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HOPE PEOPLE PURPOSE PERFORMANCE SUMMIT 2025

IPMA SOUTH AFRICA international project management association

Risk in Numbers

Why Risk Registers Fail?

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UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Department of Engineering and Technology Management

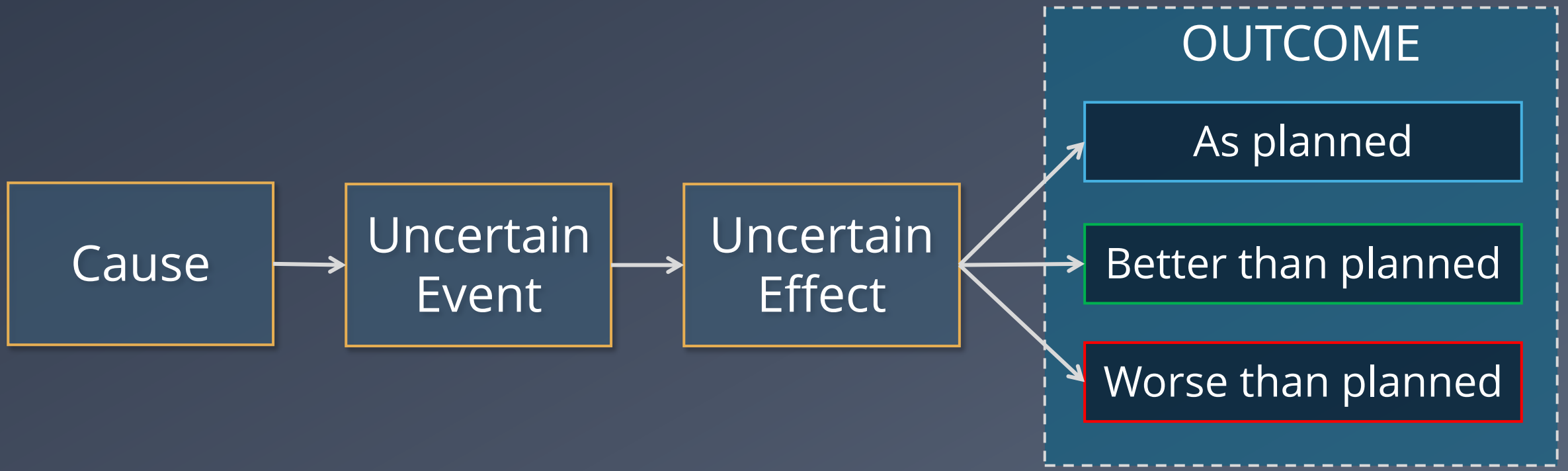
Research is the engine of progress in project management.

Without it, we repeat our mistakes; with it, we build a foundation for more predictable and successful project delivery.

Ignaz Semmelweis

https://www.sciencehistory.org/education/scientific-biographies/ignaz-semmelweis/

WHAT IS RISK?


Cause
Uncertain Event
Uncertain Effect
OUTCOME
As planned
Better than planned
Worse than planned

RISK REGISTERS

Cause	Risk Event	Effect	Rating		Score	Response Actions
			Probability (1-5)	Impact (1-5)	P x I	

Rating	Probability	Descriptor
5	80% to 100%	Almost Certain
4	60% to < 80%	Likely
3	40% to < 60%	Possible
2	20% to < 40%	Unlikely
1	0% to < 20%	Rare

		Impact Categories		
Rating	Descriptor	Cost	Schedule	Health & Safety
		% budget	% duration	
5	Catastrophic	> 5%	> 15%	Multiple fatality Permanent injuries
4	Major	3% to <5%	10% to <15%	Single fatality Multiple LTI
3	Moderate	2% to <3%	5% to <10%	Lost Time Injury
2	Minor	1% to <2%	3% to <5%	Medical treatment Restricted work
1	Low	< 1%	< 3%	First aid injury

		Impact				
		1	2	3	4	5
Probability	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

Decision Framework

	Take immediate mitigation actions.
	Plan actions to actively manage and monitor the risk.
	Monitor the risk as part of standard management processes.

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RESEARCH PROBLEM

Qualitative*	Risk Score = Probability x Impact Risk Score = 3 x 4 = 12
Quantitative*	Expected Loss = 15% x $100,000 = $15,000

1. Do qualitative and quantitative methods produce different risk assessments?
2. If they differ, which method is more accurate?

*Cox, L. A., Jr. (2009). Risk analysis of complex and uncertain systems (Vol. 129). Springer Science & Business Media.

DATA & ANALYSIS

DATA

- Risk Registers from **43** organisations working in mining.
- **91** Projects (infrastructure, buildings, dams, processing facilities).
- **1,144** risks (qualitatively and quantitatively assessed).
- **180** project professionals.

ANALYSIS

- Presentation of risk matrices.
- Score clustering.
- Qualitative vs. Quantitative analysis.
- Calibration and accuracy of professionals.

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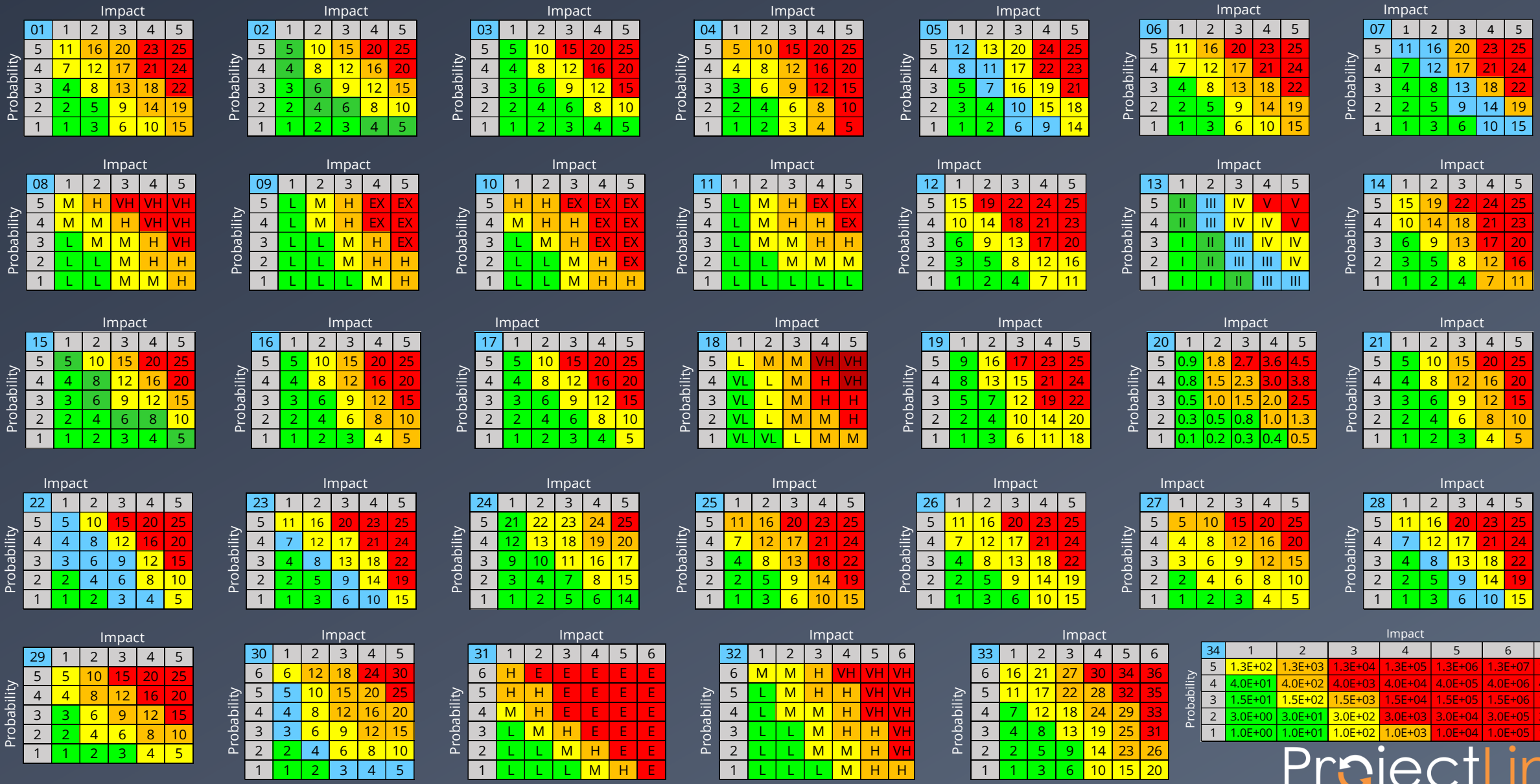
1: RISK MATRICES



01	1	2	3	4	5
5	11	16	20	23	25
4	7	12	17	21	24
3	4	8	13	18	22
2	2	5	9	14	19
1	1	3	6	10	15

02	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

03	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

04	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

05	1	2	3	4	5
5	12	13	20	24	25
4	8	11	17	22	23
3	5	7	16	19	21
2	3	4	10	15	18
1	1	2	6	9	14

06	1	2	3	4	5
5	11	16	20	23	25
4	7	12	17	21	24
3	4	8	13	18	22
2	2	5	9	14	19
1	1	3	6	10	15

07	1	2	3	4	5
5	11	16	20	23	25
4	7	12	17	21	24
3	4	8	13	18	22
2	2	5	9	14	19
1	1	3	6	10	15

08	1	2	3	4	5
5	M	H	VH	VH	VH
4	M	M	H	VH	VH
3	L	M	M	H	VH
2	L	L	M	H	H
1	L	L	M	M	H

09	1	2	3	4	5
5	L	M	H	EX	EX
4	L	M	H	EX	EX
3	L	L	M	H	EX
2	L	L	M	H	H
1	L	L	L	M	H

10	1	2	3	4	5
5	H	H	EX	EX	EX
4	M	H	H	EX	EX
3	L	M	H	EX	EX
2	L	L	M	H	EX
1	L	L	M	H	H

11	1	2	3	4	5
5	L	M	H	EX	EX
4	L	M	H	H	EX
3	L	M	M	H	H
2	L	L	M	M	M
1	L	L	L	L	L

12	1	2	3	4	5
5	15	19	22	24	25
4	10	14	18	21	23
3	6	9	13	17	20
2	3	5	8	12	16
1	1	2	4	7	11

13	1	2	3	4	5
5	II	III	IV	V	V
4	II	III	IV	IV	V
3	I	II	III	IV	IV
2	I	II	III	III	IV
1	I	I	II	III	III

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1	1	2	4	7	11

15	1	2	3	4	5
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3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

16	1	2	3	4	5
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4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

17	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

18	1	2	3	4	5
5	L	M	M	VH	VH
4	VL	L	M	H	VH
3	VL	L	M	H	H
2	VL	L	M	M	H
1	VL	VL	L	M	M

19	1	2	3	4	5
5	9	16	17	23	25
4	8	13	15	21	24
3	5	7	12	19	22
2	2	4	10	14	20
1	1	3	6	11	18

20	1	2	3	4	5
5	0.9	1.8	2.7	3.6	4.5
4	0.8	1.5	2.3	3.0	3.8
3	0.5	1.0	1.5	2.0	2.5
2	0.3	0.5	0.8	1.0	1.3
1	0.1	0.2	0.3	0.4	0.5

21	1	2	3	4	5
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3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

22	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

23	1	2	3	4	5
5	11	16	20	23	25
4	7	12	17	21	24
3	4	8	13	18	22
2	2	5	9	14	19
1	1	3	6	10	15

24	1	2	3	4	5
5	21	22	23	24	25
4	12	13	18	19	20
3	9	10	11	16	17
2	3	4	7	8	15
1	1	2	5	6	14

25	1	2	3	4	5
5	11	16	20	23	25
4	7	12	17	21	24
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2	2	5	9	14	19
1	1	3	6	10	15

26	1	2	3	4	5
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3	4	8	13	18	22
2	2	5	9	14	19
1	1	3	6	10	15

27	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

28	1	2	3	4	5
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4	7	12	17	21	24
3	4	8	13	18	22
2	2	5	9	14	19
1	1	3	6	10	15

29	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

30	1	2	3	4	5
6	6	12	18	24	30
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

31	1	2	3	4	5	6
6	H	E	E	E	E	E
5	H	H	E	E	E	E
4	M	H	E	E	E	E
3	L	M	H	E	E	E
2	L	L	M	H	E	E
1	L	L	L	M	H	E

32	1	2	3	4	5	6
6	M	M	H	VH	VH	VH
5	L	M	H	H	VH	VH
4	L	M	M	H	VH	VH
3	L	L	M	H	H	VH
2	L	L	M	M	H	VH
1	L	L	L	M	H	H

33	1	2	3	4	5	6
6	16	21	27	30	34	36
5	11	17	22	28	32	35
4	7	12	18	24	29	33
3	4	8	13	19	25	31
2	2	5	9	14	23	26
1	1	3	6	10	15	20

34	1	2	3	4	5	6	7
5	1.3E+02	1.3E+03	1.3E+04	1.3E+05	1.3E+06	1.3E+07	1.3E+08
4	4.0E+01	4.0E+02	4.0E+03	4.0E+04	4.0E+05	4.0E+06	4.0E+07
3	1.5E+01	1.5E+02	1.5E+03	1.5E+04	1.5E+05	1.5E+06	1.5E+07
2	3.0E+00	3.0E+01	3.0E+02	3.0E+03	3.0E+04	3.0E+05	3.0E+06
1	1.0E+00	1.0E+01	1.0E+02	1.0E+03	1.0E+04	1.0E+05	1.0E+06

Cox, L.A., Jr., 2008. *What's wrong with risk matrices?* Risk Analysis: An International Journal, 28, 497–512.

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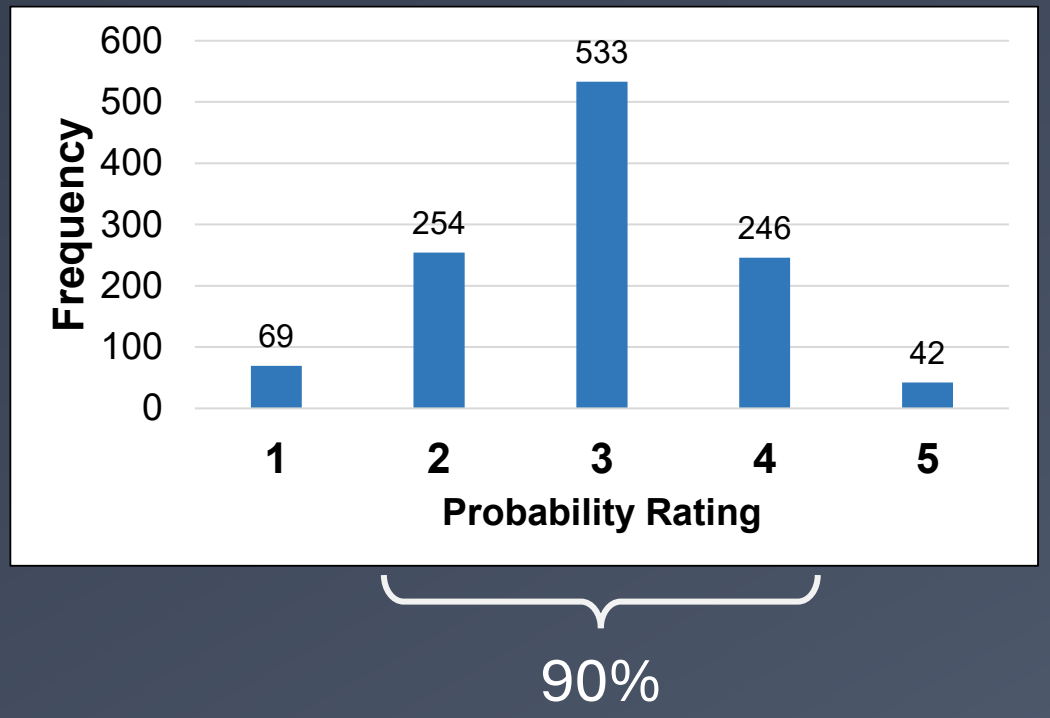
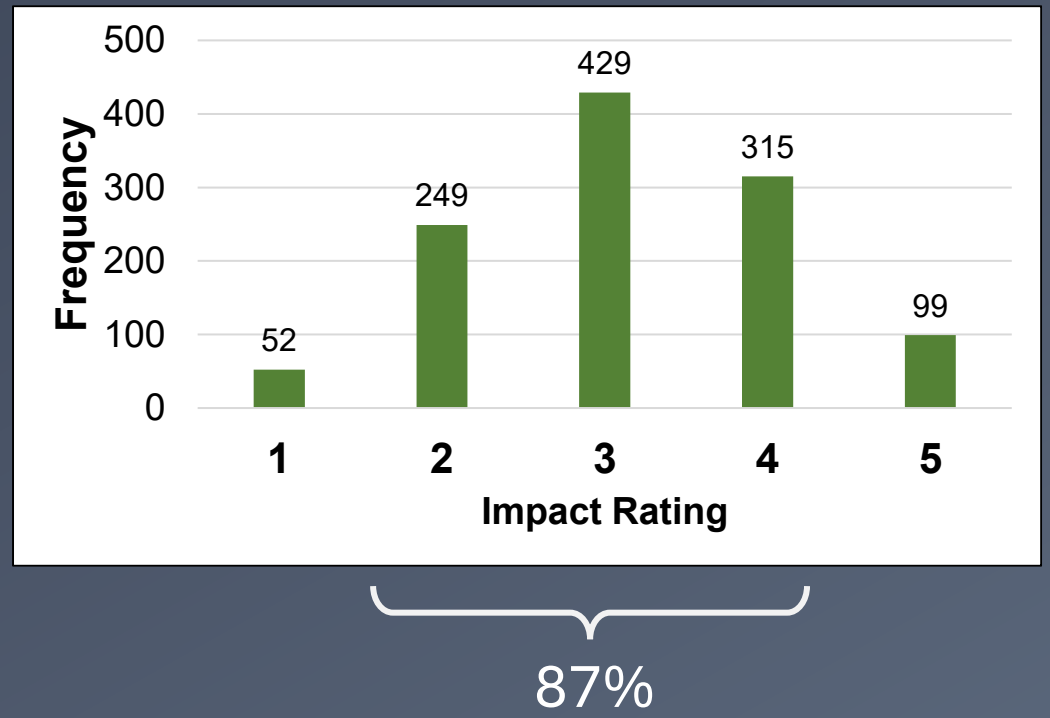
2: SCORE CLUSTERING

Qualitative Risk Assessment Ratings and Scores





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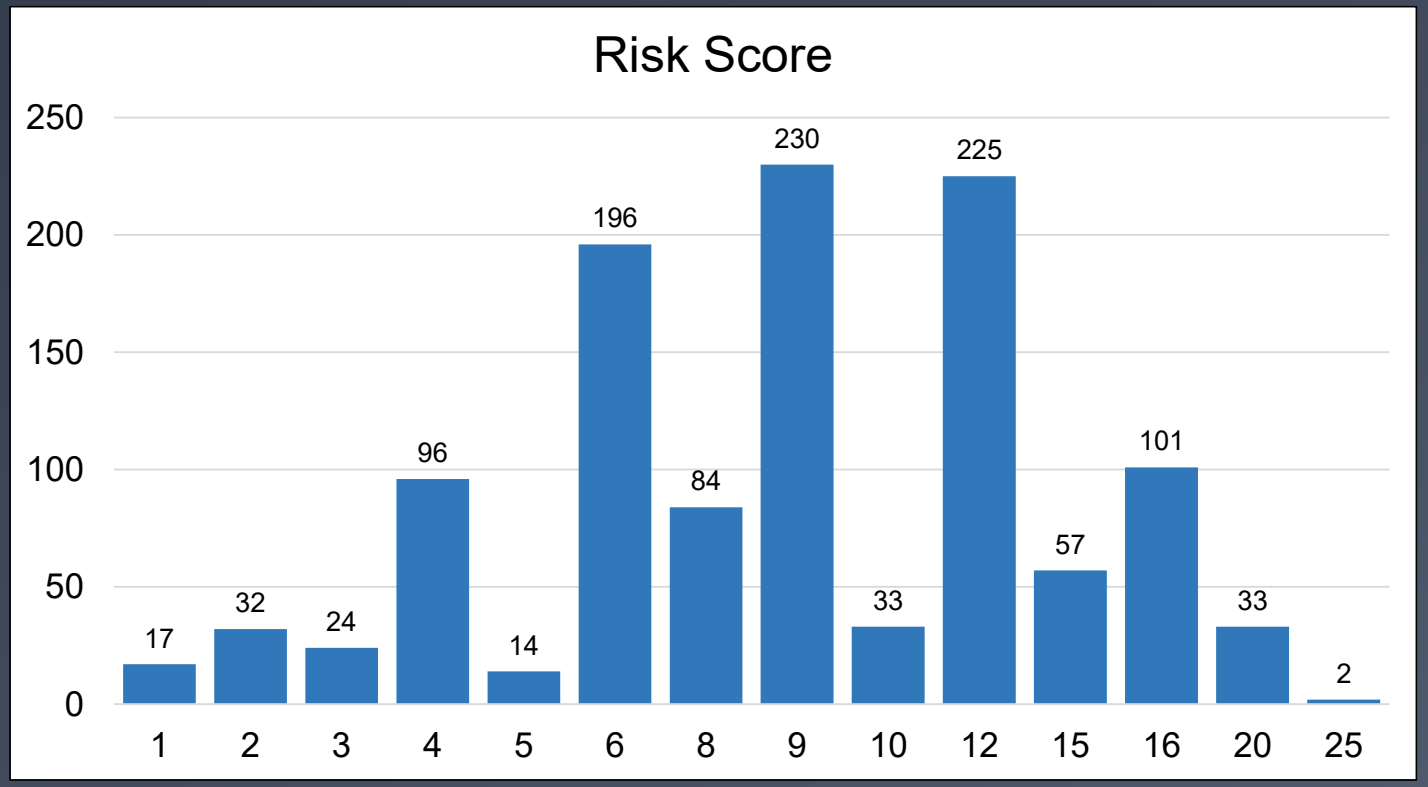
2: SCORE CLUSTERING

Qualitative Risk Assessment Ratings and Scores



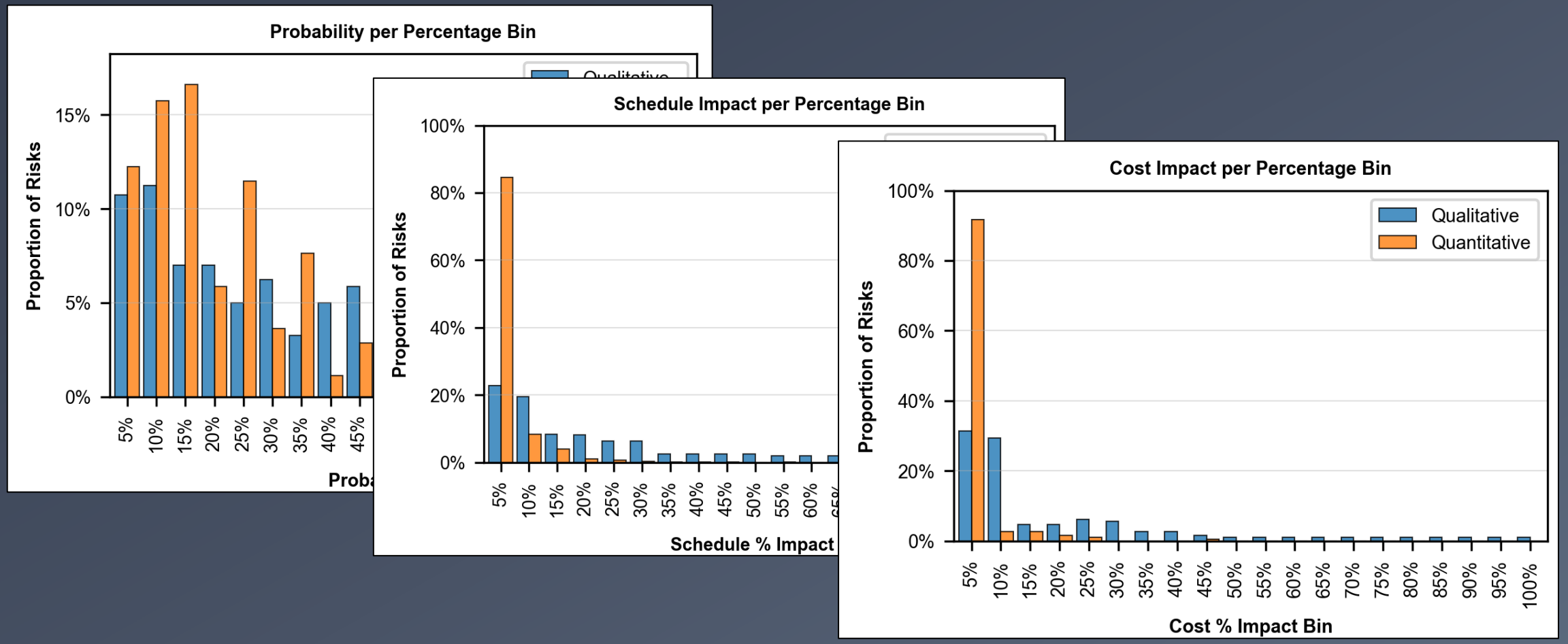
Probability \ Impact	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	74%	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Crosetto, P., Filippin, A., Katuščák, P., Smith, J., 2020. *Central tendency bias in belief elicitation.* Journal of Economic Psychology, 78, 102273.

Hubbard, D., Evans, D., *2010. Problems with scoring methods and ordinal scales in risk assessment.* IBM Journal of Research and Development, 54, 2:1–2:10

3: QUALITATIVE VS. QUANTITATIVE

Qualitative and Quantitative Probability and Impact Assessments



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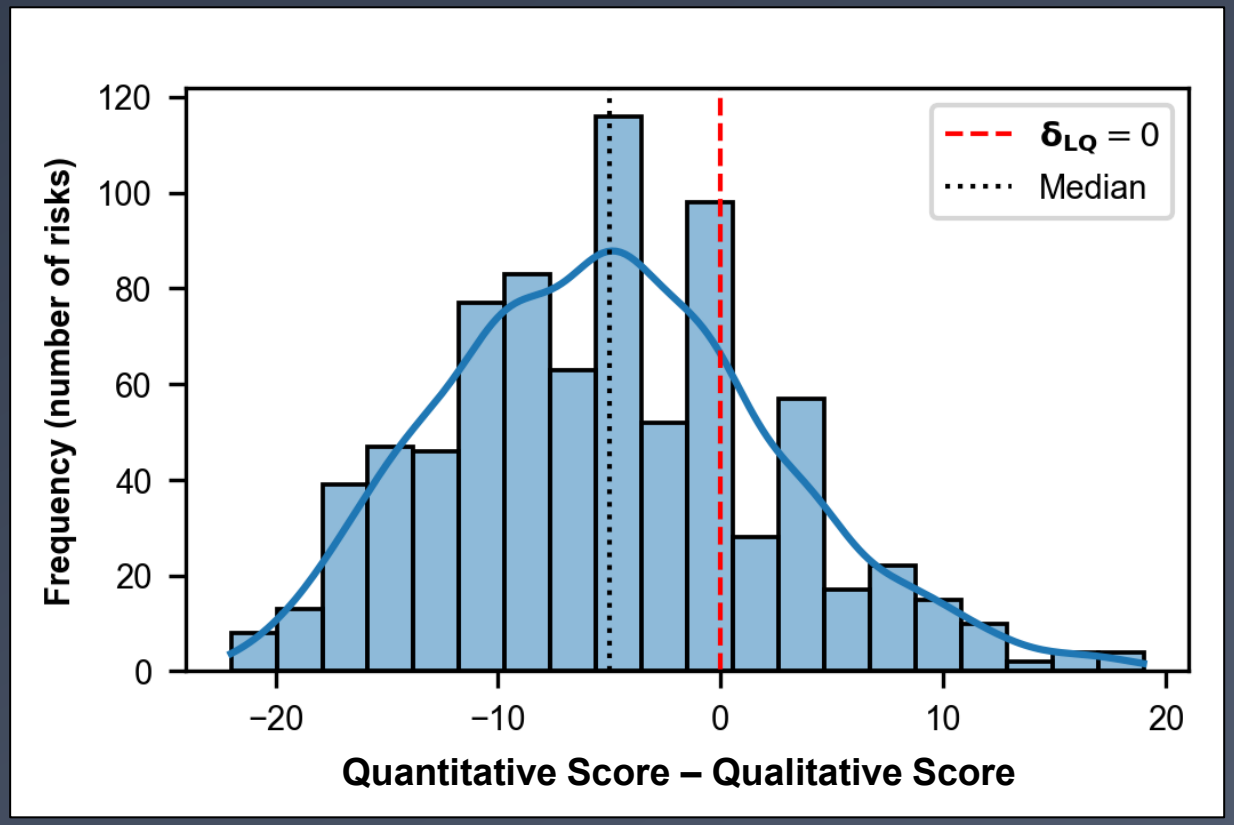
3: QUALITATIVE VS. QUANTITATIVE

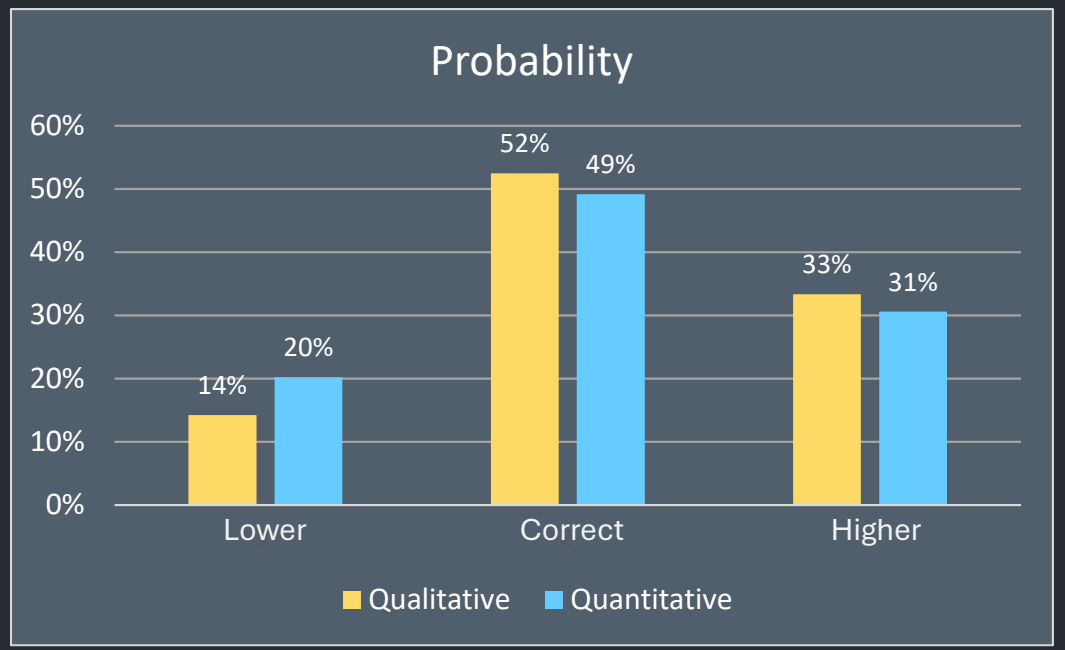
Comparison of Qualitative and Quantitative Risk Scores

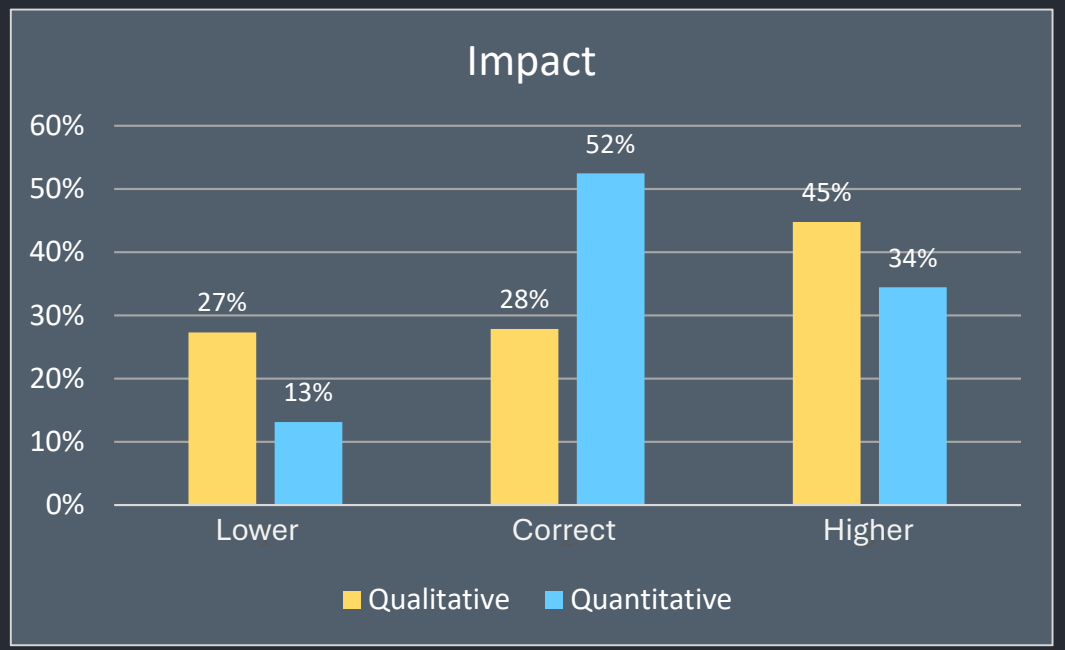


Condition	Count	%
Quant > Qual	242	21%
Quant = Qual	79	7%
Quant < Qual	823	72%

4: CALIBRATION

Accuracy of Qualitative vs Quantitative Assessments





N=180

Bruine de Bruin, W., Carman, K.G., 2018. *Measuring subjective probabilities: The effect of response mode on the use of focal responses, validity, and respondents' evaluations.* Risk analysis, 38, 2128–2143.

Erev, I., Cohen, B.L., 1990. *Verbal versus numerical probabilities: Efficiency, biases, and the preference paradox.* Organizational Behavior and Human Decision Processes, 45, 1–18.

Keren, G., 1991. *Calibration and probability judgements: Conceptual and methodological issues*. Acta psychologica, 77, 217–273.

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KEY INSIGHTS

RISK MATRICES

- Inconsistent colour coding
- Unscientific design
- Score clustering
- Risk exposure (cost, delay) is not visible
- Poor basis for project decision making

QUAL VS QUANT

- Qualitative **probabilities** are somewhat overstated
- Qualitative **impacts** are substantially overstated
- Quantitative assessments are more **accurate**

QUALITATIVE ASSESSMENT

Project	Cause	Risk Event	Impact
Duration: 100 days Cost: $1,000,000	Computer chip shortage	Equipment shipping delay	**Time:** Late project completion **Cost:** Standing time and penalties

Probability	Time Impact	Cost Impact
Risk of shipping delay is 35%.	If the risk occurs, it could delay installation by 15 days.	Standing time: $1,000 per day Penalties: $2,000 per day Total Cost: $3,000 per day Risk Cost: $45,000

WHAT SHOULD WE CHANGE?

QUANTITATIVE APPROACH

1. Use numbers instead of labels.
2. Use ranges for probability and impact.
3. Use probability distributions instead of categories.
4. Use simulation to get a risk a distribution of outcomes.

QUANTITATIVE APPROACH

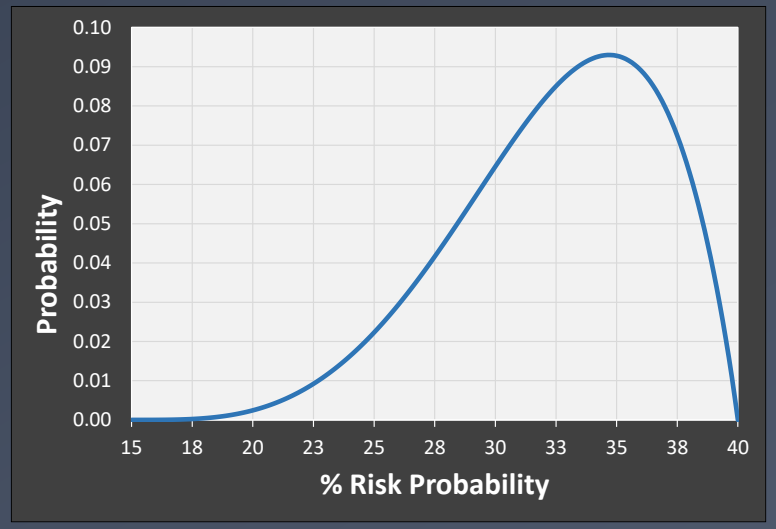
Project

Duration: 100 days
Cost: $1,000,000

Cause	Risk Event	Impact
Computer chip shortage	Equipment shipping delay	**Time:** Late project completion **Cost:** Standing time and penalties

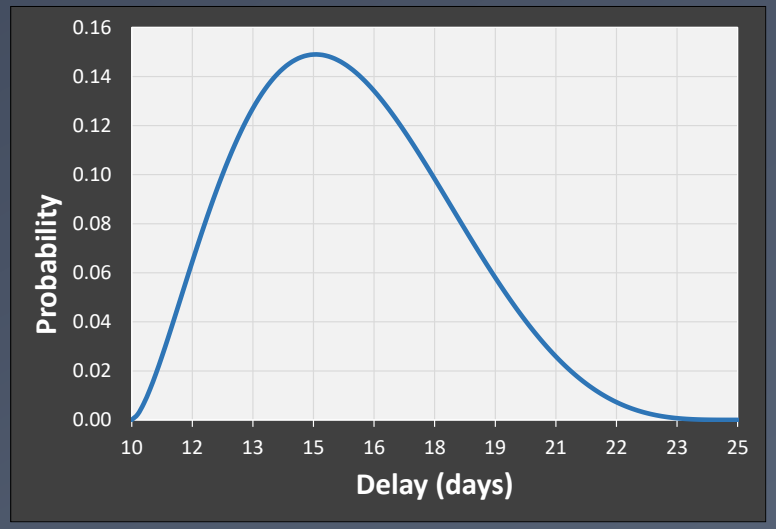
Probability

The probability of a shipping delay is between 15% and 40%, but 35% is most likely.



Time Impact

If the risk occurs, it could delay installation by 10 to 25 days, but most likely 15 days.



Cost Impact

Standing time: $1,000 per day
Penalties: $2,000 per day
Total Cost: $3,000 per day
Risk Cost: $30,000 to $75,000

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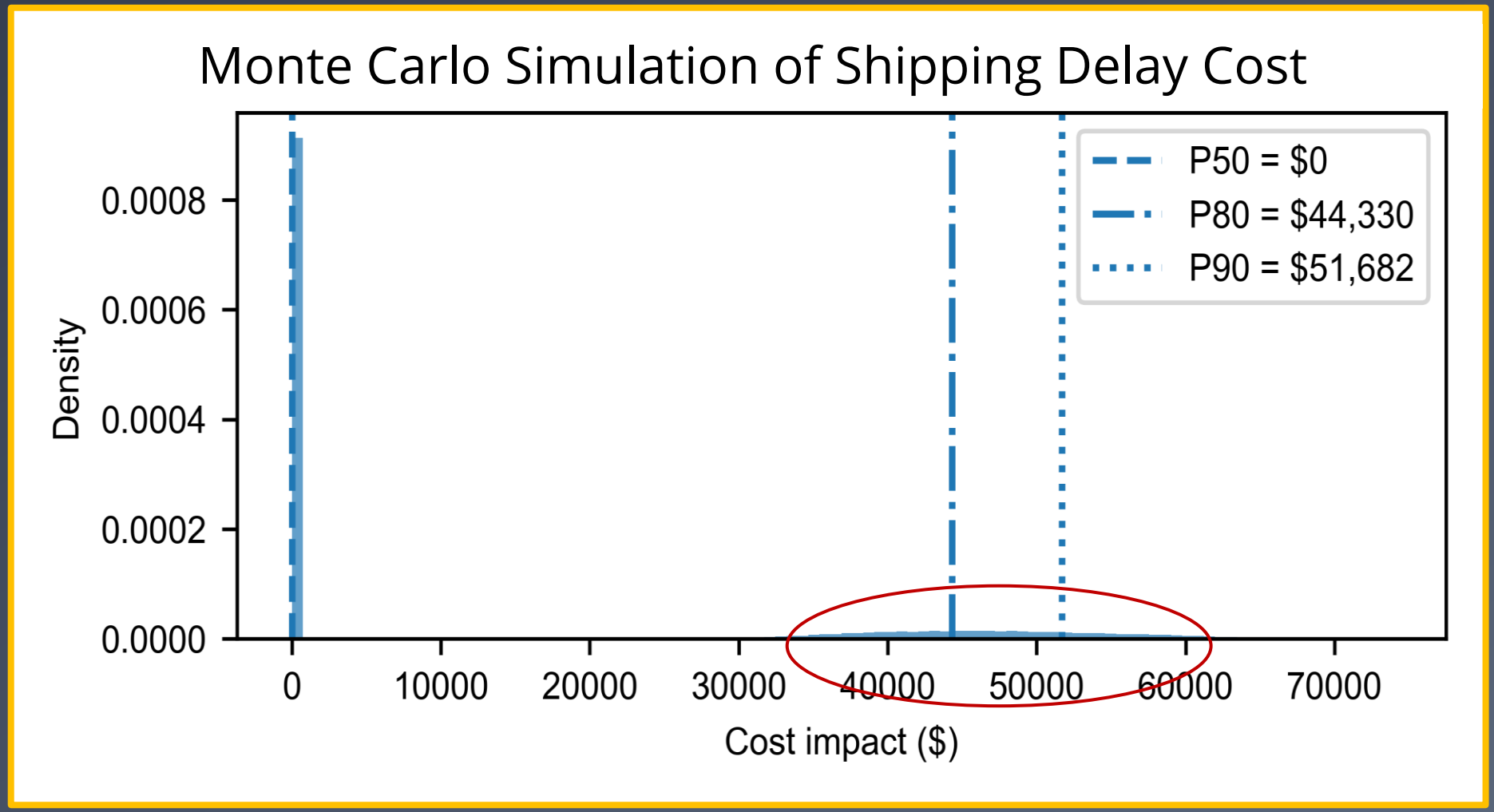
QUANTITATIVE APPROACH



Please support my research:

How Risks Are Judged

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Department of Engineering and Technology Management

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