

Technology Transfer to Forecasters: SNOW-V10 Experience

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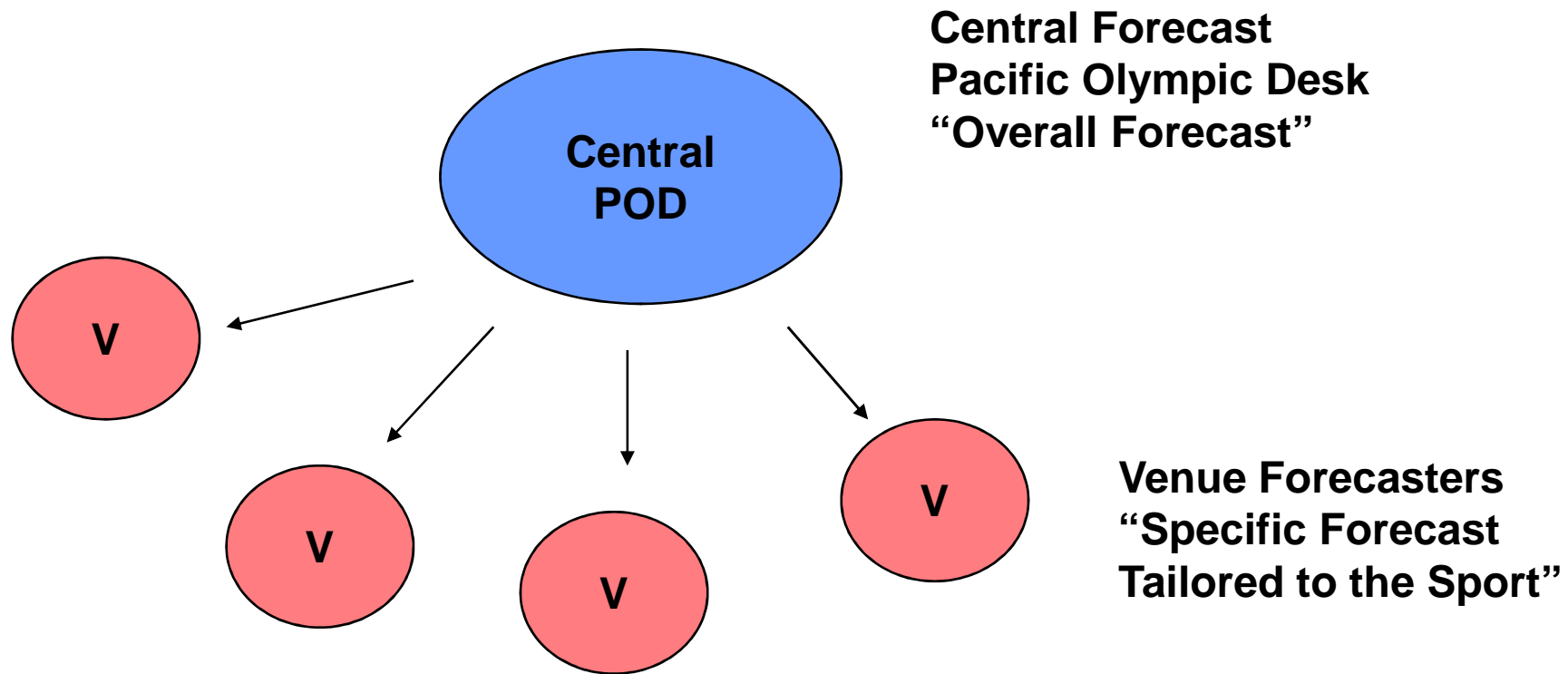
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Outline

- Background
- Knowledge management and exit Interviews
- Summary of Interviews



Organization, Roles and Responsibilities



**Forecasters selected about 4-5 years
in advance in a competition.**

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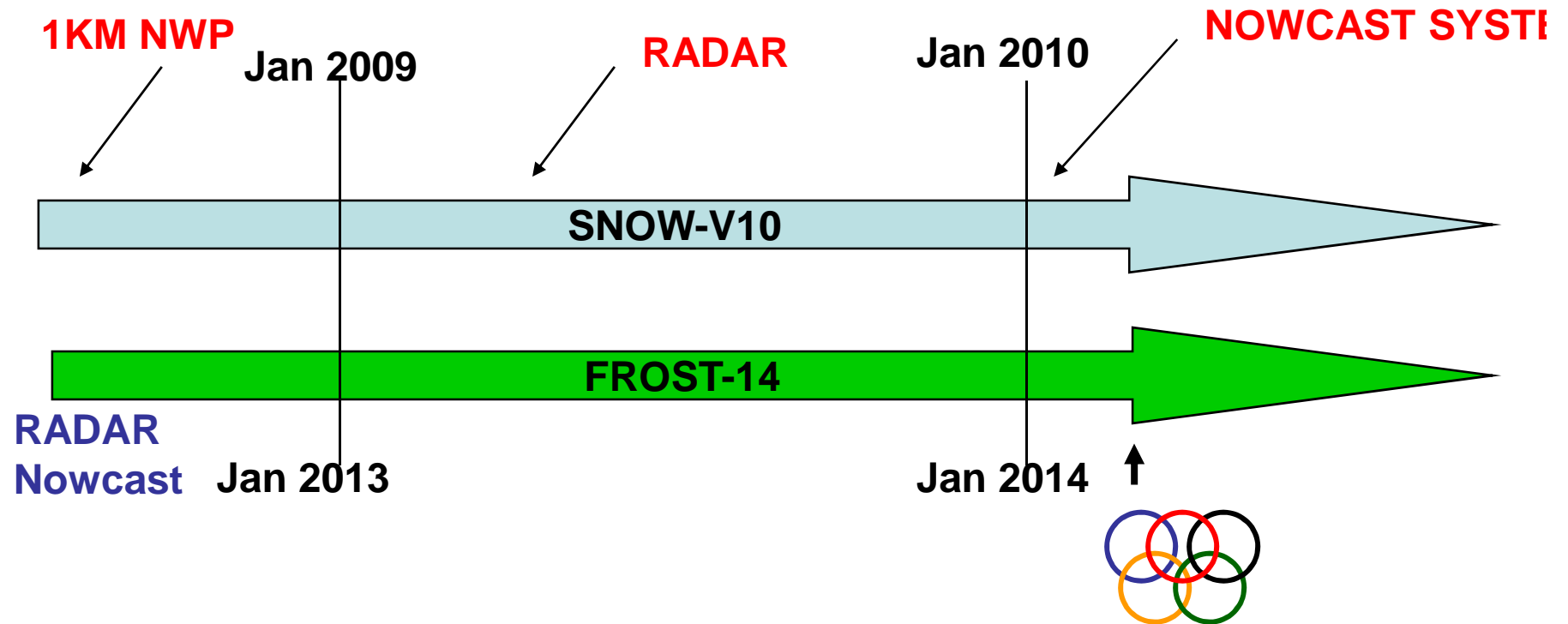
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A very short timeline between implementation of sensors to Olympics



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The normal situation....

A kilometer wide and a centimeter deep!

“partially sunny” or “partially cloudy”

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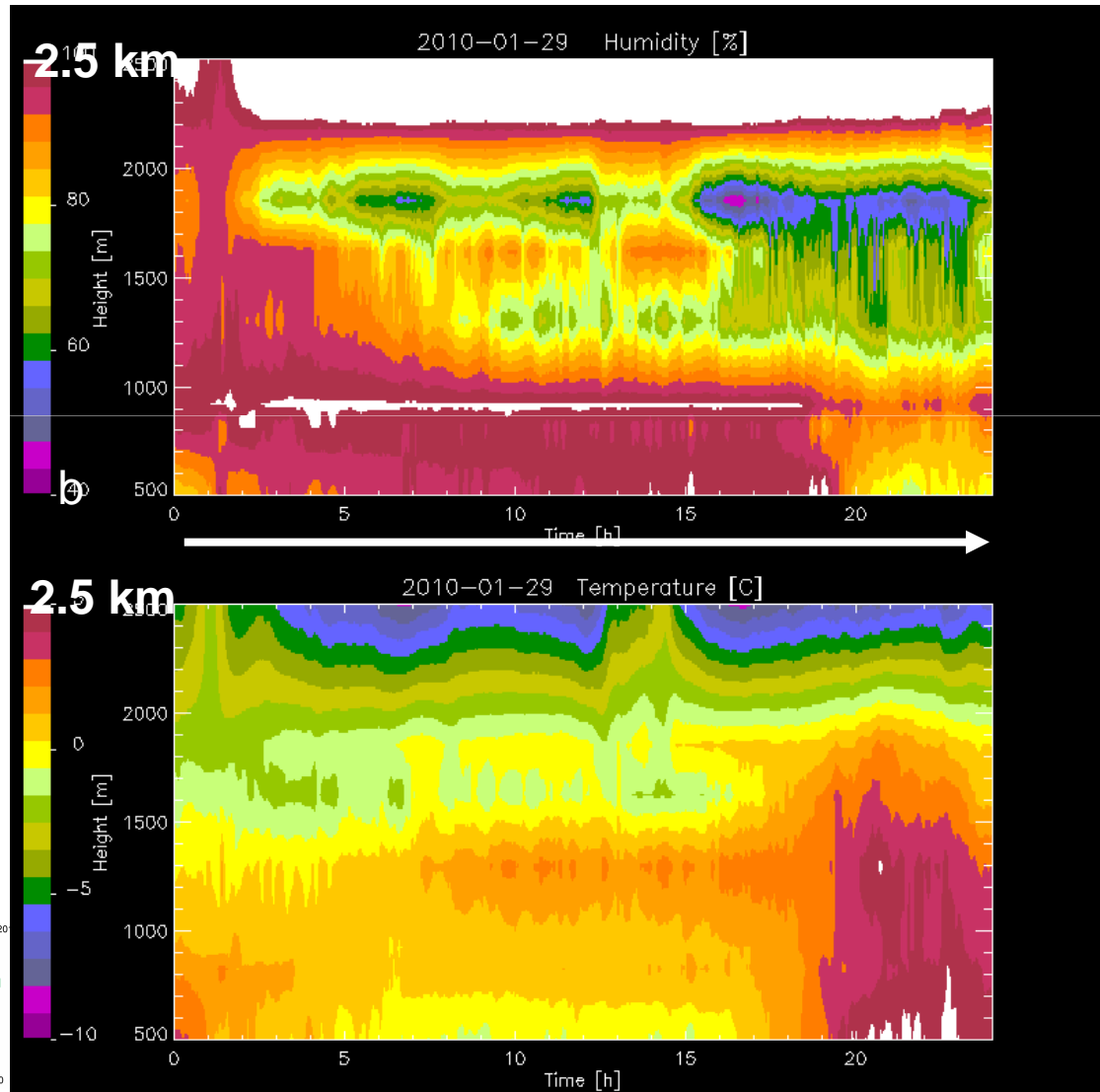
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Time-height of humidity and temperature also show considerable layering...

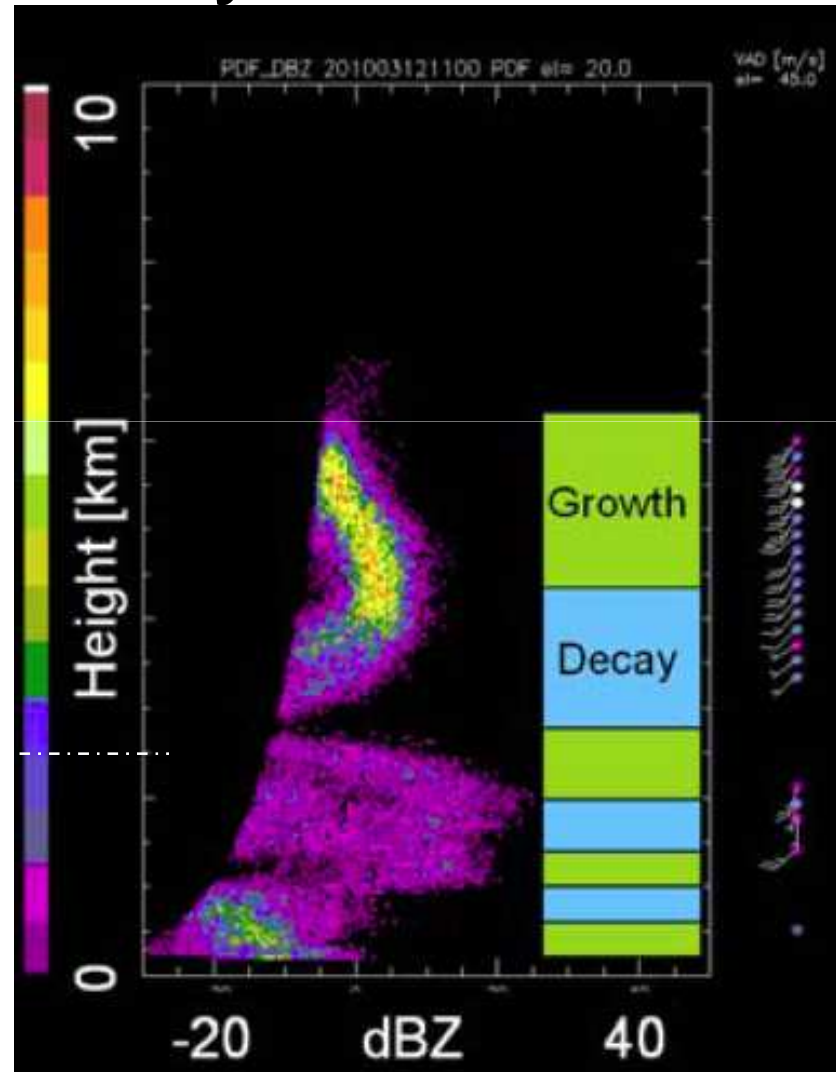


Humidity

1 Day

Temperature

Vertical Profile of Reflectivity shows at least 7 layers



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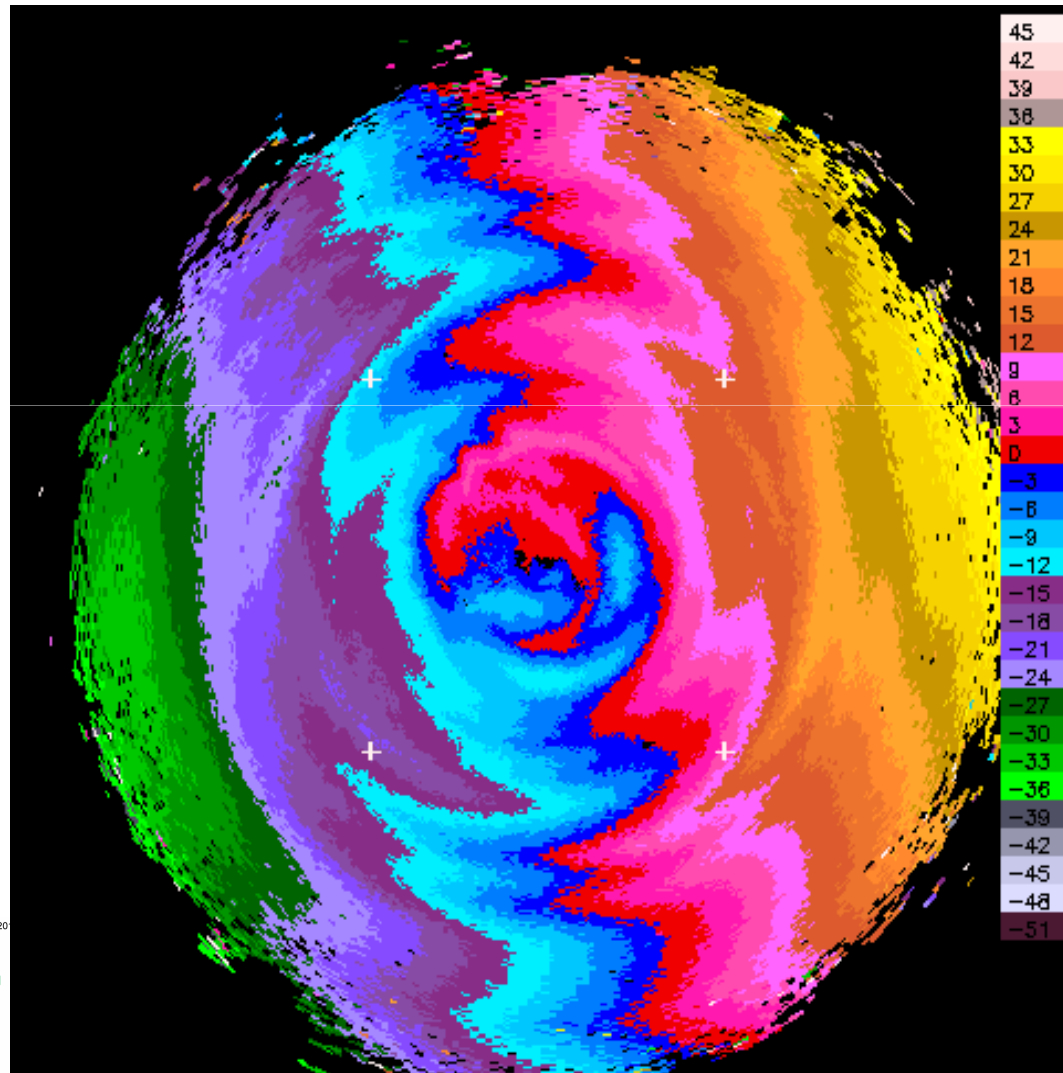
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Doppler Radial Velocity PPI shows complex flow structures...



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We heard these comments...

A centimeter wide and a kilometer deep!

“there will be a 90 min period beginning at 1145am where the variance in the upslope/downslope winds on the ski jump will be less than 1 m/s”

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Issued at 9am in the morning

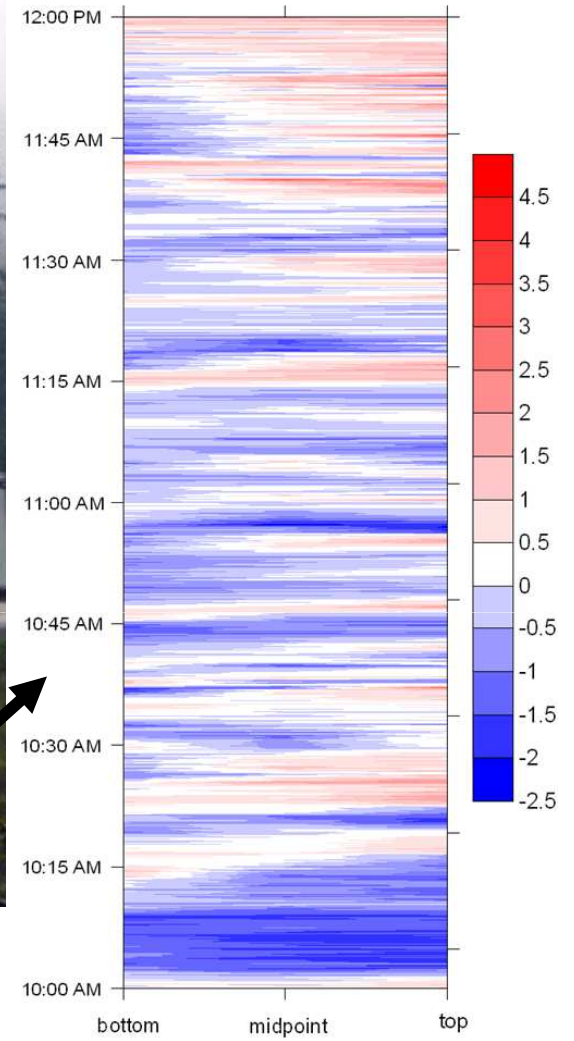


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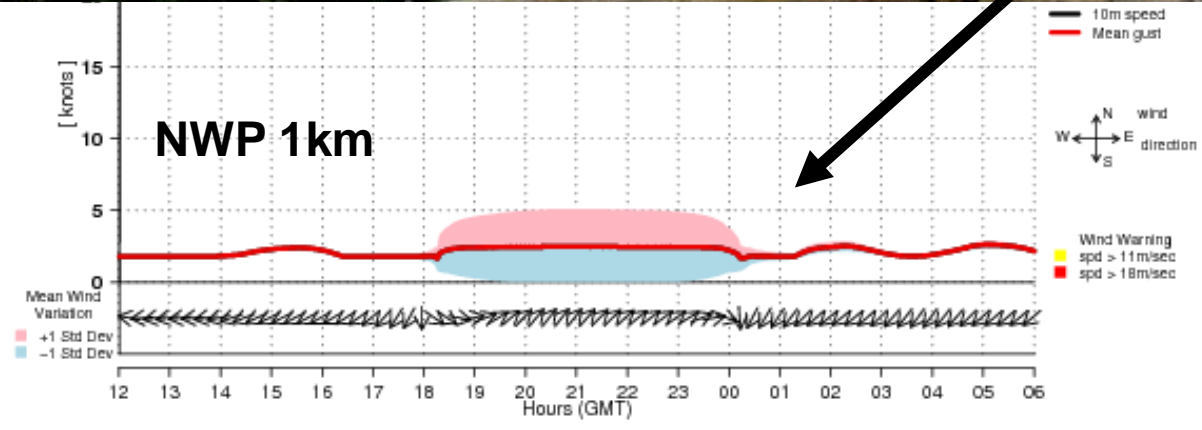
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Upslope component of the wind (+ve is upslope, -ve downslope)



Location on the ski jump



Venue forecasters were providing an extraordinary high level of service. Innovation took place, so...

- How did they develop the concepts?
- What were the conceptual models?
- What was the role of training?
- What was the role of the SNOW-V10 data?
- What were the keys to success?
- **Need to capture their knowledge**

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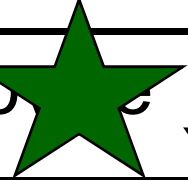

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Classification of Forecasting Expertise

 <p>No</p>	<p>Understanding is limited. Limited behaviour and flexibility.</p>
<p>Beginner</p>	<p>Can recognize recurring situation. Global situation recognized. Need help in priorities.</p>
<p>Competent</p>	<p>Able to formulate, evaluate and modify goals and plans. Can focus on the important. Lacks speed and flexibility. Sense of mastery, able to cope in variety of situations.</p>
<p>Proficient</p>	<p>Sees the big picture. Rules based and well developed perceptual skills. Can recognize when the typical situation requires modifications.</p>
<p>Expert</p> 	<p>Do not rely on rules or guidelines. Intuitive grasp of each situation, focuses on the critical problem and not on alternatives. Not aware of features and rules. Fluid, flexible behaviour.</p>

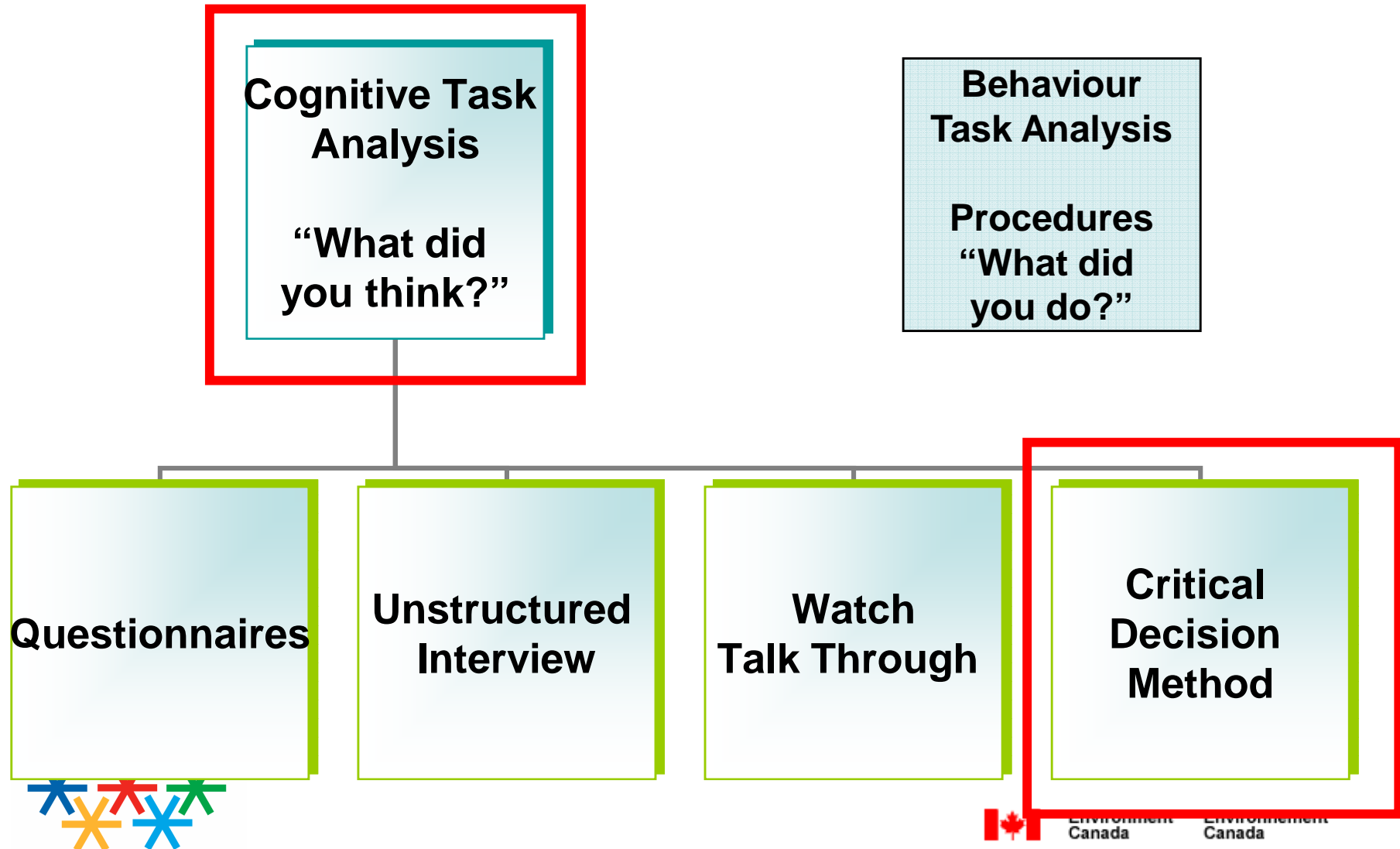
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How to create data to study technology transfer and elicit knowledge about decision-making, etc?

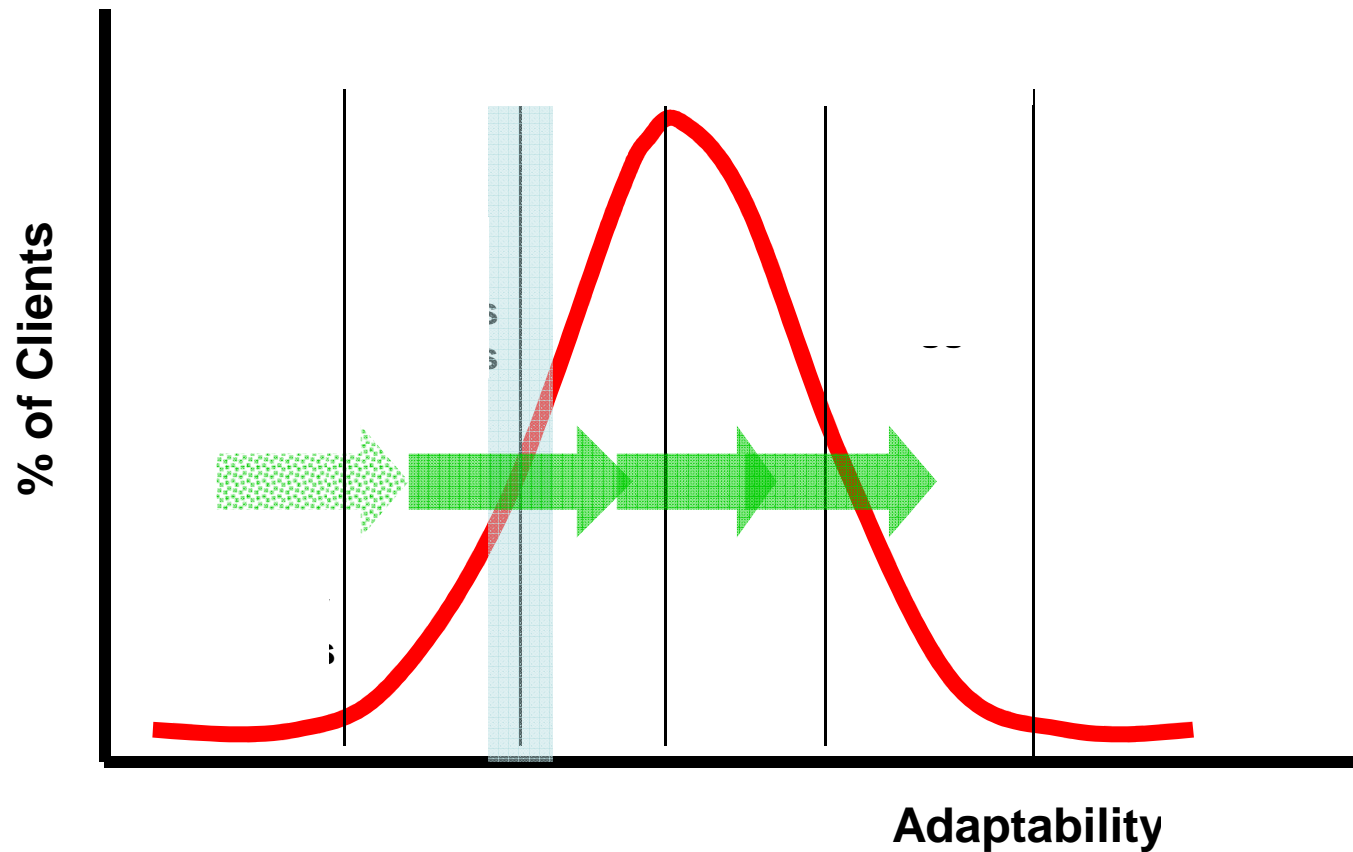


The Critical Decision Method (à la Gary Klein)

1. Asked for a “memorable” case where that was critical
2. 25 word summary (*look for cues*)
3. Coarse time line/recite facts
4. Refine the time line and group at critical decision points
5. Deepen each group, ask “probing questions” based on *cues!*
6. Final pass: ask hypothetical questions
7. Write up notes -> data
8. Analyze data -> Create Decision Requirement Tables, etc



Professional Technology Transfer is a social process!



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YouTube Movie

<http://www.youtube.com/watch?v=fW8amMCVAJQ>

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Experts and Expertise

- A few, not all, of the Olympic Forecasters exhibited the signs of Experts
 - *a priori* not obvious who they were or were not
- Not all Olympic Forecasters are early adopters
 - Biased, Rigid mindset



Who is the innovator/early adopter?



Signs of the Early Adopter

There is a new Ops briefing at VANOC that started this morning at 0630 (prior to this it was at 2 pm) and I was able to **use our vast array of sophisticated observing systems and short range NWP to summarize our POD forecasts** into "wishy washy". Much appreciated by the audience :)

- Chris Doyle

On the VOC **webcam** this morning you can see some stringy low cloud over the townsite - you know, typical fog/cloud produced by moist emissions in a cold environment with light winds. From the **ceilometer at VOT** you can see returns several meters to 10's of meters above the instrument. I'm suggesting that is what the instrument was sensing...and perhaps snowmaking too.

- Chris Doyle

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POD forecasters were not early adopters, did not use ~~SNOW-V10~~ data!

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Role of Training

- Classroom mountain meteorology training (special COMET)
- Pre-Olympic Test Events
- Mountain Meteorology Conference
- Final Training/Case Simulations
- ***Soft Start*** *
- ***On the Job***

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The Learning Environment

- Learning occurred with close user interaction
- Learning occurred in the days leading up to the Olympics*!
- Learning also occurred in the last test events
- Training creates a learning expectation and learning culture.
- *Most learning occurred with a failed forecast and followed by case study by venue teams.
Development of Conceptual Model!*

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*Ashton, **Pilon, Teakles

Interaction / Trust with End Users

Can not just say “use it”!

- Need to be on-site:
 - To interact with users*
 - To understand their problems*
 - To develop credibility and trust*
 - To understand the weather; observations are sampled
 - Users understand weather and have their own techniques to manage the events
- Display of high tech data and products provided credibility to venue forecasters
- External forecast bust!

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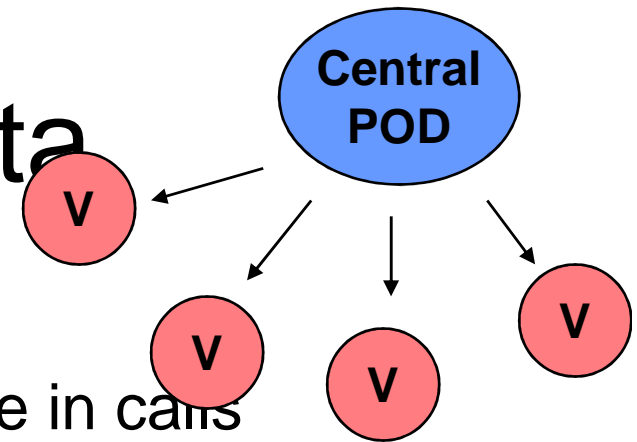
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Use of SNOW-V10 Data



- Nowcast mode at about T-6hours
- POD then Venue forecasters participate in calls
- Experts used everything and more, focus on relevant weather and products
 - Experts are never overloaded, can filter out noise
 - Some POD forecasters did not use SNOW-V10
- **Web cams**, wind profiler, High res models, Radar cross-sections, 1 min model/data meteograms, ceilometer
 - Web cams where interpolators
 - Monitoring provided sampled observations
- **Precipitation intensity, Radiometer, snow-v10 products**



Role of NWP...

- Several selected cases where the model was essentially correct but...
 - Not what the users needed -> concept model
 - Forecasters waiting for events to unfold and worried about precision of the timing
 - Diagnostic capability lacking. Did NWP match the observations for the right reasons?
 - Big impact when modelers were in the field (i.e. soft start)

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Summary

- Technology Transfer is a social process!
- Technology Transfer is a personal commitment
- Technology Transfer depends on open, learning environment and attitude
- End user interaction is key to deliver service with impact!
- The Project can create the environment
 - “We” are all learning!
 - Mutual dependency on knowledge, skills, etc
 - Interaction, interaction, interaction!

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Definition of Innovation

Introduction of new technology into operations.

- Bridging the gap from research and development into operations!
- Technology Transfer
- Change!

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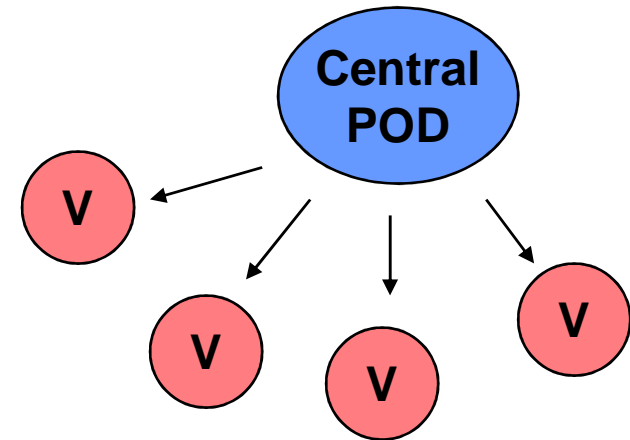


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Summary Observations of Interviews

- Venue Forecasters had the biggest behaviour change, through interaction with users
- “Inch wide, mile deep” - New conceptual models developed, more details, greater precision
- Interaction with users focused the details required ***



Key #1...

Who are the early adopters?

They find you, you don't find them!

Attitude
Culture of Excellence eg always striving to do the best as one can
Learning mode
Moral Imperative
Fear!

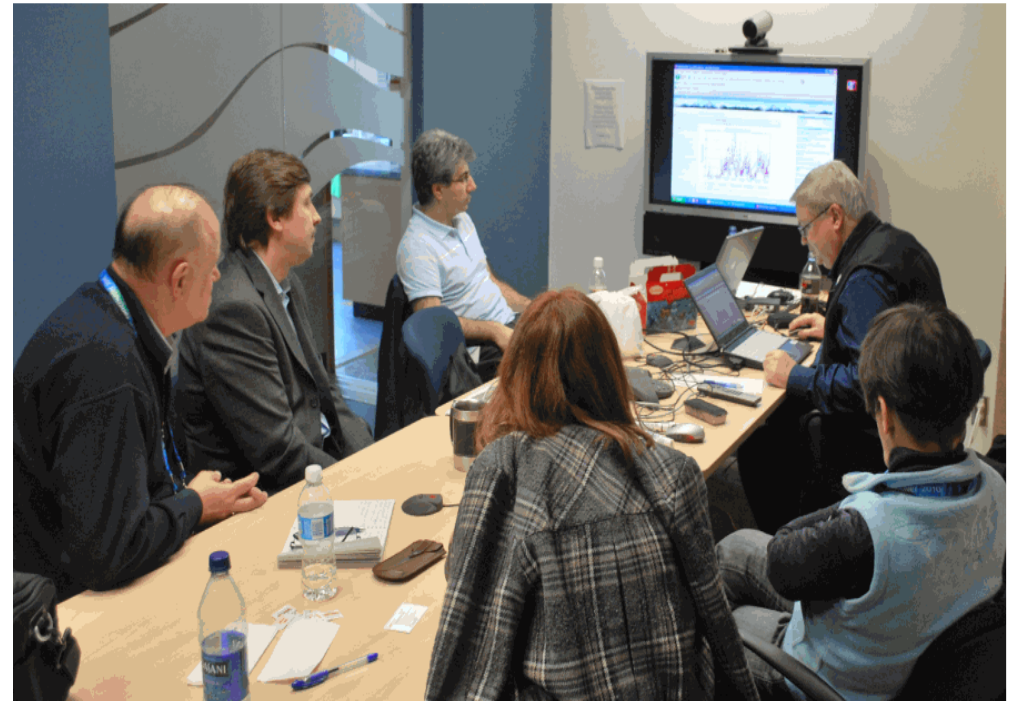


Key #2

New systems!

We are all learning!

Mutual dependency!



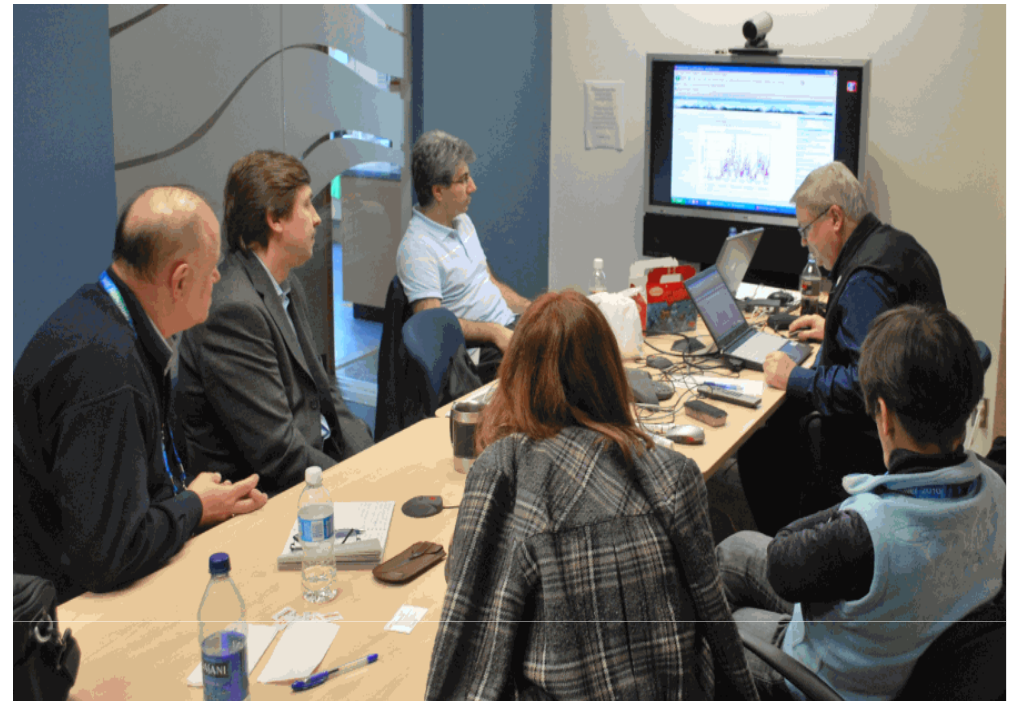
Key #2

New systems!

We are all learning!

Mutual Dependency

Must Overlap



Background

Generating Data

Summary of Results

Some Interesting Observations