

# System for on-board weighing on maintenance trucks

2016 International Conference on Winter  
Maintenance and Surface Transportation  
Weather

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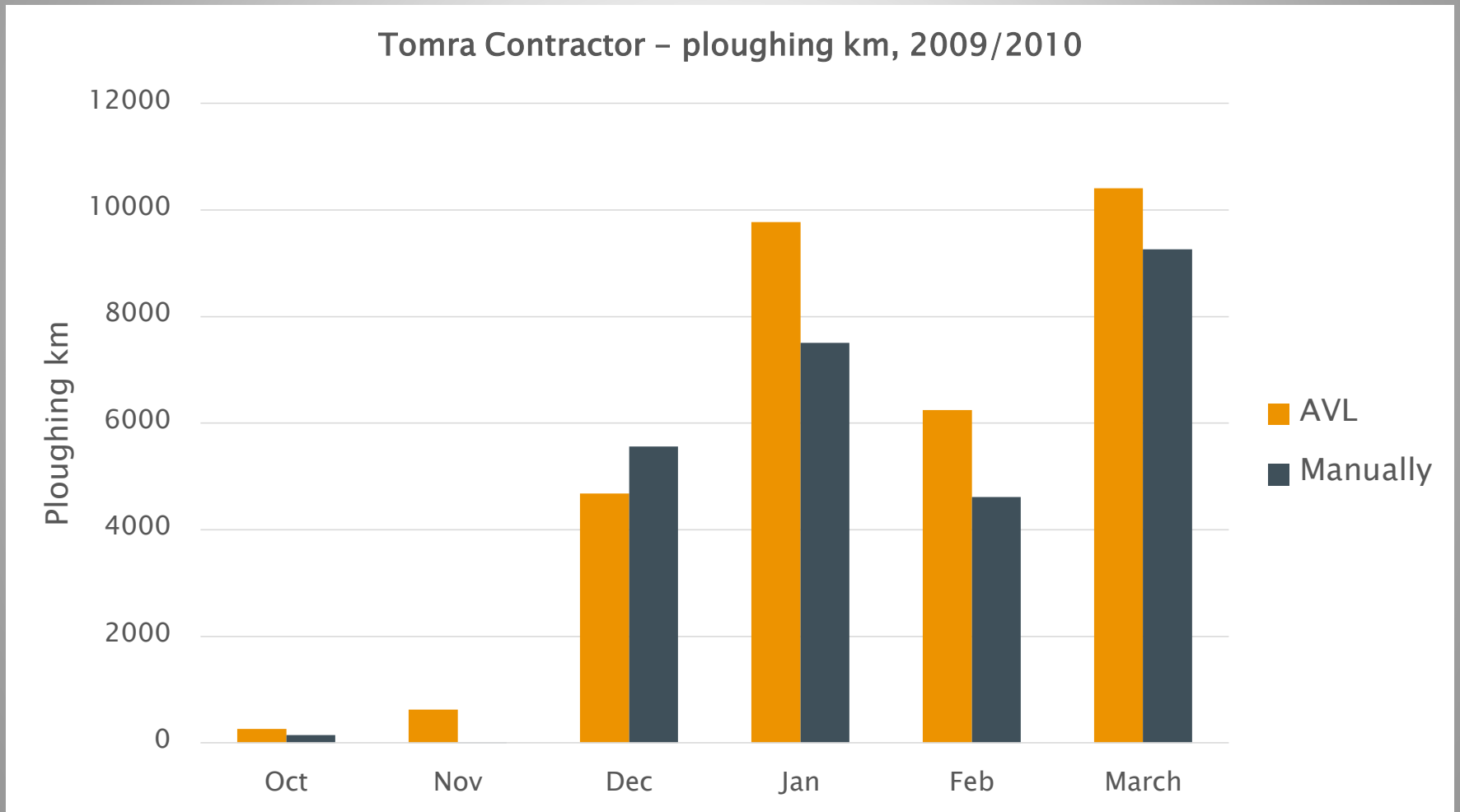
# Learning outcomes

- There is a need for improvement in the reported quantities of salt and sand used in winter operations
- The study show how a weighing system based on load cells can be used for dynamic quantity control
- The weighing system can be factory fitted or retrofitted
- The accuracy of the weighing system is better than 5% compared with actual weight controlled on an external weight

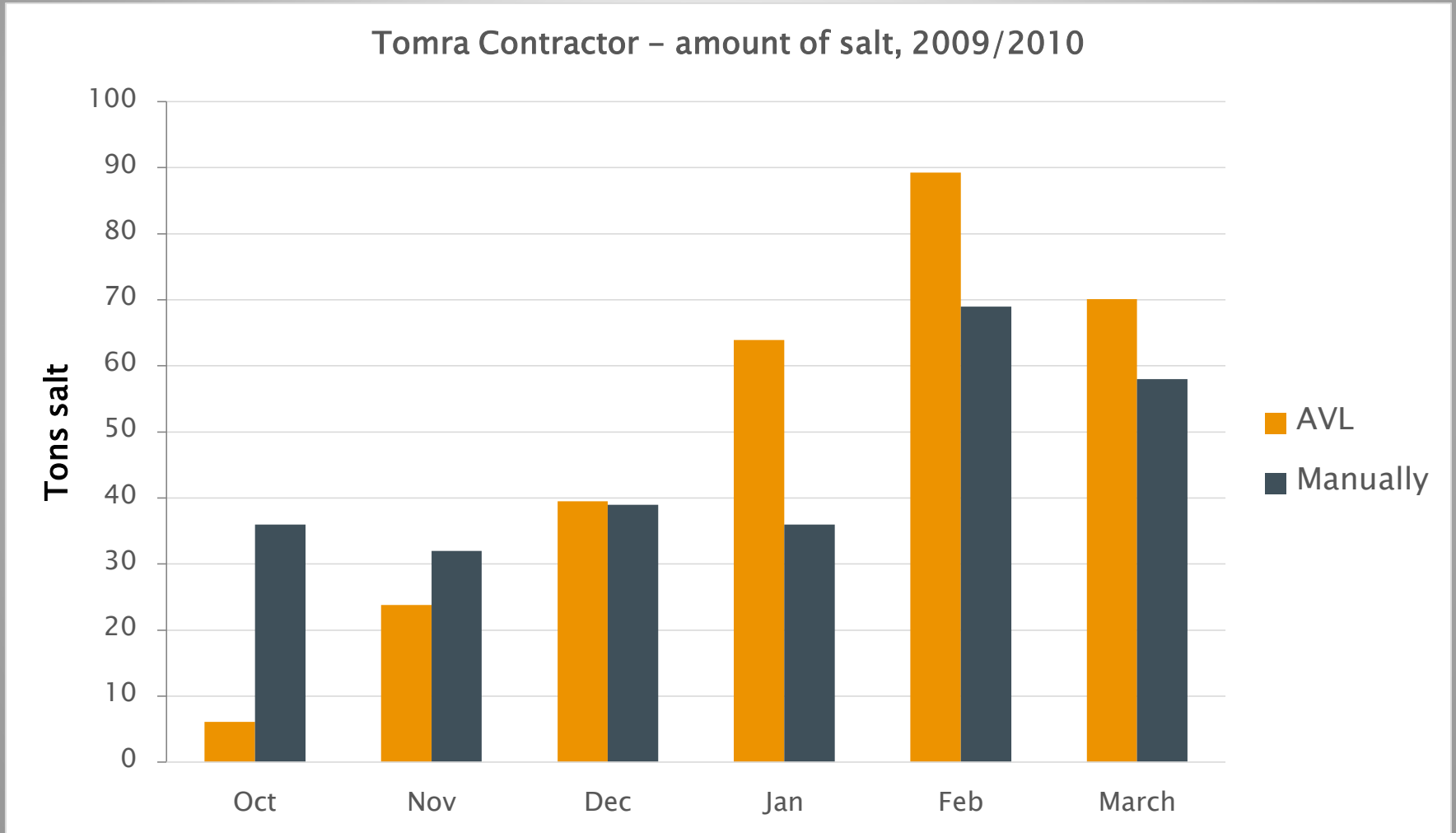
# Background

- It is proven large deviation in the quantity of salt and sand when comparing data from automatic data collection systems (AD) and manual statements from contractors

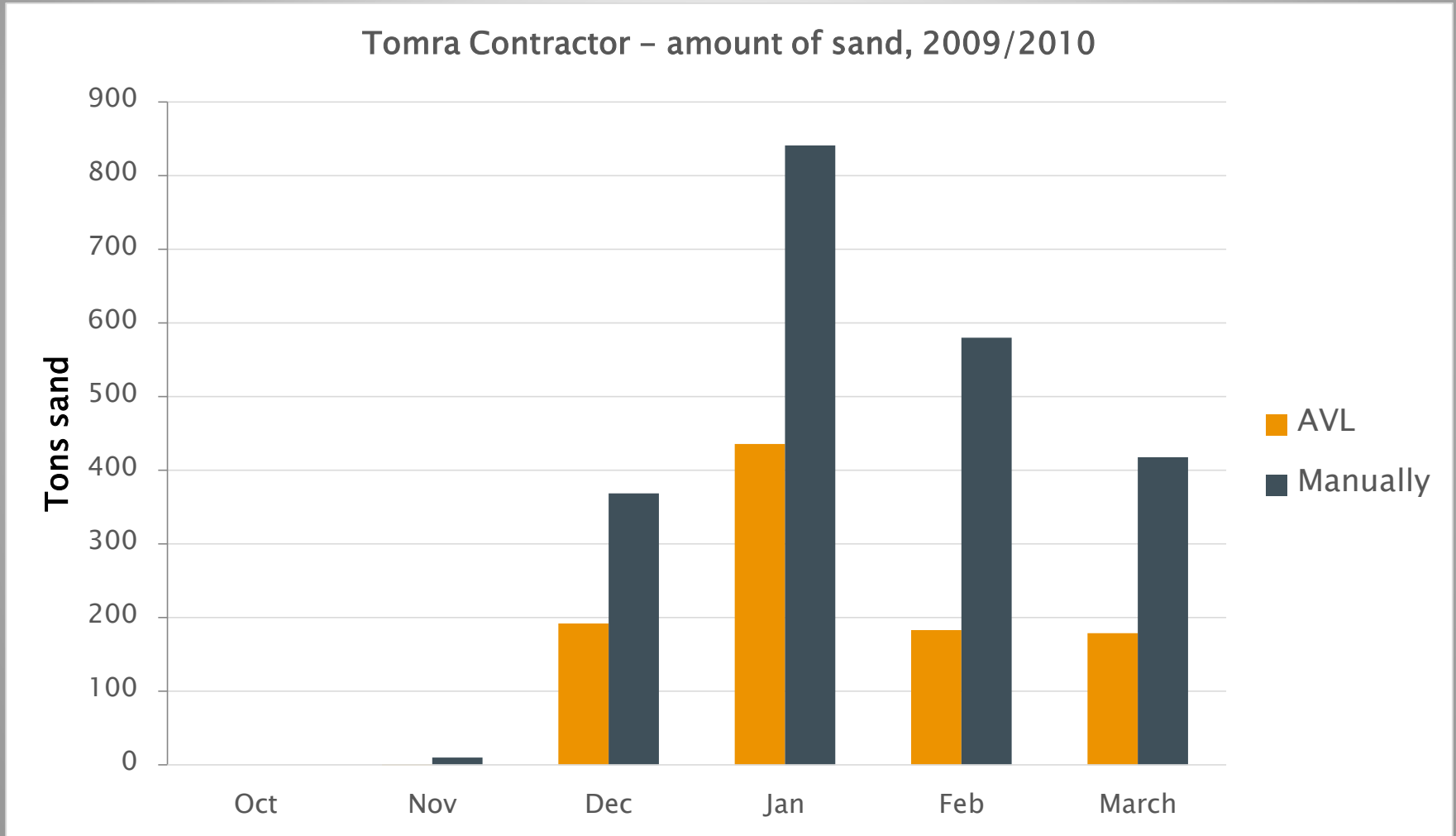
# Example: ploughing kilometers



# Example: amount of salt



# Example: amount of sand



# Background

Unsatisfactory quantity control can have as consequences:

- Measures are not executed according to the standard requirements
- Systematic errors means that one party loses money
- Poor confidence in AD systems enables transition to billing by electronic quantity tasks takes a long time

# Background

Consequences of improper calibration and other deviations:

- “Wrong” actions are carried out? Too little / too much grit agent?
- Cannot rely on the statistics: Where and how much grit agent is laid out?
- Cumbersome routines for settlement of quantities of salt and sand since the normal practice is that the contractors note manual statements



# Pilot project – the two first trucks



# System for on-board weighing

## Short history:

- Winter season 2010/2011: Started with two trucks: «Lesja truck», Mesta and «Tomra truck», Kolo Veidekke
- 4 load cells and riser pipe for measuring amount of liquid in the tanks
- Plan strapped and traditional strapping



# System for on-board weighing

## Short history:

## Conclusions from the first trials:

- Promising test results
- Necessary to co-operate with spreader manufacturers/suppliers
- Improve the attachment solution
- Include more trucks in the pilot
- Look at the possibility for self calibration



# System for on-board weighing

## Project phases:

2011/2012

- Invited to co-operation with spreader manufacturers/suppliers – two companies responded positively



2012/2013

- The pilot project was extended with trucks with factory fitted weighing system



2013/2015

- Extension of the pilot project including more contract areas
- Further development and testing with focus on accuracy



Autumn 2015

- Requirements for weighing system in one contract area in each of the five regions

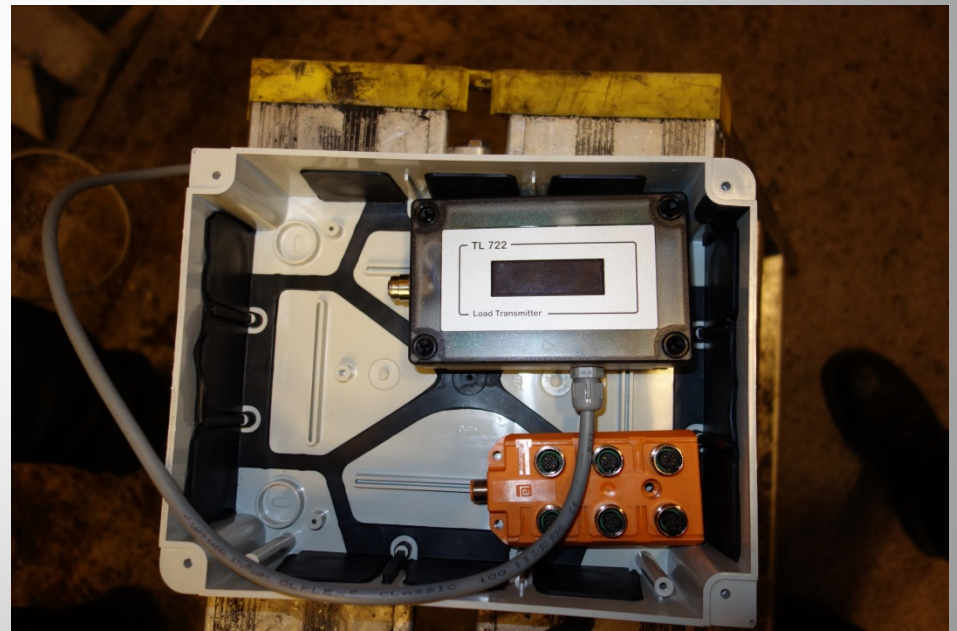
# On board weighing



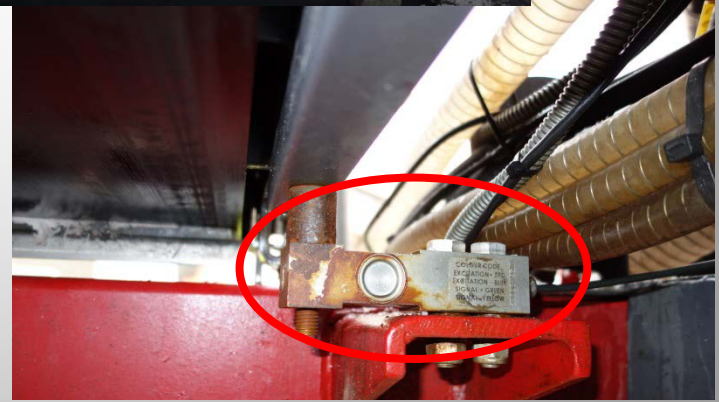
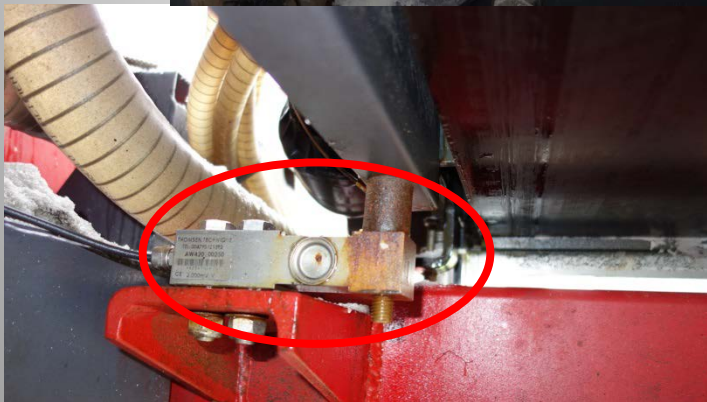
# Load cells, hook lift spreader



# Pressure sensor for measurement of liquid level and signal amplifier/load transmitter



# Weighing the material on the conveyor belt



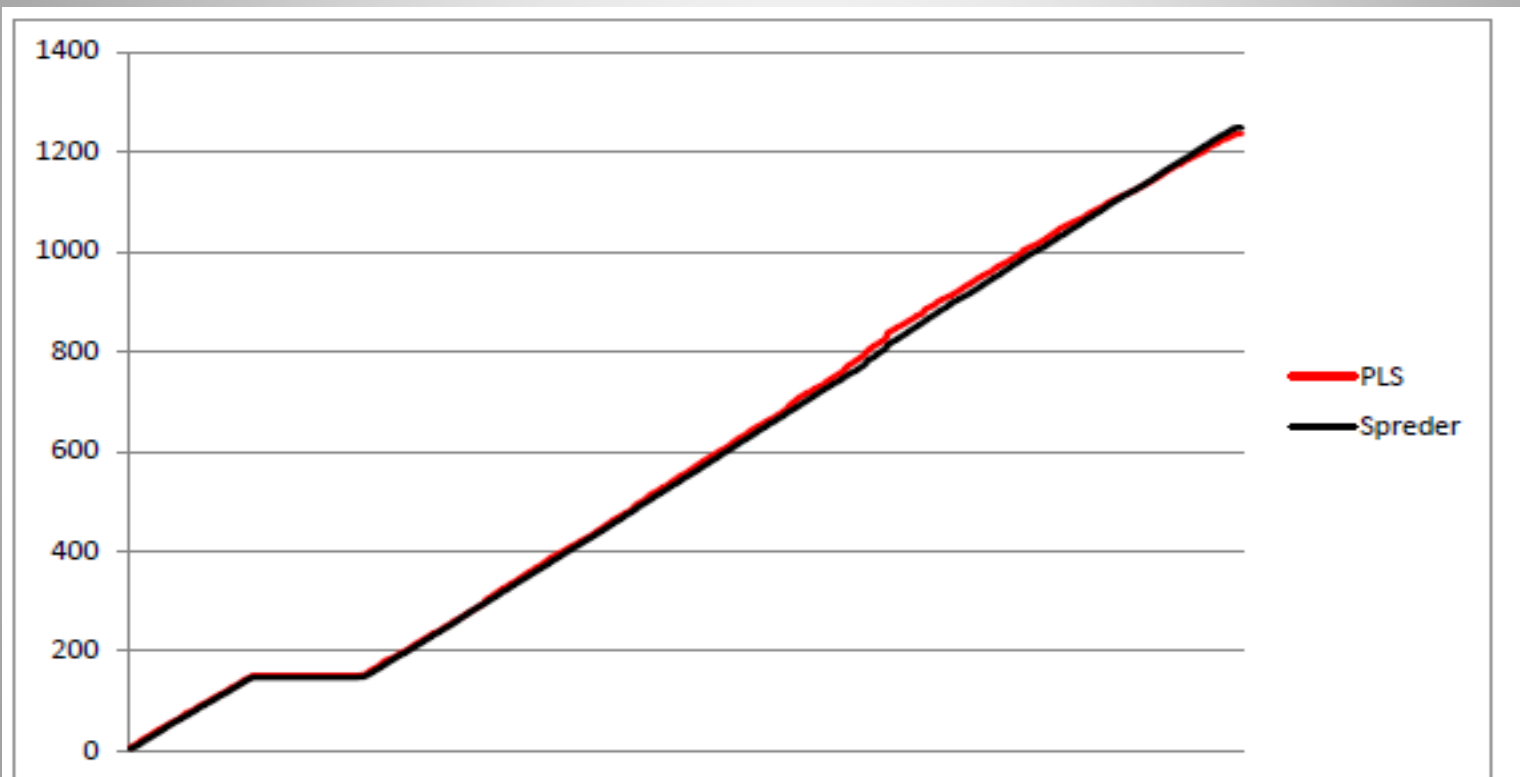


# On board weighing - control weighing



# Comparison – spreader data and data from weighing system – coinciding curves

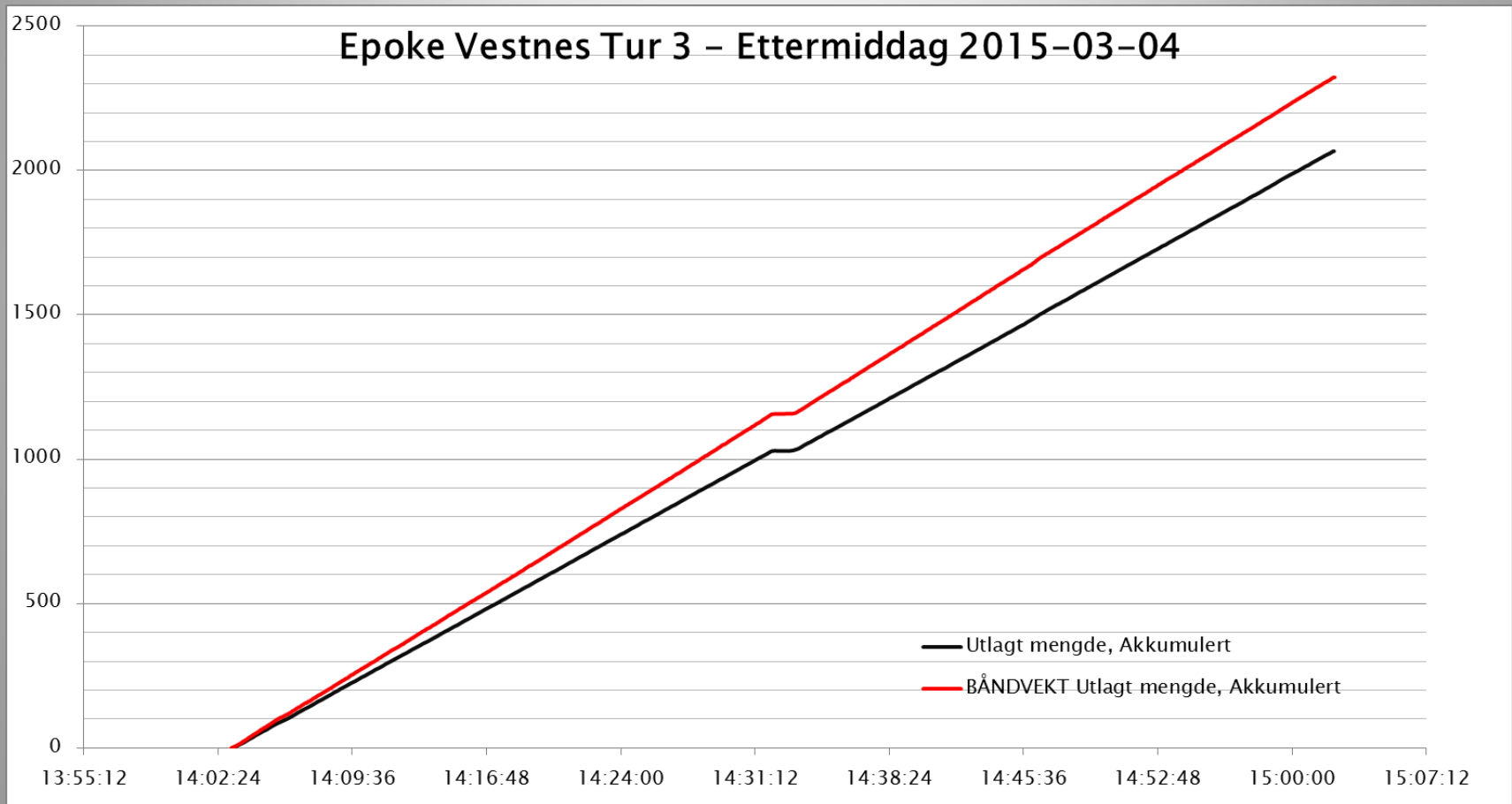
Correct calibration and homogenous material



**Figur 4** Sammenfallende kurver for spreder og PLS, tur 2. Loddrett akse viser kg utlagt gjennom tiltaket på 59 minutter.

# Comparison – spreader data and data from weighing system – diverging curves

Calibration of spreader is deficient?

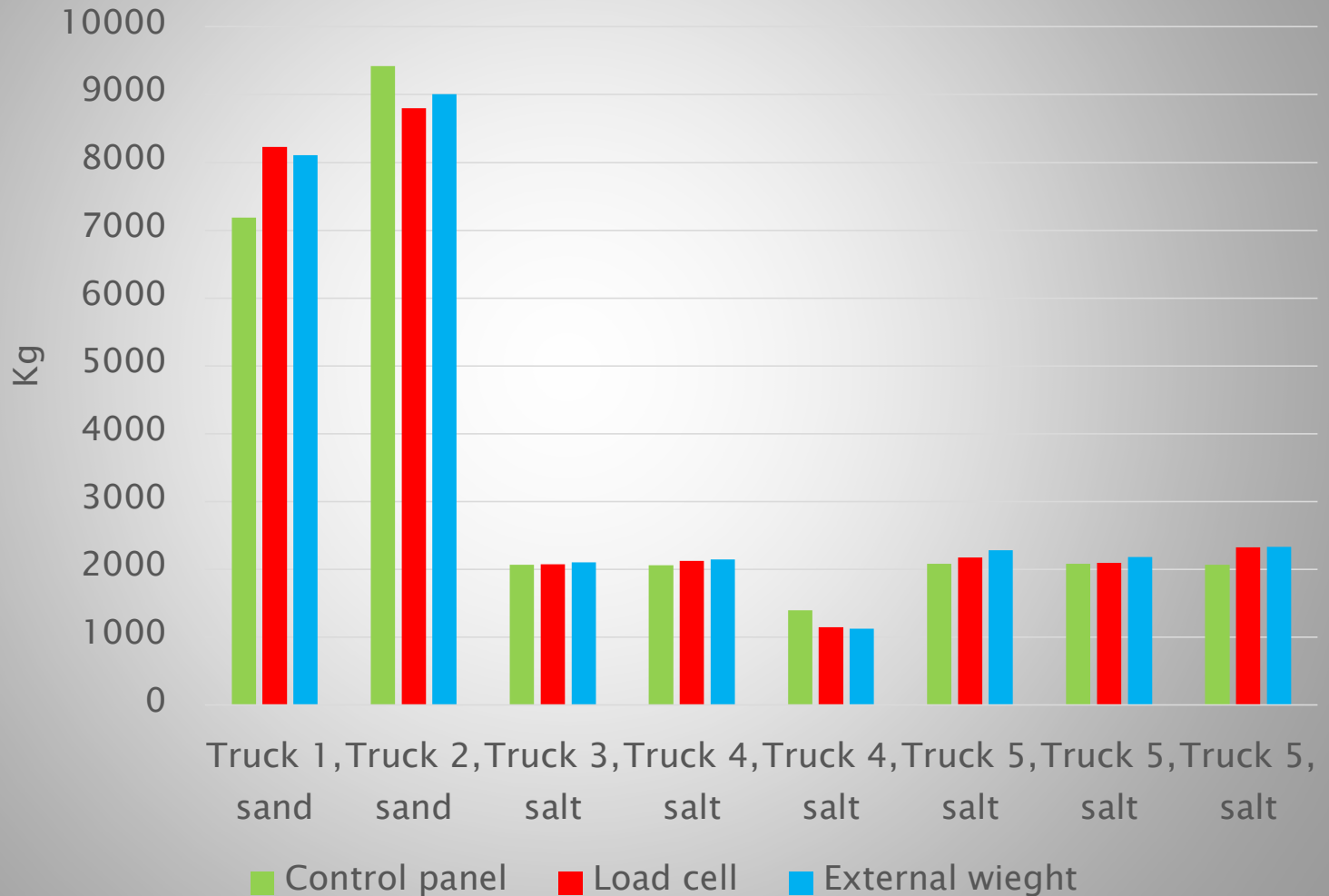


# Test Åndalsnes 4. March 2015

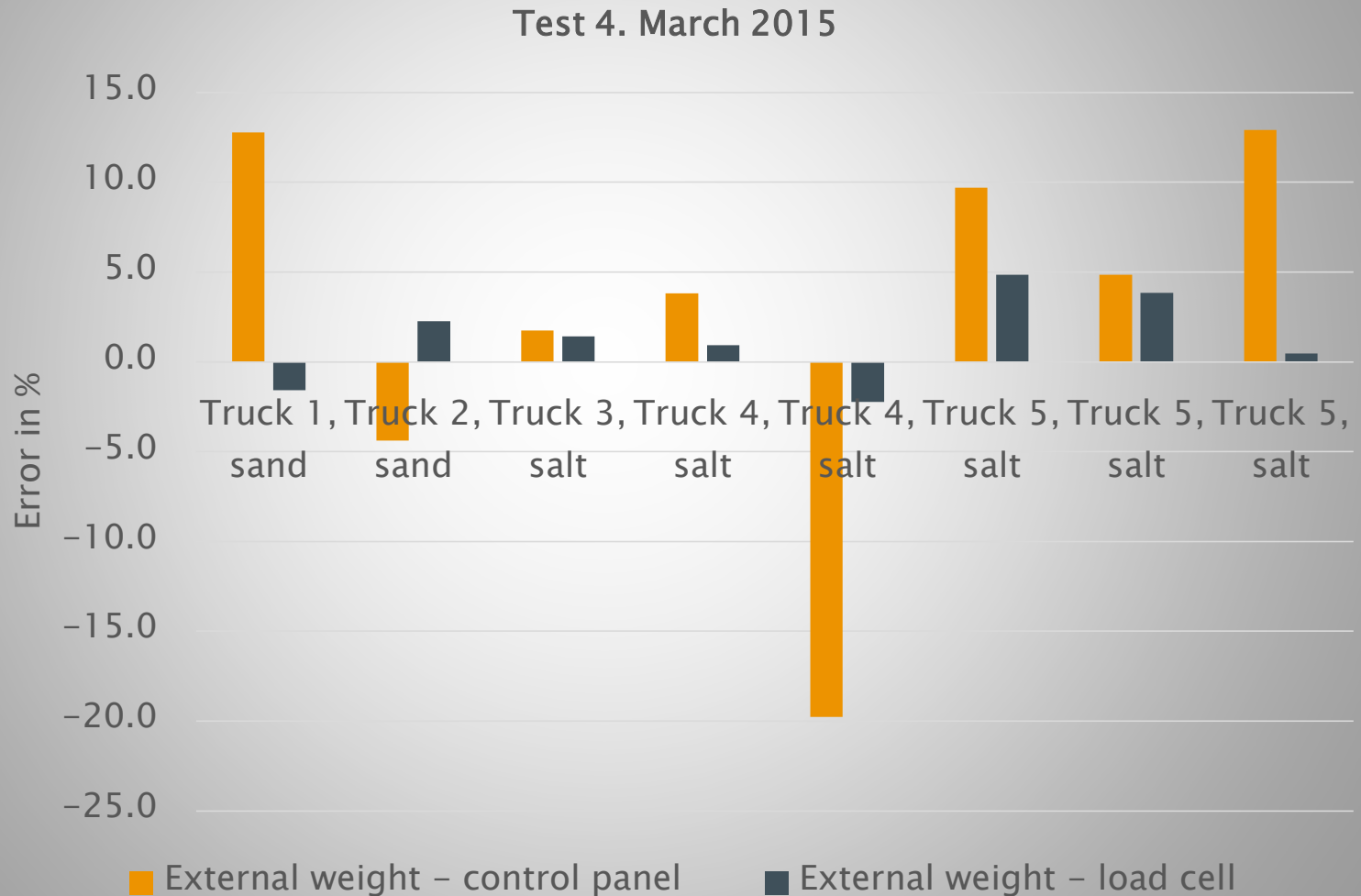
## Veiesystemtester, Åndalsnes, 4/3-2015

Dato				UTLAGTE				MENGDER			Differanse Veiging av bil og Veiesystem (Data fra Loggfiler/EpoTrack)					
04.03.2015				Avlest fra sprederpanel [kg]			Veiging av bil på vekt	Fra veiesystem, Loggfiler/EpoTrack [kg]			Tørrstoff (Sand/Salt)		Væske		Sum Tørrstoff og Væske	
Spreader	Materiale	Strekning [km]	Sand/Salt	Væske	Sum	Sum utlagt [kg]	Sand/Salt	Væske	Sum	Kg	%	Kg	%	Kg	%	
Falköping, Dombås	Tørr sand	11,8	7187	0	7187	8105	8232	-257	7975	-127	-1,6	-257	N/A	130	1,6	
Falköping, Dombås	Fastsand	13,3	7797	1621	9418	9005	8065	735	8800	N/A	N/A	N/A	N/A	205	2,3	
Falköping, Romsdal	Salt, tørt	34,5	2069	0	2069	2105	2075	0	2075	30	1,4	0	N/A	30	1,4	
Falköping, Romsdal	Salt, tørt	34,5	2066	0	2066	2145	2125	0	2125	20	0,9	0	N/A	20	0,9	
Falköping, Romsdal	Salt, befuktet	24,2	1078	324	1402	1125	852	298	1150	N/A	N/A	N/A	N/A	-25	-2,2	
Epoke, Vestnes	Salt, tørt	34,3	2083	0	2083	2285	2174	0	2174	111	4,9	0	N/A	111	4,9	
Epoke, Vestnes	Salt, tørt	34,3	2084	0	2084	2185	2101	0	2101	84	3,8	0	N/A	84	3,8	
Epoke, Vestnes	Salt, tørt	34,3	2067	0	2067	2334	2323	0	2323	11	0,5	0	N/A	11	0,5	
														<b>DIFFERANSE - GJ.SNITT:</b>		<b>1,6</b>
N/A: Ikke tilgjengelig																

# Test Åndalsnes 4. March 2015

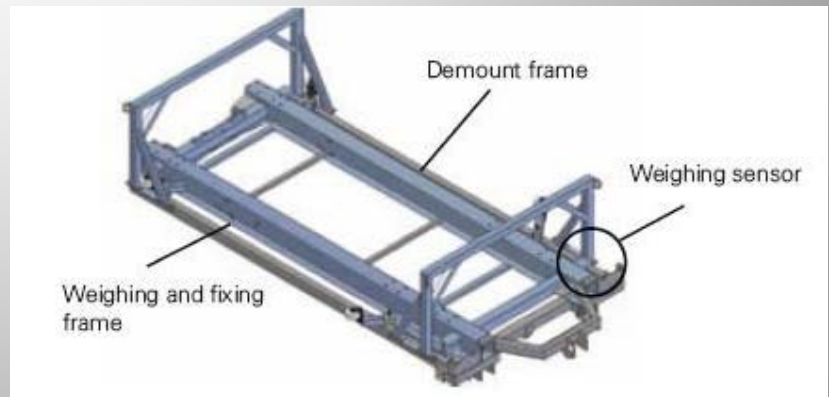


# Test Åndalsnes 4. March 2015



# Is the spreader market prepared?

- Epoke – been a partner in the pilot project – weighing the conveyor belt
- Falköping – been a partner in the pilot project – offers a solution based on load cells
- Aebi-Schmidt – offers a solution based on load cells



# Requirement in contracts starting September 2016

- Requirements for weighing system in one contract area in each of the five regions in Norway
- Spreaders for salt/sand shall have equipment to register the amount of dry material and liquid during spreader actions
- Accuracy within  $\pm 5 \%$
- Self calibration function – automatic adjustment of the spreader as a minimum per ton or per m<sup>3</sup>



# Demonstration project

Starting point:

- New system, functions and procedures may have some challenges
- Need for closer support and control during the first years
- It will take some time to establish new procedures and routines
- And the system is still under development

# Microcontroller replaces PLS

- PLS
- Open source microcontroller
- Smart phone
- Cable or Bluetooth shield
- More flexible and cheaper



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