Modular Techniques for S&C Installation
The “54 to 8” journey

Kevin Percival
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Network Rail
Requirements of Modular Switches & Crossing installation
The Network Vision in 2006
Modular S&C Sponsor

• “We must engineer our railway as a complete transport system which is…
  – On-time
  – Open 7 days a week
  – “Whole journey”
  – Low maintenance
  – Energy efficient
  – …at an affordable price”
Modular S&C Programme
Sponsors remit

- Switches & Crossing with improved ‘up-time’/quality
- Staged & increasing benefit delivery from 2006 to 2013
- Safe, repeatable, lean, seamless process
- Clarity, simplicity & standardisation
- Adopting best practice from UK & abroad
Modular S&C Programme
Sponsors remit

To be delivered through…

• New processes & behaviours for
  – Modular standard layout designs,
  – Optimisation of pre-assembly,
  – Transportation
  – Installation,
  – Equipment
Modular S&C Programme
2005 Typical installation durations

Lead or turnout ~ 36 hours
Modular S&C Programme
2005 Typical installation durations

Crossover ~ 54 hours
Modular Switches & Crossing Programme
Modular S&C Programme

Improvement Phases

• 1st Phase  “Early Deployment” – Process changes

• 2nd Phase  “Mark 1” – Standard “Modular” panel designs

• 3rd Phase  “Mark 2” – Tilting Wagon introduction

• 4th Phase  “Mark 3” – Develop 8 hour renewal methods
Modular S&C Change Programme
The Step-by-step S&C Journey

Early Deployment 37 hours
Process changes 2006 onwards

Mark 1.0 27 hours
Standard Designs - Panel assembly

Mark 2.0 21 hours
Tilting wagon (SCPV) delivery

Mark 3.0 8 hour
Optimised installation 2012 onwards

Tilting Wagons (SCPV)
Design - Build
2006 - 2009
Modular S&C Programme
Improvement phase - Early deployment

Early Deployment – target 37 hours
2006 onwards
Modular S&C Programme

Improvement Phase – Early Deployment

Planning
• Removal of waste, standardisation & parallel working

Transportation
• Switch panels by road

Construction
• Point Operating Equipment fitted prior to core possession
• Reduce set up & cycle times

Behaviour
• Challenge method, rates, resource & supervision
Modular S&C Programme
Improvement phase - Mark 1

- 54 hours
  < 2006

- Early Deployment – 37 hours
  2006 onwards

- Mark 1.0 – target 27 hours
  2007 - 2009
Modular S&C Programme
Improvement Phase - Mark 1

Design
• Standard Modular panel designs

Assembly
• Fit Points operating equipment & heating strips prior to installation

Transportation
• Panel assembly for road delivery

Construction
• Parallel working
• Introduction of Bearer Tie for Crossovers & Turnouts
Modular S&C Programme
Mark 1 – Bearer Tie

Bearer Tie – What is it?

- Conventional bearer cut in 2
- Drilled for 8 Vossloh Screws
- Rubber membrane underneath
- U-shaped Shroud (steel)
Modular S&C Programme
Mark 1 – Standard Panel designs

NR 60 C11 Lead

NR 60 C11 Crossover
Modular S&C Programme
Mark 1 – Trials site

Innerwick
Oct 2006

Hunterston
April 2007
Modular S&C Change Programme

Improvement phase - Mark 2

54 hours
< 2006

Early Deployment  37 hours
Process changes 2006 onwards

Mark 1.0  27 hours
Standard Designs - Panel assembly

Mark 2.0  21 hours
Tilting wagon (SCPV) delivery
2010 onwards
Modular S&C Programme
Improvement Phase - Mark 2

Design
- Standard Modular panel designs to fit wagon deck

Assembly
- Factory fit points operating equipment & heating strips

Transportation
- Panel assembly for rail delivery

Construction
- Parallel working & reduction of cycle times
- Introduction of tilting wagons
- Introduction of lifting & handling system
Modular S&C Programme
Mark 2   Changing installation from this.....
Modular S&C Programme
Mark 2  To this!
Modular S&C Programme

Mark 2: Innovative fixing & load handling system

• Eradicated the need to work at height
• Remote & quick fix & release from the tilting wagon
• Has a centre of gravity shifting device
• Handle both straight and curved panels
• Suitable for all UK Kirow cranes
  – under over head lines.
Modular S&C Programme
Mark 2    UK Tilting wagon W6a

Bearer length
Europe 4.8m
UK 3.5m
Modular S&C Programme
Mark 2    UK Tilting wagon

- Deck can be shifted to either side for easier planning and logistics:
Modular S&C Programme
Mark 2    Western: Heywood Road Jan 2010
Modular S&C Programme
Improvement Phase - Mark 3

- **Mark 1.0** 27 hours
  Standard Designs - Panel assembly

- **Mark 2.0** 21 hours
  Tilting wagon (SCPV) delivery

- **Mark 3.0** 8 hour
  Optimised installation

   2012 onwards
Mark 3 aim:

To prove the techniques & processes to achieve full Modular S&C installations in 8 hour modules.
Modular S&C Programme
Improvement Phase - Mark 3

Planning

• Adopt TiLoS – Time distance planning software

Construction

• Adoption of System Engineering processes to prove optimal 8 hour solution.
• Create testing, proving & contractor rehearsal facility at Beeston, Nottingham
• Utilise “3D” for design, controlling excavation plant, panel installation & real time geometry recording
Modular S&C Programme Mark3
TILOS : Time LOcation Software

- Time – Distance Planning
  - Combines staging drawings and bar charts into one system
  - Allows distance to be taken into consideration when planning works
  - Shows the plan for all time slots
  - Allows quick analysis of changes to elements affecting the work
Modular S&C Programme: Mk 3.0

**Systems Engineering for S&C renewals**

- **Set** **System goals** - 8 hour S&C installation trial
- **Measure** all S&C track renewal activities – video & data analysis
- **Apply** **Lean** thinking & remove **Waste** from the existing system methods
- **Explore** **alternative** system activities, processes & equipment
- Selection and implementation of the **best activities** (balanced, repeatable and robust)
- **Verify** that activities are actually built and properly integrated in accordance with specifications
- **Assess** how well the system meets the goals
Modular S&C Programme: Mk 3.0

Systems testing at Beeston: Sub systems

1. Dismantle track ~ 13 sub systems
2. Excavate track-bed ~ 14 sub systems
3. Lay & compact bottom ballast ~ 20 sub systems
4. Install track ~ 21 sub systems
5. Place top ballast ~ 5 sub systems
6. Join & weld ~ 5 sub systems
7. Level & line ~ 4 sub systems
8. Signal test & commission ~ 83 sub systems trials
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td>Safety risk</td>
<td>Required competency</td>
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<tr>
<td>Unit cost</td>
<td>Training requirements</td>
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<tr>
<td>Production rate</td>
<td>Specialist equipment</td>
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<td>Manpower required</td>
<td>Deployment ease</td>
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<td>Quality</td>
<td>Industry acceptance</td>
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Modular S&C Programme: Mk 3.0
Testing, proving & contractor rehearsal facility

Beeston

Before

After
Modular S&C Programme: Mk 3.0
Systems Engineering: Results

• 8 hour S&C installation proof of concept achieved
  - Best in class recorded sub 7 hour rehearsal
• All existing S&C contractors trained & rehearsed
• Uses existing rail construction equipment in an optimised way
• Knowledge transfer available through web based “Modular S&C portal”
### Modular S&C Programme: Mk 3.0

**Systems Engineering: The knowledge portal**

#### Modular S&C – Activity Reference Portal

**S2 Excavate**

S2.2.3 – FSE 2D – 3D Doze – Static Train (REMOVE BALLAST)

Removal of the old ballast using an FSE (2D) and a 3D Laser Dozer with a stationary train.

- **Data**
- **Video Clip**
- **Sample Photos**

Only recommended for sites where excavated volume is less than

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<td>-</td>
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#### Health & Safety Risk Assessment

#### Method, Equipment & Resource

#### Task Briefing Sheet

#### Lessons Learned
Modular S&C Programme: Mk 3.0

Systems Engineering: Innovations

Dismantle Bruff mounted disc cutter

400mm “Durablade” disc

Triple “whacker” compaction in one pass

Ratchet jack

3 D – No tapes!

Bearer tie magnetic lifter
<table>
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<tr>
<th>Location</th>
<th>Type</th>
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<tr>
<td>Bamfurlong</td>
<td>Crossover</td>
<td>LNW</td>
<td>21 hrs</td>
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<td>Farnborough</td>
<td>Crossover</td>
<td>Wessex</td>
<td>21 hrs</td>
</tr>
<tr>
<td>Willesden N\textsuperscript{th} Jcn</td>
<td>½ Crossovers</td>
<td>WCML S\textsuperscript{th}</td>
<td>&lt; 12 hrs</td>
</tr>
<tr>
<td>Hesk Bank</td>
<td>½ Crossovers</td>
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<tr>
<td>Shap Summit</td>
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<td>&lt; 12 hrs</td>
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<tr>
<td>Whitlocks End</td>
<td>½ Crossovers</td>
<td>Chilterns</td>
<td>&lt; 9 hrs</td>
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<tr>
<td>Wool</td>
<td>½ Crossovers</td>
<td>Wessex</td>
<td>&lt; 8 hrs</td>
</tr>
<tr>
<td>Whareham</td>
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<td>&lt; 8 hrs</td>
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Modular S&C Programme:

- Bamfurlong Crossover
  - LNW
  - 21 hrs

- Farnborough Crossover
  - Wessex
  - 21 hrs

- Willesden Nth Jcn Half Crossovers
  - WCML S
  - < 12 hrs

- Hesk Bank Half Crossovers
  - WCML Nth
  - < 12 hrs

- Shap Summit Half Crossovers
  - WCML Nth
  - < 12 hrs

- Whitlocks End Half Crossovers
  - Chilterns
  - < 9 hrs

- Wool Half Crossovers
  - Wessex
  - < 8 hrs

- Whareham Half Crossovers
  - Wessex
  - < 8 hrs
Modular S&C Programme

Improvement Phases: The future!

- 1st Phase “Early Deployment” – Processes changed
- 2nd Phase “Mark 1” – Standard “Modular” panel designed
- 3rd Phase “Mark 2” – Tilting Wagon introduced
- 4th Phase “Mark 3” – Developed 8 hour renewal methods
- 5th Phase “Mark 4” – Developed 6 hour renewal methods
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