Managing fatigue in aviation: it's about the system

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Background to my involvement.....the story

Human Factors and Ergonomics

- Systems approach
- Design driven

- Maintain human well being, safety and performance
- Optimise or balance system performance and productivity

What does HFE aim to do?

Environment

- Workstation
  - Machinery/Tools
    - assists
    - executes

Task

MATCH
- Safety, Efficiency, Productivity & Work well-being
- Comfort, Reliability

MISMATCH
- Green, Red
- Productivity & Work well-being
- Accidents
Approach to understanding work and work systems

- Systems focus
- Context
- Interactions
- Holism
- Emergence
- Embedding

Framework for effective HFE

Stakeholders

Government
- Regulations, Associations
- Company
- Staff
- Work
- Access to resources
- Changing public opinion and public awareness
- Changing market conditions and financial pressure
- Changing societal needs and education
- First phase of technological change

The context of aviation: a complex system

Increasing demand and therefore, increasing traffic

Future of work – what will it look like?

Key Reports submitted to the Global Commission

- The Future of Work: the World at Work in 2030 and Beyond
- Women, gender and work: social choices and inequalities, volume 2
- The future of work: Trends and scenarios of the emerging work world
- The future of work: The future of work: The emerging work world
- The future of work: The future of work: The emerging work world
- Decent work for all

Changes in technology, makes work more complex or easier?
The context of aviation: a plethora of risk

Despite all the systemic changes......
Humans systems and functioning remains largely unchanged

The context of aviation: a changing world

Continued occupational challenge

Future of the airline industry 2035
International Air Transport Association (IATA)

Despite all the systemic changes......
Humans systems and functioning remains largely unchanged
What is fatigue?

...a hypothetical construct which is inferred because it produces measurable phenomena even though it may not be directly observable or objectively measurable...it is not a "single, definite state" (Grandjean, 1979, p.175).

...physical fatigue is characterised by a reduced force producing capacity following physical exertion (Grandjean, 1979; Lal and Craig, 2001).

...mental fatigue can arise through reduced motivation, efficiency and alertness during or following task performance (Grandjean, 1979).

...may also be characterised by reduced efficiency, perceptions of weariness (Lee et al., 1991) and an unwillingness to work (Grandjean, 1979).

...transient state that occurs between wakefulness and sleep,... referred to as a "biological drive for recuperative rest" (Williamson et al., 2011, 499). It can be acute (short lasting, requiring a sufficient rest or sleep) or chronic (longer lasting, with clinical symptoms that have a major, detrimental effect on overall health and function).

Fatigue can result from a conflict in this case, the conflict arises from the incompatibility between the demands of a system and the capabilities of the human to cope with these demands.

..active fatigue results from over arousal due to increasing task difficulty or complexity or the need to consistently adjust performance based on changes in the environment or task (Desmond and Hancock, 2001; Sady et al., 2008; Sady et al., 2013).

..passive fatigue is the product of reduced arousal due to the need to monitor a system, without necessarily having to make adjustments, but is distinct from boredom (Desmond and Hancock, 2001).

In addition to the characteristics of the task, the inherent interest in it and whether it is self or externally paced can affect the "flow" of the task (Hockey, 2012).

..is exacerbated by the time-on-task effects (Mackworth, 1948; Lim et al., 2010) and the frequency of the break opportunities reviewed in Tucker, 2003).

..arises from the interaction of several factors (Williamson et al., 2011, Di Milia et al., 2012; Sady et al., 2013) individual-specific, multifaceted, complex, inevitable
What is fatigue?

“A physiological state of reduced mental or physical performance capability resulting from sleep loss, extended wakefulness, circadian phase, and/or workload (mental and/or physical activity) that can impair a person’s alertness and ability to adequately perform safety-related operational duties.”

ICAO, 2016

Current approaches to fatigue management

South African Civil Aviation Regulations:
SACAA CAR/CATS 121.02.13 FLIGHT TIME AND DUTY PERIODS SCHEME

Current approaches to fatigue management

Scientific evidence + Operational experience

Systems approach to understanding fatigue

Carayon et al., 2006: Implementing a Systems Engineering Intervention for Improving Safety in Outpatient Surgeries
Focusing on the human

Managing fatigue: It’s about sleep
Drew Dweon*, Kirsty McCulloch


What about the human?

Light-Dark Cycle
Age
Sex/gender
Chronotype
Ethnicity
SES
Personality
Sleep need
Family
Health
Sleep disorders

Systems approach to understanding fatigue

Carayon et al., 2005: Implementing a Systems Engineering Intervention for Improving Safety in Outpatient Surgeries

Other organisational factors in aviation


Systems approach to understanding fatigue

Carayon et al., 2005: Implementing a Systems Engineering Intervention for Improving Safety in Outpatient Surgeries

Task / Activity demands: workload


Systems approach to understanding fatigue


Carayon et al., 2005: Implementing a Systems Engineering Intervention for Improving Safety in Outpatient Surgeries
Environmental factors and fatigue

<table>
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<tr>
<th>Effect on activities / tasks</th>
<th>Effect on recovery</th>
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<tbody>
<tr>
<td>Adds to workload, vigilance and attention requirements</td>
<td>Poor inter shift sleep</td>
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Fatigue is the product of complex interactions


Don’t forget what happens away from work....
It is not fatigue perse that presents the challenge, but rather it’s a fatigued human's interaction with the system that may present a risk to occupational safety.

Broader health implications


My journey

Framework for effective HFE

- Systems focus
- Context
- Interactions
- Holism
- Emergence
- Embedding
Some concluding thoughts and outlook

- Fatigue results from a **complex interaction of biological, personal, work and environmental factors** – appreciate this complexity

- Some degree of fatigue is inevitable and necessary as it points to inadequate recovery and the need for it

- It is not the **human’s fault**

- As sleep researchers, we **can assist** in a variety of ways:
  - Screening tools, education, risk management, roster design
  - “Co-operative co-responsibility” (Pat Scott)
  - Stakeholders and networks
  - Science informs practice and practise informs science

Thank you

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