

BIG DATA AND ITS APPLICATIONS

Rodrigo Garro, Industrial Engineer,
Orbita, Valencia, Spain



Big Data use is causing a revolution in different organisational as well as industrial sectors. Major sectors such as health care, automotive, retail, manufacturing, supply chains and public sector administration are increasing investment annually into the production and use of massive data. This article seeks to discern how this affects the port and terminal industry.

WHAT IS BIG DATA?

Big Data consists of the acquisition, storage, model analysis and representation of massive data collected over time. Usually, this data is bigger or more complex than traditional data processing, so there are some challenges in every part of the process:

- **Acquisition:** almost everything can be sized, measured or quantified. In the industrial sector, there is a wide range of sensors capable of measuring speed, position, presence, consumption, flow and weight. There are lots of models and types of sensors for different sectors and industries that can support harsh environments; dust, marine or explosive zones, for example. The analogue and digital signals obtained can be collected by programmable logic controllers through industrial networks and sent to higher-level systems
- **Storage:** maximum data in minimum off-time means that a massive amount of space is needed to store information. From the point of view of IT leaders, the big challenge is how to handle this. In some applications, the size needed could be a lot of terabytes or even petabytes. There are some structured databases on the market ready to handle billions of variables of data
- **Model analysis:** raw data obtained doesn't offer so much value until it is processed. Once it has obtained as much data as possible, it can start creating patterns. They will depend on the results that any organisation wants to obtain. The first step is a descriptive analysis in which a summary of data should be made. Usually, most operations will be aggregate functions (for example, to count how many times a machine needs to be recharged), but sometimes more complex functions like standard deviations, variance or p-value are used. After this data is ready for a predictive analysis where it will be used by different tools in the form

of statistics, in data-mining and through machine learning techniques to study recent and historical data. This allows analysts to make forecasts of what can happen in the future

- **Representation:** how Big Data is presented in a way that business leaders can quickly use and understand is by no means a minor consideration. Mining millions of rows of data can create a big headache for analysts tasked with sorting and presenting data. One of the common ways is to create template charts and graphs that can facilitate such information, but the final report should be defined together with the final reader. One thing is clear; it has to be made graphically. Studies show the brain processes images 60,000 times faster than text, so the use of graphs, maps, tables, shapes, etcetera, is mandatory. The use of infographics to show results informally are recommended as well

COMMON INTEREST

There are several uses of Big Data. One of the main uses could be as a tool to help leaders to make decisions in order to improve company productivity. A data-driven company is an organisation that bases its decisions on empirical results. Managers could use scientific processes of controlled experimentations that include the formulation of a hypothesis, then design and conduct experiments to test those hypotheses. After this, leaders can then analyse results with precision before making a decision.

In addition, the advantages of applying Big Data are beneficial to an entire organisation. In the production layer of a company, making information obtainable will improve performance significantly, as no group of workers wants to be the worst and once people know they are underperforming, the competitive factor will transform personal performance without any other incentive required.

BIG DATA IN PORTS

Concerning ports, terminals and shipping, there are many applications in which Big Data can be integral:

- **Dynamic Lighting Management:** the idea of this system is to automatise the lighting systems of terminals so they can be managed dynamically. In areas where there are ongoing operations, the system will keep the appropriate lighting, and in areas without operations, it will decrease the intensity of the lighting. This process will be updated in real time to adapt lighting conditions to specific operational needs. To be able to do this, the system needs to know the actual position of vehicles in the yard, the destination of those vehicles, weather conditions and time. The estimated reduction in energy consumption is 30%
- **Predictive Maintenance Optimisation:** any piece of port machinery that fails costs time and profits. Capturing data from equipment sensors, visual inspections, manual measurements and past experience allows the design of an appropriate predictive model for each type of machine. This will maximise equipment life and yield while reducing maintenance costs and unplanned equipment failures
- **Energy Consumption Forecast:** electricity cannot be stored naturally, so for the electrical companies it is vital to adjust production to demand in real time through the accurate planning of operation windows in different power plants. In many countries, customers have to deliver their expected consumption to the electricity companies, and they are risking



being penalised if they exceed the contracted consumption. If ports and terminals, acting here as customers, are able to get accurate predictions, negotiations with electricity companies will make rates cheaper. Big Data can cross-calculate information from years ago in myriad scenarios, thereby creating more accurate reports. In addition, different models applied to the same data will show which equipment is using the most energy and where to invest to reduce the reactive power and optimise installations

- Smart Routing for 3PL's: with real time traffic information, accident records, scheduled roadwork, potential congested areas and weather forecasts all taken into consideration, new routes can be mapped should obstacles arise and thus save vital time for trucks

These are just a few ideas for uses, but Big Data is an open-ended tool with infinite potential.

A SUCCESS STORY

SeaTerminals is a European project with the aim to encourage a new culture in the current operative model of the port industry by introducing eco-efficiency as a key variable in order to improve activities and processes linked to container terminals.

Orbita is collaborating with Noatum in one of the main phases of the project, which consists of the design, prototyping and deployment of a smart, efficient and adaptive energy and operative management system. Using the principles of Big Data, the first activity is to acquire data from all the machinery in the yard (STS, RTGs, ECH, RS and TTs), with signals like positioning, energy consumption, orientation, type of operation to be carried out, and so forth. Those signals are stored in a local PLC and then sent via Wi-Fi to a centralised database. Experts in analytics from Noatum defined the key performance indicators and worked on model analysis and the results obtained can identify operational bottlenecks, thus allowing the system to assign suitable working modes that will optimise cycle times and reduce unnecessary fuel consumption.

This is expected to save 10% of fuel costs and between 10-20% in operational costs, as well as cancelling time-outs and imbalances within the supply chain. In addition, a Dynamic Lighting Management system will be able to manage illumination in real time, saving up to 30% in energy consumption.

CONCLUSION

According to IBM, over 90% of all the data in the world was created in the past 2 years. Industry sectors are not blind to this exponential growth and they are increasing investment in the qualification of employees. Ports, terminals and shipping might be a step behind compared to health care or retail, but its potential is enough to take off in the next years. In this globalised world, companies cannot afford to be left behind.

ABOUT THE AUTHOR

Rodrigo Garro is an Industrial Engineer specialising in electronics and industrial automation. He is Project Manager at Órbita Ingeniería. Rodrigo joined Órbita in February 2006 as a Project Engineer in the automation area where he developed projects for different sectors.

ABOUT THE ORGANISATION

Órbita Ingeniería is an engineering company specialising in process control and automation with a significant presence in the container ports and terminals market, plus other industrial sectors through its factory automation and process automation divisions. Orbita's ports and terminals range of products automate processes at terminal gates, for STS cranes and improve the overall performance of a terminal's business. By dramatically improving gate, quay and yard performance as well as reducing errors in container inventory management, a rapid return on investment is ensured. A modular design, plus the use of standard, highest quality components, allows Orbita to make maximum use of existing infrastructure and technology; minimising up-front expenditure.

ENQUIRIES

Pol. Ind. L'Alter C/ Dels Ferrers, 22 · 46290 Alcàsser, Valencia
Tel: +34 961 43 39 95
Email: info@orbitaports.com
Web: www.orbitaports.com

IMPLEMENTING BIG DATA



More than a year ago, I wrote an article where I put emphasis on the growing importance of obtaining and processing massive data, as an essential to help decision-makers of companies to choose the right path to follow. The benefits were reducing the operative costs, analysing bottlenecks in production, saving energy and even more importantly, greatly reducing the risk of accidents as some examples.

Now is a good opportunity to reflect on the evolution of the ports and shipping sector, regarding the implementation of Big Data. As proof, three examples from last year:

- Noatum Container Terminal: The Noatum Group started an ambitious Big Data project at its Terminal in Valencia in 2014. After a successful initial phase, Noatum is evolving the process focusing on the evolution of the core hardware systems. There they are currently working on a powerful enough computer cluster, for data acquisition and achieving faster data mining. In the words of Francisco Blanquer, R&D Manager and Development Engineer of Noatum, "The application of Big Data technologies hasn't been easy to implement and need special dedication to make them work properly. In return, the result has been immediate and it has improved the limits of improvement in our Terminal". The use of the data obtained, has led them to design

an ambitious terminal optimisation plan in operational terms, to take place in the coming years.

- Kalmar Insight. Kalmar has recently launched its Big Data application, where in addition to the data obtained directly from the machinery, they add the advantage of integrating data from the TOS and Maintenance Management Systems, creating a holistic view of the Terminal.
- Paceco Spyder: It was launched in June this year, and it mixes Big Data and Internet of Things technologies. With the same objectives, they also go deeper into remote maintenance, obtaining very particular KPI's from all the systems of the Container Handling Equipment.

In the near future, Big Data will be a key tool for autopiloted vessels. The artificial intelligence of the ships will evaluate tons of data like wind, tide, changing routes or fuel consumption. This will come with a necessary reduction of the communication costs onboard ships, to be able to share data with the fleet owners in real-time. For instance, one good example is Tesla Model S: the flagship of the autopiloted cars, collect up to 5 TeraBytes of data per month. This data coming from its multiple sensors and the internet, to feed the algorithms to make the decisions.

So, our sector is moving in Data Analytics' technologies. Maybe not as fast as other sectors, but it's difficult to deny that Big Data is here to stay.