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KAJT Spring Seminar 2023

# Trackwork Schedule Stability in Sweden

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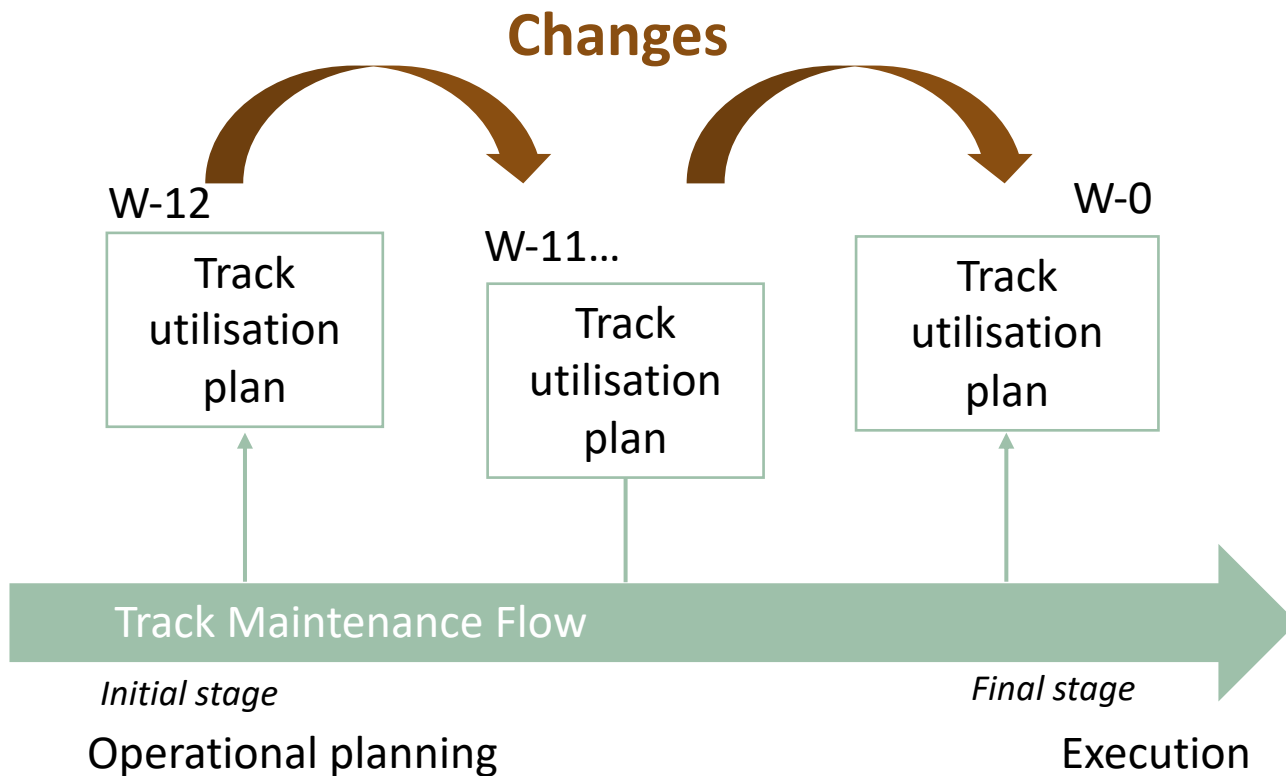


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# Research objectives

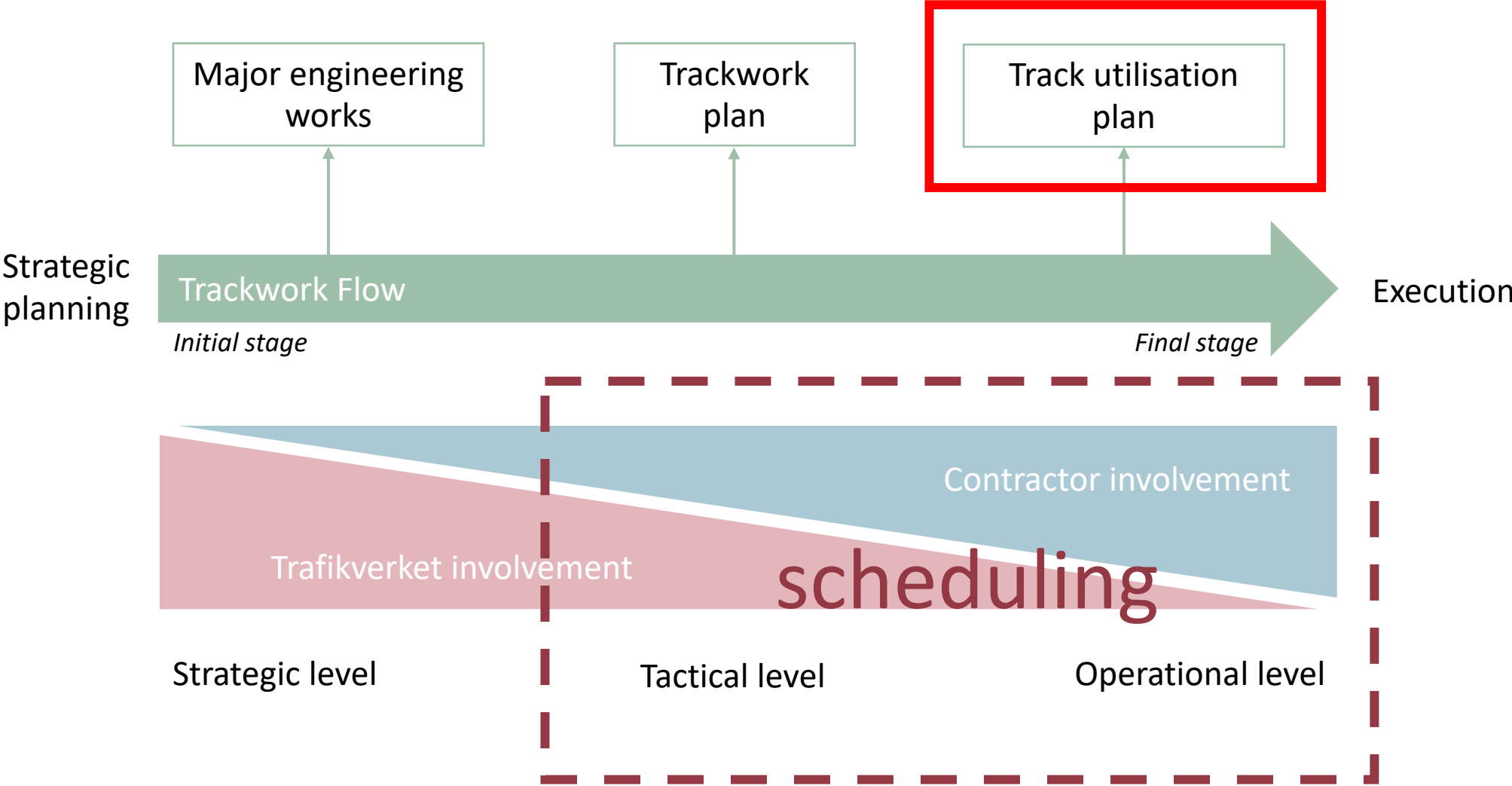
**Aim:** Understand factors leading to changes in booked time for trackwork over a planning cycle



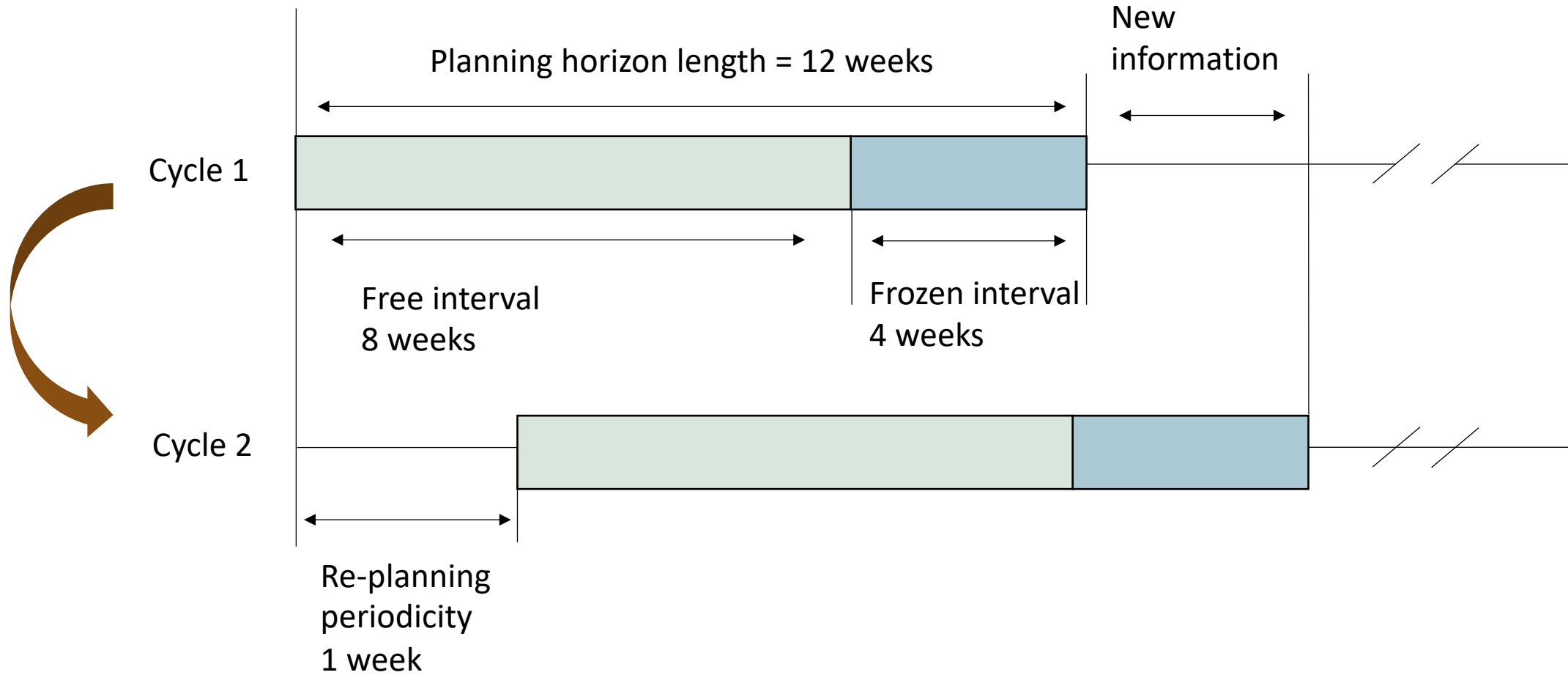
## Research questions:

1. How stable is the trackwork schedule at the tactical and operational planning levels?
2. Which factors affect the modification of the booked time on track in the track utilisation plan?

# Trackwork in Sweden



# Rolling Horizon Plan



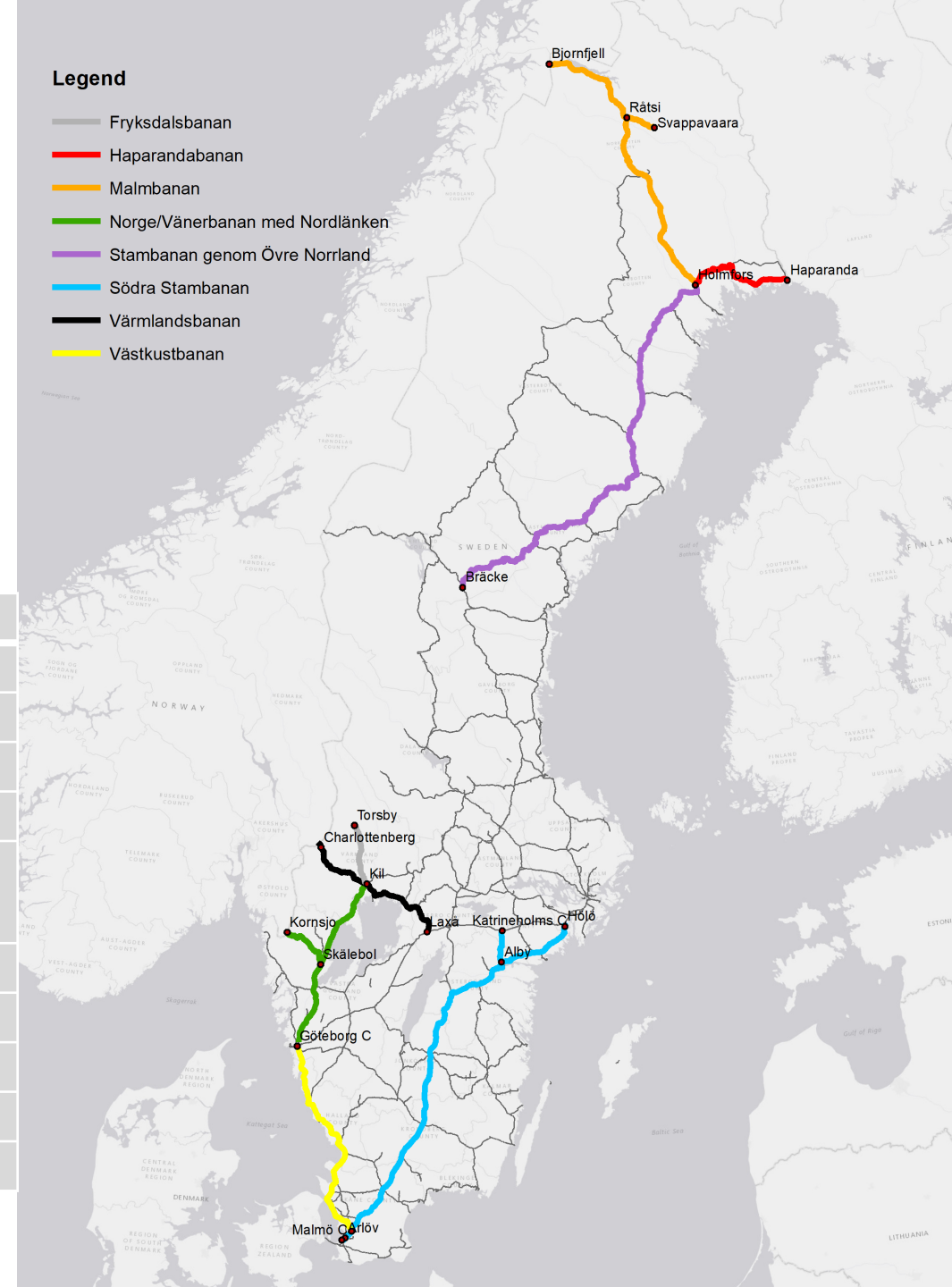


# Data

Weekly updates of track utilization plan (excluding investments)

- Plan time recorded: January 2020 – December 2020
- Data collection: April 2020 – December 2020
- Rolling horizon plan 12-4 (0) weeks
- 6 646 trackwork (32 updates)

	Rail line	Length	Track type
South			
1	Södra Stambanan	483 km	Double
2	Väst kustbanan	283 km	Double
3	Norge/Vänerbanan med Nordlänken	300 km	Double
4	Värmlandsbanan	202 km	Single (95%) and double
5	Fryksdalsbanan	82 km	Single
North			
6	Malm banan	398 km	Single
7	Haparandabanan	159 km	Single
8	Stambanan genom Övre Norrland	626 km	Double



# Method

Variables:

	Change	Yes/No
categorical	Previous change	Yes/No
	Location (line)	8 lines
	Track type	Single/Double
	Daytime	Day/Night
	Month	8 months
	Work is at station	Yes/No
	continuous	Count of previous changes
Freight share (%)		
Traffic volume (train/km)		
Trackwork duration (days)		

Multiple logistic regression:

$$\log \left( \frac{Y = 1}{Y = 0} \right) \\ = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_{10} x_{10},$$

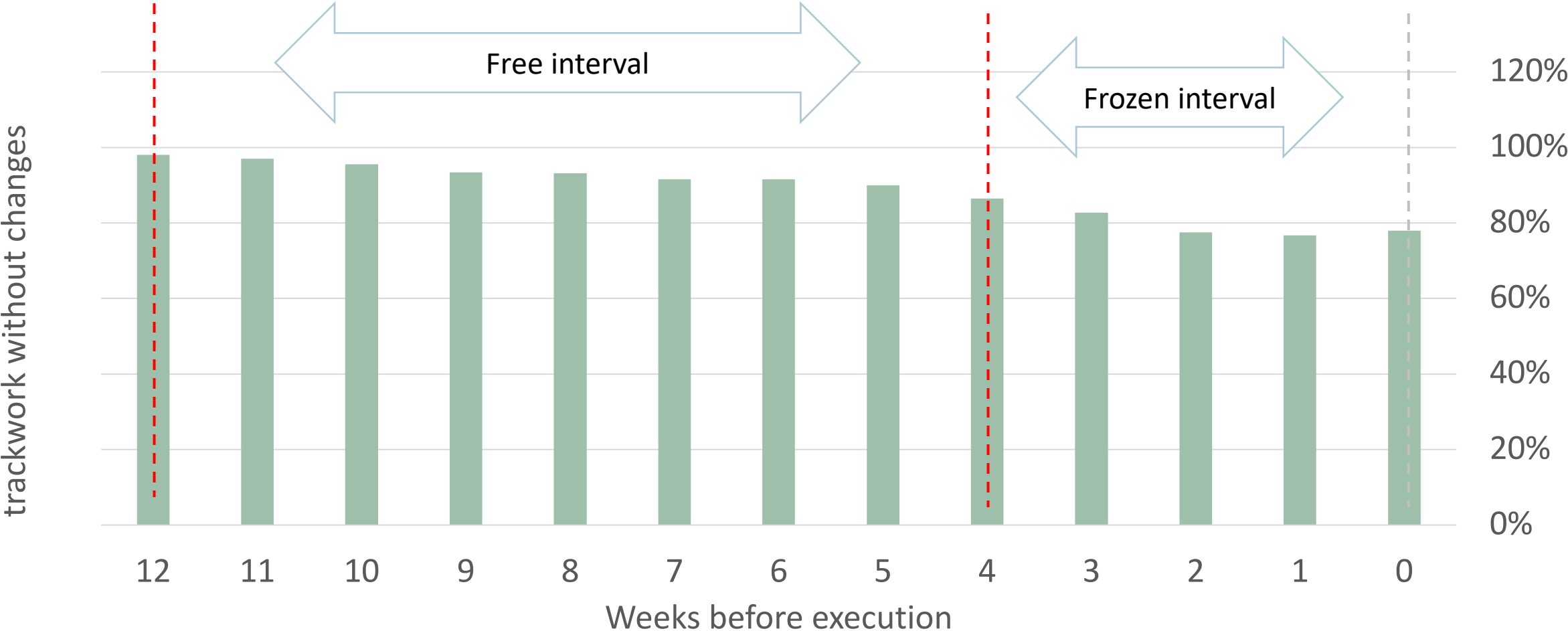


# RESULTS

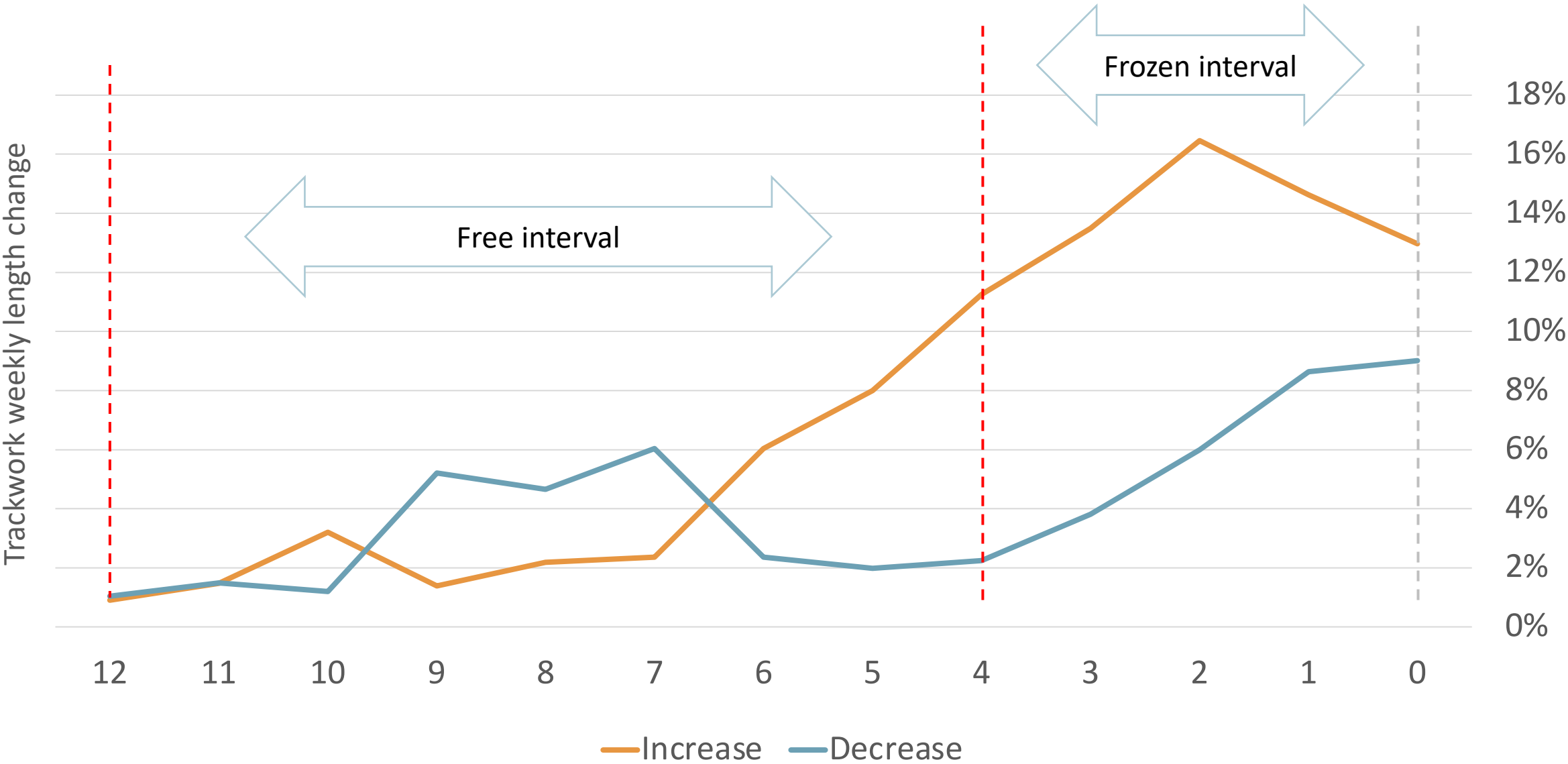




# Plan Stability



# Types of changes



# Regression results

Coefficients:	Estimate	Std. Error	z value	Pr(> z )
(Intercept)	-0.9923	0.0666	-14.8980	< 2e-16 ***
Previous change (Yes)	0.1883	0.0365	5.1590	0.0000 ***
Count of previous changes	-0.2334	0.0167	-13.9670	< 2e-16 ***
Track Type (Single)	0.2587	0.0325	7.9680	0.0000 ***
Work is at station (Yes)	0.1471	0.0244	6.0380	0.0000 ***
Daytime (Night)	-0.3060	0.0252	-12.1310	< 2e-16 ***
Train traffic volume	-1.522E-09	0.0000	-0.5720	0.5676
Freight share	0.3311	0.0590	5.6090	0.0000 ***
Work length in days	-0.0545	0.0094	-5.8000	0.0000 ***

Significance codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1



# Regression results

Coefficients:		Estimate	Std. Error	z value	Pr(> z )	
$\beta_9$	Weeks ahead 1	0.0222	0.0420	0.5290	0.5969	
	Weeks ahead 2	-0.0668	0.0427	-1.5650	0.1175	
	Weeks ahead 3	-0.4309	0.0453	-9.5060	< 2e-16	***
	Weeks ahead 4	-0.7430	0.0484	-15.3450	< 2e-16	***
	Weeks ahead 5	-1.1170	0.0525	-21.2670	< 2e-16	***
	Weeks ahead 6	-1.3300	0.0554	-24.0000	< 2e-16	***
	Weeks ahead 7	-1.3470	0.0557	-24.1680	< 2e-16	***
	Weeks ahead 8	-1.5880	0.0596	-26.6510	< 2e-16	***
	Weeks ahead 9	-1.6380	0.0605	-27.0600	< 2e-16	***
	Weeks ahead 10	-2.0730	0.0694	-29.8800	< 2e-16	***
	Weeks ahead 11	-2.4920	0.0806	-30.9270	< 2e-16	***
$\beta_{10}$	Month (May)	-0.4839	0.0447	-10.8320	< 2e-16	***
	Month (June)	-0.1174	0.0415	-2.8270	0.0047	**
	Month (July)	-0.0799	0.0436	-1.8320	0.0670	.
	Month (August)	-0.3430	0.0455	-7.5390	0.0000	***
	Month (September)	0.1799	0.0416	4.3240	0.0000	***
	Month (November)	0.0743	0.0447	1.6610	0.0967	.
	Month (December)	-0.2897	0.0671	-4.3170	0.0000	***

Significance codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1' ' 1

# Conclusions

- Trackwork schedule stability decreases towards the end of the planning horizon
- Changes are done during the frozen plan period
- Schedule stability depends on trackwork circumstances
- Making changes earlier in the plan preventing from later adjustments

# Thank you for your attention!

Questions?



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