

Bringing service to life



VTISM analysis to inform the allocation of variable usage costs to individual vehicles – initial results

Andy Rhodes, Principal Consultant
Serco Technical Services - Rail



Recap

- Serco are supporting Network Rail in re-calibrating the Variable Usage Charge (VUC) model as part of the 2013 Periodic Review (PR13)
- Review of track damage formulae used to allocate costs between vehicles
 - Track impact costs associated with Vertical forces only (70% of total variable track costs)
 - Lateral (RCF and wear-related) costs being reviewed by Network Rail in a separate internal study
- Remit developed in consultation with an industry working group (ATOC, freight operators and ORR)
- Proposed methodology based on using the Vehicle-Track Interaction Strategic Model (VTISM)

Methodology clarifications

- Can additional speed sensitivity steps be considered?
 - 4 steps expected to be sufficient for curve-fitting purposes
- Why is speed limited to 100 mph?
 - The ‘vehicle operating speed’ rather than vehicle max. speed will be used when applying the TAC formulae
- Can results be expressed in terms of track damage to provide more transparency?
 - VTISM provides track damage, work type volume and cost outputs
 - Remit is to provide cost per vehicle mile outputs using VTISM
 - ▶ Requires unconstrained budgets to maintain track condition
 - ▶ Possible to show the equivalent damage impact using budgeted runs

Progress

- VTISM model setup using latest (2012) track and traffic data
- VTISM scenarios analysed to determine representative route sample and projection time frame
 - 5% network sample provides acceptable accuracy compared with full network
 - 37 years projection period to end CP11 (ORR sustainability requirement)
 - ▶ 1% change using a 60 year projection
- Review of VTISM theoretical track damage models to establish appropriate algebraic function
- Methodology trialled on ECML route
- Meetings arranged
 - Industry stakeholders (ATOC, RFOA) and NR (civils and signalling)

Development of algebraic function

- Main elements of track damage include:
 - Geometry model
 - ▶ General form of geometry (vertical SD) deterioration is highly non-linear with contributions from static and dynamic forces
 - Defect model
 - ▶ Exponential relationship with cumulative tonnage
 - ▶ Linear relationship with geometry
- Track damage and other parameters drive maintenance, renewal and inspection work activities
 - Complex interactions between maintenance and renewals requirements
 - Work volumes link to standard NR unit costs
- Conclusion:
 - A general purpose fitting function is required
 - Form to be determined from sensitivity analysis
- Anticipated formula is similar to existing formula, subject to review of results:

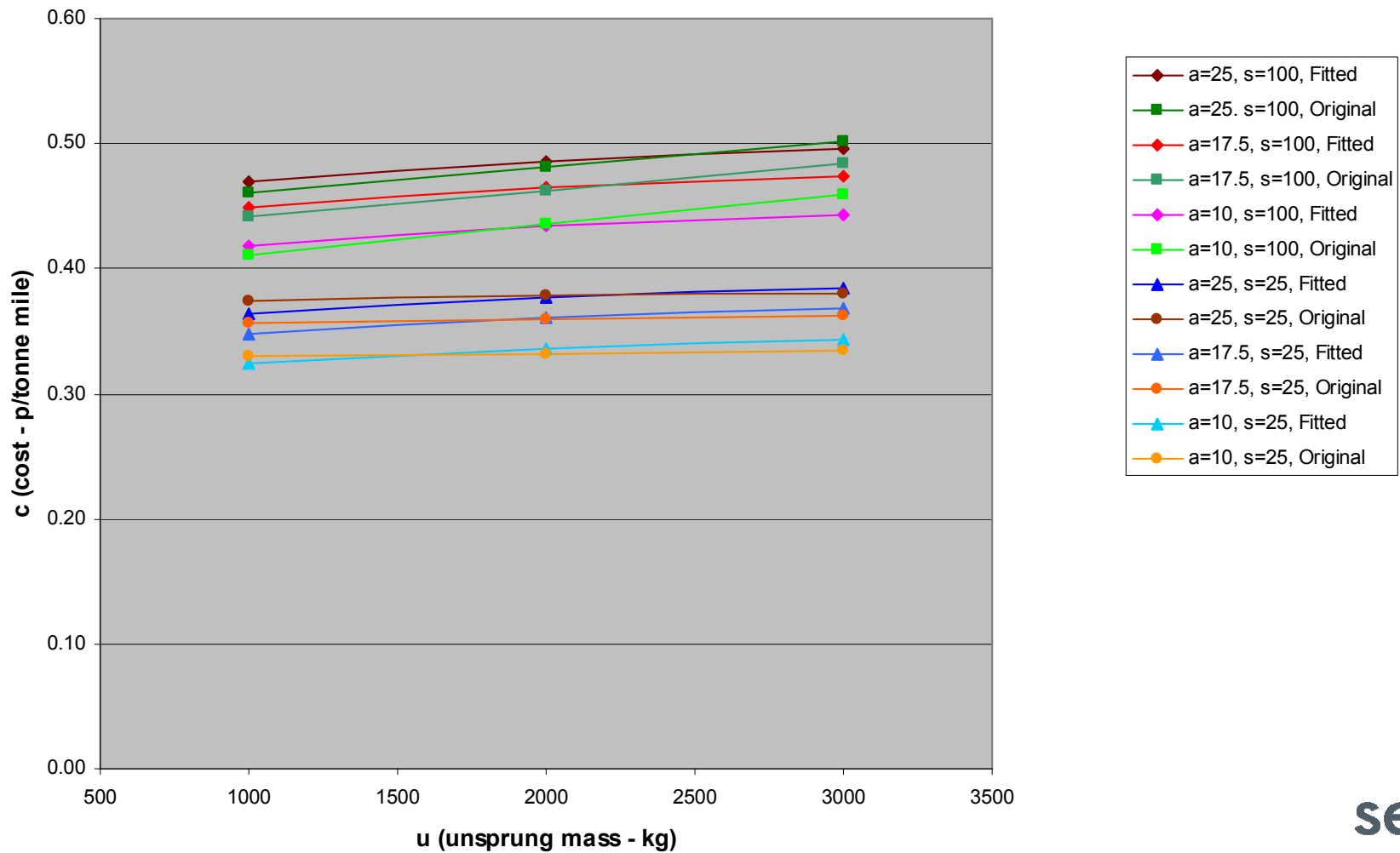
$$\text{Cost per mile} = k * A^p * S^q * \text{USM}^r$$

Initial results from ECML trial

- VTISM simulations of a fleet of artificial vehicle variants on ECML route section (approx. 120 miles, plain line only)
- 37 years projection period
- Total 18 combinations to cover sensitivity limits
 - Operating speed (25 and 100 mph)
 - Axle load (10, 17.5 and 25 tons)
 - Un-sprung mass (1,000, 2,000 and 3,000 kg)
- Cost (pence) per tonne.mile = $0.1 * A^{0.12} * S^{0.18} * USM^{0.05}$
 - Compare with existing vertical track damage equation:
 - ▶ **Equivalent Track Damage = $C_t * A^{0.49} * S^{0.64} * USM^{0.19}$ GTM (1)**
C_t is 0.89 for loco-hauled passenger stock and multiple units, and 1 for all other vehicles, A is the axle load (tonnes), S is the operating speed (miles/hour), and USM is the unsprung mass (kg/axle)
Further factors are applied for freight wagons to account for suspension types

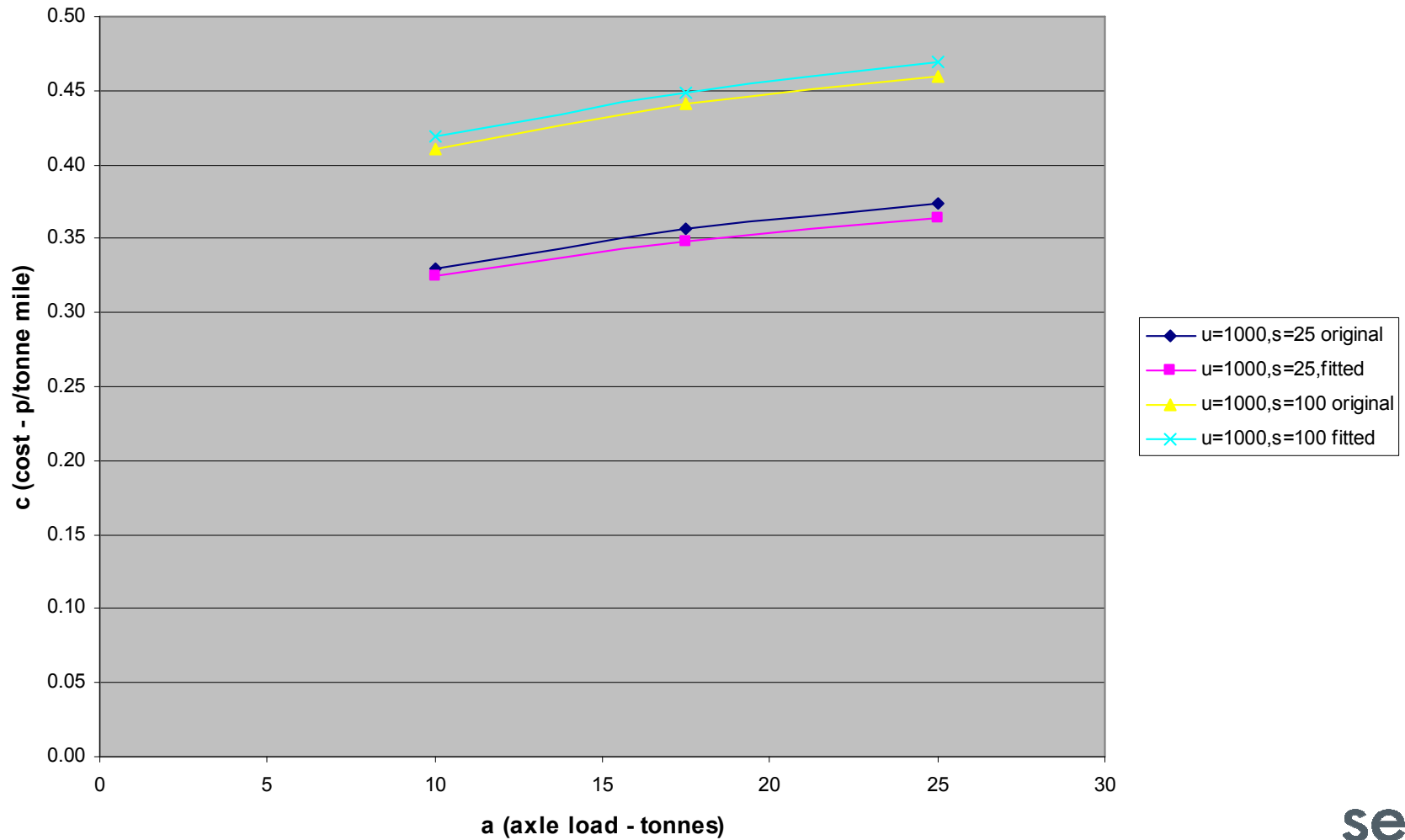
Cost vs USM

Cost vs. Un-sprung Mass



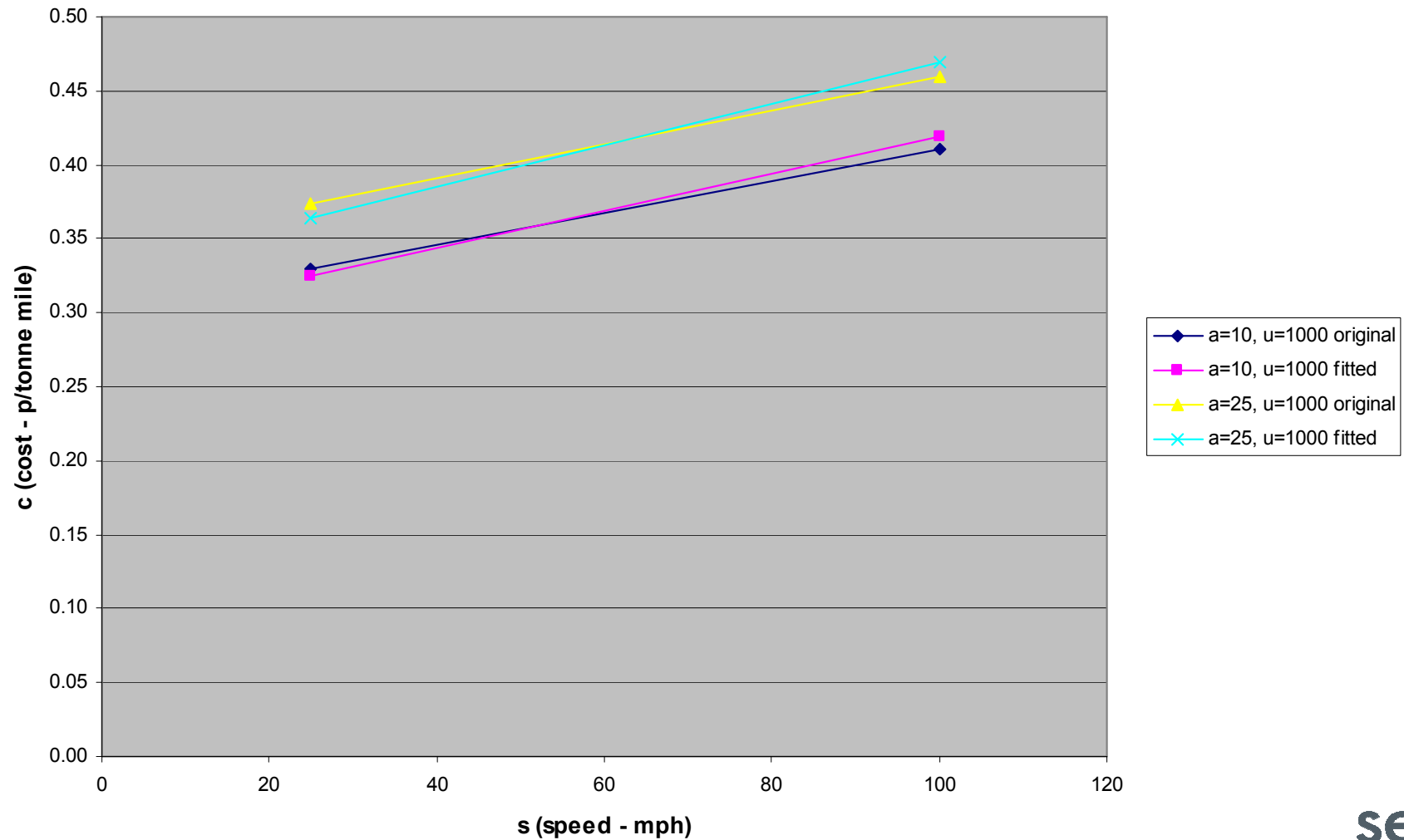
Cost vs Axle Load

Cost vs. Axle Load



Cost vs Speed

Cost vs. Speed



Timescales

- Present summary of methodology and initial results at the monthly track access charging meeting – **22 August 2012**
- Deliver draft report – **21 September 2012**
- Deliver final report incorporating comments from Network Rail and the industry – **5 October 2012 (assuming comments received by 28 September)**
- NR industry consultation on the VUC – **November 2012**
- Present summary of methodology and results to the industry at a CP5 VUC consultation workshop hosted by Network Rail - **November / December 2012**

Thank-you

- Q&A