Quantifying investment risks

Forecasting Delivery Time of New-Build Projects for Dutch Housing Associations

P5

Edwin Seda

Mentors: Ellen Geurts (1st),
Vincent Gruis (2nd) ,
Maarten van ‘t Hek (Ortec Finance)

17 June 2022

RESEARCH
CODE
WORDS

RESEARCH
CODE
WORDS

Social Housing

RESEARCH
CODE
WORDS

Social Housing

Housing associations

RESEARCH
CODE
WORDS

Social Housing

Housing associations

Better promises

CONTEXT

Kwart minder nieuwbouw door woningcorporaties

29-5-2017 02:00

© ANP

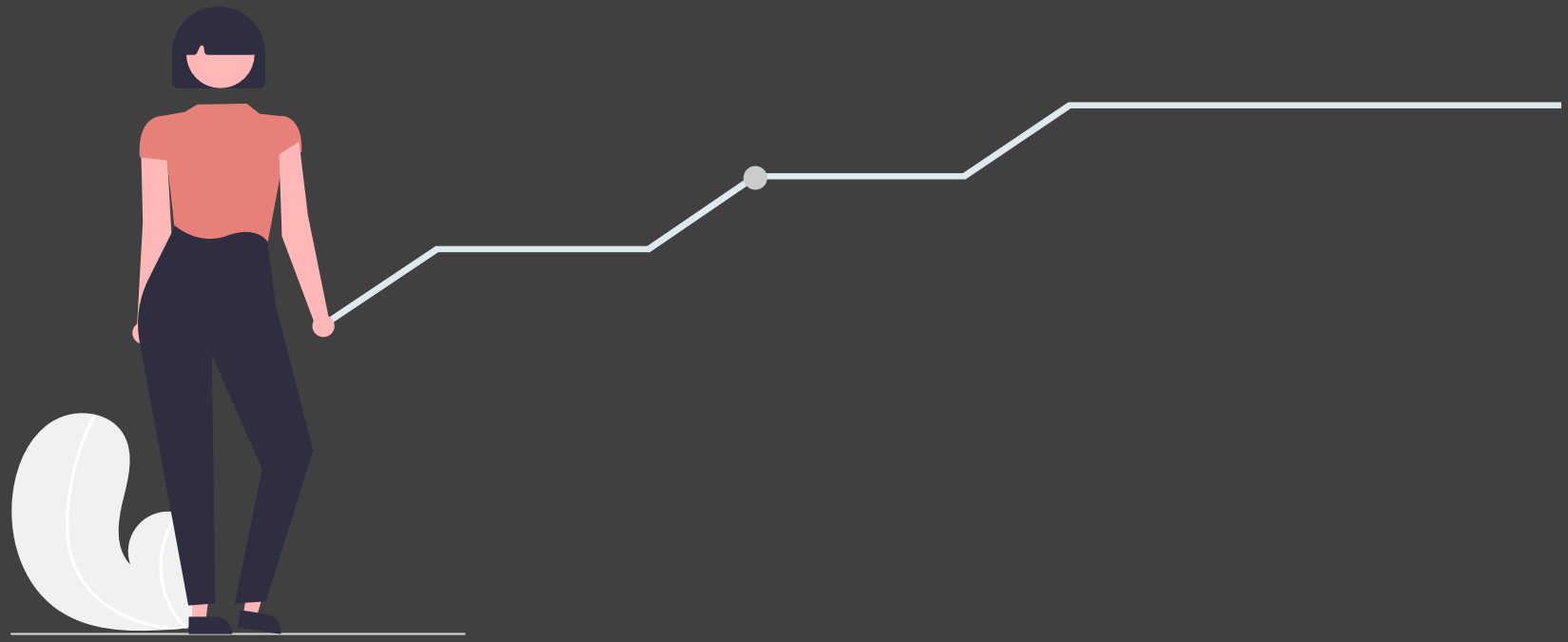
vereniging van woningcorporaties

aedes

< Nieuws

WSW: Meer onzekerheid in prognoses woningcorporaties

CONTEXT



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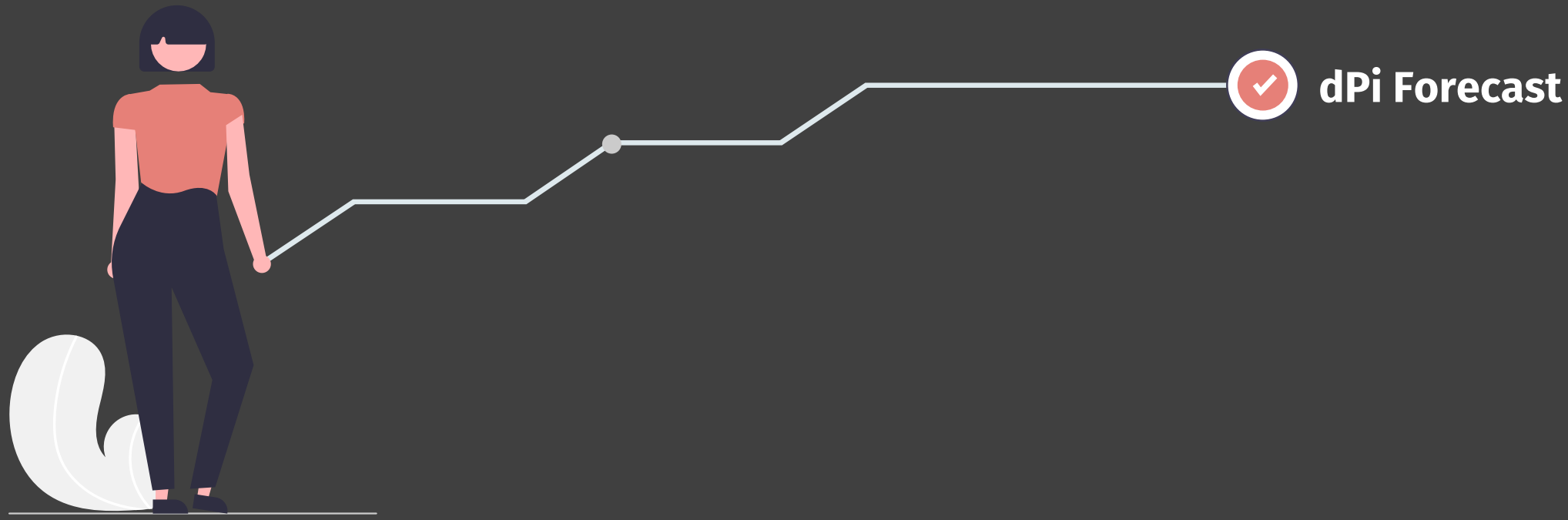

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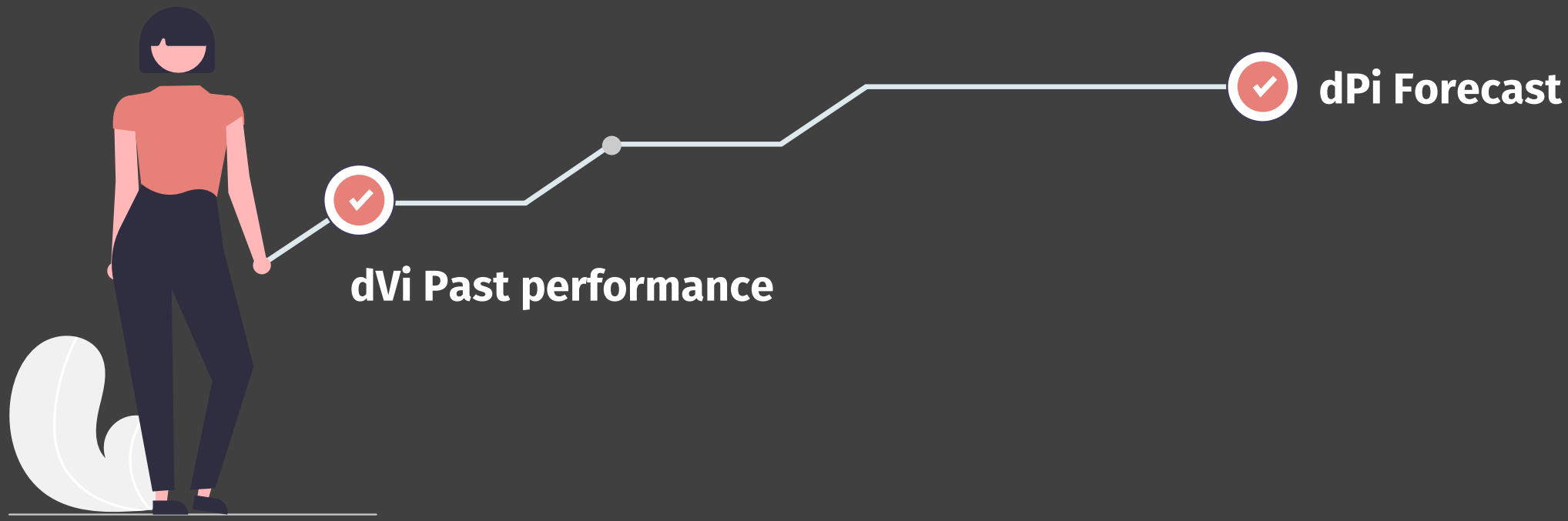

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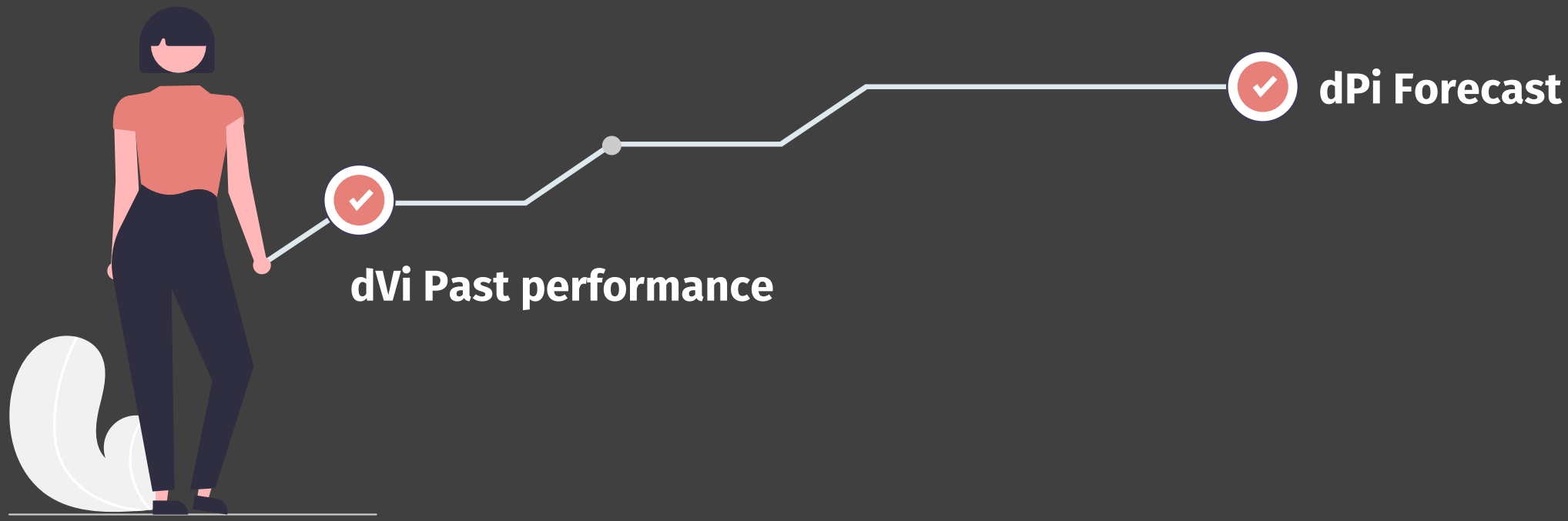
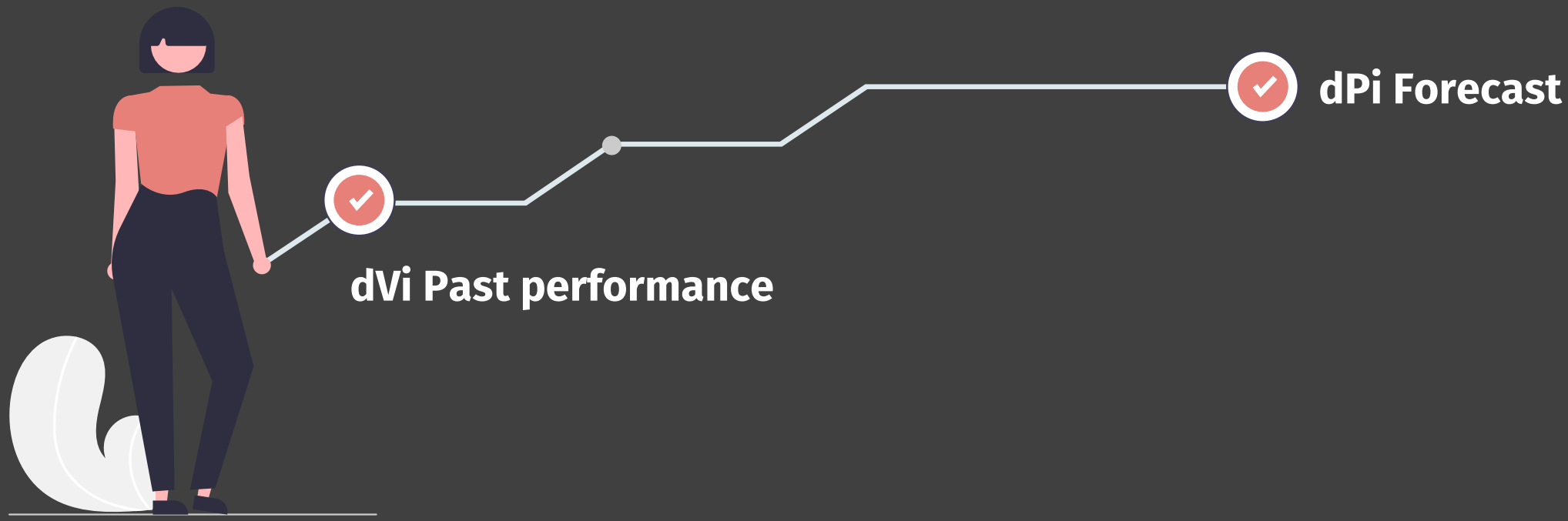


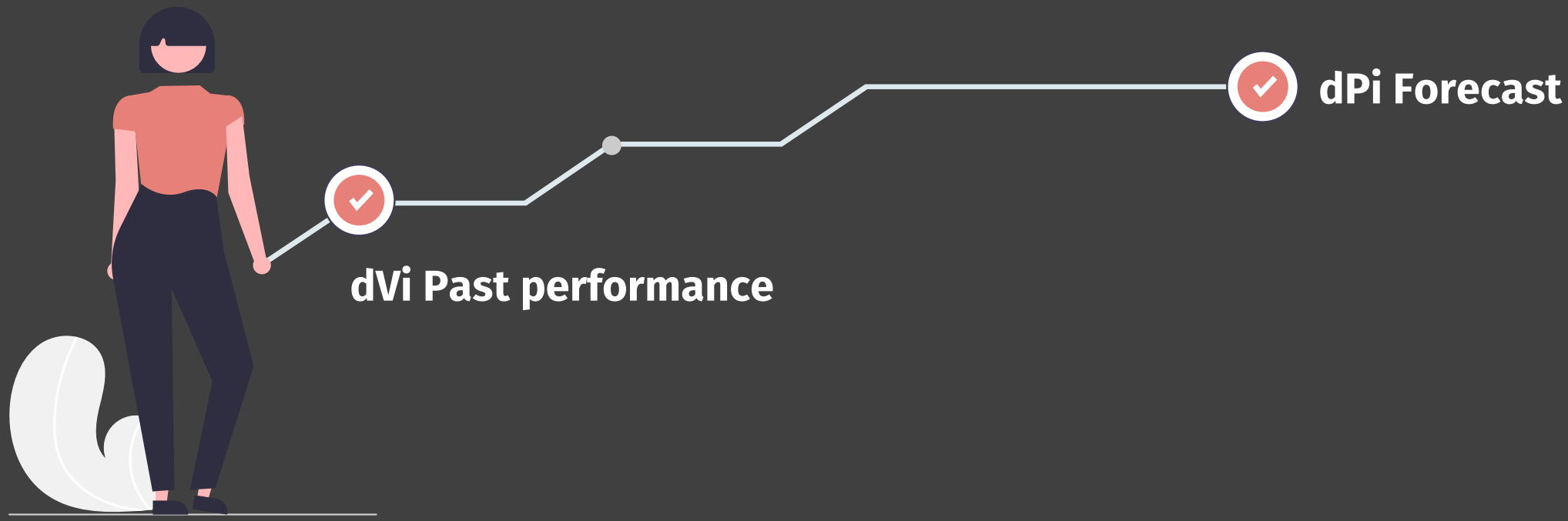
dVi ÷ dPi =

CONTEXT



dVi ÷ dPi = Realization index

CONTEXT

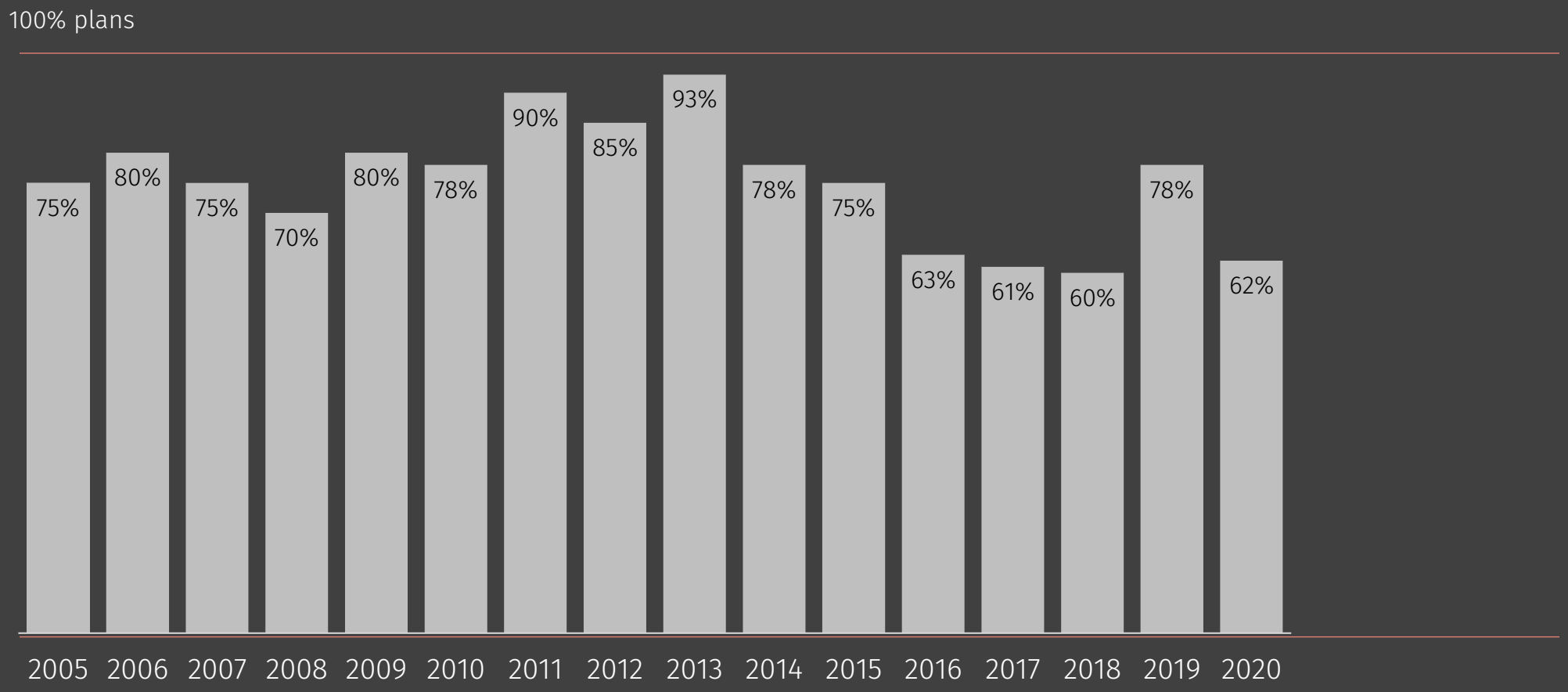


dVi ÷ dPi = Realization index = prediction power

PROBLEM STATEMENT

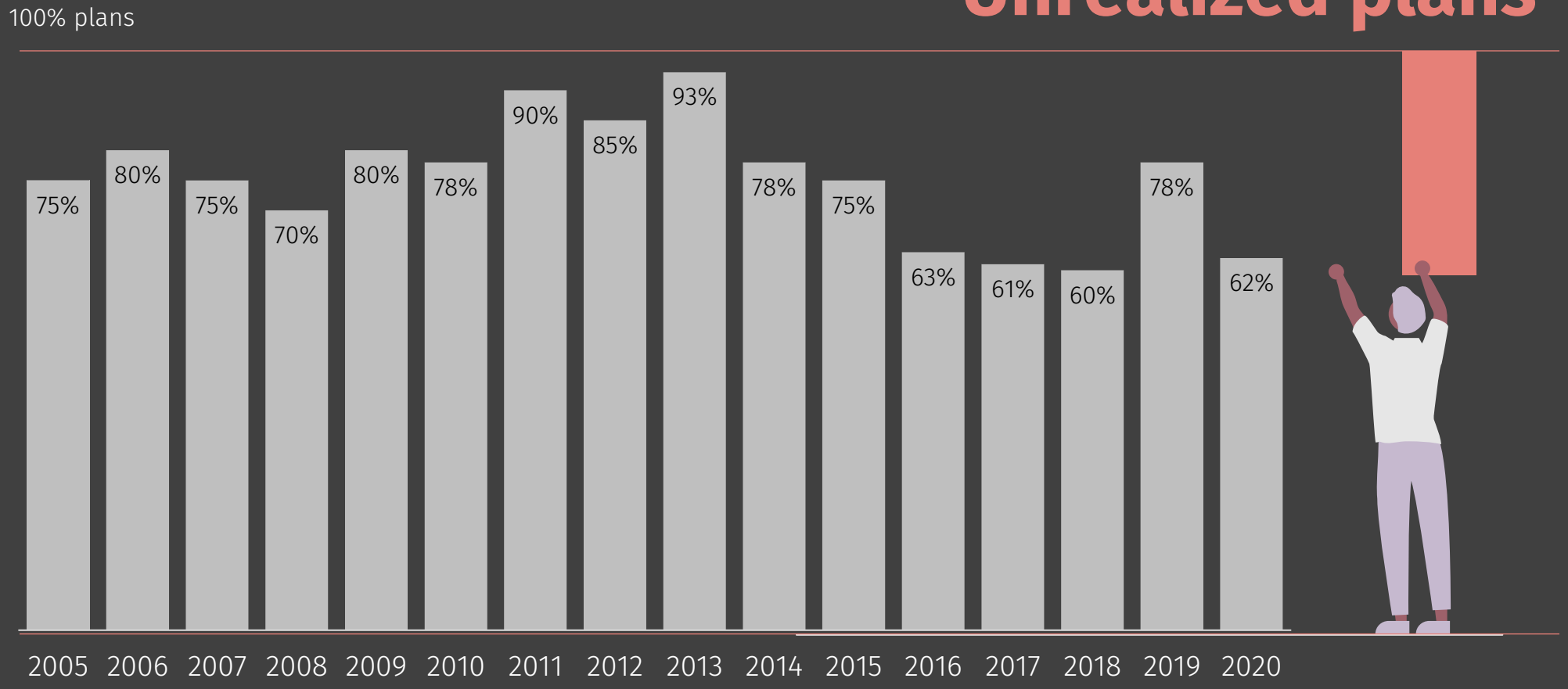
100% plans

PROBLEM STATEMENT



PROBLEM STATEMENT

Unrealized plans



PROBLEM STATEMENT

Inaccurate investment forecasts...

PROBLEM STATEMENT

Inaccurate investment forecasts...

Financial risks

PROBLEM STATEMENT

Inaccurate investment forecasts...

Financial risks

Reduce financial guarantees

PROBLEM STATEMENT

Inaccurate investment forecasts...

Financial risks

Reduce financial guarantees

Disappoint stakeholders

AIMS AND QUESTIONS

Identify...

AIMS AND QUESTIONS

Identify...

Risks affecting project time

AIMS AND QUESTIONS

Identify...

Risks affecting project time

Resolution process and **gaps?**

AIMS AND QUESTIONS

Identify...

Risks affecting project time

Resolution process and **gaps?**

Alternatives to resolve gaps?

METHODS

METHODS

QUALITATIVE

QUANTITATIVE

METHODS

QUALITATIVE

QUANTITATIVE

Literature review

METHODS

QUALITATIVE

Literature review

Indepth Interviews & Surveys

QUANTITATIVE

METHODS

QUALITATIVE

Literature review

Indepth Interviews & Surveys

Expert opinion

QUANTITATIVE

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Stochastic Decision Tree Analysis [SDTA]

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Multiple Linear Regression [MLR]

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Expert opinion

Process + risks + techniques of investment

METHODS

QUALITATIVE

Literature review

Indepth Interviews & Surveys

Expert opinion

Process + risks + techniques of investment

5 Policy + Data managers

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29 HA's >10,000Vhe

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5 Policy + Data managers
29 HA's >10,000Vhe

3 Portaal experts

METHODS

QUANTITATIVE

Stochastic Decision Tree Analysis [SDTA]

METHODS

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Stochastic Decision Tree Analysis [SDTA]

Multiple Linear Regression [MLR]

IBM SPSS Statistics + Portaal dataset

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Stochastic Decision Tree Analysis [SDTA]

Multiple Linear Regression [MLR]

Monte Carlo Simulation [MCS]

IBM SPSS Statistics + Portaal dataset

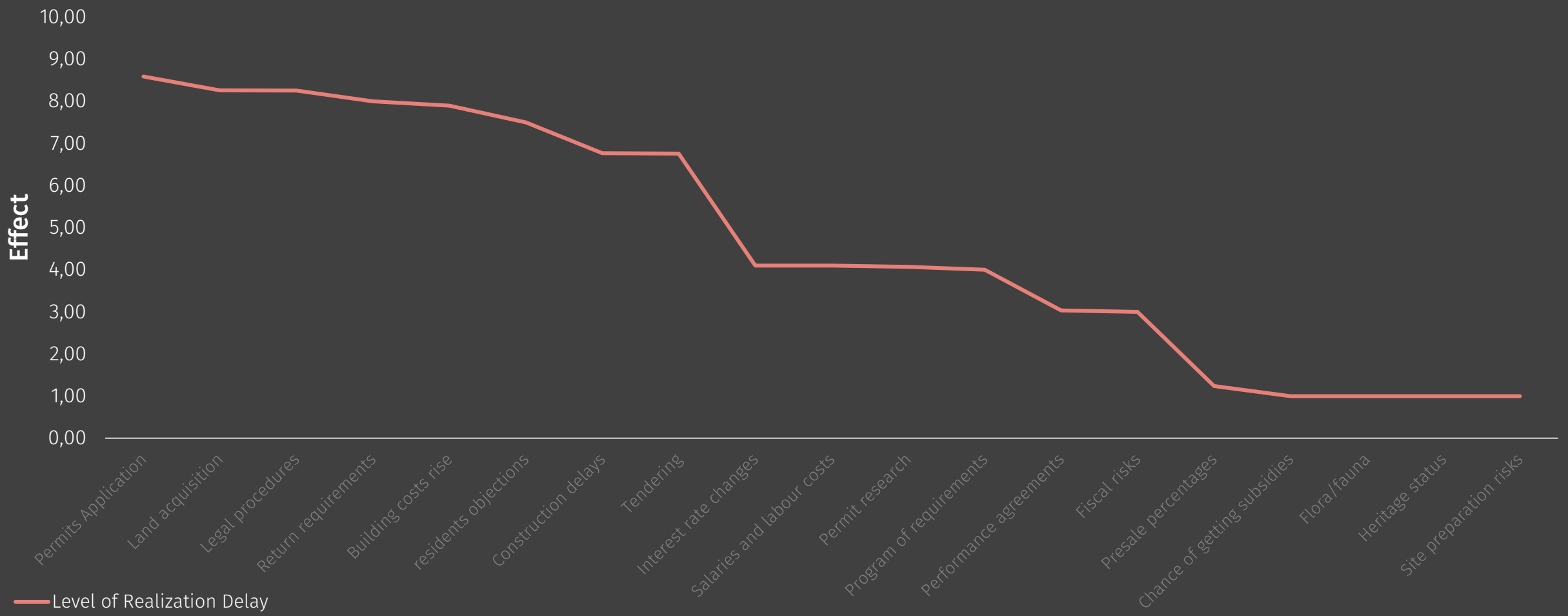
Microsoft Excel + Palisade @risk and Precision Tree

FINDINGS

TOP DELAYING RISKS

FINDINGS

TOP DELAYING RISKS



FINDINGS

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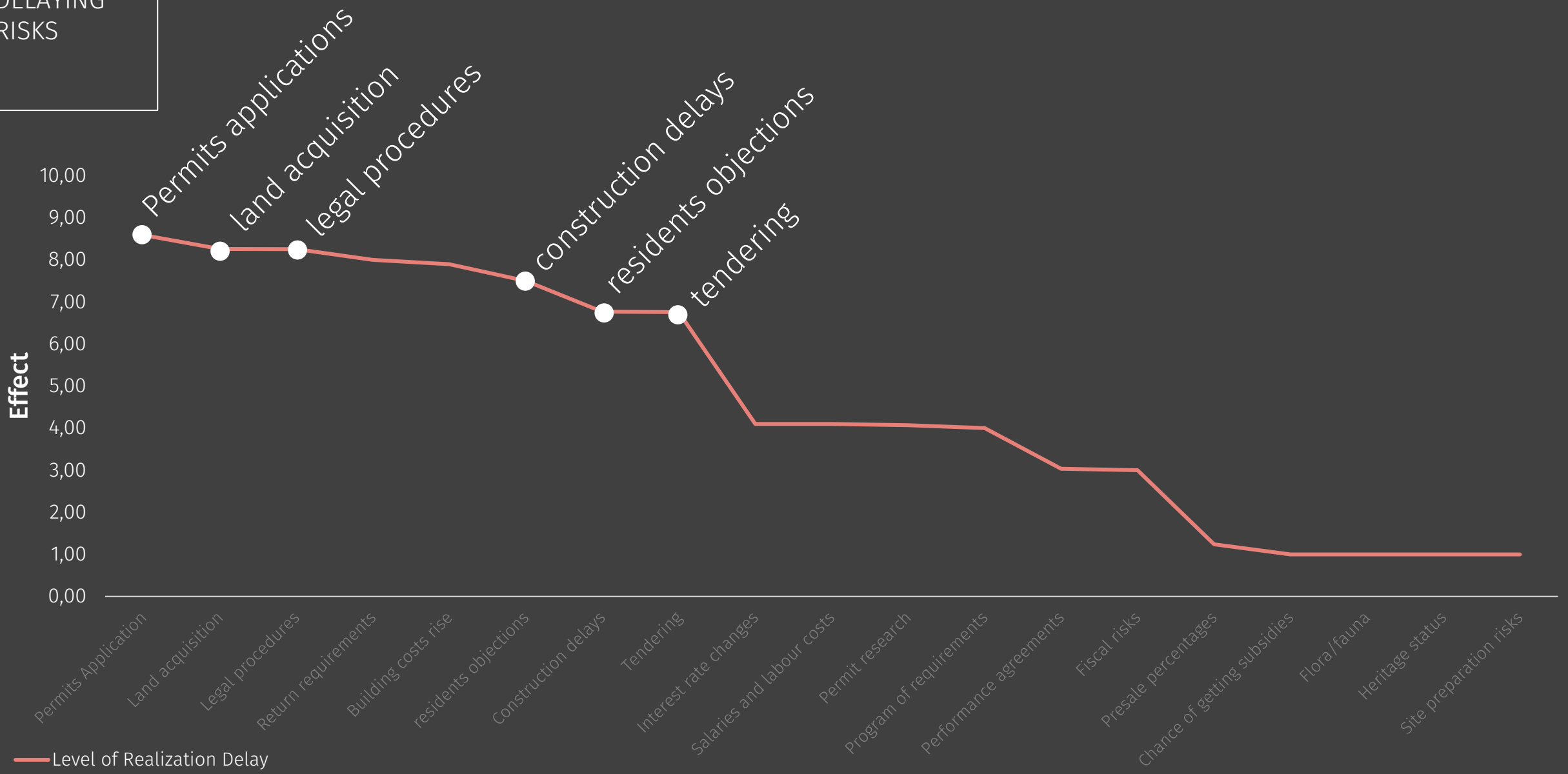

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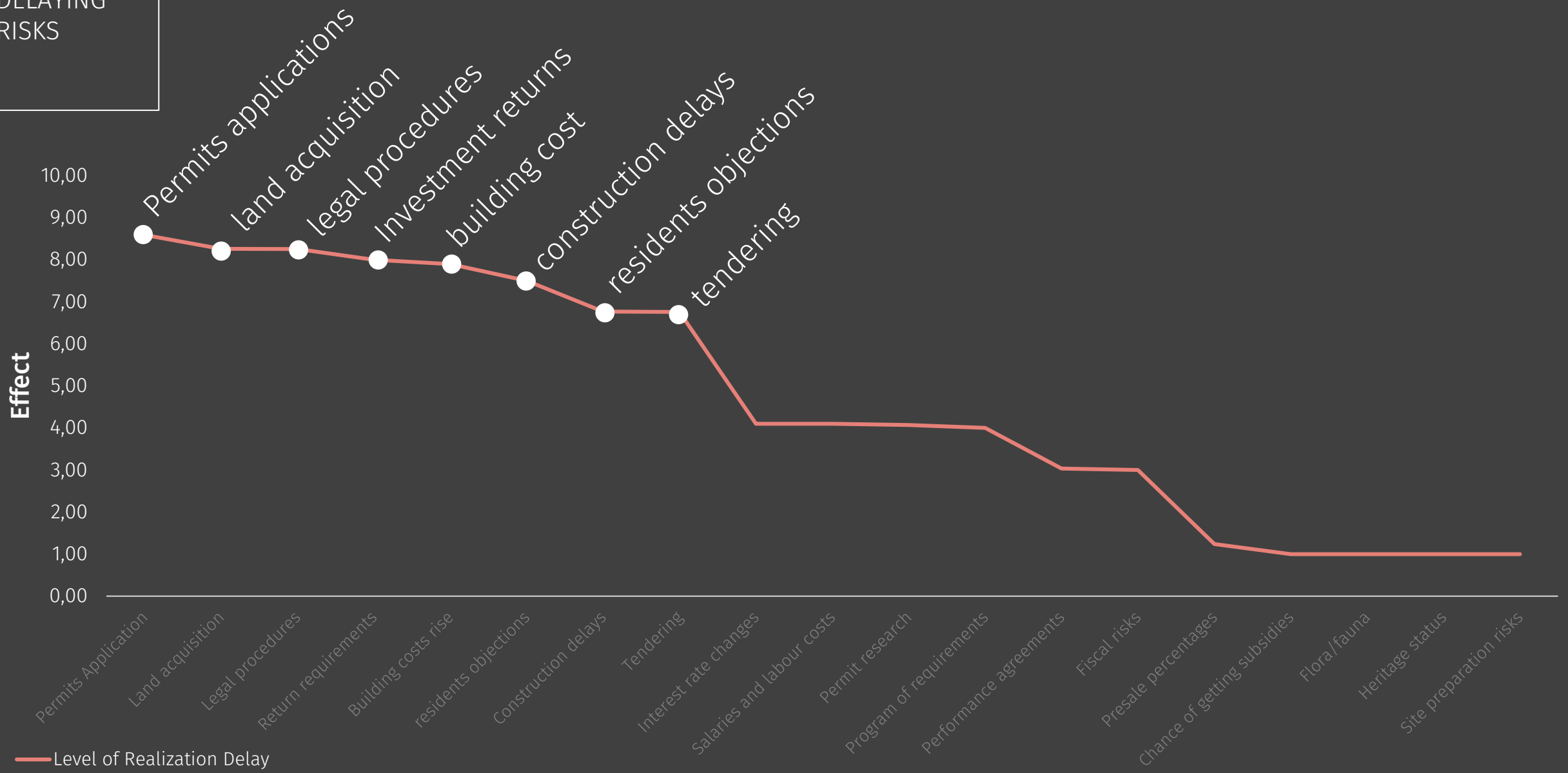

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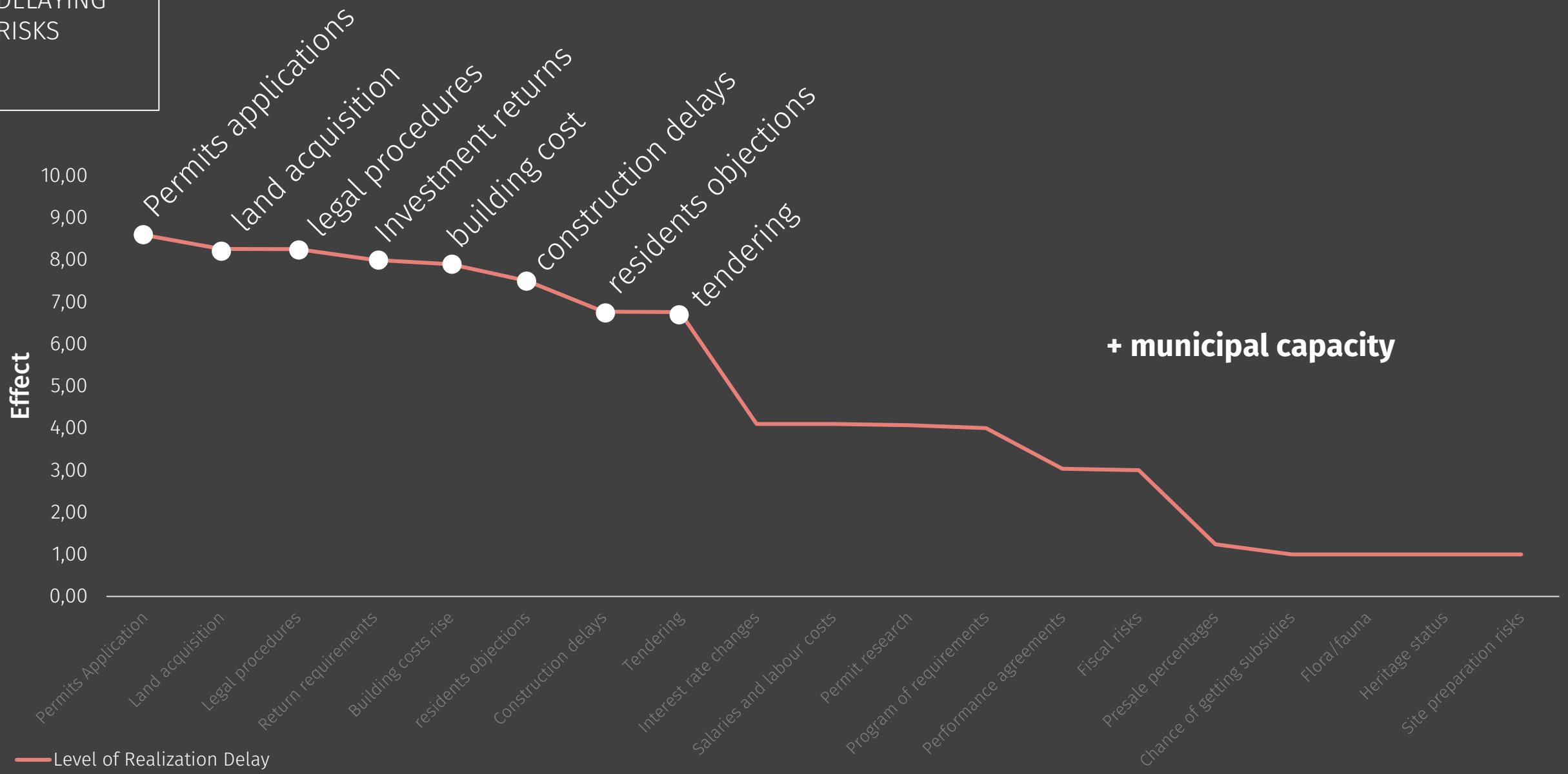
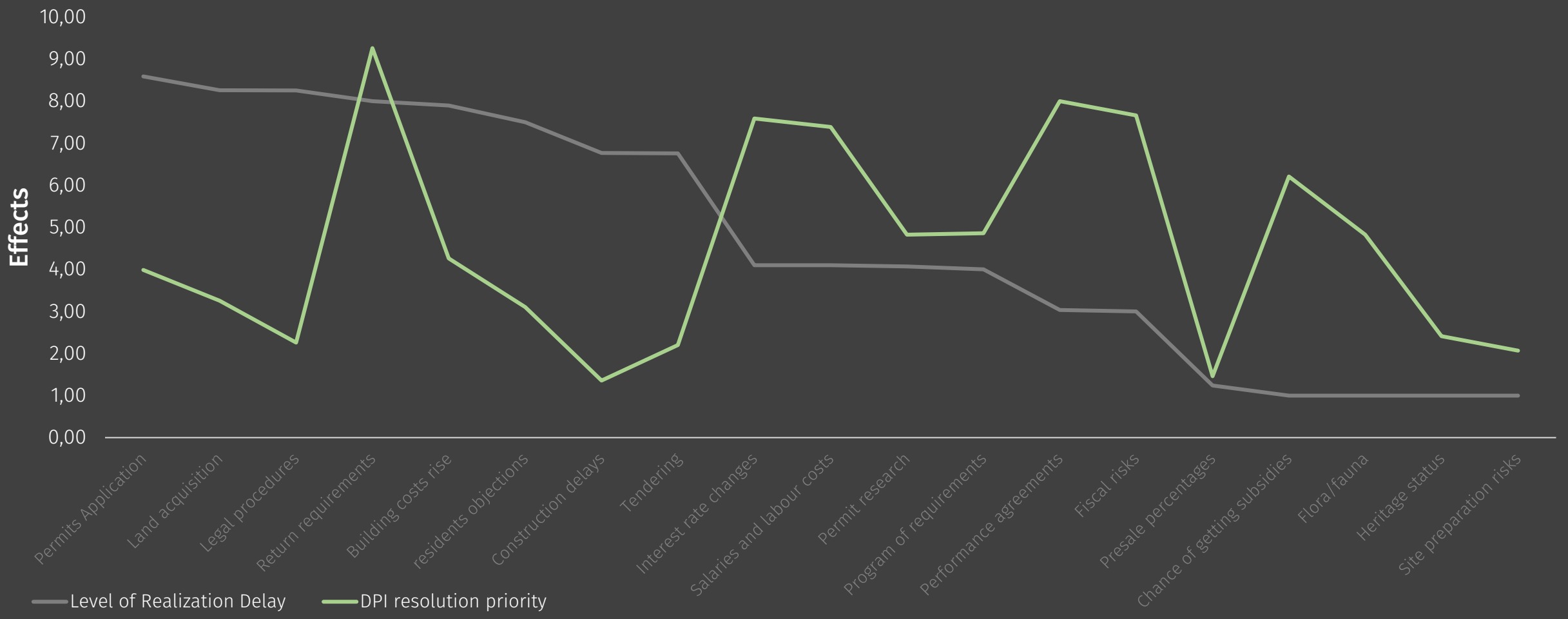


FINDINGS

RISK
FORECAST
PRIORITY

FINDINGS

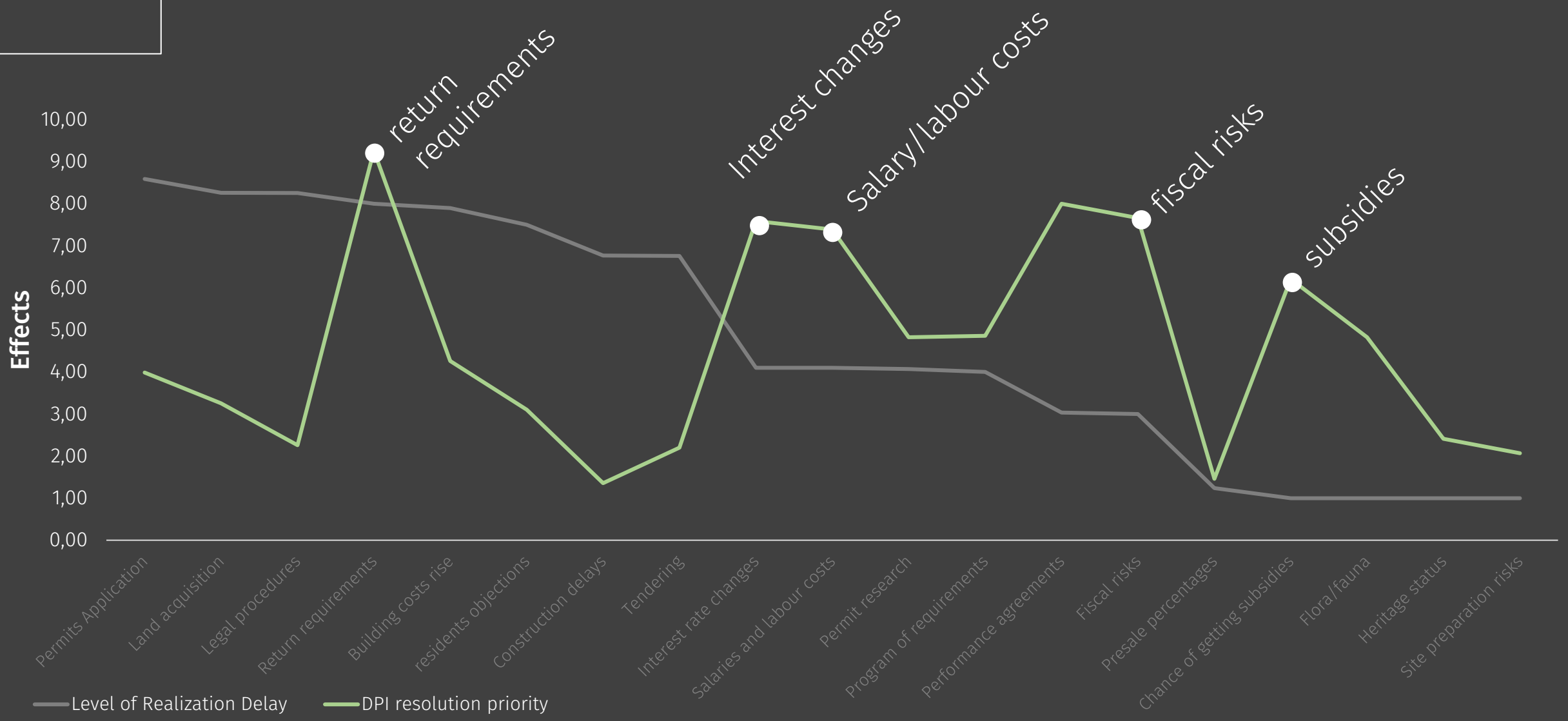
RISK
FORECAST
PRIORITY



FINDINGS

RISK
FORECAST
PRIORITY

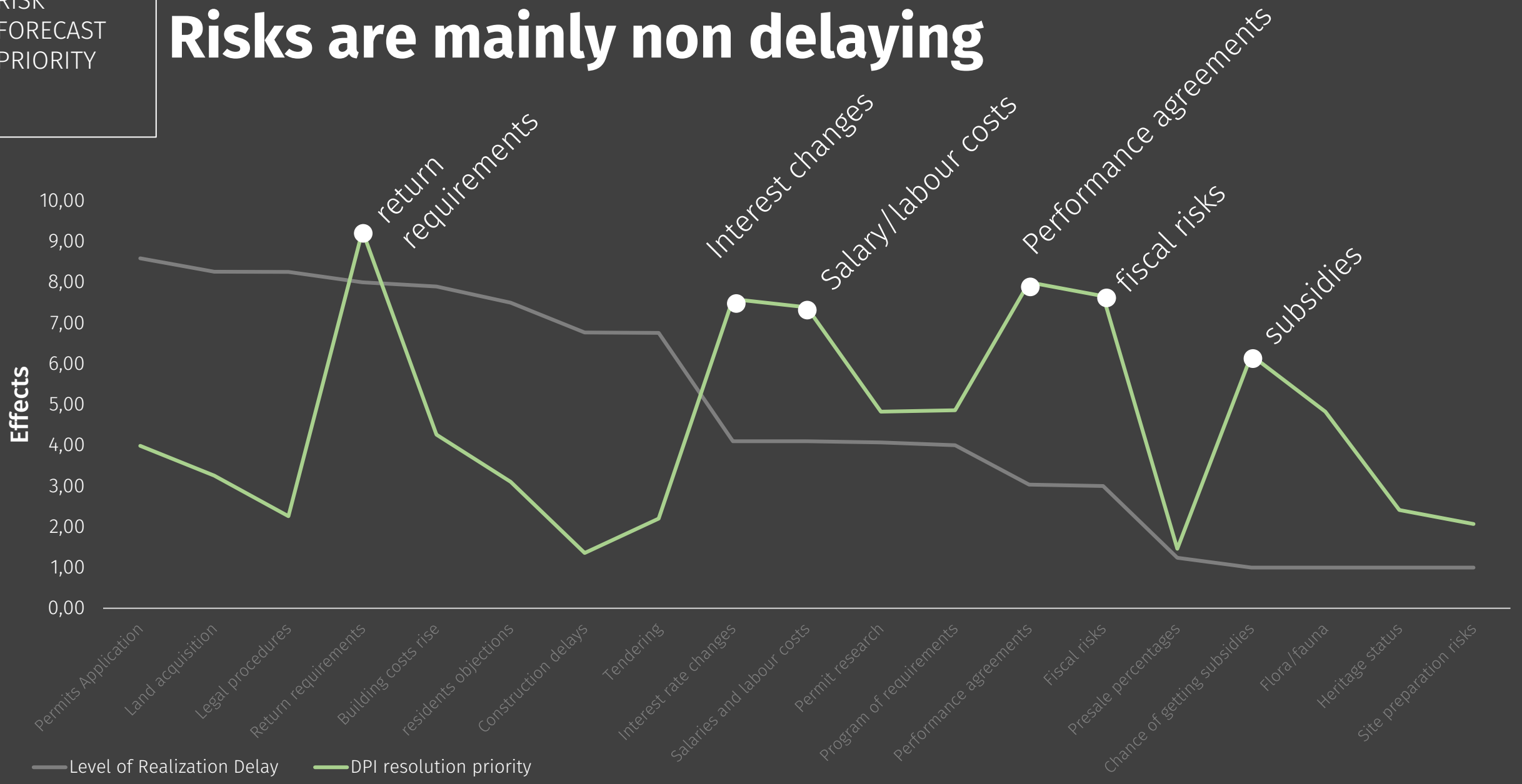
Focus is on financial risks



FINDINGS

RISK FORECAST PRIORITY

Focus is on financial risks
Risks are mainly non delaying



FINDINGS

RISK APPRASAL TECHNIQUES

N=29

A	**Intuition/Experience**
B	**Valuation Methods**
C	Risk assessment checklist
D	Scenario analysis
E	Sensitivity analysis
F	Probabilistic methods

FINDINGS

RISK APPRASAL TECHNIQUES

A **Intuition/Experience**
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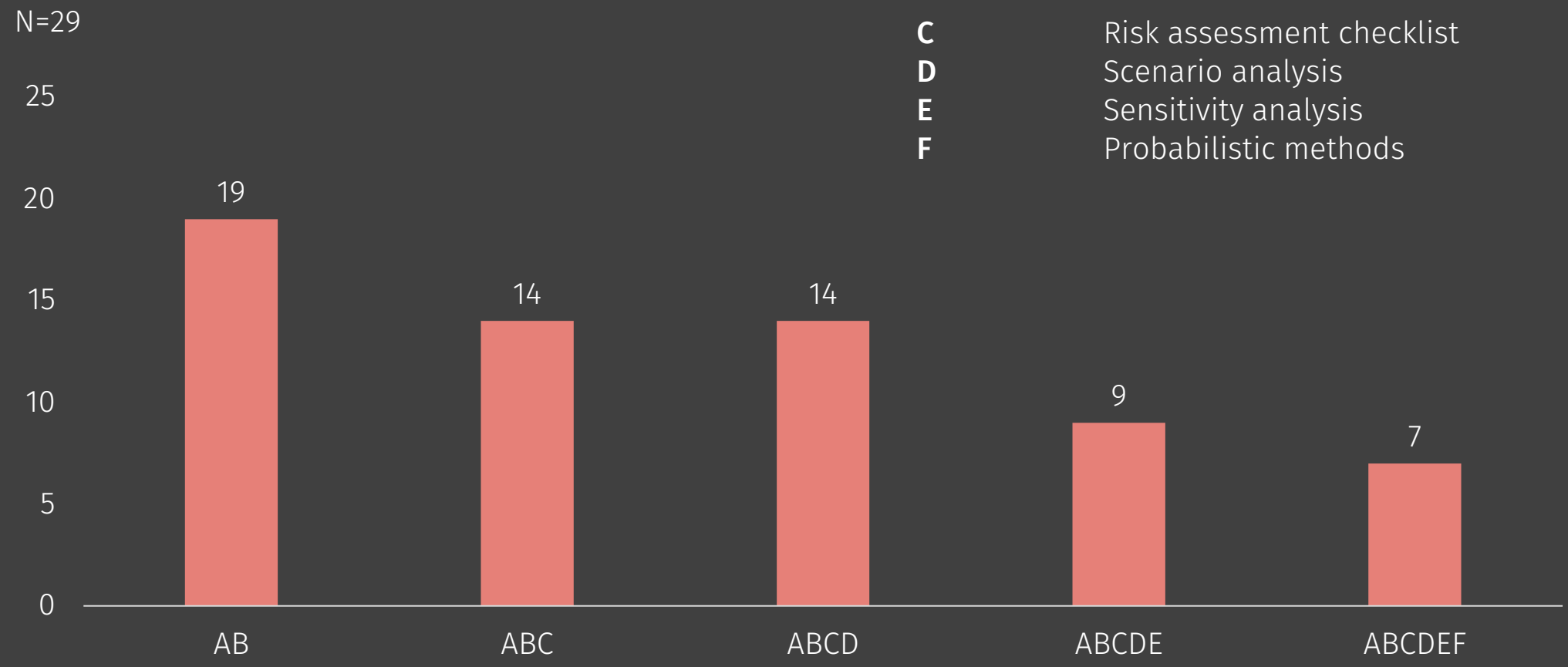

FINDINGS

RISK APPRASAL TECHNIQUES

Intuition + Valuation methods

A	**Intuition/Experience**
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C	Risk assessment checklist
D	Scenario analysis
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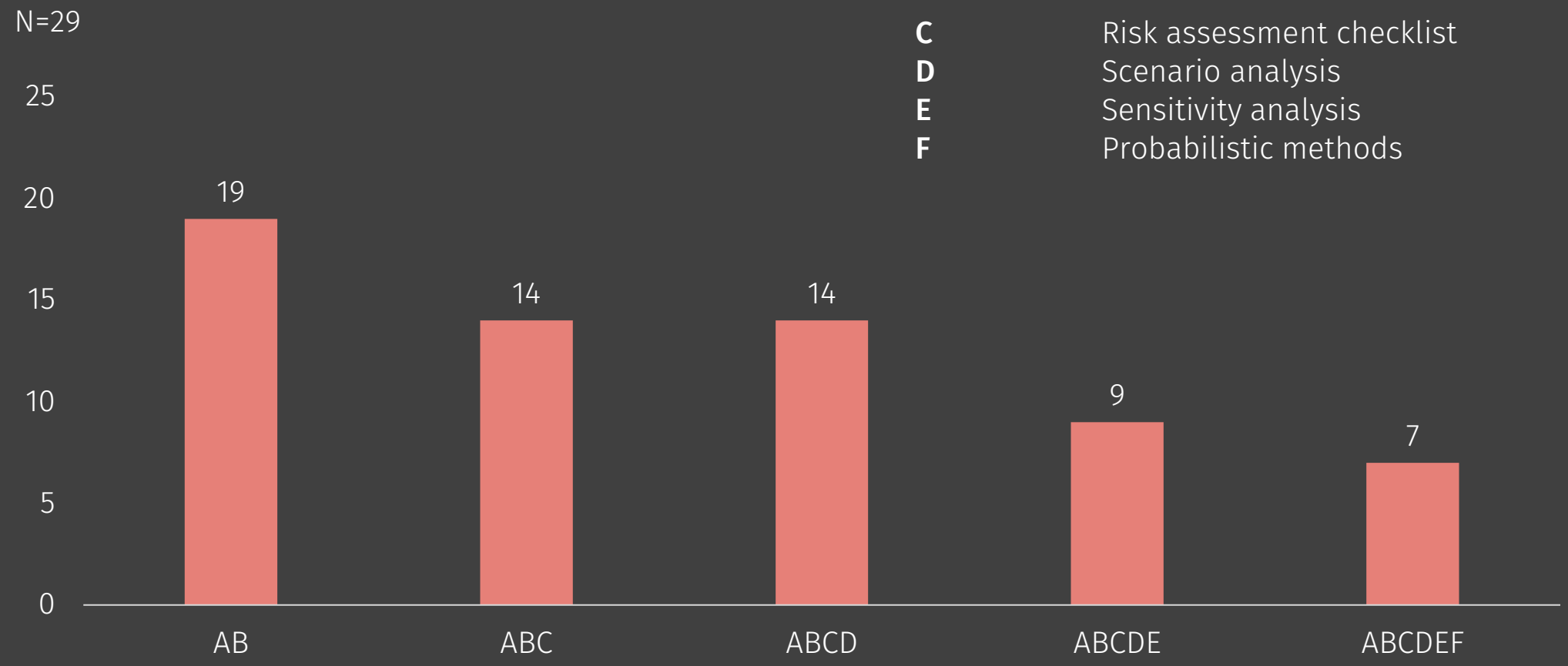
F	Probabilistic methods

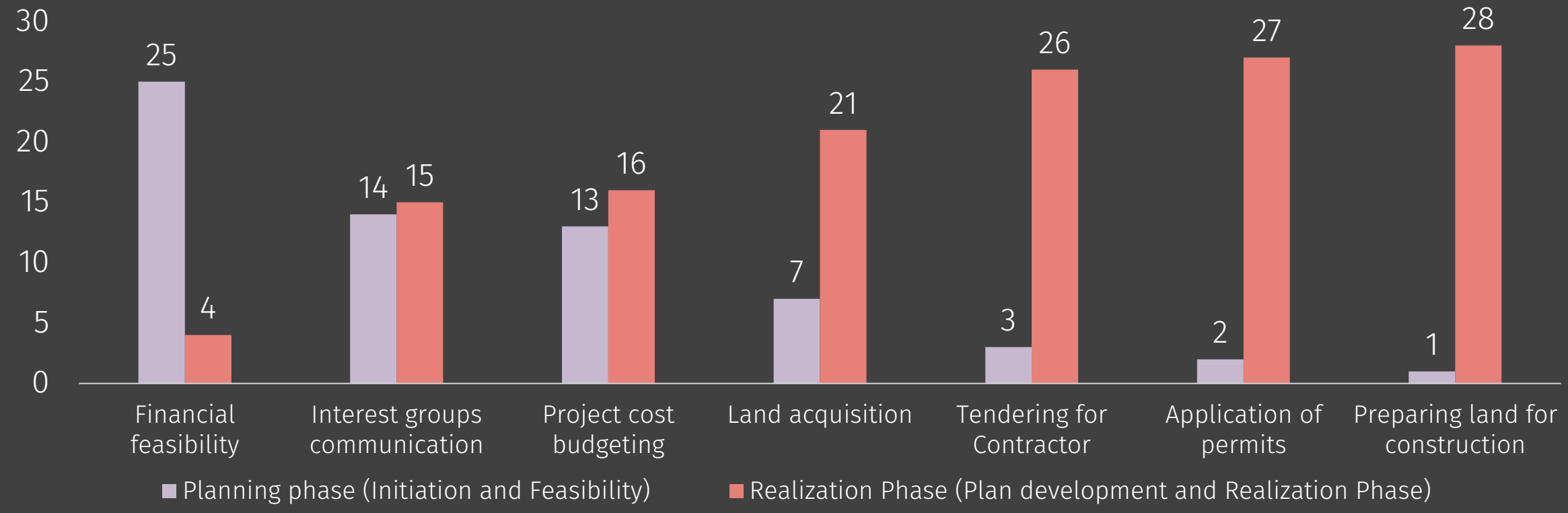


FINDINGS

RISK CAPTURING PER PHASE

FINDINGS

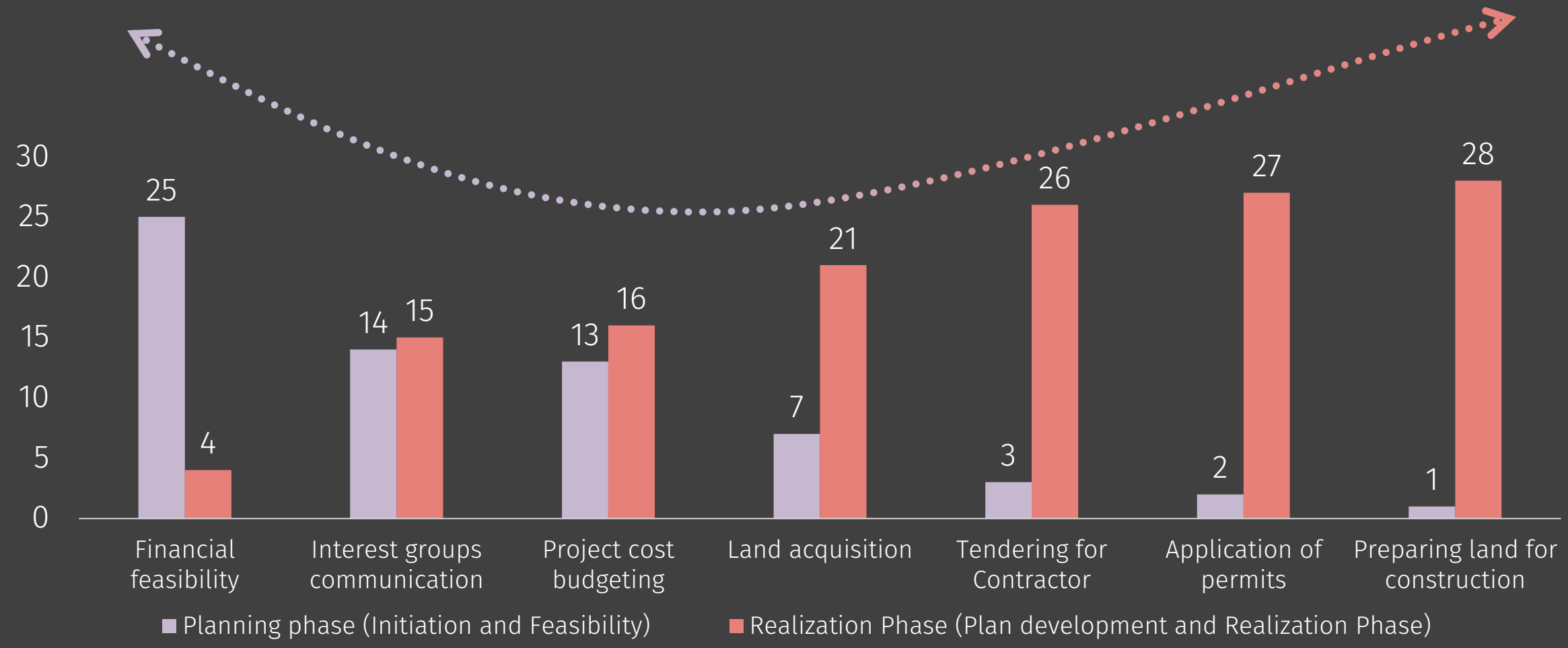
RISK CAPTURING PER PHASE



FINDINGS

RISK CAPTURING PER PHASE

Financial risks detached



FINDINGS

CAPTURING TIME IN APPRAISAL

Portaal Model

FINDINGS

CAPTURING TIME IN APPRAISAL

Portaal Model

= Construction budget x index x delay in months

FINDINGS

CAPTURING TIME IN APPRAISAL

Portaal Model

= 1,000,000 x index x delay in months

FINDINGS

CAPTURING TIME IN APPRAISAL

Portaal Model

= 1,000,000 x 2% x delay in months

FINDINGS

CAPTURING TIME IN APPRAISAL

Portaal Model

= 1,000,000 x 2% x 3 months

FINDINGS

CAPTURING TIME IN APPRAISAL

Portaal Model

= 1,000,000 x 2% x 3 months

Add €60,000

FINDINGS

CAPTURING TIME IN APPRAISAL

Portaal Model

= 1,000,000 x 2% x 

Add €60,000

FINDINGS

CAPTURING TIME IN APPRAISAL

Decision Tree Analysis

FINDINGS

CAPTURING TIME IN APPRAISAL

Decision Tree Analysis

Expected value EV =

FINDINGS

CAPTURING TIME IN APPRAISAL

Decision Tree Analysis

Expected value EV = Probability x Outcome

FINDINGS

CAPTURING TIME IN APPRAISAL

Decision Tree Analysis

Time effect of risks

Expected value EV = Probability x Outcome

FINDINGS

CAPTURING TIME IN APPRAISAL

Decision Tree Analysis

Time effect of risks

50%

Expected value EV = Probability x Outcome

FINDINGS

CAPTURING TIME IN APPRAISAL

Decision Tree Analysis

Time effect of risks

50%

Getting permit

Expected value EV = Probability x Outcome

FINDINGS

CAPTURING TIME IN APPRAISAL

Decision Tree Model

FINDINGS

CAPTURING TIME IN APPRAISAL

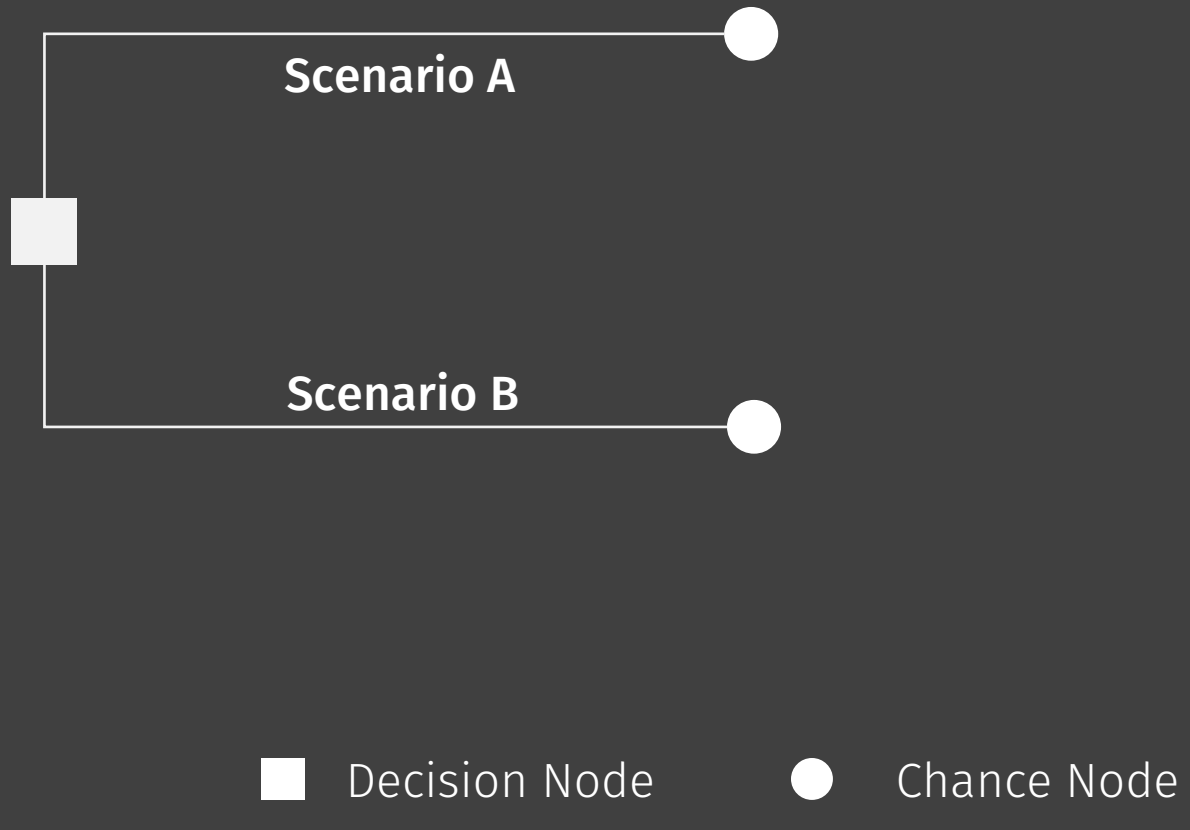
Decision Tree Model

Decision Node

FINDINGS

CAPTURING TIME IN APPRAISAL

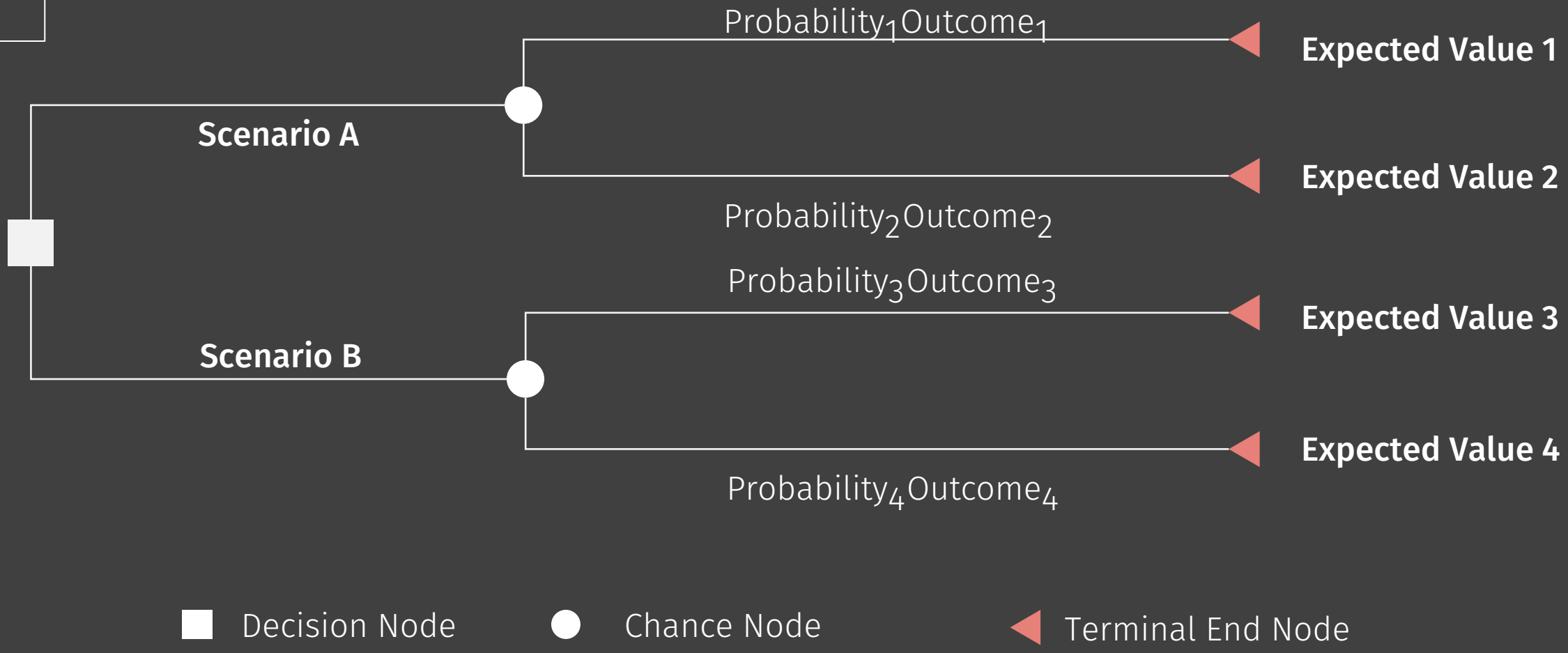
Decision Tree Model



FINDINGS

CAPTURING TIME IN APPRAISAL

Decision Tree Model



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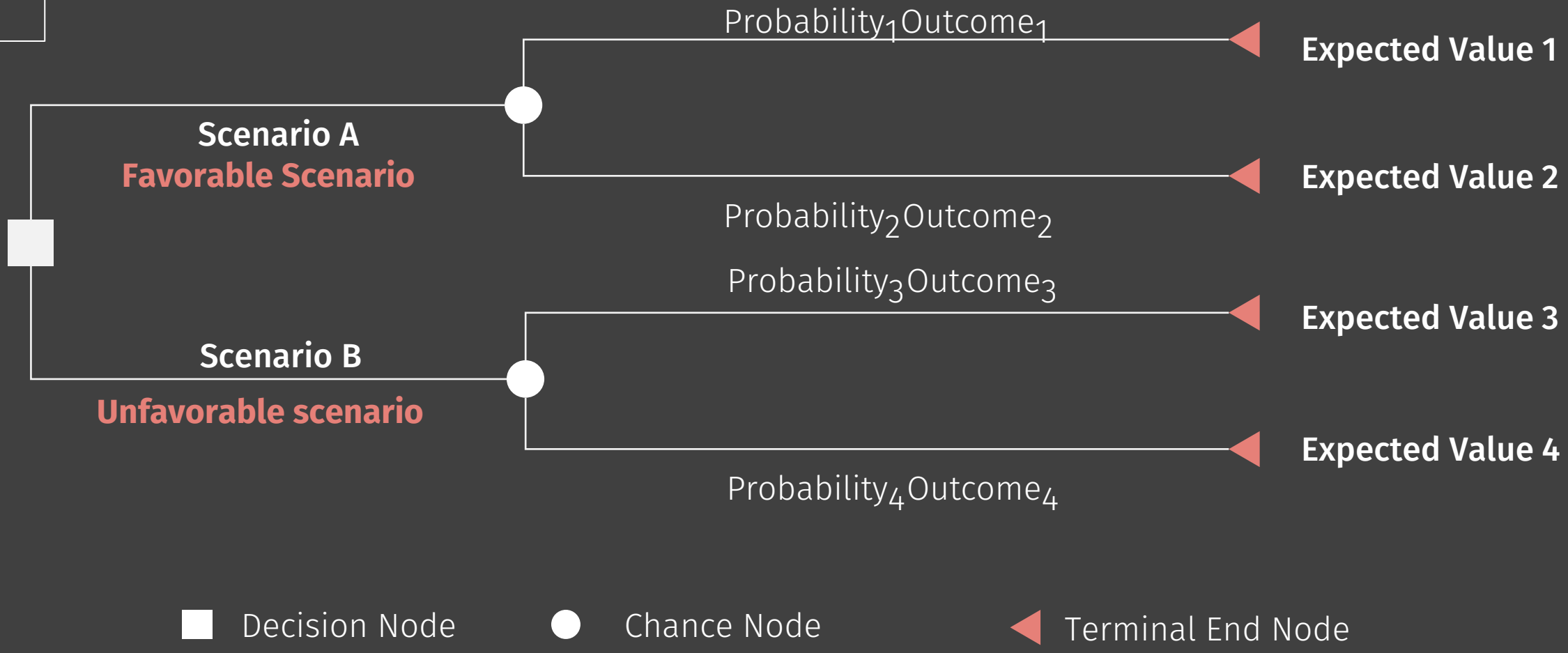
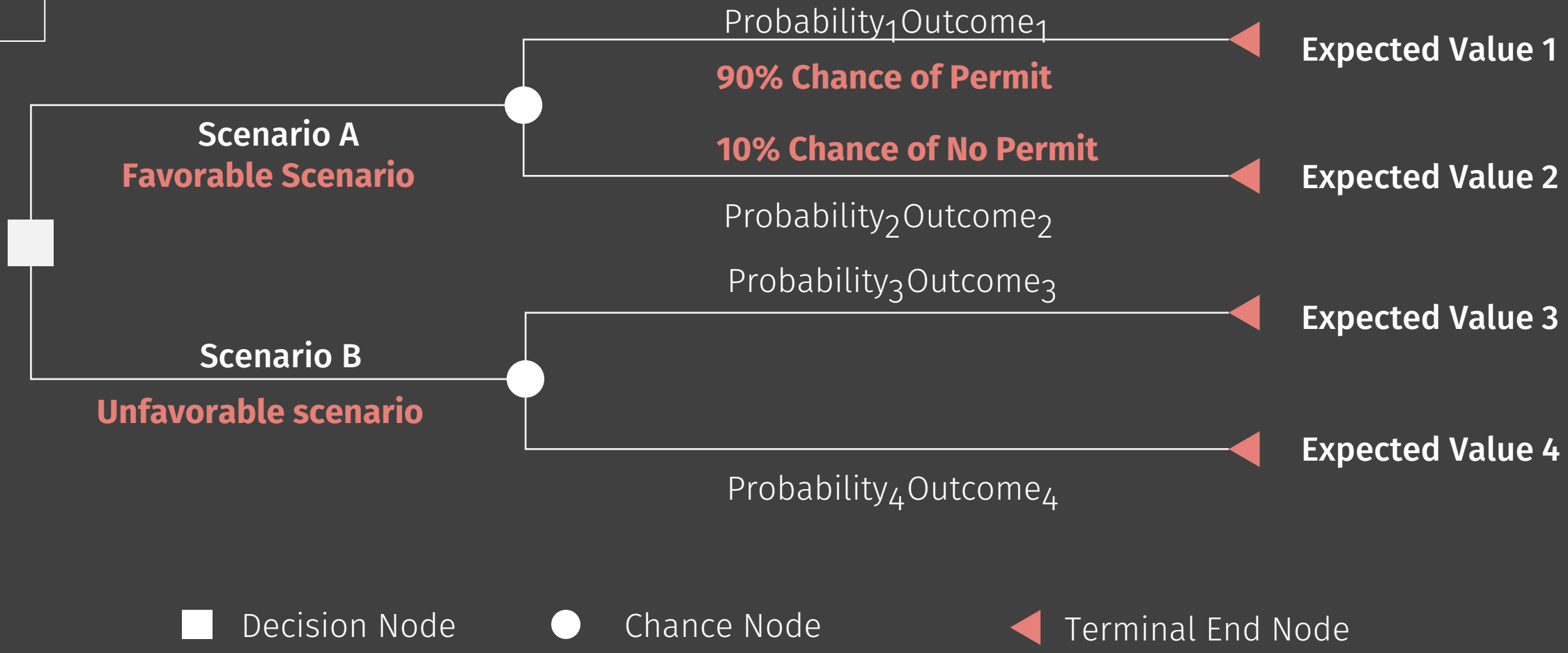


FINDINGS

CAPTURING TIME IN APPRAISAL

Decision Tree Model



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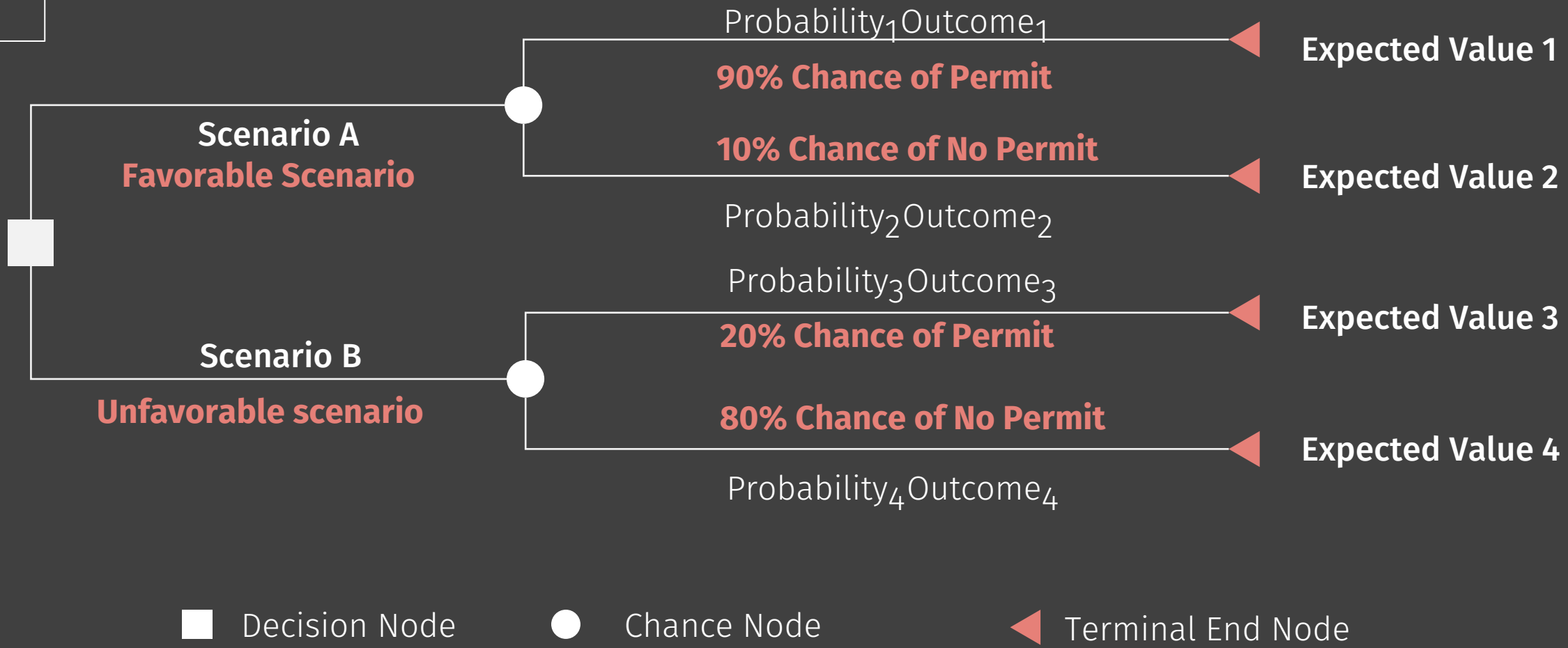

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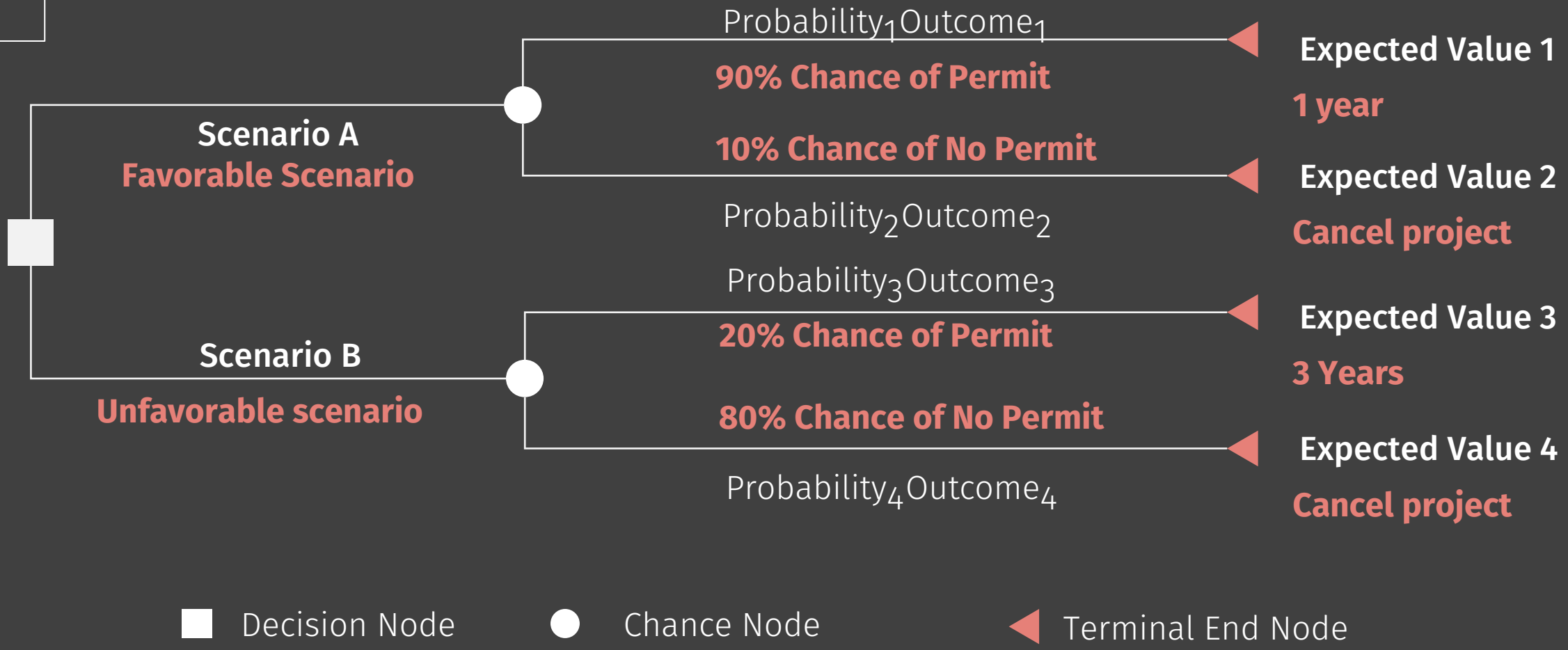
CAPTURING TIME IN APPRAISAL

Decision Tree Model



FINDINGS

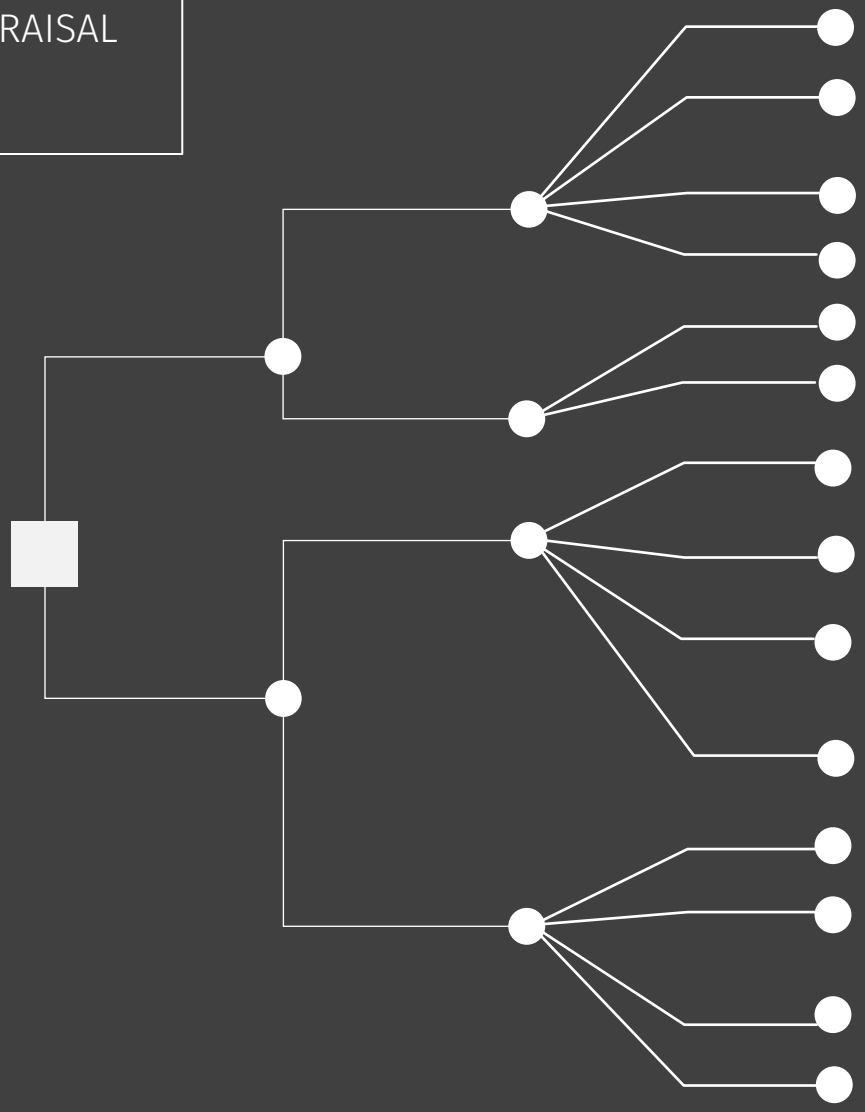
CAPTURING TIME IN APPRAISAL

Too many decision paths?

FINDINGS

CAPTURING TIME IN APPRAISAL

Too many decision paths?



FINDINGS

CAPTURING TIME IN APPRAISAL

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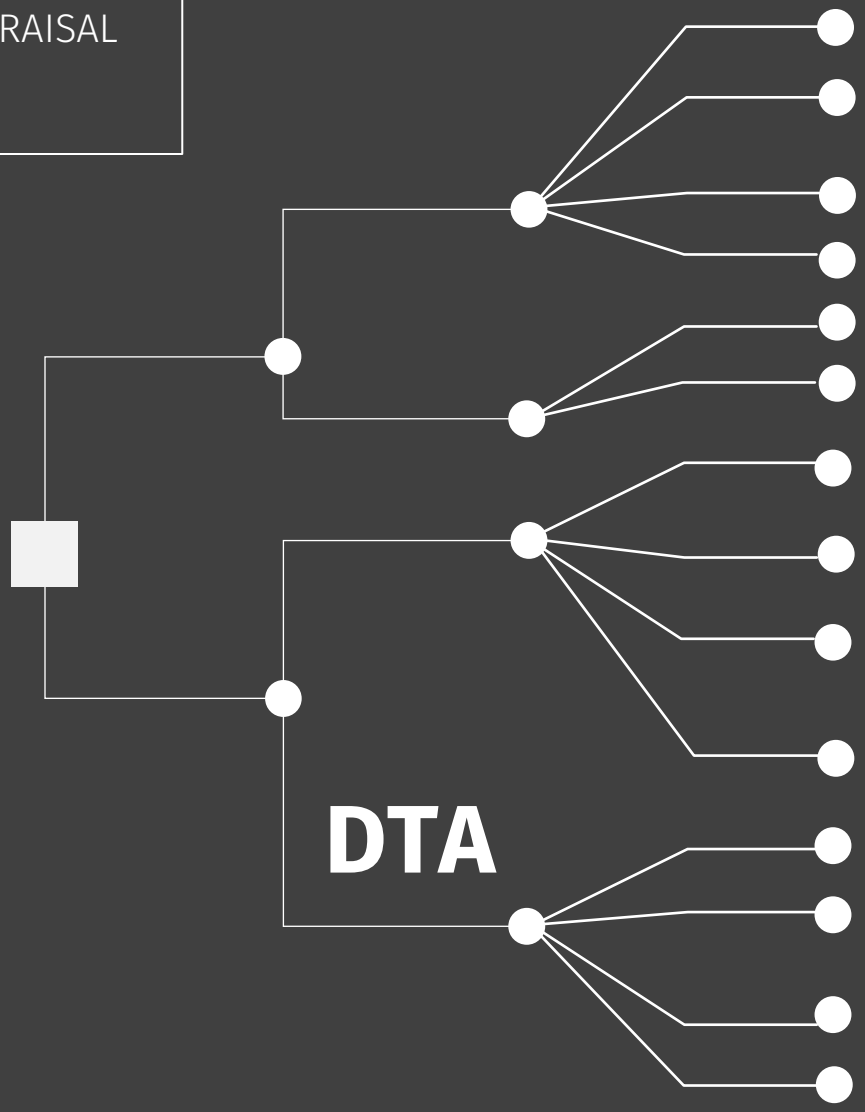

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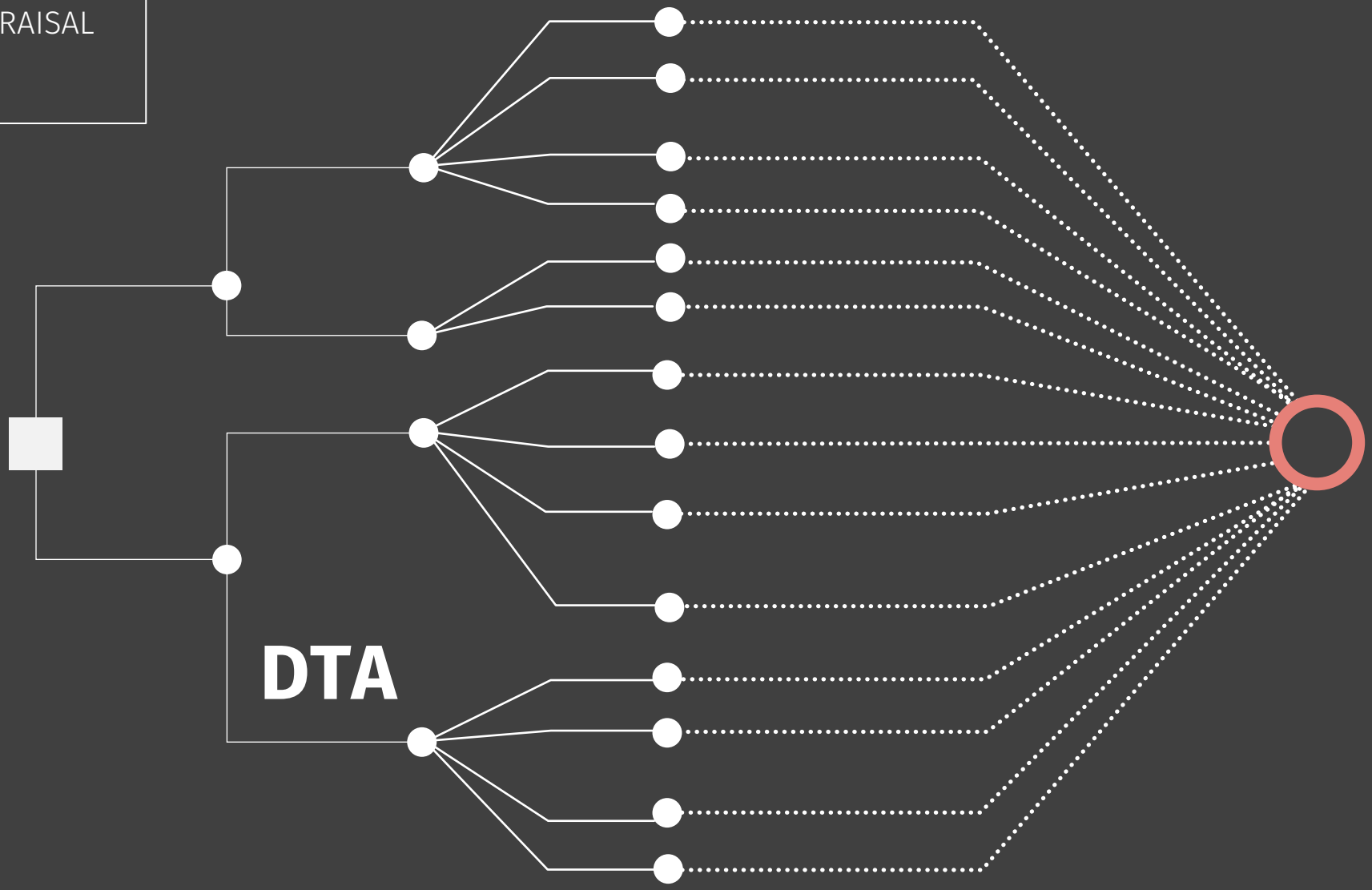

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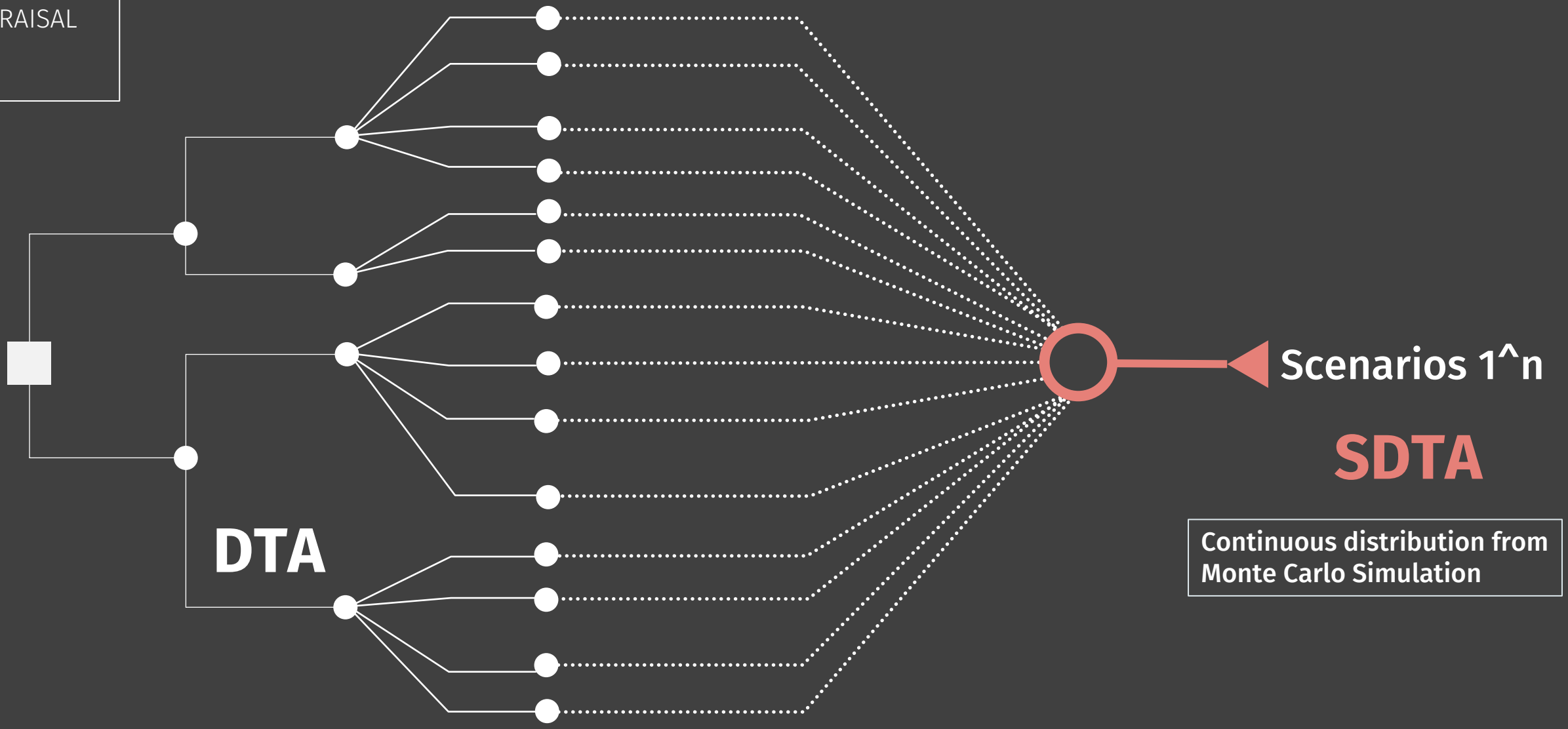

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

Permit procedures

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

Property type: Apartment(1) vs (House(0)

Permit procedures

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

Permit procedures

- **Property type: Apartment(1) vs (House(0)**
- **Number of Homes**

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

Permit procedures

- **Property type: Apartment(1) vs (House(0)**
- **Number of Homes**

Land acquisition

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

Permit procedures

- **Property type: Apartment(1) vs (House(0)**
- **Number of Homes**

Land acquisition

- **Construction type: New build (1) vs Demo Build (0)**

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

Permit procedures

- **Property type: Apartment(1) vs (House(0)**
- **Number of Homes**

Land acquisition

- **Construction type: New build (1) vs Demo Build (0)**

Tendering

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

Permit procedures → **Property type: Apartment(1) vs (House(0)**

Permit procedures → **Number of Homes**

Land acquisition → **Construction type: New build (1) vs Demo Build (0)**

Tendering → **Construction budget**

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

Permit procedures → Property type: Apartment(1) vs (House(0)

Permit procedures → Number of Homes

Land acquisition → Construction type: New build (1) vs Demo Build (0)

Tendering → Construction budget

Municipal capacity

FINDINGS

CAPTURING TIME IN APPRAISAL

Working with Numbers

Permit procedures	Property type: Apartment(1) vs (House(0)
	Number of Homes
Land acquisition	Construction type: New build (1) vs Demo Build (0)
Tendering	Construction budget
Municipal capacity	Municipality (1,2,3,4 .....n)

FINDINGS

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Permit procedures	Property type: Apartment(1) vs (House(0)
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Municipal capacity	Municipality (1,2,3,4 .....n)
Cost increase	

FINDINGS

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Permit procedures	Property type: Apartment(1) vs (House(0)
	Number of Homes
Land acquisition	Construction type: New build (1) vs Demo Build (0)
Tendering	Construction budget
Municipal capacity	Municipality (1,2,3,4 .....n)
Cost increase	Input price index @ decision moment (2000=0)

FINDINGS

CAPTURING TIME IN APPRAISAL

Hypothesis: n57 indicator dataset

Total project time (Years)

FINDINGS

CAPTURING TIME IN APPRAISAL

Hypothesis: n57 indicator dataset

Total project time (Years)

- Number of Homes (10)
- Input price index (1 pts)
- Building cost per million ((10 mln)
- Property type (1 = MGW , 0= EGW)
- Construction type (1=New Build, 0= Demolish and Build)
- Municipal location (1=Utrecht; 2=Leiden; 3=Arnhem; 4=Eemland; 5=Nijmegen)

FINDINGS

CAPTURING TIME IN APPRAISAL

Hypothesis

FINDINGS

CAPTURING TIME IN APPRAISAL

Hypothesis

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n + \varepsilon$$

FINDINGS

CAPTURING TIME IN APPRAISAL

Hypothesis

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n + \varepsilon$$

$$Y = \text{Constant} + \sum (\text{Weights} \times \text{Indicators})$$

FINDINGS

CAPTURING TIME IN APPRAISAL

Hypothesis

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n + \varepsilon$$

$$Y = \text{Constant} + \sum (\text{Weights} \times \text{Indicators})$$

Total Time

FINDINGS

CAPTURING TIME IN APPRAISAL

Hypothesis

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n + \varepsilon$$

$$Y = \text{Constant} + \sum (\text{Weights} \times \text{Indicators})$$

Total Time	Constant Time

FINDINGS

CAPTURING TIME IN APPRAISAL

Hypothesis

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n + \varepsilon$$

$$Y = \text{Constant} + \sum (\text{Weights} \times \text{Indicators})$$

Total Time

Constant Time

Weights

FINDINGS

CAPTURING TIME IN APPRAISAL

Hypothesis

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n + \varepsilon$$

$$Y = \text{Constant} + \sum (\text{Weights} \times \text{Indicators})$$

Total Time

Constant Time

Weights

Risks indices

FINDINGS

CAPTURING TIME IN APPRAISAL

SPSS

FINDINGS

CAPTURING TIME IN APPRAISAL

SPSS

Total project time	Weights	Standard Dev.	Significance	R^2
				0.421
(Constant)	7.837	2.509	.003	p<.001
Number of Homes	-.020	.015	.200	
Input price index	-.080	.039	.047	
Construction type	-1.968	.957	.045	
Building cost per million	.322	.097	.002	
Property type	-.291	.867	.739	
Location 2.0 Leiden	2.796	1.273	.033	
Location 3.0 Arnhem	-.238	1.474	.873	
Location 4.0 Eemland	1.527	1.393	.278	
Location 5.0 Nijmegen	1.382	1.203	.257	

FINDINGS

CAPTURING TIME IN APPRAISAL

SPSS

Total project time	Weights	Standard Dev.	Significance	R^2
				0.421
(Constant)	7.837	2.509	.003	p<.001
Number of Homes	-.020	.015	.200	
Input price index	-.080	.039	.047	
Construction type	-1.968	.957	.045	
Building cost per million	.322	.097	.002	
Property type	-.291	.867	.739	
Location 2.0 Leiden	2.796	1.273	.033	
Location 3.0 Arnhem	-.238	1.474	.873	
Location 4.0 Eemland	1.527	1.393	.278	
Location 5.0 Nijmegen	1.382	1.203	.257	

FINDINGS

CAPTURING TIME IN APPRAISAL

SPSS

Total project time	Weights	Standard Dev.	Significance	R^2
				0.421 p<.001
(Constant)	7.837	2.509	.003	
Number of Homes	-.020	.015	.200	
Input price index	-.080	.039	.047	
Construction type	-1.968	.957	.045	
Building cost per million	.322	.097	.002	
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CAPTURING TIME IN APPRAISAL

SPSS

FINDINGS

CAPTURING TIME IN APPRAISAL

SPSS

Project Time =

FINDINGS

CAPTURING TIME IN APPRAISAL

SPSS

Project Time =

$$\beta_0 + \beta_1 X \text{ Construction cost} + \beta_2 X \text{ Input index} + \beta_3 x \text{ construction type} + \beta_4 X \text{ Location}$$

FINDINGS

CAPTURING TIME IN APPRAISAL

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$$7.837 + (0.322 X 10) – (0.080 x 1) – (1.968 x 1) + (2.796 x 1)$$

FINDINGS

CAPTURING TIME IN APPRAISAL

SPSS

Project Time =

$$\beta_0 + \beta_1 X \text{ Construction cost} + \beta_2 X \text{ Input index} + \beta_3 \text{ x construction type} + \beta_4 X \text{ Location}$$

$$7.837 + (0.322 X 10) - (0.080 \times 1) - (1.968 \times 1) + (2.796 \times 1)$$

FINDINGS

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FINDINGS

CAPTURING TIME IN APPRAISAL

total project time ...

FINDINGS

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reduces when project is a new build (empty land)

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Is average 10 years in the NL

increases when construction budgets increase

reduces when labour and material costs increase

reduces when project is a new build (empty land)

increases in Leiden as compared to Utrecht

FINDINGS

CAPTURING TIME IN APPRAISAL

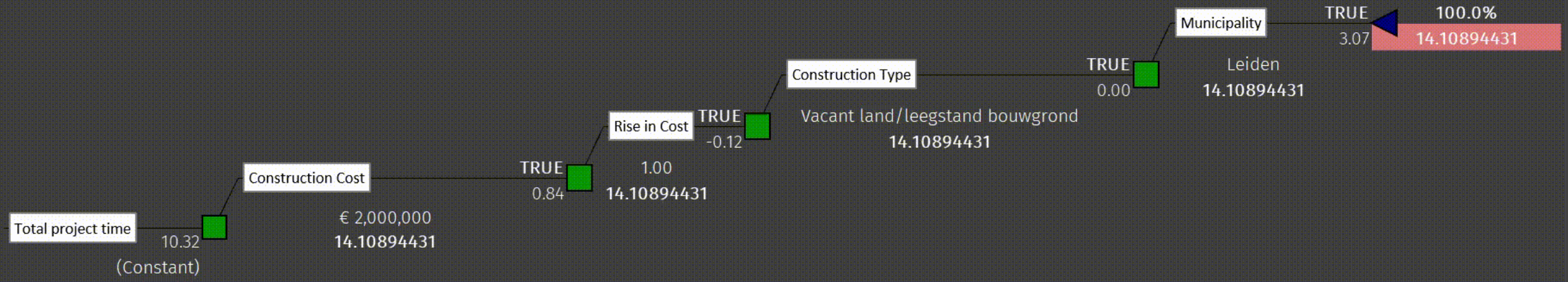
Demolish and Build project “A” in LEIDEN

FINDINGS

CAPTURING TIME IN APPRAISAL

Demolish and Build project “A” in LEIDEN

Inputs	Project characteristics	Input	Weight/gewicht	Standard deviation/ standaardafwijking	Monte Carlo
(Constant)			7.84	2.5090	10.31987105
Construction cost	€ 2,000,000	2.00	0.32	0.0970	0.417559688
Municipality	Leiden	1	2.80	1.2730	3.070085914
Construction Type	Vacant land/leegstand bouwgrond	0	-1.97	0.9570	-1.578023554
Material and labour index	1.00	1	-0.08	0.0390	-0.116132035



FINDINGS

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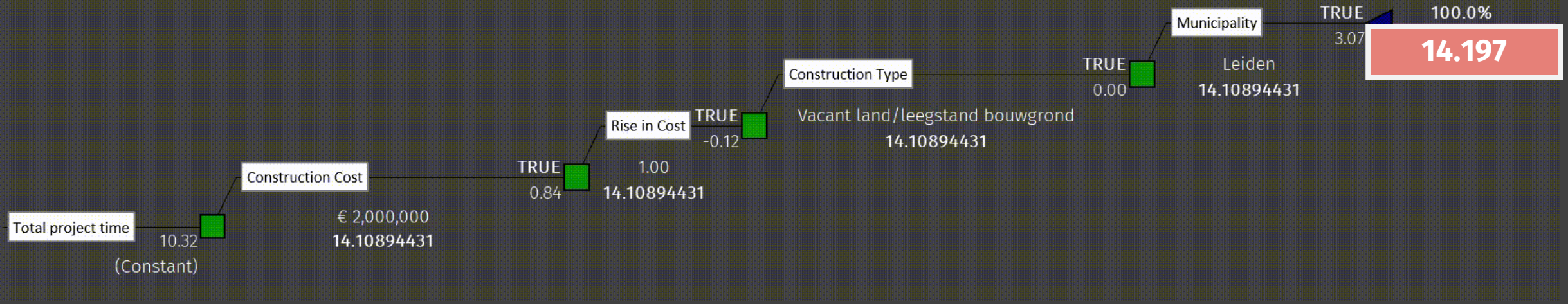

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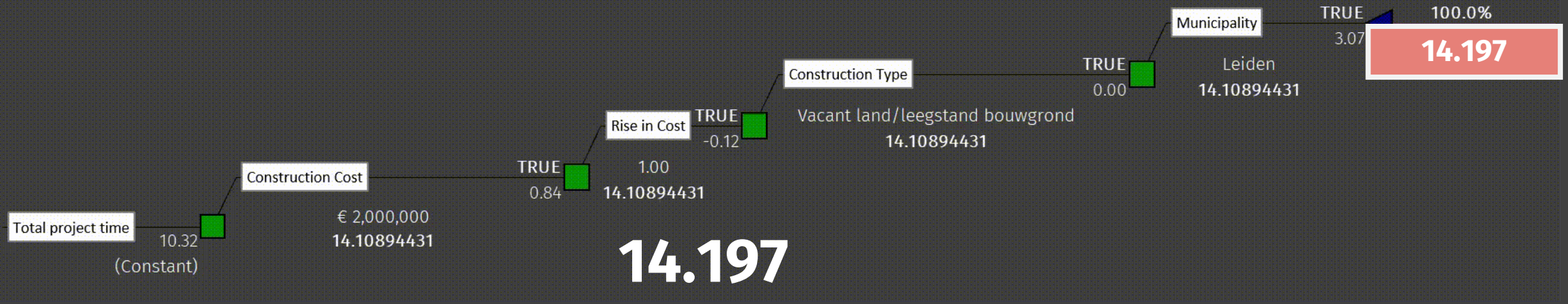


> 8.376

< 19.85

FINDINGS

CAPTURING TIME IN APPRAISAL

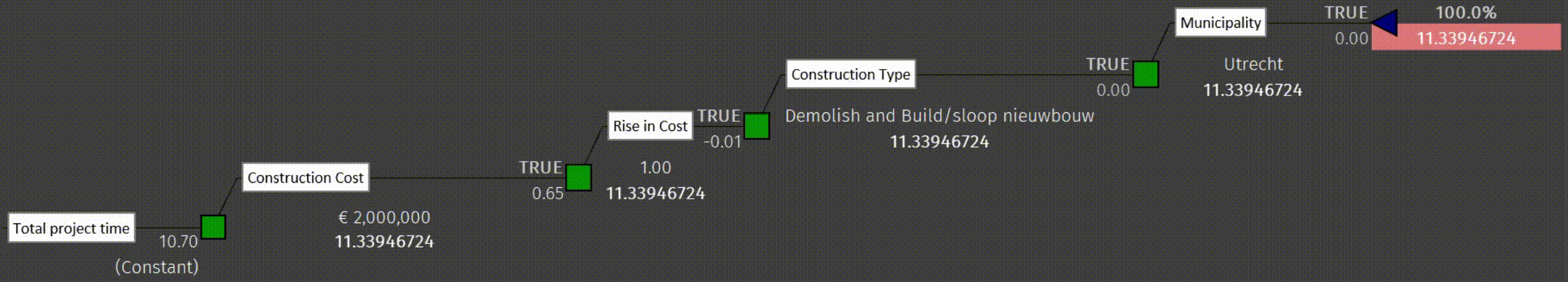
Demolish and Build project “B” in UTRECHT

FINDINGS

CAPTURING TIME IN APPRAISAL

Demolish and Build project “B” in UTRECHT

Inputs	Project characteristics	Input	Weight/gewicht	Standard deviation/ standaardafwijking	Monte Carlo
(Constant)			7.84	2.5090	10.70316968
Construction cost	€ 2,000,000	2.00	0.32	0.0970	0.324500751
Municipality	Utrecht	0	2.80	1.2730	1.206525902
Construction Type	Demolish and Build/sloop nieuwbouw	0	-1.97	0.9570	-4.282222315
Material and labour index	1.00	1	-0.08	0.0390	-0.012703941



FINDINGS

CAPTURING TIME IN APPRAISAL

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Inputs	Project characteristics	Input	Weight/gewicht	Standard deviation/ standaardafwijking	Monte Carlo
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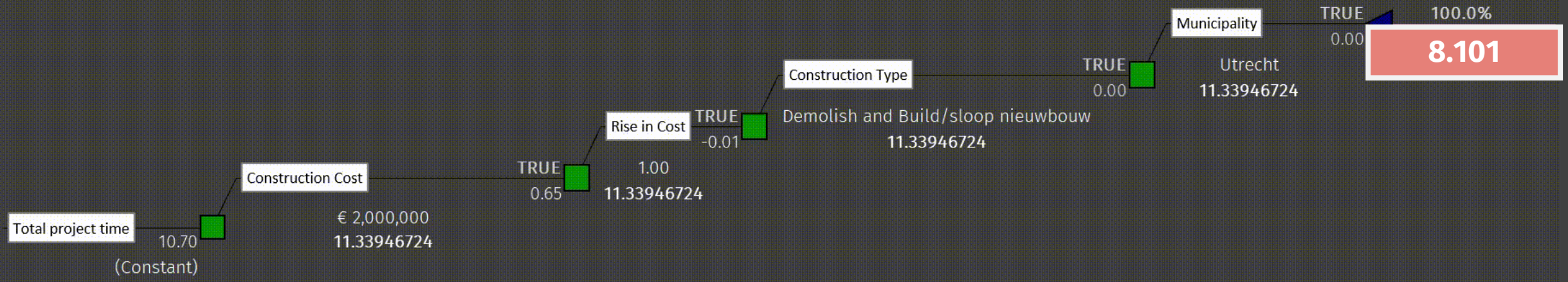

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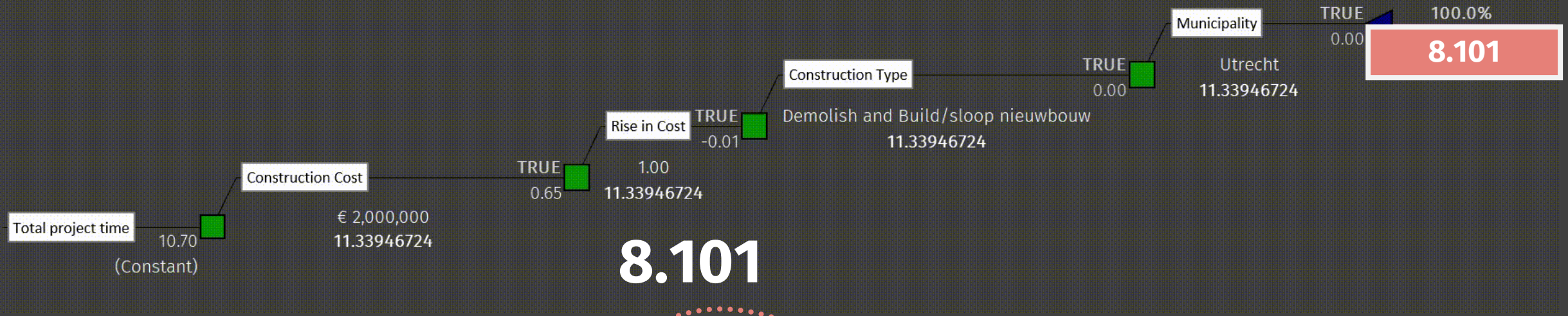

> 4.88

< 11.98

CONCLUSION

CAPTURING TIME IN APPRAISAL

Why is model important?

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Linear relationship between risk indicators and project time

CONCLUSION

CAPTURING TIME IN APPRAISAL

Why is model important?

Linear relationship between risk indicators and project time

Realistic delivery time = realistic financial budgets

CONCLUSION

CAPTURING TIME IN APPRAISAL

Why is model important?

Linear relationship between risk indicators and project time

Realistic delivery time = realistic financial budgets

Resolves over optimism at internal planning level

LIMITATIONS AND FUTURE RESEARCH RECOMMENDATION

LIMITATIONS AND FUTURE RESEARCH RECOMMEND ATION

Qualitative survey use

LIMITATIONS AND FUTURE RESEARCH RECOMMENDATION

Qualitative survey use

Review R^2

LIMITATIONS AND FUTURE RESEARCH RECOMMENDATION

Qualitative survey use

Review R^2

Dataset from 1 HA used

LIMITATIONS AND FUTURE RESEARCH RECOMMENDATION

Qualitative survey use

Review R^2

Dataset from 1 HA used

Sectoral quantitative research

LIMITATIONS AND FUTURE RESEARCH RECOMMENDATION

Qualitative survey use	**Review R^2**	**Dataset from 1 HA used**
Sectoral quantitative research	**Use dataset for more indicators**	

LIMITATIONS AND FUTURE RESEARCH RECOMMENDATION

Qualitative survey use	**Review R^2**	**Dataset from 1 HA used**
Sectoral quantitative research	**Use dataset for more indicators**	**Capture 10,000vhe HA's**

RECOMMEND
ATION

RECOMMEND
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Supervisory bodies

RECOMMEND
ATION

Supervisory bodies

Prioritize indicators that affect time in dPi

RECOMMEND
ATION

Supervisory bodies

Housing Associations

Prioritize indicators that affect time in dPi

RECOMMEND
ATION

Supervisory bodies

Prioritize indicators that affect time in dPi

Housing Associations

Acknowledge time delaying risks

RECOMMEND
ATION

Supervisory bodies	Housing Associations	Ortec Finance
Prioritize indicators that affect time in dPi	**Acknowledge time delaying risks**	

RECOMMEND ATION

Supervisory bodies

Prioritize indicators that affect time in dPi

Housing Associations

Acknowledge time delaying risks

Ortec Finance

Explore datasets for modelling

SUMMARY

Key take aways

Biggest Risks causing delay

Gaps

Solutions

SUMMARY

Key take aways

Biggest Risks causing delay

Permit procedures
(application, objections, legal procedures)
Construction delays
Tendering
Land acquisition
Municipal capacity*
Return Requirements
Building costs rise

Gaps

Solutions

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Solutions

Project indicators of risk

SDTA (MLR + MCS)

CONCLUSION

CONCLUSION

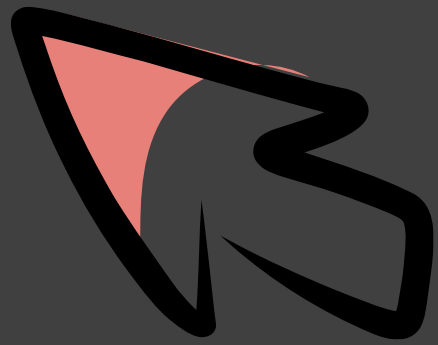
Accurate forecasts =

CONCLUSION

Accurate forecasts = Financial + loss effects

CONCLUSION

Accurate forecasts = Financial + Time loss effects



Thank You