How Vestas´ Project Management Tools have Enhanced Upsides in Brazilian Wind Farms

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INTRODUCTION

Project management skills and techniques have become a science in past few years, projects after all, are very similar in terms of concept and best practices to manage; and those practices have being collected and summarized in organization such as PMBOK and PRINCE2. The development and use of such knowledge have been the goal of MBAs, post-graduate and certifications courses which have led to significant performance improvements in project teams. The usage of these modern project management concepts have been taken into consideration for the purposes of this paper.

Vestas on the one hand, has developed specific project management tools to optimize such skills and techniques when applied to the wind energy industry. Brazil, on the other hand, has many peculiarities that impact performance in projects, the so called “Brazil’ Cost”: logistic restrictions, BOP delays resulting from environment licensing lengthy processes, union intervention, isolated sites, low performance, among others. Erection and installation low-performance has contributed as well (due to lack of skilled workers and subcontractors), grid connection delays (due transmission line installation delays), land-owners right-of-way issues, utility company bureaucracy, and basic grid re-powering are just some of the issues faced regularly on projects in Brazil.

In order to deal with many of these issues, Vestas Brazil has implemented and customized Vestas´ project management tools to recover from project delays and/or to create the necessary

schedule buffers in order to reduce the risk of delay in commencement of wind farms' commercial operations or anticipating thereof; thus guarantying that the finance modelling is not affected by such delays or considering upsides to enhance such finance models. The presentation of such tools as well as examples of daily use and finally and most importantly, the results achieved are the primary goals of this paper.

Keywords: *Vestas, Project Management, Brazil' Cost.*

V110 – THE BEST TRACK RECORD EVER

One important factor for Vestas Brazil's success when implementing projects is the turbine itself.

The power of scale: Vestas 2 MW platform is the most widely applied turbine platform in the history of wind power generation — with more than 18,000 turbines installed in 45 countries — no other turbine platform benefits from as deep a level of performance data and insights, in as diverse conditions.

Another important product development was keeping the dimensions and mass of the nacelle and hub unchanged, and mounting the full drivetrain in the nacelle for easier installation and less expensive transportation. Staying within the 70-tonne maximum nacelle mass with the drivetrain mounted, enables standard, rather inexpensive road transportation, as well as the usage of standard narrow track cranes.

A third benefit is that each complete nacelle can be tested and pre-commissioned before leaving the assembly plants. In terms of construction, this means less pre-assembling on the site, which results in higher quality of the final turbine installed – site conditions are very different from the factory floor. Thus, Vestas Brazil reduces the risk of adding defects when pre-assembling parts on site (gearbox, transformers, power cabinets, cables etc.).

As a result of this design evolution, the Vestas V110 is a very easy turbine to transport, erect, assemble and commission; with a well-trained team there is little room for mistakes.

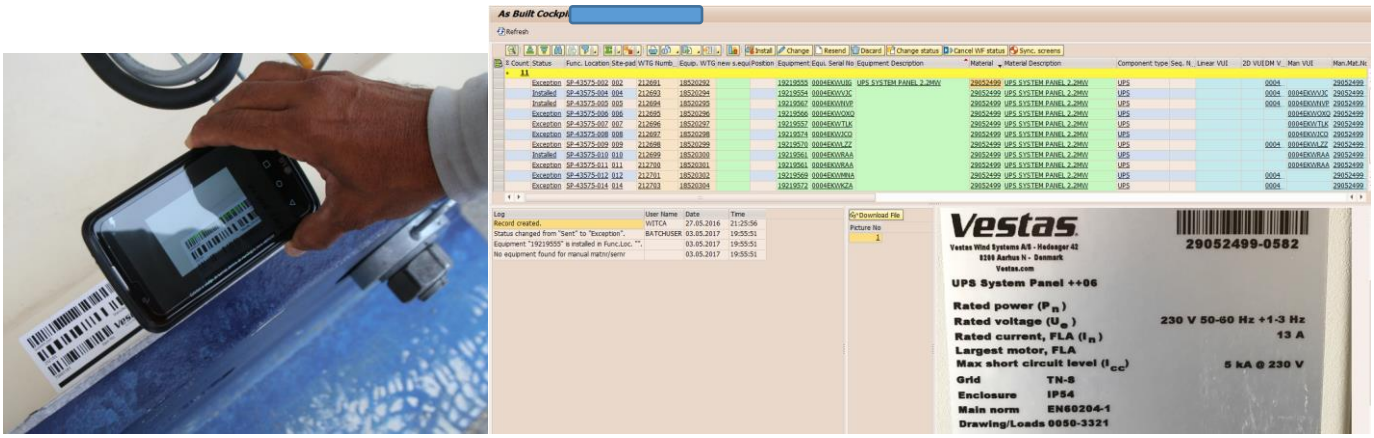
Tools Management

When discussing physical tools for turbine assembly, Vestas takes a vertical approach. All tools necessary are kept in one of 6 global tools warehouses – one of which is located in Brazil. This guarantees that all correct and necessary tools will be on site in a timely manner; and all of these are certified and calibrated.

Misassemble can be quite common at some Wind Farm sites due to wrong tools, non-calibrated tools: over-torqueing, misalignment, over-gapping, these are all really rare in our operation thanks to this approach. This also allows clients to do their own installation if they want; Vestas rents the tools for such cases.

Special tools are designed specifically to increase safety and productivity at site. Take the Multi-Blade Installer for example, which can be operated remotely to make the installation easier:

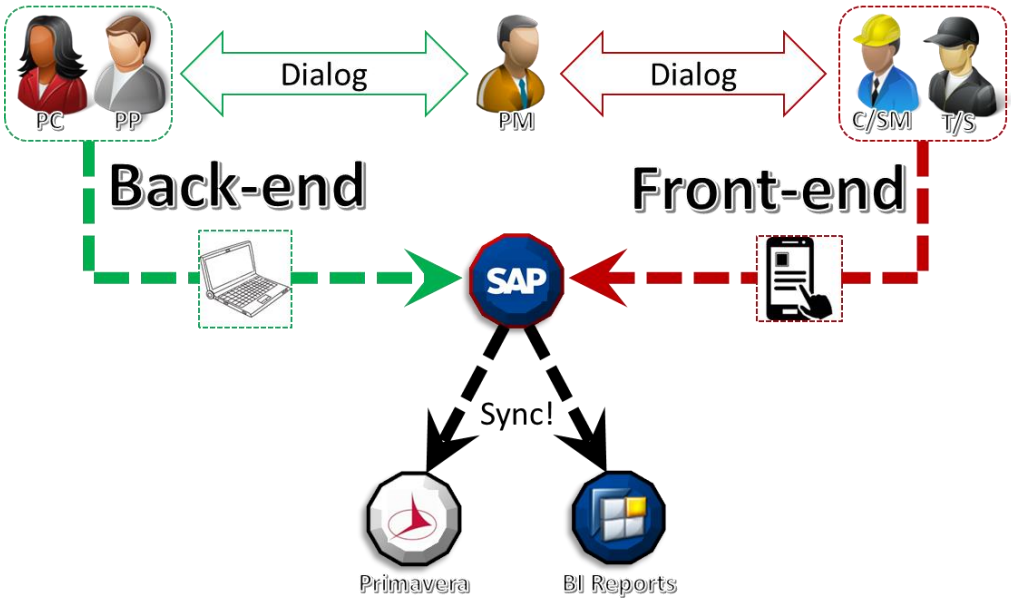
Site-Pro and One Plan



Mobile and PC applications that allow a simple and effective interaction between the site and back-office, with multiple key Features:

- Activity Start/Finish Dates
- Primavera Synchronization
- Site progress (delays and anticipations)
- Crane Hours on Pad
- Head counts & Shifts
- Transport Frame Returns
- Daily Reports

- Non-Conformity reports
- As-built
- Weather Forecast



This allows site progress feedback to be quickly and easily sent directly to SAP and then to produce Primavera and BI reports. The Planner/PM, for example, knows exactly what the actual progress is on site; and the site team does not need to expend time preparing these reports manually. Example, when one component arrives on a specific platform, the supervisor scans the bar code and immediately the 'as-built' is reported, there will be no error in Finame reports!

Mandatory Training and Certification for Installation team:

For Vestas supervisors and subcontractors alike, training is mandatory for the workers that install Vestas turbines; passing the tests and being certified is not optional. This guarantees the necessary knowledge to assemble Vestas turbines is spread out on site. These requirements are add employment value for the installation workers, since certification is given to the individual and

not the company. Vestas Brazil has a simulator for the 2 MW plataform in Fortaleza, CE to attend our team and all of our subcontractors.

That is the 2nd step on the quality pillar, the 1st being the pre-assembly and testing on factory, and 2nd is the quality of the installation team.

Requirements	Course	Target Group	01/01/2016	01/07/2016	01/01/2017	01/07/2017
General Safety	GWO Basic Safety/Local Legal Equivalent	All Installation Team	100%			
	Safety Intro for Technicians	All Installation Team	100%			
	Electrical Safety for Qualified Persons	All employees performing Electrical Work on Energised Systems / Components	10%	20%	30%	
	Lockout Tagout (LOTO) 2	Person in Charge - Responsible for Lockout Tagout of all Hazardous Energies	10%	20%	30%	
Installation	Level D Installation	All Installation Team	25%	50%	75%	
	Level C Installation (2MW)	Installation Team Leads	10%	20%	30%	
	Level C Installation (V112 3MW)	Installation Team Leads	10%	20%	30%	
Lifts	Operation of Avanti Service Lift	All Installation Team		25%	50%	75%
	Operation of Power Climber Service Lift	All Installation Team		25%	50%	75%
	Installation of Avanti Service Lift	Installation Team Leads		10%	20%	30%
	Installation of Power Climber Service Lift	Installation Team Leads		10%	20%	30%
	Installation of Avanti Ladder and Rail	Installation Team Leads		10%	20%	30%

Vestas Doc App:

This application contains Vestas Documentation for transport, handling, preservation, storage and installation of Vestas turbines, both Vestas personnel and subcontractors have direct access to the latest versions of documents, thus avoiding the risk of using expired documents.

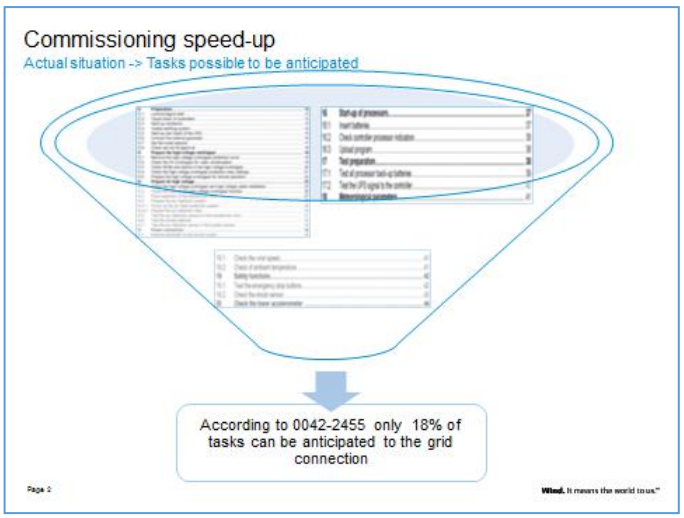
Pre-Commissioning using 150 kVA Genset:

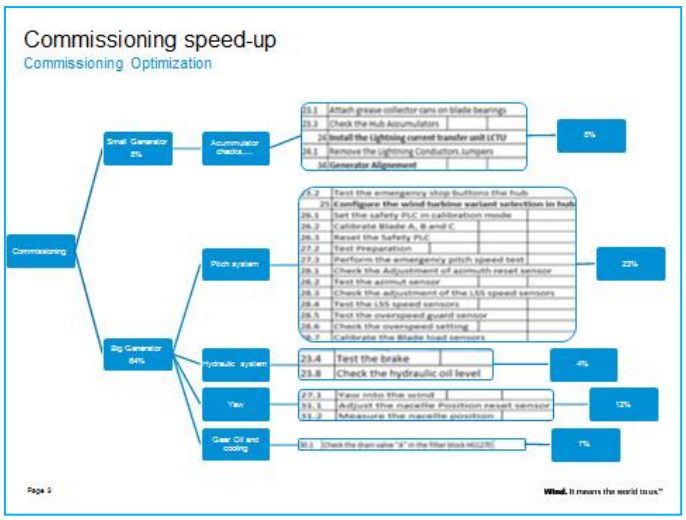
Most grid connections in Brazil are delayed due to innumerous circumstances, therefore it is not unusual to have the site fully erected when the grid access arrives. This being the case, the turbines must be as ready as possible to be able to be up and running as soon as they are connected to the grid.

Some developers in Brazil have invested millions in load banks to commission the turbines, see below an estimation for a 5 MW load bank associated with an equivalent diesel generator set to be installed in a 200 MVA HV substation:

	months	k R$/month	Total
load bank	5	600	3.000
Fuel	5	1.166	5.832
		BRL x1000	**8.832**
		EURx1000	**3.533**

Vestas has developed highly effective pre-commissioning using 150 kVA genset; this allows commissioning teams to complete up to 72% of commission tasks:





As result, the final commissioning tasks when connected to the grid take only 4hr per turbine, making the most of the load bank gain margin, therefore much more cost-effective to the client than the expensive and problematic load banks solution.

Results:

The final result is that Vestas Brazil has been able to help clients to catch up on their BOP delays by both improving and speeding up logistics and installation, as well as improving pre-commissioning and final commissioning phases. Below are some examples of effective catching up:

	Weeks	
Projects	BOP Delay	Caught Up
Example 1	20	6
Example 2	21	6
Example 3	18	6
Example 4	8	5

CONCLUSION

Vestas Brazil has achieved excellent results on executing its projects with V110, due primarily to:

- **V110 optimized designs' long track-record associate with pre-assembling and testing in factory;**
- **Training and Certification of installation crew, both Vestas and subcontractors;**
- **Effective IT apps; and**
- **Best world practices in project management customized to local conditions.**

The "Brazil Cost" is real; there is no question about it. The more planning and preparation you invest in, the more prepared you will be to deal with all the risks that can easily become reality. A passive approach will lead your project to being passenger in an uncontrolled journey. There is no other effective way to deal with "Brazil Costs" than investing in technology and planning to mitigate those risks and creating buffers to be used to implement back-up plans, or, if the risk does not become reality, captured as upsides on project execution.