What does Work-As-Imagined (WAI) and Work-As-Done (WAD) Mean?

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How well do these people ... 

Work-as-imagined

... understand what happens here?

Work-as-done
Looking at work-as-done

Scientific management was formulated in the late 19th and early 20th in order to increase efficiency of work and decrease waste. It introduced empirical methods to study work as it actually took place (WAD) – with the intention of prescribing a “better” way of doing it (WAI).

Principles of scientific management (1911)

- **Analyse** tasks to determine most efficient performance
- **Select** people to achieve best match between task requirements and capabilities
- **Train** people to ensure specified performance
- **Insure** compliance by economic incentives
WAI-WAD in behavioural science

Homo Economicus

- Completely informed
- Infinite sensitivity
- Rational

Decision theory assumes all options, outcomes and preferences are known and amenable to evaluation.

“Muddling through”
Satisficing
Naturalistic decision making

Decision theory recognises that most situations show incomplete, dynamically changing conditions and competing goal structures.
Blunt end and sharp end

- Organizational Influences
- Unsafe Supervision
- Preconditions
- Unsafe Acts

Accident!

WAD

Blunt end

WAI

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The need to “imagine” how others work

- Design (tools, roles, environment)
- Work & production planning ("lean" - optimisation)
- Safety management, investigations & auditing

Work-As-Imagined → Work-As-Imagined → Work-As-Imagined

Work-As-Imagined

Work-As-Done

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Work as imagined – work as done

Work-as-imagined (WAI) is what designers, managers, and authorities believe happens or should happen.

Work-as-done (WAD) is what actually happens.

Work-as-imagined (WAI) is the basis for design, training, and planning (safety and production).

Work-as-done (WAD) is what people have to do to cope with the complexity of the actual work environment.
Designing for work-as-imagined

What tools do the operators need?
What have they been thinking of?
How should it be provided?
What is this supposed to do?
How will it fit existing ways of working?
Why does it not fit the way we work?
How should it be used correctly?
How can we get it to work?
Managing work-as-imagined

Procedures

“Runway incursions will be substantially reduced and aviation safety improved through the use of clear, unambiguous phraseologies related to surface operations.”
During a normal work, on different sectors and different positions, a controller has to consider around about 70 – 100 restrictions – although NOT all at the same time.

Audits

To ensure that safety in the provision of ATS is maintained, the ATS authority has to implement formal and systematic safety management programmes for ATS under its jurisdiction. Furthermore, one of ICAO’s requirements is the regular conduct of safety audits of ATS by trained, experienced and qualified personnel.

Performance targets (SESAR goals for 2020)

- enable threefold increase in capacity
- improve safety by a factor of 10
- cut ATM costs by half
- reduce environmental impact by 10%
The sharp end and the blunt end

The sharp-end is here and now

Actual workplace

Work management

Department management

Executive management

Authorities / regulators

The blunt-end is earlier and somewhere else
“Us” and “Them”

I know what I am doing.

But what about them?

I know what I am doing.

But what about them?

I know what I am doing.

But what about them?

I know what I am doing.

But what about them?
And now over to Thomas ...
Work as imagined - design assumptions

- System input is regular and predictable
- Other people behave as prescribed
- Demands and resources are compatible.
- Working conditions fall within normal limits.
- Output (actions) will comply with norms.

... no need to make adjustments
Work as done

Demands vary and resources may be inadequate.

System input may be irregular and unpredictable

Other people behave egocentrically

Working conditions may at times be sub-optimal.

Output (actions) will vary considerably.

... necessary to make local adjustments
Efficiency-Thoroughness Trade-Off (ETTO)
Performance adjustments are necessary

Availability of resources (time, manpower, materials, information, etc.) may be limited and uncertain.

People adjust what they do to match the situation.

Performance variability is inevitable, ubiquitous, and necessary.

Because of resource limitations, performance adjustments will always be approximate.

Performance variability is the reason why everyday work is safe and effective. 😊

Performance variability is the reason why things sometimes go wrong. 😞
Efficiency-Thoroughness Trade-Off

Thoroughness: Time to think
Recognising situation.
Choosing and planning.

If thoroughness dominates, there may be too little time to carry out the actions.

Neglect pending actions
Miss new events

Efficiency: Time to do
Implementing plans.
Executing actions.

If efficiency dominates, actions may be badly prepared or wrong

Miss pre-conditions
Look for expected results

Time & resources needed
Time & resources available

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Focused and scattered work

Work at the sharp end is usually focused:
- Activities are joined (are a whole).
- Activities have a clear beginning and end.
- Dependence on others – outside team – is limited.
- Work environment is designed with specialised support (tools, training, etc.).
- Information is concentrated.

Work at the blunt end is often scattered:
- Activities are isolated, only loosely connected to what went before or what comes after.
- Dependence on others often considerable.
- Work environment is generic.
- Information is dispersed.
ETTOing at the sharp end

**AVOID**

anything that may have negative consequences for yourself, your group, or organisation

**CREATE/MAINTAIN**

conditions that are necessary to carry out the work.

<table>
<thead>
<tr>
<th>Limitations</th>
<th>Part of work, but not always easy to see.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resources, means</td>
<td>Many, specific, due to system design.</td>
</tr>
<tr>
<td>Decision space</td>
<td>Limited (local).</td>
</tr>
<tr>
<td>Detection, correction</td>
<td>Good possibilities (part of system design).</td>
</tr>
<tr>
<td>Predictability</td>
<td>Reasonable in most cases.</td>
</tr>
<tr>
<td>Time frame</td>
<td>Decisions: short Consequences: short</td>
</tr>
</tbody>
</table>

**COMPENSATE FOR**

conditions that makes work difficult or impossible.
ETTOing at the blunt end

**AVOID**
anything that may have negative consequences for yourself, your group, or organisation

**COMPENSATE FOR**
conditions that makes work difficult or impossible.

<table>
<thead>
<tr>
<th>Limitations</th>
<th>Vague, uncertain, usually time and money</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resources, means</td>
<td>Limited, general</td>
</tr>
<tr>
<td>Decision space</td>
<td>Large, extensive (global)</td>
</tr>
<tr>
<td>Detection, correction</td>
<td>Few possibilities (delays).</td>
</tr>
<tr>
<td>Predictability</td>
<td>Low, due to complexity and delays</td>
</tr>
<tr>
<td>Time frame</td>
<td>Decisions: short, Consequences: long</td>
</tr>
</tbody>
</table>

CREATE/MAINTAIN
conditions that are necessary to carry out the work.
Delay in getting information

How long time does it take to get information about what is happening?

\[ \Delta T \]

Actual workplace

Work management

Department management

Executive management

Authorities / regulators

Minutes-hours-days

Weeks

Months

Years

Minutes-hours-days

Years

Months

Weeks

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Decay of information

How long does it take before half the information is obsolete?

- Actual workplace: Minutes-hours-days
- Work management: Weeks
- Department management: Months
- Executive management: Years
- Authorities/Regulators: Years

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And now again over to Thomas ...
Different roles of the blunt end

Work management  
(schedules - norms)  
BE prescribes and prepares work for the SE;  
BE manages how SE do their work (quality, productivity)

Production planning  
(“lean” - optimisation)  
BE – as the monitor or manager of actions  
(sampling rate, level of detail, ETTO organisational)

Investigations & auditing  
(errors - compliance)  
BE – as regulator and arbiter, right or wrong.  
Limited time to do their work
Contrafactual reasoning

Going back through a sequence, investigators often wonder why opportunities to avoid bad outcomes were missed. This, however, does not explain the failure.

“Why didn’t he do A”?

A

Possible outcome 1

“Why didn’t he do B”?

B

Possible outcome 2

Actual outcome
The 90% solution

When something goes wrong, e.g., 1 event out of 10,000 (10E-4), humans are assumed to be responsible in 80-90% of the cases.

Who or what are responsible for the remaining 10-20%?

Investigation of failures is accepted as important.

When something goes right, e.g., 9,999 events out of 10,000, are humans also responsible in 80-90% of the cases?

Who or what are responsible for the remaining 10-20%?

Investigation of successes is rarely undertaken.

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Problems with safety as risk reduction

The causality credo lead to explanations in terms of simple causes and effects. The 90% solution: “human error” - humans in wilful disregard of critical cues or factors.

Explanations are incomplete and misleading, hence an ineffective basis for changes. Investigations are concluded a “culprit” has been found. This severely limits learning.

Incidents are described by after-the-fact stories. In hindsight they seem to be easily preventable by relatively simple measures, such as new policies and procedures or calls to increase vigilance or compliance of operators.

The focus on failures juxtaposes Work-As-Imagined and Work-As-Done – and assume the former is correct (blunt-end or management perspective).
WAD ≠ WAI – seen from the blunt end

Limited time  | Limited resources  | Limited information
---|---|---
Clear causes  | Clear conclusions  | Accident model

The people who, directly or indirectly, are involved in the accident.

The people who investigate the accident.
WYLFIWYF


Accident investigations that look for causes, find causes. The assumptions about the nature of accidents (causality credo) constrain the analysis.

We can be safe – with a little more effort, a few more resources, a more refined set of recommendations from a knowledgeable inquiry, some new tools, an updated IT system, a better policy, and an improved safety culture. In other words, WAD should be made more like WAI.
Work-as-done: The non-compliance view

Unintentional
Unintentional Understanding failure – when people have a different understanding of what the procedure is and what they have to do.
Unintentional Awareness failure – when people are not aware of the existence of a rule or procedure and therefore operate with any reference to it.

Intentional
Situational non-compliance – when the situation makes it impossible to do the job and be compliant, e.g., because of insufficient time or resources.
Optimizing non-compliance for company benefit – individuals take short-cuts believing that this will achieve what they believe the company, and their superiors, really want;
Optimizing non-compliance for personal benefit – short-cuts taken to achieve purely personal goals;
Exceptional non-compliance – deviations from the official procedures that may be difficult to follow under specific, and usually novel, circumstances.
Looking at work-as-done also follows a What-You-Look-For-Is-What-You-Find (WYLFIWYF) principle.

Work studies should focus on how things normally work and why that succeeds. Something that goes wrong, has usually gone right many times before.

“We can only be safe if we understand how work is done. Neither WAI nor WAD are absolute references, but both serve useful purposes. There are no ‘silver bullets’ - no simple solutions. We must learn how continuously to realign WAI with WAD.”

“Safe” and “unsafe” behaviours happen in the same way. Adjustments / improvisation can be useful. People successfully balance competing goals.
## Work-as-done: The ETTO view

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Avoid</th>
<th>Maintain/establish</th>
<th>Compensate for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Waste of time</td>
<td>Time buffer</td>
<td>Inadequate timing</td>
</tr>
<tr>
<td>Human effort</td>
<td>Waste of effort</td>
<td>Spare effort / work capacity</td>
<td>Manpower shortage</td>
</tr>
<tr>
<td>Workplace (HF)</td>
<td>Inadequate work conditions</td>
<td>Workable conditions</td>
<td>HMS deficiencies</td>
</tr>
<tr>
<td>Workload /stress</td>
<td>Work overload</td>
<td>Manageable workload</td>
<td>Overload (underload)</td>
</tr>
<tr>
<td>Materials / resources</td>
<td>Waste of material &amp; resources</td>
<td>Buffer of material / resources</td>
<td>Unavailability / inaccessibility</td>
</tr>
<tr>
<td>Equipment / tools</td>
<td>Improper use</td>
<td>Workable equipment / tools</td>
<td>Unavailability of tools</td>
</tr>
<tr>
<td>Finance (cost)</td>
<td>Waste of money</td>
<td>Financial buffer</td>
<td>Excessive cost</td>
</tr>
<tr>
<td>Data</td>
<td>Data overload</td>
<td>Data buffer</td>
<td>Missing data</td>
</tr>
</tbody>
</table>
When worlds collide ...

WAI ≠ WAD

Solution: Make sure that WAD is more like WAI.

Tempting because WAI seems to be clear and well-defined, and it is easier to prescribe that WAD should be changed than to change WAI.

WAI ≠ WAD

Solution: Adjust WAI to be more like WAD.

Difficult because WAD appears to be unclear and difficult to grasp, because WAD is forever changing, and because it will threaten those in charge.

WAI ≠ WAD

Solution: Realign WAI and WAD.

To change WAI: Get information about WAD faster. Improve quality of information about WAD (Safety-II).

To change WAD: Encourage mindfulness. Make informal communication easier.