

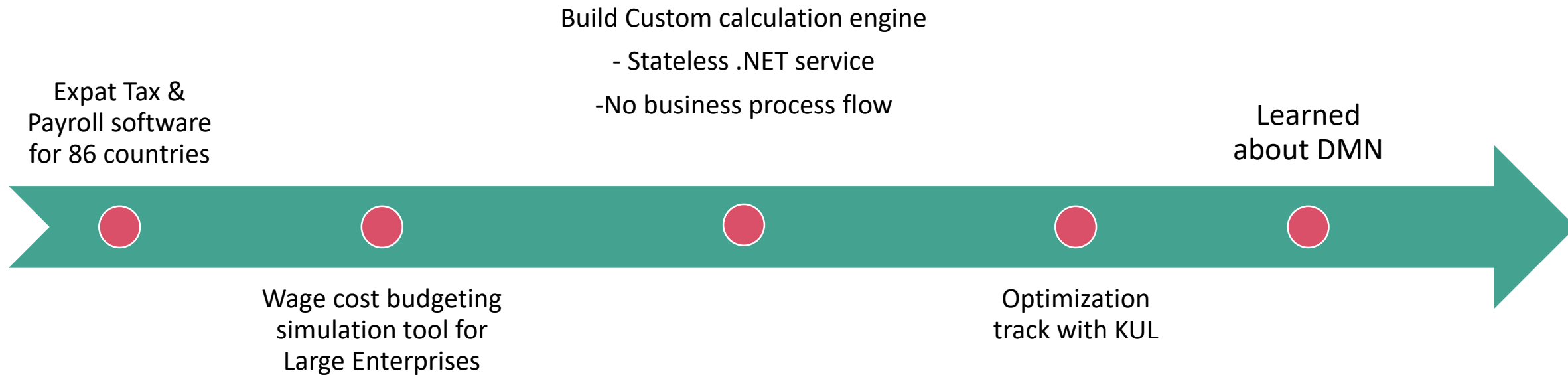
EXPLOITING PAYROLL KNOWLEDGE

Supporting decisions from an end-user point of view

Challenges when modelling knowledge

TEAL PARTNERS BACKGROUND

- Partner in elaborating digitalization tracks
- Goal: Putting business in control when legislation changes

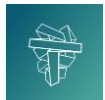


CONTEXT –PAYROLL/HR IN BELGIUM

- Complex domain
 - Six governments
 - Third place Global Payroll Complexity
 - High taxes
 - Second highest taxed country in Europe
 - Multiple legal statutes
 - Different taxation
 - Different social security
- => Uncertainty about choosing most beneficial statute

OBJECTIVES

- Show setup simulation tool
 - Short demo
 - General architecture
 - Optimization solution
- Different route to similar destination

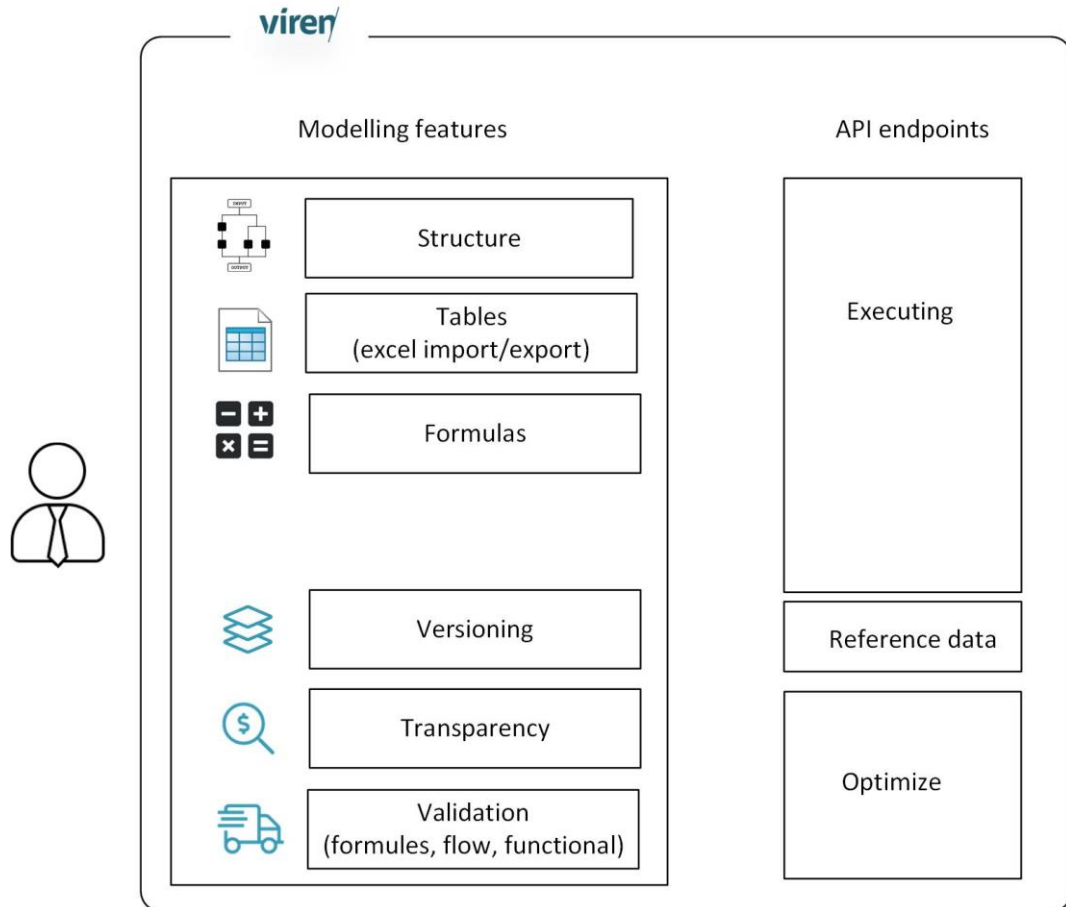


Started from process logic
End 2 end production focus

Process management
100% decision completeness



GENERAL ARCHITECTURE



2. Customize calculation

Daily rate Net income Working days

Dagtarief ⓘ
€ 349 /dag

Inkomsten
€ 76.817 /jaar

Stap 1: Profile

Legal statute	Ik start een eenman
Aanbod ⓘ	Diensten
Profile	Consultant
Marital state	Stielman
Children	Vrij beroep
	Horeca
	Handelaar
	Consultant
	Startup
	Andere

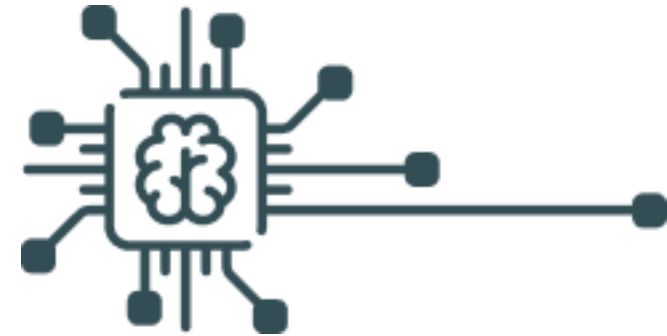
Opslaa

Stap 2: Inkomsten

Stap 3: Uitgaven

EXPLOIT KNOWLEDGE

- Knowledge
 - Declarative set of rules
 - Structured data
 - Descriptive tables
 - Clear in-and outputs
 - Types with meta info
- *Optimal* Decision taking
 - How many days should I work to earn a certain income
 - What is the optimal day rate to minimize taxes and earn a certain income



OPTIMALIZATION SOLUTION (1/3)

- “Brute Force”
 - Simple scenarios are possible
- Started with miniZinc
 - Widely used for constraint programming
 - Has built-in optimization
 - No solver suited for our domain
 - Decimal numbers are not well supported
 - Non-linear constraints, not always possible to linearize.

```
variable dailyWage: Int;
variable workingDays: Int;
variable incomeNetto: Int;
variable incomeBrutto: Int;
constraint incomeBrutto = dailyWage * workingDays;
constraint incomeNetto =
    if incomeBrutto > X then incomeBrutto * p1
    else incomeBrutto * p2;
constraint incomeNetto > 50000;
constraint incomeNetto < 70000;
constraint workingDays < 150;
solve maximize incomeNetto;
```

OPTIMALIZATION SOLUTION (2/3)

Used Z3 constraint solver

- Fast in determining (un)satisfiability
- Compile model to SMT-LIB2
 - JIT compilation with input values
 - Limit search space
- Custom optimization algorithm
- Created by Microsoft

BasisForfaitaireBeroepskosten	JaarloonBedrijfsleider + TotaalVoordelenVaa + wagenVAA
PercentageForfait	lookup(BV_ForfaitaireBeroepskosten,'Percentage', TypeBerekeningBedrijfsleider)
MaximumForfait	lookup(BV_ForfaitaireBeroepskosten,'Maximum', TypeBerekeningBedrijfsleider)
Forfait	min(BasisForfaitaireBeroepskosten* PercentageForfait, MaximumForfait)
Basis	BasisForfaitaireBeroepskosten - Forfait

```
(declare-const PercentageForfait_BasisSocialeBijdragen Real)
(declare-const MaximumForfait_BasisSocialeBijdragen Real)
(declare-const Basis_BasisSocialeBijdragen Real)
(declare-const BasisForfaitaireBeroepskosten_BasisSocialeBijdragen Real)
(declare-const Forfait_BasisSocialeBijdragen Real)
(assert (= BasisForfaitaireBeroepskosten_BasisSocialeBijdragen
  (+ (+ JaarloonBedrijfsleider_BedrijfsleiderLoon 252.0) 2200.0)))
(define-fun min_Real ((x Real)(y Real)) Real
  (ite (< x y) x y))
(assert (= Forfait_BasisSocialeBijdragen
  (min_Real MaximumForfait_BasisSocialeBijdragen
    (* BasisForfaitaireBeroepskosten_BasisSocialeBijdragen
      PercentageForfait_BasisSocialeBijdragen))))
(assert (= Basis_BasisSocialeBijdragen
  (- BasisForfaitaireBeroepskosten_BasisSocialeBijdragen
    Forfait_BasisSocialeBijdragen)))
```


OPTIMALIZATION SOLUTION (3/3)

- Multiple dynamic parameters => pareto front

Business Owner X | Z3 optimize Business Owner X

Inputs from block

Margin On Sale	<input type="text" value="0,00%"/>	+	Monthly wage Manager	<input type="text" value="3.500,00€"/>	+
Has Cellphone	<input type="checkbox"/> False	+	Has cellphone Subscription	<input type="checkbox"/> False	+
Turnover from sales	<input type="text" value="0,00€"/>	+	Profile	Consultant	+
Laptop	<input type="checkbox"/> False	+	Tablet	<input type="checkbox"/> False	+
Mobile data subscription	<input type="checkbox"/> False	+	Company car segment	A-segment	+
Marital status	Married	+	Number of children	2	+
Income Partner	<input type="text" value="0,00€"/>	+	Income Partner from pens...	<input type="checkbox"/> False	+
Meal Checks	<input type="checkbox"/> False	+	Flat-rate professional cos...	<input type="text" value="0,00€"/>	+
VAPZ	<input type="checkbox"/> False	+	Has Hospitalization Insur...	<input type="checkbox"/> False	+
Payment mechanism Type	Dividend	+	IPT	<input type="checkbox"/> False	+
Miscellaneous costs	<input type="text" value="0,00€"/>	+	Claimed Fixed Expenses	<input type="text" value="0,00€"/>	+
			Has Guaranteed Income	<input type="checkbox"/> False	+

Optimized input

Day rate: -

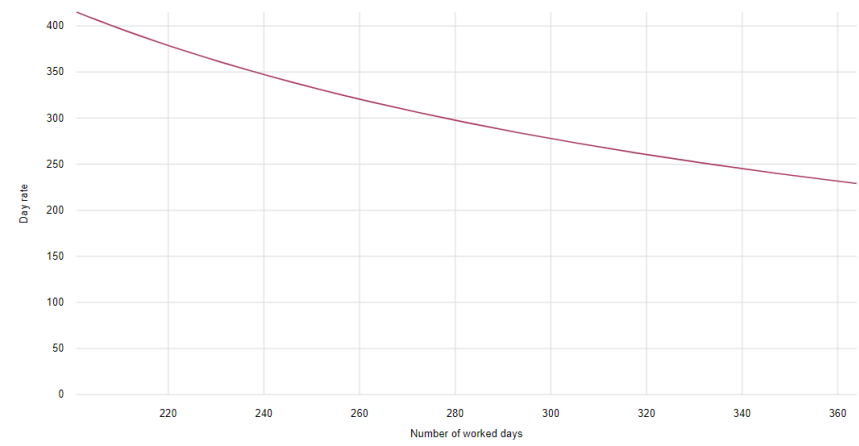
Number of worked days: -

Output to optimize

Choose column

TotaalOmzetUitPrestaties TotaleOmzetVerkoop KostenInkoop BedragBoekhouder
 JaarloonBedrijfsleider tabletVaa TotaalVoordelenKost GsmAbonnementVaa tabletKost laptopVaa
 GsmVaa GsmAbonnementKost GsmKost laptopKost mobielDataAbonnementKost
 mobielDataAbonnementVaa BasisForfaitaireBeroepskosten Forfait Basis TotaalSocialeBijdragen
 WagenKostVenootschap Brandstof solidariteitsbijdrage wagenKost PercentageAftrekbaarheid
 WagenVAA Beschikbaar BV belastbareBasis AftrekVAA Totaal BedrijfsleiderNetto
 ForfaitaireBeroepskosten HospitalisatieVerzekering IptJaar EbitResultaat brandstofVerworpen
 wagenVerworpen TotaalDividend ResultaatNaBelasting VAPZ MaaltijdCheques Belasting
 Pensioensparen BedragBoekhouderPerMaand TotaalVoordelenVaa
 TotaalBedrijfsleiderNettoPermaand TotaalBeschikbaarNettoResultaatPerMaand
 RapporteringBedrijfsleiderBelasting RapporteringBedrijfsleiderBelastingPercentage
 RapporteringBedrijfsleiderNetto RapporteringBedrijfsleiderNettoPercentage
 RapporteringBedrijfsleiderOmzet Venootschapsbijdrage RapporteringBedrijfsleiderSocialeZekerheid
 RapporteringBedrijfsleiderUitgaven

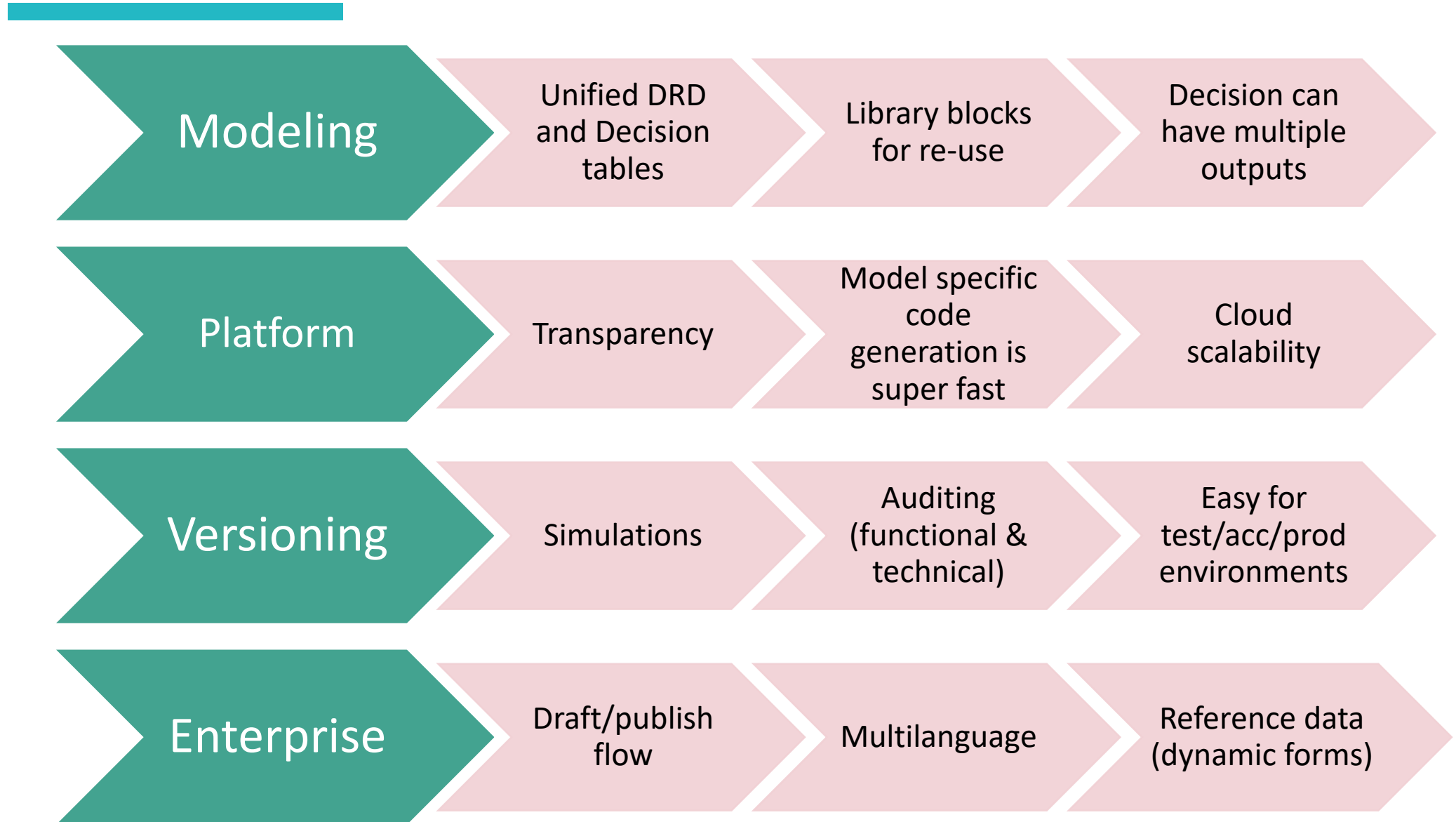
Total available net result:



Z3 optimize result

Result 1 found in 98ms	
Day rate	229
Number of worked days	363.9207329278
Result 2 found in 99ms	
Day rate	240
Number of worked days	347.2410326686
Result 3 found in 107ms	
Day rate	251
Number of worked days	332.0232981692
Result 4 found in 142ms	
Day rate	262
Number of worked days	318.0833887041
Result 5 found in 120ms	
Day rate	273
Number of worked days	305.2668419065
Result 6 found in 111ms	

SIGHTSEEING TIPS FROM OUR JOURNEY



CONTACT INFORMATION



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BACKUP SLIDE: WHERE WE HEADING NEXT

- Comparing versions
 - Git like functionality to “merge” knowledge
 - “apply patches” to propagate new knowledge
- DMN compliancy
 - Decision tables: extra abstraction above blocks and tables
 - Auto convert them to switch block
 - Limit formula syntax to be in sync with FEEL