



# **Crossrail Rolling Stock and Depots Project**

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# Crossrail Background

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Bombardier had lost the Thameslink contract

Derby threatened with closure

Electrostar phasing out

On the back of VLU and SSL, Bombardier invested in the new AVENTRA train platform development

- 150 engineers
- Procurement specialists
- Methods and manufacturing team

12month programme, £15m investment, coincidental with Crossrail tender

# Crossrail: Challenge to design best in class platform *from existing portfolio to AVENTRA*

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- **High function:**
  - Good passenger and driver environment
  - Configurable functionality
- **Low Cost to manufacture**
  - Competitively priced capital
- **Low cost for maintenance team:**
  - World beating maintenance costs
  - World beating reliability
- **Low cost for operator:**
  - Low weight
  - Low energy
  - Low track damage



# Crossrail: Challenge over and above the platform *from AVENTRA to Crossrail*



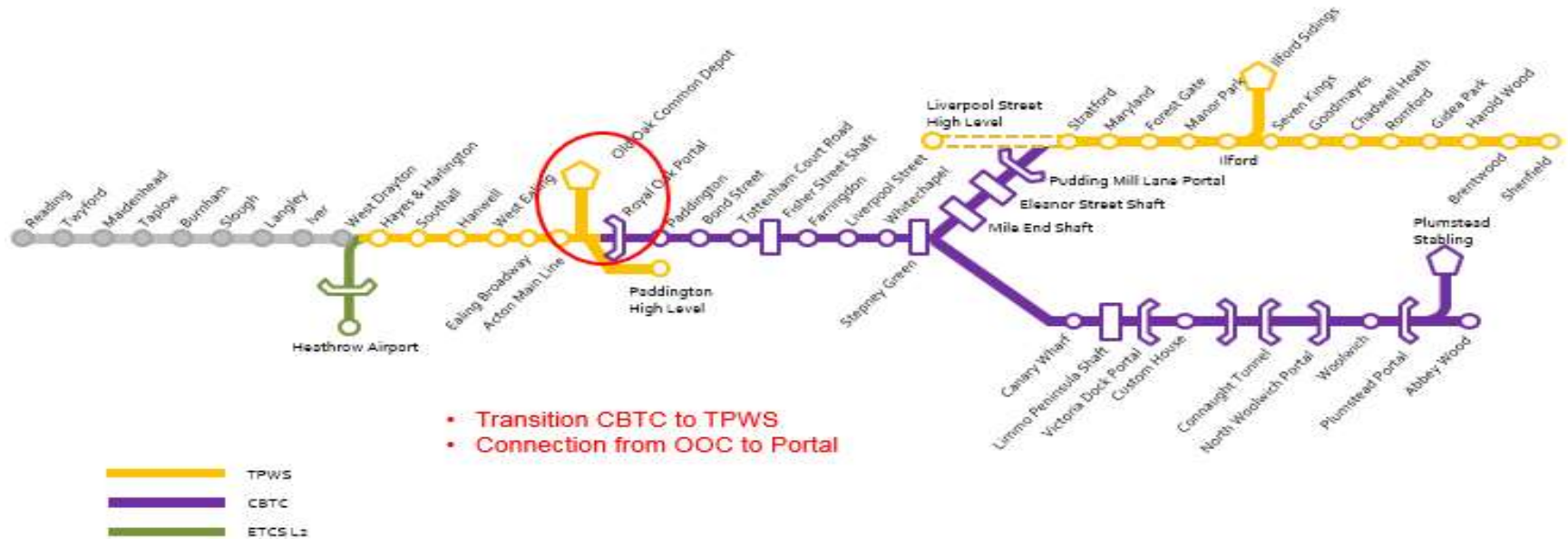
## Additional Crossrail Scope

- Deliver first trains as 165m to extend to 205m
- Massive level of wayside connectivity
- DOO CCTV wayside equipment
- Iconic looks and interior design
- 30 year maintenance contract
- Build a depot (£180m)
- Interface to platform edge doors
- 3 types of Signalling including ATO



# Signalling Integration

## Signalling for Crossrail



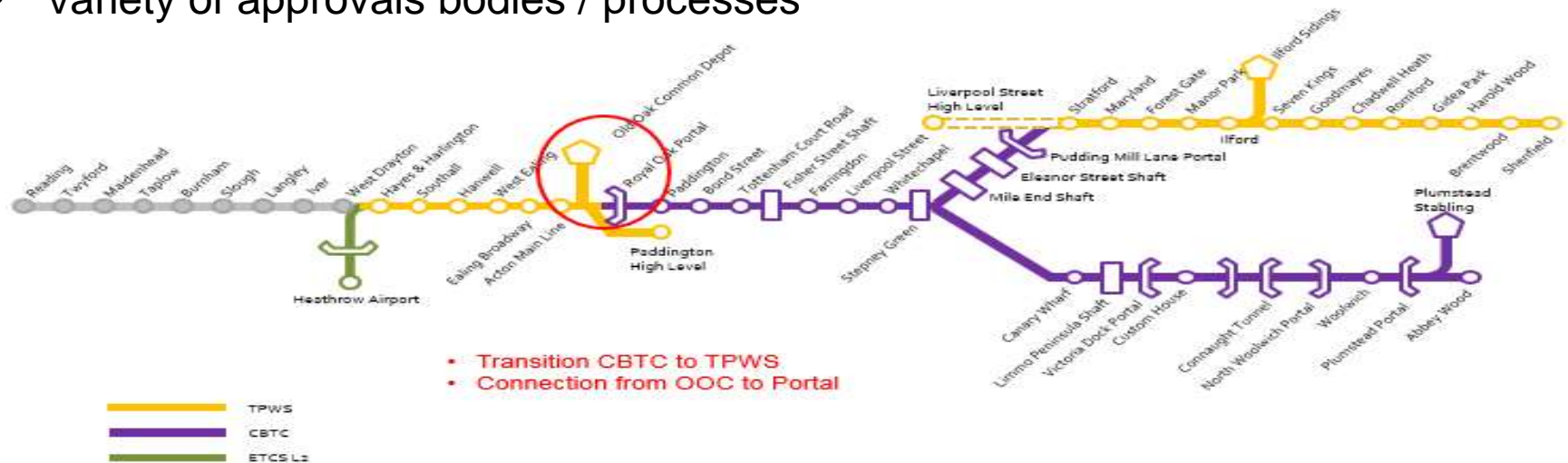
- 3 different systems, 3 different suppliers
- All new developments
- Handover on-the-move



# Crossrail: Challenge over and above the norm

## Process

- Significant integration challenges – integrate to:
  - Legacy Network Rail infrastructure on Great Eastern
  - Legacy Heathrow Infrastructure and Network Rail infrastructure on Western
  - Brand new Crossrail tunnels
- Variety of approvals bodies / processes



# Crossrail

## Engineering challenge

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- 12 volumes of contract documents translated into 34,000 vehicle level requirements all of which need to be demonstrated to the satisfaction of an approver either through test, argument or both
- 148 train level test specifications
- 150 engineers in 13 different countries



# Crossrail

## validation of requirements: noise

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- Validation of requirements eg....



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# Crossrail

## validation of requirements: reliability, endurance

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IFE Doors:

- 176mi cycles of guidance system
- 100mi cycles of motor / rack & pinion / gearbox
- 4 mi cycles of locking system

Test in dusty environment, cold environment, cars laden, cars passing.....etc



# Crossrail

## Engineering challenge

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Complex functions require simulation to ensure integration issues identified and resolved quickly

- Train test
- Whole train off train system integration testing (Train zero)
- Off train systems integration between systems (eg signalling Integration rig<sup>S</sup>)
- System integration testing (eg propulsion, doors)

This is a significant investment into the UK Bombardier site

# Crossrail

## Engineering integration effort

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Train Zero: (Derby)



Propulsion Clean Software Tool: (Vasteras)



Signalling Integration Rig: (Derby BT, Stockholm RCS & Germany Siemens)



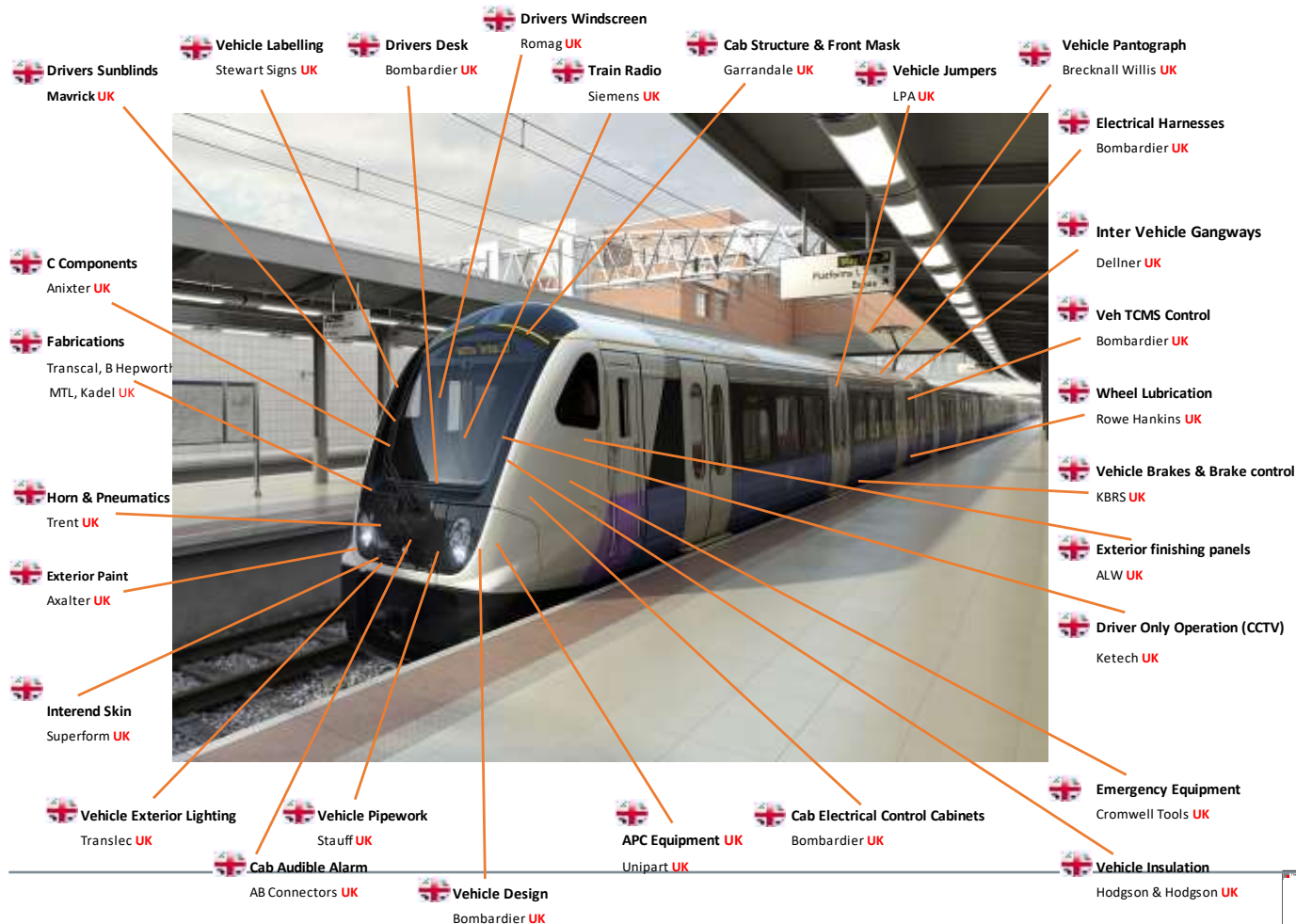
# Crossrail

## Process Flow – how do we build trains?



# Crossrail Procurement Challenge

- Number of purchased parts are; 2,532
- Crossrail has approximately 70 suppliers, of which 28 are UK entities (40%)



# Crossrail

## Challenges translated: quality



# Crossrail Finished design



# Crossrail

## Status

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- 5 test trains built and undergoing type test
- 2 trains at Old Dalby
- 1 train about to go to network testing
- 1 train about to start ATO testing at Old Dalby
- Series build commenced
- On target for Stage 1 Service start date (May 2017)
- Signalling development on track for Stage 2 (Western) and Stage 3 (Central section) service start dates
- Depot building largely complete – fit-out and yard works to complete

# Crossrail Status

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# Delivering London's latest most iconic new train for prestigious Crossrail contract: Legacy



## Crossrail Project

- 65 x 9-car trains (585)
- Entry into service from 2017
- £80 million product development
- £16 million facility investment at Derby
- Jobs at BT:
  - Team of 190 engineers in Derby
  - 760 manufacturing jobs
  - 80 apprenticeships
  - Others.....
- Jobs elsewhere:
  - At least 15 major tier 1 UK contracts – ranging from £200k to £35m
  - Several smaller UK contracts
  - Many tier 2 and tier 3 contracts into non UK companies
  - Multiple support contracts with Derby based rail consultancies
- Unparalleled integration experience
- Healthy UK order book

