MANAGING LINEAR ASSETS

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Revisit important concepts regarding linear assets and learn how Pragma's On Key Enterprise Asset Management system can help you to manage these assets optimally.

> A good linear asset management capable EAM will enable its users to unlock value through more precise and easily obtainable management information.

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1 Executive summary

Asset owners in industries like oil and gas, roads and utilities have unique asset management requirements and are often left stranded with asset management software which was designed for discrete assets. Such software systems fail to address the unique needs associated with linear assets and often necessitate the use of several standalone applications and manual actions to store and retrieve asset related information.

Accessing asset related information across several loosely grouped systems makes it difficult and often inaccurate to aggregate and analyse performance, cost and condition data related to assets for decision making purposes. Prioritising, scheduling and monitoring work performed on such assets is equally cumbersome. Since information is often duplicated in several systems it is also difficult to identify one single version of the truth.

The solution to these problems lies in a single EAM system that is capable of effectively dealing with all key linear and discrete asset data to allow the transformation of data to information for decision making purposes.

This paper outlines some key considerations related to the management of linear assets and briefly describes how On Key fulfils these needs.

2 Linear Asset Management considerations

Linear assets extend along one physical dimension in space and often connect with each other through their relationship with the linear infrastructure they are associated with. A good example of this is a service road that runs alongside sections of a railway line, where the railway line is the primary linear asset and the service road is a linear sub asset related to the railway line. Linear assets can be repaired or replaced in situ as a unit or in segments that can vary dynamically based on condition or operational considerations associated with the asset.

The structure of the asset register plays an important role in an organisation's ability to analyse the performance, cost and risks associated with its assets and this is no different for linear assets. Linear assets can often be configured into hierarchical asset register structures by forcefully segmenting the assets into sections.

These segments will be determined by one primary feature of the asset which in many cases will not align well with other features of the asset.

This inevitably results in complicated, ineffective reporting and high administration overheads in the event of changes. Two important aspects that should be considered when configuring a linear asset are:

- the level of detail required when capturing the cost, reliability and maintenance history of assets, and
- the organisation's ability to main such level of detail.

Linear Asset Management (LAM) pre-dates geographical information systems and these two concepts should not be confused.

All physical assets have geospatial coordinates, but it is not always practical or beneficial to maintain such information for all assets; many linear asset owners prefer to maintain linear assets in non-geospatial referencing systems when planning and recording work history. Enterprise Asset Management (EAM) systems

2 Linear Asset Management considerations

with linear asset capability have the important feature of dynamic segmentation in which assets can be split into virtual segments. These dynamic segments can be used to associate work, record condition or varying attributes with a linear asset along its length.

For example, a section of road could be anything from 1km to 100km in length and have varying attributes such as type of pavement and number of lanes. The road condition, maintenance cost and failures (potholes), etc. could also vary along its length over time. But the road remains one asset, and EAM systems with linear referencing capabilities allow an organisation to manage it as such without splitting it into discrete segments as required by a traditional hierarchical asset register.

The position on a linear asset can be specified as a single point or segment with start and end positions, all relative to a known position along the specific linear asset or higher level linear asset. This known position could be an intersection with another road, dedicated marker or prominent feature with a known, recorded position.

The LAM system is able to translate these relative offsets to an absolute position(s) on the asset that could even be translated into geospatial coordinates if the reference linear asset has been mapped with geospatial coordinates.

3 Linear Asset Management functionality in On Key

On Key is known for its industry leading functionality related to hierarchical asset type and asset tree structures that uniquely provide for structured management of maintenance plans for discrete assets from generic to very specific maintenance tasks. This functionality has further been enhanced through the introduction of a number of key functions in support of LAM with the release of On Key 5.10, namely:

- Integration with AIV systems in the establishment of geospatial data associated with linear assets.
- The ability to subdivide parent linear assets into linear sub assets.
- Association of work requests with dynamic segments of linear assets.
- Creation of work orders for linear assets and the recording of planned or completed work history against dynamic segments of these assets.
- Configuration of custom monitoring points for recording measurement data associated with linear assets in time, linear reference and geospatial dimensions.
- Opportunities to analyse condition, failure history and costs over time and along the length of a linear asset.
- The On Key LAM functionality is illustrated through the road infrastructure example illustrated in Figure 1

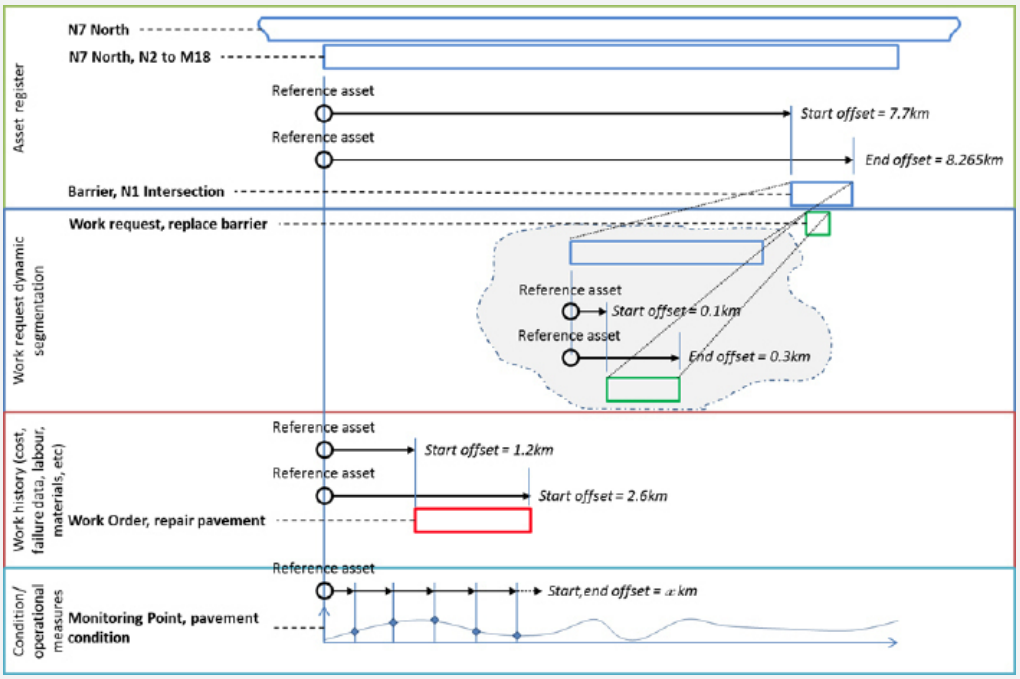

Fig. 1. Example of a highway with linear sub assets, dynamically segmented to record work requests, work history and condition measurements.

4 Asset Identification and Verification

On Key provides an Asset Identification and Verification (AIV) solution whereby new and existing assets can be identified and assessed for their current condition during a physical verification process. Data recorded during this verification process is captured through a mobile device which also provides the opportunity to record the geographic position of the asset. This geographic position could then serve as the reference point for a linear asset.

Figure 2 illustrates how the On Key linear referencing functionality can be used in combination with geospatial data to relate a roadside barrier, being a linear asset itself, to a road section, its parent linear asset. The linear offsets of the roadside barrier can be entered explicitly or calculated from its geospatial coordinates relative to that of the road section.

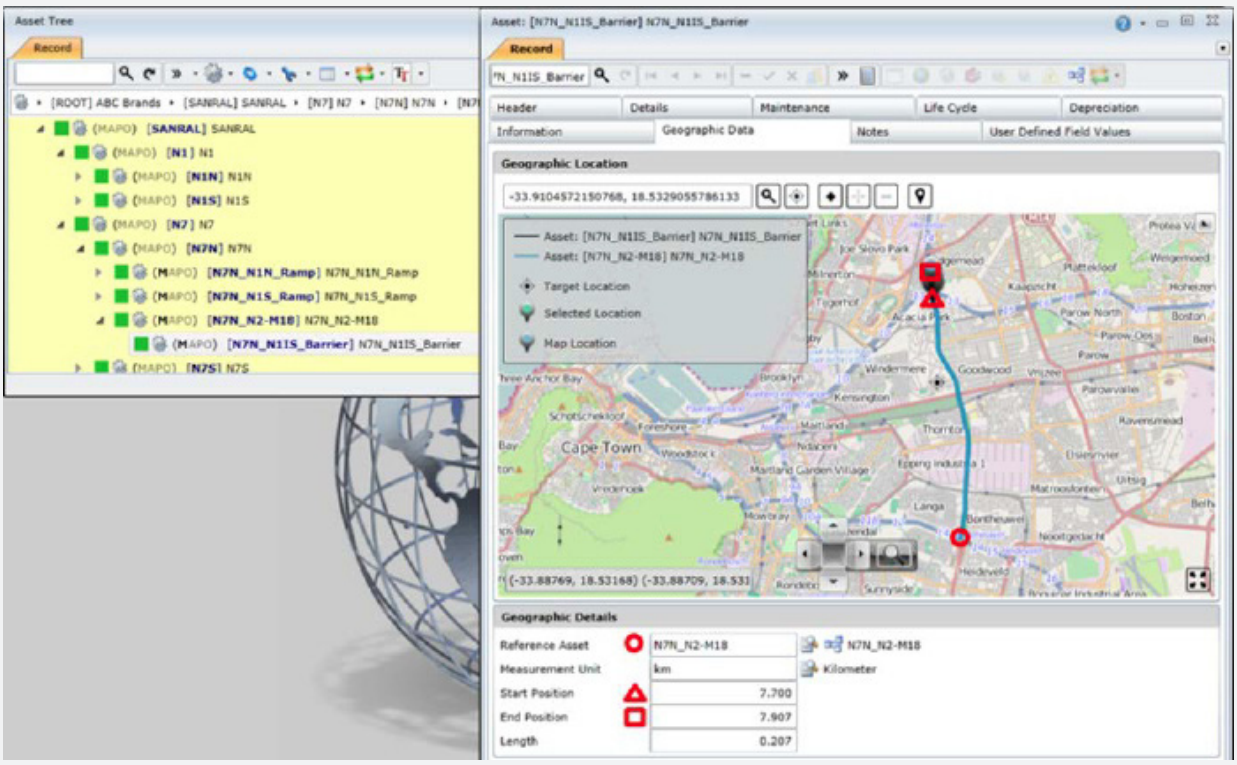

Fig. 2. Linear sub asset (barrier) referenced to a higher level linear asset (N7 North highway section).

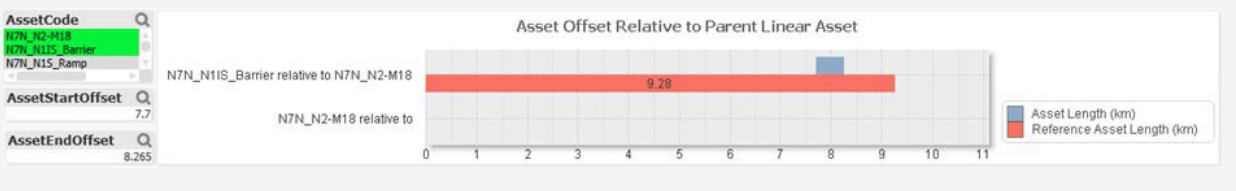

Fig. 3. Barrier (N7N_N1IS_Barrier) relative to its parent linear asset (N7N_N2-M18) in linear terms.

5 Work identification

Non-tactical maintenance work identified for linear assets due to failure or ad hoc decisions will require work requests to be generated for specific dynamic segments or points on a linear asset. This requirement is addressed through On Key's functionality that. allows a user to enter a work request for a selected dynamic segment of a linear asset. The location of the work request is specified by entering the linear references (offsets) for the beginning and end of the dynamic segment relative to the beginning of a selected reference asset, or by specifying the geospatial coordinates for the beginning and end of the required work

The selected reference asset can either be a higher level parent linear asset or the direct linear asset with which the work request is associated. The line graph in Figure 4 was generated using the On Key Analytics and illustrates the number of work requests that were raised for a linear asset with code "N7N_N1IS_Barrier". The dynamic segment with start and end offsets of 0.25km and 0.5km respectively had 3 work requests raised against it – this could indicate that the segment is more prone to failure, requiring a design change or other specific action to improve its reliability.

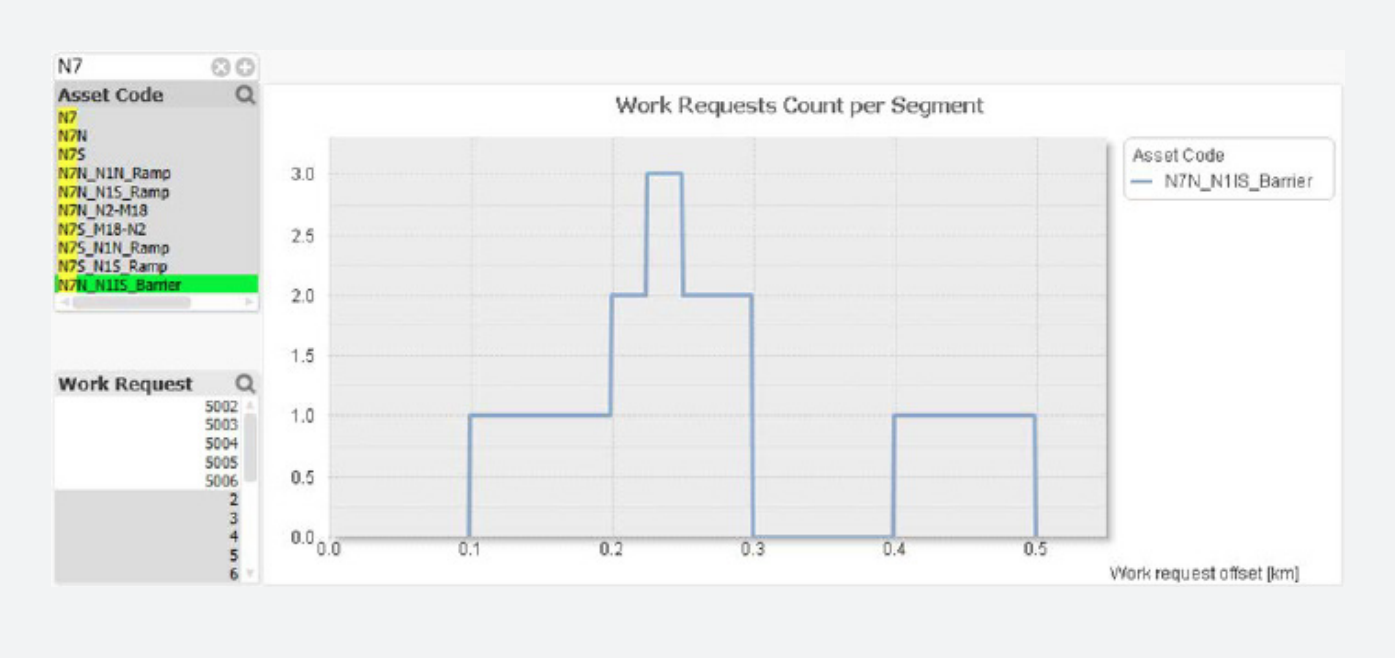

Fig. 4. Work request intensity for a section of roadside barrier on the N7 North highway.

6 Work allocation and execution

In On Key, all work to be executed against an asset is controlled through work orders issued against the asset. Thus, once a work request on an asset has been validated, a corresponding work order must be created before the work can be planned, scheduled and executed.

Work orders can be associated with dynamic segments on a linear asset in the same way that they are provisioned for work requests. By associating work orders with dynamic segments of a linear asset, On Key allows maintenance staff details, labour hours planned/used, downtime, repair materials used, special resources, failure analysis data, etc to be associated with the dynamic segment.

This allows maintenance planners and management to obtain valuable insight into the maintenance costs, reliability and risks associated with parts of a linear asset and improve future decision making when managing the asset. Figure 5 illustrates the cumulative maintenance cost per kilometre for a road section over time. The segment from 1.2 to 2.6 kilometres clearly cost more to maintain than the average for the entire road. The analytics functions within On Key allows the user to identify the work orders associated with this segment of road for further analysis (see Figure 6).

Fig. 5. Historical work order cost per kilometre for a road section.

Fig. 6. Work order R05041 shown to contribute significantly to maintenance cost of the N7N_N2-M18 road section.

7 Condition Monitoring

Different types of monitoring points can be defined within On Key. These monitoring points can be used to record any measurement values in a time and linear or geospatial reference system. The results below illustrate measurement values from two measurement point types, namely “Pavement Condition” and “Road Shoulder Condition” that have been configured against the “N7N_N2-M18” road section linear asset. The results are illustrated on a map and in a linear referencing system. Filtering can be applied in both views to narrow down the selection to only a specific dynamic segment of road for analysis purposes. Measurement results from the different measurement points can also be plotted on the same graph for comparison purposes.

Fig. 7. Road Shoulder Condition measurements for the N7N_N2-M18 section of the N7 North highway illustrated in a linear referencing system, and a heat map for analysis purposes.

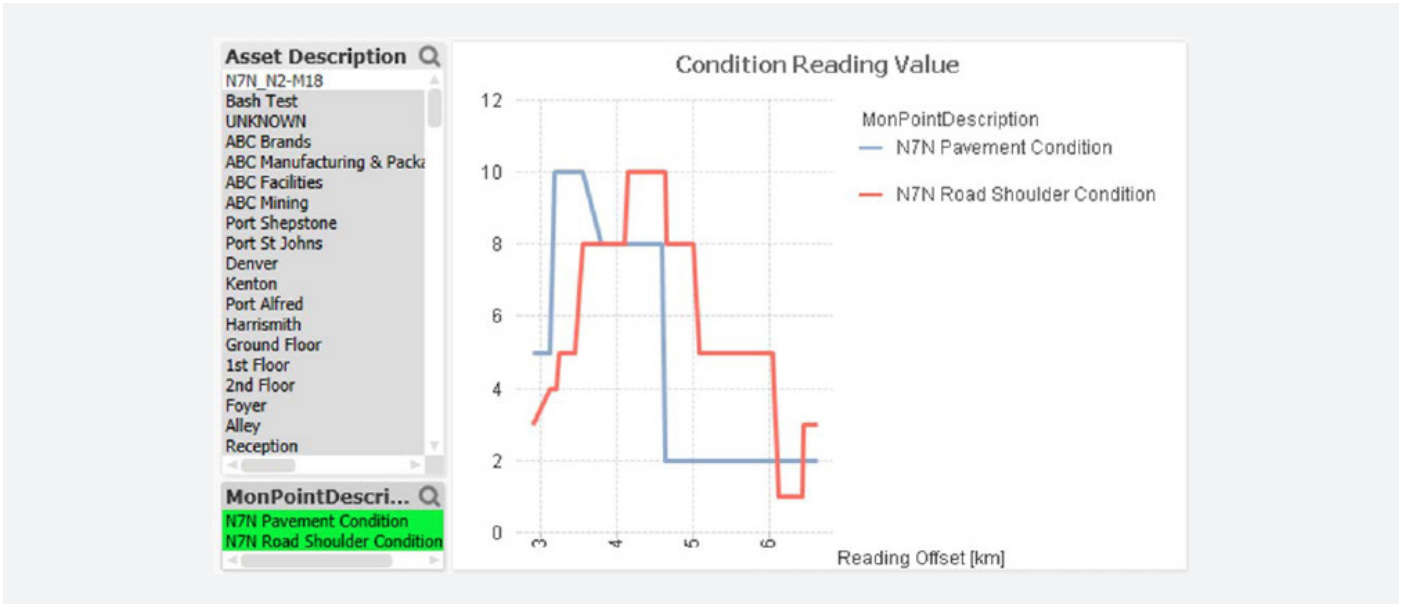

Fig. 8. Relationship between Road Shoulder and Pavement Condition measurements for the N7N_N2-M18 road section.

8 Realising value through Linear Asset Management

An integrated approach to the management of linear assets enables asset owners to get a bird's eye view of the performance of their linear and discrete assets without having to manually integrate data from various standalone systems.

This integrated approach makes it easier to keep track of assets, accurately identify the location of required work and dispatch maintenance crews to segments of assets on which work must be performed. Through the ability to dynamically break up large linear assets into more appropriate segments, measures like maintenance costs, failure frequencies, types of work, downtime, condition, age and many other values can be recorded more precisely against the relevant part of the asset without dividing the asset into complex discrete hierarchical structures OR losing the ability to gain an aggregate view of the asset as a whole.

A good linear asset management capable EAM will enable its users to unlock value through more precise and easily obtainable management information, more efficient maintenance administration practices and more effective management of linear assets through their life cycle.

Linear referencing capabilities within the asset register, work request, work order, condition monitoring and analytics modules of On Key give the user the ability to capture and use linear referencing data in the management of their assets. This, combined with On Key's ability to interface to third party systems, puts the user in a good position to maximise the use of information held in ERP and GIS systems external to On Key.

This integrated approach makes it easier to keep track of assets, accurately identify the location of required work and dispatch maintenance crews to segments of assets on which work must be performed.

9 Concluding summary

Linear asset management has been around for years, yet many organisations still attempt to manage their linear assets using traditional hierarchical asset registers. This paper highlighted some key considerations in the management of linear assets and illustrated through some examples how Pragma's On Key EAM can help users to better manage their linear assets.

10 More information

Visit Pragma at www.pragmaworld.net or contact us on +27 21943 3900 for more information on how Pragma can assist you with your Linear Asset Management.