

The value of flexibility in baseball roster construction

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Introduction

- Inspired by theory of production flexibility in manufacturing networks
 - Players → factories
 - Innings at each position → products
- Our goal: quantify the value of positional flexibility in the presence of injury risk
 - In both average-case and worst-case settings



Flexibility chaining (May 2, 2012)

- B.J. Upton removed from CF (quad tightness)
- Desmond Jennings moves from LF to CF
- Matt Joyce moves from RF to LF
- Ben Zobrist moves from 2B to RF
- Will Rhymes moves from 3B to 2B
- Sean Rodriguez moves from SS to 3B
- Elliot Johnson replaces B.J. Upton, playing SS



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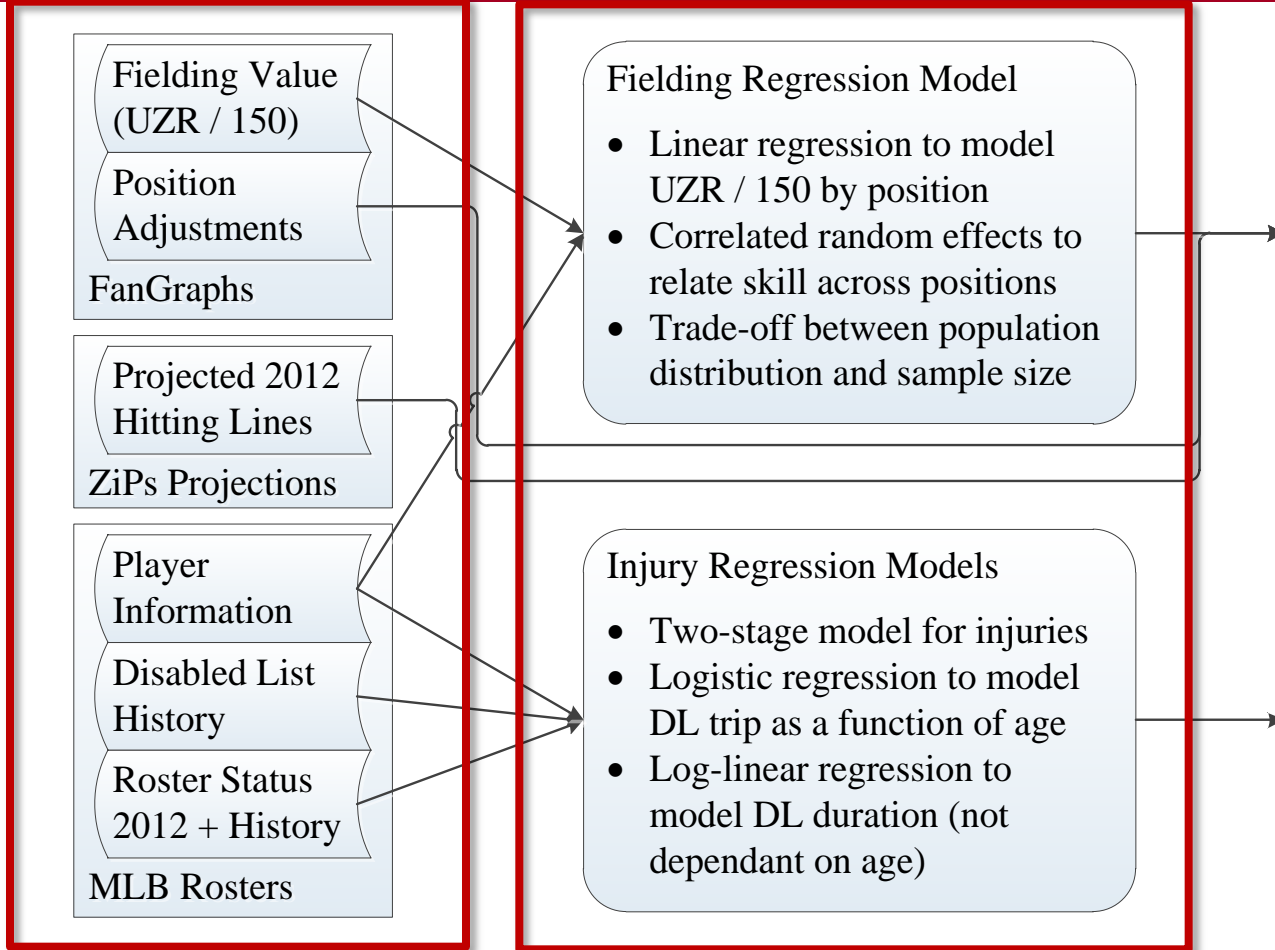
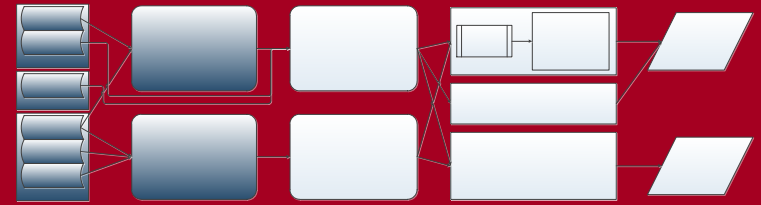
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Contributions

- Novel statistical models for assessing:
 1. Injury risk by age, and
 2. Fielding skill across multiple positions
- Optimization models of player-to-position assignment to determine value of flexibility
 - Simulation-optimization (average-case)
 - Robust optimization (worst-case)
 - First optimization-based analysis of flexibility



Method, part 1



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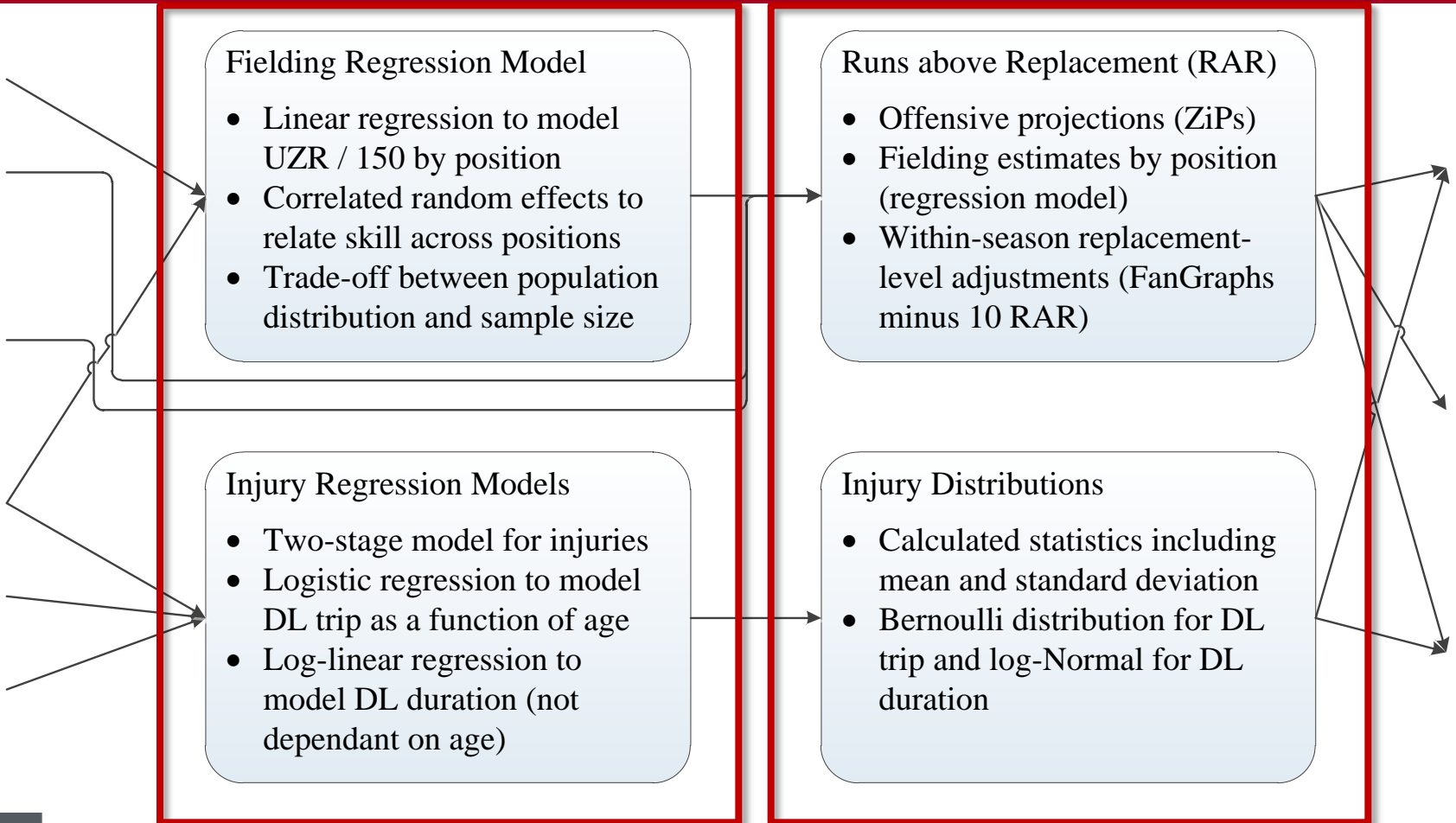
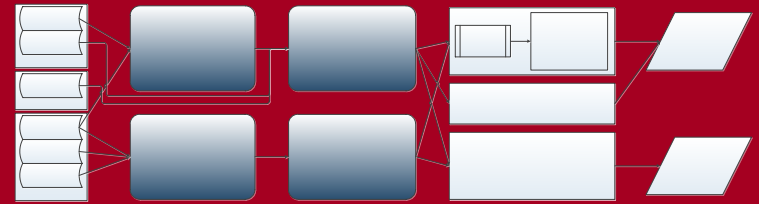
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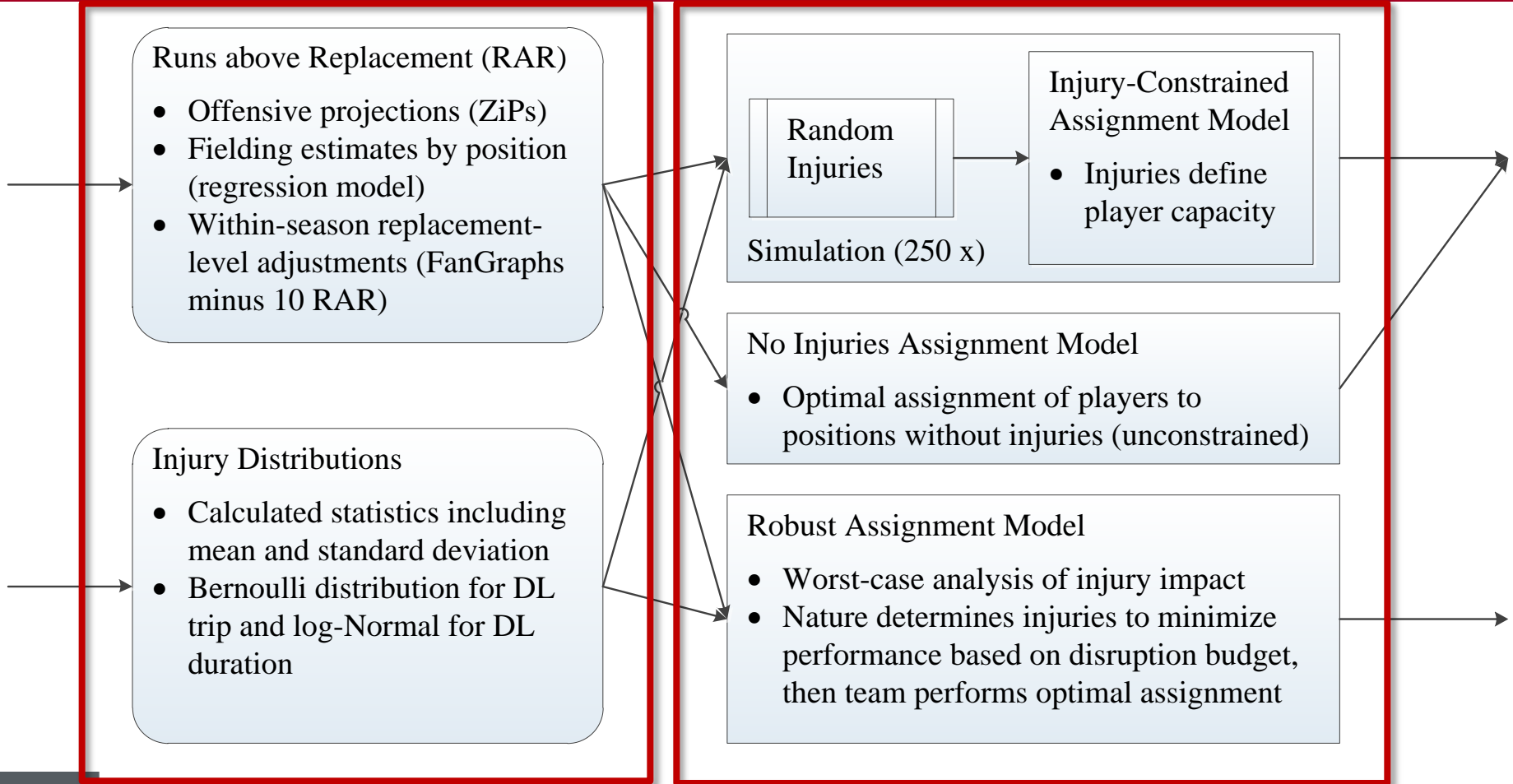
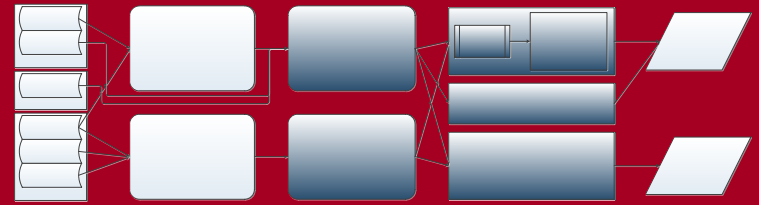
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Method, part 2



Method, part 3



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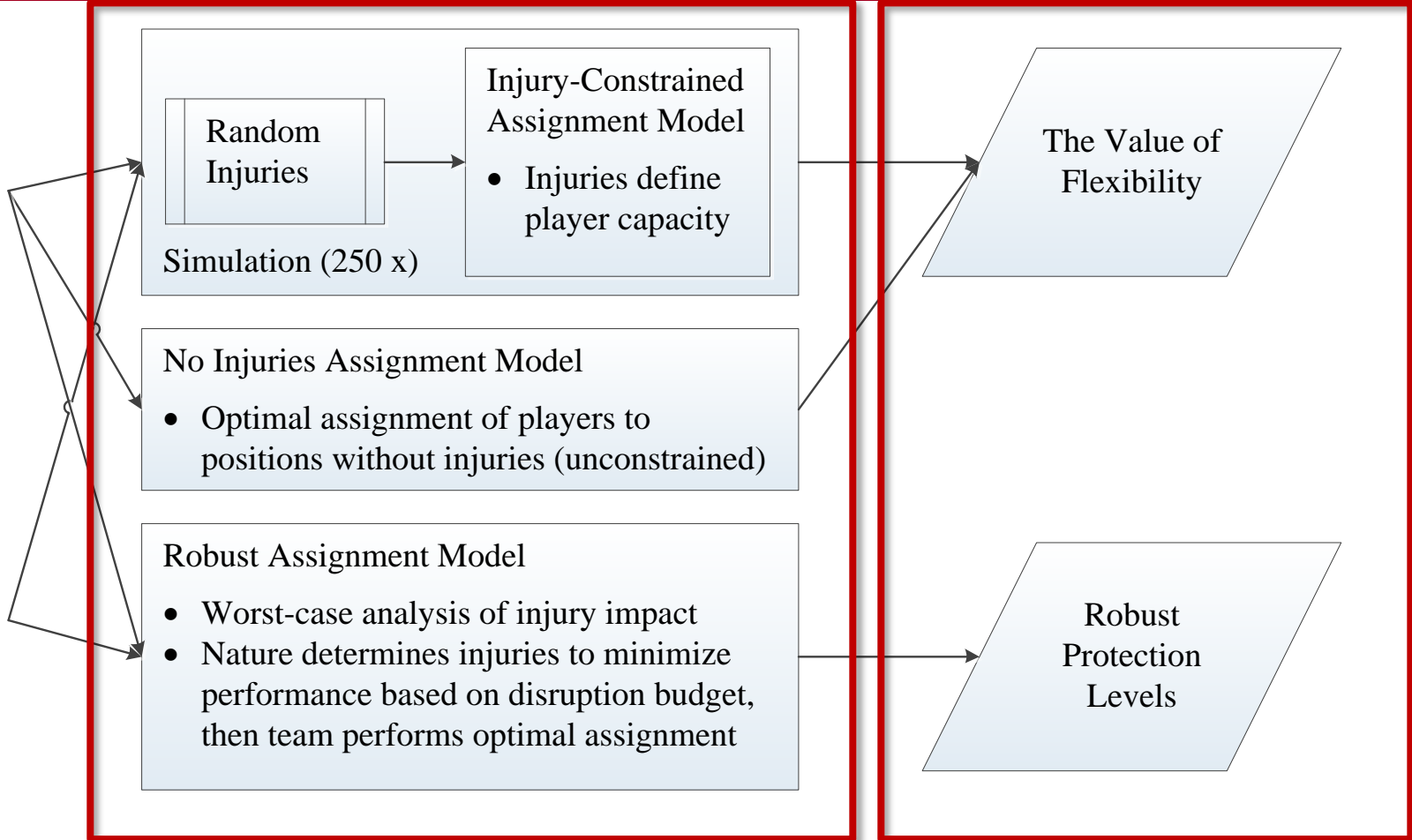
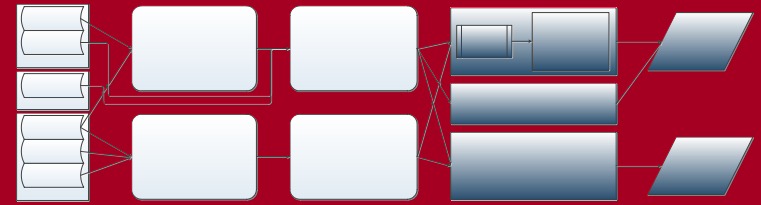
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Method, part 4



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Dodgers – the value of platooning

	No flexibility	RAR	With flexibility	RAR
A.J. Ellis	C (0.25/0.60)	17.9	C (0.25/0.60)	29.4
T. Federowicz	C (0.04/0.11)	1.4	C (0.04)	4.7
J. Loney	1B (0.30/0.70)	10.5	1B (0.70)	12.8
A. Kennedy	2B (0.30/0.70)	13.0	2B (0.70)	17.4
J. Uribe	3B (0.30/0.70)	22.9	3B (0.30/0.70)	14.6
J. Hairston	SS (0.30/0.70)	18.5	SS (0.30/0.70)	28.9
A. Ethier	LF (0.30/0.70)	23.6	LF (0.70)	20.7
M. Kemp	CF (0.30/0.70)	38.0	CF (0.30/0.70)	10.1
T. Gwynn	RF (0.30/0.70)	25.5	RF (0.70); LF (0.30)	15.4
M. Treanor			C (0.11)	2.3
J. Rivera			1B (0.30)	9.6
M. Ellis			2B (0.30)	7.1
J. Sands			RF (0.30)	5.8



Cubs – the value of flexibility

	No flexibility	RAR	With flexibility	RAR
G. Soto	C (0.21/0.49)	28.8	C (0.21/0.50)	29.4
S. Clevenger	C (0.08/0.19)	6.1	C (0.01/0.18)	4.7
A. Rizzo	1B (0.24/0.57)	12.4	1B (0.25/0.59)	12.8
B. DeWitt	2B (0.25/0.58)	16.7	2B (0.04/0.58); 3B (0.21/0.02)	17.4
I. Stewart	3B (0.25/0.60)	18.6	3B (0.08/0.46); 2B (0.08); SS (0.05)	14.6
S. Castro	SS (0.26/0.61)	28.4	SS (0.26/0.60)	28.9
D. DeJesus	LF (0.24/0.56)	24.5	LF (0.01/0.57); RF (0.07/0.02)	20.7
D. Sappelt	CF (0.24/0.56)	15.2	CF (0.25/0.24)	10.1
M. Byrd	RF (0.24/0.56)	15.6	RF (0.22/0.54); CF (0.01/0.01)	15.4
W. Castillo			C (0.08/0.02)	2.3
A. Soriano			LF (0.21/0.12)	9.6
B. LaHair			3B (0.22); 1B (0.01/0.10); RF (0.03)	7.1
J. Baker			2B (0.25); RF (0.01)	5.8
L. Valbuena			2B (0.04)	0.5
D. Barney			SS (0.04/0.04); 2B (0.01/0.01)	1.5
R. Johnson			LF (0.08); CF (0.03)	3.2
T. Campana			CF (0.44); RF (0.11); LF (0.01)	12.7

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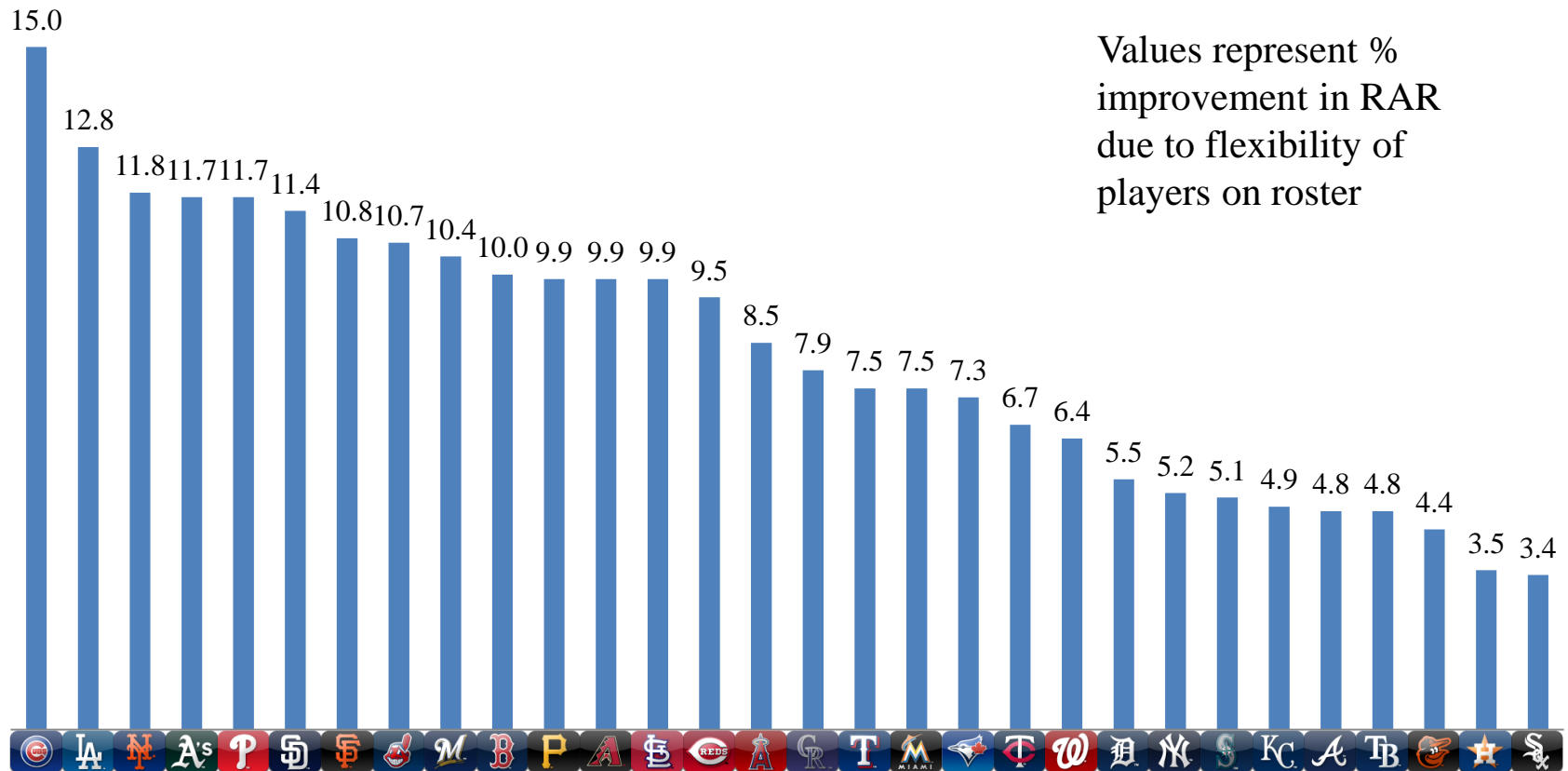
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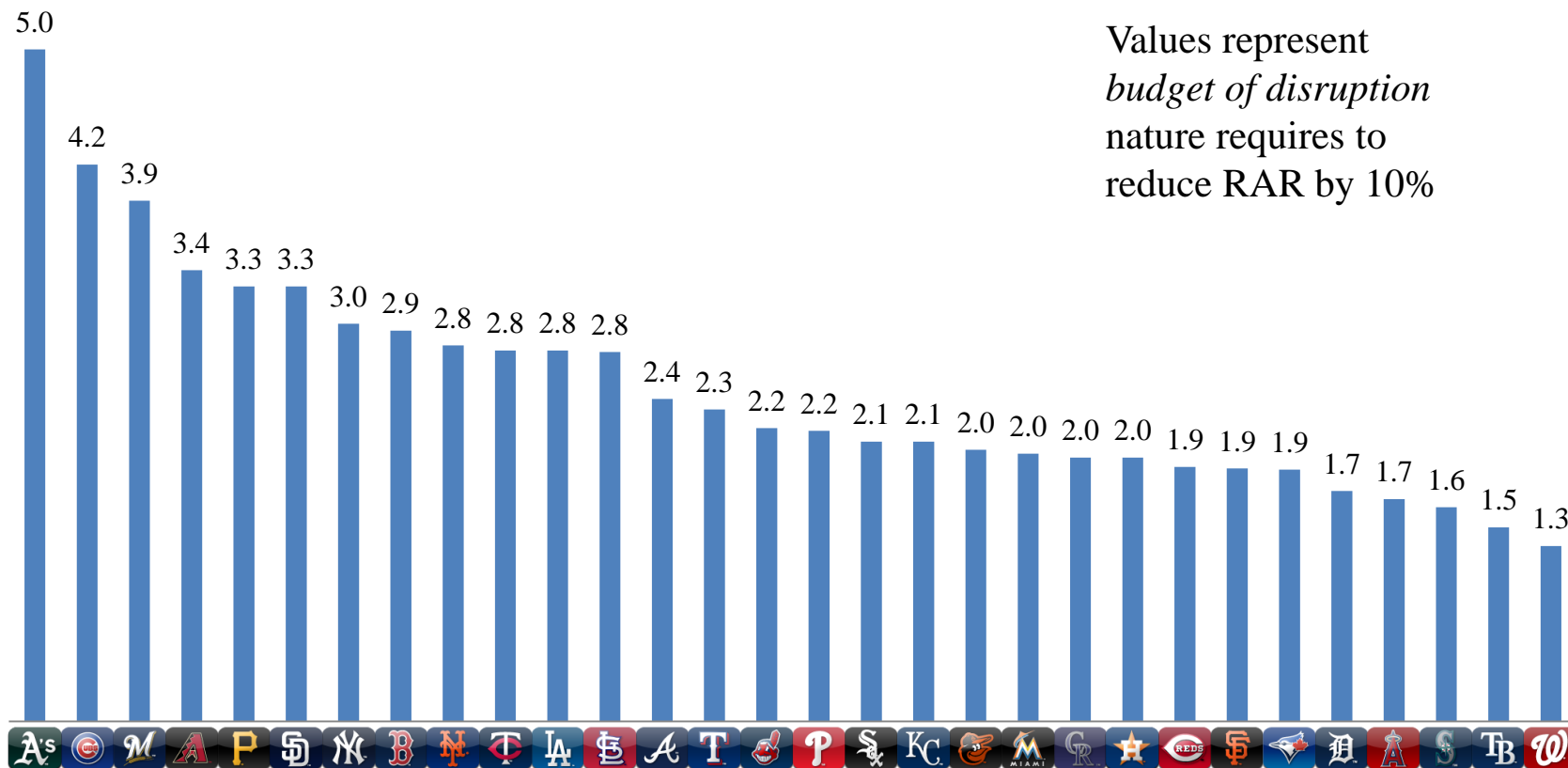


Value of flexibility



Robust 10% protection levels

Values represent
budget of disruption
nature requires to
reduce RAR by 10%



Conclusions

- Risk of injury depends significantly on age
 - But, injury duration does not
- Significant variation across teams
 - In value of flexibility and protection levels
- Flexibility and team balance both provide protection against worst-case injuries
- Our approach can help teams identify how to best add flexibility to their roster

