

London Underground Asset Management Strategy Summary

June 2016
Version 1.2



EVERY JOURNEY MATTERS

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1. Foreword

London is at the heart of the UK economy and continues to grow with forecast population levels predicted to increase to just under 10million by 2030.

As the population grows, so will the city with new housing and businesses planned over the coming decades. An efficient and reliable transport network is therefore key to unlocking the growth of our Capital city.

London Underground is at the heart of this transport network and in response to increasing demand, upgrades to the capacity on Jubilee, Victoria and Northern lines have already been undertaken with plans in place to increase services even further on those lines.

The four lines modernisation programme (Metropolitan, District, Hammersmith & City and Circle) is well under way, introducing 191 new trains and upgraded signalling systems.

Beyond that, investment is planned to provide a 'New Tube for London' which will introduce 250 new trains, upgraded signalling, power and cooling systems onto the Piccadilly, Waterloo & City, Bakerloo and Central lines.

Planned extensions to the Northern and Metropolitan lines as well as a portfolio of station capacity schemes complete the means by which the capacity challenge will be met.

Over the last decade network reliability has improved by 50% and with it an increase in customer satisfaction, all against a backdrop of rising customer expectations and a more intensively used and crowded network. In addition, operational costs have continued to reduce.

London Underground's physical assets will play a major role in enabling our ambition to provide world class customer service not only through growth of the network but also by continuously improving reliability and delivering further cost reductions.

This Asset Management Strategy is aimed at informing internal and external stakeholders, as well as industry peers and suppliers; about the significant role LU's asset will play in meeting the challenges over the coming decades. It sets out the long term approach to managing assets and ensuring that the goal to keep London moving and growing be met. It also acts a key contributor to informing our medium and long term Line, Asset & Network Plans (LANP).

2. Background

This LU Asset Strategy sets out the long-term direction for our key physical assets, notably: Rolling Stock & Depots, Signalling & Control systems, Power, Track, Civils, Stations (including Lifts & Escalators) and Information & Communication Technology. The strategy outlines the role and contribution of our assets and how, through TfL’s Asset Management Policy and LU’s Asset Management Framework, we will manage them in order to assist the delivery of our Purpose, Promise and Ambition through our Priorities.

2.1 Our Purpose, Promise, Ambition & Priorities

London is a growing city, not only in terms of its population (forecast to grow over the next decade by the equivalent of two full tube trains every week), but also in terms of its reputation on the world stage and its importance to UK economic development.

Our response to this is to offer a Purpose, Promise and Ambition for the future of our network which sets a strong direction and imperative for change:

Our Purpose

To keep London moving, working and growing and make life in our city better

Our Promise

Every Journey Matters

The promise to our customers every time they travel.

Our Ambition

To be a customer-focused, commercially driven service provider and the envy of transport authorities, cities and governments around the world

Our Priorities

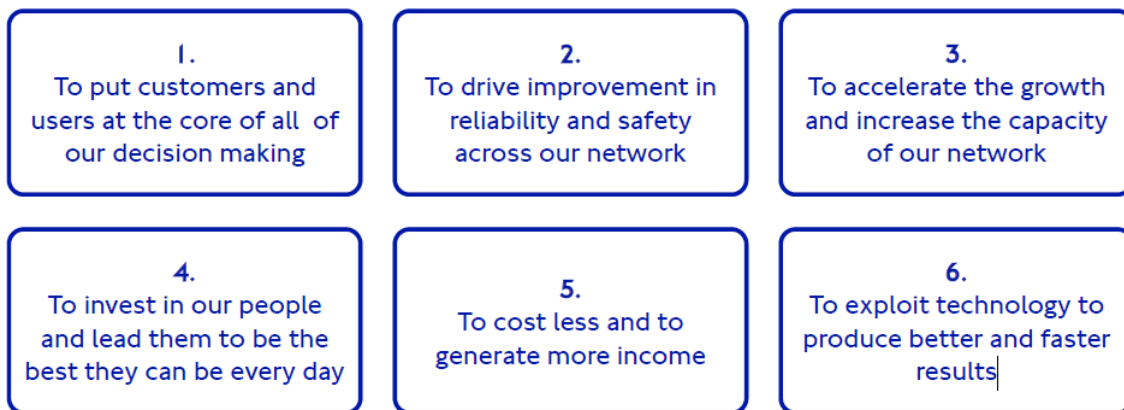


Figure 1: The TfL Priorities

Our priorities provide a focus for us both as individuals and as an organisation on what we should be doing to deliver every day and achieve our Ambition:

1. To put customers and users at the core of all of our decision making

Our customers are at the heart of what we do. Customer satisfaction levels are high but we still need to respond to rising expectations by offering our customers even greater value for money and a personalised level of service, supported by cutting edge technology that will make our system even easier to use.

2. To drive improvement in reliability and safety across our network

These are the foundations for the whole of our service. Our safety record is one of the best in the world but we must never be complacent – the safety of our customers and our people must always come first. We have also improved our reliability and met the Mayoral target for reducing delays by 30 per cent. But as our customer numbers grow and the capacity of our network is put to the test, further improving reliability is becoming both more important and more challenging.

3. To accelerate the growth and increase the capacity of our network

To enable London to grow, we need our network to function as part of a comprehensive, integrated transport system. Investing in our current assets to maximise their capacity and reliability, both now and in the future, will not only help us to manage the rising demand we are experiencing on the network but will also support London's growing economy.

4. To invest in our people and lead them to be the best they can be every day

Our people are the most important part of our organisation. You are essential to achieving Our Ambition.

5. To cost less and to generate more income

This is about much more than making efficiency savings; it is thinking about how we operate, the resources we use and the quality of our planning and budgeting, as well as using innovative ways to generate more income to ensure that we get the most out of what we have as well as delivering at a sustainable cost.

6. To exploit technology to produce better and faster results

This is about using technology to provide the best level of service we can to our customers and to improve our ways of working to be better and get things done faster.

In summary, our **Purpose**, **Promise** and **Ambition** set a clear direction for the business and our Priorities provide the focus on how we should deliver. It is within this context that LU's Asset Strategies (summarised below) have been developed.

3. The Role of our Assets

So what are our assets, how will they contribute to the delivery of our **Purpose, Promise** and **Ambition** through our **Priorities**, and how are they managed?

3.1 Our Assets – In Numbers

We manage an extensive and varied asset base that requires high quality stewardship. In 2014/15, LU operated 80m train km, enabling 1.305bn passenger journeys. An operation of this magnitude is only made possible by the effective management of our:

619	Trains
14	Maintenance depots
4	Major signalling systems (soon to be 5)
1,000+	Kilometres of track
1,000+	Points & Crossing units
270	Stations
427	Escalators & Passenger Conveyors
196	Lifts
500+	Kilometres of drainage
16,000	Bridges & Structures
350	Kilometres of Deep Tube Tunnels
235	Kilometres of Earth Structures
Plus	Numerous other communication, fire, electrical, mechanical and power systems

The cost of maintaining and renewing these assets is approximately £2.4bn per annum, which represents around 60% of LU’s total budget:

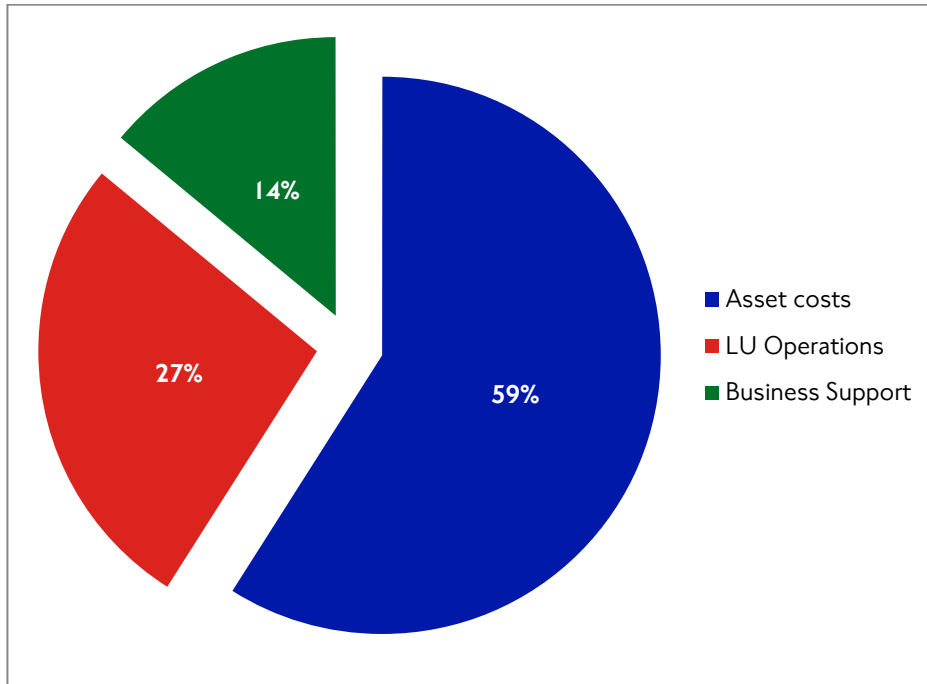


Figure 2: Breakdown of LU budget (TfL Business Plan)

Approximately 60% of the investment in assets focuses on upgrade and renewal projects, with 40% supporting day-to-day maintenance:

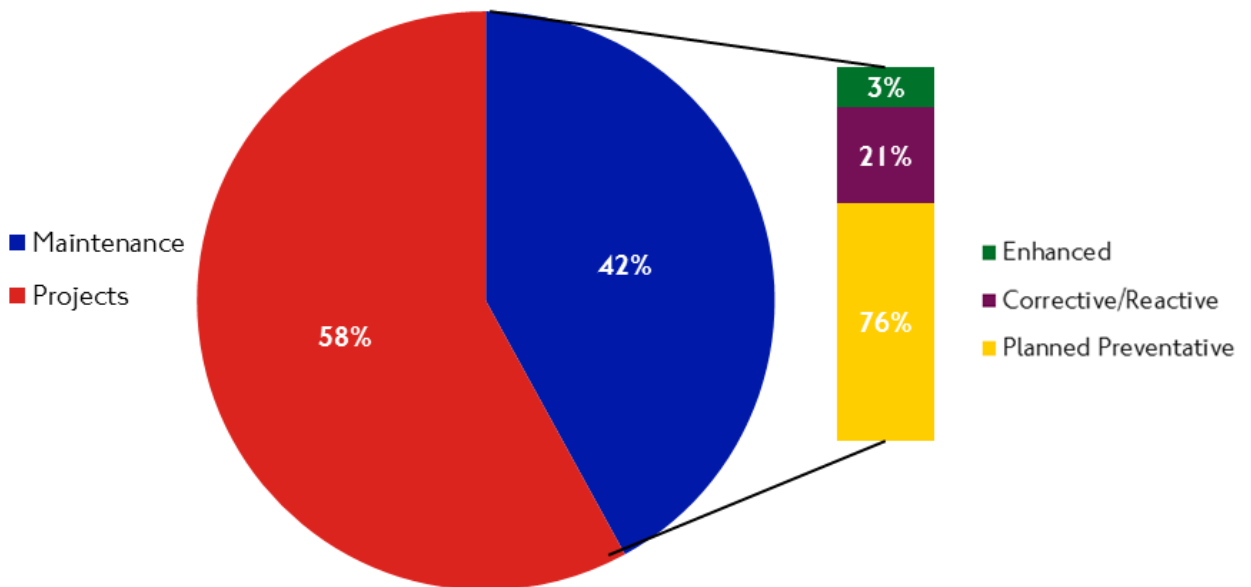


Figure 3: Breakdown of LU asset spend by type of spend (TfL Business Plan)

With 80% of the investment focusing on trains systems, track and stations:

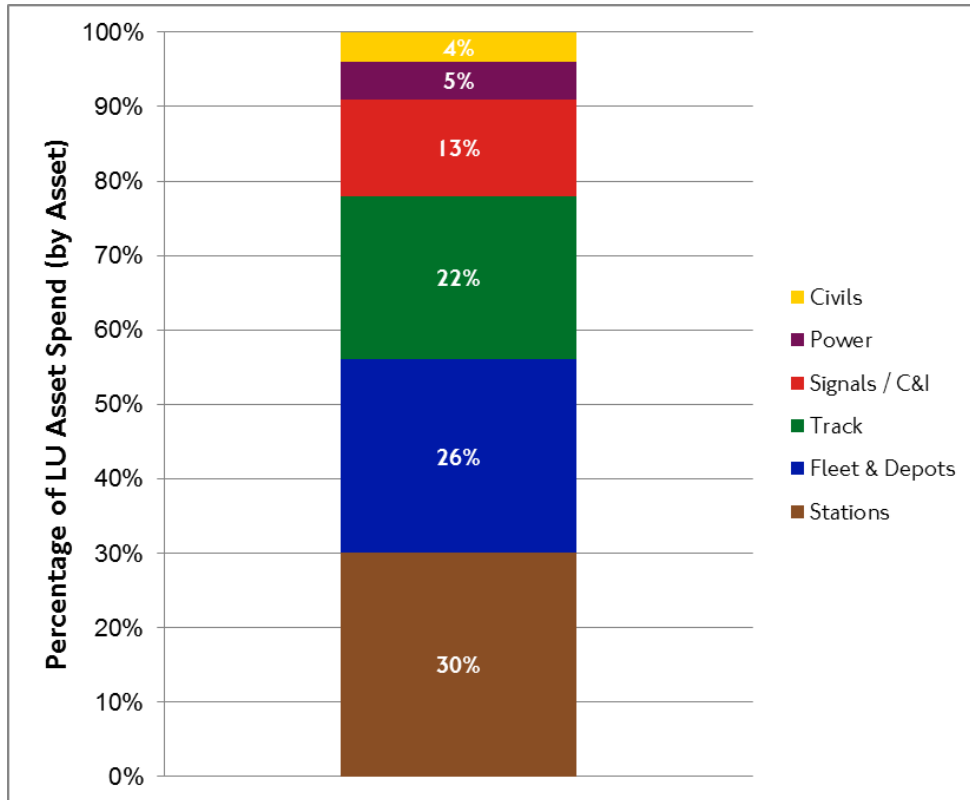


Figure 4: Breakdown of LU asset spend by asset (TfL Business Plan)

Tube Reliability has doubled since 2000, and enhancements to our assets have played in big role in reducing delays:

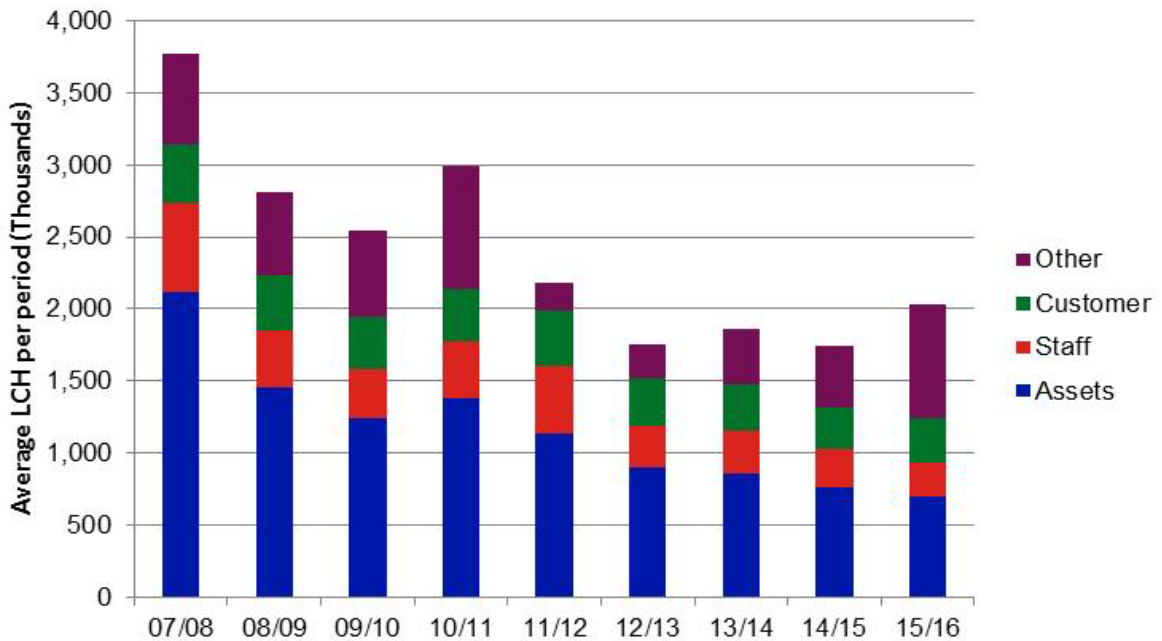


Figure 5: LU Reliability (Last Customer Hours)



But asset related failures still account for 50% of the total delays on the network, and we must continue to support the drive for improved reliability, focusing on those assets which offer us the greatest opportunities (or risks):

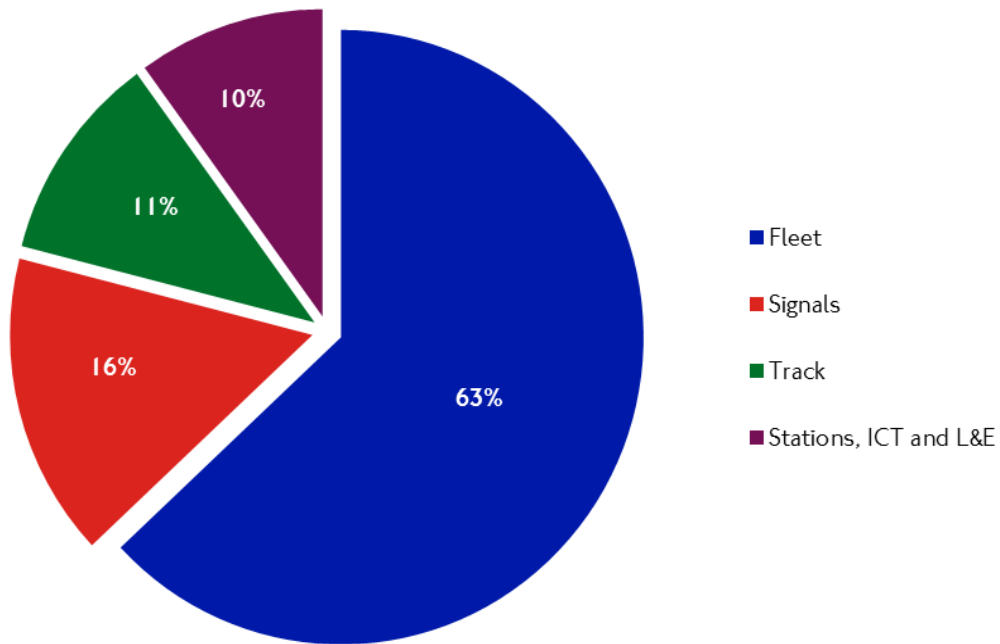


Figure 6: Breakdown of Total Lost Customer Hours for Assets (by Asset)

3.2 Our aim to achieve World Class delivery

The Asset Strategies set out a long term aim over their 40 year timeframe of becoming world class. Whilst the current financial restrictions are likely to make this more difficult to achieve it is important that we maintain a clear vision of how our assets will achieve our long term strategic priorities. The CoMET/NOVA benchmarking study ‘International Metros Benchmarking study How World Class are we?’, highlights LU’s current position against 32 other Metros using 2014/15 data. LU’s position is summarised below for three parameters, demonstrating that whilst LU has made significant progress there is a long way to go.

Operating Cost: LU is still amongst the most expensive metros to operate on a cost per passenger basis. LU is approximately 150% more expensive than the average cost of metros. When adjusted for structural factors (wages, network age and intensity of service) LU’s costs are slightly above average and 100% above world class.

Labour Productivity: LU’s labour productivity is around average, but significantly behind World Class whilst DLR is the fifth best. Whilst LU’s labour productivity is improving, mainly due to increasing passenger journeys. LU would need to improve by 9% p.a. for the next 10 years to match World Class.

Reliability: LU’s reliability has improved from the average of Western European & North American metros, to the average of all metros, but we are still 80% below Barcelona’s performance despite 66% improvement between 2010/11, in 2014/15. LU on average, has older rolling stock and signalling equipment than the World Class metros and no world class metro have trains that are controlled manually.

4. LU's Asset Framework

LU's approach to Asset Management is structured around its Asset Management Framework.

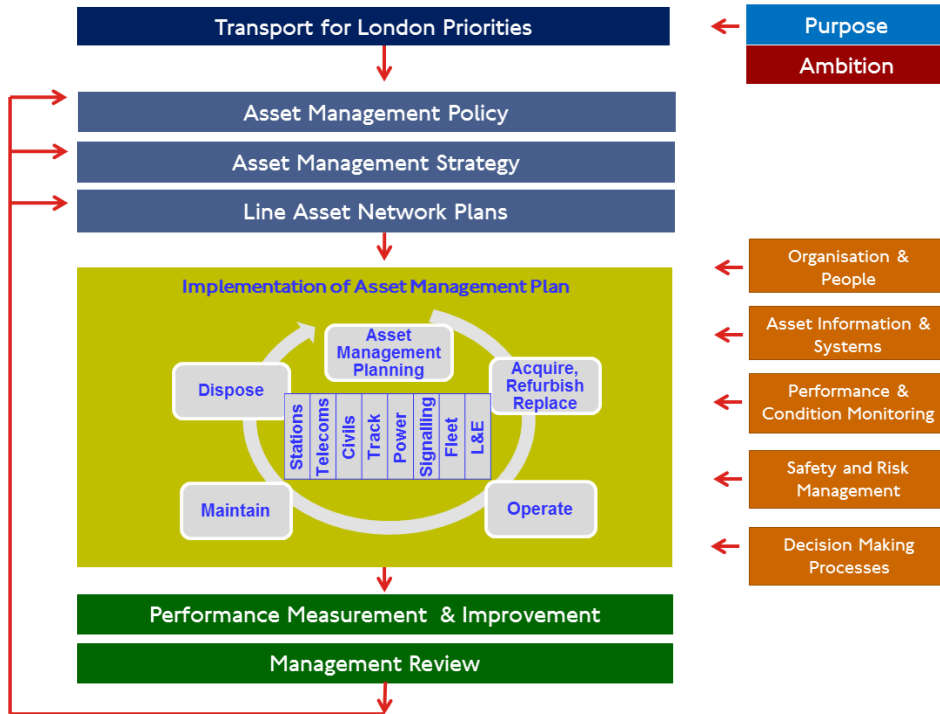


Figure 7: Asset Management Framework

4.1 Asset Management Policy

Our Asset Management Policy States how we will manage our assets:

TfL shall use effective, efficient and sustainable asset management practices for its physical assets to support the achievement of customer, Mayoral and organisational goals and outcomes. Asset management shall be holistic, co-ordinated, consider the whole lifecycle of the assets, and deliver optimum whole life value through informed decision making that takes account of safety, risks, performance, the environment and costs.

4.2 Our Asset Management Goals

Embrace new and proven technology. We must make the most of new and innovative solutions and ensure we maximise functionality, so as to deliver the most value from our investment and our asset base.

Reliability by design: Reliability will be designed upfront, ensuring seamless integration between old and new. This is central to our transformation to becoming world class. As part of this our assets need to remain available and perform well, even in the midst of project delivery. The correct balance must be struck between closing the network for work and keeping the service running.

Whole life value: As part of the drive for greater efficiency, an increasingly mature whole life view

practice in order to realise significant productivity and process savings. In essence, we will make the right decision for our assets and ensure that these are delivered at the right price. Energy efficiency will be driven towards as part of this search for lower whole life costs.

Safe: TfL has a proven track record of safe delivery and we will utilise the knowledge and expertise we have gained to successfully deliver the future upgrades and network extensions that London’s development is dependent on, ensuring that we put the principle of “Zero Harm” at the heart of everything that we do for our customers, staff and contractors.

4.3 How we are organised

LU is set up as a sponsor/deliverer organisation. The sponsor acts as an internal client to make sure that the needs of the business are being addressed at every stage of the asset lifecycle. Work is delivered by the project and maintenance teams and the support functions work with both the sponsor and the delivery teams and provide consistent services to all parts of the organisation.

Each group of assets has a strategy which details the asset goals and how these goals will be achieved. These strategies are detailed further in this document.

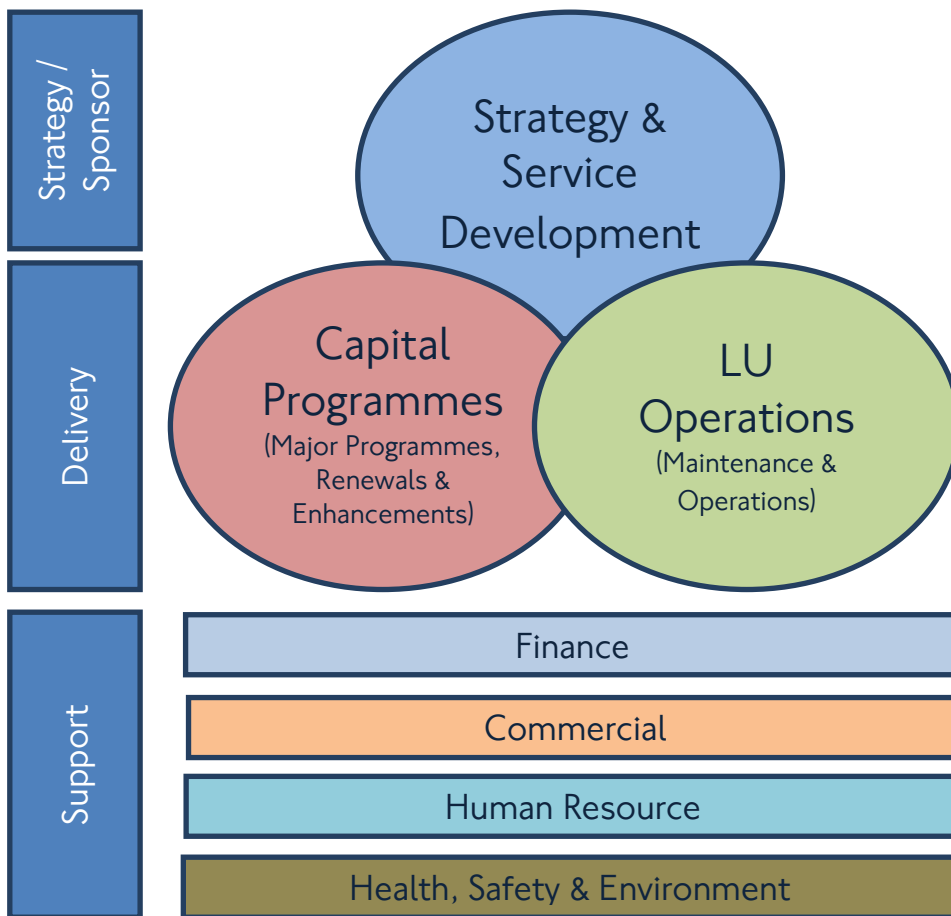


Figure 8: the Sponsor and Delivery organisation

5 Rolling Stock & Depots Asset Strategy

This strategy sets out the vision and objectives to achieve a world class position whilst achieving our goal:

“to efficiently deliver and sustain safe, reliable, clean, and comfortable trains for all customers”

5.1 Overview of Assets

There are 7 types of passenger rolling stock on the LU network comprising 619 trains made up of 4,316 cars, operational heritage trains and rail adhesion trains. These operate on 11 lines and are maintained at 14 maintenance depots. There are numerous sidings where trains are stabled overnight and occasionally minor maintenance is also performed. Rolling stock accounts for 39% of maintenance and 27% of total capital costs.

Over the last 12 years the average reliability of LU rolling stock has improved significantly from 5000km to 24000km Mean Distance Between Failure (MDBF). The asset portfolio spans a broad spectrum of age and performance and as such brings different requirements and challenges.

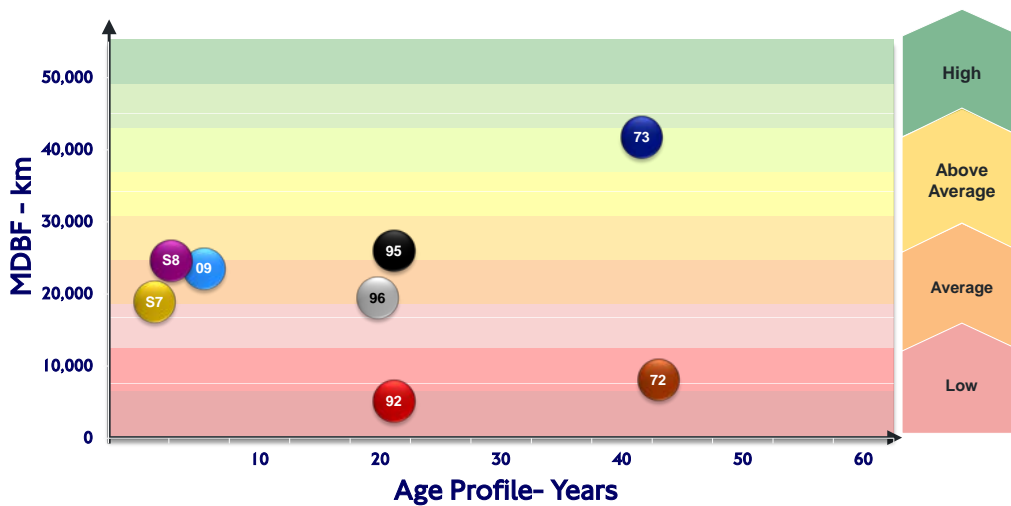


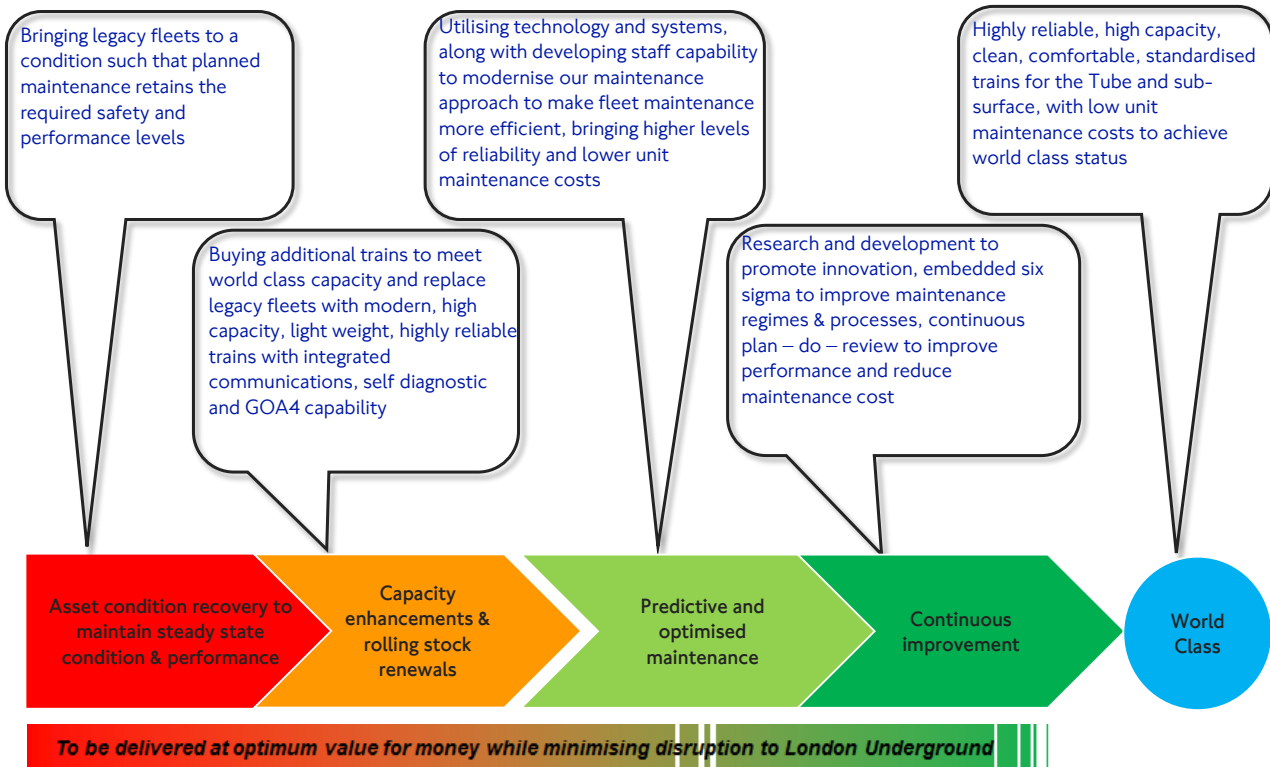
Figure 9: Rolling Stock Age and Performance Profile

The variation in the performance is largely due to design robustness, simplicity and the historical level of investment. We aim to reduce this variation and achieve parity. The long term objective is to improve reliability, ambience and capacity, whilst maintaining low whole life costs and reducing the variation in performance between fleets. The demand loading is ever increasing with signalling upgrades and timetable changes. This ever increasing growth demand will put additional pressure on our trains and train components, resulting in additional maintenance activities and renewals.

Depots are used for stabling and maintenance of both engineering and passenger rolling stock. Within the confines of a depot environment, there are a large number of asset types. The condition of the depots varies from recently upgraded to almost 50 years old and in some cases availability of space present a significant challenge to increase capacity of the depots to meet train maintenance requirements.

5.2 Asset Strategy

Effective asset management is important to ensure that investment is made in line with the strategy to meet the demands of both the current and future railway while reducing the overall cost to achieve world class status. The diagram below sets out the rolling stock strategic framework of LU's journey to world class.



The legacy investment programme will continue to recover the condition of the Bakerloo, Piccadilly, Waterloo & City and Central fleets to an acceptable level from where normal maintenance and minor works will sustain their performance, ambience and safe operation. Following this recovery of condition, in the early 2020's, our optimised maintenance regimes will continue to maintain asset condition and service life until their replacement. This improved condition and reliability will reduce unit maintenance costs and permit increased capacity from our existing fleet.

Our rolling stock will support the capacity uplifts provided by line extensions such as the MLX, NLE and possible Bakerloo Line Extension. We will support this through the provision of extra trains where necessary and ensuring our trains can meet the increased demand that this and signalling upgrades will bring.

The Piccadilly, Waterloo & City, Bakerloo, and Central lines will be renewed as a part of the New Tube for London (NTfL) programme from 2022 to 2033 bringing modern, technologically enabled assets which improve safety, capacity and automation. New fleet designs will meet the future needs of our customers and staff and consider their impact on the environment, maintainability, operability (including the capability of GOA4 operation), and provision of real-time customer information. The new rolling stock will be maintenance friendly with a modular design, enhanced diagnostics capability and through gangways. New fleets with high reliability and capacity will allow

In 2035/36, the rolling stock on the Jubilee and Northern will be nearly 40 years old and a decision on whether to replace or extend their life will be required. The future NTfL trains are required to be compatible with any future signalling system that is installed on these lines. The new signalling system will be a CBTC based moving block system with the capability of unattended train operation i.e. GOA4 (Grade of Automation 4 operation).

After delivery of the NTfL programme, our strategy to increase capacity on the existing network will be largely satisfied and there will be limited opportunities for further step changes in capacity improvement. As such, our main focus will then be to maintain asset condition in a steady state, reduce unit maintenance costs and improve performance through the further adoption of risk based and ultimately predictive maintenance practices and the continuous improvement of maintenance.

A transition will then be made to a 'risk based and predictive maintenance' asset stewardship approach supported by remote condition monitoring. This will reduce service affecting failures by detecting problems before they occur and enabling trains to be withdrawn from service before they cause service disruption. The transition to a predictive requires significantly higher quality, real time data to inform decision making.

Finally, we will enter a phase of continuous improvement. Maintenance regimes will be optimised to transfer maintenance periodicities from a calendar/ service day based approach to a condition and usage basis to focus interventions on criticality. These regimes will exploit our knowledge of the assets with remote condition monitoring technology integrated with our maintenance management system and a utilisation of hand held technology. Extending maintenance intervals whilst avoiding impact on safety and performance will reduce whole life maintenance costs.

We will continue research and development to explore & trial new technologies that can reduce whole life cost and improve performance. We will promote an environment of continuous improvement to deliver world class performance by identifying what is best possible for each line's fleet through the use of benchmarking, both internal and external, coupled with a commitment to work with industry peers and our supply chain to implement the advantages offered by technology.

The depot asset comprises plant, equipment and buildings. Depots provide a vital supporting and it is vital that depot buildings and equipment are upgraded and maintained so they support rolling stock to in delivering the level of customer service required by our strategic goals

Modern trains will contain more computerised equipment and require a different type of maintenance. As new trains are delivered onto the network by the f upgrade programmes over the next 30 years, depots will also be upgraded to provide high quality facilities. . Our goal for depots is to deliver an efficient and flexible service for the delivery of rolling stock maintenance and engineering activities across the network to ensure that optimal capacity is achieved at all times

6. Signalling & Control Asset Strategy

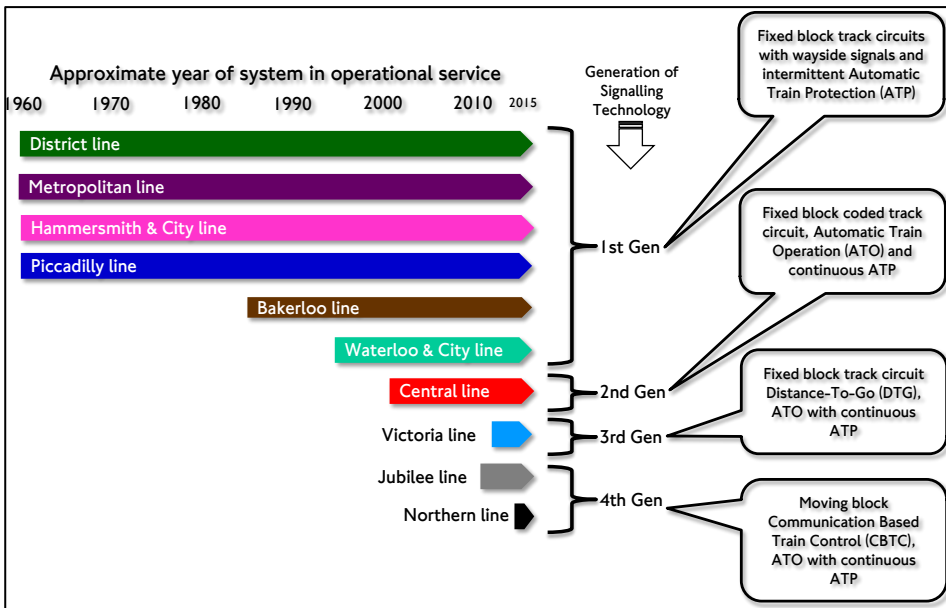
This strategy sets out the vision and objectives to achieve a world class position whilst achieving our goal to:

“Deliver a reliable and resilient signalling and control system, able to facilitate the maximum capacity train service from the fixed infrastructure, and provide intelligent information for maintenance optimisation and service decision making.”

This will involve migration from the current network of mixed signalling systems, of which approximately 75% remains as fixed block technology, to moving block systems, enabling realisation of maximum capacity from our fixed infrastructure.

6.1 Overview of assets

We currently operate 4 types of S&C systems on our 11 lines based on technology commissioned from the 1960s through to 2014. The figure below summarises our position:



6.2 Asset Strategy

Our first stage will ensure the operation of 1st and 2nd generation systems ‘legacy’ assets that are suffering from degradation due to their age. In conjunction with this we will extract the full potential from our recent 3rd and 4th generation asset replacements. We will remove components with a high risk of obsolescence and replace them with equivalents that we are able to support for the life of the system. Where it is cost effective, remote condition monitoring will be installed, to allow us to predict failures and maintain accordingly.

The next stage of the strategy involves the removal of legacy assets and fixed block signalling, and replacement by 4th generation moving block CBTC systems on the sub surface lines, with control consolidated under a single Command and Control organisation.

Once this stage is complete, we will have 100% moving block CBTC across the LU maintained network and will realise the capacity, control and increased reliability benefits that this brings.

This will enable a migration from a 'fix on failure' maintenance regime to a more efficient risk based predictive regime. The asset condition and real time operational data will be monitored to understand the health of the assets. This will allow failures to be predicted remotely, without the need for interval based inspections improving reliability and reducing the unit cost of maintenance.

This strategic journey will enable world class signalling and control. We will be able to adapt dynamically and quickly to changes in customer demand and offer a more efficient service. Asset condition monitoring will be integral to a reduced cost of ownership and a more reliable asset base. High levels of redundancy in the network will reduce the impact of asset failures on the ability to provide a service to our customers. In addition, the rich operational information, combined with the information our assets provide can be used to provide our customers with enhanced real time information and an ability to predict problems before they happen. This will assist our customers with their journeys and provide an enhanced customer experience.

7. Power System Asset Strategy

This strategy sets out the vision and objectives for LU’s Power Network (the power supply and distribution system) for the next 50 years. Our ambition for the Power network is:

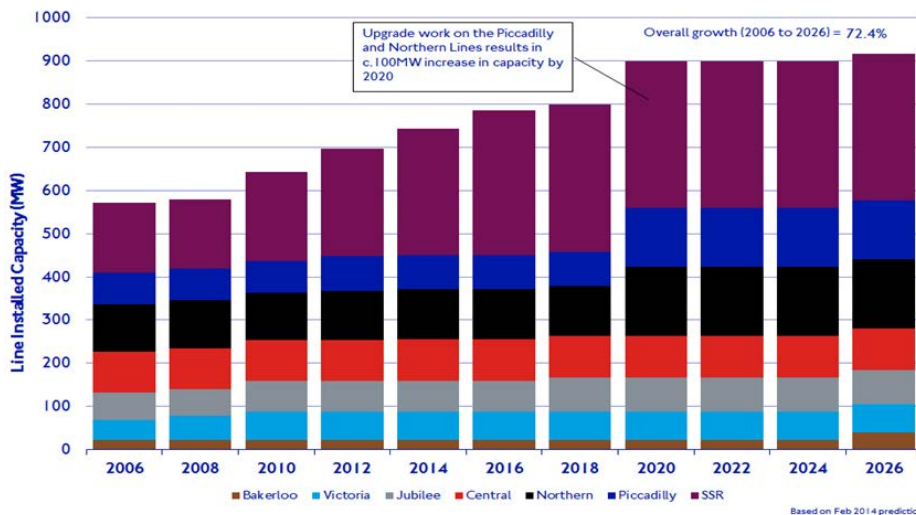
“A safe, energy efficient system that anticipates the needs of London Underground and its role within Transport for London’s wider emerging needs”

Our Power assets are currently managed in accordance with whole life cost principles, taking into account cost, risk, performance, asset condition and statutory compliance. This approach optimises network capacity, energy consumption, renewals and maintenance activities. Upgrades to existing assets, or construction of new ones, will continue to adopt cost effective and energy efficient designs that consider future maintenance costs and network sustainability.

7.1 Overview of Assets

The London Underground power network can be broadly classified in to High Voltage Network and Distribution assets and Low Voltage Network and Distribution assets. The high voltage asset base includes 6 major and 2 minor bulk supply points. In addition LU has one emergency generating station that incorporates 7 gas turbine generator sets. The power network also has 230 buildings that comprise of substations, switch houses and transformer room. Our Low Voltage Network assets consist of LV electrical distribution and low voltage AC supply.

Demand for power demand will continue to grow and the linkage with line upgrades is shown below.

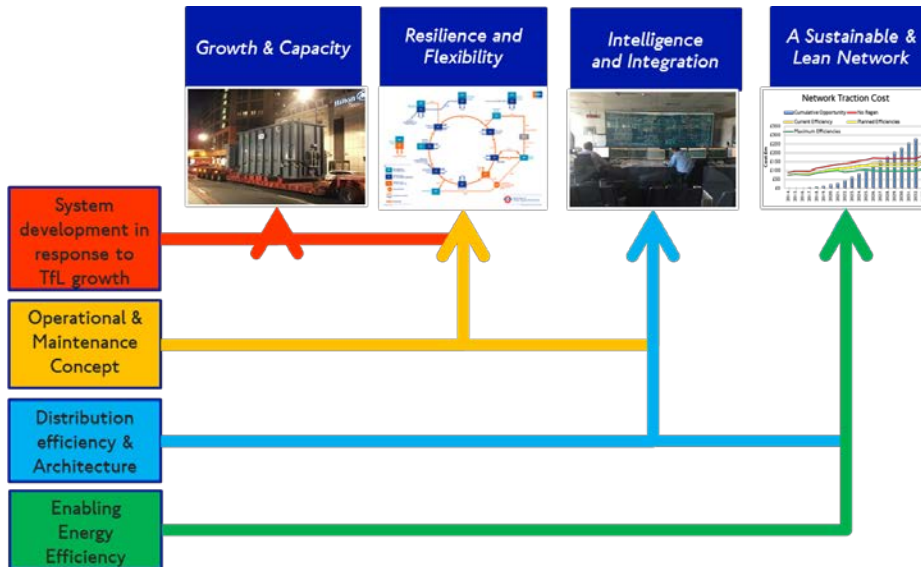


This is especially important as energy consumption makes up 77% of power operating expenditure. As such, traction energy efficiency is a priority and will continue to be pursued.

7.2 Strategy

The long term strategy comprises four key delivery work-streams:

- System Development in Response to wider TfL and London Growth
- Operational & Maintenance Concept
- Enabling Energy Efficiency
- Distribution Efficiency & Architecture



TfL’s wider energy growth must be considered as part of our long term plans. The power system must take in to consideration the potential impact of new lines (such as Crossrail 2) on network capacity, the impacts of the GLA Energy Plan and the wider move across TfL to move towards electric vehicles. This requires a co-ordinated, strategic approach that thinks beyond LU and ensures a robust supply and distribution system for TfL.

Our operational and maintenance concept must be developed. Firstly, it must be aligned with the developing C4 programme across LU and the impacts upon future Power command and control must be evaluated. This alignment and support will help to deliver the more streamlined command and control across LU. Furthermore, the maintenance concept will be developed further to reflect a move towards a risk based and preventative maintenance approach , future skills and competence requirements and revised asset obsolescence characteristics.

A more efficient and sustainable long term power transmission system will support the growth in demand, minimise unit costs of equipment and align with emergent international practices. In order to deliver this we will determine a more sustainable and optimal distribution system architecture that takes account of future demand. We will also determine the optimal future distribution voltages and the value of ‘Smart grid’ approach to LU

It is our vision that an optimised smart flexible network will enable energy, carbon and cost efficiency.

This vision will require:

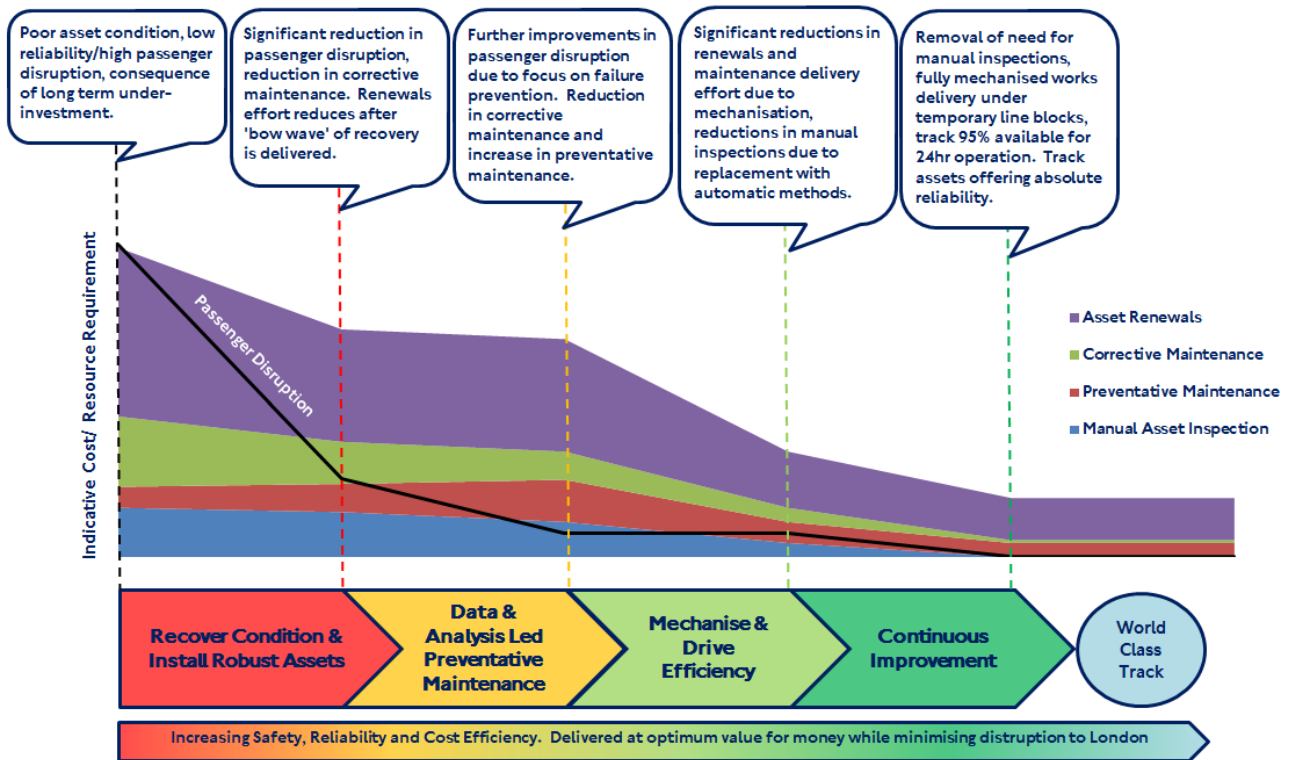
- Network leadership on Traction Energy Efficiency initiative development
- Working closely with Line Upgrade Programmes, to ensure Traction Energy Efficiency is optimised across train system
- Exploit Opportunities for Localised Low Carbon cost efficient Generation
- Long term CFPS strategy.

8. Track Asset Strategy

8.1 Strategy Summary

This Strategy sets out the works and objectives for the next 30 years to achieve a ‘World Class’ position and our Goal of:

Goal
 “To efficiently deliver and sustain Track infrastructure that is the foundation for rail services with zero disruption for all customers”



The strategy and associated drivers can be summarised as:

8.2 Overview of Assets

The track & track drainage assets provide a safe and reliable surface on which to run the train services operated by London Underground. The track & track drainage assets can be summarised as:

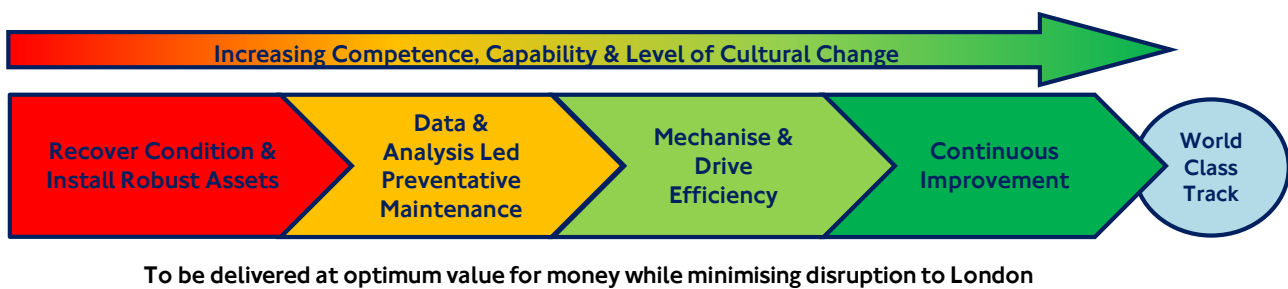
- 1,047 route km of Track
- 181 km in Depots & Sidings,
- 866km on Passenger Routes



- 301 route km in deep tube (35%)
- 83 route km in sub-surface tunnels (10%)
- 985 units of Points & Crossings (P&C)
- 749 units on Passenger Routes
- 500km of track drainage
- Various plant including trolleys, iron men, ultrasonics equipment etc.

8.3 Asset Strategy

The Track Asset Strategy is a route map from a position where there is still a substantial volume of ‘traditional’ track assets on the network requiring high levels of inspection and maintenance to a ‘World Class’ position. This route map is articulated in the diagram below:



The first stage involves continuing to reverse the impact of historic under investment in the track assets and restore the asset condition to a ‘steady state’ position where a lower level of annual renewal is required to sustain a consistent asset condition. This will replace the more traditional track components with modern designs which have a longer service life and fewer failure modes delivering a more cost efficient ‘steady state’ position.

Having recovered the condition changes in technology, process and skills will be developed to transition from the existing approach of ‘fix on failure’ to ‘data and analysis based preventative maintenance’. This will reduce in service failures and correction cost, increase labour utilisation and extend asset life. This approach is enabled by:

- Intelligent asset monitoring to allow more efficient maintenance planning and reduced manual inspection
- Improved equipment for condition monitoring and defect detection
- Training and development to create skills sets necessary to manage the data and information and realise the benefits of decision making based on richer data.
- A risk based maintenance approach to provide greater efficiency and targeting of maintenance.

Further efficiencies will be targeted through mechanising work activities or introducing new technologies which increase the volume of work delivered to high quality and at least cost. This will be enabled by a wide variety of technological and process initiatives which will require capital investment. The whole life cost approach will ensure value for money for the business. Further details can be found within the Track Asset Management Strategy.

Continuous improvement in reliability, cost, risk and quality will continue to be achieved across all

- Use of Whole Life Value tools to optimise asset management.
- Further development and review of new trackforms to deliver better Whole Life Value.
- Development of new Track Maintenance Regimes to support 24 hour operation
- Continuous research and development of new products and processes
- Benchmarking and knowledge share with peers and the rest of industry
- Development of video analytics to further reduce the requirement for manual inspection of assets.
- Intelligent analysis of rail monitoring data to continuously tune and refine rail grinding delivery to meet emerging trends

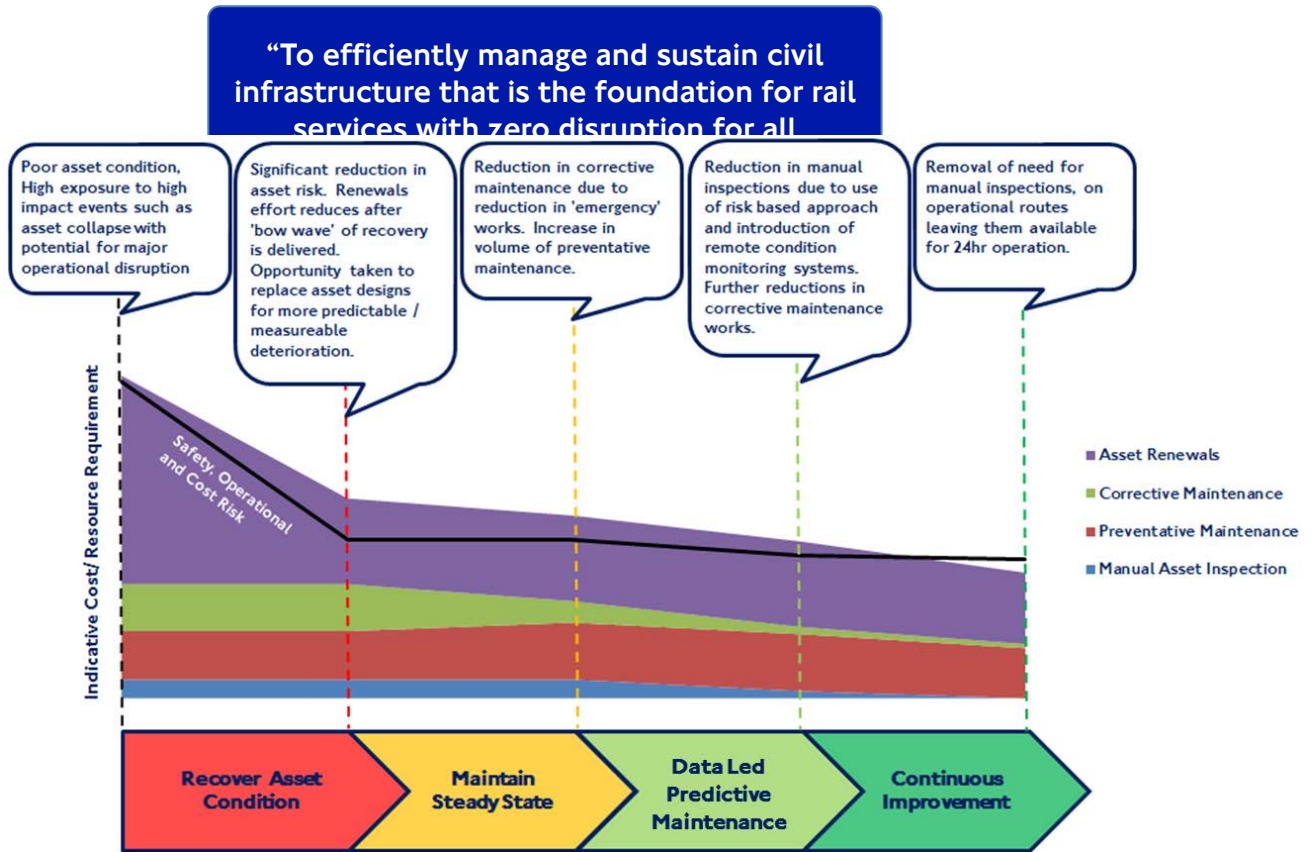
This strategic pathway will result in world class track asset management. The vision of world class is as follows:

The information gathered through the condition monitoring systems will be sufficient to remove the requirement for a manual inspection. This means that there will only be ‘boots on the railway’ when there are planned physical works to be undertaken, which will have been planned for some time to make the most efficient use of available resources. Engineers carrying out these works will travel to and from the worksite on a dedicated vehicle, potentially running amongst passenger traffic, and then undertake the works within a temporary line block. These dedicated vehicles will carry all of the materials, equipment and facilities needed to undertake the works efficiently and safely within the shortest possible time windows.

The assets will be robust and predictable, and the condition monitoring systems of sufficient quality and resolution to ensure that service affecting failures due to track assets are exceptional. This will be reinforced through continuous improvement and review to improve the management systems, processes and responses. Where critical assets cannot be made robust and predictable enough to provide reasonable surety of complete reliability, options for designing in system ‘redundancy’ will be explored to ensure passenger services are not affected.

9. Civils Asset Strategy

This Strategy sets out the works and objectives for the next 30 years to achieve a ‘World Class’ position and to achieve our Goal of:



The strategy and associated drivers can be summarised as:

9.1 Overview of Assets

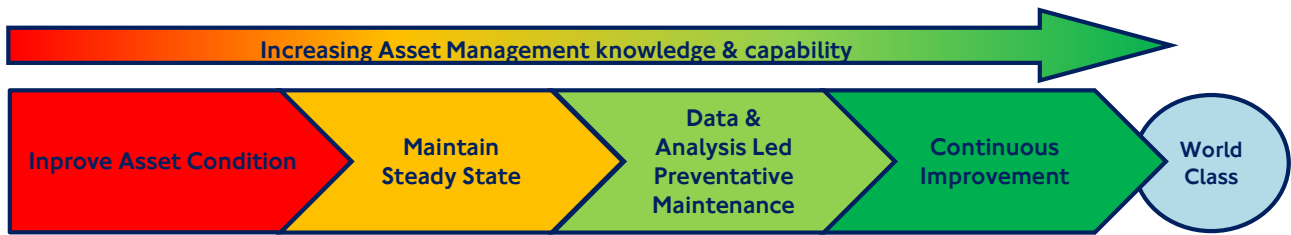
The primary purpose of the Civils assets is to provide structural support and stability to the other assets and to carry the required live loading. Effective and robust Civils assets are therefore critical to the safe and reliable operation of the railway.

The assets include:

- 16,000 Bridges & Structures
- 235km of Earth Structures
- 350km of Deep Tube Tunnels

9.2 Asset Strategy

Our strategic approach to reaching our goal for civils assets is outlined below:



The initial stage will recover the asset condition to reduce the requirement for special inspections, and to reduce the overall risk of asset degradation leading to a performance impact. This will reduce the long term cost of sustaining civils assets. We are currently approaching the end of the recovery phase, with the volume of ‘heavier’ asset rectification expected to have been largely completed by 2019, contingent on maintaining the current level of funding. This will be enabled by asset replacement and heavy maintenance, including ‘design for future maintenance’ and wherever possible replacing materials with sudden or undetectable failure modes with modern materials with predictable deterioration. In addition, we will remove assets that are no longer required.

Once we have achieved this steady state condition, maintenance will be undertaken to keep the conditions of the assets to an acceptable level. Alongside this, we will move to a risk based approach to inspections and maintenance driven by asset condition so we are carrying out work in the most economic and appropriate way. Additionally, the development of a cyclical asset painting regime will control corrosion and the associated risks.

The next stage is the move to data and analytics led preventative maintenance supported by improved data processes and skills. This will require initiatives in collaboration with industry and academia to develop our approach. We will also introduce automatic inspection techniques for tunnels and hidden assets. These initiatives will help us to develop a greater understanding of asset degradation rates and develop appropriate maintenance and information models.

Following the implementation of a ‘predict and prevent’ approach, we will continuously improve asset management practice. Risk forecasting will allow better identification of future synergies in work delivery. Furthermore, improvement will be achieved through the introduction of standardised designs, innovative materials and working methods that minimise the number of closures.

The delivery of this strategic framework will culminate in a position of world class: The information gathered through condition monitoring systems will remove the requirement for manual inspection. Maintenance staff will have the skill sets to analyse information to enable improved decision making and long-range planning. This means that there will only be ‘boots on the railway’ when there are planned physical works to be undertaken.

10. Stations Asset Strategy

The Stations Asset Strategy sets out the long term goal for Stations assets to 2050. The ultimate goal of the Stations Asset Strategy is as follows:

“To sustainably operate a network of world class stations, ensuring reliable access to our service, whilst maximising revenue.”

10.1 Overview of Assets

We currently own, maintain and operate 270 stations and circa 1000 lineside building which comprise the following asset groups: Fire, Communications, Mechanical, Electrical, Premises, Lifts (196) & Escalators (427).

A number of assets are outside the remit of Stations maintenance, e.g. Retail units and ticketing equipment. Communications assets within stations are part-governed by the ICT Strategy.

10.2 Asset Strategy

The asset strategy moves stations assets from reactive maintenance to a pro-active risk based approach. It delivers efficiencies through a reduction in asset numbers, standardised products and appropriate bundling of maintenance and renewal activity.

The road map to deliver this approach is illustrated below:



Optimising Value is achieved through **robust asset information** that allows effective decision making that balances operating and capital expenditure.

- Consolidated Pan TfL contracts and associated organisational restructure: restructuring of maintenance and renewals in to pan-TfL contracts provides optimum value through the reduction in duplication of cost, effort and management overheads.
- Optimise risk based maintenance regimes: maintenance regimes will be optimised based on criticality and importance.
- Standardise products: move from ‘bespoke for TfL’ products to standard products with generic requirements / specifications and designs will reduce whole life costs.
- Asset Information: timely information management focused on condition and criticality utilising a standard hierarchy in compatible systems will result in high quality asset information used for decision making.
- Recalibrate key performance indicators: realign our KPIs with our objectives and drive the right behaviours and performance.








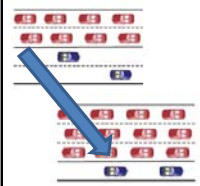

Optimise and recover condition: Robust data will enable the prioritised recover of condition and the optimisation of our asset base. This will be delivered through two work streams:

- Asset Resilience – Targeted: Risk based renewal ensuring stations remain safe, legal and operable
- Asset Resilience – Network: removes redundant assets across the network and systematically replaces core assets. This enables a reduction in maintenance costs.

Digitise and automate: involves installing smart system assets that feedback condition data, enabling centralised decision making and reducing the level of manual inspection.

Continuous improvement: Optimised Access (capacity and accessibility); world class asset management and performance; sustainable revenue generation (e.g. commercial, energy generation, ticketing, etc.) and connected wayfinding across all transport modes.

At the conclusion of this road map, we will have world class stations with: sufficient access, expanded 24 hour operation and optimum whole life costing. The key highlights of how these stations will look to our staff and customers can be found below:

	World Class customer service delivered by our competent and motivated people		A LEAN Approach: Industrialisation and Standardisation and Configuration Management		Automated Multi Modal customer information that can be localised
No Gatelines. Stations only used to access trains and for Commercial Development Activity.		Personalised, Real Time, Multi Modal wayfinding while on the move		Decentralised Power generation. Harness the heat and energy within our stations.	
	"Real & Virtual" Retail. Click on your product, collect on your way home.		Removal of local pinch points and utilisation of Dynamic Capacity Management utilising changeable signage and barriers		Centralised asset information automatically populated by ' smart ' assets.
Underpinned by a World Class Asset Management: Truly understanding our asset base and its condition. Making optimised, planned maintenance and renewal decisions based on criticality / risk. Understanding our cost base and getting benchmarkable value.					

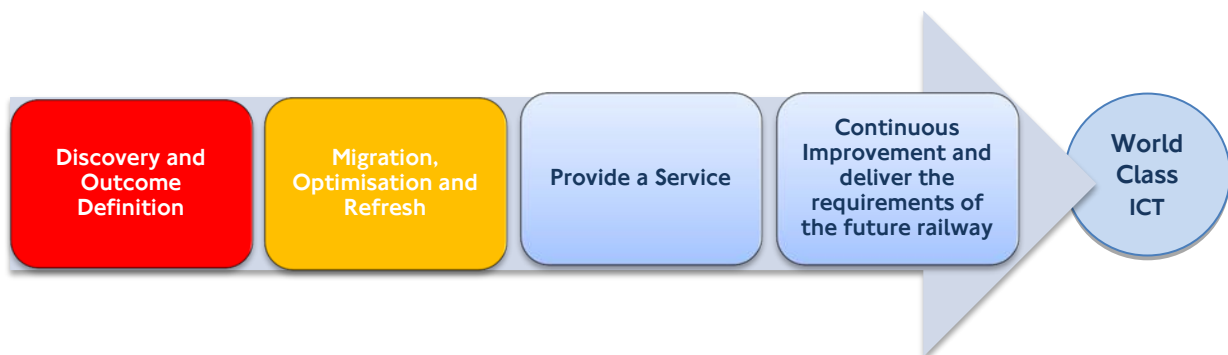
11. Information & Communication Technology

11.1 Strategy Summary

The challenge for information and communication technology (ICT) is to:

- To help provide a “digitally enabled railway” facilitating high quality, customer focussed services that work for everyone.
- Work with others within TfL to provide effective and efficient sharing, storing and processing of data and automation of services.
- To ensure that ICT acts as a catalyst for improved business capability.

This strategy reflects a change to the procurement of “data, storage or integration services” from a pan TfL provider utilising a mix of wholly owned or purchased solutions. The below diagram outlines the strategic journey from our current position to world class ICT:



11.2 Overview of Assets

The assets under the stewardship of the ICT asset management team can be categorised in to four distinct groups:

- **Voice and Communications Networks** – radio, cellular, mobile, fixed telephone lines and supporting data networks.
- **Video Services** – CCTV and the means to review, record, playback and share with 3rd parties.
- **Customer Information Services** – data sources, data integration, content management and visual and audio means of dissemination.
- **Business Services** – systems and services used to support the operation or maintenance of the railway.

These four distinct groups are in differing stages of maturity and strategy development and as such, their initial strategic path will be different. However, the latter stages of end to end service development and continuous improvement are common across all groups.

11.3 Asset Strategy

The initial stage of the ICT strategy for voice and communications networks and business services is to fully understand the future business requirements. This understanding will guide future stages of the strategy as to the specifics of the systems that will be delivered. The key focus for video services is to optimise the coverage that the system offers. This will be achieved through rationalisation of the number of assets (e.g. cameras) and improved use of technology. This will mean a reduced cost of ownership alongside an improved coverage of the service. Customer information services will continue with the development of a pan-TfL strategy for provision, the main focus of this will be 'everyday excellence' and the details of this strategy will have obvious implications upon future stages and strategic decisions.

The second major stage of the ICT strategy is significantly different across the asset categories and as such needs to be explained separately from each other. Voice and communications networks will enter a phase of migration, refresh and optimisation. This will be based upon the requirements clarified at earlier stages and will lead to greater integration with other pan-TfL networks. The changes to the future use of networks will allow for the decommissioning of legacy voice systems such as tunnel telephones and signal post telephones.

Video services will also undergo a phase of migration and refresh. This will include the completion of networking to allow greater centralised management. In addition, the system will be fully digitised to ensure it is fit for purpose and meets business requirements for the use, retention and disposal of data. Business services will have a specific path based upon the individual needs of the system. This is vital in delivering the optimal outcome for each service.

Customer information services will focus upon the centralised generation of information and management of assistance systems. This will be managed through the CSC at Pier Walk and the LUCC at Palestra. At the heart of this provision of consistent local information is the optimal refresh of station management systems and digital voice announcers. By managing information centrally and disseminating it through improved station systems, it will drastically improve the quality of our information provision to our customers. The final part of this refresh programme is to remove legacy systems for providing train destination information. This will ensure all locations are in line with the minimum standard of visual and audio 'time to next train' and destination information.

The latter stages of the strategy assume the four asset areas have matured to a common level and therefore allowing a single path to world class. The earlier stages ensure a change to managing the assets as an "end to end solution". The next stage is to deliver ICT as a service. Further efficiencies will be targeted by automating process, work activities and maximising delivery through existing resources. Changes in process and skills sets supported by technology change will enable the transition to operation and maintenance which is largely predictive. The predictive approach requires significantly higher quantity and quality of data to inform decision making. The benefits of this approach includes lower in service failure rate, reduced correction cost, with a reduced impact on the railway and the extension of asset and system life.

The final stage of the strategy builds upon the benefits of a robust set of services maintained under an efficient maintenance regime. Continuous improvement in reliability, cost, risk and quality will be delivered enabled by:

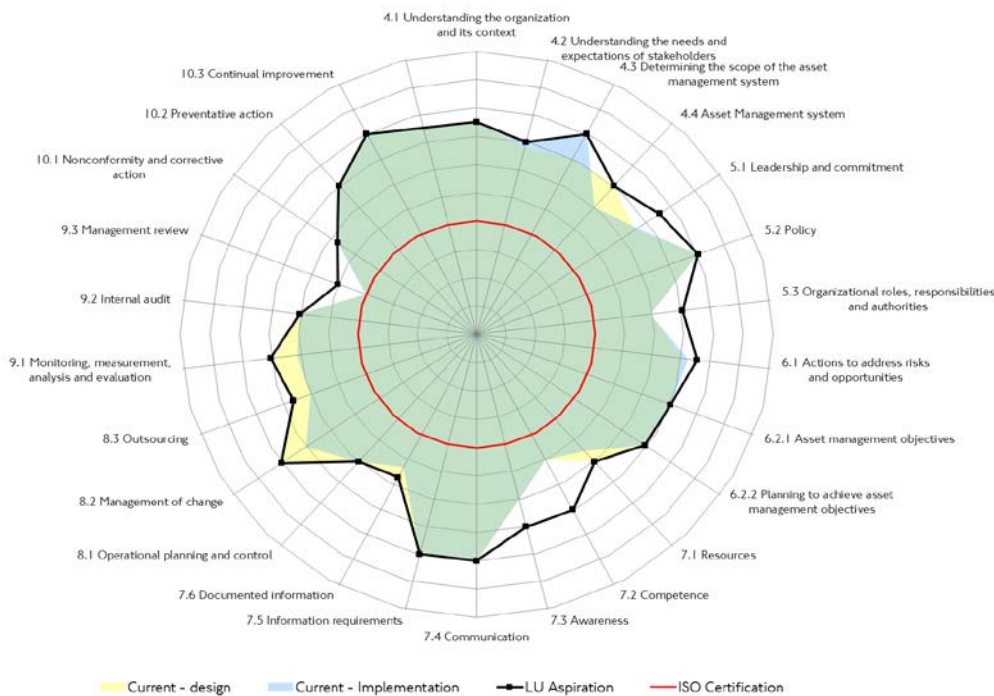
- Ensuring a clear upgrade path exists for both voice and data systems taking account of obsolescence of software, hardware and the technology life cycle.
- Utilising technology and systems along with developing staff capability to make maintenance more efficient, bringing higher levels of reliability and lower unit maintenance costs.
- Continuously assessing the capability and quality of data traffic to predict when upgrades in capability are required.

The full achievement of the milestones set out in this strategy will result in world class ICT. This will mean where fresh opportunities and ideas continue to be identified, developed, tested and converted in to changes in how ICT services are provided. ICT can be regarded as a catalyst for the transfer, storage and analysis of information without which the railway cannot operate. In summary, to be “world class” the assets will be robust, predictable, and able to monitor condition and of sufficient quality and resolution to ensure operational failures are reduced to a minimum.

12. Asset Management Improvement Programme

LU’s asset management system maturity was assessed by Lloyd’s register as beyond the level required for ISO 55001 certification in the majority of areas. The auditor noted that the overall maturity is one of the highest seen across organisations in several sectors.

The radar graph below shows the asset management system maturity results against the sub clauses of ISO 55001. The areas in green represent LU’s assessed maturity. This visual representation identifies areas of the asset management system where implementation and design are not equally mature. It also clearly shows the high performing areas of the system. The Bold line indicates LU’s target maturity over the next 2 years. Progress is required where there is a gap between the green areas and the bold line in order to meet our target maturity.



Leadership & Commitment and Organisational Roles: We can further improve the clarity of organisational roles across the business. To facilitate clear communication of the LANP and Strategy, asset interfaces and boundaries will be reviewed and communicated across the business.

Competence: LU has an Asset Management Competence Framework embedded in a Role Families framework. This approach needs to be further developed to ensure that relevant AM competencies are incorporated in the competence framework and role families for Engineering, Commercial, Operations, Project Management and included in the graduate training program.

To support staff in competence development a three level Asset Management Training program has been established. LU will continue to develop the professionalisation of asset

management and develop the competence of staff in the discipline encouraging attendance at the AM courses and achievement of the certificate and diploma qualifications.

Information Management Improvement: LU has a detailed [Asset Information Strategy](#) that outlines the Asset Information Strategic Objective. The LU Asset Management Information System (AMIS) project is currently underway to review the future requirements of LU's information.

Whole Life Value: Whole Life Value (WLV) decision making is key to achieving AM practices that delivers best value from our assets. In order to embed WLV thinking in business decisions across the business Pan TfL WLV guidance will be developed which will be supported by the AM training.

Planning: The Line Area Network Plan (LANP) has improved year on year, however there is scope to further improve. To achieve this following areas of focus have been identified: Further improvement of LANP forecast accuracy and developed measurement and review of LANP performance. This will be supported by a revised LANP planning process.

Management Review: Management review can be used as a useful tool to deliver improvements and continue improving our asset management system. To improve maturity in management review we will review and if required update the scope and process of management review. In addition we will clarify ownership of the management review process.

13. Asset Management Information

13.1 Strategy Summary

Asset management information is an essential enabler which supports asset management and ensures that we can make effective and consistent decisions across TfL. The TfL Asset Management Information Strategy sets out the framework and the associated principles that are required to ensure that asset management information is managed effectively.

The long term objective is that:

TfL will Identify, manage and continually improve asset information that supports decisions, ensuring it is accessible and of the required quality

13.2 Strategic Objectives

To achieve the Asset Management Information Strategic Objective the principles summarised below must be addressed holistically.

Asset Information Governance & Leadership: ensure that governance and leadership for asset management information is led at a Director level.

Asset Management Information Strategy: develop an Asset Management Information Strategy which sets out the target asset management information maturity and associated plan.

Business Process Standardisation: provide consistent approach to its asset management information processes across all business areas.

Master Data Management: ensure a 'single source' of master data that can be accessed from known and trusted sources.

Data Visualisation: develop a plan for the visualisation of asset management information (e.g. through a common GI enabled portal or a data warehouse solution).

Assurance & Change Control: ensure that processes for assuring asset management information are in place and deliver the right levels of information quality, throughout the asset life cycle.

People Development: Ensure the full engagement of the people collecting, collating, analysing and using the data and information, with an organisational structure that clearly sets out individual's asset management information]

Monitor & Continuous Improvement: monitor and improve its business practices against industry good practice by benchmarking itself both internally and externally against other business areas across TfL and external transport and other asset intensive organisations across the world.