



# Human Factors in the digital world

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Digital technologies are changing the way we work

Digital technologies are changing the way we practise E/HF



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Economy**  
Transforming Business and Society



# My pathway



1994

2016

Virtual Reality  
side effects

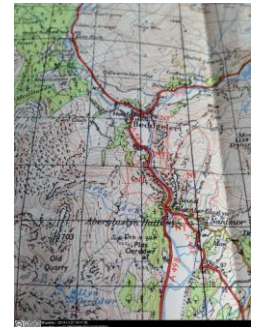
Virtual Reality  
usability

Workload and  
decision  
making

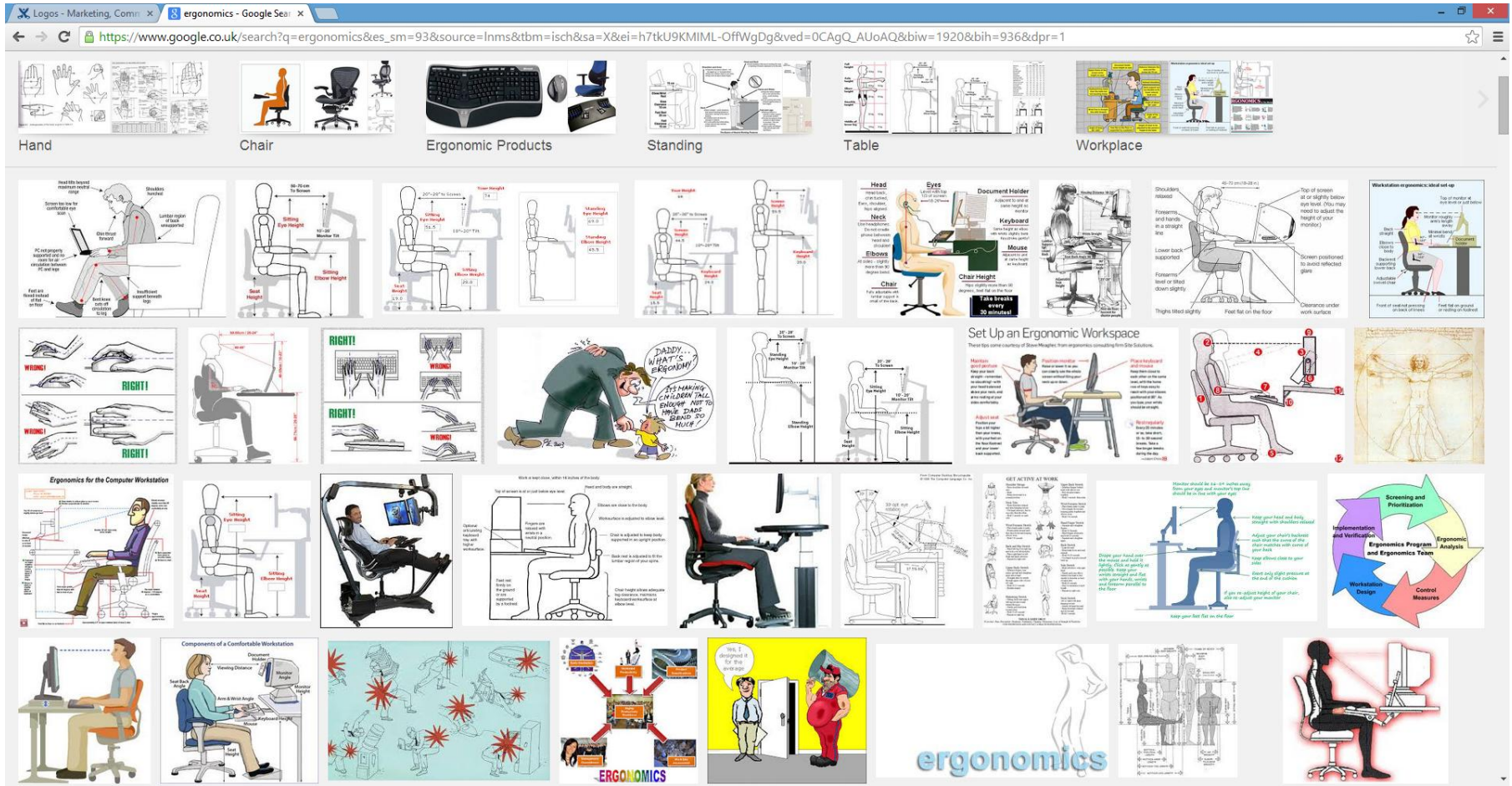
Automation  
and systems  
analysis

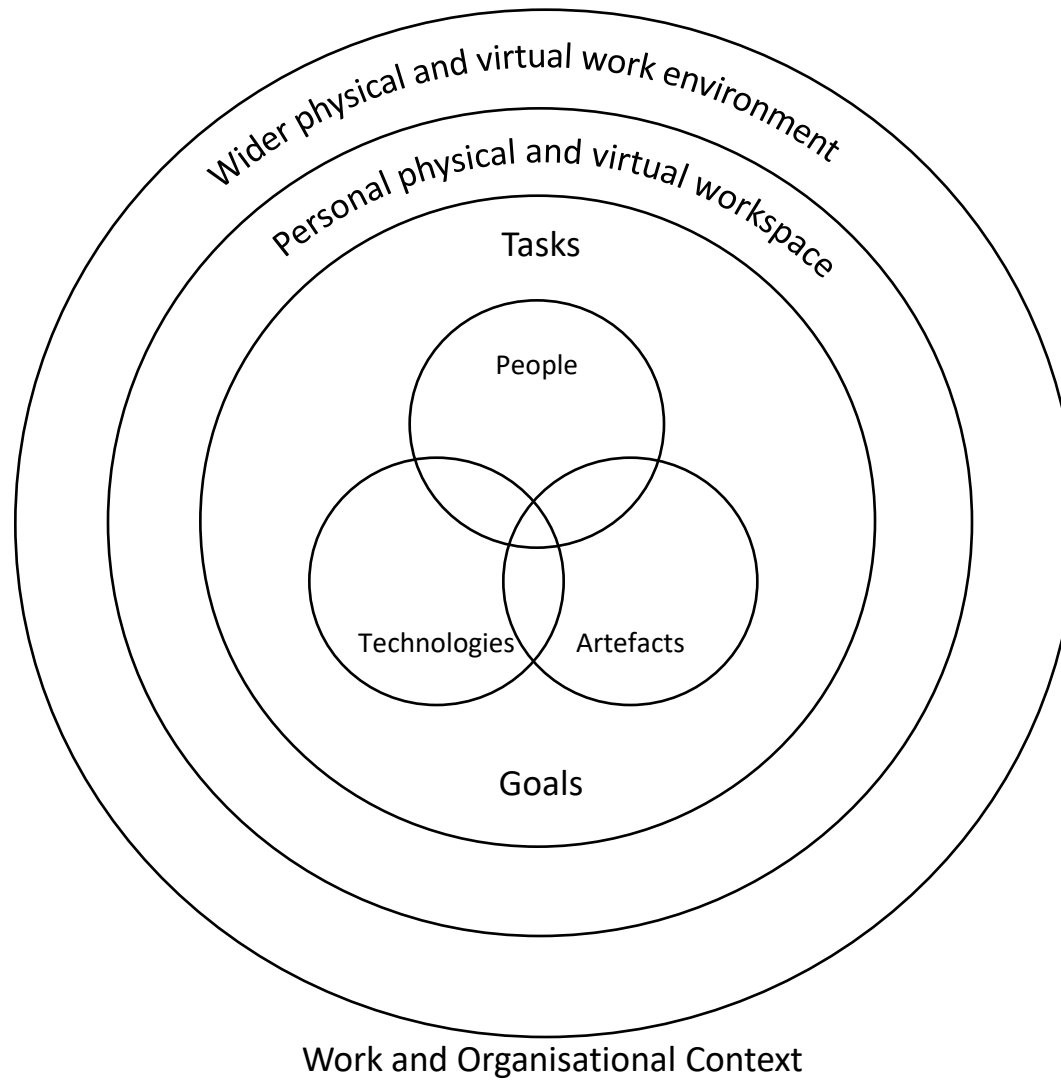
Personal,  
shared and  
distributed  
technologies

Distributed  
sensing and  
data



# Ergonomics/human factors is about more than chairs....





### Better Work Design

Human-system  
interaction  
Workplace layout  
Workload  
Job design

### Better Work Performance

Human reliability  
Skill utilisation  
Team working  
Decision making

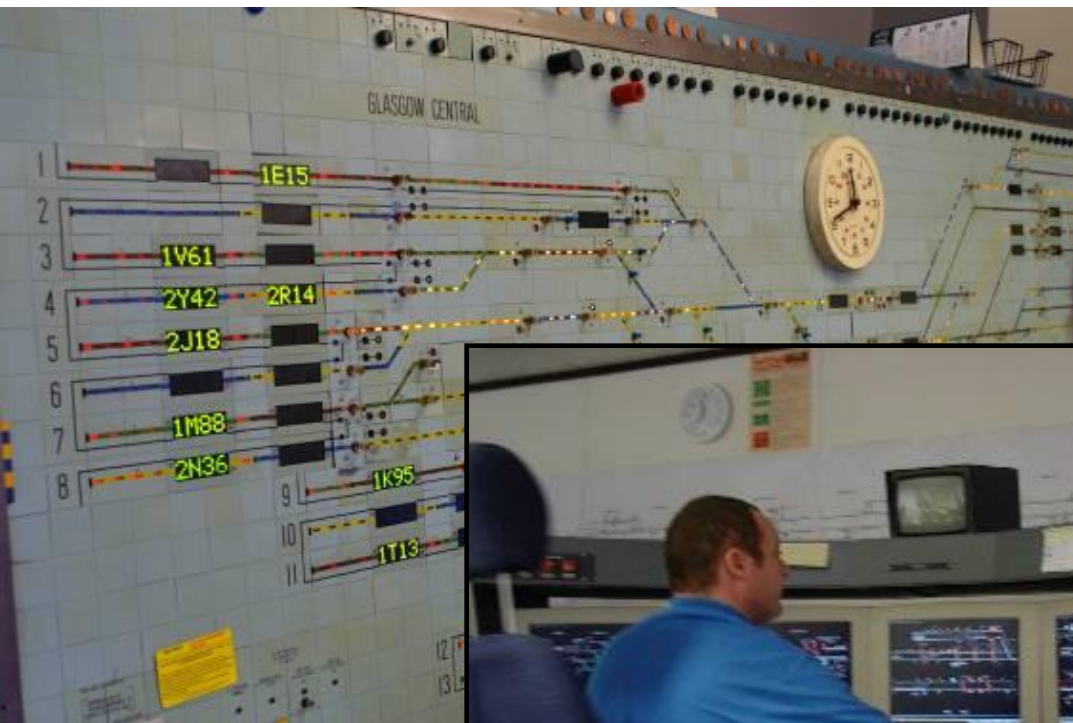
### Better Work Culture

Sickness  
Absenteeism  
Labour  
turnover/retention  
Behaviour/compliance

Financial constraints and priorities  
Technical developments and capabilities  
Legal and regulatory framework  
Social influences, expectations and norms

Wilson, J.R. & Sharples, S. (2015)  
Method in the Understanding of  
Human Factors. In J.R. Wilson & S.  
Sharples (Eds.) (2015) *Evaluation  
of Human Work: 4<sup>th</sup> Edition*. Boca  
Raton: Taylor & Francis.

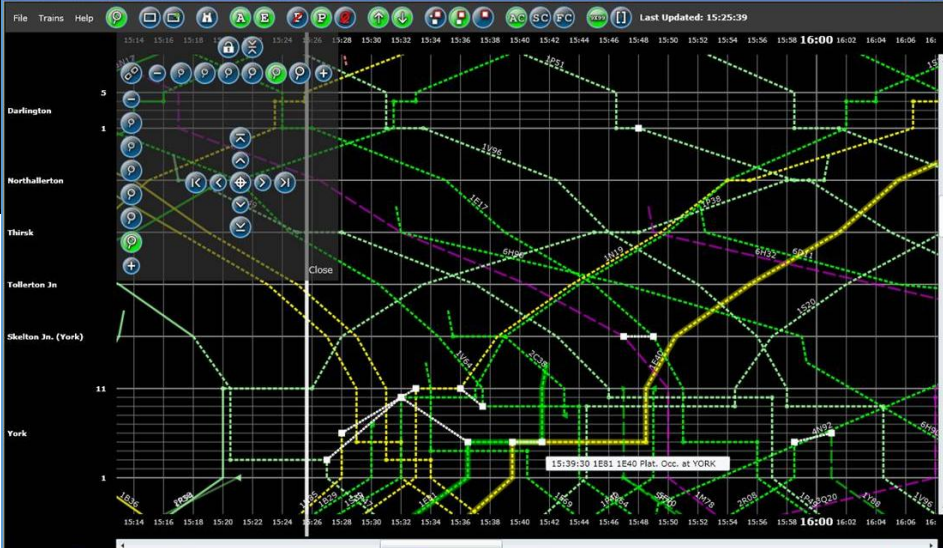




Control



Monitoring



Planning and anticipation



## Summary of Levels of Driving Automation for On-Road Vehicles

Level 0	No automation
Level 1	Driver assistance
Level 2	Partial automation
Level 3	Conditional automation
Level 4	High automation
Level 5	Full automation

1	<b>Driver Assistance</b>	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes	Assisted	1
2	<b>Partial Automation</b>	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	<b>System</b>	Human driver	Human driver	Some driving modes	Partially automated	2
<b>Automated driving system ("system") monitors the driving environment</b>			System	<b>System</b>	Human driver	Some driving modes		
3	<b>Conditional Automation</b>	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>					Highly automated	3
4	<b>High Automation</b>	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	<b>System</b>	Some driving modes	Fully automated	3/4
5	<b>Full Automation</b>	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	<b>All driving modes</b>	.	



10. The computer decides everything, acts autonomously, ignoring the human
9. Informs the human only if the computer decides to
8. Informs the human only if asked, or
7. Executes automatically, then necessarily informs the human, and
6. Allows the human a restricted time to veto before automatic execu
5. Exe
4. Suggests one alternative
3. Narrows the selection down to a few, or
2. The computer offers a complete set of decision/action alternatives, or
1. The computer offers no assistance; human must take all decision and actions.

## Information vs. Partnership

Parasuraman, Sheridan and Wickens (2000)

# What are the consequences of automation?

If the-human operator must monitor the details of computer decision making then, ironically, it is necessary for the computer to make these decisions using methods and criteria, and at a rate, which the operator can follow, even when this may not be the most efficient method technically.

If this is not done then when the operator does not believe or agree with the computer he will be unable to trace back through the system's decision sequence to see how far he does agree.

Bainbridge, L. (1983) Ironies of Automation. *Automatica*, Vol. 19, No. 6. pp. 775 779.



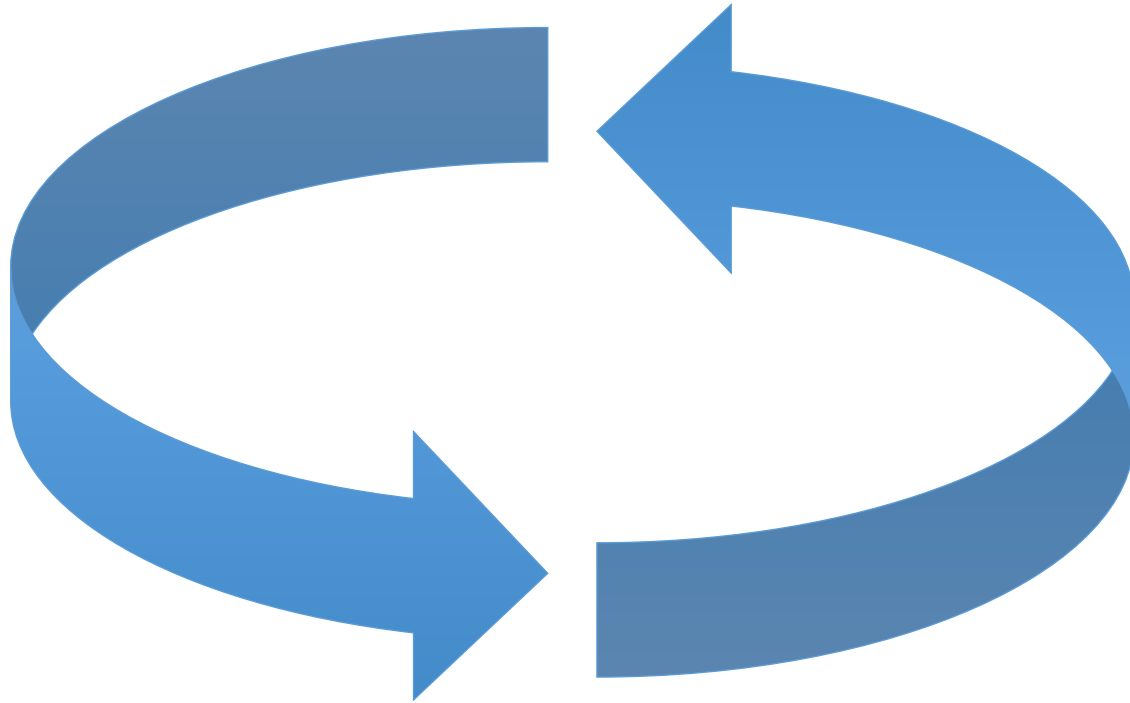
Creative  
Commons:  
Highways  
Agency



From this



To this



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# The notion of the workplace







# In fact, the workplace often looks like this....









Work has changed on a cognitive level

Work has changed on a practical, physical  
and organisational level

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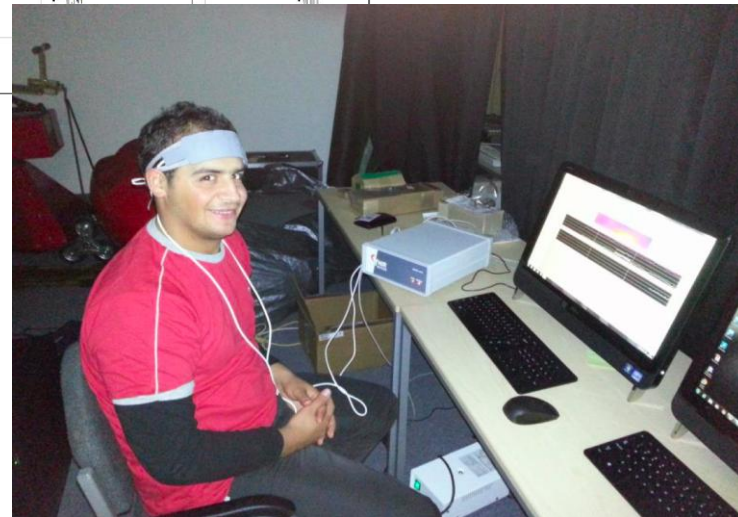
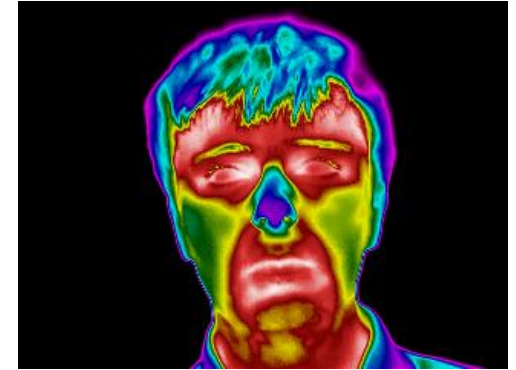
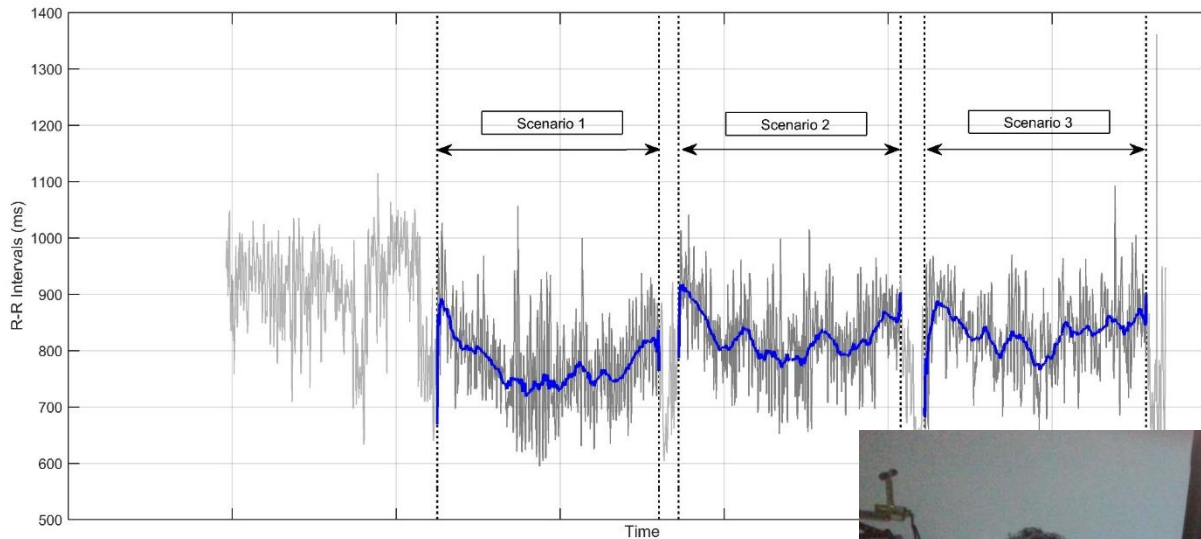


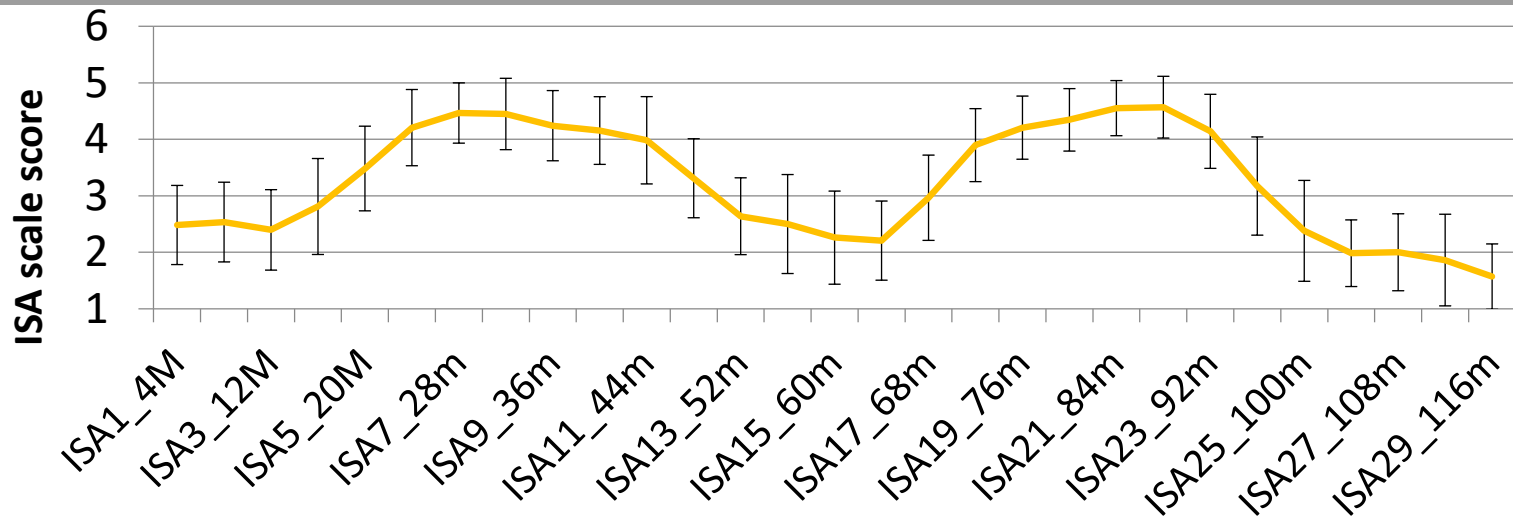
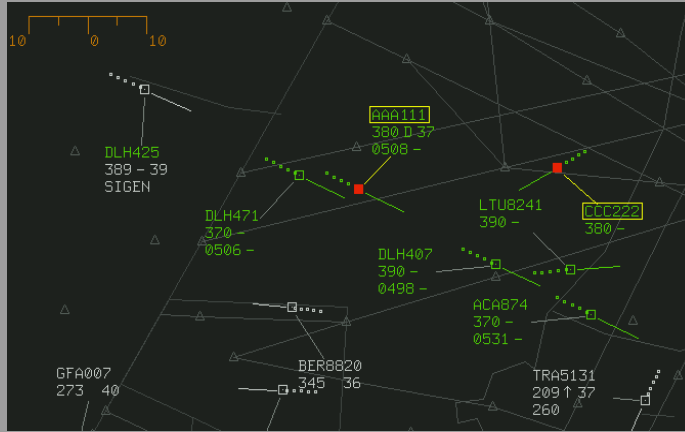
# From work to life

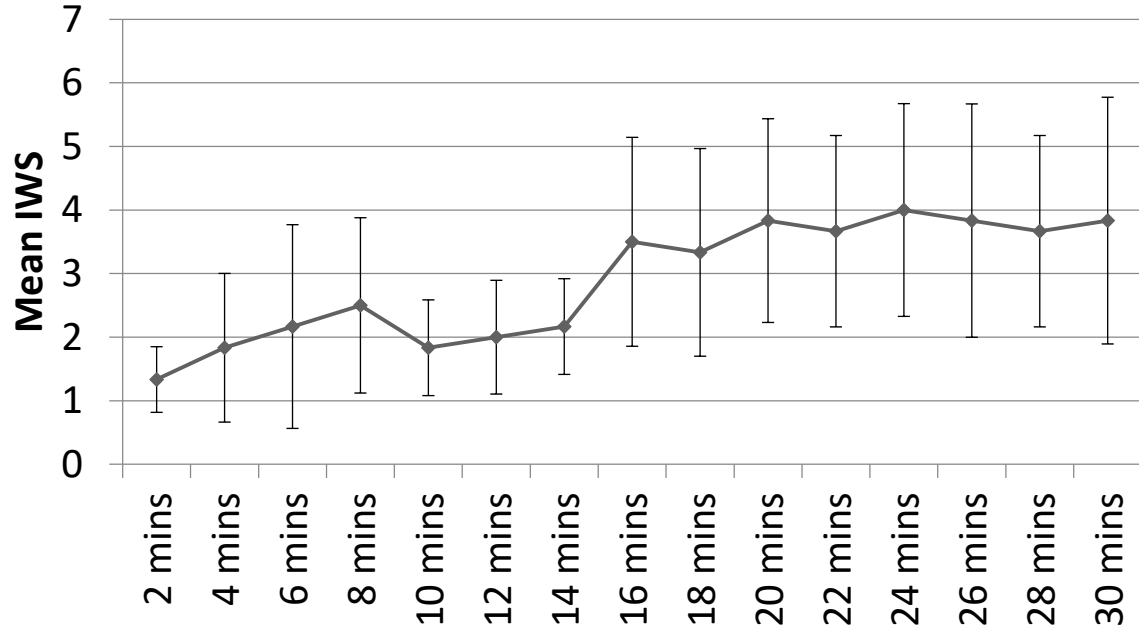




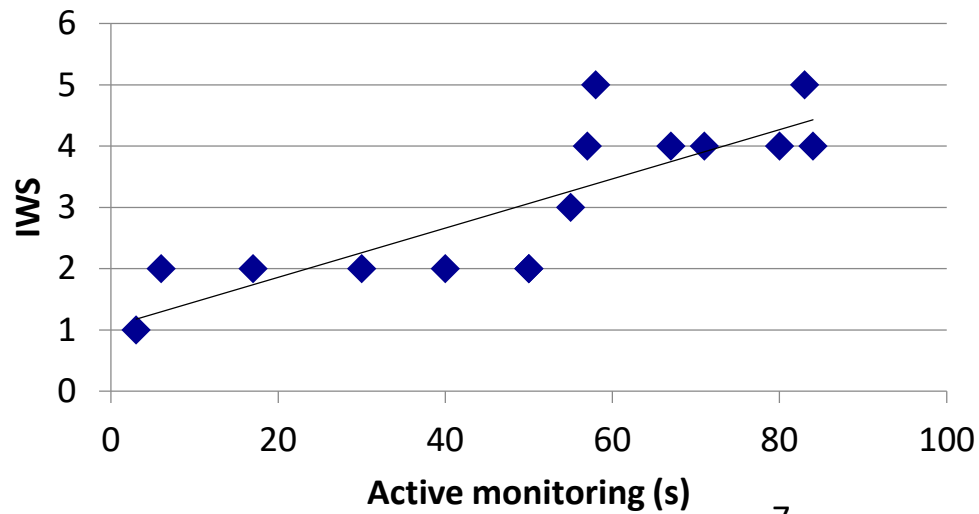
# Monitoring and sensing work





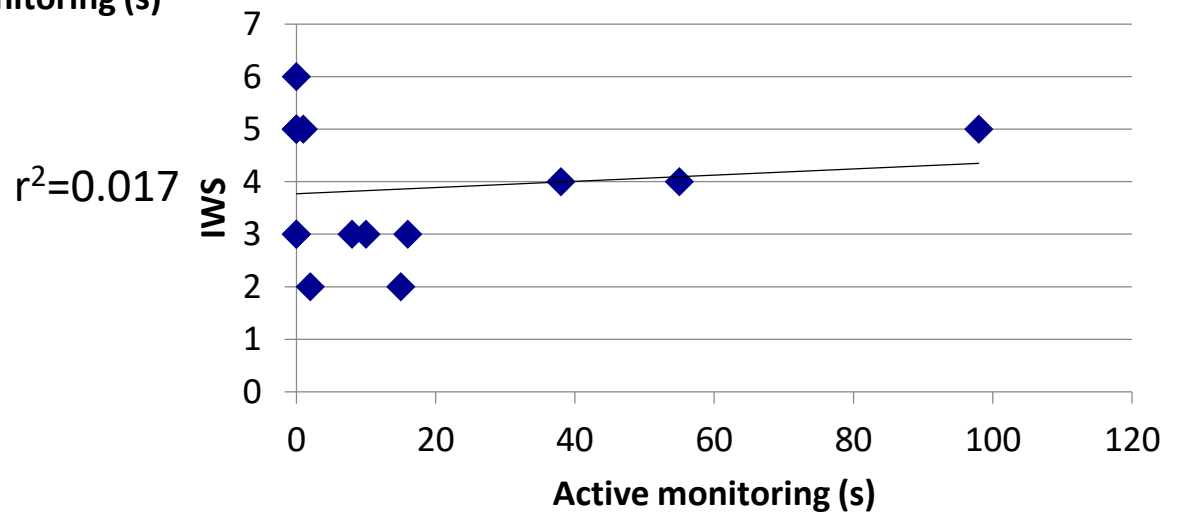






$$r^2=0.687$$

Different signallers' data demonstrated different relationship strengths



$$r^2=0.017$$

# Changing the type of data we have access to



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# Changing our analytical approach

	1	2	3	4	6	7	8	9	11	12
Count	5.00	21.00	9.00	29.00	4.00	0.00	17.00	9.00	26.00	32.00
Expected Count	12.47	16.17	10.63	20.79	13.40	6.01	12.01	13.40	19.40	27.70
% within scenario	18.52	60.00	39.13	64.44	13.79	0.00	65.38	31.03	61.90	53.33
Std. Residual	<b>-2.12</b>	1.20	-.50	1.80	<b>-2.57</b>	<b>-2.45</b>	1.44	-1.20	1.50	.80
Adjusted Residual	-3.01	1.73	-.71	2.64	-3.67	-3.41	2.04	-1.72	2.19	1.20
Count	6.00	8.00	4.00	11.00	11.00	3.00	4.00	7.00	4.00	11.00
Expected Count	5.66	7.34	4.82	9.44	6.08	2.73	5.45	6.08	8.81	12.50
% within scenario	22.22	22.86	17.39	24.44	37.93	23.08	15.38	24.14	9.52	18.33
Std. Residual	.14	.24	-.38	.51	<b>1.99</b>	.17	-.62	.37	-1.62	-.40
Adjusted Residual	.17	.29	-.44	.62	2.35	.19	-.73	.44	-1.95	-.50
Count	16.00	6.00	10.00	5.00	14.00	10.00	5.00	13.00	12.00	17.00
Expected Count	8.86	11.49	7.55	14.77	9.52	4.27	8.53	9.52	13.79	19.70
% within scenario	59.26	17.14	43.48	11.11	48.28	76.92	19.23	44.83	28.57	28.33
Std. Residual	<b>2.40</b>	-1.62	.89	<b>-2.54</b>	1.45	<b>2.77</b>	-1.21	1.13	-.48	-.60
Adjusted Residual	3.05	-2.09	1.13	-3.34	1.86	3.45	-1.54	1.44	-.63	-.80
Count	27.00	35.00	23.00	45.00	29.00	13.00	26.00	29.00	42.00	60.00
Expected Count	27.00	35.00	23.00	45.00	29.00	13.00	26.00	29.00	42.00	60.00


$$r^2$$

$p < 0.05$



# Some challenges for the future

- E/HF as a distinct discipline
  - “Chartered status has conferred recognition, at the highest level, of the uniqueness and value of our scientific discipline”
- Embracing technology, and the change it brings
- Managing legacy
- Getting the most from our varied research approaches

{ Anthro  
Nomos  
Ergos

man  
law or  
work.

# Human Ergonomics

Vita

life

Actio

activity

“What the world needs is ergonomics, not ergonomists”

Hywell Murrell ~1950s

Source: Waterson, P. & Sell, R. (2006) Recurrent themes and developments in the history of the Ergonomics Society. *Ergonomics*, **49** (8), 743-799.

E/HF may not always be about delivering the right solution(s), but it is always about delivering the right approach  
Sharples & Buckle (2015)

Source: Sharples, S. & Buckle, P. (2015) Ergonomics and Human Factors as Reflective Practice. In J.R. Wilson & S. Sharples (Eds.) (2015) *Evaluation of Human Work: 4<sup>th</sup> Edition*. Boca Raton: Taylor & Francis.



# Thank you



@scsharples