Contact Information

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Recognise

Highway construction projects require highly repetitive work sequence throughout the construction areas. Isolated unique activities introduce fragmentation into the repetitive tasks thus making them less efficient. Therefore, any types of delays on those operations mays cause delays of the project delivery. This research used a combination of three separate case studies that were performed to study the highways earthworks operations in deep detail and then provide some key recommendations to Highways England (HE) on the base of these study works.

Define

Key identified measures in terms of Earthworks processes included:

* Improved utilization of resources (e.g. machinery such as excavators and dump trucks).
* Work continuity across different schemes and optimization within each scheme.
* Better value for money.
* Less disruption to travelling public. Improved cost efficiency leading.

Key identified constraints in terms of process improvement included:

* Road users are disturbed due to the movement of heavy vehicles on streets.
* 10,000 m^3 of movement of material everyday using 40T, 56T and 76T dumpers and dozers.
* The proposed road is 7.5 km long and work is carried out in patches which affects work flow.
* Weather related factors affecting earthworks.

Actions Required

- Utilizing Innovation efficiently and timely
- Increased and Improved Collaboration
- Changing Current Work Styles
- Feedback from Users
- Real-time Data sharing among Stakeholders
- Recycling on Works Sites

Strategic Outcomes

- Smooth Traffic Flow
- Less Interruptions Due to Maintenance
- Safe and Serviceable Network
- Increased User Satisfaction
- Achieving Real Efficiency
- Better Environmental Outcomes

Measure

- Earthworks A556 scheme : Various processes like excavation of road box, proof roll subgrade formation, LWD testing, and laying CBGM material etc. were observed to capture data for simulation of the actual process to be developed, in a computer based environment. Most of the data was provided by the Highways England's contractor.
- Resurfacing Operation Improvement : A previous study performed by Highways England (1000 tons) was used as a primary source of data. Then 3 nights were spent on site to observe the process in person and record the inaccuracies between the theory and practical timings. Discrete Event Simulation was then used to perform various what-if scenarios using this data.
- Decision making for Resurfacing : A thorough review of literature was performed and unstructured interviews with experts in pavement maintenance management from different local road authorities were conducted in order to identify and account for the factors influencing pavement maintenance prioritization decisions. All these efforts lead to creation of GIS based decision making tool for pavement.

Analysis

- Earthworks A556 scheme : Research teams engaged with stakeholders in different collaborative workshop sessions, to review findings and to discuss constraints affecting outputs and optimization of resources and find possible improvements. One key observation during various simulation experiments was that productivity is greatly impacted by working style and of the organisation weather and not so much by the equipment.
- Resurfacing Operation Improvement : A detailed root cause analysis was performed to study the inefficiencies in manpower, machines, methods undertaken and materials used. Different what if scenarios were performed in this case to check the effects of on the actual system and how the process can benefit from these experiments. Some of the cases that were studied, simulated and validated are explained in next section.
- Decision making for Resurfacing : Despite the major developments in pavement maintenance techniques in the last few years, and the existence of pavement management and maintenance systems in the UK, Highways England (HE) and Local Highway Authorities (LHA) need to adopt a joint effort strategy to develop these systems. Highways England should consider using GIS as decision-support tool as it is justified to be suitable for tackling problems with spatial data and predicting, which are at the center of pavement maintenance prioritization and decision-making.

Improve

Different packages like Simio were used to create fully working 3-D simulation models to perform different what-if scenarios (that are not usually possible to experiment in real life) to find out the best practice in the earthworks. Several recommendations were made based on the results obtained from these models. GIS mapping software like ArcGIS was used to map several factors (e.g. scheme costs, risk of failure, possible overlap, traffic diversion etc.) on the map to facilitate decision making for resurfacing.

Stakeholders:

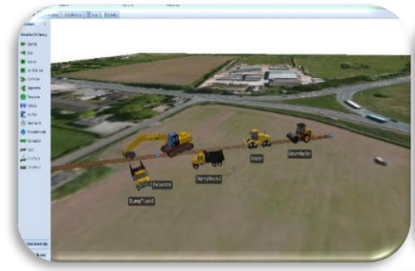
University of Salford MANCHESTER

highways england

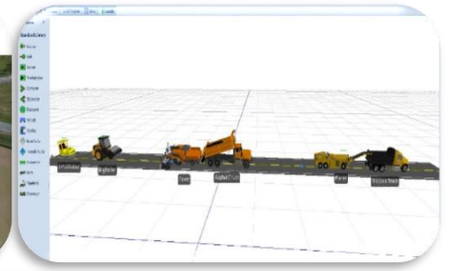
Control

In order to ensure that the improved process can be sustained on future schemes, it is important that all improvement initiatives are carefully achieved and recorded. Different what-if scenarios that were tested on the machines can be replicated on future earthworks projects as well. Issues like recycling and dumping of soil are subject to work sites and will differ on each site and project. However, other aspects of the process e.g. improved value stream maps, equipment utilisation and 4d visualisation can help future projects.

Simulation of equipment in Earthworks



Resurfacing process simulated for experimentation



Pavement maintenance priority visualisation using GIS

Transfer

After performing three different types of case studies related to Earthworks and analyzing with the help of Simulation and GIS techniques, several recommendations were made.

Recommendations related to Earthworks A556 case study included areas issues Telematics, Innovation and Automation, Recycling on site, Data sharing with HE, Data sharing within contractors and sub-contractors, Site management and Quality assurance.

Recommendations related ta Pavement improvement included issues like Increasing paving machine's utilization, closure of multiple lanes, utilize all lanes that are shut (keeping health and safety), Penalty and reward system for contractors and importing some ideas from other countries like USA to improve the output.

A GIS based decision making tool was developed for resurfacing and paving of roads which included 23 different factors and