

Living Lab



Transport Infrastructure Efficiency Strategy

TIES LIVING LAB PROGRAMME

Advanced logistics for end-to-end collaboration
and coordination (IP12)

October 2022





INTRODUCTION

Infrastructure and construction projects are increasingly adopting off-site construction, and are becoming more competitive and collaborative, making well-timed delivery of off-site components/volumes essential. Logistics for off-site construction and infrastructure is a complex activity, requiring careful planning and organisation to ensure that prefabricated and preassembled components arrive on time at construction sites.

Improved logistics will help the industry to improve its performance and reputation, as well as increase its profit margins.

The TIES Living Lab Programme aimed to promote the use of modern methods of construction (MMC) – particularly the off-site manufacture of constructed assets – and a key challenge of that approach is to ensure delivery to site of the manufactured components. Under the programme, University of the West of England (UWE Bristol) was tasked with building and testing a suitable cloud-based advanced logistics platform for off-site construction projects.

This information paper presents an overview of the Advanced Logistics Demonstrator Project and the state-of-the-art integrated asset management platform developed under the project on Advanced Logistics.

BACKGROUND

Advanced logistics is a critical issue in transforming the UK construction agenda because it addresses one of the root causes of poor performance: assets not being delivered at the appropriate time, causing time delays and cost overruns.

The objective of the project was to develop an integrated platform that will enable users to view, search and exchange asset data and information in a single dashboard that connects the supply chain in a transparent manner, providing a “single source of truth”.

The platform would need to create and integrate customised advanced logistics tools so that project team members can:

- Identify the separate components within the design of an asset
- Schedule their delivery from the off-site manufacture programme
- Provide asset tagging for tracking the components
- Provide analytical capabilities, such as calculating the carbon footprint of an asset during the design stage, as well as selecting



the appropriate delivery and off-loading vehicles (e.g. lorries and cranes) required

- Plan delivery routes to avoid blockages, minimise the asset's transport-related carbon emissions and ensure timely delivery
- Validate an asset's status against deliverables
- Facilitate access to legacy data for each asset.

CHALLENGES

Advanced logistics is already well established in, for instance, the food and drink, and automotive sectors. The use of building information modelling (BIM) as an enabling technology is already proven, and widening the scope of digital technologies into logistics is now regarded as an essential technology that can overcome a number of challenges by:

- Supporting design for manufacturing and assembly
- Reducing delivery and erection costs
- Saving time on pre-project planning, including time spent on generating reports and document transmittals
- Reducing the iterations of design and construction verification processes
- Reducing asset management and operation costs
- Saving on construction-related fuel use and reducing associated emissions of greenhouse gases (mainly carbon dioxide) and particulates.

A SINGLE SOURCE OF TRUTH

The Advanced Logistics Demonstrator Project was tasked with harnessing advanced technology to assist in smart planning for off-site logistics activities to ensure just-in-time delivery of assets to construction sites.

This work required applying knowledge and expertise on digital logistics to the tasks of integrating and coordinating between project design, planning and scheduling, off-site manufacturing scheduling, optimum management and routing of manufactured and preassembled components/systems, as well as advanced planning of site logistics to ensure timely and stress-free access to the site, and off-loading and storage of prefabricated assets.

The advanced logistics ADIMS is a cloud-based platform plus smartphone apps that streamline collaboration and coordinate asset data in an end-to-end process.

The tools developed through the project help to synchronise – in real time – project planning and scheduling by using BIM, and production, manufacturing, transportation and on-site logistics coordinated through an asset data intelligent management system (ADIMS) (see <https://advanced-logistics.co.uk/>), as summarised below.

KEY FEATURES OF THE ADVANCED LOGISTICS DEMONSTRATOR

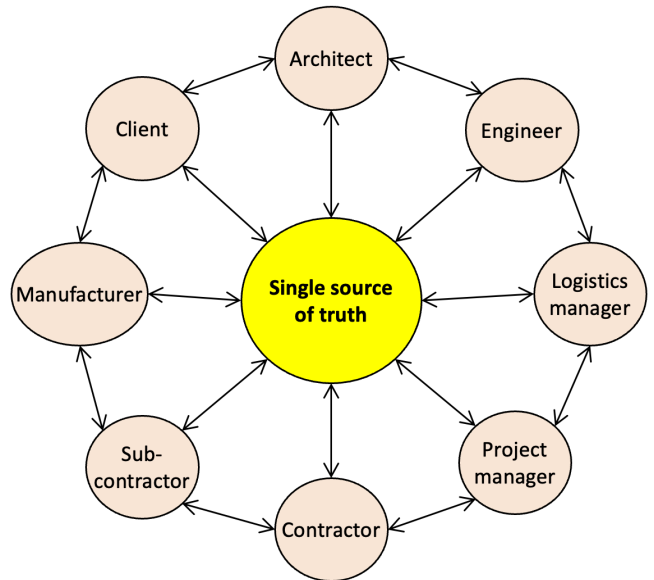
The digital tools and platform make it simple to track the status of an asset from design to on-site installation, but by tagging assets using radio-frequency identification (RFID), there is also the potential to use the ADIMS for operation and maintenance, and at decommissioning.



The tools feature:

- Harmonisation of asset data and information using the latest data standards from British Standards and the International Organization for Standardization
- Use of Industry Foundation Classes (IFC) – an open file format used by BIM programs – to facilitate the seamless flow of asset data and information during the project life cycle
- An asset scanning app, available for smartphones, making it easier and cheaper to scan and tag an asset
- A single dashboard accessible by the project team, which functions as a “single source of truth” for the end-product asset (e.g. a footbridge).

Single source of truth



Key features of advanced logistics platform



Decision making

Gain powerful insight from digital twinning BIM and physical assets



Golden thread

Keep track of status of an asset's journey, and mine the legacy data



Project performance

Improved certainty of onsite delivery and improved productivity



Standardisation

Asset data/information structured according to the latest BS and ISO standards



Actionable intelligence

Identify asset delay, receive daily notifications to take corrective measures



Cognitive visualisation

Intuitive colour coding to visualise latest asset status and ability to query data



Benchmarking intelligence

Trade-off between HGV delivery routes, carbon footprint, cost and disruption to road users



Effective asset scanning

Easy and cost-effective asset tagging and scanning



Asset data flow

Seamless data flow between asset graphical and non-graphical data

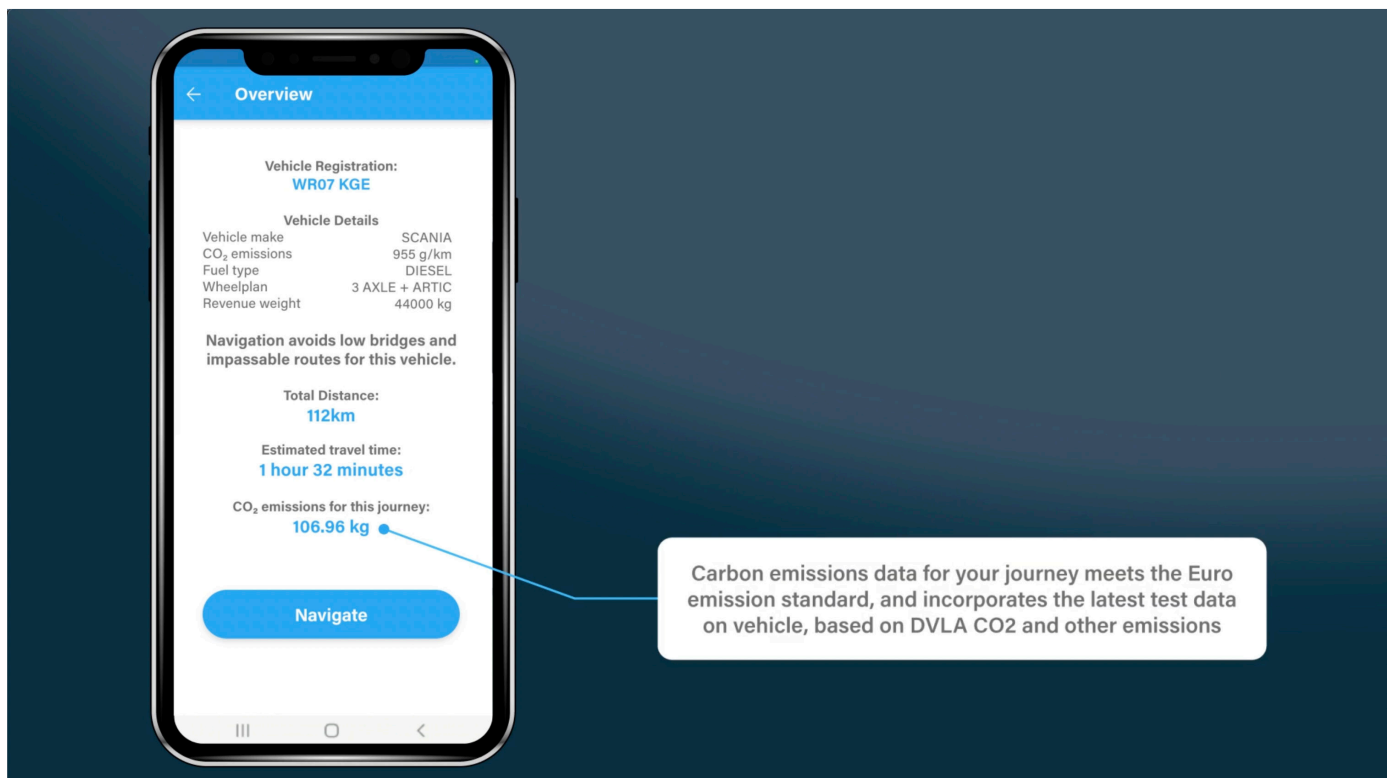


The project has developed several digital solutions that work together to deliver an advanced logistics capability tailored to the needs of the transport infrastructure sector, comprising:

- Asset data points (ADP), based on the Construction Operations Building Information Exchange (COBie) non-proprietary data format, are used to automatically populate the BIM model
- An asset tagging system that is compatible with BIM protocols (BIM asset tagging, or BAT)
- Smartphone asset data scanning (ADS) apps
- An optimised delivery route (ODR) tool
- The asset data intelligent management system (ADIMS).

The digital solution uses a colour-coding approach so that users can see the latest status of an asset, and also includes the capability for data query and exchange within the BIM environment. In addition, the platform offers the capability for calculating the carbon footprint of an asset throughout its journey from design to on-site installation.

Using ADP ensures that the advanced logistics platform is based on widely used protocols (COBie is a sub-set of BS ISO 16739), and ensures that clients and the supply chain can use natural language to define their requirements for an asset throughout the project life cycle.





TIES BIM asset tagging (TIES BAT)

This custom-built digital solution facilitates automated synchronisation between the ADP and the associated objects within the building/asset information model. This tool for accurately and reliably tagging an asset makes it possible to query and exchange data within the BIM environment. The combined information includes manufacturing, delivery and installation date and time for an asset, which should lead to improved coordination and avoiding mistakes and misunderstanding.

For example, using TIES BAT it is possible to predict which heavy goods vehicle (HGV) would be suitable to carry the asset and an appropriate crane to lift the asset into place, avoiding potentially costly errors in ordering the wrong crane or HGV.

TIES asset data scanning (TIES ADS)

TIES ADS is a QR code-based app for smartphones used to scan asset data and print out QR labels. The app makes it easier to track the status of an asset throughout the project life cycle because the QR code is unique for each asset.

When the QR code is scanned, the system will update the asset status automatically and the result can be visualised and queried in the BIM model.

This mobile app meets the latest GS1 (barcoding) standards and, with its ease of use, cost-effectiveness and availability through a smartphone, it may help to overcome a significant barrier to adopting asset tagging in the construction sector.



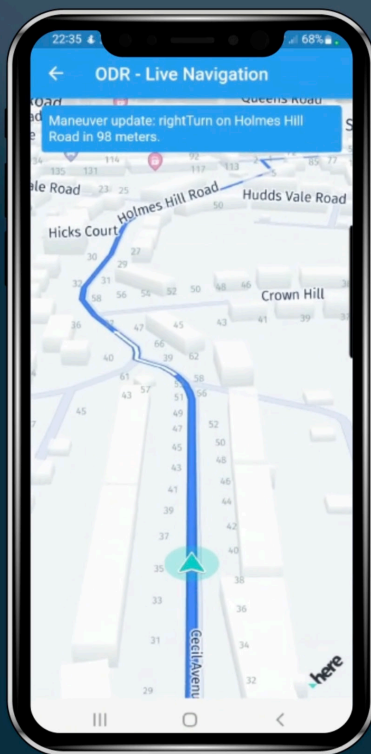


TIES intelligent routing optimisation system (IROS)

Delivering assets to a construction site is paramount for improving the success of off-site construction. The IROS artificial intelligence (AI) solution developed during this project helps when choosing the optimum route for timely asset delivery. For example, its AI algorithms assess and trade off between available delivery routes for HGVs,

carbon footprint, transportation costs and level of disruption to other road users.

The ODR smartphone app makes it possible for users to select the best delivery route for achieving reductions in transport cost and carbon footprint, as well as improvements in certainty and reliability of on-site delivery and – crucially – last-mile logistics, so that on-site teams can prepare for the imminent arrival of the asset to the construction site.



Optimised route for reduced carbon emissions

Avoids impassable routes

Live traffic data

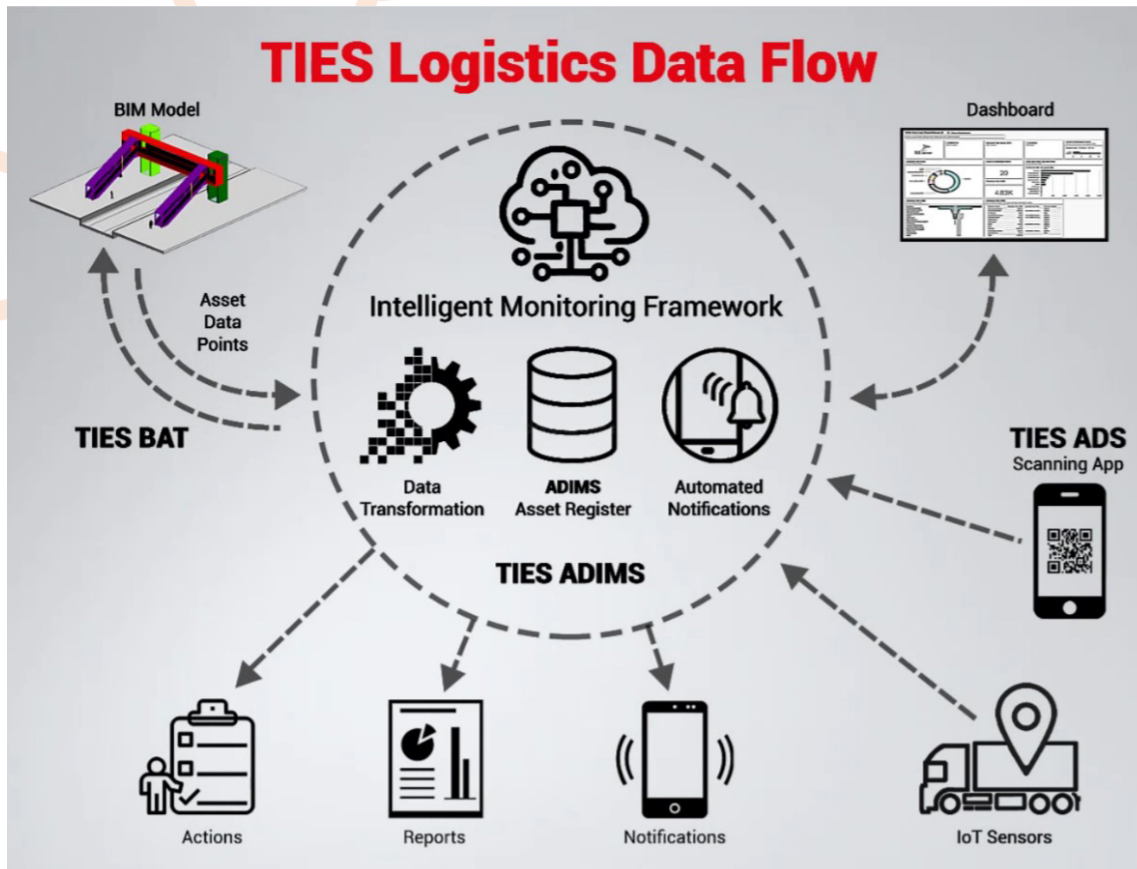
Voice navigation

Next maneuver update

TIES asset data intelligent management system (ADIMS)

The TIES ADIMS is an intelligent digital solution for bi-directional asset data and information integration and synchronisation. It processes scanned data from the ADS app, and other data input devices and

systems, and can provide just-in-time data and advanced notifications for appropriate recipients. The colour-coded information presented through the user interface conveys the right data at the right time to the right people for action and decision-making.



LESSONS LEARNED

The platform described in this information paper was trialled with test data from one of the four TIES Living Lab asset demonstrator projects (the AVA footbridge, see IP14), showing that it can be used to track an asset throughout its life cycle, from “as planned” (BIM), through “as manufactured” to “as installed”.

LEAVING A LEGACY

The TIES Living Lab provides the foundations and tools for future collaboration among TIES

Partners. At a strategic level, this project helps in the adoption of off-site construction and offers advanced logistics intelligence for the delivery of manufactured assets where and when needed on site.

As part of the TIES Living Lab Programme commercialisation plan some Tier 1 contractors have agreed to trial the platform. There is also the potential to further develop the system for the operation, maintenance and decommissioning stages of an asset’s life cycle.

This work was led by Professor Lamine Mahdjoubi (Professor of Digital Built Environment) of University of the West of England (UWE Bristol), under the TIES Living Lab project on Advanced Logistics, overseen by the Modern Methods of Construction Steering Group.

Living Lab



Transport Infrastructure Efficiency Strategy

The TIES Living Lab is a transformative collaboration of 25 partners together with Government, i3P and the Construction Innovation Hub that use data, technology and Modern Methods of Construction within live transport infrastructure projects to deliver significant value-adding benefits across the transport infrastructure sector. The programme is funded via a grant from Innovate UK through the Transforming Construction programme, plus contributions from the Department for Transport, HS2, Transport for London, Network Rail and National Highways.

The four strategic outcomes of the collaboration are to:

1. Improve the way Transport Infrastructure projects are set up to maximise value
2. Achieve better assurance of project and programme value and what assets should cost (benchmarking)
3. Accelerate the wider adoption of MMC
4. Establish the TIES Living Lab as a catalyst for long term cultural change across sectors by making a compelling case for long term HM Treasury funding to scale this facility.

Project led by:



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