

# Using CTA to improve operator control room performance

**NERC Human Performance Seminar**

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*Rusty Rae, Alstom ATI; Dick Clark, USC; Bror Saxberg, Kaplan*



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# Today's program



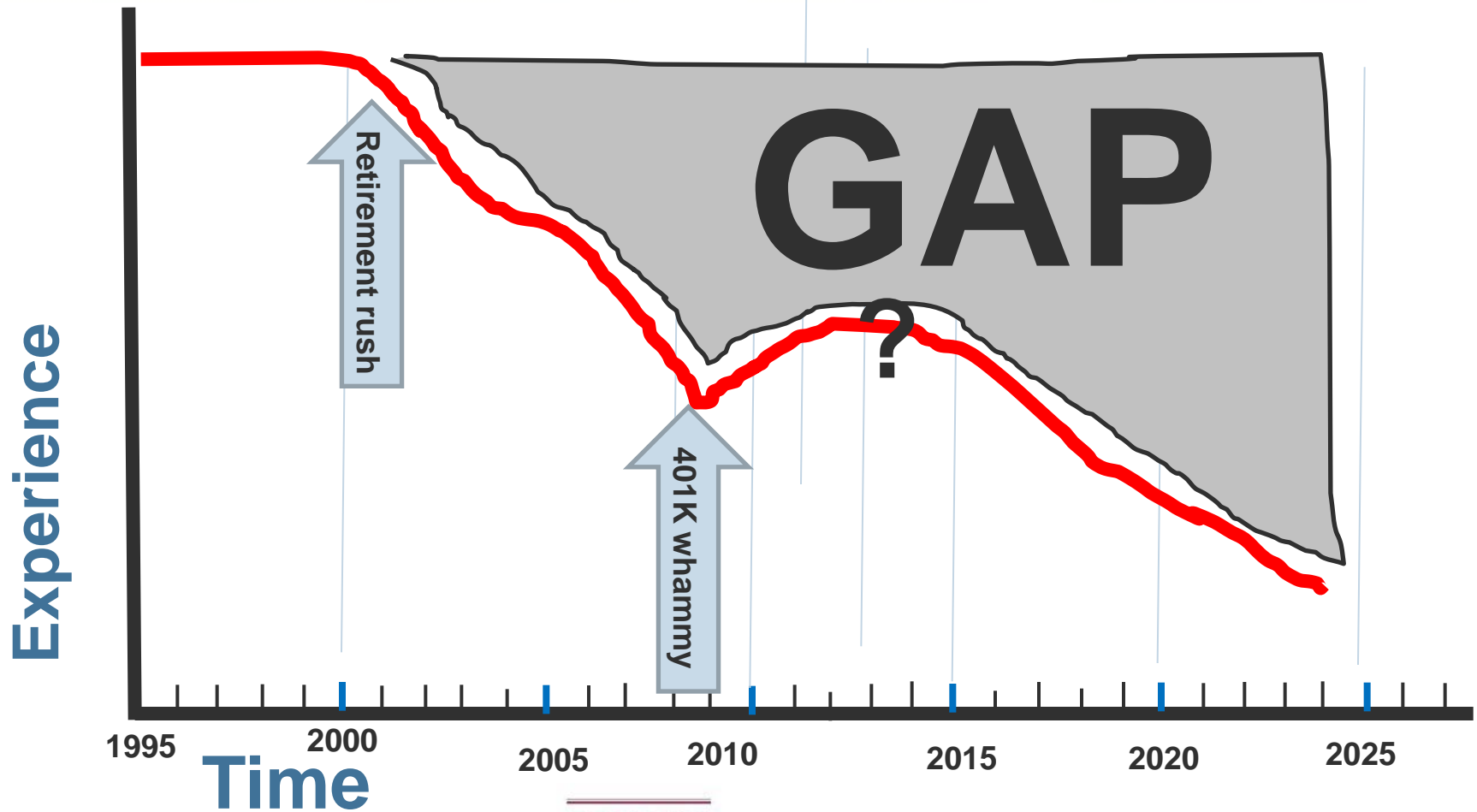
- Introductions
- Filling the gap
- The case for **cognitive task analysis**
- Q&A



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# Operator experience in the control room



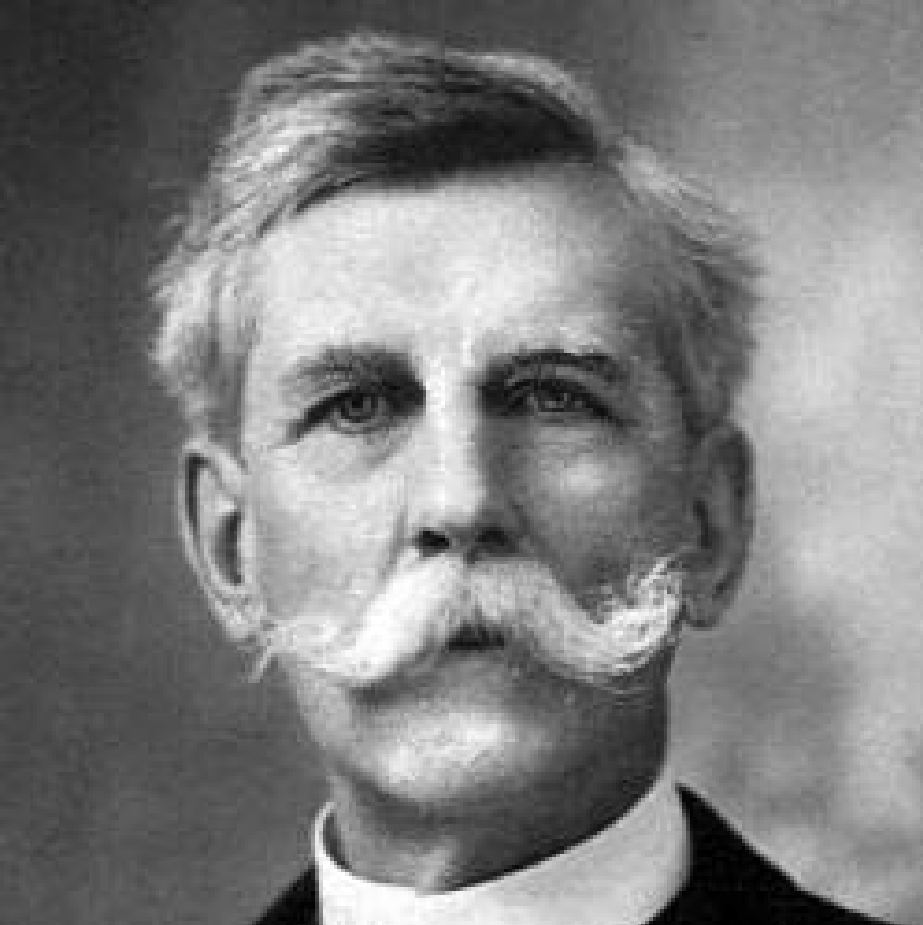
# How do we keep on keeping the lights on?



- **NERC Certification**
  - **NERC required JTA**
  - **32 hours of EOPS Simulation**
- 

Does this meet  
readiness requirements?

# Knowledge and wisdom



**‘The young man  
knows the rules,  
but the old man  
knows the  
exceptions’**

*~Oliver Wendell Holmes Sr.*



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# Knowledge and wisdom

A cinematic still of Indiana Jones from the movie 'The Temple of Doom'. He is wearing his signature brown fedora and a light-colored, worn-in shirt. He is holding a large, golden, spherical object (the 'Golden Idol') in his left hand, which is extended towards the camera. His right hand is also extended, holding a small, dark object. The background is dark and textured, suggesting an underground or cave setting. The lighting is dramatic, highlighting the golden object and the texture of his clothing.

**Wisdom consists  
of the anticipation  
of consequences.**

*~Norman Cousins*

# Knowledge and wisdom

**‘Wisdom comes from  
experience and experience  
comes from making  
mistakes’**



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# How do we get 15 years of experience in 5 years?



- **Capture the know how of experienced operators**
- **Develop simulations based on this analysis**
- **Develop a culture of deliberate practice among staff**



# Cognitive Task Analysis (CTA) can facilitate capturing know-how/ know-when knowledge

**CTA combines structured interviews and other approaches to capture the cognitive strategies that highly successful experts apply to solve problems and perform complex tasks**

**70%** of work expertise – esp. the “when and how” to do things - is automated and non conscious – and so not easy to pass on



# CTA process



Based on **structured interviews** with top experts identified with data, not opinion.

Interviews **identify key decisions and tasks** and the steps behind these

Interviews are refined to a “**gold standard**” and used to drive instruction.

# Cognitive Task Analysis fills the gap in what experts teach about their expertise

Expertise remaining to be discovered

20%

What can be discovered by CTA

50%

What experts teach

30%

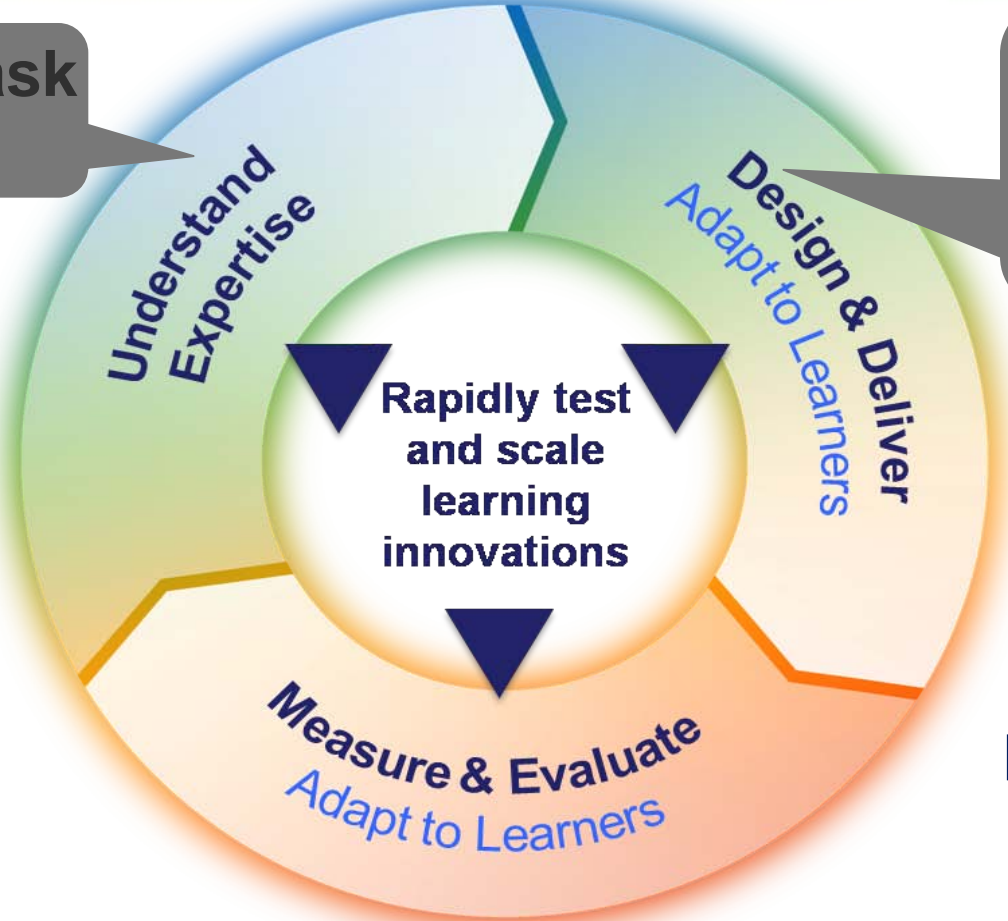
Expert performance  
100%

CTA unlocks **50%** more of the knowledge required to be an expert in a field

CTA helps learner move from **30%** to **70-80%** of expert decision-making and analysis strategies

# Integrate with evidence-based data in ADDIE framework

Cognitive Task Analysis






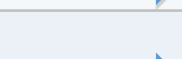





Evidence-Based Instructional **Design, Development, Implementation**

Evaluate



... Which a well-designed CTA aligns with very well

<b>CTA Report</b>		<b>GEL* Design</b>
Task Objective		Learning objective
Benefits & Risks (Reasons)		Reason (benefits & risks)
Main Tasks & Procedures		Overview
Prerequisite Skills/Knowledge		Prior Knowledge
Concepts, Processes, Principles		New Conceptual Knowledge
Action & Decision Steps		Demonstration
Problems from SMEs		Practice
Checklist from Steps		Feedback



\* GEL: Guided Experiential Learning



# Use of CTA in medical training

## Medical school surgical instruction

**CTA-trained surgeons had 34% greater performance gains and 25% more conceptual knowledge from pre to post test**

**Also made no harmful errors whereas controls committed serious errors**



# Use of CTA in emergency response training

## Emergency and safety procedures

**CTA did require 85% more front-end time for design and development**

**New course presentation required half the time with 35% gain in test scores on the performance post test**



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# Use of CTA in medical training

## Medical school surgical instruction

**When two simulator designs were tested with the surgery CTA information (evidence-based versus “Kolb type” problem-based learning)**

**EB + CTA led to 26% more learning, 37% more transfer and 30% fewer minor errors.**





# Cautions: Limitations of CTA

- Requires participation by experts for whom we have reliable and valid evidence of a consistently successful work record.
- 100+ different versions of CTA exist but only 6 have been tested and only three of the six produced maximum results.
  - Most CTA versions were designed for machine learning and/or AI applications – not training.



# CTA has benefits for employers and employees

- Captures skills of most senior problem-solvers before they leave/retire
- More complete identification of key tasks and decisions (especially about when to do tasks) than a typical job task analysis – and what's *not* needed
- Decreases error rates on the job
- Reduces training time from traditional training
- Improves motivation – training closely matches tasks, ties to success
- Increases employers' understanding of jobs and barriers to good work - tends to change job descriptions and increases productivity even further



# CTA also upgrades current job training curricula: Example - Only 4 of 13 critical paralegal tasks are taught

CTA expert identified activities	Modules in Paralegal Curriculum
Intake interview	Unit 1: Justin King Case Unit 2: Pre-Complaint Investigation
Identify conflicts	<b>Not taught</b>
Determine and comply pre-litigation notices or demands	<b>Not taught</b>
Draft and file a complaint	Unit 3: Drafting the Complaint Unit 4: Pre-Answer Investigation Unit 5: Draft the Answer
Motion/Pleadings	<b>Not taught</b>
Discovery	Unit 6: Discovery I Unit 7: Discovery II
Pre-trial	Unit 8: Pretrial Motions and Settlements Unit 9: Getting Ready for Trial
Trial	<b>Not taught</b>
Post trial	<b>Not taught</b>
Settlement	<b>Not taught</b>
Appellate filings and hearings	<b>Not taught</b>
Technology Tools: e-Discovery	<b>Not taught</b>
Technology tools: Litigation Tools	<b>Not taught</b>

# From fighter pilots to chicken sexers use CTAs



- **Commanding Generals**
- **Trauma Surgeons**
- **Radiological Cardiologists**
- **Neonatal Nurses**
- **Fighter Pilots**
- **SWAT Teams**
- **Emergency Room Teams**
- **Blackjack (21) winners**
- **Nuclear Generator Design Engineers**
- **Chicken Sexers**

# Many lines of evidence for effectiveness of CTA...

Typically **30% – 50%** learning gains with CTA

Meta Analysis of studies:

- **Lee (2004)** - 34 studies averaged **47%** performance increase.
- **Tofel-Grehl (2011)** 57 comparisons averaged **30%** learning increase over controls using conservative analysis – some much more effective.

Patent examiners finish **75%** faster (6 mo. vs. 2 yrs.)

- Production increase 200%+ mistakes down 65%



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# Case Study: The European Patent Office

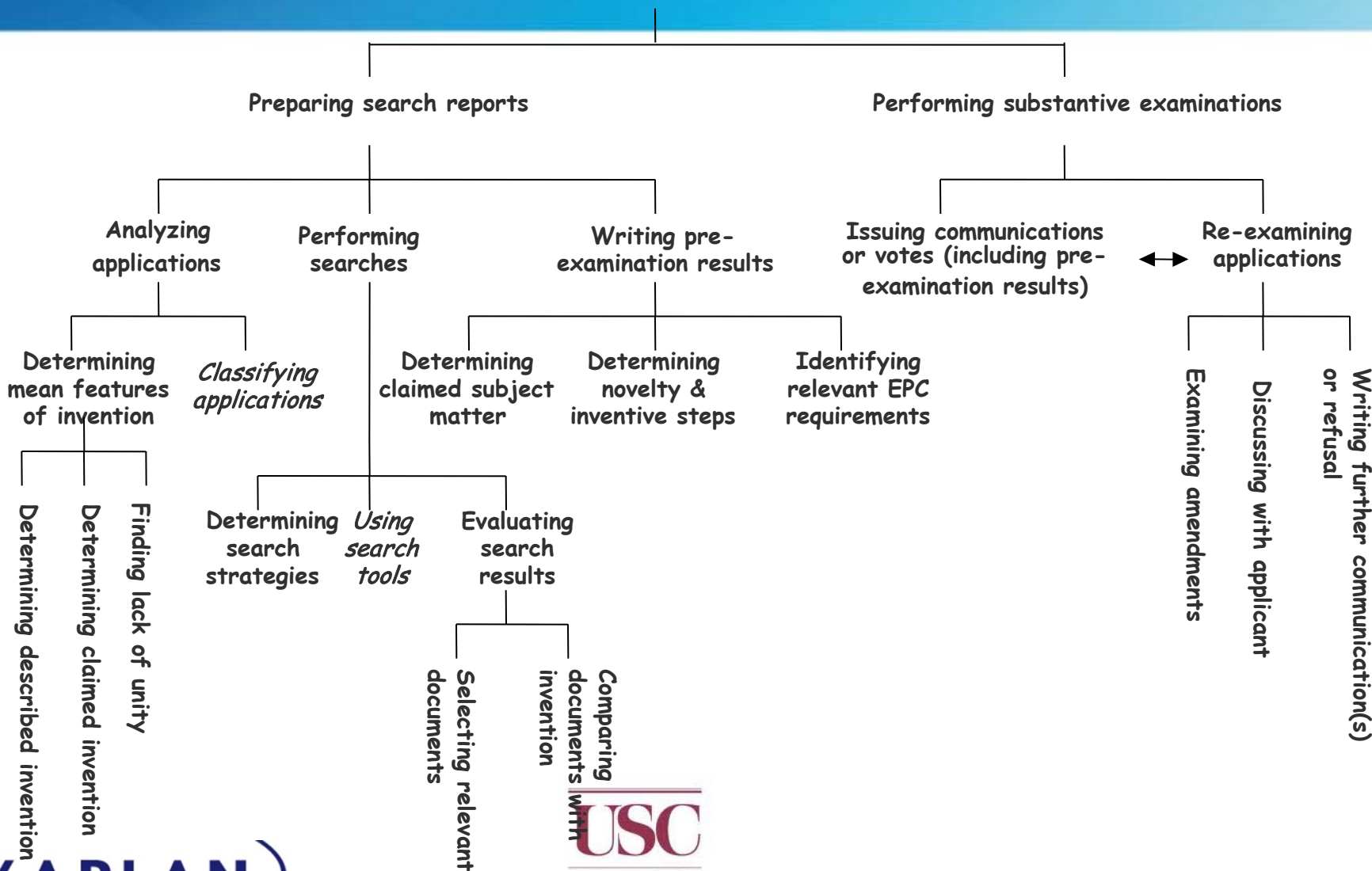
**Situation:** Existing training model required two years of full-time apprenticeship before patent examiners were allowed to examine a patent application independently; considerable amount of time from experienced examiners also needed to serve as mentors

**Solution:** Cognitive task analysis was used to develop a new training system

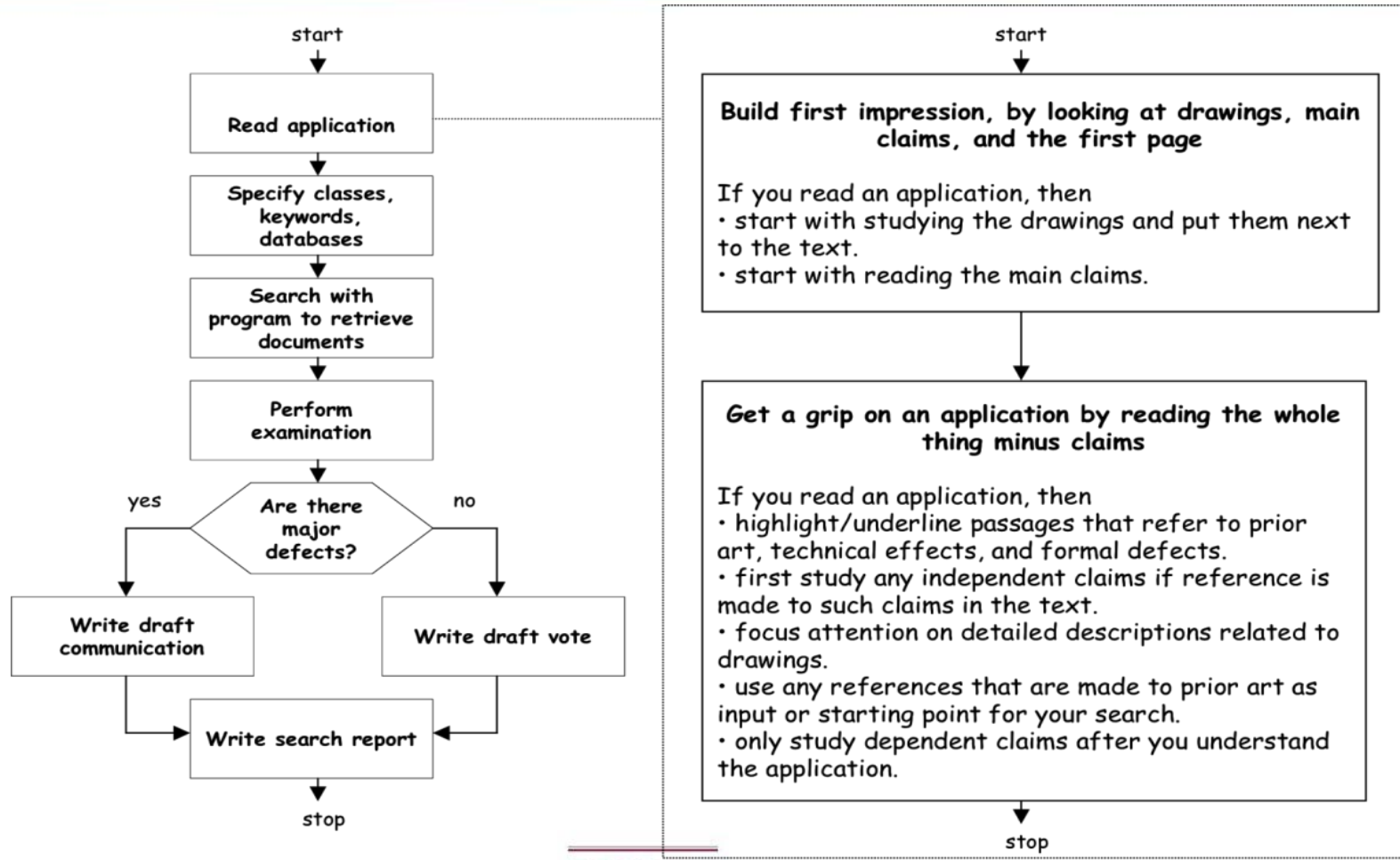


# European patent examiners

First, CTA interviews outline the range of tasks/decisions



# Then, more CTA interviews split apart tasks into steps





# Results of CTA

- **Productivity of new examiners was increased 200%** above their former production and above the average for all examiners...
- ...while **decreasing errors 65%**, and...
- ...based upon results of training decision made to **reduce training from 2 years to 6 months**



# The end of the beginning

## Q & A



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For additional information:

- <http://www.cogtech.usc.edu>  
***Access 'publications' page***
- **Contact Bror Saxberg:**  
**Email: [bror.saxberg@kaplan.com](mailto:bror.saxberg@kaplan.com)**
- **Contact Rusty Rae:**  
**Email: [rusty.rae@alstom.com](mailto:rusty.rae@alstom.com)**



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