A Practical Example of Data Exchange and Expert System Applied to Ground Improvement Works

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Abstract. OMNIBOX^{TM} is a MENARD in-house and all-in-one solution that enables a smooth data exchange from office-to-site-to-office and that provides intelligent pilot assistance to operators for several ground improvement techniques. This expert system combines machine data and soil data. It is currently used on MENARD sites in different countries. To be able to use this system on very different machines and in many countries, an extensive work has been done regarding the structuration of both soil and machine data using an AGS-based data format. The aim of this extended abstract is to present this expert system applied to ground improvement works and give feedback on its set up on and the added value to the whole company.

Keywords: Ground Improvement, Data Exchange, Sensors, Soil Data, Pilot Assistant.

1 Context

It is often said that a ground improvement site is a prototype; every site has its specificities and its challenges. Location changes, ground conditions change, surroundings and production patterns vary. It cannot be denied. Site crews - on a daily basis - do their best to adapt to these changing conditions and perform high-quality and efficient work.

The site crews are the link between sites; their expertise acquired over the years comes with the hundreds of situations they have been through and all the solutions they put in place on site. The efficiency and high-quality work on site is mainly owed to the crews, the added value of their accumulated experience and their feedback. Consolidated human memories are the keys to our performance and expertise.

Whereas we use only our five senses to record memories, sensors embedded on our machines record dozens of parameters and several times per second. It becomes therefore undeniable that consolidation of machine data and soil data collected on ground improvement projects is a mine of knowledge even though it is currently extremely under-used in our industry. Furthermore, current monitoring systems in the cabins are either provided by the machine manufacturer – whose expertise is not in the ground improvement processes – or by electrical and automation companies whose business is more focused on standardizing screens and services rather than understanding the specific needs of a given user.

Following this observation, MENARD decided to launch the development of a universal and flexible solution to be retrofitted on its entire fleet of equipment, with the aim to consolidate both machine data and soil data for ground improvement works. In other words, to bring in one place the memories of the sensors and the expertise of crews in order to streamline day-to-day production and prepare for artificial intelligence (AI).

2 Setting up a new activity

It seems clear however that collecting sensor data, developing embedded interfaces and setting up a universal data exchange format between an online platform and an embedded system is far from the usual ground improvement activities. MENARD found reliable partners and reorganized its skills to be able to go through this strategical challenge while involving technical teams from all countries in the project.

Under the brand OMNIBOXTM, MENARD reinvented and digitalized its activity to streamline data exchange from existing ERP and CRM software to resource planning tools and embedded systems mounted on the machines. The full solution is made of:

- A data acquisition box that is universal enough to be able to read the machine protocols of the very diverse machines of MENARD's fleet while requiring limited skills in electrical engineering to add new sensors for a

given project. The parameters measured by the sensors – whatever their brand or type – are standardized across all countries so that the collected parameter data can be consolidated and compared.

- A pilot assistant consisting of the interface with the operator which provides various applications specific to ground improvement techniques – every application enables MENARD technical teams to better assist the operator executing the works
- An online platform – developed internally – to communicate with the application on site in real-time, perform high level quality control and improve the machine use and maintenance.

Fig. 1. Sketch explaining the architecture of the OMNIBOX™ solution

3 Roll out and added value

One year and a half after it was mounted on the first machine of the fleet, the solution is now available in eight countries, mounted on more than thirty machines and has been used on more than 250 jobsites. This was made possible thanks to the great involvement of the operations teams across the countries to define the tools that match the most their needs – on an "office"/engineering point of view as well as on a "site"/operator point of view.

The standardization of data collection helped plant departments to be more efficient in their maintenance planning; it allowed also very specific performance analysis to take place easily on site in order to improve processes. Design departments have a closer look to the execution and interactions with site crews are simplified for unexpected ground conditions for instance. Production data consolidation for internal use or to produce reports for clients is also much easier; site engineers and project managers can focus more on quality control, process follow up and productivity analysis. The mass of available data also opens the way to more advanced analysis in order to, for instance, streamline operating processes towards more energy efficient works.

4 Conclusion

Even though this approach from a ground improvement specialist is uncommon, it may become more and more popular as the needs for process monitoring and process optimization are key in a competitive market. The open and custom approach of the OMNIBOXTM makes it a real asset for operation teams, and its quick roll out on Menard sites helped the ongoing digitalization of the site processes with immediate gains in efficiency, productivity and quality. OMNIBOXTM is also AI-ready and coming developments aim at bringing even more know-how and intelligence to operations in the field.