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Freight Vehicle Fleet Changes and Track Twist Derailment History

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Freight Vehicle Fleet Trends

Fleet Analysis - Introduction

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- Current (2013) fleet data: RSL
  - Identifies wheelbase, suspension type etc.
  - Care required in interpreting (no. axles etc)
  - Includes internationally registered vehicles
  - Some CARKNDS have many variants
- 1999 fleet data: paper records/books
  - Adequate but must be treated with caution
  - Some types missing, some only 1989 values
  - Max / min values for 1999 fleet derived

Fleet Summary

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		2-Axle	Bogie	Total	% Bogie
Total Fleet Size	2013	9841	21921	31762	69%
	1999 Min	24553	12155	36708	33%
	1999 Max	33459	14821	48280	31%
New build since 1999		1250	10500	11750	89%

- Fleet size reduced by ≈25%
- Bogie wagons were ⅓ of fleet, now ⅔ of fleet
  - Probably account for >90% of tonnage
- 70% of two-axle wagons withdrawn/scrapped in period
- 89% of new build is bogie wagons
  - But new 2-axle vehicles still being built/registered

Two-Axle Wagons by Wheelbase

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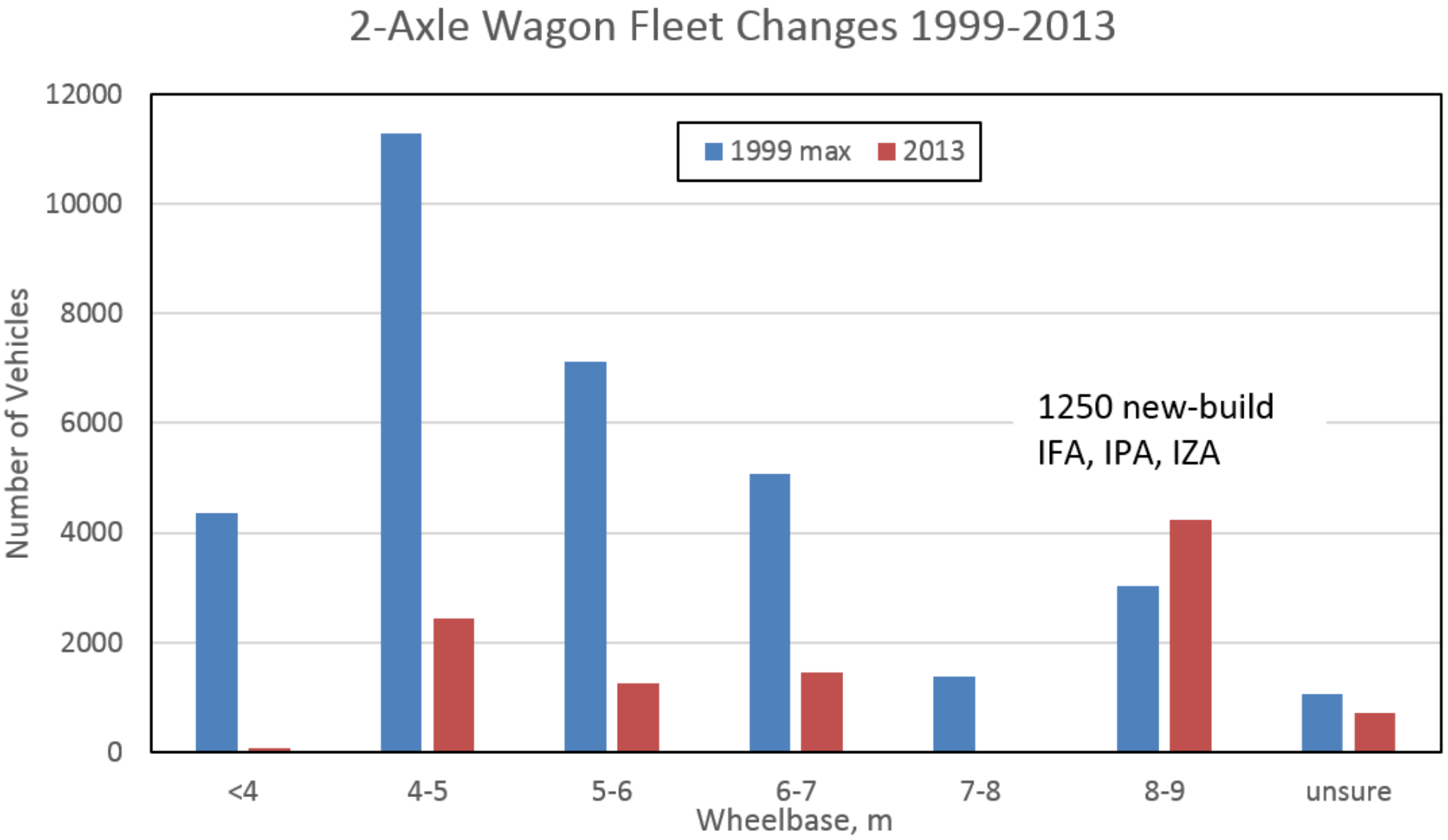

Bogie Wagons by Wheelbase

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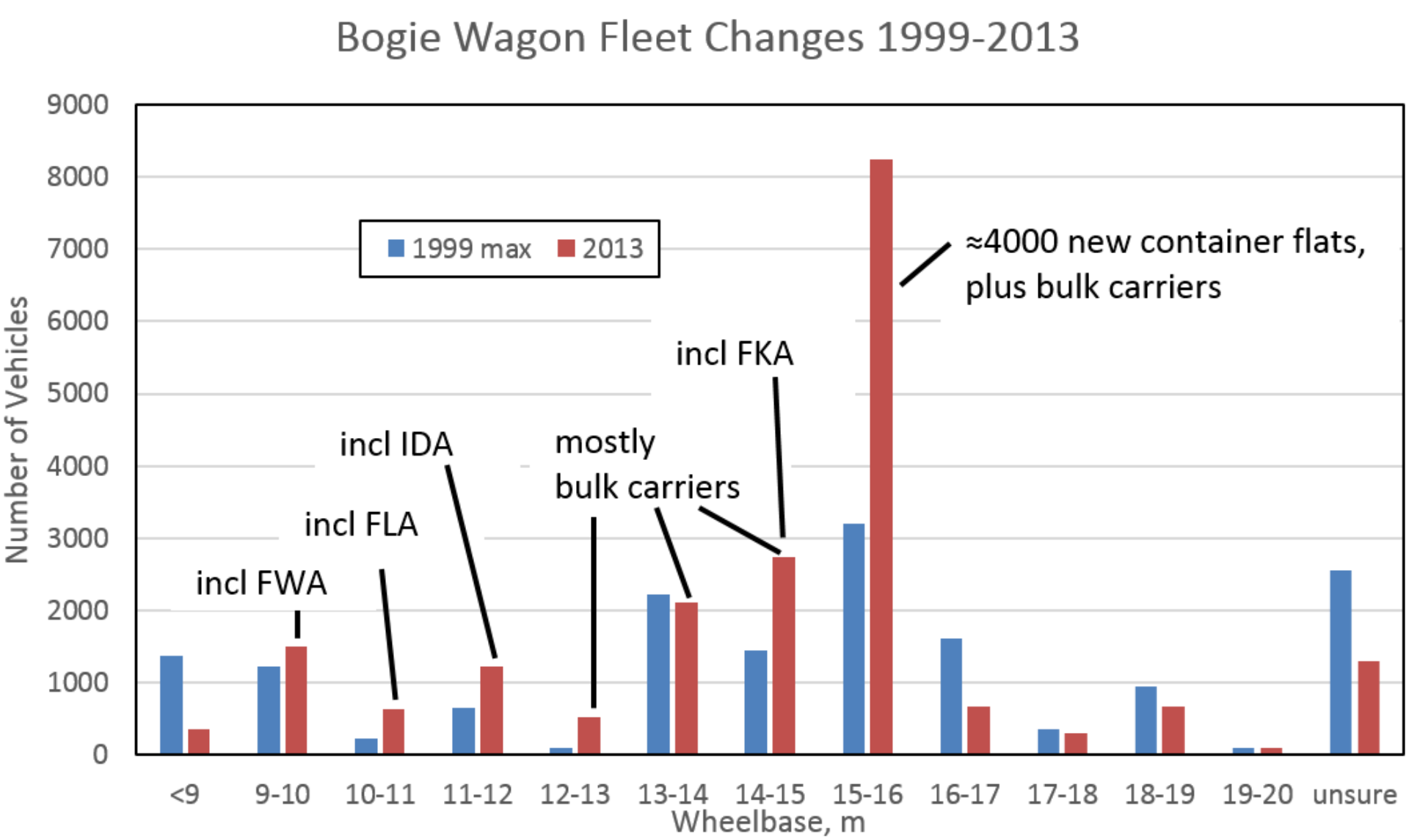

Fleet - Conclusions

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- Two-axle vehicle fleet has shrunk by ⅔ since 1999
  - But still represents ⅓ of total fleet
  - 9m wheelbase wagons have *increased* in number
  - Suspensions mostly Brűnnighaus leaf springs and links
  - Pedestal and HAA type suspensions also significant
- Bogie wagons now dominate the fleet
  - Comprise ≈90% of new-build wagons
  - Mostly Y-series bogies
  - Wide range of other bogie types also significant
- ≈35% of bogie wagon fleet is container flats
  - Intermodal fleet size has ≈doubled from 1999 to 2013
  - Intermodal ton-miles ≈doubled from 2002 to 2014

Track Twist Derailment History

‘All’ Running Line Derailments

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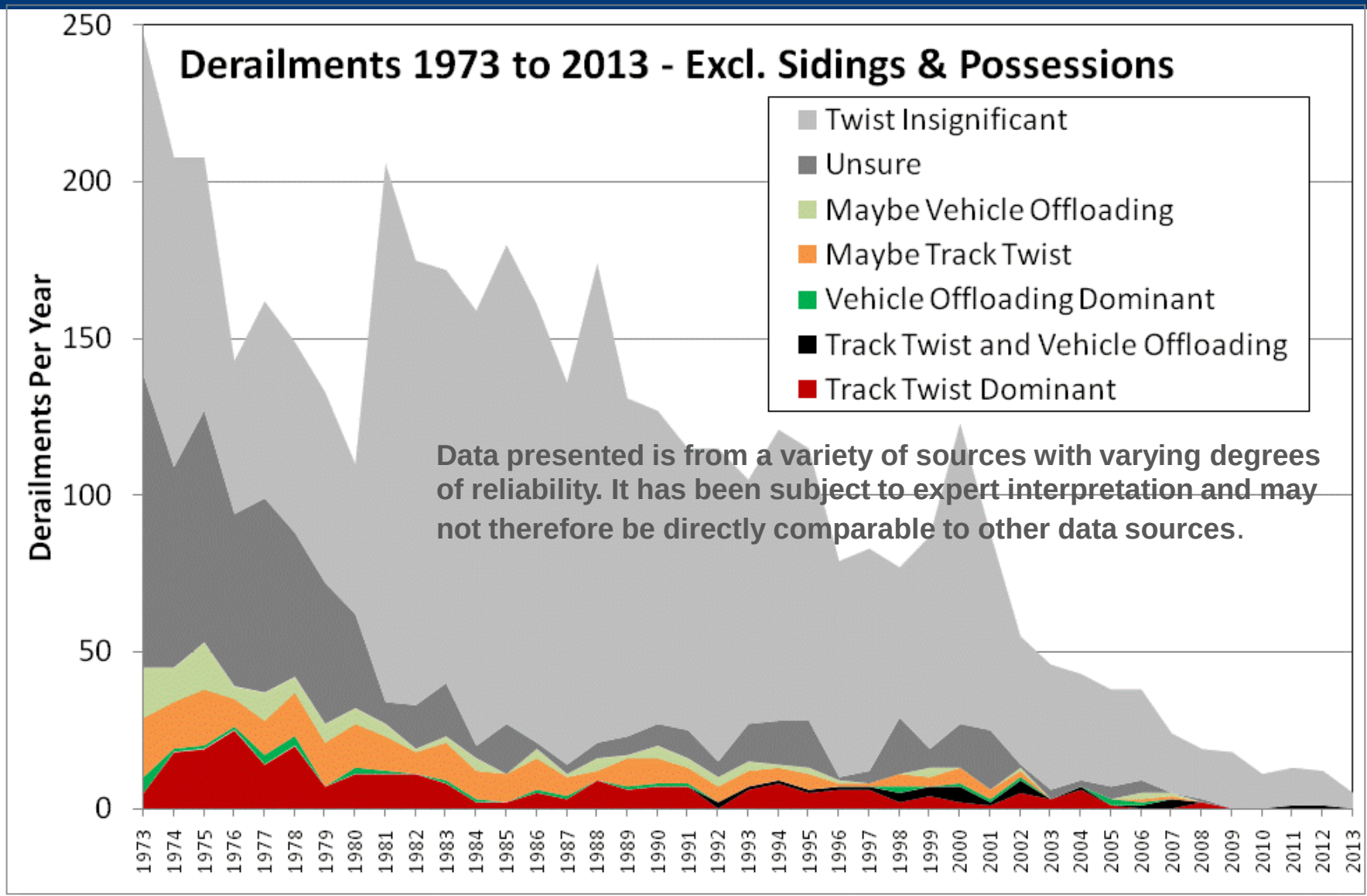

Track/Vehicle Twist Derailments

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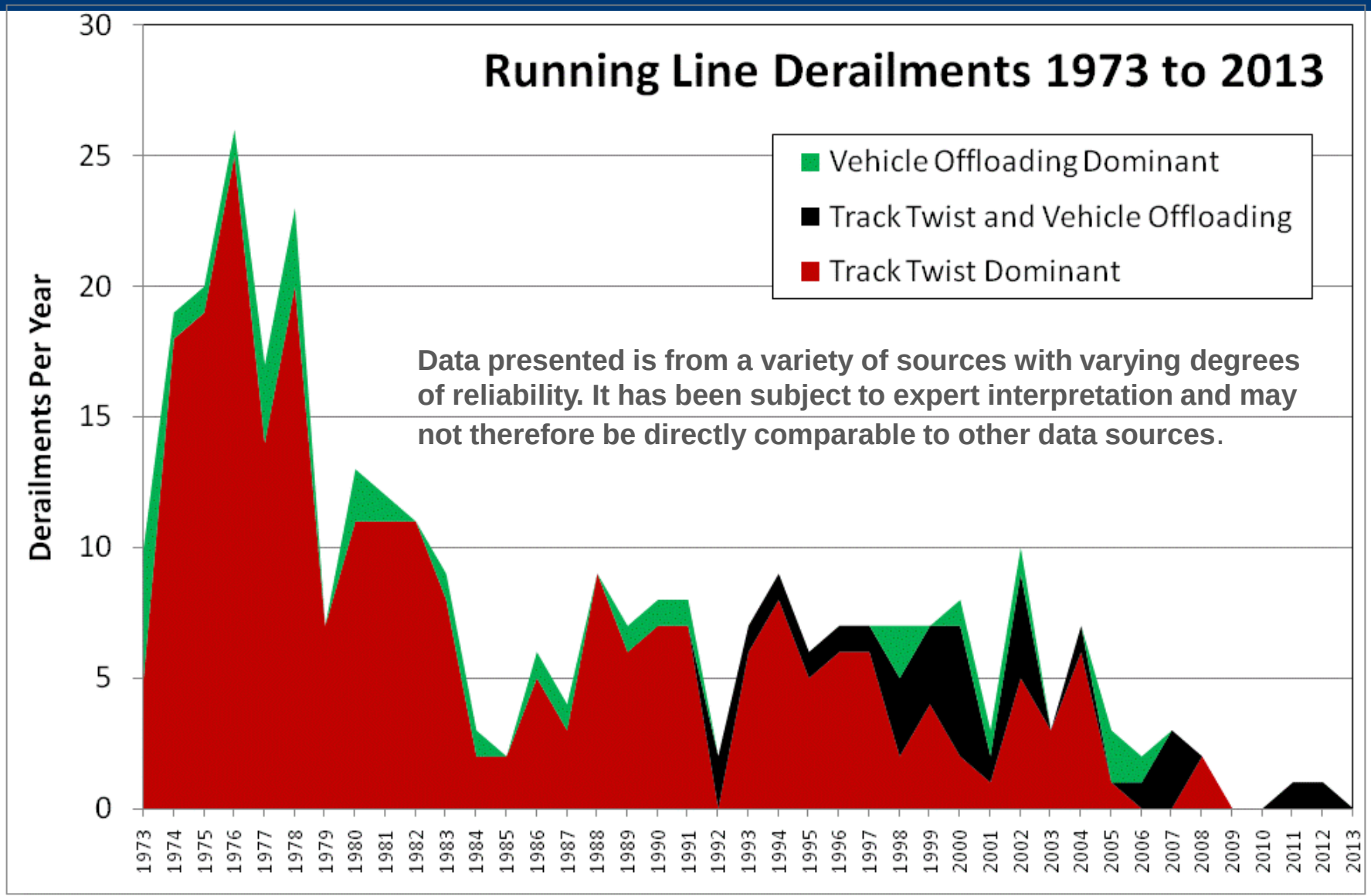

Key Trends in Twist Derailments

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- Derailments on running lines where Track Twist is definitely the dominant cause are a small proportion of the total
- Reduction over 40 years but pre-2000 other derailment types reduced more quickly.
- Higher proportion now have vehicle influence too (or just better investigation/recording?)
  - Twisted underframe/bogie
  - Biased load
  - Torsionally stiffer body types (within acceptance limits)

Track Characteristics

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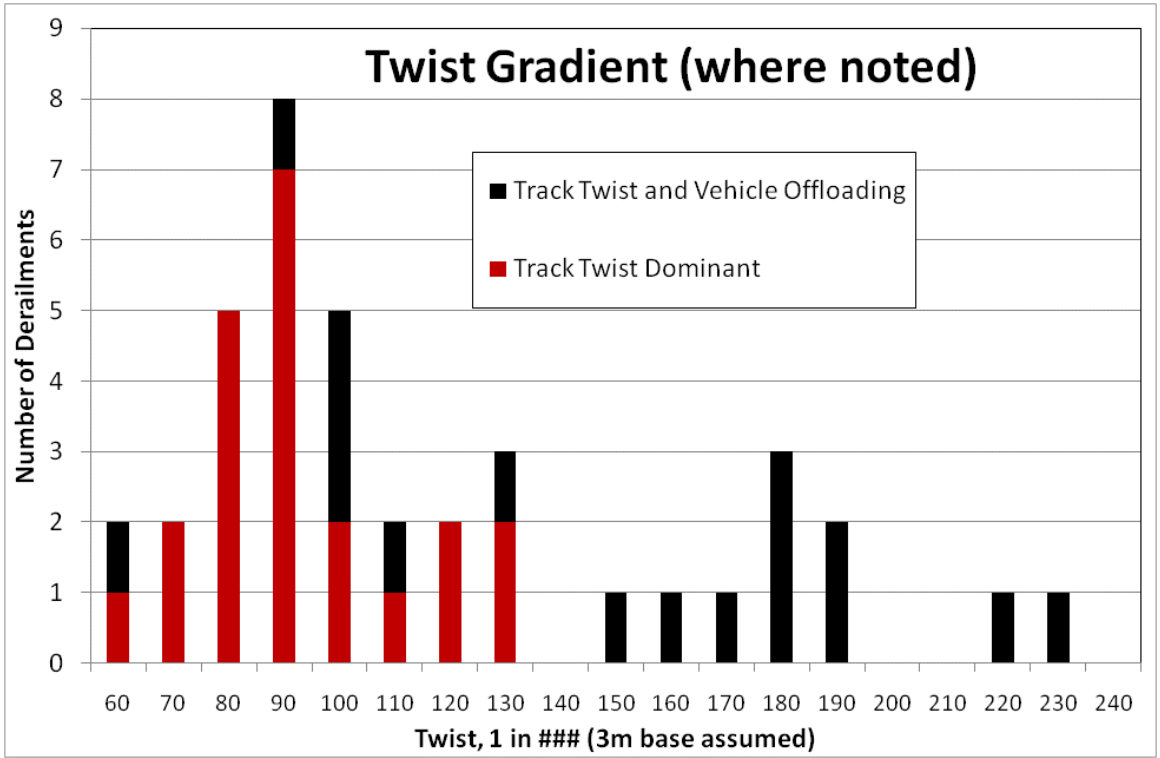
- Recording of twist gradient is very patchy:
  - Only 15% of derailments quote twist in databases
  - SMIS database does not include appropriate fields
  - Most twists believed to be quoted over 3m
  - Classification of derailment cause is influenced by whether twist is compliant with standards



Twist Wavelengths

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- A 1:100 twist over 10m is much worse than over 1m!
- Commonly, twist is measured over 3m base
  - NR/L2/TRK/001 (Module 11) uses a 3m base
  - Derailment investigations typically measured twist over 3m
  - 5m twist base was also used in the past
- Up to the 1980s, most running line twist derailments involved wagons with a wheelbase around 3m
  - ZBA / ZCA ‘Rudd’ now mostly withdrawn
- Is 3m the right base length?
  - Longer vehicles are sensitive to longer wavelength twists
  - Few wagons now in traffic with wheelbase less than 4.5m
  - Most 2-axle wagons over 6m and bogie vehicles over 10m
  - BUT... most bogies have a wheelbase less than 3m
- GM/RT2141 (vehicle acceptance) uses 1:150 over 6m then 1:300
- LU controls 2m and 10m twist, and a combined ‘derailment index’

What Twist Wavelengths Matter?

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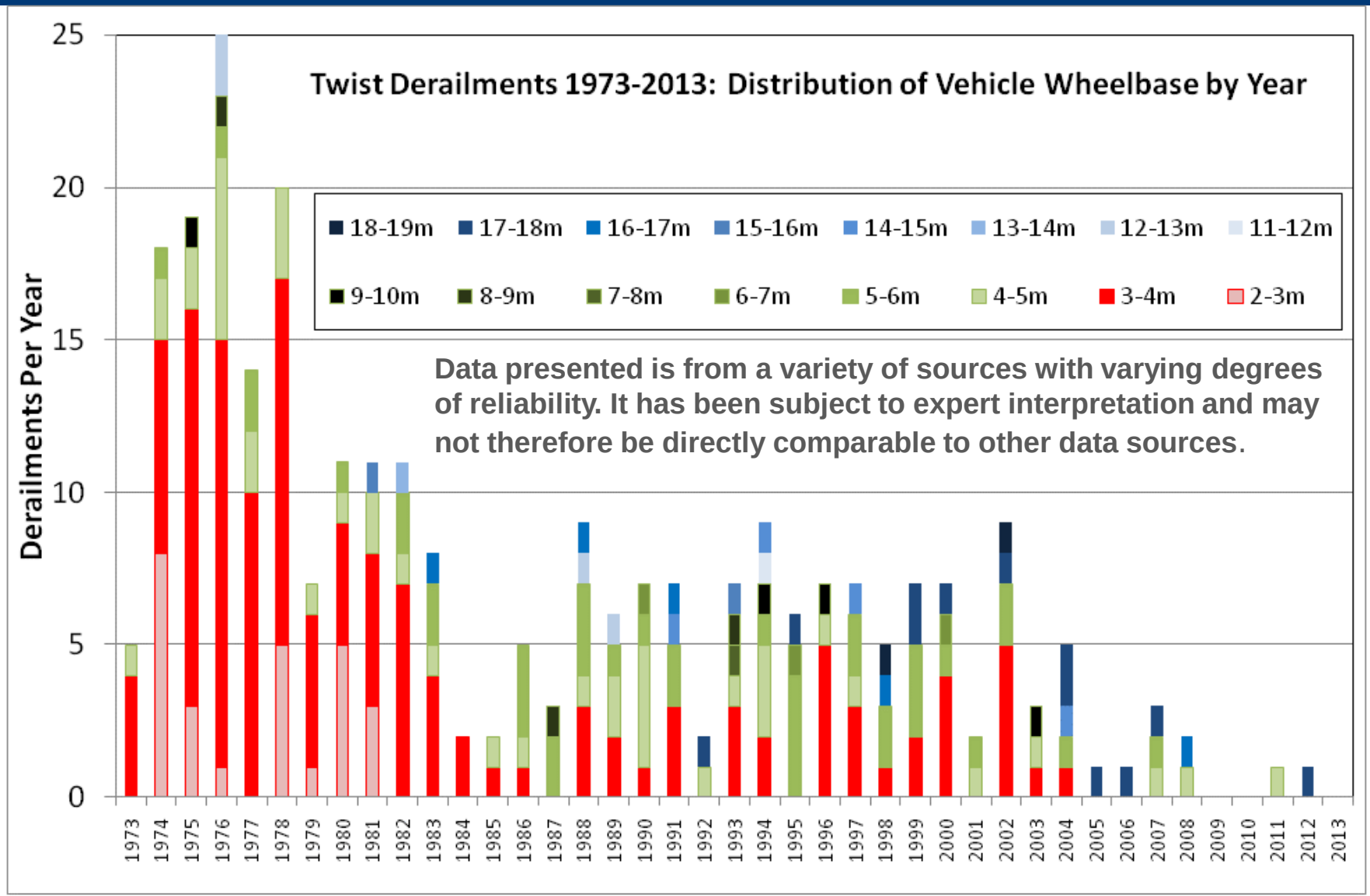

Focus on Container Wagon Twist Derailments

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- Uneven or partial vehicle loading is most prevalent in intermodal traffic
- Recent twist derailments of bogie vehicles have mostly been container wagons

This is based on numbers of derailments alone. This does not necessarily mean that container wagons are more prone to derailment per-se as the data has not been normalised (for example by miles run per wagon type)

- The next few slides examine some relevant container wagon derailments in the past 20 years
- There are probably more derailments in yards and sidings that do not appear in the available data

Container Wagon Twist Derailments

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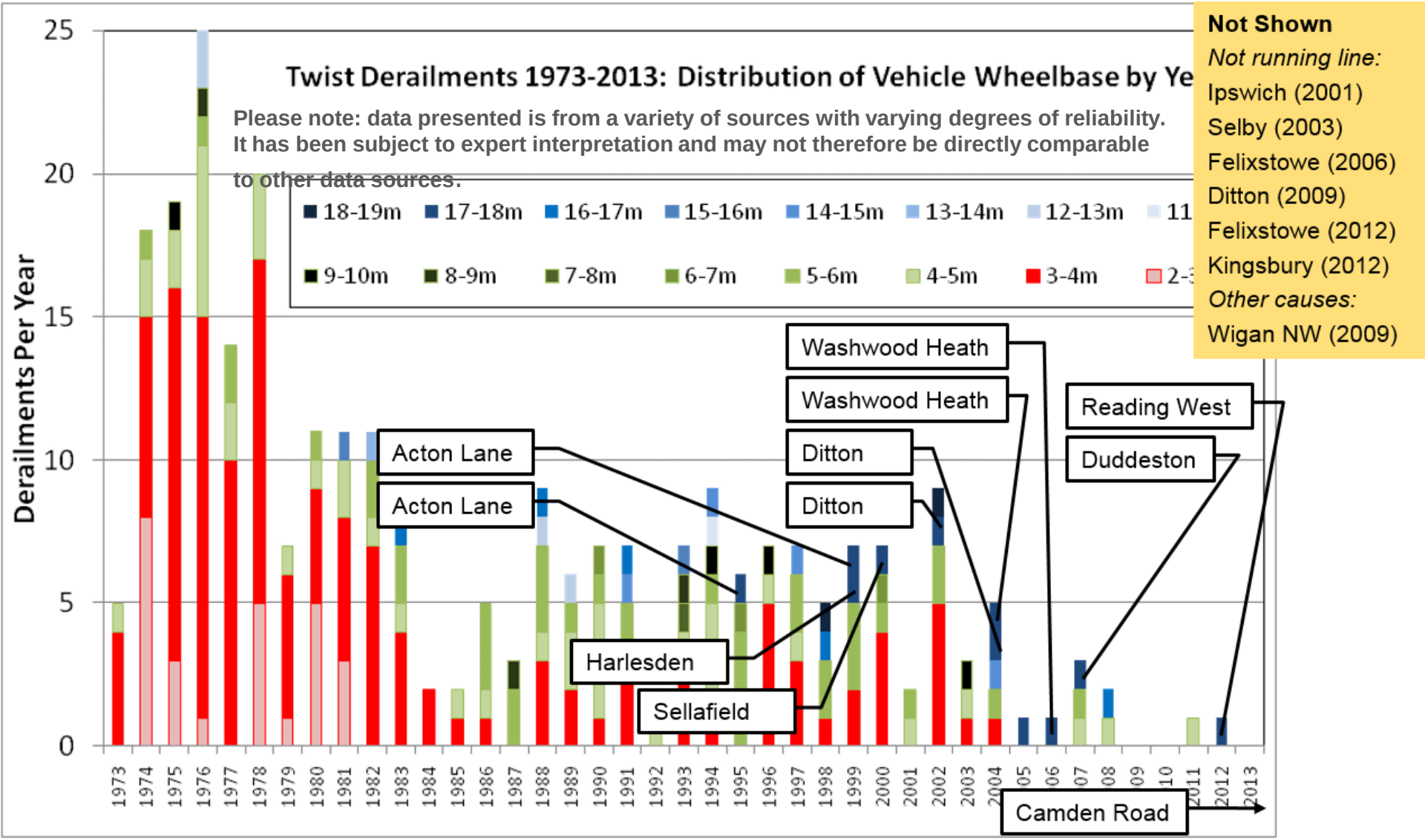

Not Shown

Not running line:

Ipswich (2001)

Selby (2003)

Felixstowe (2006)

Ditton (2009)

Felixstowe (2012)

Kingsbury (2012)

Other causes:

Wigan NW (2009)

Container Wagon Twist Derailments

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Event	Vehicle	Load	Twist	Dist Run	Track
Acton Lane ‘95	FIA	Ety Containers	1:103	80m	Crossover, running line
Acton Lane ‘99	FIA	Part Laden	?	20m	In yard, no details
Harlesden ‘99	FAA*	Ety Containers	1:96	?	Crossover, running line (* sloped sidebearers)
Sellafield ‘00	KFA‡	Laden	severe	20m	Crossover, yard exit (‡ seized suspension)
Ipswich ‘01	FAA*	Tare	1:118	(yard)	In yard, no details (* sloped sidebearers)
Ditton ‘02	FIA	?	?	(yard)	In yard, propelling move
Selby ‘03	FCA	Offset Load	?	(yard)	In yard, no details
Washwood Heath ‘04	FAA*	Tare	1:101	10m	Ladder crossover (* sloped sidebearers)
Ditton ‘04	FIA	?	?	(yard)	Reception road
Felixstowe ‘06	FAA	?	?	(yard)	Reception road
Washwood Heath ‘06	FAA	?	1:108	re-railed	Ladder crossover
Duddeston ‘07	FEA-B	Offset Load	1:103	200m	Crossover, running line
Ditton ‘09	FEA-B	Offset Load	?	(yard)	Reception road
Wigan NW ‘09	FCA	Tare	1:219	20m	Sharp curve into loop, no check, rail step
Reading West ‘12	FEA-B	Offset Load	1:188	re-railed	Ladder crossover
Felixstowe ‘12	FEA-B	Heavy 20’ety 40’	?	(yard)	Siding, on turnout
Kingsbury ‘12	FEA-B	?	?	(yard)	In yard, no details
Camden Road ‘13	FEA-B	Offset Load	1:150	900m	Sharply curved junction chord

Twist Derailments: Common Factors

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- Most derailments occur:
  - On crossovers or in yards and sidings
  - At slow speeds (5-15mph) so distance run derailed is very short
  - Limited risk to other trains
  - Camden Road was one which did not fit this pattern
- These locations are not usually measured by TRV
  - Severe twists not identified
  - Manual measurements inaccurate on voided track
  - NR addressing this using instrumented MPVs
- Long-wavelength twist contributed to several incidents
- Offset loads feature in several derailments
- Vehicle design/condition is a factor in several cases
- Recording of load condition or twist gradient is patchy!

Key Issues and Gaps

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- Track Features:
  - Relevance of current track twist standards
    - 3m base
    - No differentiation between plain line and cant transitions
  - Effectiveness of track monitoring regimes
  - Visibility of how quickly a fault will develop
  - Understanding of combination faults
- Vehicle:
  - Link between acceptance requirements and derailment history
  - Influences of design differences between container wagons
- Load:
  - Interpretation of load conditions to be considered at acceptance
  - Control of load conditions in practice

Thank You