conference room steels some of the systems clout, and that's because we've got a physical library in there of components, and whilst I might be tempted to go to the design system to see projects I can walk through with the engineer that designed it and he can talk to me there.

[Physical Components still better, Colleague Explanation, Assumes Colleague Present]

Do you feel the benefits of the system are worth the effort of documenting your work?
I think that I would, I think there would be more value logging the special design solutions within the job and being able to search on those. If I could, I if was putting those in more people would access them. The thing that I don't think, the interfaces and the dependability's, the engine level project stuff, and responsibility and customer that stuff doesn't really matter to me although I can see other people whom it would matter to, so it is good to populate. But when I am putting it in, I am not imagining that Designer C will use that.

[-Design Detail, Doesn't see value]

Can you imagine other people using it?
Yes maybe or Manager M, it services many different roles and I can see that might be used in a more organisational or managerial position.

[-Not for designers]

The system wasn't used much prior to this summer, why do you think that is?
Well I can only talk from my experience since I have arrived, so to compare it before I arrived is a little difficult. I'd say that it has always been Manager M's intent that we fill it in as soon as we finish project, during a project, to try and capture as much information. Especially he asked me to as, working here for 12 months any discoveries that I make have to be logged, otherwise the value of my contract goes down and it's not an investment any more it's a service.

[Manager driven]

If you were managing the use of the system, how would you improve it?
I'd want to be able to search by solution, design solution, so that joining techniques, rather than having to categorise something as a device, you could have it, categorise it, as an idea, so that you could go to it and say "right I need things to do with, direction of gas, joining dissimilar materials, joining materials of different thicknesses, how have we attached pipe to metal in the past, is there a quick way of producing a particular type of form" These things are very part specific but the ways you might produce may have relevance. I would never think that I could go onto the system and trawl through and find what I need at the moment. As an example, I need to mount some titanium springs onto stainless steel box; I have 0.9 stainless steel and 2 mm titanium and what I need is a way of fixing them together. It's completely not specific, I can't think to myself "right I'll go on the system and look at splitter fixtures or I'll go the system and I'll look at everything with a hinge". Maybe that's my failing I haven't checked, maybe I could go on there and look for devices and look for hinges.

[Poor search function, -Project Orientated]

There is a devices function, but it hasn't been used as much as we had hoped.
Because hinges, there might be hundreds on there, but I just don't know where they are.

[Visibility Issue, Poor search function]

Ok, so there is a visibility issue there then as well. How would you encourage its use?
I would use it more. I don't know whether you can encourage or enforce it use, if it not's as useful as it can be. If a system is only being used for an hour at the start of every project and that's enough and it informs the designer and saves them time. I don't know whether you need to try and improve on that. If you feel it's being underused and there's information that could be valuable information for me to get to but I don't know how to get to it or I'm using the wrong search, maybe it could be training, or say "this is the strategy that you can use to find the information that you want". It could be, you can encourage me to use it in the way we've already spoken about. So that I can go in there and find these solutions rather than specific projects, and sorting by relevance.

[Encourage through benefits, Different strategy]

So you see it very much a search based thing, I was thinking of how to encourage people to put knowledge in.
I think that comes with the information out. If people are using it more often and getting great benefits from it then other people can see the worth, I suppose it's only as useful as the information that's put in, but if you find it difficult to access that information after its in there I suppose you might resent putting it in.

[Reap and Sow]

Would you recommend a new Chief Executive to continue using the system and why?
Yes. It's a very valuable thing at the moment it reminds me more of an encyclopaedia than a quick reference book, you need to know what you are looking for.

[Poor search function]

End @ 248

Designer E:

Start @ 000

What do you feel are the main aims and objectives of capturing and storing knowledge?

Main aims are that you don't have all this skill, expertise and knowledge locked up in someone's head its transferrable and can be shared with the team.

[Business Reliance, Knowledge Sharing]

Do you feel that the Design System supports these aims and objectives?

If it's populated correctly, with my experience on the pipe clip, yes it seems to do that successfully.

[If Populated]

How?

Its broken down into three tabs, the specification, solution and appraisal. It works in the way that I'm used to dealing with a design job. You get a specification, that would be written up into the design folder and you can't picture work without that, the criteria. Its sort of progresses nicely, the way I'm used to tackling a design and validating the design.

[+Process Support]

Do you feel you have been given enough guidance on how to use the system?

I think so, in the way I personally tend to learn is to be shown enough to get me up and running and then I really just need to keep using it and I 'haven't had a problems with it, there are few aspects that needed clarification, to find some documentation stored within it. But it seems very user friendly, a couple of things when you try and read stuff back, the text doesn't wrap in certain fields so you have to drag the corners out but you know its there.

[Yes, Poor Formatting]

How often do you access the system, and how long do you typically spend using the system?

Fairly intermittently I guess. I'm not in the habit yet of accessing the design system, I would say before I did this pipe clip job I didn't access it more than once a week. Maybe because I'm not used to using it I don't I know. I would tend to go off and do the job, and I wouldn't be constantly adding to the design system. In the heat of the moment that's when you need to add stuff because it's clear in your mind. If you don't do that then you will have lost allot of the subtlety of what you are learning. Having done this as a demonstration of the design system, its made it a lot clearer that if you don't use it certainly every day, if you take half an hour everyday to dump photographs on there that need to go on the design system

[Low Frequency, High Depth]

What information and knowledge do you need the most when working and working on a project?

If there are similar products that I am evolving or utilising different aspects of, then I want the geometry, that's the most important thing and I personally would like the geometry in .PRT UG format rather than having to read across from the DWG or DXF files with the unit issues the scaling issues.

[Geometry, Same CAD program]

Do you feel the system captures that?

It has the facility to capture the data, but people have to be rigorous in sticking it on there. When its there I can get to it, bar a little messing about to get the geometry into to UG, it's easy enough to get there.

[Yes, Poor Usage]

Where do you feel the primary bottlenecks are in the design and manufacturing process?
I think dealing with the components after they have been cut, if you don't have the experience or the information isn't on the design system, for example "I'm going to use a M5 bit of bar and I need that to go through a 5mm hole", you can cut that, but I'm discovering at the moment that you need to do some fettling, tweaking of the cut top get it to fit, so its experience really, but its the fact that the information isn't there on the design system. So we maybe need a library, like a limits and fits library for Pro-laser but it's the tidying linishing and de-burring getting the components to fit together.

[-Manufacture Knowledge, Lacking Knowledge]

How well you feel the Design System integrates with your existing workflow?
I think it does. It fits the style I'm used to working with. It just seems to be the way engineers work. You get a specification that's what the customer envisages, what the key points are and you design, that's just the natural way design works.

[Integrates Well]

Has the system provided tangible benefits to your design and manufacturing activities?
Yes because there are, its a library of photographs that have been very useful. It lives or dies on the data input. But when you do find something that has been populated to a reasonable degree, then it's very useful.

[Tangible Benefits, Reap and Sow, Library, +Photographs]

What effect has the use of the system had on your workflow?
I suppose its when you, I've found with the previous pipe clip job, it makes you take stock of the previous pitfalls and benefits that you just couldn't. It may be tempting to think you have an idea of how its going to be achieved, and charge off and try and solve it the way you think. If you are using the design system, you might find that someone already tried things but they weren't necessarily the right way to go.

[Reflection, Avoid Mistakes]

When during the design process do you find you use the Design System the most?
During the very early concept definition prior to starting to model, and also I was constantly referring back to previous drawings as I was modelling in UG.

[Start, Continuously Referring]

Has the system been able to save you time, for example suggesting ideas or helping to avoid mistakes?
No, I think it's taken me longer but then it may have. There were certain pitfalls that were highlighted in the appraisal section in the pipe clip that you did, had I not read that then I may have repeated the same mistakes. The more information search, digging through different documentation adds to the length of time, but I don't think you can afford not to look at them because it could save you a complete iteration of an entire job.

[Slowed Design, Avoided Mistakes]

Do you feel the benefits of the system are worth the effort of documenting your work?
Yes definitely.
What has been the most valuable function or aspect of the Design System and why?
It structures the way you work and knowing that its there and knowing you need to keep it up to date as you go along means you are recording your findings. They are then much more useful to somebody later on, as they are accurate, and you are not trying to remember something a week or two weeks ago if someone comes in asking if you did this, what did you find. It captures it, but it's got to become an habitual thing.

[Improves Workflow, Need to input, Need to be Accurate, Capture part of process]

So how would you improve it for other people, say if you were managing the system?
I think being able to read all of the text without having to drag windows around. I'm sure there are lots of ways to improve it. As I'm using it I need to think about it. It's hard to recall, it's not perfect, but it works.

[-Formatting]

How would you encourage its use?
I don't know, I think people need to discover it, realise the benefits themselves. I get the sense that the designer's mindsets are, "I've got an idea, I'm going to charge off and use it". To say well hang on stop, make them stop and read around the subject I don't know how you get them to do that. Just having someone experience the benefit of having read something.

[Reap and Sow, Authority]

What about the capture? How would you improve that?
It is quite clunky, how you need to load everything individually.

[-Upload]

How else do you think knowledge should be stored and captured, i.e. outside the design system?
Like using tools? Because everything to do with the design should be together, you can't have lots of different receptacles.

[Single Repository]

Firstly, how did you find the actual task?
Its perhaps, it wasn't the most interesting of tasks, but then I haven't done that many projects and the interactive tooling is quite unique, its interesting stuff. But I think I have learned as much from doing this as I have done from the previous three jobs I have done. This is the first time I have used some of the techniques such as the banana springs, the slot rivets, but it has been a very useful task, not just for demonstrating the importance of populating the design system, the information and knowing that for example if it is used correctly the information for other jobs will be there and is useful and can stop you repeating mistakes.

[Learned Lots, Useful, Not interesting]

What were the primary challenges you faced during the task?
I think trying to get the mechanism to be easy to use, yet robust when it's actually in its locked position, trying to use and trying to set the geometry up so that I thought the cam was going to work in the correct way, and deliver the correct amount of displacement. That was harder than I thought. Talking about it now it sounds like it should be easy using the CAD system, but it really was quite tricky. But then the spring I saw in the flesh, that was the first time I had.

[Geometry Generation, CAD Generation]

Overall what were your experiences having used the system specifically to support the redesign of a product.
I felt like I knew – having read the information on the design system - the previous design very well, having not seen the thing in the flesh, I felt that I knew an awful lot about it, the techniques and the sort of things hitherto I thought you would only learn and get from getting hold of it and using it. That was quite a surprise. When you offered me to see it, I didn't need to and I thought it was more useful not to.

[Knew the Design without Geometry, Surprised at level of detail]

What knowledge did you access and use?
I did have a look at some 'How To's' on springs. But I got frustrated, I felt like I had spent allot of time on it up to that point, but I couldn't get the information I hope was on the design system. I read one

how to document but it wasn't really what I was after. It wasn't a spring calculator, it was just talking about crescent springs and giving different examples that the technical expert had done in the past. It wasn't really as explicit as I had hoped, so I didn't dig much further in terms of the guides or how to's.

[Frustrated, Lacking Knowledge]

So I presume you used the knowledge from the specific previous fixture?
Yea, I was dithering at the start of the project trying to, I knew the focus of this was to trial the design system, that was the main emphasis of the job, but I wasn't too sure on the mechanism, the spring and the cam, and having seen every other spring and clamp, none of them seemed to employ this cam idea and I wondered is there a reason for that, I wonder if there is if it was less positive. I dithered a bit about how to approach it. After talking to you on the Monday morning, the best thing to do was to take up the previous design that was on the system, rather than trying to do something completely different.

[Confused by novel approach, Concern over differing knowledge]

What was the main benefit you saw in having access to the previous knowledge?
Well you felt like you weren't starting from scratch. It was there in black and white, why the user felt that it was less than perfect.

[+Not starting from scratch]

Was there any disadvantages?
I suppose there is a tendency to be led by it, and maybe having not seen the cam in a latch before, I would not have gone down that route, had I not seen it reproduced in the previous design and would have looked at the Gas Shields maybe, because they are basically using the latest latch methodology and would have gone a got a physical example. So yes there is a risk you could be led, so maybe it would be worth before you look at previous designs, take the spec and have an hour and just brainstorm and just try and think of all the different ways so you don't discount things that you may have come up. It depends on how suggest able the person doing the design work is.

[Over trust of knowledge, Should combine with Brainstorming]

You mentioned earlier that it helped you avoid pitfalls, can you give any examples?
The shape of the spring certainly one thing, and just being generally aware of the amount of displacement and trying to avoid a large amount of force being put in and maybe that's resulted in, I was so conscious of trying to avoid a mechanism that required a great deal of force to operate that I've ended up with a mechanism isn't really strong enough I don't think.

[Aware of values chosen, Over trust of knowledge, Over focus]

When during the design and manufacture did you access the knowledge?
I don't think I accessed it at all during the manufacture, no that's not true. I accessed it daily, if not every few hours during the design and as an example of looking at it during manufacture, when I saw the springs I designed in the flesh I came upstairs and had another look at the cross section of the spring you had used in yours, and that's when I found the document on spring design that, but didn't really dig much deeper. Just thought well I will put a stake in the ground and I'll use a semi circular spring.

[High frequency, Looked up issues]

How long did you spend searching, accessing and reading the knowledge?
In total I suppose a day easily.
How detailed did you find the knowledge?
Detailed enough, so that I felt I didn't need to look at the physical thing.

[Sufficient Detail]

Did you want more detail?
No I don't think so, I don't think you would want to stifle the freedom of the next person to do the design to limit them, it depends on the person, but I think if it was very detailed, I might get fixated on, if it worked using that again, or if it didn't avoiding them.

[Sufficient Detail, Design Fixation]

Was there anything that you didn't understand and felt that you could have done with more detail to understand?
The questions I found, its' got to fit around a pipe, there were certain aspects that you picked up from the technical expert that you changed and there certain aspects you didn't and I was able to find everything I needed. I mean trying to think of shortfalls, as you said there was an issue of a radius on one of the rails that wasn't in there, but then I hadn't noticed that it was a problem.

[Key point not described]

Was it easy to understand and contextualise the knowledge?
Yes
Do you feel you would have sought knowledge for the task had it not been an exercise?
Honestly I probably wouldn't have done I'd have come and found some physical examples and that would have been my first port of call, I probably would have gone to the design system when I had a problem or I wasn't sure.

[Problem Specific]

Overall, do you feel it would have been quicker to have designed anew or slower?
Oh a lot slower, because I was able to lift allot of bits of geometry that read across like the hinge for example.

[Speed up design, Geometry Re-use]

How easy was it to find the relevant knowledge?
I was able to find the knowledge relating to the specific jobs relatively easy. But in terms of general , 'how do I design a spring' to work with a certain amount of tension or deliver a certain amount of clamping force, I didn't find that at all.

[Solution specific, Not Problem Specific]

Overall how useful was the system?
Very useful.
What would you have done differently?
I think I would have liked to have an hour or so just to come up with ideas without looking at the previous design. It would be interesting to see if there were any similarities or differences, but I think I am quite a suggestible person. I think it would have been interesting to do that. I wonder whether it would have been better to do a two dimensional trial try and pin a couple of profiles to a sheet and just operate the mechanism, but then that's my experience working within pro-laser.

[Design Fixation]

End @ 440

Manufacturing Engineer:

Start @ 032
What do you feel are the main aims and objectives of capturing and storing knowledge?
Well, basically so we capture all lessons learnt then if we revisit a specific project or even a part of a project where we have been using some sort of generic structure such as twist dowel or whatever we are not making the same mistakes again, plus it allows us to cost work better because there is a better understanding of the what the costs what the timescales will be, what problems we can

envisage and also on the design aspect side of things what problems were encountered and why we went a certain route we might try, there might be something that looks obvious but when the structure is assembled something highlights itself which might be in there, things to watch out for.

[Avoid mistakes, better costing]

Do you feel that the Design System supports these aims and objectives?
If it was populated, yes.

[Poorly used, poorly populated]

Do you feel you have been given enough guidance on how to use the system?
I think, no. I have been shown, I haven't really consolidated it. We have had a five minute session. But for my level of what I would do, I would be more "how to" type documents that are very general rather than specific projects. Because when I work on specific projects I tend to work with the engineer, and I am reliant on him updating the system and if it's not on the system I don't feel it useful.

[Resentment towards poor usage]

"So you would like to know more about how to put things on the system?"
Yes I've not actually done it. What I need to do is go my how to documents, what would be a good exercise, you show me how to it again then watch me do one and allow me to carry on doing it.

[Need practice]

How often do you access the system, and how long do you typically spend using the system?
Occasionally, when I go on the pc, I will have a look at it because it is open; I have a quick flick through of it to get comfortable with it. I would say frequent, once every two weeks, for 5 minutes.

[High frequency, low depth]

What information and knowledge do you need the most when working and working on a project?
It depends on the job that I am doing, allot of the time the communication I get is very poor, it really is, allot of the time its "can you help somebody on a project", I don't know what the project is, I don't know what I am making, I don't what it's supposed to do, what is function is, it's just "can you cut that", "deburr that" or whatever, I think that's poor.
The design system is one of the last things to be updated, with regard to the project, and it's like the horse has already bolted. Its then the lessons learnt from that - I can't learn anything from the system.
I think as its grows, as the system grows, it's like, "ah well we have done that before" things like he gas shields "we've done these before", that's a good example actually, to understand what exactly we are doing with it, I've been told, people have drawn quick sketches, and I have a reasonable idea of what they do, but I have never seen videos or photos actually where they are being used so I can make judgments and inputs on it, Some of the problems they have had with the catch mechanism or anything, I haven't been involved with that, just "can you cut these bits" which is not quite right.
I think, as and when, if I was asked to do them in the future then hopefully that information will be logged, if I know we are doing gas shields, I can go to the Design System I will have a look at what is on there and if there are any shortfalls.

[Resentment against current behaviour, Self benefit, Instructive us, Improve project understanding]

Do feel the Design System is providing any benefit?
I think it will, it's one of these things, I'm guilty in not using it but I think it's the whole thing isn't it., Although we shouldn't be, we are very much in our infancy in terms of manufacturing . We have a system in place, it's not entirely robust, but it exists, and I don't think people are using, because of that it causes problems along the way.

[Poor usage, not robust]

Do you feel the benefits of the system are worth the effort of documenting your work?
Absolutely, I think it's essential.
What has been the most valuable function or aspect of the Design System and why?
That's a difficult question to answer. I probably learnt more from that on what I am doing than from the people themselves, i.e. the function of what it is that has to be done. I think there is allot of information that can be put on there, some of it is very basic, just a couple of view foils, but I would hopefully be accessing it on a regular basis. I mean, at the moment I am working on a restricted project, so it's not relevant.

[+Requirements, +Project Detail]

The system wasn't used much prior to this summer, why do you think that is?
Well two things really. I think because yourself and Manager M have been pushing it, you have been telling people they need to update it. And I think people are starting to learn from it. I think it's like a toolbox and you are filling draws up.

[Management Pressure, Reap and Sow]

The system is still not utilised very much, why do you think this is?
Because they are not following procedure. Because people, what they do is they get blinkered, let's put it another way, they are getting focused. All their attention is being tunnelled to getting the job out, and they are not following protocol and they are not following procedure when they are doing it. I think what they should do is, as soon as they get the job, what they should do is, instead of running with it one of the first things they should do is they should document it in the design system, what it is I should do, what its function is. It should come in there, it shouldn't be an afterthought, it shouldn't be "oh right if I have time I'll do that before I start the next job" it should be part of it and it should be on going. Its why we have quality procedures, that's why we have route cards and job sheets with standard procedure that you follow for every job. There is only one person that uses route cards, and that is Designer A, for all the rest it is too much hassle. But that's where problems occur, I had an individual in the workshop recently who was looking at cutting parameters, and wanted to look if it was possible to cut something and didn't even have an idea of how to log things, and how to do a little doe, so he was documenting what he was doing to get where he wanted, so I had to nurture him through it because I said "you won't know what you've done, and if it's feasible you won't have learnt anything" I think that's the problem, people are running, and they need to walk through it and tick the boxes, and be fed into the system, which I think it should.
Make them do it. To me, its something that needs someone like the Manager, people don't listen to me right, I have no authority anyway, so I ask people to do things and they don't do them. I say to them "you should have a route card" and they say "yea, I know...whatever" and nothing gets done and because of that then they are not going to do the design system or anything. Before they start, it should said, "before you start, you have to do this" and then someone like the Manager, says initially "Have you done this? Why not? Can you do that now?" to me the disciple needs to start higher up, or even Designer A.

[Lack of discipline, Job Pressure, Lack of procedure, Need Authority]

How would you improve the system, how would you encourage its use?
I think the idea of it is brilliant, it's a great tool that we use, but it's like having a multiple drawer spares box, it's only good if you fill it. It's like my material sheet, this is a very loose comparison, I have a very small little spreadsheet that is a simple thing, that is very important to controlling the material stock, but is no use if people do not use it. When people come to me and say "the material sheet says there is material, but I can't find it. Well that because you haven't been updating it isn't it" and I think you're guilty and you're guilty. I think that's the problem and its inherent in this place and I think although this isn't really the forum, we need to step up a gear.

[Resentment of current practices]

APPENDIX B: - RESOURCES

EQUATIONS WRITTEN UP

ASSUMPTIONS:

- Assume working day is 7.6 Hrs

Metrics would be normalised by division of previous value i.e.: Mean Lead Time in 2008 = 76 Hrs, Lead Time in 2009 = 68 Hrs, Balanced Scorecard Metric would be:

$$\left(1 - \frac{68}{76}\right) \times 100\% = +11\%$$

VARIABLES:

Number of Full Time Equivalent employees	-	E_{FTE}
Number of Employees Leaving	-	E_l
Total Number of projects completed over period	-	n_{total}
Number of new designs	-	n_{new}
Number of repeat designs	-	n_{repeat}
Number of times geometry reused	-	n_{Fb}
Number of Full Prototypes Built	-	n_{Pb}
Number of Part Prototypes Built	-	n_G
Lead Time (Date Started – Date Delivered)	-	t_L
Design Time	-	t_d
Production Time	-	t_p
Time spent using system:	-	t_{DS}
Cost of project	-	C_n
Price of project	-	P_n
Fixed Costs	-	C_F
No. Of Jobs in Design System	-	n_{DS}
Job satisfaction rating	-	S_n
No. Of Patents	-	k
Knowledge Gap	-	l

Financial:

Turnover:

$$= \sum_{i=1}^{n} P_n$$

Gross Margin Percentage:

$$= \frac{\sum_{i=1}^{n}(P_n - C_n)}{\sum_{i=1}^{n} P_n}$$

Mean Cost per Project:

$$\bar{C} = \frac{\sum_{i=1}^{n} C_n}{n}$$

% Income from Rolls-Royce plc:

$$= \frac{\sum P_n(RR)}{\sum_{i=1}^{n} P_n} \times 100\%$$

Learning and Growth:

Patents filed:

$$= k$$

Staff Turnover per annum:

$$\dot{E} = \frac{E_l}{\bar{E}_{FTE}}$$

Design System Usage:

$$= \frac{\sum_{i=1}^{e} t_{DS}}{E_{FTE}}$$

Design System Population:

$$n_{DS}$$

Employee Skill Level Increase:

$$= \frac{\sum_{i=1}^{e} l}{\sum_{i=1}^{e} e}$$

Internal Business Process:

Reduce prototyping/ error rate:

$$= \frac{n_{Fb} + (0.25 \times n_{Pb})}{n}$$

MCE:

A division of the value added time by the total lead time (from confirmation of order by Rolls-Royce Sheffield):

$$MCE = \frac{t_d + t_p}{t_L}$$

Geometry reuse:

$$G = \frac{n_G}{n}$$

New Product/Process Development:

$$n_{new}$$

CUSTOMER PERSPECTIVE:

Delivery Cycle Time or average lead time:

$$\bar{t}_L = \frac{\sum_{i=1}^{n} t_L}{n_{total}}$$

Mean Customer Satisfaction:

$$\frac{\sum_{i=1}^{n} S_n}{n}$$

New Customers over a fixed period:

$$= \frac{n_{(new\ Customers)}}{n_{total}}$$

Mean Geographical Reach:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_n}{n_{total}}$$