RÉSEAU TRIPALIUM

Wind EMPOWERMENT

Maintenance Working Group
Kickstarter final report

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WISIONS of sustainability

A/ Maintenance manual

Introduction

The *Hugh Piggot Wind Turbine Recipe Book* is widely known and many wind turbines have been manufactured during workshops and according to this manual. The French organisation Tripalium has modified this construction manual and published their own. Whilst most of the turbines built according to these specifications performed well initially, many broke down after some time due to a lack of appropriate monitoring and maintenance. This is a particular problem for Wind Empowerment (WE) members who implement electrification projects in remote areas of developing countries, where local technical capacity to perform repairs is low and travelling times out to installation sites are particularly long.

For this maintenance manual we wanted to include preventative and corrective maintenance according to common issues that are happening, based on our experience and the WE-members feedback from around the world.
We also wanted to take into account environmental factors influencing maintenance needs, a list of the tools that you need to perform, the maintenance steps, more detailed maintenance procedures, troubleshooting, a check list and nally a crash page with stories of what went wrong at different SWT installation sites.

Nevertheless, other events not listed can occur. For this reason this document is meant to to be updated in the future. A database will be available online to monitor SWT maintenance actions but also failures or breakdowns that occured, so we encourage WE members to give us their feedback.

WindEmpowerment's Maintenance Working Group (WG) was formed in Athens during the 2 the following group vision:

"To mutually empower people to keep their turbines running."

This work has been achieved by an international crew : Marie Laure (Spain), Jérôme Stravilla (Germany), Gaël Cesa (France, coordinator).

How did we worked

We worked with an online platform to share all our document and on going work. We had some monthly meeting for the first 4 months and for the last two months we moved to 2 weeks and finally every weeks.
We encounter each other to finalise the document in France for a week.
We splited up the works between each of us. Two were more on producing the content and one were more working on the layout and reviewing.

Work that has been done

The maintenance manual is a 46 pages document. The document took us around 380 hours.

It 's available online on the WE Website :
http://windempowerment.org/wp-content/uploads/2016/11/Maintenance-manual-v3.0-low-def.pdf

How do we spread it

It's downloadable on the WE website and on the WE members web site.

It's free to download but we invited people to donate to help the future improvement of this manual.
(5 euros is recommended).
We will also send some printed copies. There available for 18 euros (free shipping).
WE is earning between 3 and 5 euros per printed copies.

Next steps of the project

This document is meant to to be updated in a near future.

We are setting an online database to monitor SWT maintenance actions but also failures or breakdowns that occurred. We encourage all the wind turbine owner to give us their field feedback.

The database will be basic. We learnt from the online survey that trying to find out the problem through oriented question is sometimes impossible. This database will contain :

- contact detail
- location
- turbine diameter
- failure description
- fixing solution
- pictures

Everybody will see this data and once we got enough answer we will start to figure out some failures pattern and how the design should evolve to be more reliable.

B/ The survey

Introduction

The main problem of small wind turbines is their maintenance needs. They require a lot of care and it's much more fun to build the wind turbine than to maintain or fix it.
To our knowledge maintenance failures and their consequences are known only locally and rarely shared. To help with that issue **we want to facilitate the maintenance operation by having a quantitative feedback of your maintenance experience with your small wind turbine through an online questionnaire.**

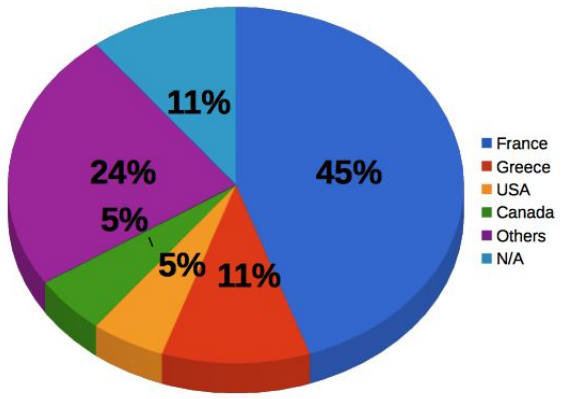
Result

There is 41 questions in the survey. It's divided in 4 parts :

- User data/ user experience
- General information about your system
- General information about your maintenance
- Failures causes and consequences.

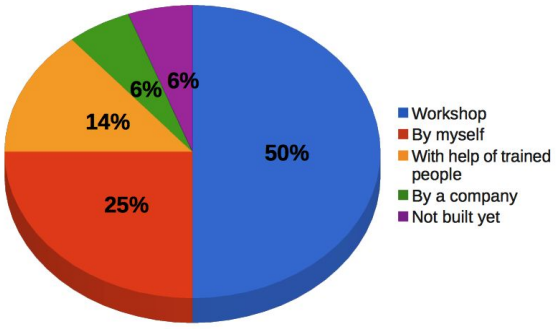
42 people answered to the questionnaire.

Where the people are from ?

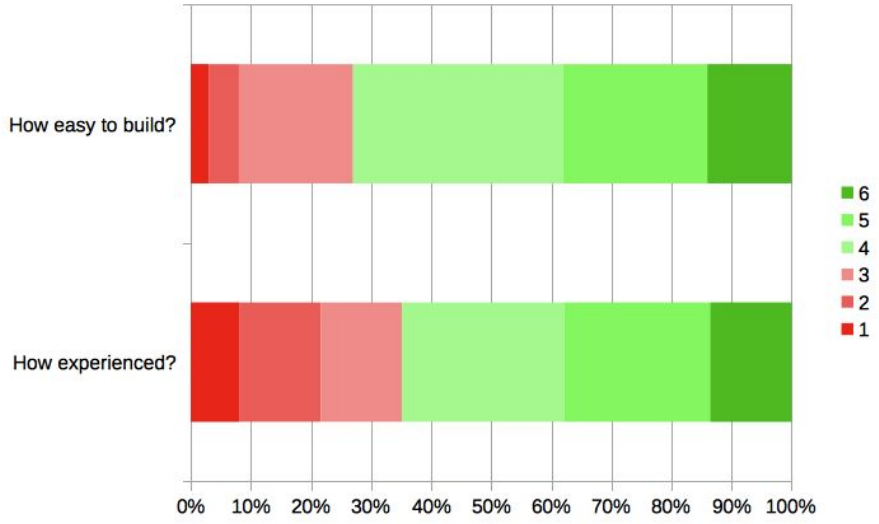


There are from 15 differents nationalities.
People are from all over the world, the 5 continents are represented.

Way of building the turbine

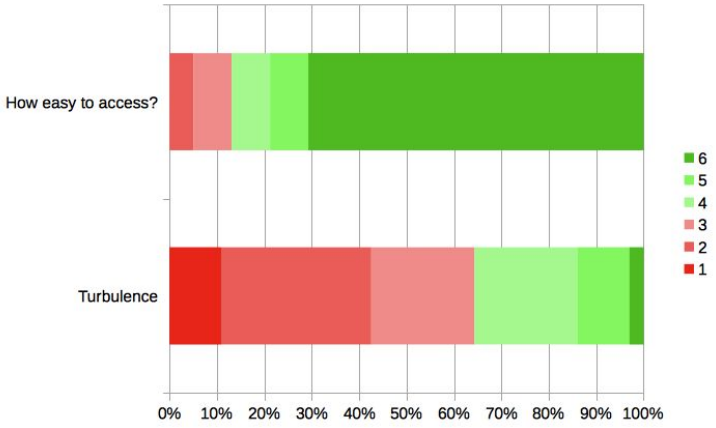


User experience



We can see that we had people with a lots of experience.

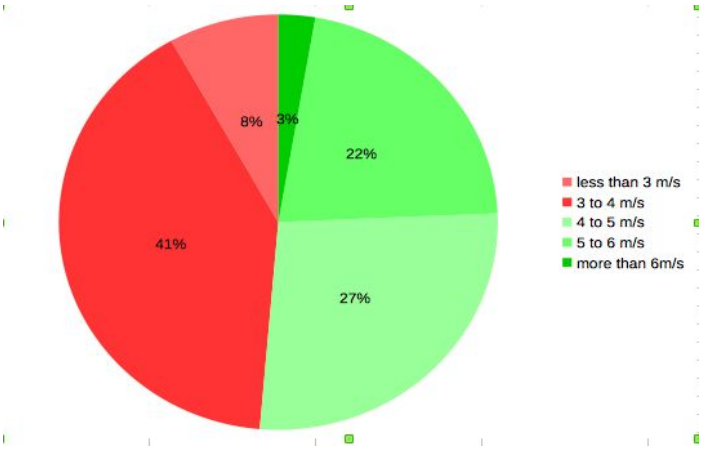
Environment factors



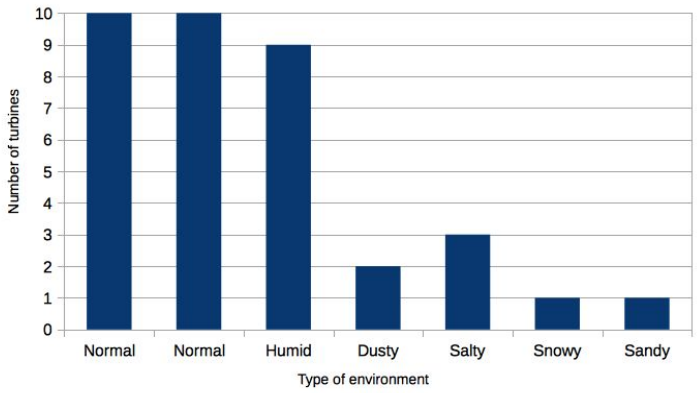
Most of the site are easy to access.

More than half of the turbine are installed on turbulent site. It can be explained that almost half of the turbine are installed in france and that the people have to make compromise so there are not always installed in perfect place regarding turbulence.

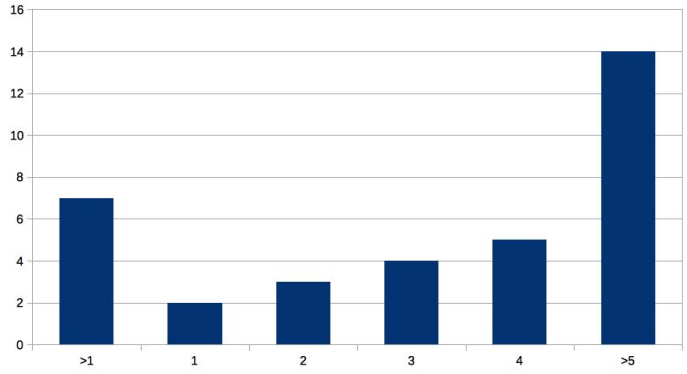
Wind resource



Type of Environment

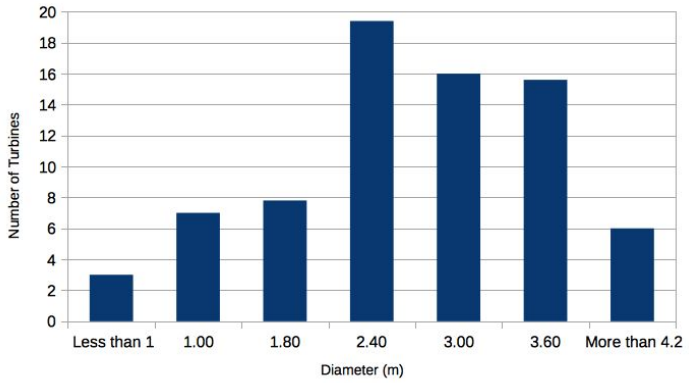


Turbine age (in years)



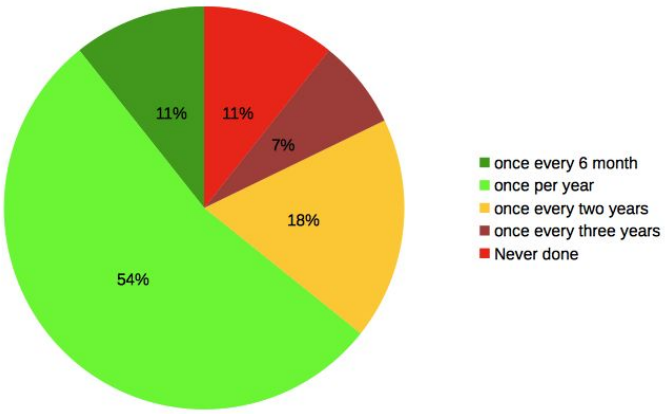
Most of the turbine have fews years which give more relevant data.

Turbine size



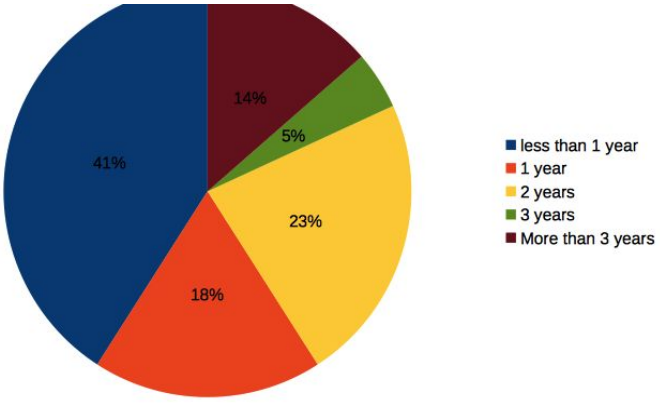
The bigger turbine are well represented.

Maintenance frequency



Most of the user are doing maintenance as recommended (once a year or less).

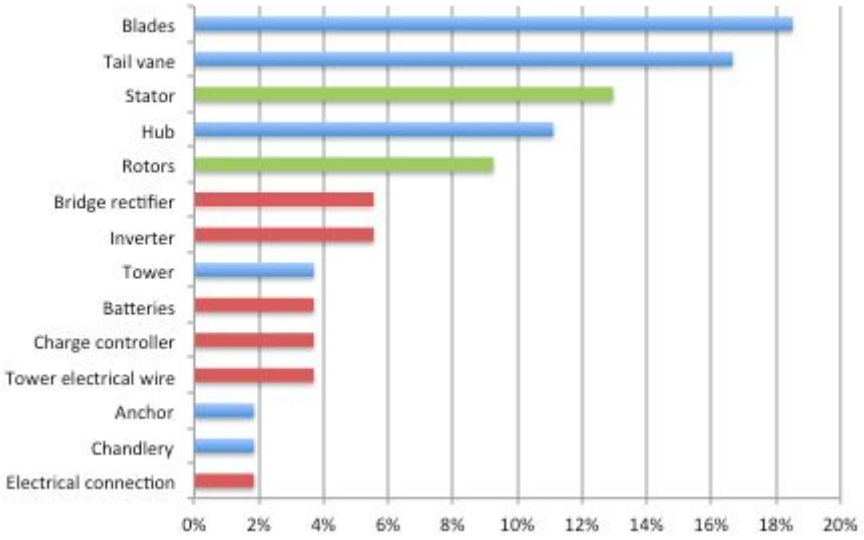
Age of the turbine when the first problem occurred



The first problem occurred during the first year in 60 % of the cases.

In average, wind turbine users will face 0,5 problem per year.

What part of the turbine is concerned

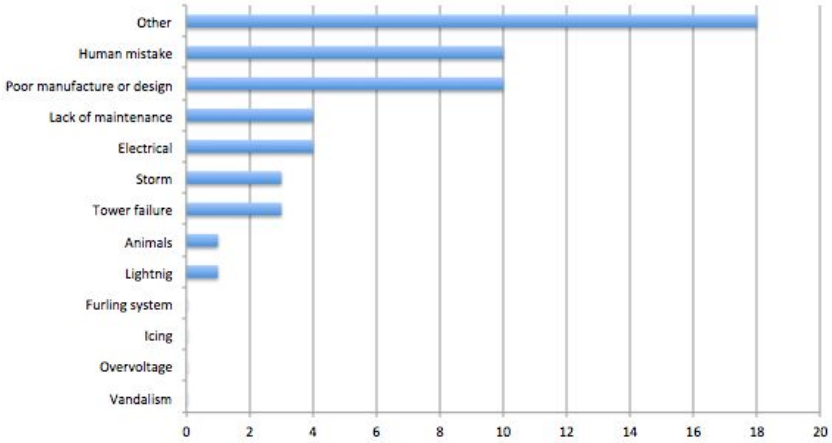


In blue we have mechanical problem, in green alternator and in red electrical problem.

The main problem are

1. alternator with 21 %,
2. blades with 19%
3. tail vane with 17%

Problems causes

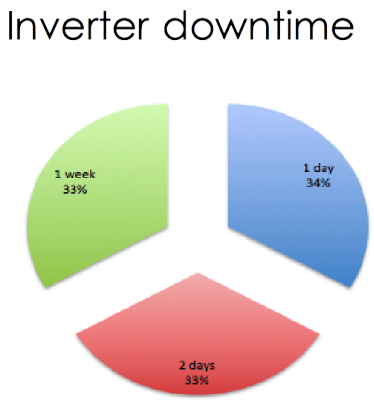


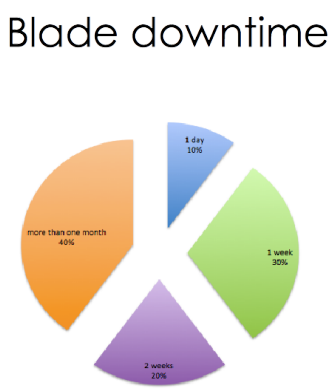
Other is in first place causes there is a lack of causes like wearing, fatigue…

Otherwise we can see that in 24% of the cases is a human factors (either mistake, poor manufacturing, lack of maintenance).

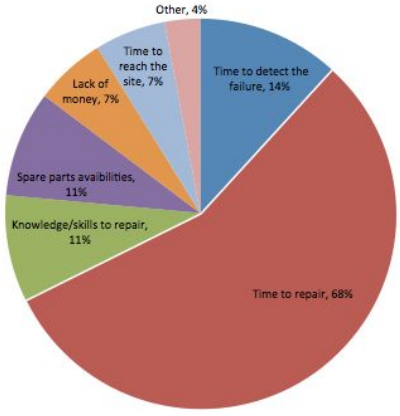
Downtime

This chart shows the general downtime. It show that the downtime is quite long a month or more in 33% of the cases. This downtime rate is depending on the problem as you can see underneath. It takes more time to redo blade than changing an inverter.





In 68% of the cases the downtime reason is the lack of time to fix the problem. Only 11% are by a lack of skills. The lack of tools has never been a problem.



Safety and reliability

People are very satisfied with safety and reliabilities of their turbine more than 83 % of the users rate their turbine at 4 or more on a 1 to 6 scale (6 was very reliable).

Conclusion

The online tools used (lime survey) made the causes of the problem hard or sometimes impossible to determinate.
There was too many question.
More data crossing are needed in order to figure out some failures pattern.

Future work

Finding people with skills to do this data crossing.

See database in conclusion of the maintenance manual.