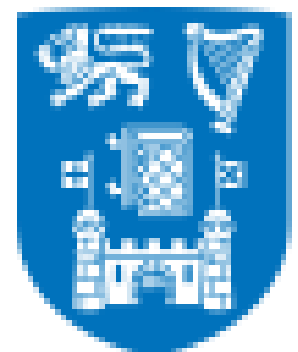


# Human Factors & Ethics Canvas (HFEC): Addressing Ethics, Diversity & the Triple Bottom Line

Dr Joan Cahill, Centre for Innovative Human  
Systems (CIHS), School of Psychology, Trinity  
College Dublin, Ireland



**Trinity College Dublin**  
Coláiste na Tríonóide, Baile Átha Cliath  
The University of Dublin



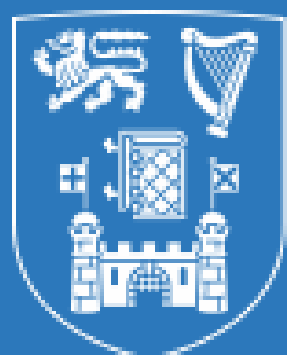
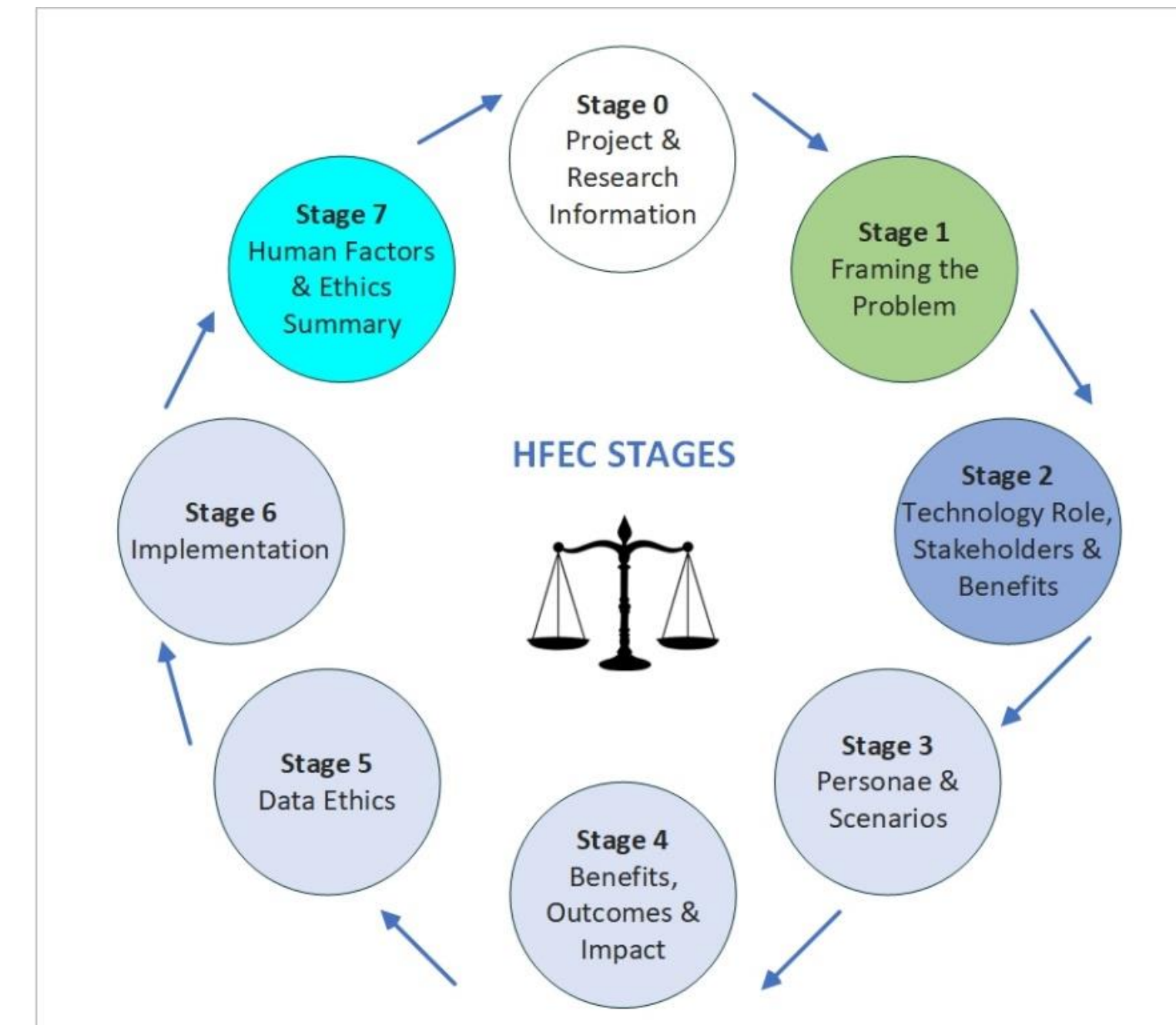
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PROCESS  
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# Webinar Overview

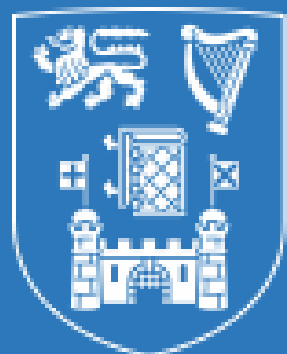
1. Introduction
2. A/IS & Ethics Challenge
3. Starting point – concepts & disciplines
4. Triple Bottom Line
5. Addressing Uncertainty & Impact
6. Human Factors & Ethics Canvas (HFEC)
7. HFEC Stages
8. Case Studies
9. Conclusions
10. Publications





# Introduction

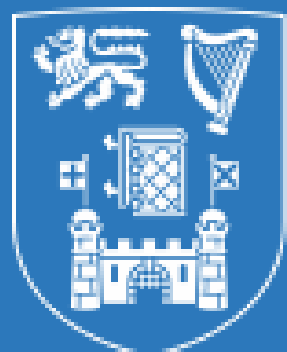
- **Dr Joan Cahill**
- Centre for Innovative Human Systems (CIHS)
- School of Psychology, Trinity College Dublin
- Human Factors, Ethics, Behaviour Science
- Technology-based supports and interventions
- Human Factors/Systems approach





# A/IS & Ethics Challenge

- Technologies might be designed to be legal, profitable and safe in their usage
- But narrowly conceived from an ethical standpoint...
- **New technologies (including innovative AI & ML components) raise macro ethics questions concerning**
  - (1) the intended use and purpose of technology
  - (2) the role of the person
  - (3) the impact of these technologies on our behaviour and activities (including potentially negative consequences)
  - (4) societal values



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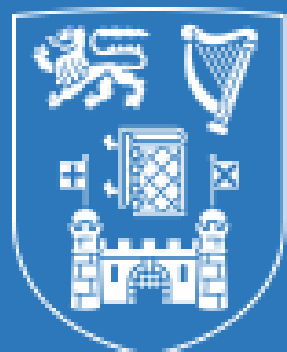
# A/IS & Ethics Challenge

1. **Contribution to human wellbeing**
2. **Gap between the intended use** of a system and its use in terms of what is **implemented**
3. **Psychosocial effects** of certain technologies are not always apparent
4. **The beneficent uses of technology have a way of being co-opted for other purposes**

**Uncertainty**



*The primary problem for the ethics of emerging technology is the problem of uncertainty. That is, how to deal with the uncertainty of future products, uses and consequences, and associated ethical issues that will result from an emerging technology (Sollie, 2007).*





# Concepts

## Progress

- Improvement
- Quality of life, lived experience (OECD, 2019)



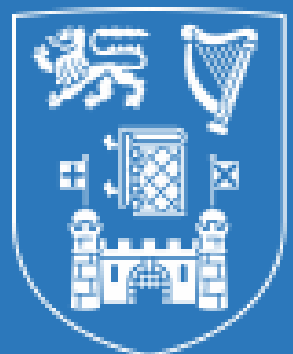
## Identity & Diversity

- **Identity:** three pillars: the person, the role and the group
- **Diversity:** condition of having or being composed of differing elements (variety)
- Inclusion of different people



## Wellbeing

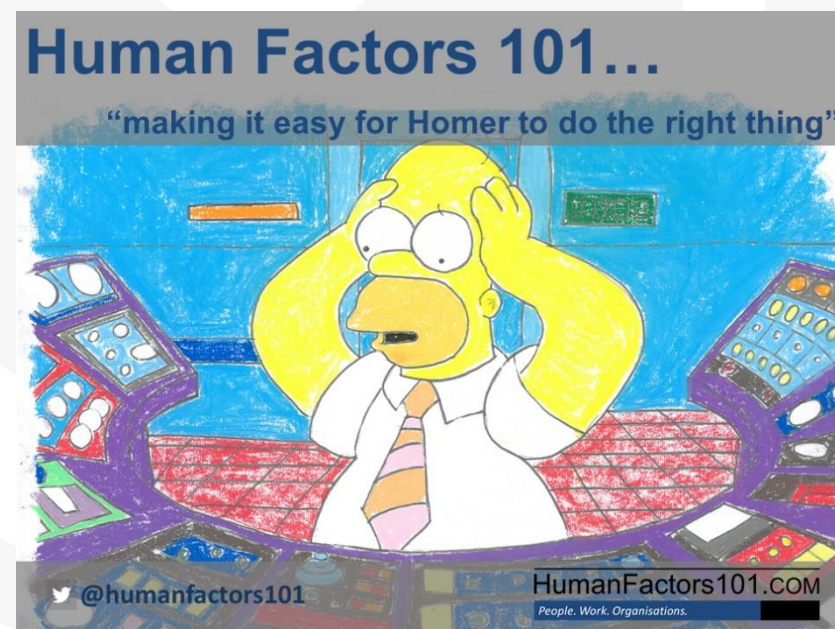
- 3 pillars of wellbeing as defined in the ‘**biopsychosocial model**’.
- **Biological**
- **Psychological**
- **Social**



# Disciplines

## Human Factors

- The practice of designing products, systems, or processes to take proper account of the interaction between them and the people who use them (ISO 6385)



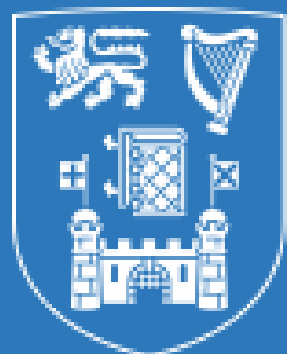
## Ethics

- Ethics concerns the moral principles that govern a person's behavior or how an activity is conducted (OED, 2019).



## Behaviour Science

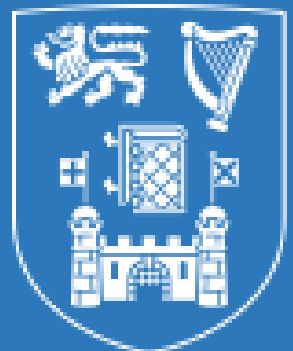
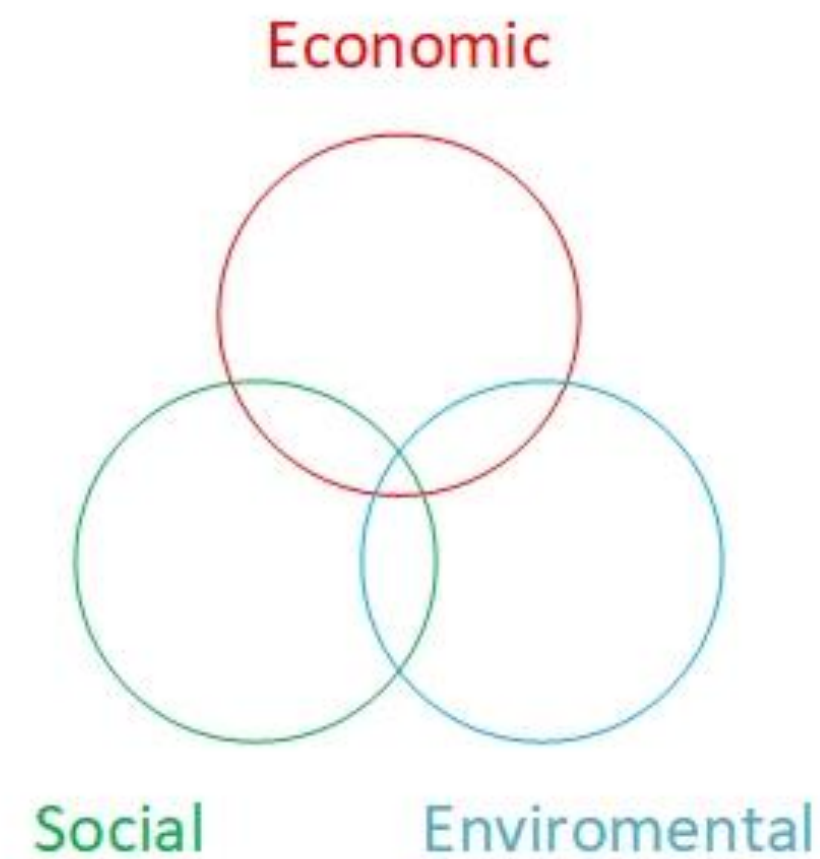
- Human behaviour is determined by a complex interrelationship of many different factors (including personal, environmental, and psychological factors).
- Behaviour models focus on understanding the psychological factors that explain or predict a specific behaviour
- Models of behaviour change seek to explain the factors that contribute to behaviour change and/or how to change behaviour.





# Triple Bottom Line (TBL) & Benefits

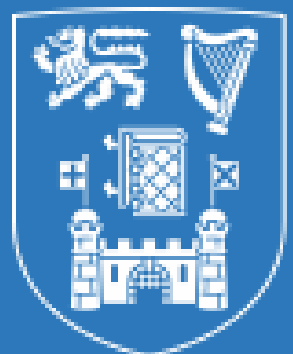
Human activity must not compromise the long-term balance between the  
**(1) economic, (2) environmental and (3) social pillars** (Elkington, 1994)





# Who is Responsible?

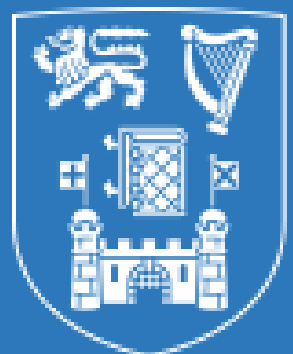
- The responsibilities of designers and questions concerning the moral quality of technology belong to the field of Applied Ethics.
- However, they also belong to the field of Human Factors.
- We are ALL responsible





# Addressing Uncertainty & Technology Impact

- New technologies have the potential to deliver benefits - society, environment, economic (triple bottom line)
- Design/technology teams **exercise choice in relation to what is valued** and advancing technology that improves the human condition (and not worsens it).
- **Technologies are inherently uncertain.**
- **Technology designers must examine the ethical implications of things which may not yet exist, or things which may have impacts we cannot predict** (Capurro, 2009)



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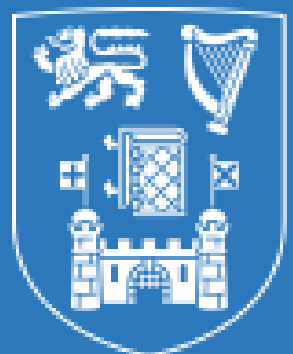


PEOPLE  
PROCESS  
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# Addressing Uncertainty & Technology Impact

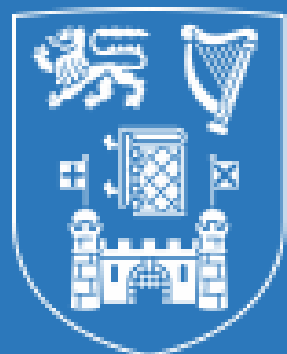
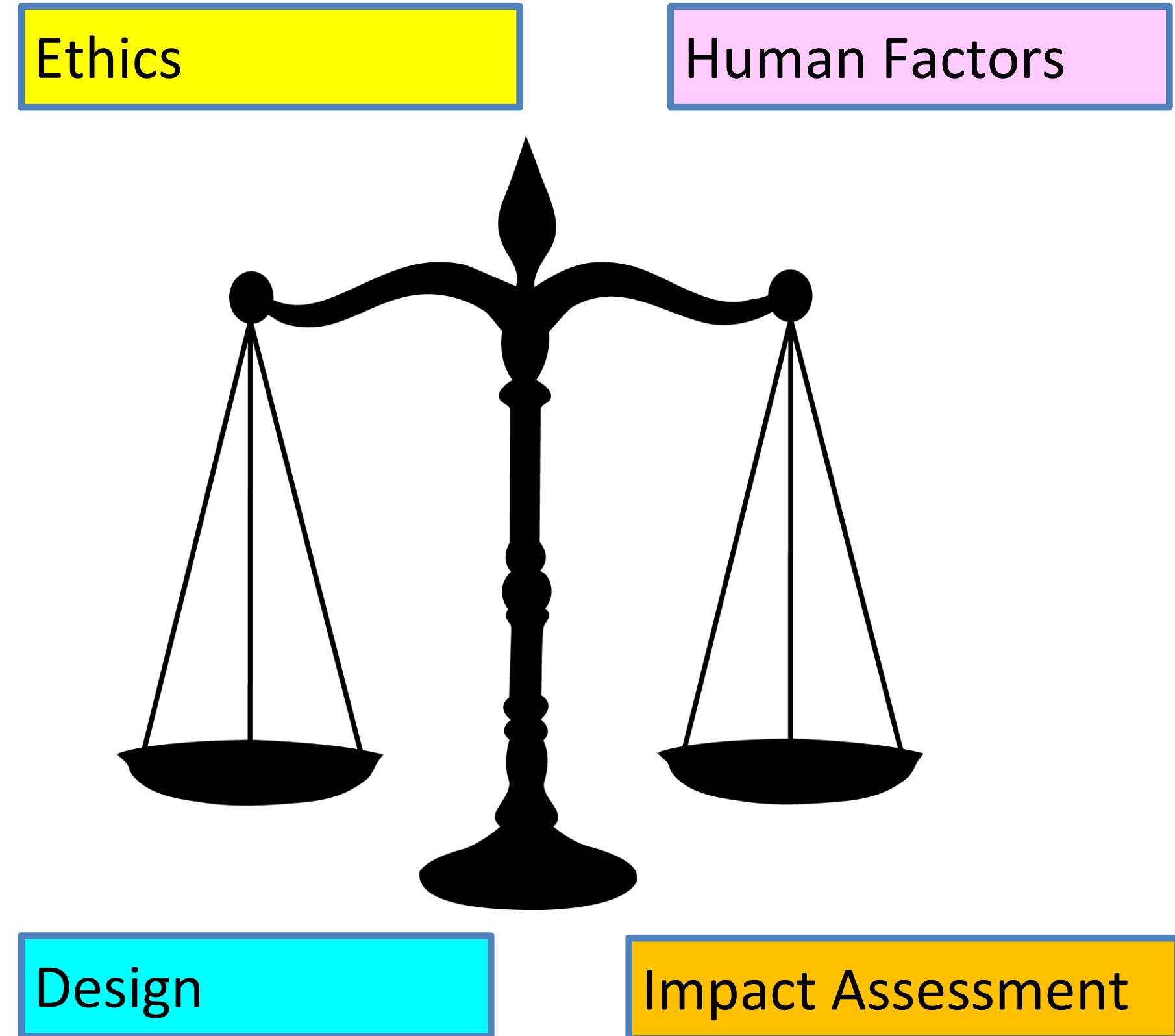
1. Positive impacts
2. Negative impacts
3. Specific psychosocial impacts
4. Specific environmental impacts
5. Unintended consequences and unknown impacts





# Introduction to HFEC & Objectives

- The objective of the ‘human factors and ethics’ canvas, is to create an evidence map in relation to the specification of an ethically responsible technology solution that properly addresses relevant human, social and ethical issues.
- Address uncertainty
- Integration of ethics and HF methods, particularly around the collection of evidence using **stakeholder evaluation methods, personae-based design, scenario-based design** approaches
- Makes use of ethical theories/perspectives that are used in relation to the analysis of technology innovation in relation to the analysis of benefit versus harm
- Consequentialism, Deontology & Principlism



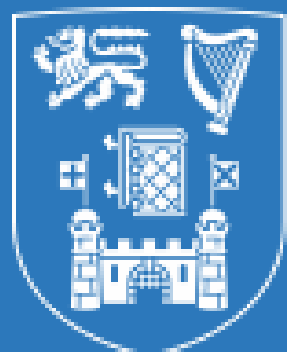


# Using the HFEC: Key Points

1. Define principles underpinning system
2. Define KPI
3. Define Impacts
  - Positive impacts
  - Negative impacts
  - Specific psychosocial impacts
  - Specific environmental impacts
  - Unintended consequences and unknown impacts

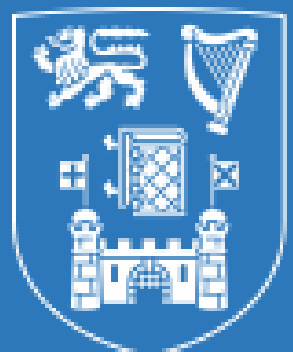
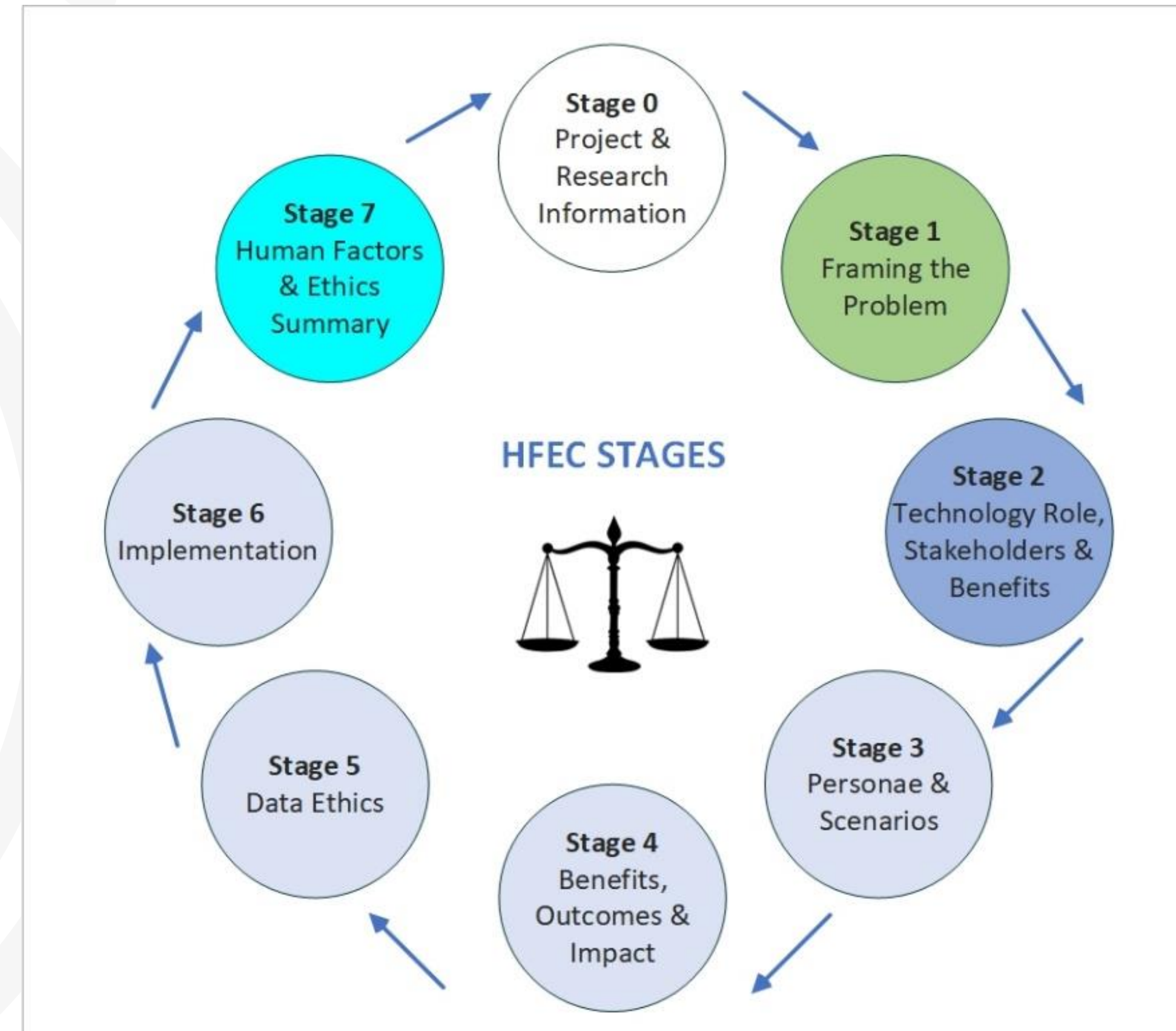
## Design

- Embed ethical principles in system concept
- User functions & design features map to ethical principles
- Positive impacts must be supported by the system concept
- Potential negative impacts must be carefully managed in relation to the design concept and execution
- Iterative...





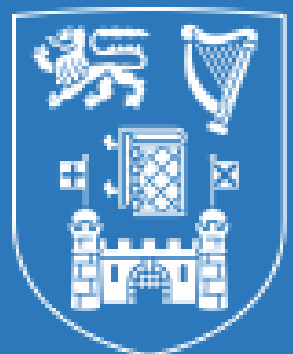
# Overview of Stages



# Stage 0: Project Information & Summary



1	Date	
2	Project Name	
3	Product Owner	
4	HF & Ethics Coordinator	
5	HF & Ethics Canvas Version No.	
6	Research & Innovation Phase	
7	Summary of Research Completed & Key Sources of Information/Evidence	
8	Research Ethics Approval & Date	

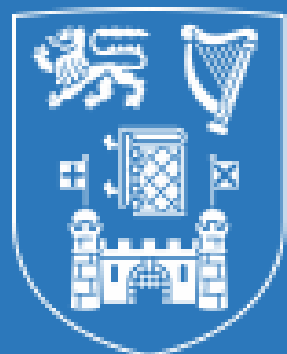






# Stage 1: Formulating the Problem & Posing the Question

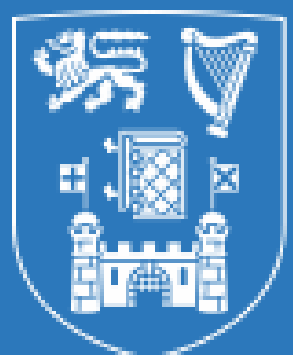
1	What is the problem that the proposed technology will address?	
2	Who is it a problem for? Key stakeholders? Who effect (directly and indirectly?)	
3	Setting & Environment?	
4	Causes of the problem?	
5	Ethical codes that apply in this setting?	
6	Ethics embedded in the problem definition?	
7	Ethics & Impact of Problem. Individual Level. Societal level. Ethics of acting/not acting?	
8	Summary of ethical issues to be addressed.	
9	Summary of relevant ethics principles and frameworks.	
10	Ethics & Key KPI	



# Stage 2: Understanding Technology & Fit to Problem/Stakeholder Needs & Expected Benefits



1	What is the technology? How does the proposed technology address the problem? What part of the problem does it address?	
2	What is the goal/objective? Intended purpose/function of technology?	
3	Setting & Environment?	
4	Direct users of technology? Goals? Needs? Expected Benefits?	
5	Other stakeholders impacted by technology? Goals? Needs? Expected Benefits?	
6	Design Decisions & Safeguards	

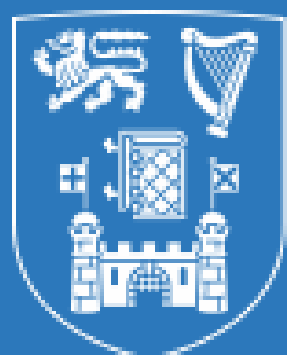






# Stage 3: Stakeholders, Benefits, Consequences & Impact

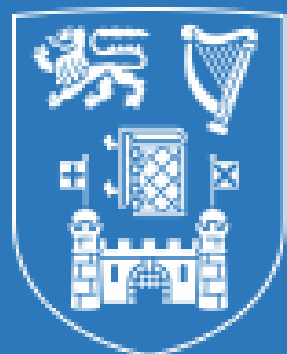
1	Overall benefits and outcomes: key stakeholders? Expected positive impacts?			
2	Expected Impact for key stakeholders (psycho-social themes). Individual level? Societal Level?	(A) Human role in the system	(B) Human Identity	(C) Lived experience, wellbeing, quality of life
		(D) Social Interaction & Relationships	(E) Activity & Behavior	(F) Attitudes & Values
3	What could go wrong? Potential failures? Potential negative impacts? Psychosocial? Environmental?			
4	Unintended consequences			
5	Unknowns			
6	Design Decisions & Safeguards			



# Stage 4: Deep Dive (Personae & Scenarios)



1	Example Scenario	
2	Example Personae	
3	How is it expected to work?	
4	What does success look like? Benefits for whom? Expected positive outcomes and for whom?	
5	What could go wrong? Potential failures? Potential negative impacts?	
6	Unintended consequences?	
7	Unknowns?	
8	Design Decisions & Safeguards	

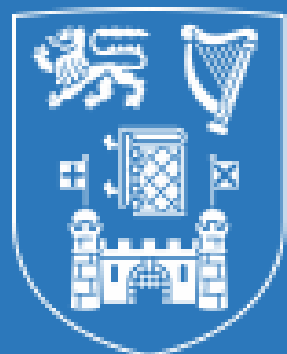




# Stage 5: Deep Dive (Data Ethics)



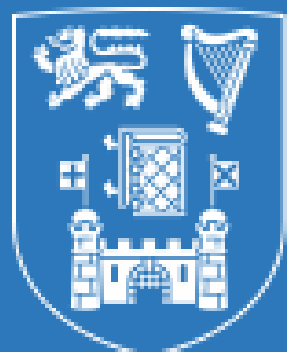
1	<p>Ethical issues relevant to data collection?</p> <p>What data?</p> <p>Why collecting?</p> <p>Potential for bias in data collection?</p>	
2	<p>Ethical issues relevant to data, model &amp; algorithms?</p> <p>Potential for harm and risk?</p>	
3	<p>Ethical issues relevant to data use &amp; predictions (i.e. application of model/algorithms)?</p>	
4	<p>Ethical issues relevant to data sharing?</p>	
5	<p>Design Decisions &amp; Safeguards</p>	



# Stage 6: Deep Dive (Implementation)



1	Implementation Approach	
2	Implementation Enablers	
3	Implementation Barriers	
4	<p>Systems Perspective: Addressing Ethics as part of Implementation.</p> <ul style="list-style-type: none"> <li>• People.</li> <li>• Process.</li> <li>• Technology.</li> <li>• Culture.</li> <li>• Training &amp; Education.</li> </ul>	
5	Design Decisions & Safeguards	

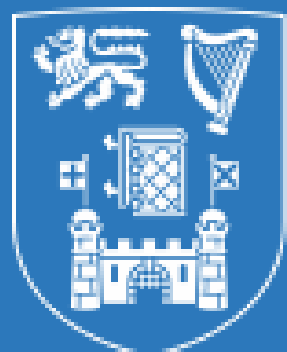




# Stage 7: Human Factors & Ethics Summary



1	Key stakeholders? Who is this technology designed for?	
2	What does success look like? Success for whom?	
3	Human/Societal Vision & Technology Role/Purpose.	
4	Summary of Key Ethical Issues to be Addressed?	
5	Ethical Principles Underlying Technology Design	
6	Design Approach: Balancing Benefits & Harm. How managing ethics issues? How increasing potential positive impacts? How preventing risk/harm? How managing potential negative impacts and unintended consequences? How addressing unknowns?	
7	Data Ethics Summary.	
8	Implementation Summary	
9	Ethics & Key KPI	

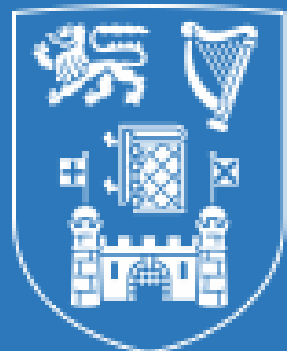


# Application & Examples

**1: Road Transport  
Adaptive  
Automation (Car  
for Older Adults)**

**2: Health  
Assisted Living  
(Wellbeing &  
Independence for  
Older Adults)**

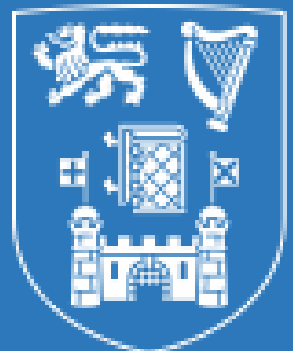
**3: Aviation  
Pilot Wellbeing &  
Healthy Behavior**



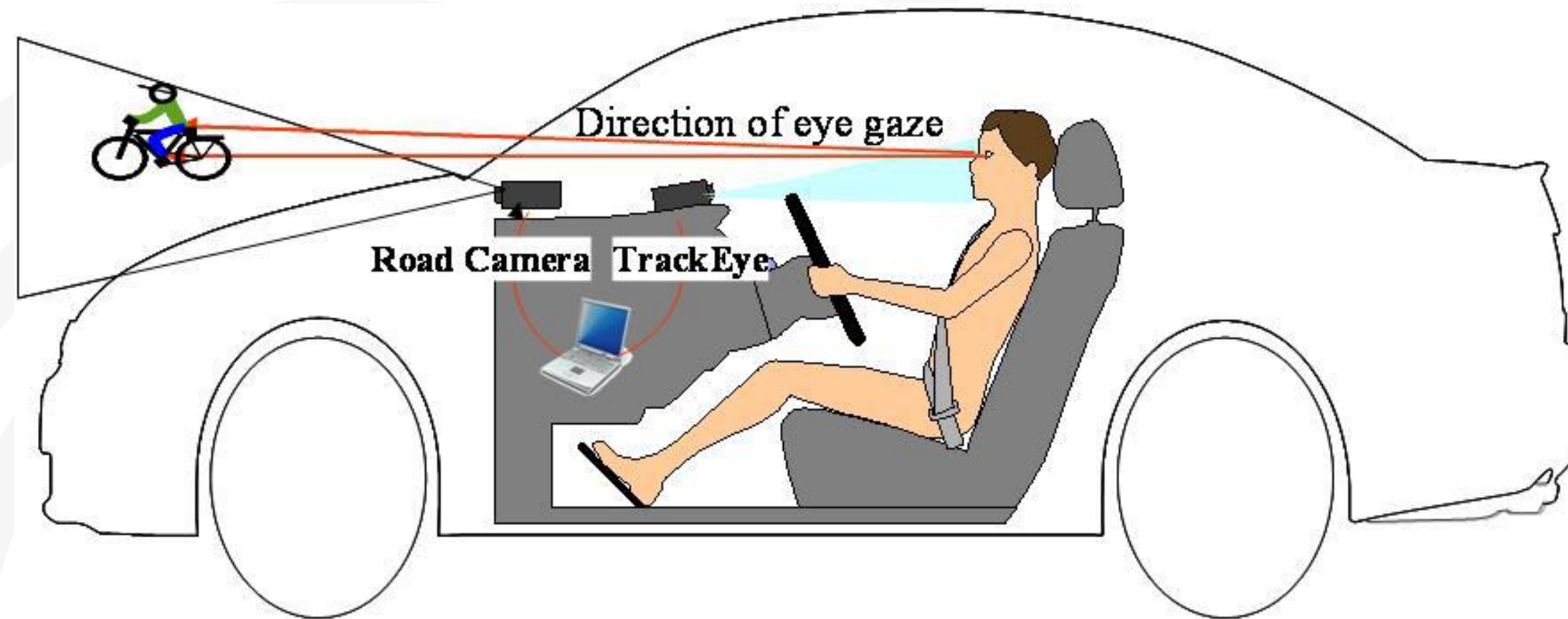


# Case Studies

## 1: Transport Adaptive Automation (Car for Older Adults)

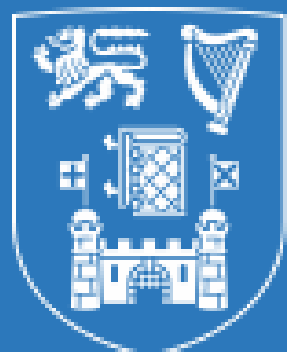


# Assisted Driving (Framing the Problem & Solution)



- System to prolong safe driving for older adults with different ability levels, and in doing so help maintain cognitive and physical abilities
- The design problem is to advance a system which can detect the health and psychological/emotional condition of the driver so that the vehicle responds as appropriate (i.e. promoting engagement/alertness, providing task supports, taking over the driving task if the driver is impaired and/or calling an ambulance).

- Design problem is framed in relation to a philosophy of ‘enablement’ and positive models of ageing.
- Vision of ‘technology progress’ is closely intertwined with concepts of progress from a societal values perspective
- The proposed co-pilot system is premised on concepts of successful/positive ageing and self-efficacy.
- System logic is underpinned by concepts of ability, adaption and assistance as opposed to vehicle automation
- Overall, the technology is designed to provide different levels of assistance/automation to drivers so that collisions are avoided
- We are proposing assistance (i.e. adaptive automation) and not full automation.
- Innovative multimodal methods – input and feedback





# Personae & Scenarios



## James, 79 years



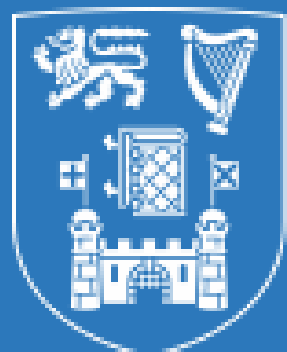
**Retired Banker. Concerned about losing independence.**

4. Continuing drivers: older adults who have continued to drive with a progressing condition, but have concerns in relation to medical fitness to drive and are at risk of giving up



*“My driving is not as good as it used to be. I should talk to my Dr about these near misses and attention problems”.*

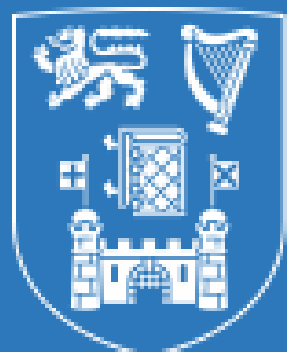
Ability & Health	Early cognitive decline (not formal Dementia diagnosis). Insomnia. Back pain. Bifocals.
Medications	Takes occasional painkillers for back pain and sleep medicines for Insomnia (hypnotics).
Driving Routines	Drives two to three times a week, often accompanied by wife. Recently, had one or two driving incidents (near miss), but not accident.
Behaviour	Meandering in lane, maintaining attention.
Pain-points & Challenges	Avoids high traffic density, night driving and motorways/high speed areas, difficulties maintaining attention.



# Assisted Driving (Underpinning Principles)

- The system should benefit all road users including older adults
- The system should support road safety (benefits all road users)
- The system should protect the rights of other road users and pedestrians who may be negatively impacted by older adult driving challenges and specifically, health events such as strokes and heart attacks.
- The system should enable continued and safe driving for all adults, including those adults at risk of limiting their driving and/or giving up
- The system should enable driver persistence – thereby supporting mobility and social participation for older adults
- The system should be premised on concepts of successful/positive ageing and self-efficacy (i.e. avoid ageist stereotypes)
- The system should promote driver engagement and provide alternatives to full automation

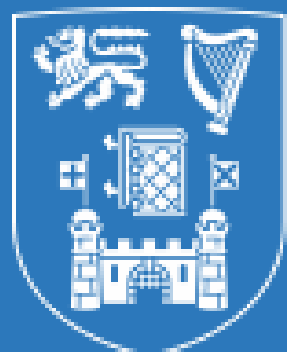
- The proposed technology should maintain the autonomy of older adults (i.e. the starting point is the engaged driver).
- The system should support all three pillars of older adult wellbeing (i.e. biological, psychological & social)
- The system should enable social inclusion and participation of older adults - this benefits society as a whole
- The system should protect human rights – including right to autonomy/choice, privacy (information access and protecting health and driver profile information)
- The system should be usable, accessible, and understood by people of all ages with different abilities and health conditions.
- Solution needs to comprehensively address real needs of people (diversity) and potential adoption barriers
- Human activity should not compromise the long-term balance between the economic, environmental, and social pillars (triple bottom line)
- The proposed mobility solution should consider environmental issues





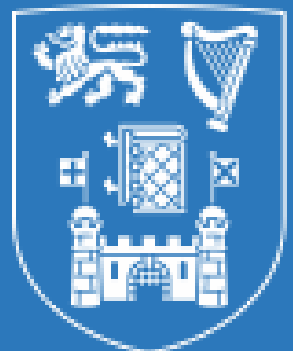
# Assisted Driving (KPI)

#	System Goal	Human Benefit & Wellbeing Objectives/Targets (Design Outcomes)	Metric (Outcome Indicators)
1	Safe driving for older adults	<ul style="list-style-type: none"> <li>Driver feels safe</li> <li>Driver feels in control</li> <li>The car is in a safe state</li> </ul>	<ul style="list-style-type: none"> <li>Subjective perception of safety/security</li> <li>Objective measure of car safety (position on road/lane, speed)</li> </ul>
2	Driver Persistence	<ul style="list-style-type: none"> <li>Car as an enabler of active ageing/positive ageing – and allied health benefits</li> <li>Car contributing to eudaemonia (living well)</li> <li>Car contributing to a sense of having a purpose</li> <li>Car as an enabler of mobility</li> <li>Supporting social connection and participation</li> <li>Supporting citizenship etc</li> </ul>	<ul style="list-style-type: none"> <li>Health status</li> <li>Mobility status</li> <li>Positive human functioning and flourishing</li> <li>Social capital</li> <li>Personal growth</li> </ul>
3	Driver Experience	<ul style="list-style-type: none"> <li>Driver feeling happy/enjoying driving activity</li> <li>Emotional state/psychological wellbeing (avoidance of stress)</li> <li>Driver in control</li> <li>Focus on ability (available capacity)</li> <li>Promote adaptation and bricolage</li> </ul>	<ul style="list-style-type: none"> <li>Subjective enjoyment of driving</li> <li>Subjective feeling of human agency/independence</li> <li>Subjective wellbeing</li> </ul>



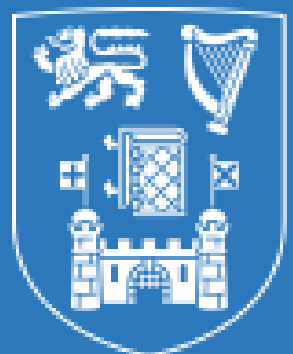
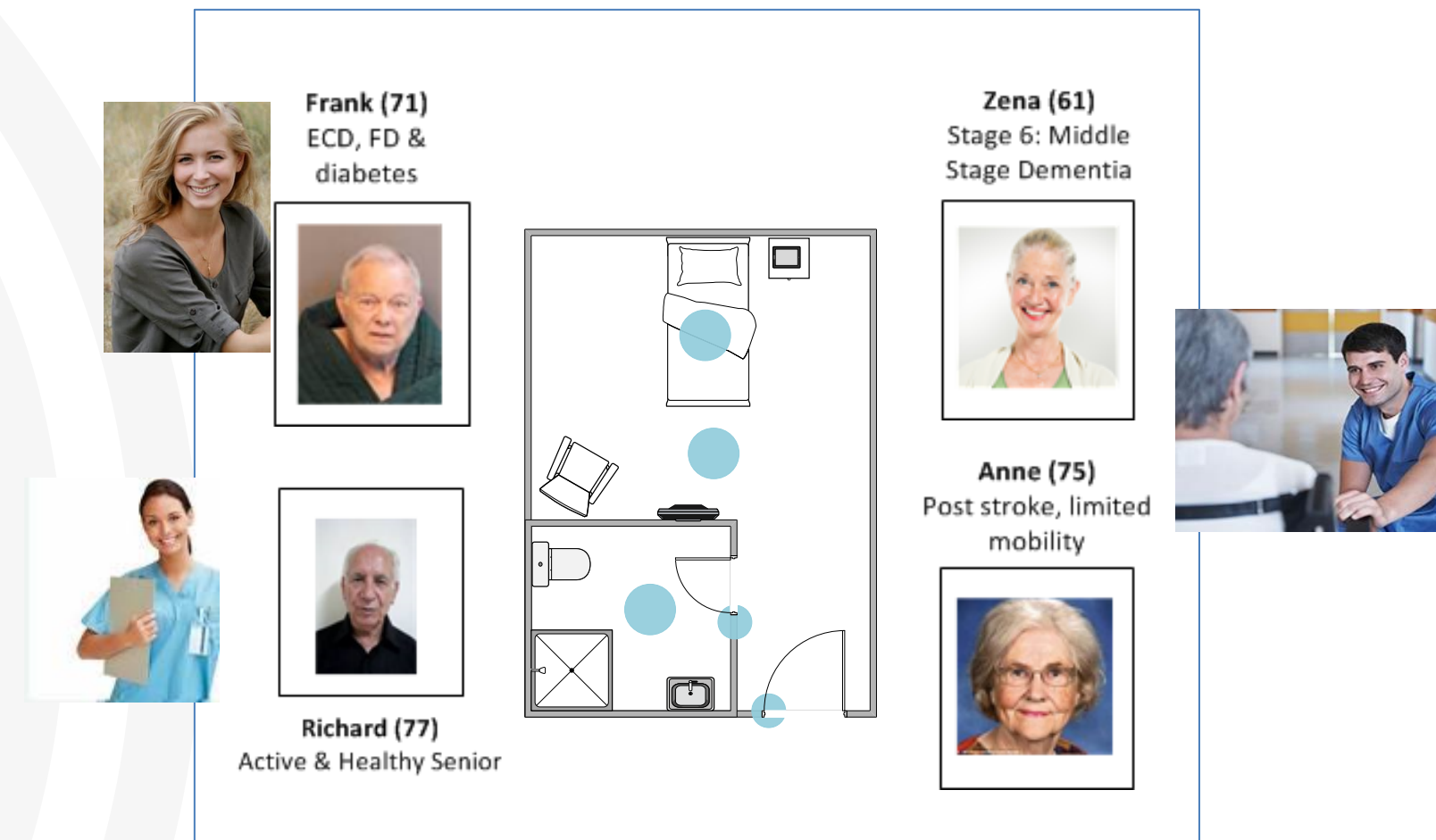
# Case Studies

## 2: Health Assisted Living (Wellbeing & Independence for Older Adults)





# Assisted Living



# Assisted Living

Product considers requirements of older adults across different aged care settings & cultural contexts (Europe, USA & Australia)

## Assisted Living Community

- **Richard (77)**
- Active and healthy
- Supporting independence, social connection and participation, education & self management of health



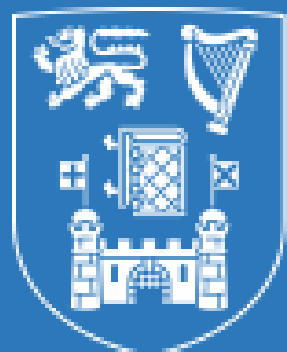
## Residential Home (Respite)

- **Frank (71)**
- ECD, FD, Diabetes
- Supporting independence, re-enablement, social connection and participation, education, self management of health



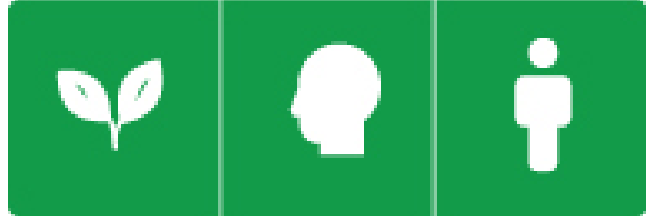
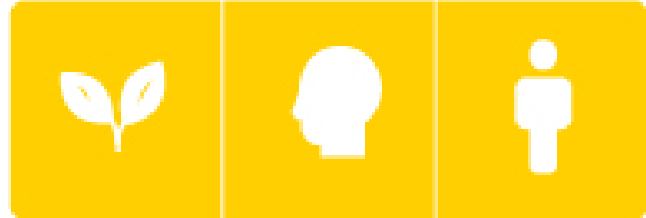

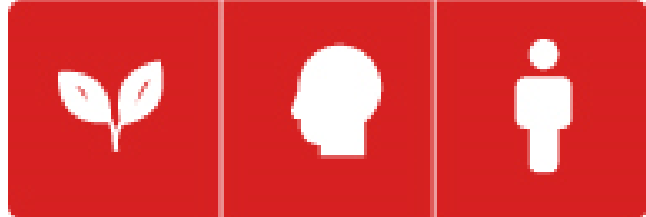
## Residential Home (Full time)

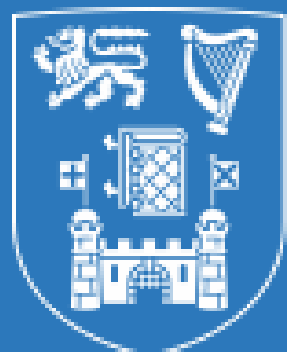
- **Zena (61)**
- Mid Stage Dementia
- Supporting purposeful activity, family participation, behaviour and mood
- Tracking falls, wandering



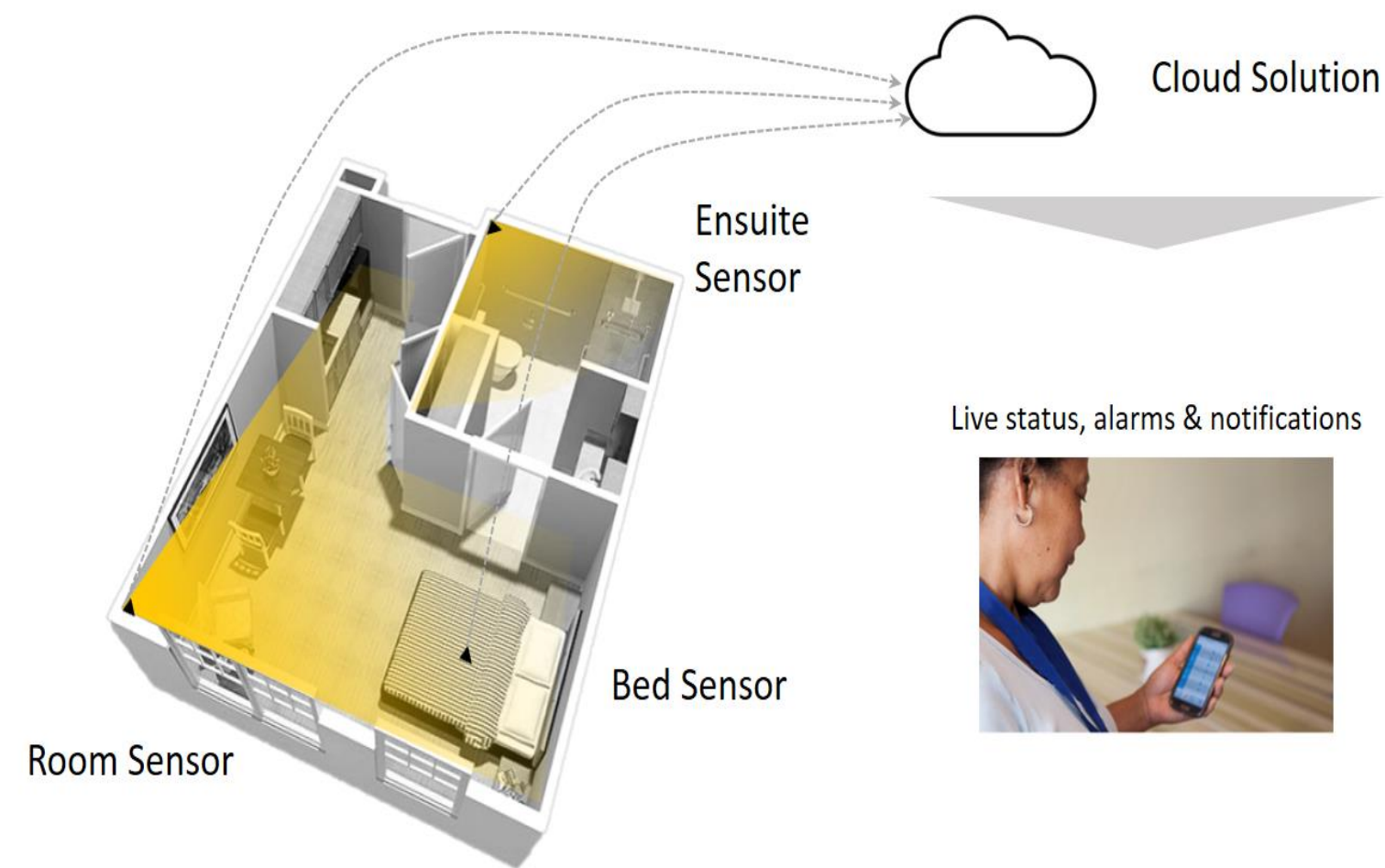


# Assisted Living

#	Change in State	Care Action	Indicator
1	No Change	None	
2	Minor Change	Monitor	
3	Significant Change	Action Required	
4	Major Change	Action Required – (Immediate/Urgency)	



# Assisted Living



Nurse Name    Monday 8 August, 2017 (13:30)    Orchard House Residential Home    75%

HOME PAGE

MY RESIDENTS

Residents: (7) Rooms: 1-7  
 Independent (2) (1, 5)     Assistance Level 1 (2) (4, 7)     Assistance Level 2 (3) (X, X, X)     Dependent (2) (2, 3)  
 New Admissions (1) Frank Wright     Discharge Today: N/A     Outpatients Appt (2) (4, 7)

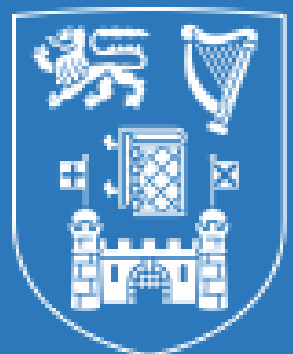
Due Check/Medicines     Fall Risk     Risk Pressure Ulcer     Concerns     Recent Challenging Behaviour

My Residents (Assigned)     All Residents

Name	Room	Location	Indep	Enablement Target	Wellness	Check/Medicines	Fall Risk	Repositioning	Notes/Concerns	Bell	Mood	Social Activity	Care Contact
<input checked="" type="checkbox"/> Jane Mansfield	1	1	Indep										
<input checked="" type="checkbox"/> Susan Clancy	2	Dining	D										
<input checked="" type="checkbox"/> Frank Wright	3	Dining	D										
<input checked="" type="checkbox"/> Anne Ward	4	Out	A1										
<input checked="" type="checkbox"/> Angela O'Leary	5	TV Room	Indep										
<input checked="" type="checkbox"/> Mark Hughes	6	6	A2										
<input checked="" type="checkbox"/> Richard Elliot	7	Out	A1										

NURSE IN CHARGE:  Mary Fitzpatrick        HELP   

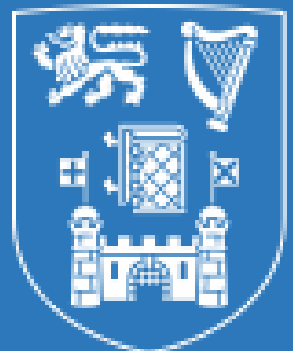
MESSAGING: To:





# Case Studies

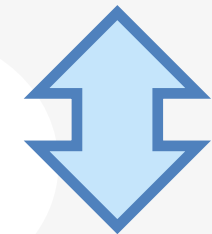
## 3: Aviation Pilot Wellbeing & Healthy Behavior



# Pilot Wellbeing & Safety Behaviour

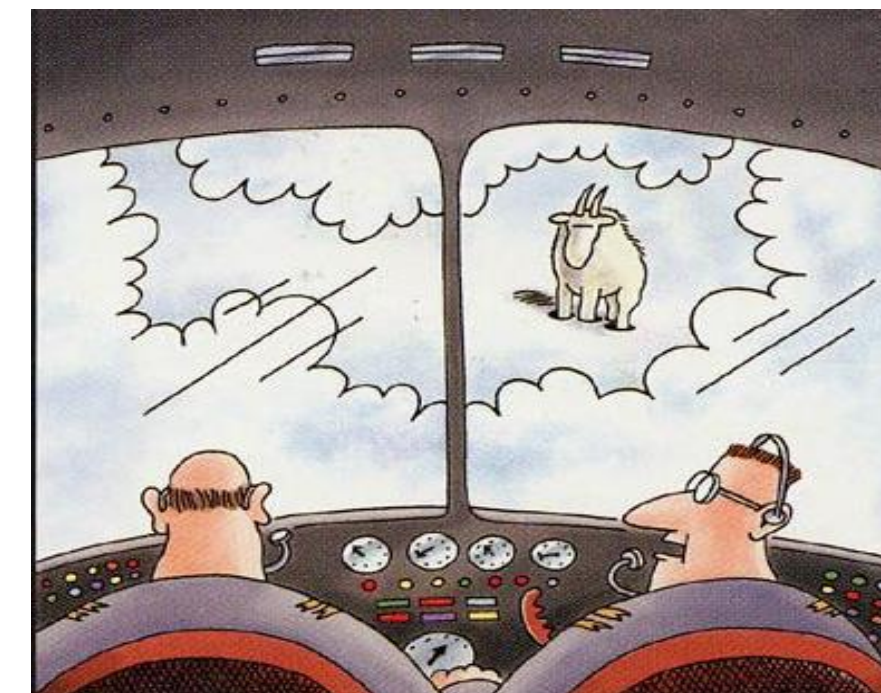
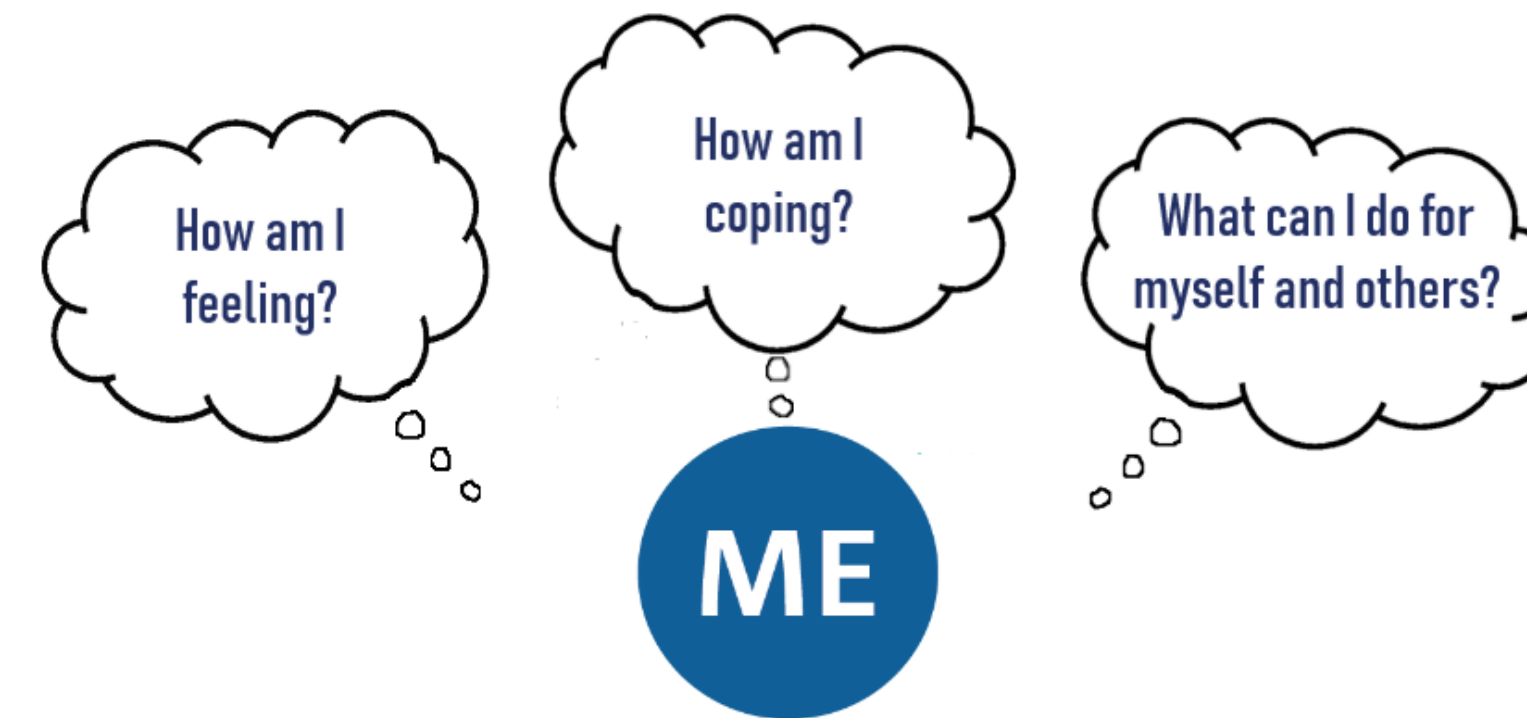
## Wellbeing, Healthy Behaviour & Stress Coping

- Home/work interface
- On duty
- Off duty

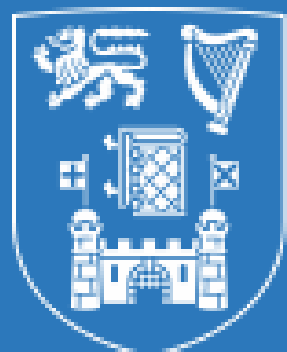


## Health Monitoring & Risk Assessment (Safety-II)

- Crew (Human Factor)
- Flight
- Aircraft
- Environment
- Safety System



“Say ... what’s a mountain goat doing way up here in a cloud bank?”





# Pilot Wellbeing & Safety Behaviour

## Simon

- 48 years
- Captain, short range, F/T
- 24 years flying
- Uses social media apps
- Working in home country
- Young family, lives near airport (short commute)
- Social isolation and health problems (musculoskeletal issues - back and knees)
- Manage sleep, diet & physical activity



## Karl

- 28 years
- First Officer, short range, F/T
- 3 years flying
- Uses Fitbit and social media apps
- Not working in home country, single, long commute to airport
- Healthy habits (exercise, diet)
- Fatigue, social isolation and loneliness
- Manage sleep, physical activity and MH risk



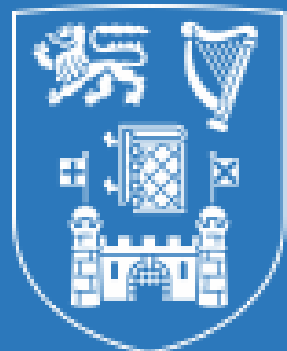
## Brian

- 56 years
- Captain, long range, F/T
- 34 years flying
- Limited experience with social media and phone apps
- Does not talk about MH/macho culture/stigma
- Working in home country
- Divorced, family grown up, lives outside Dublin (long commute to airport))
- Unhealthy behaviours (occasional binge drinking, binge eating)
- Fatigue and health problems (gastrointestinal and musculoskeletal issues)
- Manage sleep, diet and physical activity and MH risk

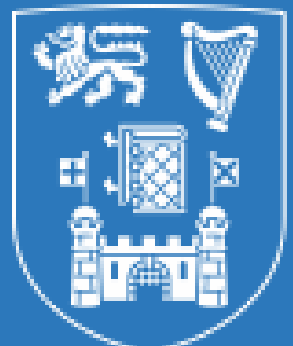
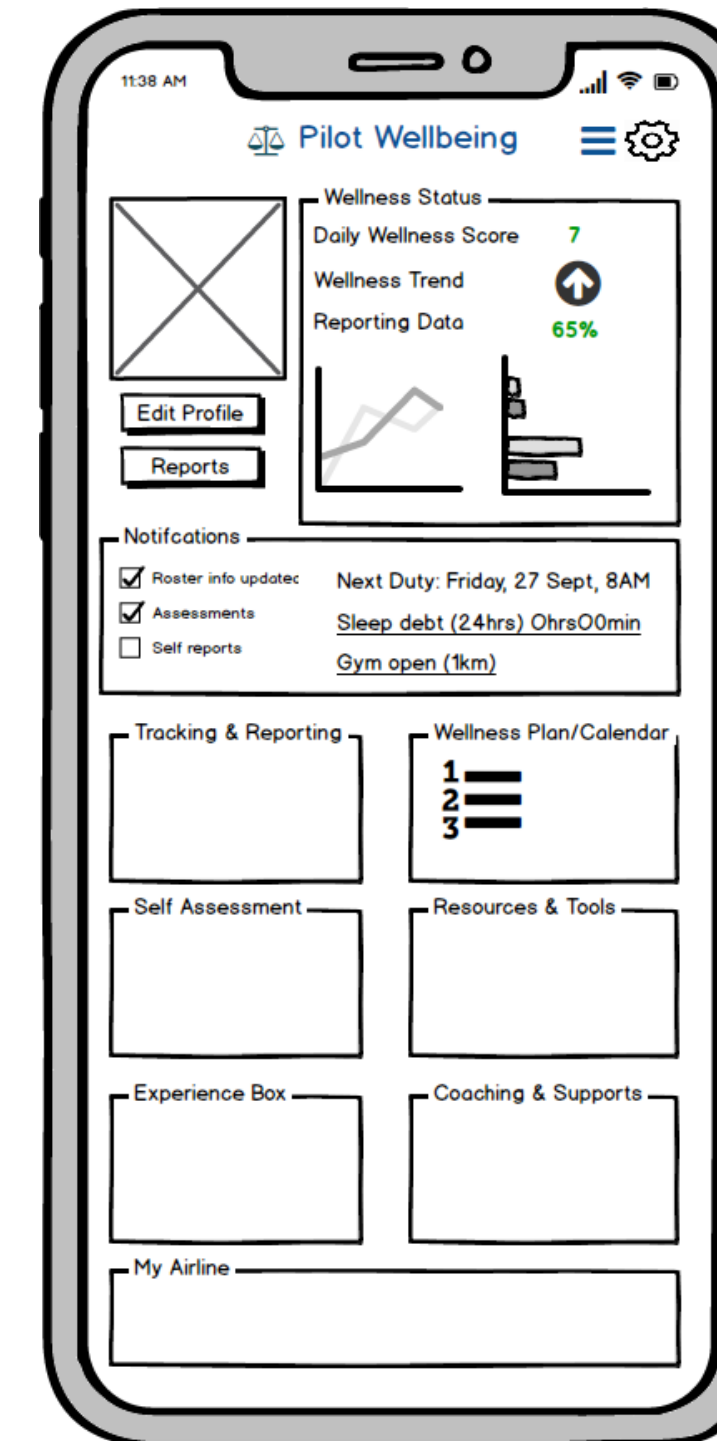
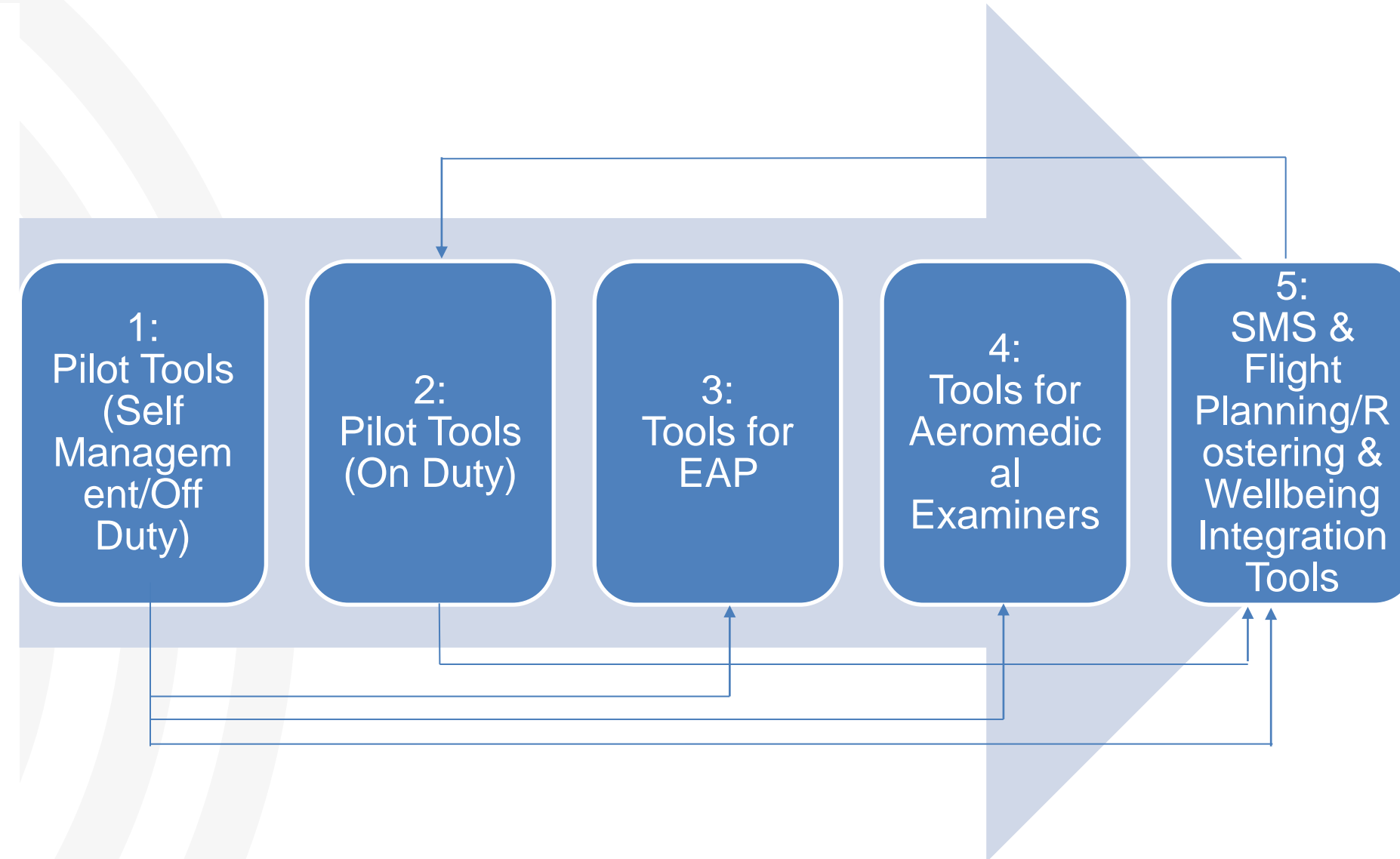
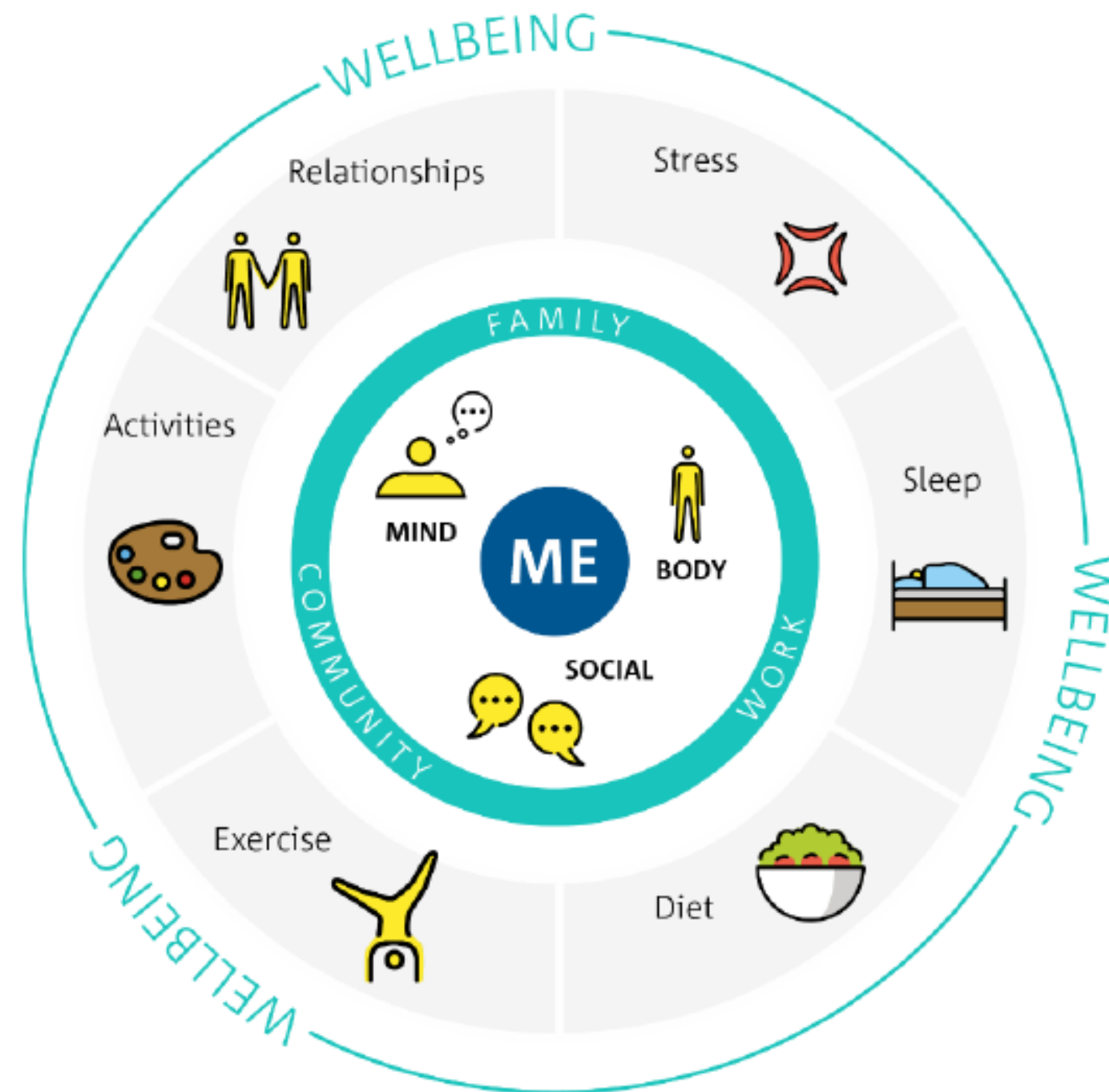


## Francis

- 45 years
- First Officer, Short range, P/T
- 18 years flying
- Uses social media apps
- Working in home country, young family, lives near airport (short commute)
- Fatigue and burnout
- Manage sleep and roster (work life balance)
- Roster bidding important

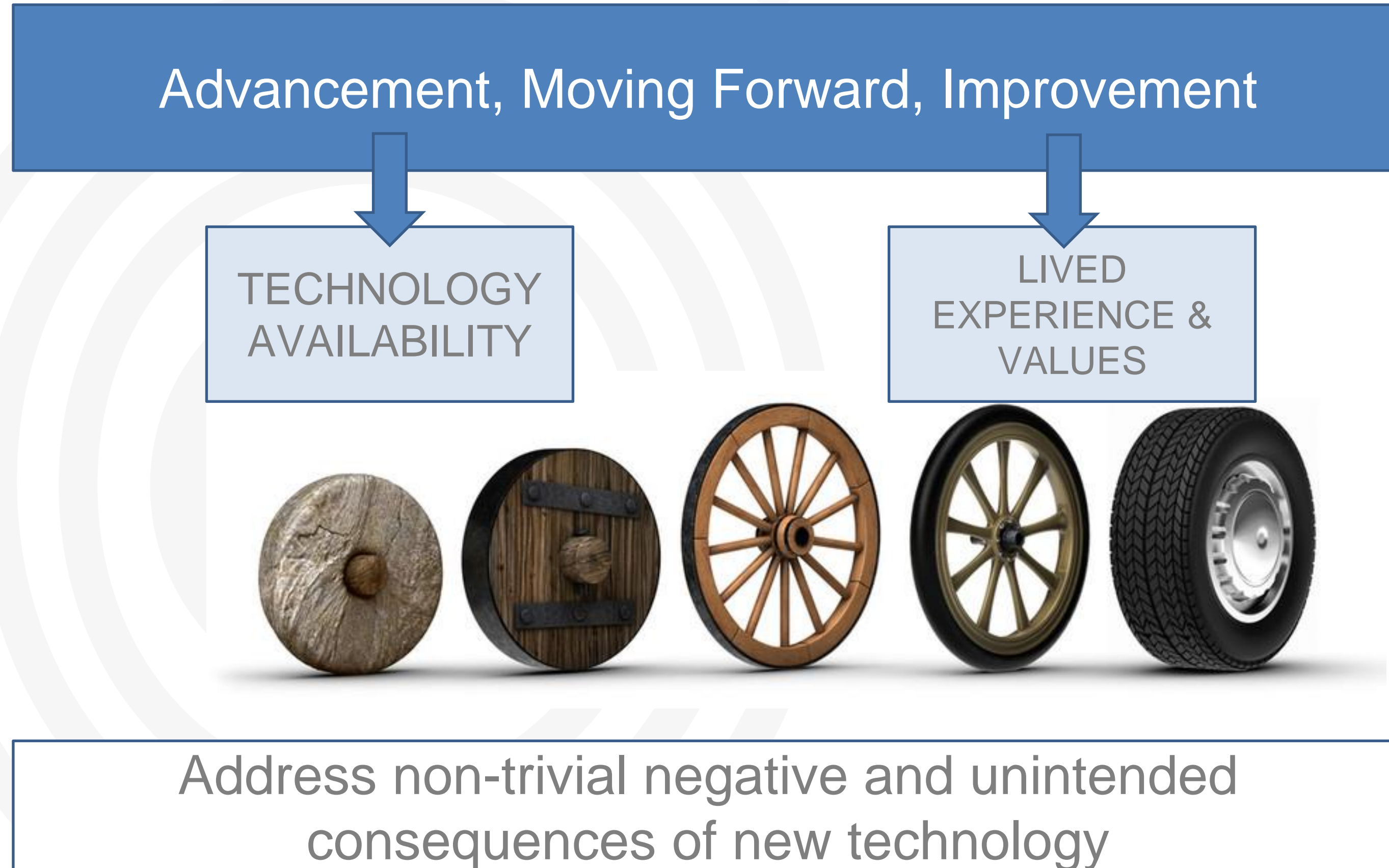


# Pilot Wellbeing & Healthy Behaviour



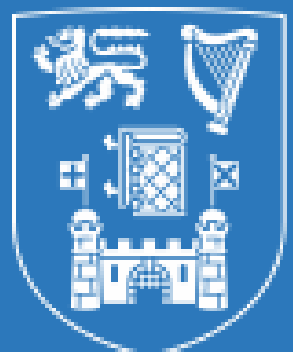


# Progress, Human Benefit & TBL



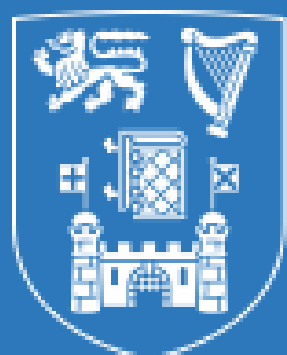
Human activity must not compromise the long-term balance between the (1) **economic**, (2) **environmental** and (3) **social pillars** (Elkington, 1994)

A/IS & full cost accounting



# Conclusion

- **Improve relationship between science/tech & society**
- Assessing the ethical implications of things which may not yet exist, or things which may have impacts we cannot predict, is very difficult
- This should not be barrier to posing important questions and ensuring that these questions are addressed as part of the design process
- Thinking about both potential positive, negative consequences and unintended consequences enables designers to build in protections into the design concept
- The specification of an ethics canvas as part of a broader human factors design approach ensures that ethical issues are considered.



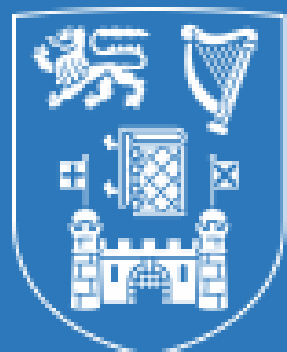


# Publications, White Papers & Podcasts

- Cahill J. (2020) Embedding Ethics in Human Factors Design and Evaluation Methodologies. In: Duffy V. (eds) Digital Human Modelling and Applications in Health, Safety, Ergonomics and Risk Management. Human Communication, Organization and Work. HCI 2020. Lecture Notes in Computer Science, vol 12199. pp 217-227 Springer, Cham. DOI: 10.1007/978-3-030-49907-5\_15
- Cahill, J. McLoughlin, S., O Neil, N. & Wetheral, S. (2020). Ambient assisted living and ethical issues pertaining to patient and care monitoring. "Elderly Care: Current Issues and Challenges". Nova Sciences Publishers. <https://novapublishers.com/shop/elderly-care-current-issues-and-challenges/>. BISAC: MED032000. ISBN: 978-1-53618-446-4
- Cahill, J., Cromie, S., Crowley, K, Kay, A., Gormley M, Kenny, E., Hermman, S, Doyle, C, Hever, A and Ross, R. (2020) Advancing a 'Human Factors & Ethics Canvas' for New Driver Assistance Technologies Targeted at Older Adults. In: Duffy V. (eds) Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management. Posture, Motion and Health. HCI 2020. Lecture Notes in Computer Science, vol 12198. pp 503-520. Springer, Cham. DOI: 10.1007/978-3-030-49904-4\_37
- Cahill, J., Cromie, S., Crowley, K, Kay, A., Gormley M, Kenny, E., Hermman, S, Doyle, C, Hever, A and Ross, R (2020). Ethical Issues in the New Digital Era: The Case of Assisting Driving. Book Chapter in 'Ethics, Laws, and Policies for Privacy, Security, and Liability'. Intech Publishing. DOI: 10.5772/intechopen.88371. <https://www.intechopen.com/online-first/ethical-issues-in-the-new-digital-era-the-case-of-assisting-driving>
- Cahill, J., Howard, V., Huang Y., Yeju, J, Ralph S & Dillon, A. (In press). The Future of Work in Financial Services: Person Centred People Operations, Intelligent Work & The Triple Bottom Line. Paper Accepted and to be presented at Digital Human Modelling and its applications: Parallel Session – Emerging Methods, as part of HCI 2021 and published in the conference proceedings. Paper selected for publication in Springer Series.

– Cahill, J. (2019). Human factors research methodologies and the specification of a Human Factors & Ethics canvas. White Paper. Centre for Innovative Human Systems, School of Psychology, Trinity College Dublin.

- Version 1, one zero one Postcast, Episode #5: Joan Cahill, TCD on The Ethical Challenges of AI. <https://www.version1.com/one-zero-one/joan-cahill-ethical-ai/>
- Version 1, one zero one Postcast, Episode #8: Ethics in Data Analytics
- Cahill, J. (May 5, 2020, 11am). Adaptive Automation: Diversity, Wellbeing, Uncertainty & The Triple Bottom Line. Linking to the Women in Tech Series. <https://www.women-in-tech-dublin.com/>





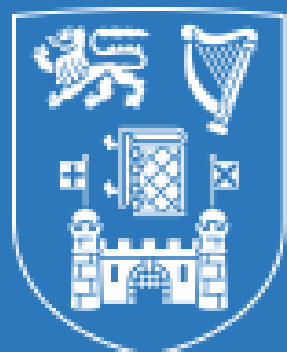
# Contact

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# Thanks



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