IMF Pathway Webinar Transcript

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18:30 – 20:00

Chair	Miranda Sharp	Approach Stream Lead, National Digital Twin Programme
Panel	Dame Wendy Hall	Regius Professor of Computer Science, University of Southampton
	Dr James Hetherington	Fellow, the Alan Turing Institute, named author of the IMF Pathway
	Dr Matthew West	Director, Information Junction, named author of the IMF Pathway
	Samuel Chorlton	DTHub Chair, National Digital Twin Programme
	Mark Enzer	Head of the National Digital Twin Programme Digital Director, Construction Innovation Hub Chief Technical Officer for Mott MacDonald
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Introduction of Panelists by Miranda Sharp

I'd like to welcome you to this Centre for Digital Built Britain (CDBB) webinar on the document that we published recently on *Pathways towards an Information Management Framework*.

I'm thrilled at the fantastic panel we have today and also the large number of you who have registered to attend. Joining me today we've got the co-authors of the report:
Dr James Hetherington is currently director of e-infrastructure at UKRI, but for the writing of this report, [James] was at the Alan Turing Institute where he was director of research engineering.
[Dr] Matthew West has significant experience in the fields of ontology and data modelling and in standards development.
Mark Enzer, he'll be kicking this off in a minute, is the Digital Director of the Centre for Digital Britain and the chair of the National Digital Twin Programme of which this progress report forms an integral and important part.
Sam Chorlton chairs the Digital Twin Hub community, which is an online community which is

progressing through sharing and learning together about digital twins.
and finally, Dame Wendy Hall, who we must call Wendy, is Regius Professor of Computer Science at the University of Southampton. Previously she worked with Tim Berners-Lee and Sir Nigel Shadbolt on the foundation of the World Wide Web.

So, I'm going to hand over to Mark now who's going to talk about the [NDT] Programme.

Mark Enzer
Miranda, thank you very much. I'd like to give just a very high-level introduction to the National Digital Twin Programme so that we can get into the meat of the discussion for the launch. [and I guess] The key thing is the *Data for the Public Good* report that came out a couple of years ago that recommended a National Digital Twin and at a high level what that report pointed towards was that we should move as a nation towards having this National Digital Twin.

In order to enable that we should deliver an Information Management Framework for the built environment and in order to deliver that we should bring together people from across government, academia and industry to pull in the same direction to deliver the above and that really is the National Digital Twin Programme. It's to deliver the Information Management Framework which will enable the National Digital Twin and to provide alignment across the industry. So that we pull in the same direction and that theme of consensus ends up being really important and a key part of what I think the Pathway document starts to layout.

When it comes to the core of all of that, the delivery of the Information Management Framework, what we're suggesting is that we should do that according to this Pathway document. The Pathway document is a key point in the overall program where we layout what we believe would be an appropriate approach to delivering that Information Management Framework.
And so what hopefully we will hear tonight is more about that Pathway document, what's in it, you can ask all the questions you like, but I have to say I'm very excited that we've now got this out. A lot of hard work went into pulling together expert opinion from across the industry and providing some of that alignment that I talked about and so really what it all comes down to is; building this consensus around a route to delivering the Information Management Framework, which will then underpin and enable the National Digital Twin, loads of nicely nested recommendations.

So that's the background, I don't think I want to say any more about that but kick back across to Miranda to get us into the meat of the webinar.

Miranda Sharp
Thank you Mark, what we have to remember about this important document is it is a *consultation* and so we are very keen to hear from you, both in this webinar and afterwards, as to what you think about the approach we're taking and what we're doing. As Mark said, the report is a balance of pragmatism and principle in semantic engineering in particular, but also the balance of scholarship and service and how we bring Information Management into that debate.

Now, as Mark said we started with the Data for Public Good report, which came from the National Infrastructure Commission. Then there was the *Gemini Principles* and in a world of an infinite number of use cases and applications where we hope a thriving commercial ecosystem

will deliver success and benefits to digital twin holders and those who connect them. We were able to align the vision of the Data For Public Good report with an internationally respected Gemini Principles to describe the traits of digital twins and how they must have a clear purpose, create trust and function effectively.

Based on that vision we embarked on the exercise to craft the Information Management Framework, or the IMF. A means of joining together, not holding in a single place, digital assets or twins. Because we want people to plan with greater certainty to intervene in the physical world with more confidence and reach a deeper understanding of the internet connected systems of infrastructure in the built environment. [Because] By creating a National Digital Twin from a nation of digital twins we will be able to enhance productivity, increase resilience and enable human flourishing.

And that's the vision that over 70 contributors agreed on when they came together to consider both the art of the possible and the excellent work which is preceded this.
I urge you to consider your views and ask questions, both now and later, we need to hear from people who both agree with us and disagree with us in what we're are doing and how we propose to do it.

So, I'm going to proceed without introduction now, between the speakers, first of all to James, and then to Matthew to Sam and then finally to Wendy before we return to answer, what I hope a buzzing questions on the Q&A line.

So, over to James.

James Hetherington
Thank you, this is James, I hope everyone can hear me OK.

Reflecting for moments on what we're trying to do here, for me the most interesting thing about this is, the what we want, as the Gemini Principle state at the approach towards a National Digital Twin is not one big model of everything, but lots of individual pieces which can talk together and those are necessarily going to be made by lots of different organizations, and the only way there for that work was scale, is if we can make it so those individual pieces that are constructed separately can work properly together. We need a solution, an approached assault to building a National Digital Twin which we should scale to the size of of the problem, and the only way to do that is to bring the Web-scale to bear and that requires the individual pieces that we're working on to be able to created separately by organizations all over, such that they can be brought together and coalesced together to form a National Digital Twin.

That requires coming up with the protocols by which those things, can share/ exchange information, and that requires, that's the solution, the information management problems that we're trying to address here unlocks.

So the emphasis I wanted to make is; by working hard to come up with the protocols by which different digital twins can share information, we bring the problem within the reach of solvability, by meaning that we can solve it in a distributed way with many, many organizations working together.

That's the only way we're going to do it. That's my introduction.

Dr Matthew West
That makes it my turn, I'm Matthew West.

It's important to remember that neither the Information Management Framework nor the National Digital Twin are an end in themselves, it's about taking better decisions with the information you need to give better outcomes and agility together with fewer mistakes and disasters. Equally there's a lot more to be done then delivered Information Management Framework and sit back and watch the National Digital Twin grow, there are other parts of the NDT programme that are there to support organisations through developing their Digital Twins as part of the National Digital Twin.

I got involved in this program when it was realized that moving beyond BIM Level 2 meant integrating data across digital twins across organizations and across sectors and including services provided by infrastructure, and someone with relevant experience with sort.

I used to work for Shell and last project I was involved with was Downstream One, a US$2 billion business improvement project across a 100 plus companies in 100 plus countries implementing common processes and systems with common implementations and reference data across Shell's downstream, that's oil tanker to petrol pump business. We had to work out what it would take to deliver consistent data across the downstream organization and then make it happen.

I'm glad to say the project was a resounding success and I've been able to bring knowledge of what that took into the NDT programme. That was, however, within a single organization, even it was spread globally.

The kind of integration architecture they deployed is different from the kind of one that we're going to need to deploy, so there are some differences but what about sharing data between organizations? Well, I was also involved with developing *ISO15926,* which is aimed at supporting data sharing and integration of data throughout the lifecycle for processed plants enabling consistent data across organizations and designing construction and consistent data across process plans. Within an organization in operations and maintenance.

ISO15926 takes an ontological approach to developing its data model which is meant the data model is proved capable and stable. Indeed, it is still in its first edition after 17 years despite a range of new requirements needing support. The learning from this is this in ontologically based approach, as the IMF sets out, can be successful in supporting a growing national digital twin without requiring that we know all the requirements before we start.

Thank you.

Samuel Chorlton
Hey. Yeah fantastic be speaking here today, my name's Samuel Chorlton and I chair the Digital Twin Hub.

For those of you that aren't aware the Digital Twin Hub is a new initiative we set up about two months ago now to support organizations, and individuals within those organizations, as they go through the process of adopting digital twins. In the space of the last two months we've grown

from having just a handful of members to not too far off 400 members now and that at just reflects the importance that individuals s and organizations are placing on enabling us to get to a point where we can adopt Digital Twins. But we're very much at the start of that journey at the moment and I think the really important thing to reflect on the pathway document highlights, is that we've got a long way to go but we got to get the foundations right an early stage otherwise going to put ourselves in a position where leveraging some of those capabilities and some of those benefits that connecting Digital Twins would likely make would be increasingly difficult and potentially impossible to achieve.

And although the document does highlight the importance and the challenge from a technical perspective, it is really important to reflect on the fact that those connections are ultimately going to be organisations connecting together, and those organizations are going to be a mixture of public and private sector organisations. [and is] What we've got to get to a point of is that this can be achieved in a manner that is accessible to those organizations and organizations of varying scales and budget, capabilities and skills availability.

We have also got to make sure that it actually delivers valuable value and benefits of those constituent organizations and so my kind of role in this today is to just make sure that we keep reflecting on the importance of those organizations in this process and making sure that they have the ability to speak into that discussion and actually work with this in collaboration as we started to develop some of these initiatives, and that's it from me.

Dame Wendy Hall
Well I'm a bit of a newcomer here really, I was very flattered to be asked to write the foreword for the report and to be on this seminar.

It's all down to Matthew West, I'm afraid he invited me to be part of, no well, but I got interested in this because of the 4D modelling work that was going on.

Miranda said I was involved in the early days of Web, I was, didn't I didn't invent the web, I have to stress that Tim Berners Lee did, but I was working before the web on this type of activity this whole information management through the use of link data. Tim called that the Semantic Web And that was his keynote in the 1994 the first web conference. These ideas have been around for a long time and it's amazing for me to see it all come together in this project because you can't envisage doing something like a National Digital Twin without the use of a really, really sharp Information Architecture, which requires ontologies and the use of linked data in ways that we only dreamt about at the beginning of the web.

This is, as it says right up front in the report, the National Digital Twin is an amazing vision and ambition that's going to be incredibly hard to achieve properly and it's an ecosystem or is a system of systems, it's going to be an ecosystem of digital twins. And again, the only way to glue all that together is to get your Information Architecture right otherwise it you just not going to get anywhere and that's what the excites me about this.

I think we've all seen, I will be the first to mention the COVID19 crisis, during the COVID19 crisis how the lack of anything like this has caused so many problems. Even the simple idea of getting PPE to the people that need it from the suppliers that can supply it, has failed us as a nation because we don't have this type of Information Architecture around, we don't have this way of exchanging information between different types of systems; between transport systems, and the

power systems, the internet infrastructure and the electricity supply system and all these infrastructure systems that are completely siloed and not linked up, let alone with businesses and the public sector information that you need and the information from the hospitals, everything.

Even before COVID19, we had the Grenfell Tower crisis, you see the problems when you have, not crisis; catastrophe, disaster and we couldn't even answer the question of which other flats have this cladding, right? These are questions, we should be able to answer, and so I think, for us it's hugely important for the country that we get behind this. It will require government to stimulate this, but it also requires a lot of people, like you see here, who are just passionate about it and want to make it work. So you need that top down and sort of bottom up approach to it, and so I think this is one of the most important things we can be doing as a country in order to grow again, as an economy and to build in the resilience that we need to withstand the sorts of things we've been going through for the last few months.

Miranda Sharp
Well, thank you very much those of you who managed to navigate asking a question without expressed instructions on how to do it, if anybody's wondering, it's on the toolbar on the top right and you can ask a number of questions. We've had a number already and we also lucky enough to have it some pre submitted questions which makes me feel like I'm on the swap shop in the 70s when people did a lot of pre submissions, but I 'd like to start with a challenge to James If I can?
How do we meet the meet the challenge from a number of our stakeholders that the approach is either far too top down and prescriptive versus laissez faire and developing, far too loose for some of our big infrastructure clients. So, the tension there is between the jungle and the garden, how do we land in between the setting allowing every flower to bloom and setting a restriction, so that we all come together as one?

James Hetherington
Yeah, thanks.
The work to get to the report has been in a very interesting experience in consensus building amongst the communities that have been engaged with it so far and I look forward to the work now it's been published to further that.

The sort of sketch outline in the direction we'd like to project to go, we would try to be evidence based, in terms of learning from the experience of building and what those connections are, what the right way to describe all the different things we need to describe are and but we do also need to make sure, that before we lock any of that down we've tested it but at the same time, we know that as soon as people start working with it will create situations where this stuff costs and it will be quite hard for people to move away from it. I think quite a subtle tension around those.

What we do see when people do this kind of model linkage on an ad hoc basis, and look you know, digital twin is it doesn't extend the latest brand name for a modeling of complex systems with a bit with bit of sensors thrown in and that's fine. That's super.

But we can at a small scale, right get all of this done on well I'll wrangle my data and you wrangle your data and we'll take a few months and, you know, Matthew described this rather well; if I got *n* different people trying to do that, then you know the number of different and bits of

data running we need to do to scale it is n^2 and that's going to be bit of a nightmare. So it's important to take a principled and disciplined approach because, you know, as Wendy just said, the scale of the challenge, will we won't be able to distribute the work, at scale without a disciplined approach to some of that a linkage.
Yet, at the same time we know there are kinds of things we want to include in these capabilities that we haven't thought of yet and that's why we need to not to be too prescriptive either, I think we would argue that the approach we've designed in the document where we build a corpus of twins that we need to link and understand and learn from experience in building the disciplined modelling frame that will allow us to link those, *not because the model we create by that is itself the output we want to make right,* that's just something we do to prove the work*, the thing we're making is the IMF,* but will have to go ahead and do some building of linked digital twins in order to get there, and that's the sort of idea behind some of that.

Miranda Sharp
Thank you, James. I think the important thing to say there is the end to end squared relationship and how complicated that will be.
We've had a number of questions on standards, Not only from Dan Rossiter at BSI but also from Lawrence and some other ones. Now I'm going to let Matthew talk on that, I think that I'm going to perhaps start with the easiest one: Is one is the national Digital Twin just a standard?

Matthew West
It will need to be much more than the standard but the IMF probably will need to be a standard that the national digital twin will be something that conforms to that standard is that a simple enough answer?

Miranda Sharp
That is one version of an answer, I was wondering as well Matthew, if you wanted to answer some of the other questions about how it fits in with the other models particularly IFC and others?

Matthew West
Yes, certainly and I'll expand a little bit since that seems to be the hint, but yes, the NDT, the National Digital Twin itself won't be a standard, it will be something that complies to a standard and that's how it will be shareable.

The elements of the Information Management Framework will inevitably, I think, need to be standardized at some point, although some of the elements quite possibly will turn out already to have been standardized. But if we move on and we look at the relationship to other standards, there are a good number of standards, as being pointed out, that are already existing but the issue is that those standards don't interoperate themselves, as things stand, you have to work quite hard to get them to work together and part of the purpose of the Information Management Framework is to facilitate that interoperation, so that data can be shared and brought together from the different standards and used in one place in a consistent way.
Another question that was asked, is someone's looking to develop something with ISO15926, and the answer is yes, that is one of the standards that we will need to be able to interoperate with.

Miranda Sharp

So now then, the next person want to ask questions of is Sam. We've had some good questions about motivations and the DT Hub, so perhaps, Sam, you can tell us how many of the hub members are SMEs and the extent to which we got local councils engaged and how anybody might want to be engaged but also, why would anybody wants to be involved in the National Digital Twin Programme and the Hub, in particular?

Samuel Chorlton
That's a really good question I guess that I'll answer the easiest piece first which is, how can people get involved and that's as simple as going to the website which is www.digitaltwinhub.co.uk, which I'm sure they can share in the chat view, and that is open to most people. We're doing a phased approach in terms of how we're extending the membership based off that but will explain more about that in the communications after you register.

In terms of what the current constituency looks like, it's broken down into 2 core parts: we've got asset owners and we've also got suppliers in those part of the supply chain and within that asset owners component we've got local authorities as well as the big infrastructure asset owners as well. We don't have the depth of membership within the local authorities yet which we'd like to get. And so I guess that's a request from our part, if anyone is involved in that space or knows anyone that's involved with that space we definitely encourage those to become part of the conversation.

SMEs are suppliers as a whole, we've very much been taking a completely open stance at the moment. We've invited those to register that are interested, we haven't done too much in the way of proactive marketing in that sense at the moment, in part because we want to be mindful of the uncertainty of the current situation, and in part because we want to learn from the members we have got before we grow and get to a point where we've got more Members that were able to deliver value to. So, I understand that doesn't necessarily provide the figures but what I can say is that there's ample opportunity for more SMEs, for anyone from any sector, to get involved with at the moment.

In terms of what is the rationale, I guess, for contributing to that the NDT Programme is as much as possible going to be using the Digital Twin Hub as the mechanism through which to engage with the community and those that are involved with the Digital Twin in the built environment space. So, we know some of the questions that we want answers to and those sorts of things that we're doing activities around and we've got forums and discussion areas to look at, but as James indicated earlier, there are things we're going to need that we don't know that we're going to need yet, and that's actually where you will play that crucial role of helping and working with us to discover what those things are.

And then we're not saying we're going be able to answer all of those, again, we then got to work collectively together to find an answer that can resolve the problem, but it also workable as a solution for as many people as possible.

Miranda Sharp
Thank you Sam I'm so a clear call to action there. Now, we had a number of questions about the ultimate interconnectedness of all things and I think this is a nicely nested set of problems in that everything is ultimately connected to everything else. How do you decide which two connections to make and that speaks quite clearly to what sort of benefits - Why would you do anything?

I want to come to Mark and then to James if I can, on the how do we decide what to connect together and perhaps Mark you can introduce it by talking about the Flourishing Systems paper?

Mark Enzer
Yes, thank you. So, I mentioned that just briefly recently, CDBB published a paper that we called the Flourishing Systems. And what this outlined is a vision for infrastructure and the wider built environment This is both people focused and systems based and so, what it was trying to say really, is it that infrastructure and our built environment needs to be all about people, all about outcomes for people because that's the reason why it exists and that the way to deliver the desirable outcomes for people is through appropriate use of the system of systems - that is, our infrastructure. Quite often we see infrastructure as a series of construction projects rather than as a system of systems that serves people. That paper is quite timely in relation to a point in the Nation's history where we can rethink what we want from our infrastructure. We can imagine a new and better future for it. Certainly as we consider the idea of bouncing forwards or bouncing back better or a new normal, I think it is important for us to consider how we can get those desirable outcomes from our infrastructure. Inevitably we think that at having a National Digital Twin as a competent tool to help manage that system or systems is part of that bigger picture. So that's the Flourishing Systems paper which I'd commend you to look at.

I think a connected question to this that I believe Miranda was pointing me to, was the one about: Why would individual organizations do this? We can see the benefits to the country, but why would individual organizations join in?

I think that the key answer to that is that within each individual organization there is an opportunity to get the benefits of joining their own digital twins. Many organizations, particularly asset owner operators, will have a number of different twins and it will make sense to them to join their own twins up and therefore it will make sense to them to have this consistent approach to data modelling and reference data management that is outlined in the Pathways document and looking around for an appropriate way to do that why not go to the Information Management Framework and use that within the individual organization. So, I guess a simplistic way of looking at this is to say that if each individual organization adopts the Information Management Framework for their own benefit, because it helps them in their own organization, connect their own twins, then by fact of each organization following the Information Management Framework then it means that we can then make the connections between twins, across organizations. So, I think that we don't necessarily need organizations to be altruistic, they can be selfish but selfish in a similar way that then ends up benefiting the nation.

One final bit of the answer I think to the question: What will guide this and how do we know which bits to connect up?

I think that comes back to the Gemini Principles, that Miranda mentioned, and the first key heading in there, of *Purpose* because I think we need to be consistently constantly guided by purpose and the reason for developing individual digital twins will be guided by the purpose of that twin and then when it comes to connecting twins, again should be guided by a purpose, by a business case, by the reason why it makes sense to make that particular connection.
So, what we wouldn't be doing is connecting all twins to all other twins in all possible ways, it will only be where it makes sense because that's the right thing to do to facilitate better decisions.

So hopefully, Miranda, that's covered off few of those particular questions.

Miranda Sharp
Thank you, Mark. Can we hand over to James for your view on how to decide what to connect to what and the ultimate interconnectedness of all things?

James Hetherington
Yeah, So, this is Ramy from Northumbria's first question. The question is, I think, that it's important to start with delivering value incrementally before we get to the science fiction answer of a magic computer that can find all the digital twins that it needs to compose in order to address - I would love to get that, right would love to get that, you know, " I think I need a model of that building. I'm sure that someone's make one somewhere", and that's still a long way off and the important thing about this work is to generate incremental value as we as we go.
We can build, in principle, a comprehensive National Digital Twin, with the n^2 approach right now, if you want, if you have you end if the entirety of humanity was trained to do this kind of thing, which they're not and we had a long, long time. That's not the point, the point is that we can make it easier, like picking off assemblages one by one. So, the first stages we'll have more human involvement in them, machine assistance gradually coming through to the full as described. The question also raises an interesting point, of course, which was - It assumes total authorization in security and, we can't do any of this without tightly integrating information governance and information access management model into the rest of it. One of the things that's interestingly emerging, of course, in all the coronavirus work we're doing, is how to bring many different datasets together to build important questions while still deeply respecting the individual information governance regimes over all those very important data sets. And that, you know, that's fascinating question.

There was a couple of other questions that were related that I wanted to ship in on that have come up; relatedly Chris from Edinburgh and the Turing is asking about are we just sharing data or are we sharing models as well?
That's another interesting piece, again, I think the first level is sharing the model envelopes; what information do they need? What parameters do they need? How do those get hooked up to other things and sharing the information you need to instantiate those models automatically onto various cloud platforms?
Next stage is, sharing some of the assumptions in a managed way, so we can check we're not integrating things where the assemblies would be invalid, there cause of inconsistencies in assumptions between the pieces that certainly in approach were taken in similar sort of composite physiological models. And again, so that's gradualism.

I wanted to pick up on Jas's question around are enough people to do this, the question was: "is there a sufficient population of knowledgeable people to make this work?"
Well clearly there isn't, and you know with my current UKRI hat on at the moment, making sure that we have in place all the research technology professionals; software engineers, data scientists, data stewards, systems engineers to build all of this is absolutely vital. And I think, working out a core piece of the infrastructure is not just all the very interesting infrastructures were talking about, but the people infrastructure as well, and there will be new careers in new professions, we need to build to address this.

Those are the things I wanted to comment on that I've seen pass by in the questions list.

Miranda Sharp
Thank you, James, I'm particularly glad that you got to talk about skills 'cause I know how keen you are that we regard skills as part of the infrastructure of the nation when we think about this Project.
I was going to Matthew now who's going to answer in amongst them Rob Guthrie's question and we were going to have the slide ready for that.

I'm worried that Matthew is looking confused.

Matthew West
Could you say what Rob Guthrie's question was I thought I was going to be answering Julian's

Miranda Sharp
You answer Julian's and I'll come back to you on Rob's, OK?

Matthew West
The question I was looking to answer first was about, 'how do we manage security?', which came from Julian Schwarzenbach.

The answer is that it has to be built in from the beginning, it's not something you can tack on later and you can see how it works in this diagram here which really just gives an overview of the whole architecture for the Information Management Framework. So, what we have are the data owners publish their digital twins according to the foundation data model and reference data library, transforming them from whatever form they have created them in the 1st place. These are then available in a catalog. A part of the authorization actually comes down even to who can see that those digital twins even exists. [And so],round on the left, on the top we have this authorization layer which relates so that data owners control who has access to the digital twins, they might make some of them completely public, they might make some only available to business partners, they might make some available to regulators that they're working with; the range is whatever is needed.
And then down the bottom you find the user trying to find the things that they might be interested in, they can see the ones that are allowed to see and if they don't have access they can ask for access and if they are then given access and they can set up an authorized view on the NDT. The ambition is that this will really be rather than a bunch of datasets that they have to sort out, it will be rather like an SQL view on a database, it'll be a virtualization which they see as a single integrated whole of what they are authorized to see across the various published digital twins.
So that's the ambition and that's how the security is dealt with. What was the other question, Miranda?

Miranda Sharp
Will the IMF be examining mapping to and maintaining mappings of industry standard schemas and taxonomies such as IFC, Uniclass, CoClass, RailTopoModel etc and if so, is the scope of which will be looked at initially known at this point?

Matthew West
I think the answer is that at least as far as the data models are concerned then the answer is, yes. We will need to be looking at mappings and I think that the standards that you mentioned, the IFC, geospatial standards, things like ISO19526 are amongst those that we will

need to have mappings to because this is very often how the people that are creating digital twins are going to be holding their data. So it's inevitable that's going to be the case. Where reference data libraries are concerned we need to end up with a single authorized reference data library, if you like, because if different people are using different reference data libraries for the same thing then you immediately having inconsistency and consistency of data across digital twins is a is a prerequisite for this stuff to work.

So, what I think might happen is that we will end up authorizing and quality assuring parts of various reference data libraries, trying to assemble across the authoritative sources for particular topics, for particular disciplines, a single, again probably distributed, reference data library that is authorized for use as part of the National Digital Twin.
The idea is that this would be opened so that there would be, for things that were missing, there would always be a qualification process that you could submit for a reference data library to demonstrate that it has the quality and relevance and non overlapping with existing parts of the reference data library.
Thank you.

Miranda Sharp
Thank you.
Now question for you Wendy that Dan Rossiter asked, ‘our colleague, Neil Thompson, often compares the commons and the elements that needs to be common in the Information Management Framework to the evolution of the internet. Would you agree that this work to form a National Digital Twin of assets, an Internet of assets, is analogous?’

Wendy Hall
That is exactly the question I wanted to answer, thank you.

It is and isn't, of course, in true academic style, but I would say it's analogous to the development of the web rather than the internet which is a different type of technical layer but I do remember when Tim first proposed the standards for the Web no one wanted to adopt them, everyone had their own Information Management System and was quite happy with that, thank you very much, and couldn't see any reason to change what they were doing or share their information with other people. Key to this was actually getting governments to adopt the standards. I remember distinctly in the 90s when Tim and Robert Cailliau were trying to get the then European Commission to adopt the web standards and they were sympathetic, but not prepared to change what they were doing. People couldn't see the benefits, it’s not until it happens, you get everything joined up that you can see the benefits.
So, that was, in fact, one of the reasons Tim went to the USA because he could get the money there to develop what became the World Wide Web consortium which developed the standards.

A previous question was about ‘How to decide what to link to what?’ which again was why the Semantic Web or the web of linked data, was part of Tim's original vision, because if you look at just serendipitous hypertext you don't know what to link to what, but you can't find the information you need through just serendipity. Often you notice that websites go very stale after time they really difficult to maintain if you're using just the vanilla website, is what you need is the other standards that enable you to link the data which is what Semantic Web,well, the linked data, and that's what you use the ontologies for, that's where that work came from this whole idea, that not this not where the work came from, other people have done it, but it's the need to have a standard you can conform to, an ontology you can sign up to, in order to share

information about transport systems or cities or councils or GP surgeries or whatever you want to, how the railway networks, all these things.

It is analogous in the sense that the web, and the internet on which it was built on, grew because of the standards, and those standards were open and universal and I think that's very, very important in this, that they understand themselves are open and universal, but in fact, with something like a digital twin, you've got to have that overarching structure, that this is this sort of the top down and bottom up, I think, so it is analogous.

I was pointing example of something that is beautiful in its construction is Wikipedia. Now, the National Digital Twin has to be much more structure than Wikipedia, but Wikipedia does represent the world's our knowledge base in effect, and it grows it's evolved with some very simple rules and when it started people said, even Jimmy Wales himself, said he didn't know if this was going to work and now look at what we've got with Wikipedia. You can't imagine can you, life without Wikipedia? Where would you go to get your facts? Everything's there, you use Google and Wikipedia and you've got all the information you need, and we need to capture the essence of those projects in a more structured way in order to build the National Digital Twin. It will be an ecosystem of digital twins and we can't do it without the local councils, all the people that run all the different network systems; the rail network and the transport networks and all those people, but we're going to have to persuade them to get involved in this because, it's a lot of work, to move from where you are now to something someone tells you will be beneficial down the line.
One last thing, I would say is that we need to build templates. I've been doing this for the data trust work, we need to build templates that people can pick up and use, so, if Rotherham, to pick an English town from nowhere, develops a digital twin project then you want these to conform to the standards, but then you need that sort of template that every other town in the UK can pick up and use and that's what we did when we were building the original web, people built websites by copying what other people had done using that common standard?
Does that make any sense?

Miranda Sharp
That was great, Wendy, and great to get your perspective on it, thank you.
Now, we're running up against time up against time now so I'm going to ask for brevity, so Mark If I can come to you and answer the question: 'Are we defining the framework or also storing the knowledge in perpetuity to support the framework? Mark, that's an interesting one for you to get your teeth into.

Mark Enzer
Defining the framework.

Miranda Sharp
Alright in that brief
Thank you very much.

Mark Enzer
I could do more but that's basically the answer.

Miranda Sharp
We get more excellent questions in, then James you wanted to come in on a COVID19 point

James Hetherington
Well it wasn't necessarily a COVID19 point but anonymous had asked, “how we're going to address the quality of models given the recent revelations about the poor quality of some epidemiological models?” Which has been an interesting point that many of us have been thinking about for a long time and you know not taking the particular to the COVID19 piece but I was working in environmental modelling when the Climategate scandal, which was the particular scandal at all, It was but some issues with code integrity and in modelling in research and came up about 10 years ago I think that's going to be one of the really interesting challenges if we have got a ecosystem into which people are publishing twins, which we made interoperable through our Information Management Framework, we need to make sure that we understand how we going to validate and audit them. I think that's going to be one of the most interesting next step challenges for this. A lot of my work over the last period on Visa software engineering been trying to build some of that capability. Wendy's answer about Wikipedia brings up an interesting model, of course, and how do we keep Wikipedia correct is one that reams and reams has been written about. I wonder if this is where the COVID19 story comes up, if we doing critical decision making on the basis of these distributed structures, then our quality control processes may need to push a bit more.

Wendy Hall
With Wikipedia you can only take that so far, because this has been much more structured than that, but you can see the idea, how it has built up.

Miranda Sharp
I think I'm allowed to ask my and finally question, then? I want to give all the panellists an opportunity to answer this question,

What is your hope for the national Digital Twin Program?

Maybe if I go to you first, Mark, seeing as you asked that question?

Mark Enzer
Yeah that's interesting It's kind of come bouncing back to me. It's that it would work. That we get something that really, genuinely works and delivers benefit to people and we know that is what motivates me in this whole thing. I see the National Digital Twin Programme as potentially having massive benefit to people in the UK and wider. And so my hope for it is that we actually end up benefiting people as a result of this, and I believe we can.

Miranda Sharp
I think you get to nominate the next person to go

Mark Enzer
in which case I nominate Sam.

Samuel Chorlton
Brilliant thanks, Mark. From my perspective there's two reasons I guess I got involved with the program and those reflect I guess my hopes for what come out of the program. The first one of those is digital twins risk becoming one of those buzzwords that emerged and failed to deliver

and I think one of the really important things is that we focus on value first not the potential tool or sales opportunities that it allows us to kind of derive from that. That ultimately for me comes back to the purpose of why the NDT Programme formed in the 1st place and that was to deliver value to the public and us into ourselves, ultimately. I think if we forget that as we go along this journey then we will risk massively failing to deliver and reach the objectives we set out. So I think every so often we need to step back and reflect and make sure that we are aligning ourselves to those priorities and I think if we can get to that point where we've demonstrated iterative value. Iterative value from a technical perspective, iterative value from an economic and societal perspective I think we should be pretty chuffed with what we've got out of this programme.

Does that mean I get to nominate the next person? OK, In which case, I'm going to pass over to James.

James Hetherington
So same as Mark; that it works. But the way in which it works is open, and so, we've created an ecosystem where by lots and lots of different people can all chip in and there's this pair creation going on And it's not mainly anchored in what we're doing anymore That's what works looks like to me.

Let’s go to Matthew.

Matthew West
I'm probably going to echo what other people have said which is that it's about delivering value but my experience in Shell tells me that the amount of value that there is out there is astronomical and relative to the costs of what we're doing, are relatively minute, and so the value proposition is just so commanding that we really should be able to deliver value to the UK and the ultimate value will actually go to UK citizens which is really nice ‘cause if this supports Government that will either mean better value for the taxes we pay or reduce costs and less taxes. So we should be winning fairly easily I think here but I think that's the real thing and we don't need to get everything 100% right and everything 100% perfect to deliver value. There's graceful degradation in what we’re doing we could miss the target by a decent amount and still deliver overwhelming benefits.

And I'll pick Wendy.

Wendy Hall

As I'm last, I'm going to answer the question rather differently. The question I wanted to answer is what record would you take to your Desert Island, which is what they were asking on Radio Four last week, when I did Desert Island Discs, the record that I saved from the waves was: Let It Be.

And that's what I would like with the National Digital Twin; I'd just like to *let it be*.

Miranda Sharp
Can you tell us what you mean by that, Wendy?

Wendy Hall

If you want the lyrics OK.
And when the broken-hearted people living in the world agree
There will be an answer
Let it be,
For though they maybe parted, there is still a chance that they will see
There will be an answer
Let it be.

Miranda Sharp
So I'm at the risk of sounding… Do you think it's going to happen on its own?

Wendy Hall
You were supposed to finish there!

I want it, I want it to happen I think, let it be, please let it be. It won't be something that you can easily deliver, right? This is not an easy thing to do, it is a majorly ambitious project. Yeah and so we need a lot of words of wisdom. Let it be.

Miranda Sharp
Never have I had to follow quite such a follow up act as that but thank you Wendy. Now I realize that we've come to an end with shuddering holt early for there was some confusion in my head about whether it was 19:30 conclusion or an 8 o'clock conclusion but let me know what have to go and see where we get too. So, I want to thank everybody for their engagement, and I apologise if you couldn't see Matthew and his slide. He was presenting the diagram in the Information Management Framework pathways document.

We will make that available afterwards and it's already available in the report. The questions have been very rich some of them a bit detailed to go into on this format, but I think I can say with confidence that we will be looking to answer them in forthcoming publications, blogs, talks, …watch this space.

I forgot to introduce myself at the beginning, so thank you for bearing with me. I'm Miranda Sharp, I lead the Commons stream and led the Approach stream that produced this document. And then, finally, I want to hand over to Mark, who's going to talk a bit about how the work we're doing builds on the, we've now got time to explore, in a bit more detail, how the work we do builds on the work of BIM and how it also interleaves very nicely with CDBBs other work on the Construction Leadership Council.

Mark Enzer
Thank you, Miranda, very much indeed. So, I'll just try to answer that question very briefly and wrap up.

So, when it comes to the UK BIM Framework and where BIM fits in, I need to say that it's absolutely foundational and we're really building on the fantastic foundations that have been laid for us in relation to BIM. I think one of the key things that BIM has done for us, as an industry, is show us how important Information Management is and that information is worth managing, if you lose information, you lose value
So BIM does provide a great foundation and really the idea is that the Information Management Framework will build on that, so it doesn't replace it, builds on it and hopefully as we work

together with the UK BIM Alliance then we can make that interface as seamless as possible. And I think what that then points to is the CDBB vision, which is around; Design, Build, Operate, and Integrate as something that is kind of a continuum rather than having a kind of a cut off between them. So yeah: BIM essential foundation for the National Digital Twin.

What I'd like to do, having said that it is kind of change gear and just thank people 'cause I think that this has been fantastic and the panellists have been brilliant. The questions were really good and really searching. Like Miranda says, there are quite a few other questions in there that we couldn't quite get too but the ones that we could get to, I thought were very good and I hope you'll agree that the panellists had a very good go at answering them. So thank you very much, indeed to the panellists for your input.

And thank you to the team that has put this together a huge amount of work in the background to put this on. Thank you very much for them and a particular thank you to, Miranda, for a great job of comparing and I'd really like to acknowledge her role in leading the team that put together the Pathway document. I think that that work, as James said, was a fantastic exercise in developing and building consensus and so I think Miranda's leadership of the team that did that was absolutely fantastic. So thank you very much indeed.

So lots of thank yous but what I'd really like to finish on is imploring, if that's the right word, you and your networks to feedback on the document. We really do want to hear what you think about it and where we could make it better, because the consensus that I mentioned right at the top, being so important to us, is something that we want to build on, so that we can help to align the industry, so that we all pull in the same direction; which I think is a key part of achieving what so many of the panellists have said about making the National Digital Twin actually work and actually deliver value and actually benefit people. We invite and implore your feedback on that and to join us on this journey which, if this panel and the questions are anything to go by, is a pretty exciting journey.

Thank you very much indeed.