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> Maximising deterrent Maximising staff conversionce

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This version of the presentation has been annotated with text boxes to provide a approximate narrative of the talk.

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# Cognitive Work Analysis

When you see the words 'Cognitive Work Analysis' what do you think?

Some of you might think of this, nuclear power stations (not the Simpsons) as after-all this is where CWA started about 30 years ago.

In fact, CWA was developed specifically for these complex sociotechnical systems.

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Some of you might be thinking of this.

An incredibly academic time consuming process that takes too long to learn and apply.

And I am sure there are a few who are probably thinking not again, change the record!





What probably doesn't spring to mind, when someone mentions CWA is this world...

The world of product design and mood boards, fabric swatches, and felt-tips.

It's quite a departure from the research and academic institutes that CWA has tended to be used, but hopefully this presentation will show that its equally at home here.

Because it's here that we are using CWA to support the design of everything from trains to toothbrushes.

## Cognitive Work Analysis

I wanted to call the talk Cognitive Work Analysis in the wild for two reasons.

Firstly, it's about the application of the framework in a practical commercial setting, as apposed to an academic one...

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... and secondly it's about application in the wild west, or the often in unregulated world.

Ironically, it's in this less regulated world that we have the opportunity to pick and chose the methods we want to apply. All too often in highly regulated industries, such as the one CWA was developed for, it's mandated or strongly suggested which approaches to use.

One advantage of applying CWA in the wild west, is that I am often explaining the approach to people who have never heard of it, so when I say "let's use a tool we like called CWA" and explain it, they tend to say "sure that sounds great".



When I suggest using CWA to people who have looked into using it before though, I tend to get two counter arguments

- 1. It takes too long to apply
- 2. It's too complicated to do, and no one really understands it



For many, CWA is viewed as a bit of a bit of dark art, and for a long time it was only really passed down between master and apprentice.

But I think that trend has definitely changed, there are some great researchers like Neelam Naikar in Australia who picked this up from the text – breaking this disciple relationship.

So it's certainly possible to do it, and arguably, given the body of literature on the topic its easier than ever.

So enough of the rhetoric,

Let's take an example to hopefully challenge some of the assumptions about the complexity and time taken to apply CWA.

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I have deliberately picked a product that I haven't designed for a number of reasons. Firstly, confidentiality is critical in product design and whenever I have asked clients about discussing their case study in public, I tend to get the same response. "Surely this is giving too much away" – then many of them say, "you can show the HTA and the manual handling assessment stuff – that's fine, but this stuff is far too sensitive."

Secondly, I wanted to show how it's a great way of exploring a new domain in a structured way.

Finally, I wanted to pick something that's hopefully familiar to all of you, because I want the focus to be on the approach rather than the domain. It's also fairly complex and socio-technical in that it relies both on humans and technology to work effectively.

WARNING:

CHOKING HAZARD Small parts. Not for children under 3 years.

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So let's start by defining exactly why this system exists...

If we make the assumption that this is the scanner for hand luggage, then we can have a stab at defining it as something like this...

> Reduce the threat to aircraft posed by passengers

So now we have defined why it exists we should turn our attention to how we assess how well the system is performing.

The system has a number of stakeholders, but let's start with these guys, the passengers. If we were to ask them what is most important to them about the system, what might they say?





Minimising training burden

Other stakeholders in the system such as the operations manager, or the head of security, might talk about different values to the passengers.

This might include minimising costs and training from an operation perspective.

Or thinking more about maximising deterrent, system reliability and staff comfort and convenience.

Maximising deterrent (maximising perception of threat detection)

> Reducing breakdowns (maximising equipment availability)

Maximising staff comfort and convenience



What we generally find though is that all the stakeholders in the system tend to care about all of these things. No one wants a system that is unsafe, massively expensive to run, causes discomfort to the operators, or makes customers unhappy. However, they do tend to place these priorities in different orders.

The problems sometimes come in when some stakeholders aren't considered, or stakeholders with more power, such as those holding the purse strings, impose their value priorities on the project without really taking a holistic view of system performance





So as an example if we asked two of the stakeholders to rank order the values we might expect to see something like this.

The senor management guy is likely to place stuff that relates to his targets at the top, i.e. the stuff that is easily measured like cost, and queue times.

Whereas the safety guy, is going to focus on the core part of his job, the real and perceived threat to the system. Minimising cost

Maximising efficiency

Maximise efficacy of threat detection

> Maximising equipment availability

Maximising passenger convenience

Minimising error (false alarms)

Maximising deterrent

Maximising staff convenience

Maximise efficacy of threat detection

Maximising deterrent

Maximising staff convenience

Maximising efficiency

Minimising error (false alarms)

Maximising equipment availability

Maximising passenger convenience

Minimising cost





And if we compare these they are likely to be quite different.

So as discussed, it's rarely that they don't care, about the things lower down their lists it's simply that they are more focused on the stuff towards the top. Minimising cost

Maximising efficiency

Maximise efficacy of threat detection

> Maximising equipment availability

Maximising passenger convenience

Minimising error (false alarms)

Maximising deterrent

Maximising staff convenience

Maximise efficacy of threat detection

Maximising deterrent

Maximising staff convenience

Maximising efficiency

Minimising error (false alarms)

Maximising equipment availability

Maximising passenger convenience

Minimising cost



DCA Reduce the threat to aircraft posed by passengers								Domain purpose
Maximise efficacy of threat detection	Maximising deterrent	Maximising staff convenience	Maximising equipment availability	Minimising error (false alarms)	Maximising efficiency	Maximising passenger convenience	Minimising cost	Domain values

Domain functions

So when working with multi-disciplinary teams, or at board levels, it's often very useful to bring all these considerations together and explicitly map them out.

And this is where the most commonly used tool in CWA comes in, the Abstraction hierarchy.

At the very top of the diagram, the domain purpose, we list out the reason why the system exists. As we defined at the start this is to reduce passenger threat to air travel.

Next we define, at a high level, the metrics that we can use to assess system performance – from our stakeholders.

Physical functions

Physical objects



Domain functions

As we link these up, we can start to see that we can reduce threat by maximising threat detection and deterrent.

We can also see a link between staff convenience and equipment availability; however, its hard to link the remaining values. This tends to suggest that our domain purpose is not quite right.

If the sole purpose of the system is on safety, we would not really care about efficiency, false alarms or cost of passenger experience

Thus we need to tweak the purpose.

Physical functions



Domain functions

Physical functions

By adding the caveat to our functional purpose, or mission statement, the remit of the system can be adjusted to include the other measures of performance that stakeholders care about.

Physical objects



#### **Standard features**

6 Colour image display (normal industry standard is only 3 colour); 9 Quadrant zoom: Auto image archiving 50,000 Images; Auto Z-Number measurement: Baggage counter; Colour and black / white imaging; Continuous Scanning; Continuous Zoom 2X to 32X: Density alert; Edge-Enhancement imaging; Geometric image distortion correction; High penetration function; Heavy duty roller castors; Image annotation; Image Review (100 Images); Manual archive: Material discrimination: Multi-Tier accessibility; Network ready;

Thus far we have been looking at the system top-down at a managerial level. However, those developing the product don't always share this focus. For the individual component engineers this is often far to fluffy and completely abstract. System performance for engineers is about more RPMs on your belt speed, more pixels on your image resolution. So how do

Physical

these far more concrete measurable relate to threat levels and notions of customer satisfaction? That's where the powerful bit of the abstraction hierarchy comes in.

Standard features (cont.) Operator training program; Organic / Inorganic imaging; Picture perfect; Print image capable; Pseudo Colour; Real-Time image manipulation; Real-Time self diagnostics; Reverse monochrome; Vertical zoom panning. Operational Penetration & Sensitivity

Contrast Sensitivity: 24 Visible levels 4,096 Grey levels; Penetration: 39mm Steel typical, 37mm Standard; Sensitivity: 40 AWG typical, 38 AWG Standard; Spatial resolution: 1.0 mm horizontal, 1.0mm vertical. Bi-Directional conveyor; Construction: Custom steel frame / panels; Conveyor belt : Seamless low maintenance ; Conveyor height: 73cm from floor; Conveyor maximum load: 165 kg evenly distributed; Conveyor Speed: 0.23 Metres per second in both directions; Levelling: Adjustable screw jack levelling feet. Motor: Sealed drum, maintenance free; Scanner dimensions: L 132cm x W 77cm x H 123cm; Scanner weight: 355 kg; Tunnel opening: Width 53mm x Height 35mm;





















So returning to the commonly cited criticisms of the approach, namely that

1. It takes too long to apply and

2. It's too complicated to do, and no one can understand it

I would argue that its certainly no worse than any other approach we have to hand in terms of time, I frequently construct these kind of diagrams in meetings with clients when being briefed on a project. It's a great way of structuring a process of transferring a lot of information about the scope, scale and constraints of a project.

When it comes to the complicated concern, there is a learning curve and an adjustment in the way of thinking. But, perhaps contentiously, I would argue that if we aren't doing this, or something similar we are just ignoring the complexity in the system and designing at risk.

When applying CWA and trying to get engagement it helps....





@danielpjenkins