SMART INFRASTRUCTURE FOR AN ADVANCED MANUFACTURING ECOSYSTEM

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Why Smart Infrastructure?

Smart Infrastructure is the result of combining physical infrastructure with digital infrastructure, providing improved information to enable better decision making, faster and cheaper. Smart Infrastructure involves applying rapid development of technologies and digital abundance to economic infrastructure for the benefit of all stakeholders. It will allow owners and operators to get more out of existing assets, increasing capacity, efficiency, reliability and resilience. It brings better performance at lower cost. Greater understanding of infrastructure performance will allow new infrastructure to be designed and delivered more efficiently and to provide better whole-life value.

The General Concept

Smart Infrastructure will vary from sector to sector, but it always has a similar anatomy, made up of three basic layers connected by communications. As shown in Figure 1, data is the key.

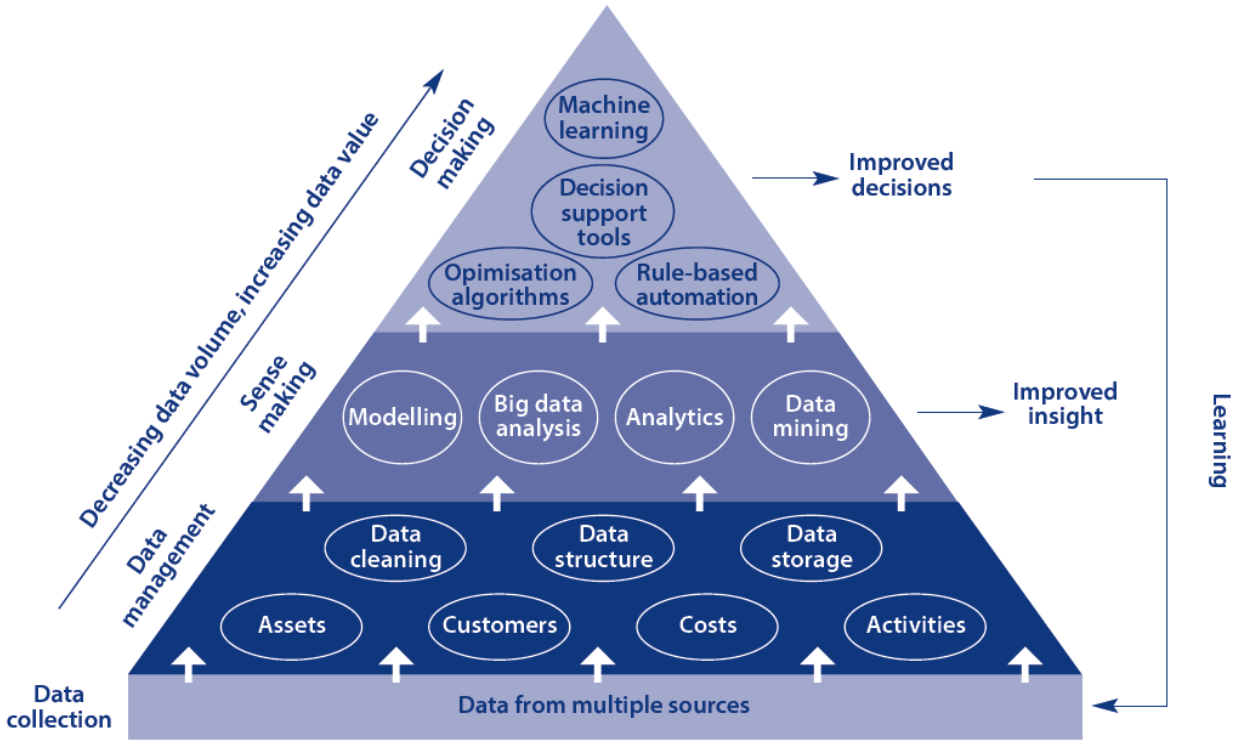

Figure 1. Hierarchy of decision layers for processing data.

The general components of smart infrastructure is as follows:

- Automated sensing: a requirement for automated, low-cost, easy-to-maintain sensing of key asset properties;

- Automated data gathering and processing: gathering of sensed and other data relevant to an asset needs to occur in an automated manner and involve processing of the data – filtering, cleaning, correction, structuring, etc.;
- Asset-oriented data: data organized in an asset-oriented manner - so that all required information relating to one asset or a set of assets can be viewed in a single location;
- Data sharing: ability to share data seamlessly as required between organizations;
- Information analysis: management and interpretation of information for both predictive and reactive responses;
- Decision support: information directly supporting asset management I maintenance planning practices;
- Value-oriented data: cost and value of asset management practices understood in the context of the whole-life cost of the asset; and
- Robustness to change: asset information and management practices should be robust to ownership changes and adaptable to changes to the operating conditions of the asset

Areas of Research

Research supporting the development of smart infrastructure requires expanding the boundaries of current state-of-the-art technologies that are the building blocks of connected physical and digital assets.

Identity: Current product and asset identification technologies simply provide a unique identifier for each asset, which can then be used to retrieve linked information from networked asset management systems. New technologies must be developed to expand storage capacity, non line-of-sight requirements, and energy harvesting capabilities.

State awareness: Current sensing technologies monitor critical parameters that can provide an indication of the rate of progression or the likelihood of development of different failure modes of an element, an asset or the system. New types of sensing technologies must be developed for continuous monitoring.

Communication: Data captured by the sensors must be communicated to data management and analysis systems for making critical decisions. Reconfigurable wireless sensor networks must be developed to enable communication between the assets and data management systems, as well as between the assets themselves.

Data management: Identifying the right data to be collected for effective whole-life management of single or multiple assets is a big challenge. Algorithms must be developed to enable all asset data to be accessed via a single query, without requiring searches across multiple databases and storage locations in different organizations.

Decision support: Novel techniques are required for the interpretation of engineering datasets produced by new sensors. Advances in predictive analytics must be made to help understand the state of infrastructure, predict impending failure, and create the opportunity to take optimized preventative action. In addition, software agents must be developed that continuously seeks data from various sources, analyze it and makes decisions without the need for human intervention.