Trafikflyghögskolan

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Remote Towers a Human Factors perspective

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What we will explore today

What are the *human factors issues* of Remote Tower

- What is Human Factors
- Remote Towers are what?
- What does research tell us
- What does this mean – theory in practical terms

Another view, is the *human factor* view of remote tower AFIS(O) operations?

The view of the work system that Remote Towers sits i

Question and Answers (well we can hope for some answers!)

What is Human Factors (and ergonomics)?

One View

"Ergonomics is the scientific discipline concerned with the *understanding of interactions among humans and other elements of a system*, and the profession that applies theory, principles, data and methods to design in order to *optimise human well-being and overall system performance." International Ergonomics Association*

The terms 'ergonomics' and 'human factors' can be used interchangeably, although 'ergonomics' is often used in relation to the physical aspects of the environment, such as workstations and control panels, while *'human factors' is often used in relation to wider system in which people work.* On this site we generally use the term that fits most closely with the research or the industry that we are discussing. *IEHF*

Another view

. . . is that branch of science which seeks to turn human-machine antagonism into human-machine synergy.

Peter Hancock

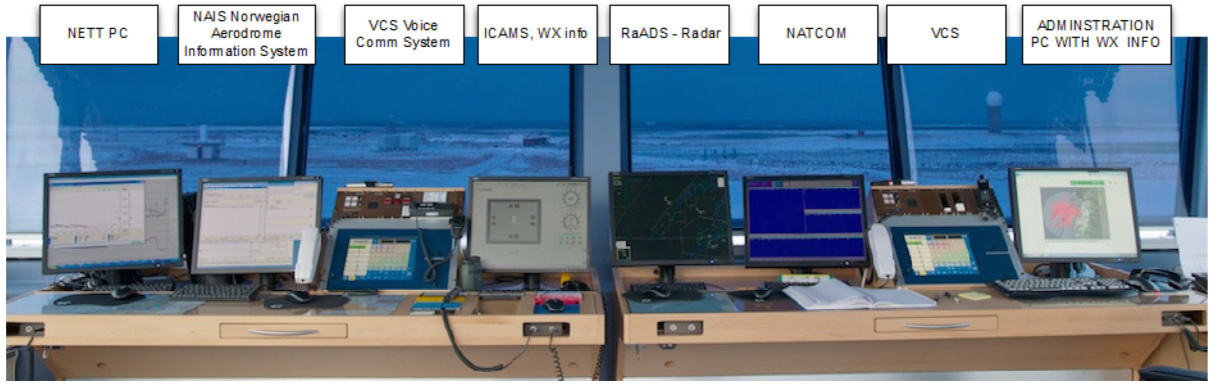
We live in a complex world…

How do we make sense of it and achieve our work?

Fitts – 1944
Aircraft landing with Gear Up

Human Factors and Remote Tower Operation

What is a remote tower?

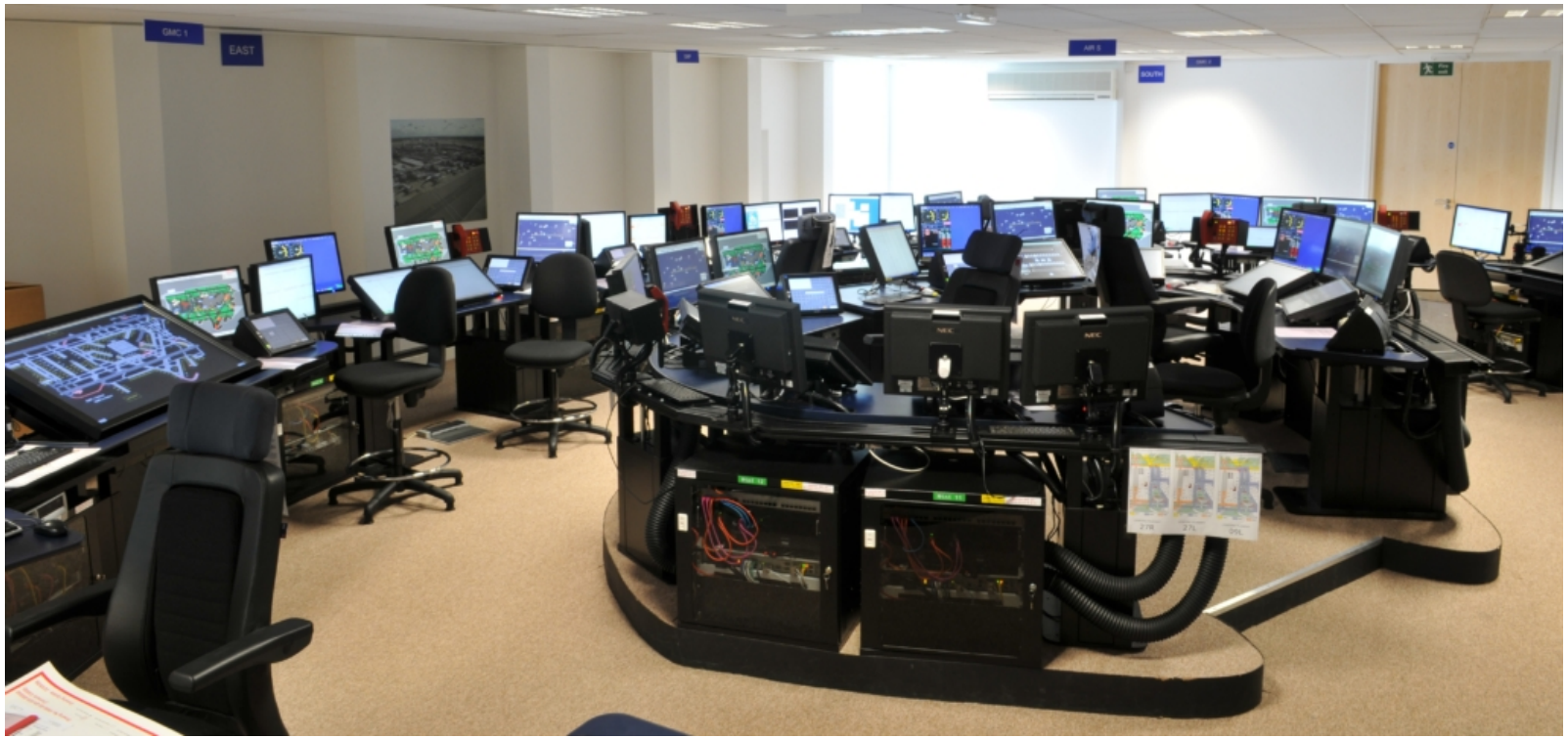


Multiple Remote Towers - 1

Single Remote Tower

Multiple Remote Towers - 2

Is this a remote tower operation?



An exercise – for you

If we wanted to introduce into service a remote tower operation that we knew the implementation ***would fail***, how would we do this?

In groups, in 5 minutes, one suggestion

Human Factors aspects Remote Tower Operations 1/2

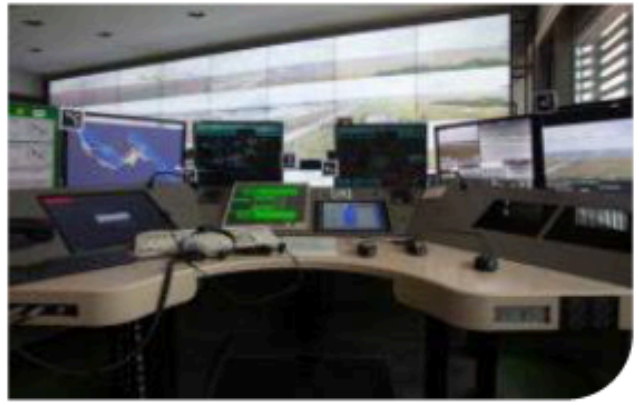
Camera perspective and resolution

IR and tools for poor visibility conditions

PTZ will replace binoculars

Data integration

Augmented data



Divide attention within CWP

Basic HF… Information Processing models

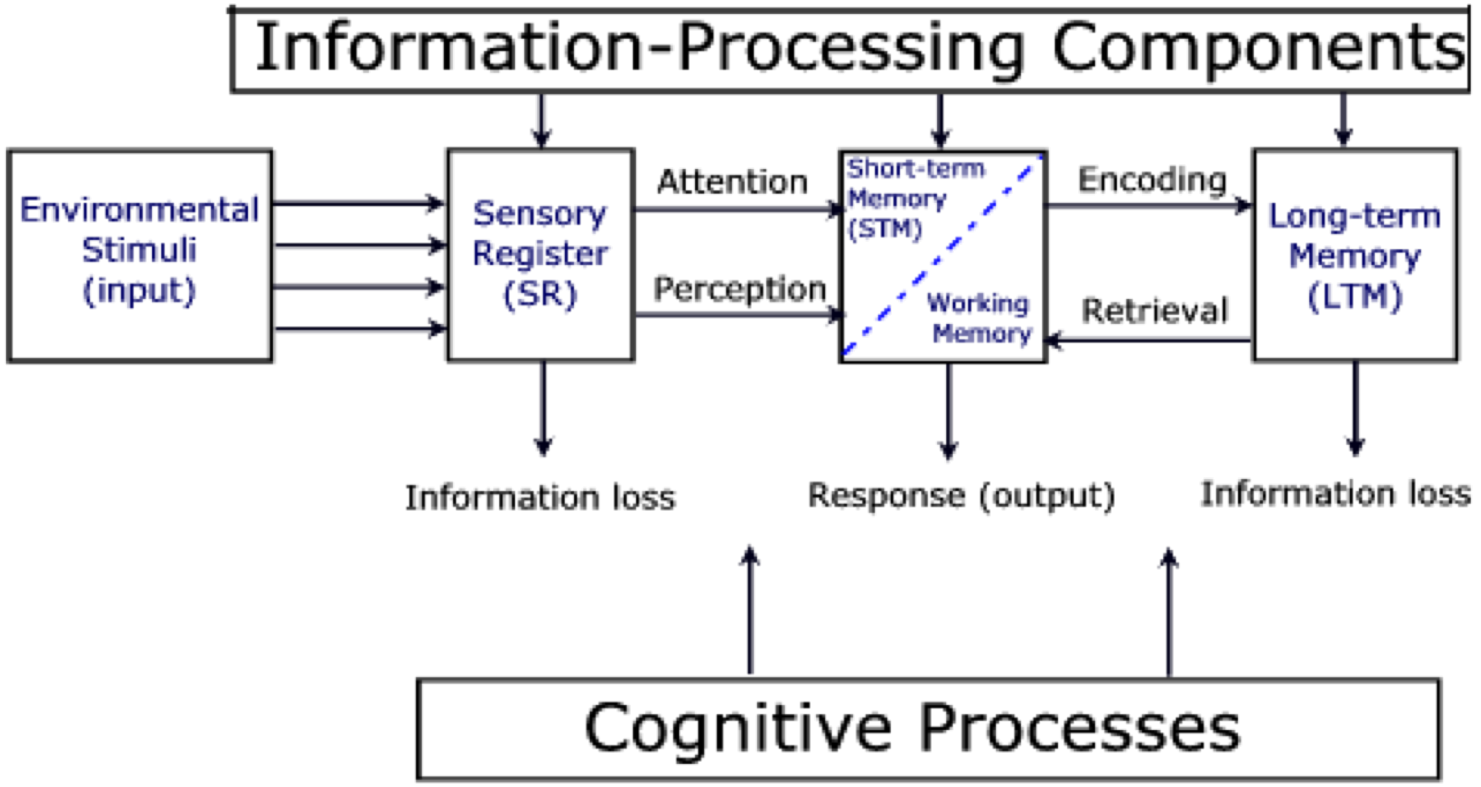
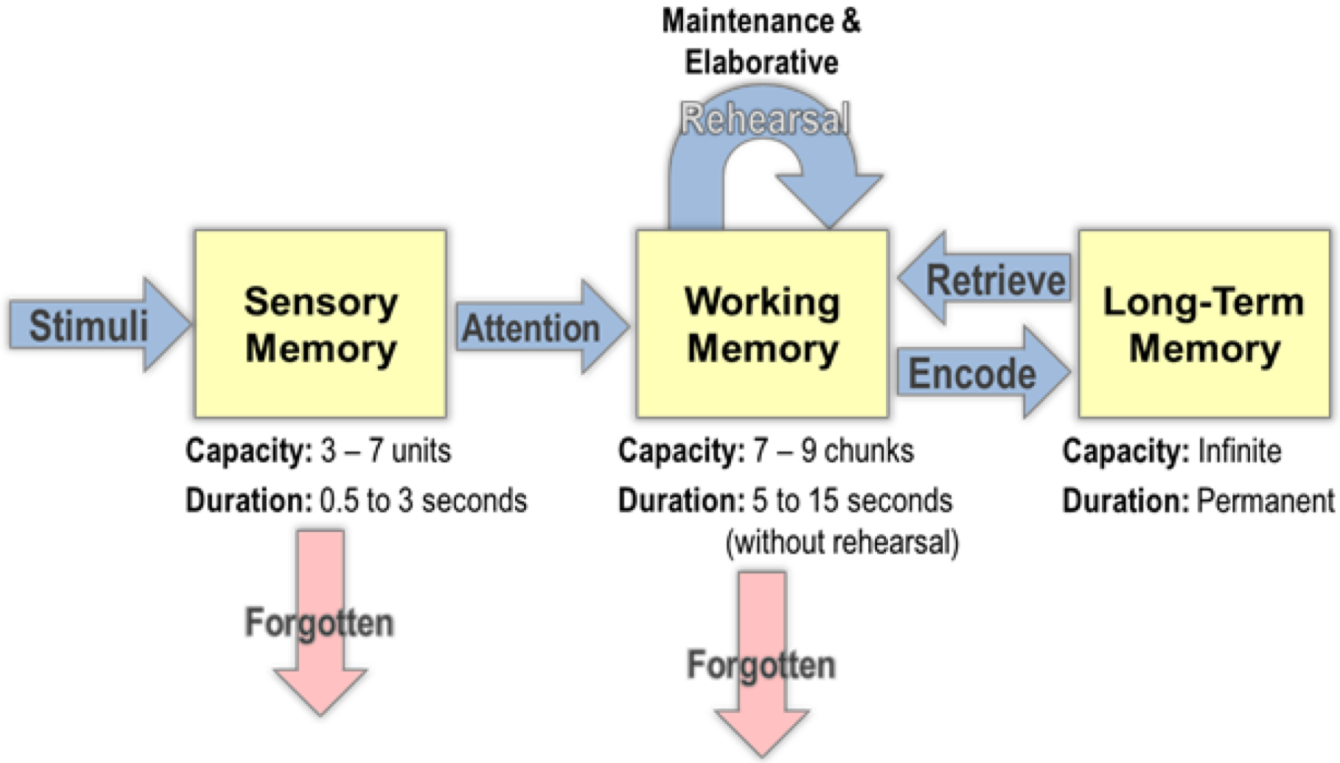


Figure 1.2 An Information Processing model

Source: Wickens, 1998

Not so basic model

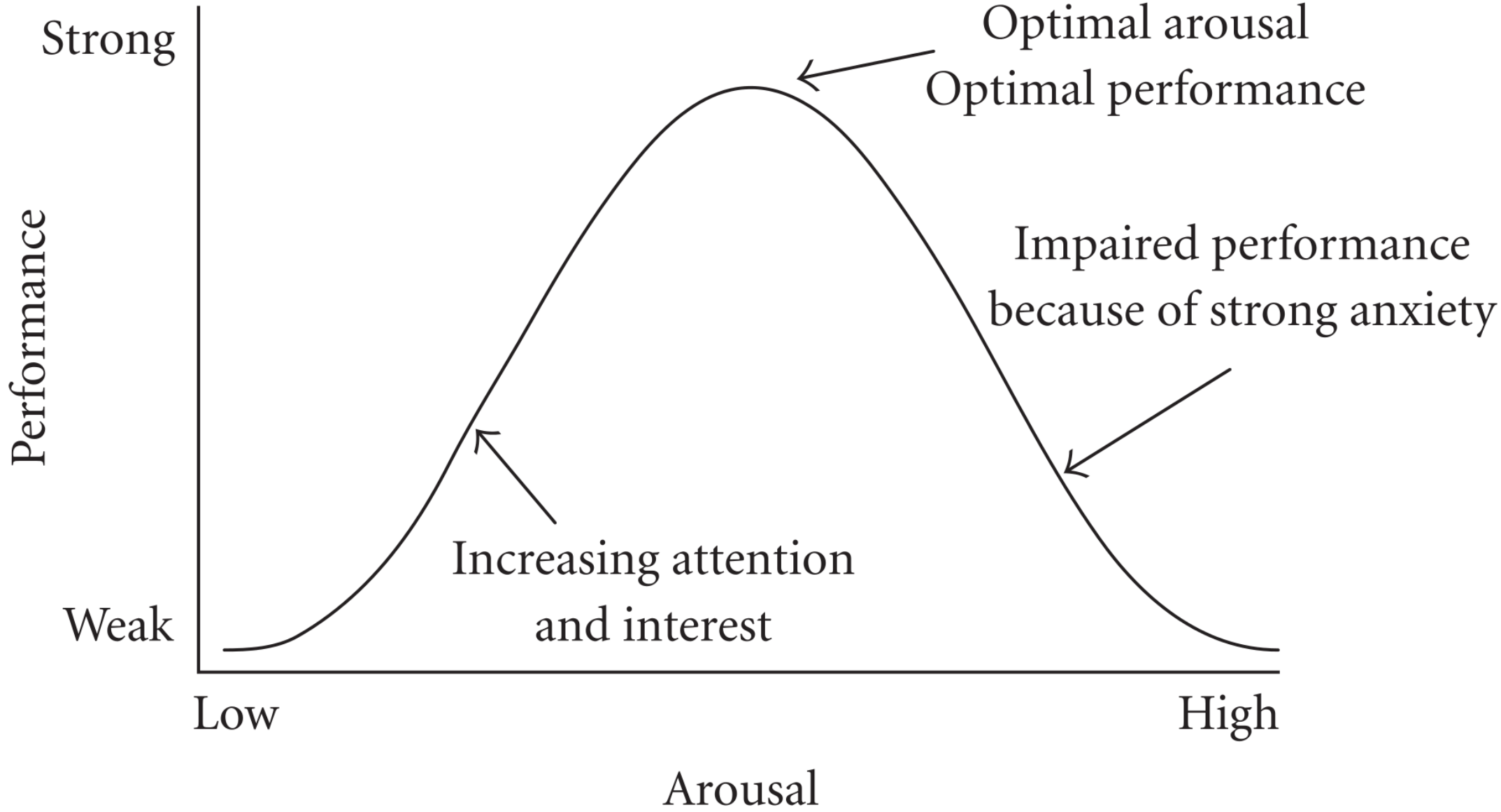


Source: Dataworks

Conclusions of the NLR RTO study

RTO has an impact on:

- Workload of the ATCOs – Multiple RTWr operation
- Information Presentation
- “Situational Awareness”
- Usability of the system
- Different scanning patterns and strategies
  - Individual differences
- Head out versus head down
- ATCOs used radar display more in conventional tower than in RTwr


Strong
Performance
Weak
Optimal arousal
Optimal performance
Impaired performance
because of strong anxiety
Increasing attention
and interest
Low
High
Arousal

What does this mean for AFISOs?

Case Study: paper to glass ‘strip’ transition

Strips…


W1 ANTRIM
123.775
SCOTTISH CONTROL
W2 ISLE OF MAN
128.050
AERODROME QNH IN RANGE
996 – 1013 hPa
TRANSITION LEVEL
35
LAFL
45
1235
BEE8AH
EGCC 6
IOM
RTO ISS

Administration (FAA)

Advanced Automation System (AAS)

- replacement air-traffic control system
- contracted to IBM in 1983 with a budget of $2.6 billion
- >1M lines of code, 100s of computers

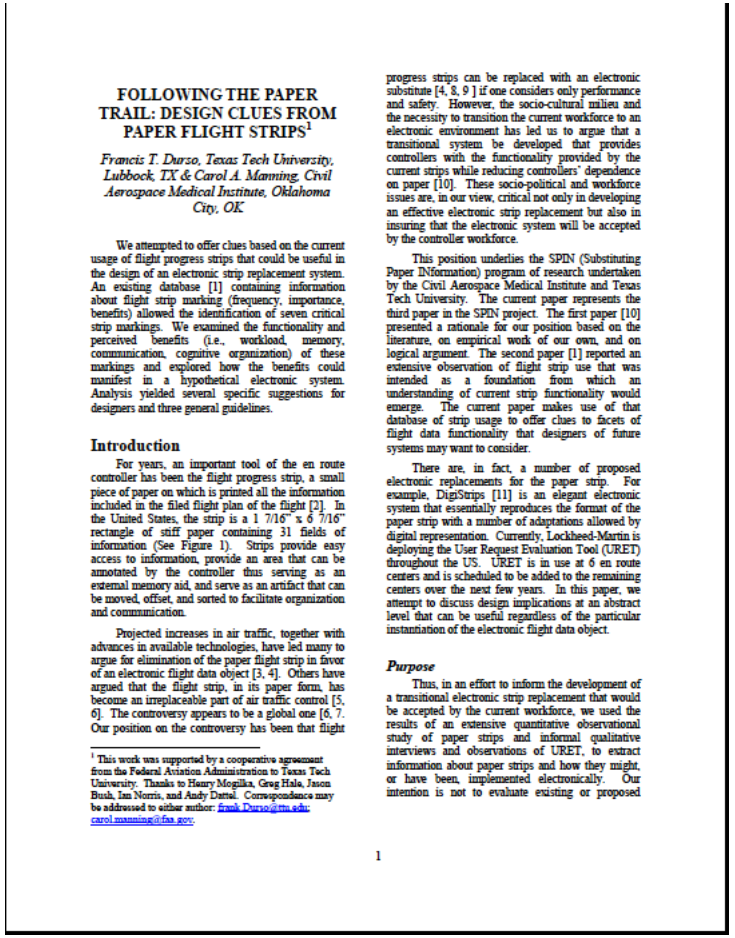
Over budget, late, and unfinished

- in 1996, General Accounting Office (GAO) reports 57% of the budget was wasted
- 2/3 of project is canceled, the rest is late

Reasons for failure

- FAA assumed that IBM would use engineering techniques
- GAO reports that “human factors” were the main reason for failure

Durso: Paper strips, following the trail



FOLLOWING THE PAPER TRAIL: DESIGN CLUES FROM PAPER FLIGHT STRIPS[1]

Francis T. Durso, Texas Tech University, Lubbock, TX & Carol A. Manning, Civil Aerospace Medical Institute, Oklahoma City, OK

We attempted to offer clues based on the current usage of flight progress strips that could be useful in the design of an electronic strip replacement system. An existing database [1] containing information about flight strip marking (frequency, importance, benefits) allowed the identification of seven critical strip markings. We examined the functionality and perceived benefits (i.e., workload, memory, communication, cognitive organization) of these markings and explored how the benefits could manifest in a hypothetical electronic system. Analysis yielded several specific suggestions for designers and three general guidelines.

Introduction

For years, an important tool of the en route controller has been the flight progress strip, a small piece of paper on which is printed all the information included in the filed flight plan of the flight [2]. In the United States, the strip is a 1 7/16" x 6 7/16" rectangle of stiff paper containing 31 fields of information (See Figure 1). Strips provide easy access to information, provide an area that can be annotated by the controller thus serving as an external memory aid, and serve as an artifact that can be moved, offset, and sorted to facilitate organization and communication.

Projected increases in air traffic, together with advances in available technologies, have led many to argue for elimination of the paper flight strip in favor of an electronic flight data object [3, 4]. Others have argued that the flight strip, in its paper form, has become an irreplaceable part of air traffic control [5, 6]. The controversy appears to be a global one [6, 7. Our position on the controversy has been that flight progress strips can be replaced with an electronic substitute [4, 8, 9] if one considers only performance and safety. However, the socio-cultural milieu and the necessity to transition the current workforce to an electronic environment has led us to argue that a transitional system be developed that provides controllers with the functionality provided by the current strips while reducing controllers' dependence on paper [10]. These socio-political and workforce issues are, in our view, critical not only in developing an effective electronic strip replacement but also in insuring that the electronic system will be accepted by the controller workforce.

This position underlies the SPIN (Substituting Paper INformation) program of research undertaken by the Civil Aerospace Medical Institute and Texas Tech University. The current paper represents the third paper in the SPIN project. The first paper [10] presented a rationale for our position based on the literature, on empirical work of our own, and on logical argument. The second paper [1] reported an extensive observation of flight strip use that was intended as a foundation from which an understanding of current strip functionality would emerge. The current paper makes use of that database of strip usage to offer clues to facets of flight data functionality that designers of future systems may want to consider.

There are, in fact, a number of proposed electronic replacements for the paper strip. For example, DigiStrips [11] is an elegant electronic system that essentially reproduces the format of the paper strip with a number of adaptations allowed by digital representation. Currently, Lockheed-Martin is deploying the User Request Evaluation Tool (URET) throughout the US. URET is in use at 6 en route centers and is scheduled to be added to the remaining centers over the next few years. In this paper, we attempt to discuss design implications at an abstract level that can be useful regardless of the particular instantiation of the electronic flight data object.

Purpose

Thus, in an effort to inform the development of a transitional electronic strip replacement that would be accepted by the current workforce, we used the results of an extensive quantitative observational study of paper strips and informal qualitative interviews and observations of URET, to extract information about paper strips and how they might, or have been, implemented electronically. Our intention is not to evaluate existing or proposed

[1] This work was supported by a cooperative agreement from the Federal Aviation Administration to Texas Tech University. Thanks to Henry Mogilka, Greg Hale, Jason Bush, Ian Norris, and Andy Dattel. Correspondence may be addressed to either author: frank.Durso@ttu.edu; carol.manning@faa.gov.

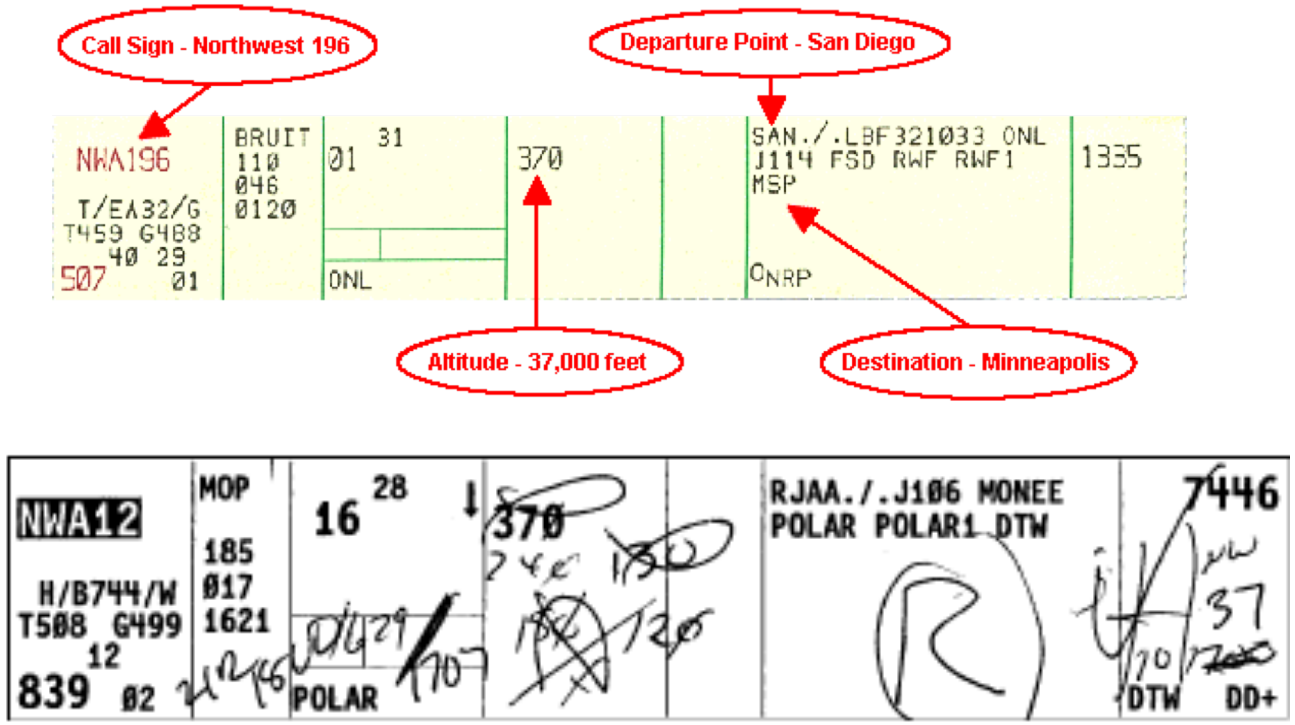


Figure 1. A flight progress strip with illustrative strip marking.

An exercise – for you

As AFISOs what should designers of Remote Tower operations – multiple and single need to know from the AFISO perspective?

In groups, in 5 minutes, one suggestion

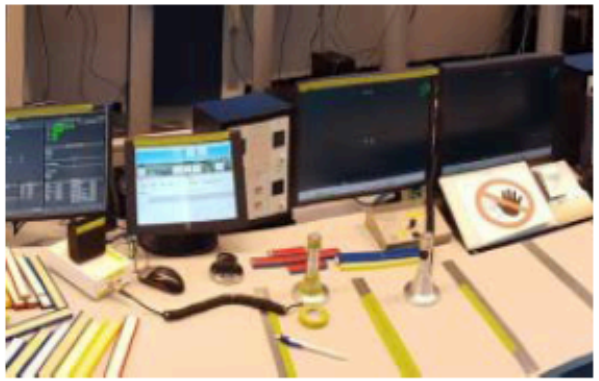
More HF considerations

Human Factors aspects Remote Tower Operations 2/2

Different workload situations

Impact on ATCo fatigue?

Impact on teamwork

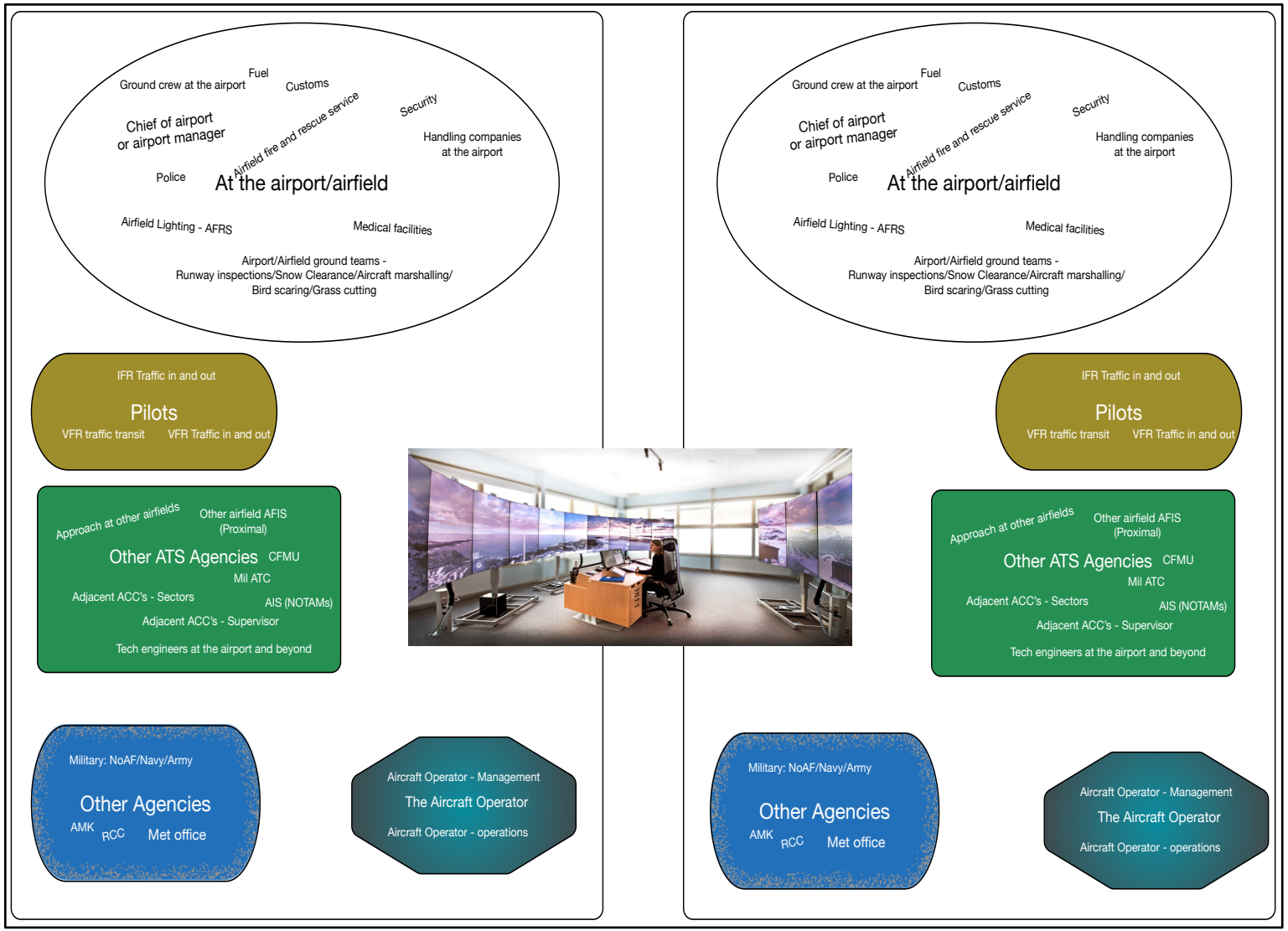


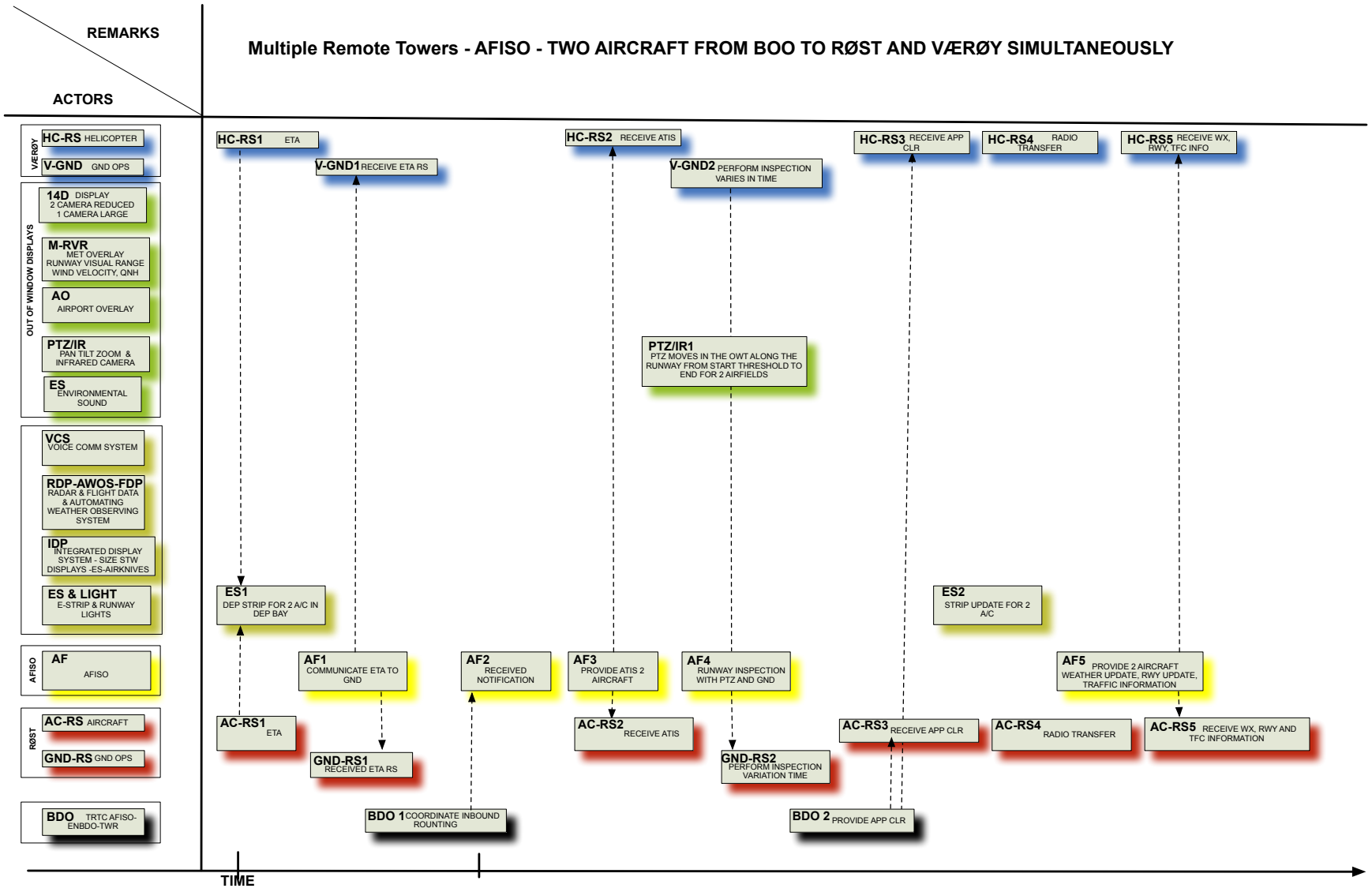
Design CWP

Positioning monitors out of window view

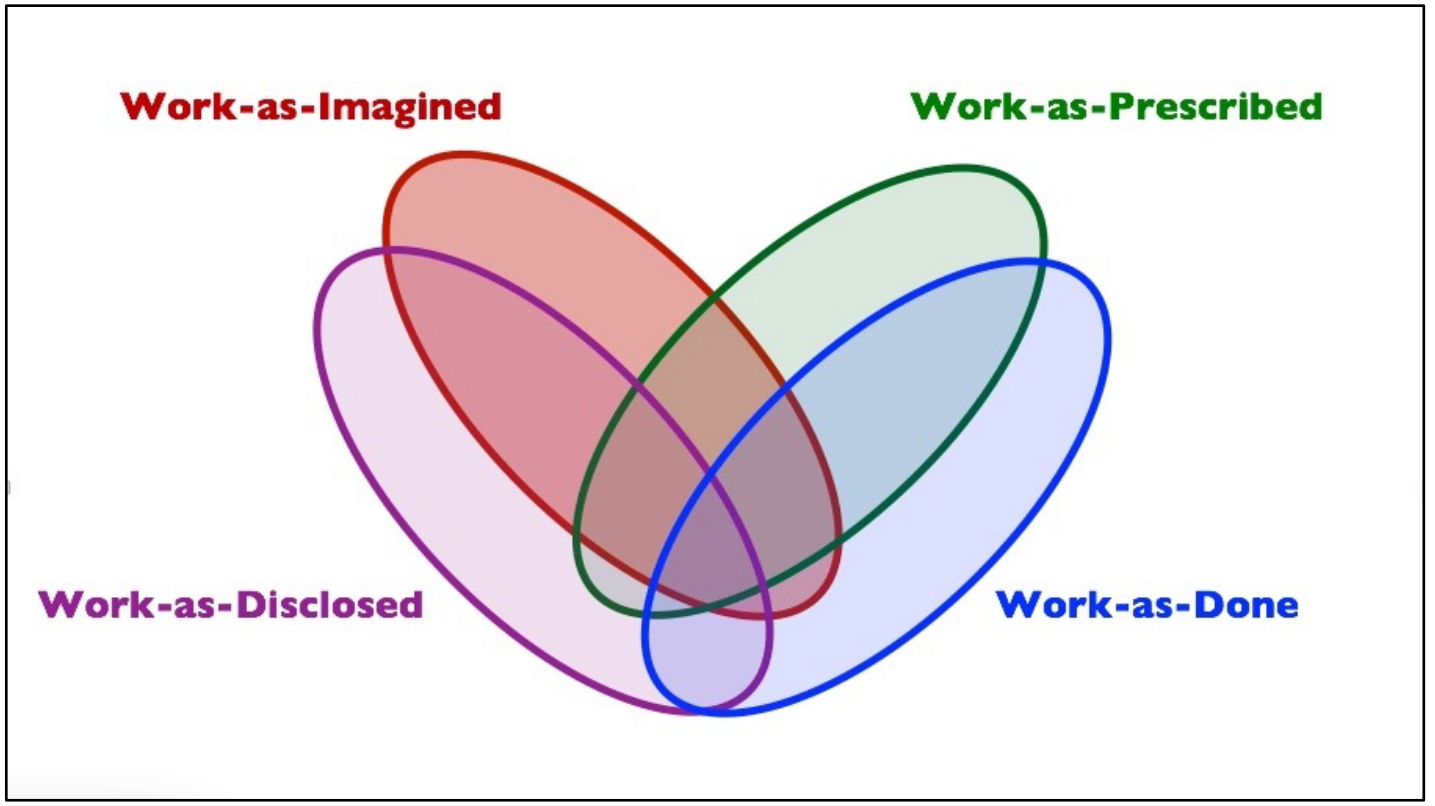
ATCo operational strategies

A ’system’ model of a MTWR operation



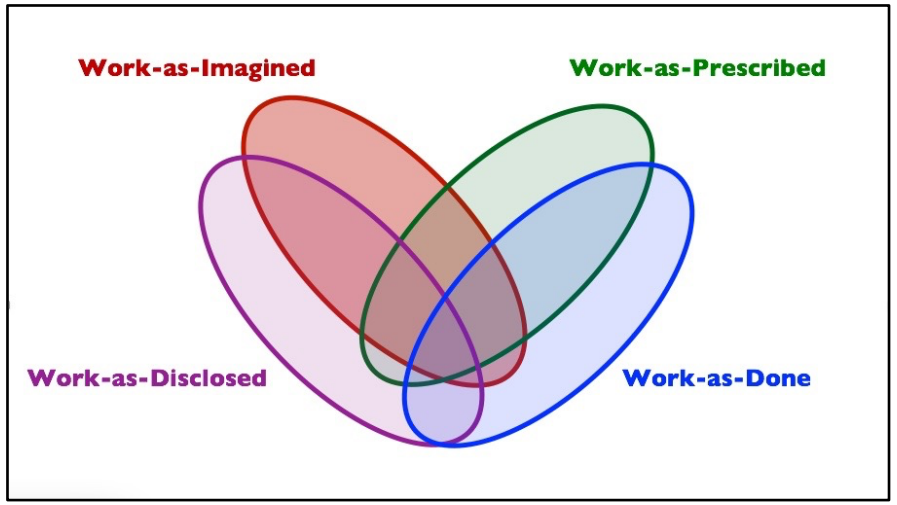

REMARKS
ACTORS
Multiple Remote Towers - AFISO - TWO AIRCRAFT FROM BOO TO RØST AND VÆRØY SIMULTANEOUSLY
VÆRØY
HC-RS HELICOPTER
V-GND GND OPS
OUT OF WINDOW DISPLAYS
14D DISPLAY 2 CAMERA REDUCED 1 CAMERA LARGE
M-RVR MET OVERLAY RUNWAY VISUAL RANGE WIND VELOCITY, QNH
AO AIRPORT OVERLAY
PTZ/IR PAN TILT ZOOM & INFRARED CAMERA
ES ENVIRONMENTAL SOUND
VCS VOICE COMM SYSTEM
RDP-AWOS-FDP RADAR & FLIGHT DATA & AUTOMATING WEATHER OBSERVING SYSTEM
IDP INTEGRATED DISPLAY SYSTEM - SIZE STW DISPLAYS -ES-AIRKNIVES
ES & LIGHT E-STRIP & RUNWAY LIGHTS
AFISO
AF AFISO
RØST
AC-RS AIRCRAFT
GND-RS GND OPS
BDO TRTC AFISO-ENBDO-TWR
HC-RS1 ETA
V-GND1 RECEIVE ETA RS
HC-RS2 RECEIVE ATIS
V-GND2 PERFORM INSPECTION VARIES IN TIME
HC-RS3 RECEIVE APP CLR
HC-RS4 RADIO TRANSFER
HC-RS5 RECEIVE WX, RWY, TFC INFO
PTZ/IR1 PTZ MOVES IN THE OWT ALONG THE RUNWAY FROM START THRESHOLD TO END FOR 2 AIRFIELDS
ES1 DEP STRIP FOR 2 A/C IN DEP BAY
ES2 STRIP UPDATE FOR 2 A/C
AF1 COMMUNICATE ETA TO GND
AF2 RECEIVED NOTIFICATION
AF3 PROVIDE ATIS 2 AIRCRAFT
AF4 RUNWAY INSPECTION WITH PTZ AND GND
AF5 PROVIDE 2 AIRCRAFT WEATHER UPDATE, RWY UPDATE, TRAFFIC INFORMATION
AC-RS1 ETA
GND-RS1 RECEIVED ETA RS
AC-RS2 RECEIVE ATIS
GND-RS2 PERFORM INSPECTION VARIATION TIME
AC-RS3 RECEIVE APP CLR
AC-RS4 RADIO TRANSFER
AC-RS5 RECEIVE WX, RWY AND TFC INFORMATION
BDO 1 COORDINATE INBOUND ROUNTING
BDO 2 PROVIDE APP CLR
TIME

Work is not always ‘as prescribed or imagined’



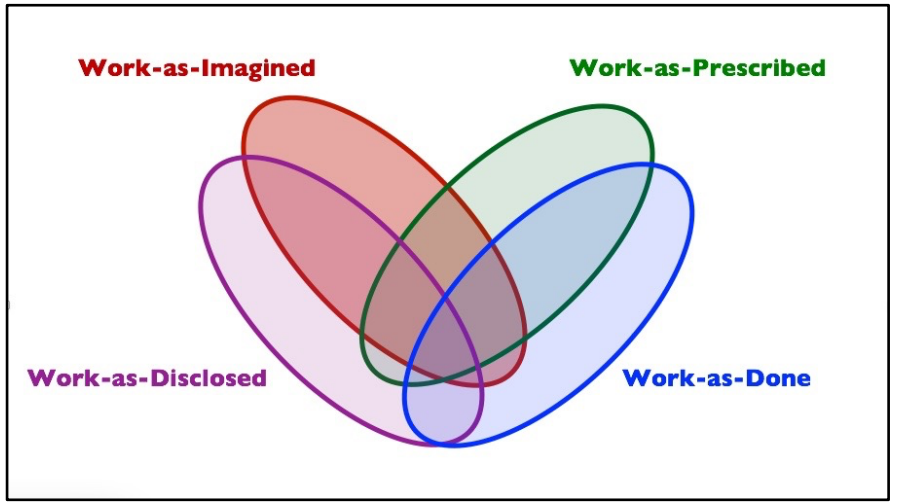
Source: Shorrock, 2017

The system view – multiple perspectives



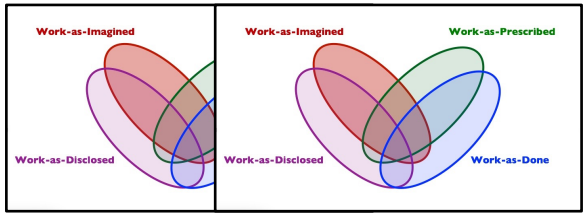
AFISO

+



Pilot

And how they overlap

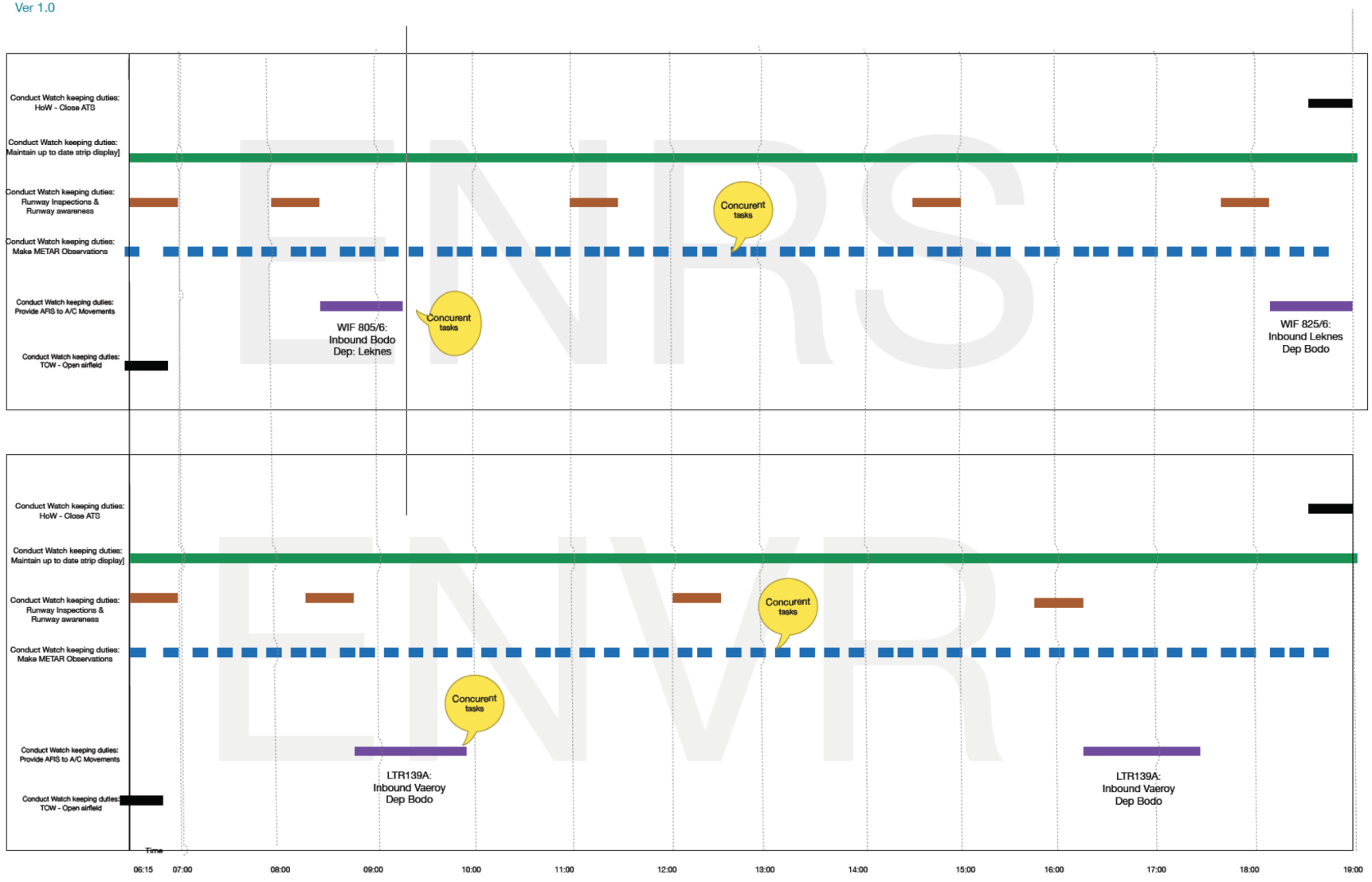


Source: Shorrock, 2017

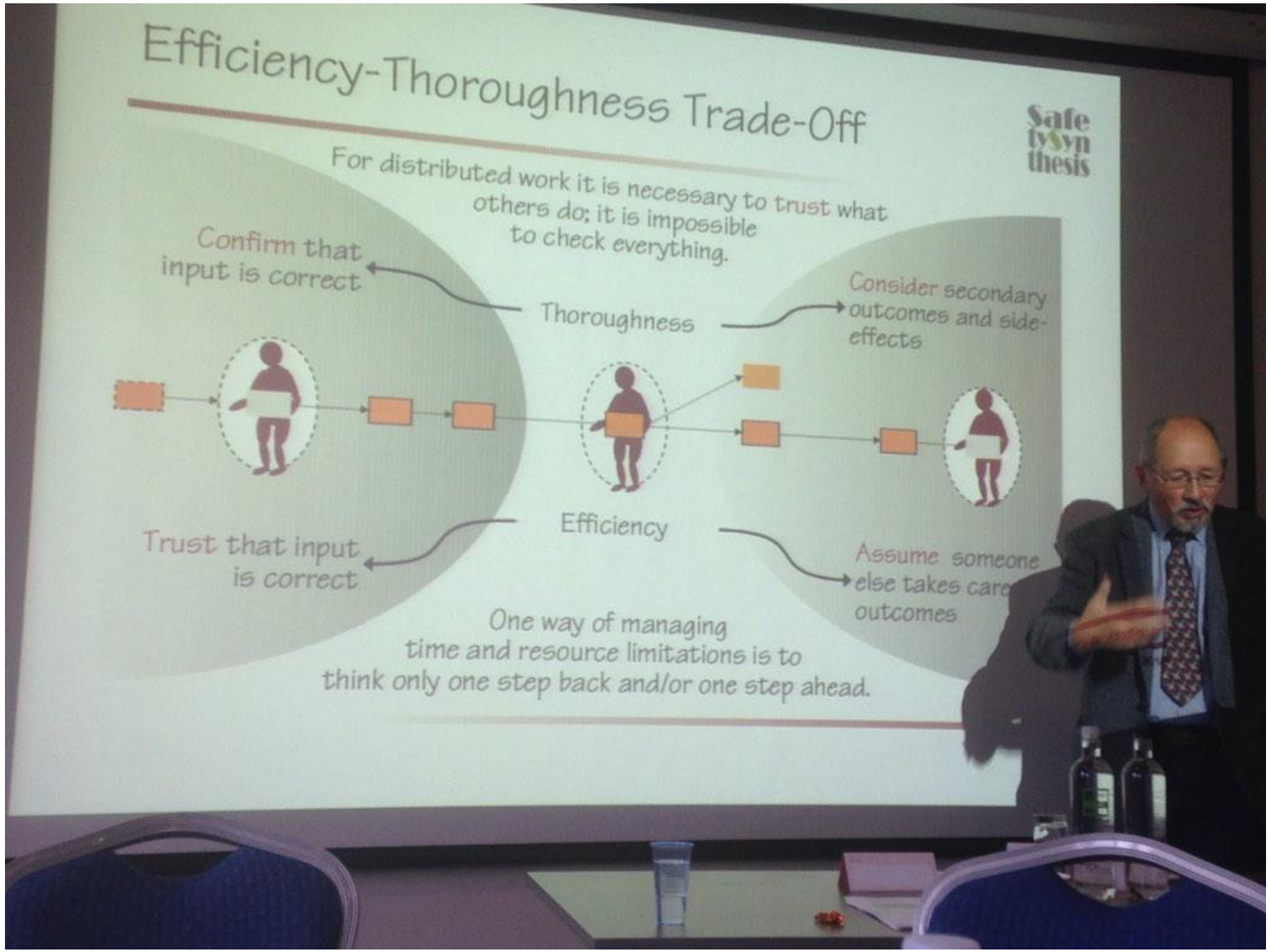
BODO RVT:

Assumptions: Rost (ENRS & Vaeroy (ENVY) - Typical day activities time and 1. ENVR migrates to a AFIS operation task line

Ver 1.0



Hollnagel's ETTO:
Efficiency thoroughness trade off



AFISO HF Issues - 1

- Under current conditions, the central issue for the AFISO is to gather and convey information accurately and in time. Single RTWr will be the same potentially, but accessed differently
- Under the MRTWRs concept, the same issue is at play, and another critical issue emerges potentially: the work is divided between multiple locations, requiring the operator to divide his/her attention across locations depending on the demands and priorities of the situation at hand

AFISO HF Issues - 2

- Local knowledge supports the timely gathering of information, potentially through involving other airport operators through established informal collaboration networks (e.g., knowledge of who to ask in emergency for a specific piece of information).
- Will work under the MRWTRs concept need to provide similar means for operators to deal with unusual situations, for which solely on information provided through sensor feeds might be insufficient.

AFISO Issues - 3

- Will the monitoring of watch-keeping tasks become a lower priority when issues occur at a different airport due to split responsibilities between locations.
- The risk here is that the situation quickly degrades due to the latency at providing information to other locations when watch-keeping cannot be conducted as usual.
- And does it influence others work, e.g. pilots?

AFISO HF Issues -4

- Multiple Remote Tower AFISO operations, how many towers can be operated simultaneously?
- If effective AFIS involves providing up-to-date and accurate information to aircraft to allow pilots to assess the feasibility of a landing procedure, Timeliness and accuracy of information are critical dimensions here, as the failure to provide such quality of information might lead to catastrophic outcomes.
- Pilots may need to find appropriate workarounds, or simply find alternative solutions – and ETTO begetting and ETTO?

AFISO HF Issues - 5

- How will a multiple AFIS remote tower centre be organised and managed
- Operational decision making is different or new.
- There are new dependencies introduced that can potentially bring operational benefits.
- More resilient operation is possible
- Will the work of the AFISO remain the same?
- Will the operating concept and philosophy of AFIS remain the same or is there potential for radical change for the better?

Conclusions

Conclusions

- Human factors can provide insight into AFIS provision into the design of Remote Tower operations
- … and different questions to ask
- The design of Remote Tower for AFIS provision needs to be informed by the nature of the actual work as done
- HF measurement of AFIS Remote Tower Operations is infomed by operational measures

Time for Questions

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