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Ecolibrium



New reality

Data ontology explored.



New reality

Each year, buildings produce greater quantities of data. But to make the most of these information riches, we need a way of organising and analysing them. Say hello to data ontologies.

AIRAH's **Big Data and Analytics Virtual Forum 2021** culminated in a panel session on data ontologies. Here, we offer some highlights from the conversation, chaired by **Jonathan Clarke, M.AIRAH**, from Dexus, with panellists **Evren Korular, M.AIRAH**, from Schneider Electric; **Richard McElhinney** from Project Haystack; and **Carl Agar** from A.G. Coombs.



Jonathan Clarke, M.AIRAH



Evren Korular, M.AIRAH

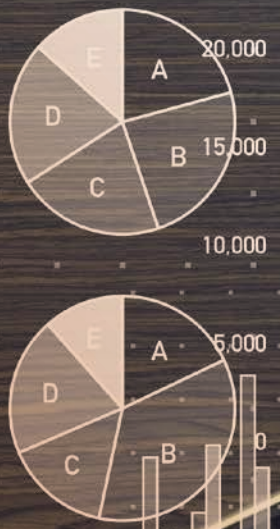
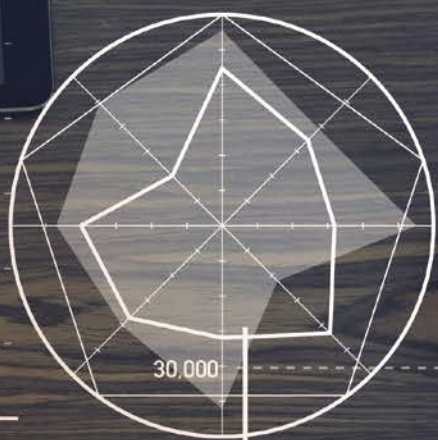
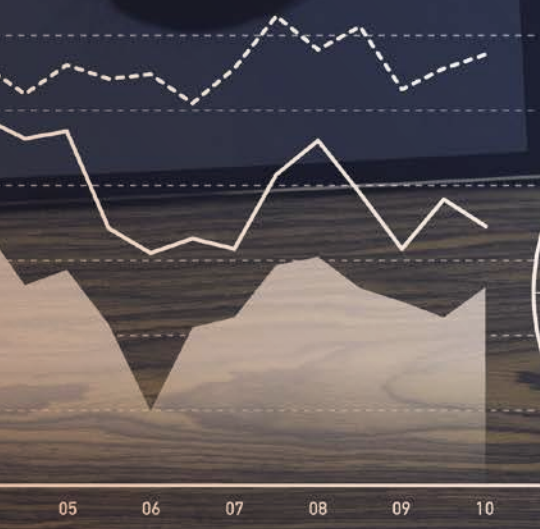


Richard McElhinney



Carl Agar

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(-35)	(+580)
MBC	LJH
3,605	9,542
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	WFF
	12
	(+12)



WWE 890 (-20)	PLO 6,350 (-200)	EER 10,985 (+580)	QRT 665 (-15)	OPY 6,800 (-115)
MJB 2,609 (+35)	PON 7,654 (+169)	NFR 6,522 (+122)	UGH 1,632 (-54)	OMJ 3,652 (+182)
MMJ 7,100 (-60)	IIT 7,150 (-150)	KLM 782 (+74)	CCX 1,901 (+101)	EMH 3,280 (-120)
HJM 134 (+5)	QLC 2,022 (-18)	LSD 631 (+40)	SDH 6,287 (-57)	GHS 12,630 (+330)

The name may sound esoteric and abstract, but data ontologies are in fact straightforward and practical. Whether it's Brick, Haystack, VBIS, or something else, their purpose is essentially the same: to allow better analysis of the built environment by defining the properties and relationships of specific objects.

For example, within a building we have a chiller. This chiller has a number of properties: type of chiller, make, model, location (in the building as well as city), year of manufacture, commissioning and maintenance history. It also has other objects related to it: a compressor, pumps, sensors, refrigerant, an HVAC system, and electrical system. These relationships connect in different directions – upstream and downstream.

To analyse all this data and make buildings perform better, we need a framework that can capture and organise these myriad properties and relationships. The data ontology is that framework.

Jonathan Clarke: What is a data ontology, how does it relate to our industry, and why is it so important?

Carl Agar: It's a skeletal framework for knowledge – a description of things and relationships. There are actually several layers to the ontology, which can be self-contained, such as Haystack or Brick, or integrated as you go.

Evren Korular: From an information technology point of view, it represents a controlled vocabulary. From our

point of view, it's a machine language that describes the important aspects of the building. And in layman's terms, it's the relationship underlying the systems. If you can define the ontology, that enables the developers to write software applications that can discover relationships and are not confined to a single technology.

Richard McElhinney: As both Carl and Evren describe, an ontology is a way to model complex relationships and to find the links between different things. But an ontology also relies on things like a vocabulary or a taxonomy to help bring all of the rich meaning to those relationships. And the ontology is really how we capture all that information and make relationships between different entities, whether it's an air handler, or a chiller, or a temperature sensor. It's how we make relationships between these items and model complex systems.

JC: When was the first time you learned about an ontology?

CA: Quite a long time ago, when I was looking at Haystack. I was one of the founders of the VBIS standard. I'd been looking at it from the point of asset management, and being able to compare different asset databases in a like-for-like way. As part of that, A.G. Coombs have got a building tuning group, and Haystack's just been part of the vocab.

RM: I was one of the very early adopters of Haystack, back in 2011. I was doing a lot of work with building data analytics and SkySpark, and it's not a trade secret

that a lot of the intellectual property for Haystack has come out of that particular product and SkyFoundry.

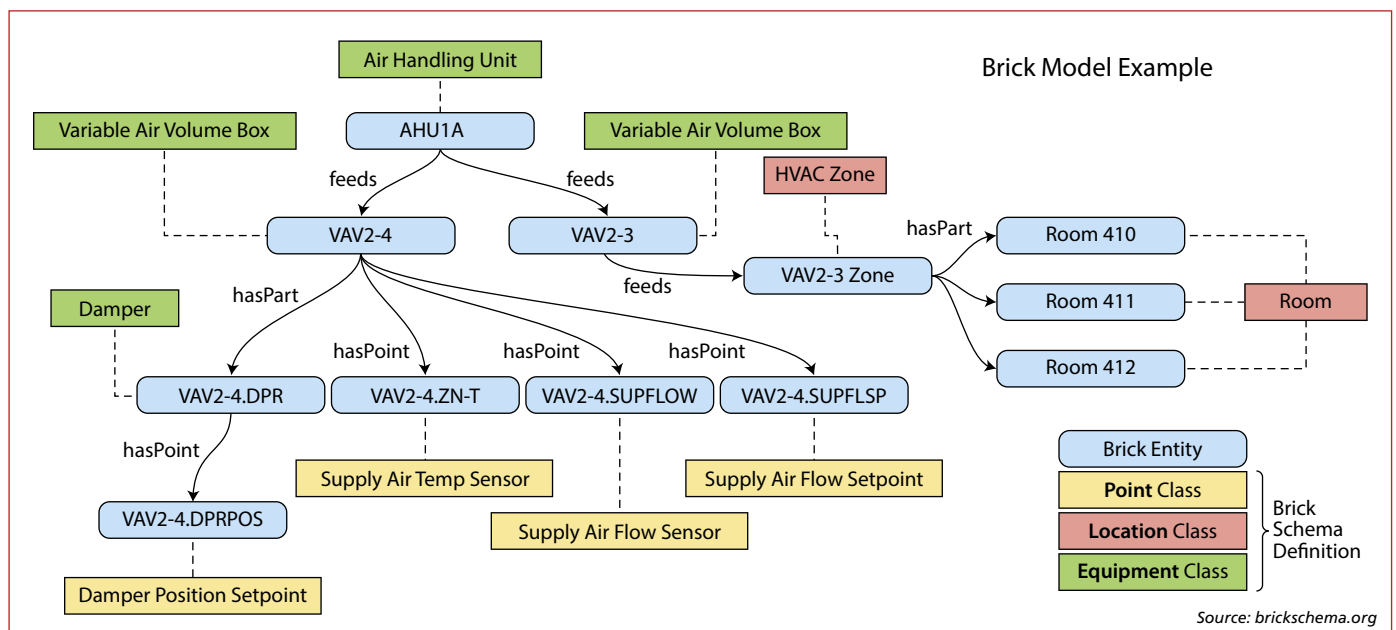
So, I've known the principles of SkyFoundry for a long time, and I worked with them in the early days because you could see the power of the ontologies. Creating relationships and doing these complex models was limitless – you could just traverse these graph databases, do comparisons and queries, and all sorts of really innovative things that no one had ever seen back in 2011. I make it sound like it's ancient history, but it's only 10 years ago!

As we have this explosion in data and in awareness of the richness of mining that data, it's now becoming understood just how powerful these relationships are.

EK: The data is so important, we all realise that's the case. But we had to create our data libraries in the Schneider's digital twins, and we needed to decide the best way to do it.

We didn't start with a specific ontology – we created our own based on naming standards, and we did the tagging ourselves. When we started this journey, ontologies were not prominent enough.

As we moved forward, we understood how critical open source is. That's why we moved to Brick. But we also understand that in some cases we need to use interchangeable ontologies like Haystack. So we're building our ontologies on Brick, but we understand that the technology is moving and industry is flexible, so you need to be able to adapt.



Source: brickschema.org

JC: ou've mentioned VBIS, Haystack and Brick. We've got lots of different standards – which is the best?

CA: Haystack, Brick and VBIS are really the one standard – they're just different levels. Brick is providing the connectivity, Haystack's providing a standard at the sensor level, and then VBIS is providing a standard more at the equipment level.

If we start down at the Haystack level, I've got a sensor alarm that has gone off. I'll work out it's on a chiller, and then I work out I've got a problem with that particular chiller. As an FM operator, how do I scan my portfolio to find out if I've got other chillers like this and if I have the problem there? What are the conditions – is it environment, the equipment, the model?

That's where you end up with an ontology that might span a city or even a country, and you can find out where they are and start to look at the issues.

It's not a case of one ontology is better than the other. They all have their uses.

JC: We are also hearing about data tagging. If I tagged a temperature sensor, and across my portfolio they're all called the same thing, wouldn't I be able to search that? What extra piece of power does the ontology give me over and above conventional naming?

RM: It could have metadata describing a location – a physical, geographical location as well, whether that be a state, a latitude a longitude, a country or a city. It's the application of metadata and tagging that allows us to add greater and greater contexts.

CA: When it comes to tagging, you're really putting an identifier on something that's a part within a bigger part. It's the camshaft within the engine, and the engine's sitting in a car, but the car is sitting in the carpark, or the car's on a freeway.

I can start with the tag, and I've identified the camshaft exactly, but it's operating things downstream and it's part of a bigger thing upstream.

EK: An object or point may have multiple relationships. It could be depending on equipment, but it shall also contain the location, which building, which level, which country, which city.

It is important that the relationship data from the tags shall be discoverable, hence point naming on its own is not enough. You need to create your objects, and the critical thing is you need to attach metadata to that object.

JC: It sounds like there could be additional effort up front to get this to be engineered correctly, and possibly additional costs. How do you justify the business case to embed an ontology in your designs?

RM: It depends on the technologies you're choosing. There are technologies available today that will actually allow a smart system integrator, particularly in the BMS or HVAC world, to reduce cost and still implement tagging and semantic modelling of the system.



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jump on board this now

Whether or not it's going to make or break your winning a tender, these things are coming. Tagging and semantic modelling is coming at pace towards the industry, and it will be the clever, forward-thinking contractors and system integrators who jump on board this now and position themselves well for the future.

If people are having trouble understanding the costs and the risks associated with that, then it's time to learn. Customers, facility managers and property owners, they're getting smarter about these things. They're learning and they know that they want this. They may not know how to get it today, and structurally, within the industry, how contracts are let, and how the main players work in all these various roles, there's probably still some things to line up. But it is coming.

System integrators should be positioning themselves and, if they're smart, they can deliver the solutions the clients want and actually reduce costs.

CA: It's about speed of information recovery. For example, BIM-MEP AUS are putting the VBIS, OmniClass and Uniclass codes in their objects. If I go to some supplier websites, for example, they've VBIS-coded everything, so I can type in the code and get a selection.

What's the difference of going in the other way and looking for a type of gear and finding pages of information that aren't relevant? It's all time, and the time is where the money is.

So, does it cost any more for an engineer when he's actually selected the equipment in the first place to put a correct code against it in his schedule? Probably very minimal time. But the benefit would flow right through, all the way to the other end of the operation if it's done.

EK: Not having it initially just shifts the cost later on. And then usually you're going to pay multiple times on it.

BIM uses IFCs – industrial foundation classes – so you know that the tags are there. You can actually use them for your estimation and everything you do throughout the life-cycle. So when you're doing an ontology, the key is to have one. It doesn't matter if you're going Brick or Haystack. To have one is the right strategy from the start, and then you can actually increase the maturity of the tagging as you go.



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JC: Coming from a portfolio point of view, if we've got 50 buildings with different types of ontologies, does that cause us a problem? Do we need to find one and stick with it?

RM: There's a business imperative and a technology imperative there. From a business point of view, you'd probably be well served selecting the appropriate technology for your business and the appropriate technology for different layers of your business as well.

Is there a one size fits all? Perhaps not. The reality is that contracts get let to different people. There's not always agreement, even internally, in any business on exactly the best way to go in various situations and it's down to a variety of factors.

It's more about, over time, the different ontologies and technologies achieving a level of either compatibility or translation or the ability to work together. That way you can be free to choose the different technologies that suit the application, confident that your business applications or your third-party service providers can work with them.

We've seen that in protocols, whether it be BACnet and Modbus, and now IOT protocols like MQTT, there's still translation between protocols. Even to this day, it's not one protocol that has ruled our world.

EK: We will have semantics interoperability. If we've got the tagging but we need core data, it doesn't really matter as long as we tag it some way. We have the information there, we will be able to convert that with the tools that we're going to create in the coming years. We already have some tools and we're going to build on it.

JC: How do you see data ontologies applied to retrofit and older buildings?

CA: The interesting thing is that's where it all started. This is all being applied for tuning in existing and older buildings to later compare assets like for like across different databases.

New projects are actually the ones that are catching up. On a couple of projects we're working with they're really pulling the FM part of the project back into the design and construction handover side, and they're starting to ask for these standards for asset databases to be handed over.

From a building owner's perspective, they're looking to project their capital expenditure further into the future. They're really looking at five or 10-year capital expenditure budget for a building.

So now we're going to map out the life-cycle of all the equipment – when it comes up for replacement, and how do we smooth out that curve and stop having peaks of expenditure. You need to start predicting life-cycle a bit better

than saying the chiller will last 25 years. You need to go into the condition of the equipment, the environment it's in, and how to push out the replacement a few years, pull it forward, or whatever.

Then there's more and more public private partnerships (PPPs) coming online. They typically work in a 25-year time-frame and they've got exactly the same issue: how do I make this equipment last for the 25 years and not have to replace it?

RM: I'd agree with that, particularly coming from the Haystack side of things. In our local market we see they're being applied through BMS, equipment and system upgrades, as the life-cycle of systems is coming to an end. We're starting to see some awareness of the application of these sorts of ontologies and technologies, whether it be for analytics or other applications, it doesn't really matter. The point is we're seeing these things and they're coming through building upgrade works, and people are choosing to start to apply them.

JC: Are you seeing very detailed specifications coming through the industry when you're looking at new projects?

EK: Sometimes they're one-liners, sometimes with more detail. But what is missing from those specs is the outcomes they are trying to achieve.

For example, you really want to look at asset life-cycle of equipment but you have no data. Do you expect it to perform for five years or 10 years? Where's the data that backs it up? We need the information so we can look at the typical application of that model and we can see that they start failing after four years. We actually have the proof that we may need to invest more money.

RM: The point about identifying outcomes is one that we need to get across to clients or building owners. Even 10 years ago, when I started doing a few basic building data analytics projects, this was the catch-cry: Work with your customers to figure out what their outcomes are.

Ten years later we're still trying to get people to identify and articulate what the outcome is they're looking for. I'm not saying that clients or building owners are at fault, but as an industry

We're going very much into an IT and data science world now, whereas traditionally it was very much HVAC mechanical/electric.



we need to work with the stakeholders to identify the outcomes. Sometimes that might be about putting forward suggestions or illustrating examples, and sometimes we're actually not very good at putting forward examples like case studies, because we all want to hold on to our own secret sauce or competitive advantage.

CA: We've still got a divide between the consultants and the constructors. The constructors have a very different use for the ontology and the tagging, because they're trying to track equipment orders, shipping to site, install and commission. They're using that equipment for a totally different purpose. But then you have this gap to the FM side.

On a lot of PPP projects, in the construction phase, they still often don't have the engagement of the FM operator, because it might take them two or three years to build it and the FM operator really isn't too interested until they come to the handover.

But I've noticed that increasingly as they do more PPPs and realise how much trouble they find themselves in because they don't understand enough about the operation and how equipment will last, they're taking a lot more interest in it.

The universities or the large super innovation funds that build these things

and want to operate them for quite some time are also starting to take a much keener interest in what happens at the commencement of the design, so that it flows through nicely into FM.

But there's still quite a gap between the end of construction and handing on to whoever's going to run that building.

JC: We're going very much into an IT and data science world now, whereas traditionally it was very much HVAC mechanical electrical. To get this to work properly out the box you've got to have collaboration between some very highly skilled individuals. Are you starting to bring in different skill sets into your organisation, and do you think now we're going to get a new discipline?

EK: We're evolving – we're learning as we go. Thinking about the pneumatic experience that we had and how long it took, 20 years. And DDC [direct digital controls] took many years, and even BMS – it is moving so fast.

The answer is yes. You need to have a converging of the skills of traditional engineers, the IT experts, cloud engineers and data scientists all working together, otherwise you wouldn't be able to manage this.

RM: There is a skills gap in the consulting phase of what we're doing. At Project Haystack we've recognised that, and we are starting to address it with training. There are some people who understand what we're talking about, but a lot of people who don't.

We need to start to raise that level of discourse and raise that awareness. It doesn't mean everyone needs to be able to go and deploy these systems, it doesn't mean they have to know individual products and be able to work with them, but they need to understand what it is they're specifying – how do they look for it, how do they check it?

No matter which technology or ontology we're talking about, or whether it's the construction phase or the operation phase, there are roles for the different technology organisations to play in training the industry. ■

Would you like to know more?

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