A CONSTRAINTS-ORIENTED APPROACH TO ACTIVITY-BASED MODELING: OHIO DOT'S 3C VERSION 2 DESIGN

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AGENDA

1. Big Idea
2. Problem
3. Proposed Solution
4. Examples
5. Implementation Status

1. BIG IDEA

BIG IDEA

In many cases, it is difficult to make predictions about travel-related outcomes because we are uncertain about the constraints under which decisions are made.

We should operationalize this in our travel models.

2. PROBLEM

PROBLEM

Practical activity-based models, including 3C version 1, generally use probabilistic model forms with numerous indirect effects to predict behavioral outcomes. This approach:

1. Increases computational effort; and
2. Decreases the legibility of the modeling system.

PROBLEM

Work Tour Scheduling

3C, Version 1

Indirect effects include:

- Gender
- Age
- Presence of a joint tour
- Presence of a non-working adult in the household
- Occupation

PROBLEM

Shortcomings

- It is not clear what the model designers intended using gender or age or occupation. Will these things change over time?

PROBLEM

Shortcomings

- A non-trivial share of the population has no flexibility in their work schedule: they arrive prior to the start of their shift and depart at the end of their shift. The version 1 approach blends and confuses this group with those that do have flexibility.

PROBLEM

Shortcomings

- The model is applied to every worker and has over 4,600 alternatives → computationally expensive.

3. PROPOSED SOLUTION

PROPOSED SOLUTION

- Move much, much more of the uncertainty to individual models that attempt to represent “constraints”.
- Similar in spirit (but different in scale) to the common practice in activity-based modeling of representing “personal mobility attributes”.

PROPOSED SOLUTION

Personal Mobility Attributes

- "Usual" driver of a vehicle
- Transit pass owner
- Toll transponder owner
- Parking discount recipient
- Automobile ownership

Constraints

- Caretaker responsibilities
- Work a fixed schedule
- Ability to do personal business at work
- Ability to travel alone
- Ability to walk more than 1000 feet
- Home environment is accommodating of home-based work
- …

PROPOSED SOLUTION

1. Move as much of the uncertainty, as reflected by probabilistic choices, to the constraints as possible.
2. Simplify, when possible, the downstream behavioral components, using deterministic forms or heuristics or random draws when constraints dictate outcomes.
3. Be mindful of desirable policy sensitivity.

PROPOSED SOLUTION

Work Tour Scheduling

3C, *Version 1*

Indirect effects include:

- Gender
- Age
- Presence of a joint tour
- Presence of a non-working adult in the household
- Occupation

PROPOSED SOLUTION

Work ~~Tour~~ Activity Scheduling 3C, ***Version 2***

Relevant constraints may include:

- Work a fixed schedule
- Ability to engage in personal business during work
- Ability to adjust start, end, and/or duration each workday
- Relative priority of work
- Must travel to out-of-home work location
- …

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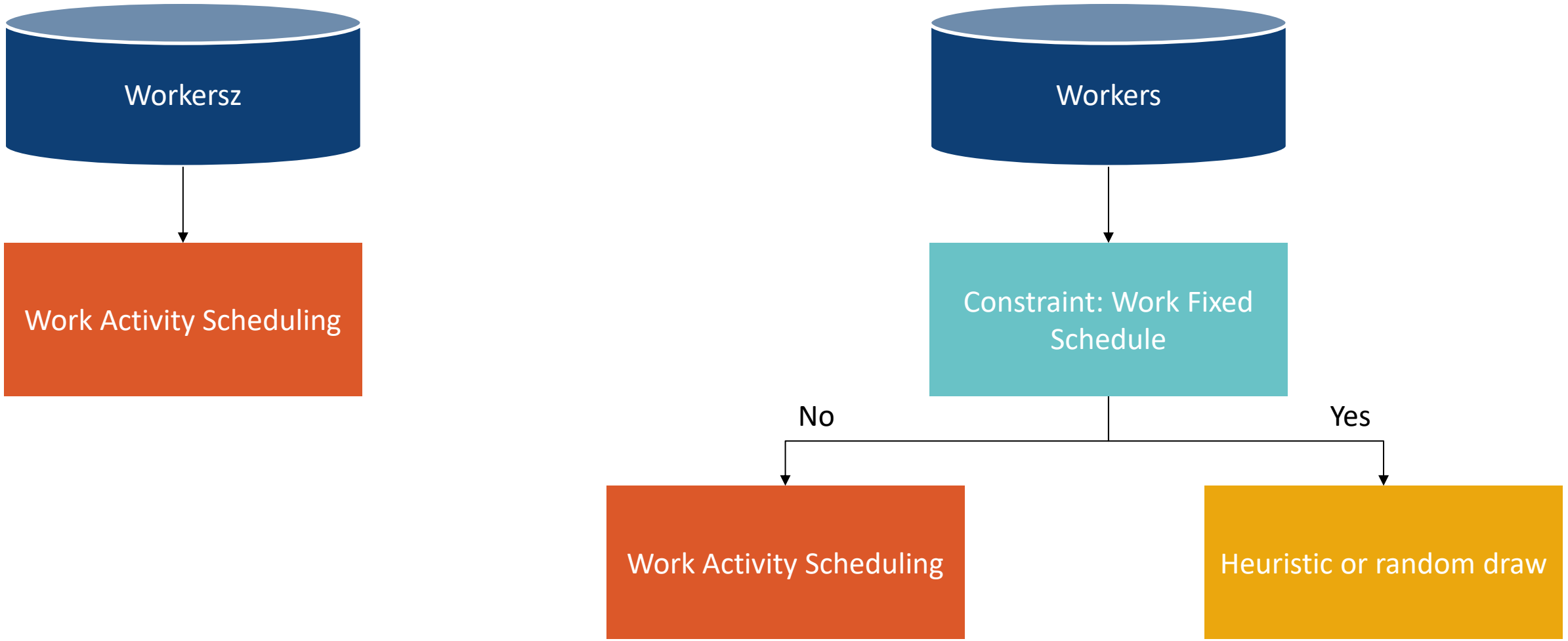
PROPOSED SOLUTION



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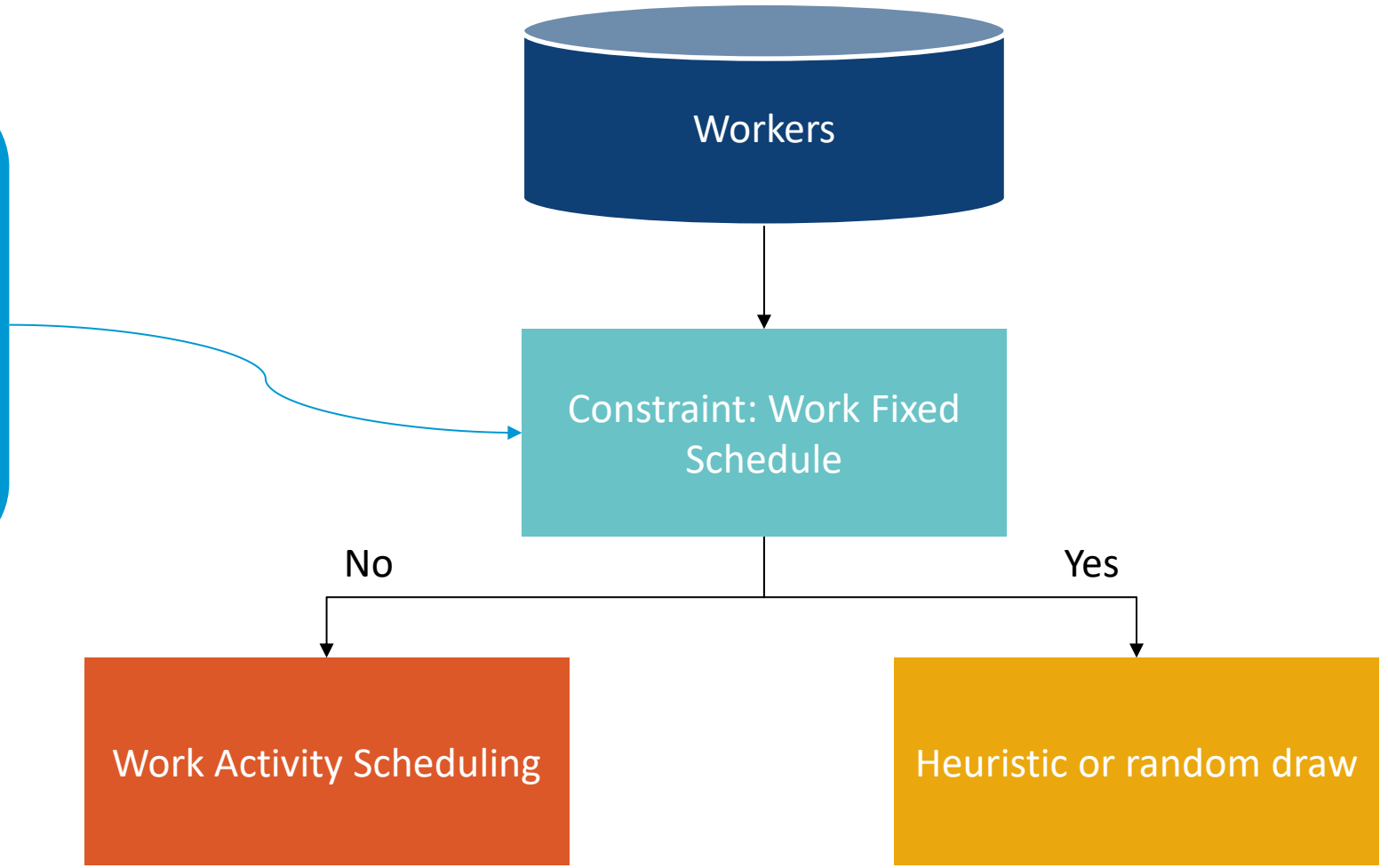
PROPOSED SOLUTION

1. Two alternatives, rather than 4,600, which → computational improvements
2. The meaning of the outcome of the constraint is not ambiguous → legibility



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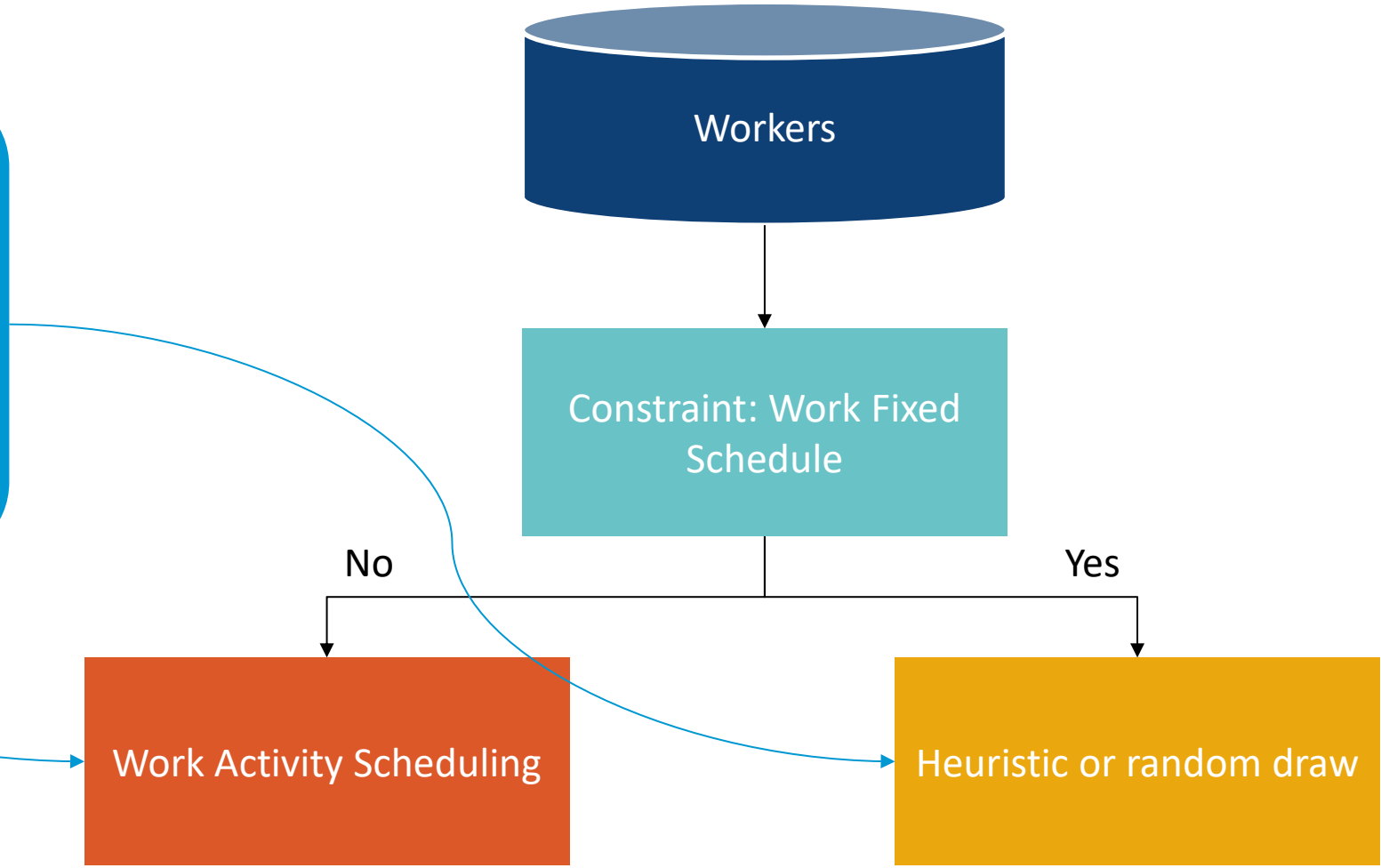
PROPOSED SOLUTION

1. “Yes” model is computational efficient
2. The “No” model is more legible: it excludes those that work a fixed schedule



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4. EXAMPLES

EXAMPLES

Mode Choice (itinerary)

3C, ***Version 1***

Indirect effects include:

- Age
- Automobile sufficiency
- Gender
- Income (beyond value of time)

EXAMPLES

Mode Choice (itinerary)

3C, ***Version 2***

Relevant constraints may include:

- Ability to travel alone
- Ability to walk
- Ability to ride a bicycle
- Ability to drive at night
- Automobile availability
- Driver's license
- …

5. IMPLEMENTATION STATUS

IMPLEMENTATION STATUS

- Initial design
- ”Roughed-in” AGENT implementation
- Integrated with full model system CUBE
- Model estimation & specification
- Version 1 model calibration & validation

IMPLEMENTATION STATUS

- Key risk: is the household travel survey sufficient to either identify or allow us to infer the constraints we are interested in explicitly representing?
  - Generally yes, though this approach may motivate collecting other/different data in the future.

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THANK YOU