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Unclassified

Workflow Automation, Today and Tomorrow

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Thesis Statement

- Workflow is about automation and integration.
- Process steps and data flow comprise a workflow.
- Saving time for the analyst is primary.
- Automating everything possible saves time, and has other benefits.
- Other key drivers…
  - Credibility
  - Provenance
  - Knowledge capture
  - Reuse
  - Reproducibility

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Central Questions

- What are the fundamental limits to automation?
- What can and can't be automated?
- What should and shouldn't be automated?
- Where are we on the arc of automation?
- What is the desired end state, and how do we get there?
  - Reduced cycle time (e.g., close the D-to-A gap)
  - Increased credibility
  - Increased fidelity
  - Increased reproducibility
  - Increase easy of [workflow-enabled-tools] use

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Simple Analysis – Easy to Automate

- Routine processes (sequences of tasks)
- Parametric runs (same workflow, different inputs)
- Store results systematically (so you can find them later)
- Simple physics – limited creativity and complexity involved (e.g., heat a cube)
- Reliable systems and processes

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Simple Analysis – Difficult to Automate

- Complex sequences of tasks
- Complex problem solving [on non-simple physics/engineering] (e.g.,
- Unreliable systems and processes

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Simple Analysis – Impossible to Automate?

- Human-in-the-loop processes?
- 'Watson' in the loop?
- Core understanding of the physics and engineering (on new problems)?
  - Problem statement / critical thinking
  - Requirements gathering / prioritization
  - Analysis approach (how to generate the results you need)
  - Validation of the results
- Communicating results / issues?

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What *should* we automate?

- *Everything easily automated that consumes significant analyst time*
- Routine processes – i.e., all the easy stuff
  - Model building
  - Simulation (workflow) runs
  - Data gathering / archiving
- Processes we want to rerun (at another time, by another person, parametrically, etc)

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What *shouldn't* we automate?

- *Everything that is difficult or impossible, with little payoff* – but the answer depends on the time frame (today vs 10+ years from now)
- Human-in-the-loop processes?
- Core understanding of the physics & engineering?
- Critical thinking skills in technical domain?
- Communication with humans?

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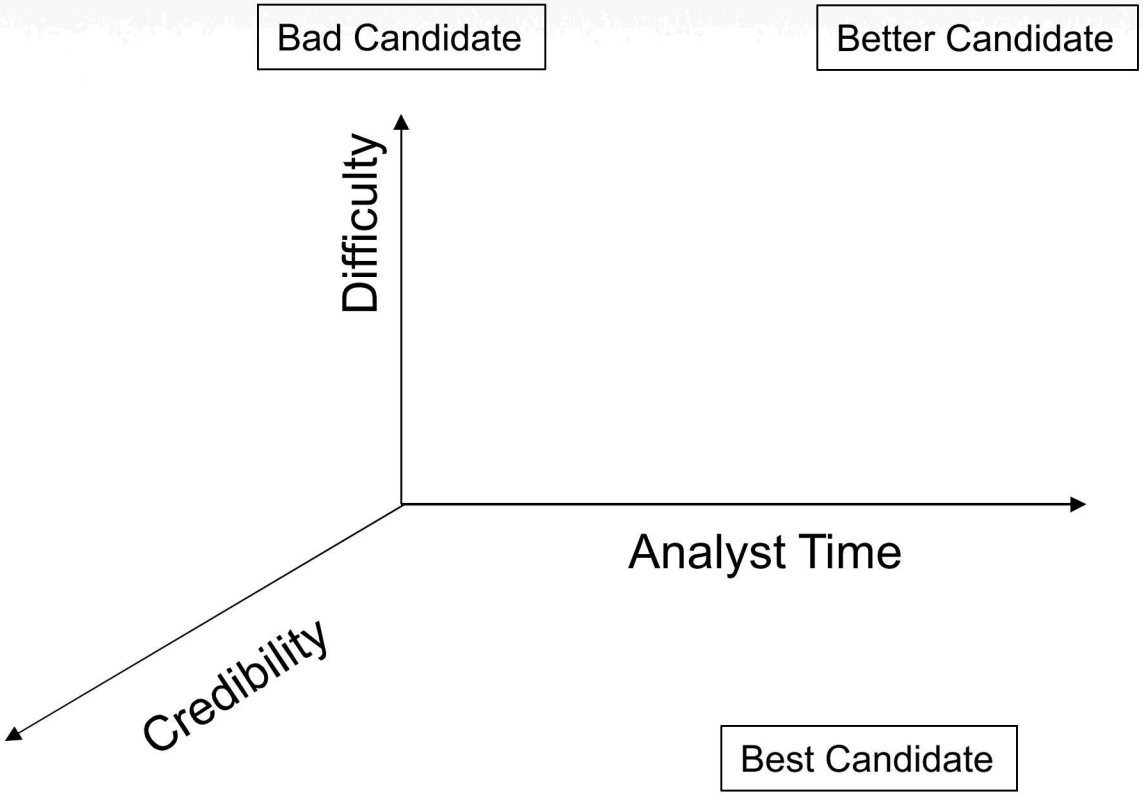
Simple Automation Map



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Other Observations

- Necessary conditions for automation
  - Do you have a [workflow] process you can run once with ‘one click’?
  - If any part won’t run, then you can’t [fully] automate that process
- The difference between fully automated and not is huge in terms of it’s usefulness
  - Not automated, then parametric analysis becomes challenging
  - How about rerunning the model periodically to verify it still works correctly? Challenging – in theory we could do this w/o automation, but do we?
- Does human-in-the-loop really kill automation?
  - Not really, we’re already doing this effectively for [QASPR] model calibration
  - But, if you introduce non-automated (e.g., humans) components, you will introduce variations (see GEO’s A2A study)

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Conclusions

- Workflow involves automation
- Automation saves time, increases reproducibility, can reduce errors, and improves credibility
- Long-term (10+ years) we may be able to almost completely automate the analysis tools
- Short-term we can focus on automating routine tasks that are easy and consume analyst time
- *Automation helps analysts focus on critical physics and engineering domain questions, rather than marshalling the tools to generate results*

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Bottom Line

We’re all going to be replaced

but not anytime soon

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Acknowledgements

- *Jürgen Schmidhuber*, SOS-21 Keynote Speaker, who more or less said we're all going to be replaced by computers. Upon reflection, maybe he was right about that.

- George Orient – visionary, as always

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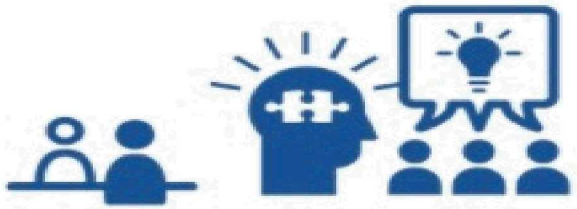
Skills Projection – WEF Speculation

Top 10 skills

in 2020	in 2015
1. Complex Problem Solving	1. Complex Problem Solving
2. Critical Thinking	2. Coordinating with Others
3. Creativity	3. People Management
4. People Management	4. Critical Thinking
5. Coordinating with Others	5. Negotiation
6. Emotional Intelligence	6. Quality Control
7. Judgment and Decision Making	7. Service Orientation
8. Service Orientation	8. Judgment and Decision Making
9. Negotiation	9. Active Listening
10. Cognitive Flexibility	10. Creativity



Source: Future of Jobs Report, World Economic Forum

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Questions?

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Save that one for the panel!

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