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Project Pitch 4
Roadmap

Group 6 (A1)

Do Good. Do Better.

01

Transformation Plan

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Current vs Future State

	AS - IS		TO - BE
BUSINESS	Manual Processes & Expert Opinions	→	Automated Processes & Data-driven Operations
TECHNOLOGY	Legacy IT & Incomplete IoT	→	Streamlined IT & Richer IoT
MODELS	Descriptive	→	Predictive And Prescriptive
GOVERNANCE	Distributed Ownership	→	Performance Control & Specialized Ownership

Current vs Future State

	FROM	TO
BUSINESS	**Manual Processes & Expert Opinion**	**Automated Processes & Data-Driven Operations**

From the business aspect, we currently rely on the expert guidelines and knowledge, so most of the decisions are made based on personal opinions and heuristics rather than on data and unbiased models. In addition, a large part of our operations involves routine manual processes such as solar panel inspection. Not only are these processes costly, they are also often suboptimal.

In order to tackle this, we plan to gradually transform the (operational) strategy of the company to a data-driven one. Consequently, we will move towards data-driven decision making and automation of routine manual processes.

Current vs Future State

	FROM	TO
TECHNOLOGY	**Legacy IT & Incomplete IOT**	**Streamlined IT & Richer IOT**

We currently rely on legacy IT systems; not only is this very inefficient, it also limits the potential of IT within the company. Therefore, moving to a more streamlined and uniform internal IT architecture would not only be more efficient but also facilitate the use of data technologies.

In addition, although our current IoT sensors are of high quality, they are installed only at the inverter-level rather than at the individual solar panel-level (each inverter is connected to around 15 panels). Investing in panel-level IoT sensors would provide the model with richer and more granular data and therefore improve model performance.

Current vs Future State

	FROM	TO
MODELS	**Descriptive**	**Predictive & Prescriptive**

Our current use of models is limited to the descriptive level. Most of our decisions are not based on insights generated by these models but rather on expert opinions and heuristics. Currently, the models are solely used for reporting, regulatory purposes, etc.

We plan to move the models to the predictive and prescriptive level. In this way, the company's decision-making will be fact-based.

Current vs Future State

	FROM	TO
GOVERNANCE	**Distributed Ownership**	**Performance Control & Specialized Ownership**

Currently, our operational staff has no full ownership over their tasks. Specifically maintenance workers' tasks are highly diverse; they range from routine inspection to inverter repairs. Since we plan to move to a predictive maintenance system, routine tasks such as grid inspection will be done largely automatically. Therefore, the maintenance staff can focus more on their core objectives (i.e. repairs) and take full ownership over this task. From a performance control perspective, it is also much more straightforward what is expected of the staff.

02

Strategy and Objectives

Data Strategy

KEY OBJECTIVES

Reduce operating expenses by avoiding unnecessary maintenance

Leverage new sources of information: both internal and external **data**

Improve the data completeness

Improve the **generation performance** by detecting faulty equipment

Generate return on investment for the existing **IoT infrastructure**

Identify new business opportunities based on our models

Mitigate operational risks

CORE ACTIVITIES

1. **Improve data collection** and extend current database (only two month of internal data at disposition)
2. Find, use and **connect** reliable **third-party meteorological data (**forecast and historical)
3. **Improve** our **IOT equipment** to improve completeness of the data
4. **Create models** based on internal and external data to improve our performance
5. **Implement** the **models**, **adapt** current **systems** to them, and **educate employees**
6. **Improve** our **models with** the **increased** collection of **data**
7. **Find novel uses of our models**

Data Strategy

DEFENSE
Reduce operating expenses
Mitigate operational risks
Improve data completeness

OFFENSE
Leverage new sources of internal and external data
Generate return on investment in data infrastructure
Identify new business opportunities
Improve generation performance

We have decided to use a mixed data strategy, though it tends to be more offensive than defensive in nature. The main focus of our transformation is to make our operations more data-driven using both the existing data infrastructure and new internal and external data sources. In this way, we aim to reduce operating expenses and risks while leveraging existing data and adding new data sources to obtain richer and more complete data. Although this is our main focus, we also see an opportunity to drive long-term company growth by using our model to aid expansion investment analysis.

Data Strategy

DEFENSIVE ELEMENTS

Reduce general operating expenses:
We aim to achieve this in two ways. Firstly, our short-term power generation forecasting system will allow for improved planning and grid management. Concretely the company can adjust its periodical maintenance planning to times when the panels are expected to produce little power, the company's clients can anticipate the future power they will be provided with, the back-up generators can be prepared in advance when power generation is expected to be low, etc.
Secondly, our predictive maintenance system both allows for faster maintenance and requires less supervisory engineers since fault detection will happen mainly automatically. This will reduce downtime (costs) and salary respectively. In addition, it allows the stand-by engineers to focus more on their core objective (i.e. performing repairs) rather than on routine inspection.

DEFENSE
Reduce operating expenses
Mitigate operational risks
Improve data completeness

Data Strategy

DEFENSIVE ELEMENTS

Improve data completeness:
We plan to invest further in our current IoT infrastructure. The existing sensors are of high quality but provide information on the inverter-level. Since –on average- 15 solar panels are connected to any single inverter, this data is incomplete and hinders operational efficiency. For instance, when a maintenance worker is deployed to investigate an issue for a certain inverter, he would still have to inspect all 15 solar panels in order to identify which panel causes the problem. Therefore, it is necessary to expand our current IoT infrastructure to the solar panel-level rather than the inverter-level.

Mitigate operational risks:
Our short-term forecasting system allows the company to anticipate poor future performance in advance and make ad-hoc adjustments to counteract the negative business effects, therefore mitigating risk. For example, if expected generation next week is very poor, the company can notify its clients, prepare the back-up generators which often have extensive set-up times and perhaps take some solar panels which require maintenance offline. Without a predictive system, one would rely on much less reliable heuristics.

DEFENSE
Reduce operating expenses
Mitigate operational risks
Improve data completeness

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Data Strategy

OFFENSIVE ELEMENTS

Leverage new sources of internal and external data:
We plan to leverage both new sources of internal data (i.e. expanded IoT infrastructure) and new sources of external data (i.e. forecasted weather data from Solcast's API). We can leverage the external weather data to bring all our proposals into practice by means of our proposed model. Without this external data, our model quite simply would not work since it relates weather info to expected Ac power generation. The new internal data, on the other hand, is not crucial to the working of our model –our model works with only the existing internal data- but it does provide extra granularity (i.e. solar panel-level generation data) which greatly improves operational efficiency.

Generate return of investment in data infrastructure:
Currently we have both (limited, only two months) historical IoT data and a high quality IoT infrastructure. However, both are currently unused and therefore lead to no improved profits. Therefore, we plan to put (among others) this IoT data infrastructure into use to provide profits for the company.

OFFENSE
Leverage new sources of internal and external data
Generate return on investment in data infrastructure
Identify new business opportunities
Improve generation performance

Data Strategy

OFFENSIVE ELEMENTS

Identify new business opportunities:
Based on the models that we develop, we believe that we can identify new opportunities as we will be able to evaluate the production of a similar solar plant in any location of the country on the condition that we have access to the weather data of that location, which is possible through the Solcast API. We will then be able the performance of several potential locations simultaneously and also understand their energy production cycle along the year. This information will of great help when considering new investment

Improve generation performance:
Based on our model, we will be able to identify any underperformance of a panel immediately and thus, fix the issue rapidly. The increase in rapidity to fix issue will lead the plant to work at a more efficient level and thus, it will increase the production of the plan compared to the plant situation without any predictive models.

OFFENSE
Leverage new sources of internal and external data
Generate return on investment in data infrastructure
Identify new business opportunities
Improve generation performance

03

Roadmap and Expected Impact

Moving Towards AI

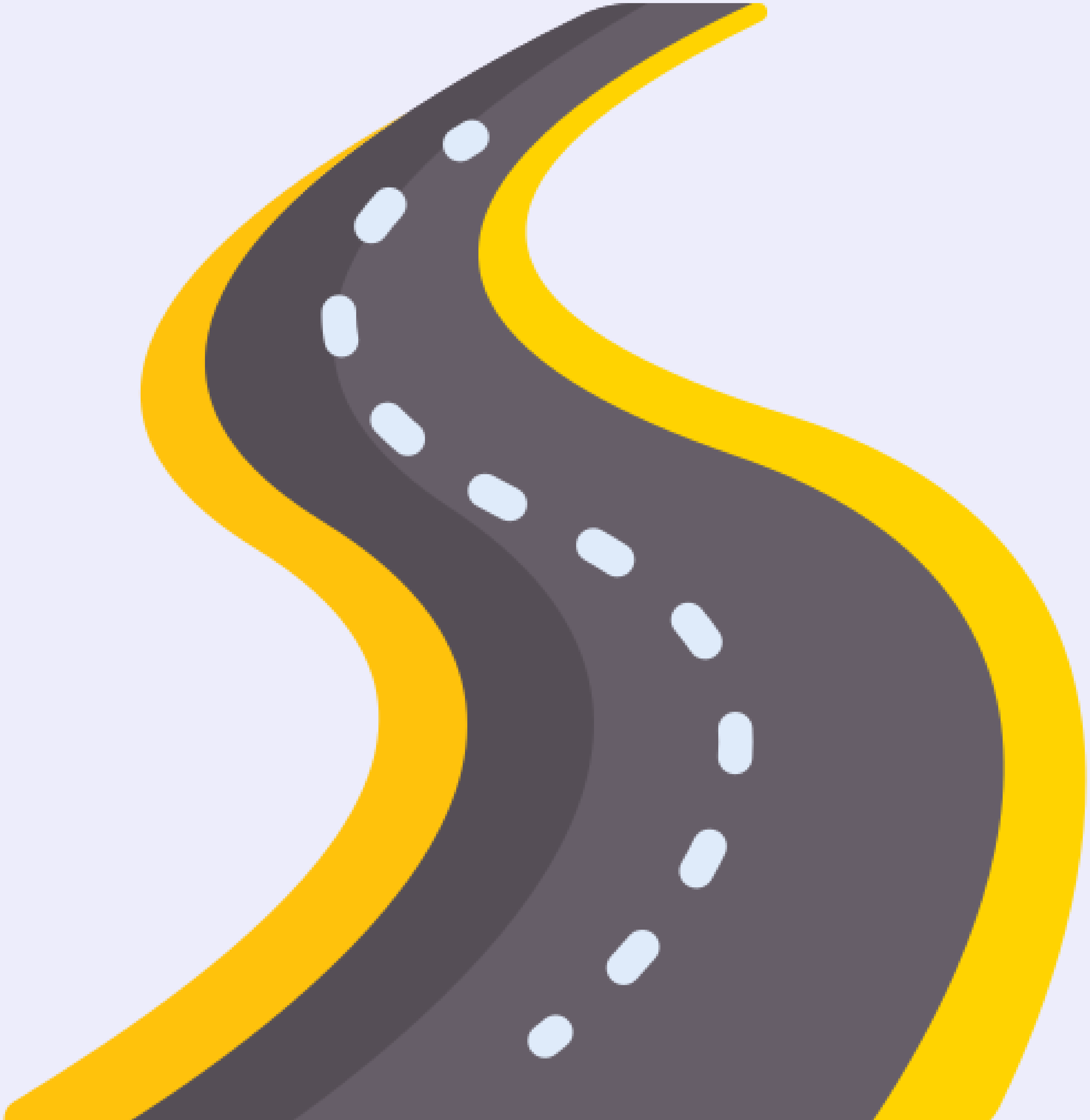
	2. Descriptive	3. Predictive	4. Prescriptive	5. AI-Driven
ROADMAP	Faulty equipment detection model based on previous data of properly working equipment and weather forecasts.	Short-term predictions of power generation, based on short-term weather forecasts (useful for power grid management). Prediction of which inverters are likely to fail in the future based on previous inverters' failure data.	Model that recommends the best location to establish a new power plant, based on expected revenues (given weather forecasts). Model that recommends when to do maintenance to inverters based on weather forecasts, in order to minimize lost revenues.	Real-time underperforming inverters detection model: Connected with an API to obtain real time weather information. Detection model with granular detail by solar panel: identify which specific panel is underperforming in order to fix it.
Quick wins	Clear visual tool with different granularity levels: visualizations by plant, inverter, different time intervals, location and different type of weather measures.	Short term power generation prediction model. Real-time faulty equipment detector.	Faulty inverters predictor model.	
Enablers	• Previous data about the relationship among power inverters and weather (irradiation and ambient temperature).	• Short-term weather forecast in the cities where the power plants are located. • Relevant information to predict likelihood of inverters to fail.	• Weather information for the most relevant cities in India. • Financial information about solar power production and commercialization in India (prices, costs, fees, regulations, etc.).	• Access to real-time weather information (access to an API that provides this service). • More advanced IoT devices capable of giving information with a higher level of granularity.

Not started **On-going** **Completed**

M. Carricano, 2017

Roadmap

1. DEVELOP FORECASTING MODEL
2. CREATE VISUALIZATION FOR DETECTION OF DEFECTS USING MODEL
3. IMPLEMENT GRID MANAGEMENT STRATEGY
4. DEVELOP MODEL ON GEOGRAPHY ANALYSIS USING FORECASTING MODEL



Timeline

Forecasting Model

Visualizations for Defect Detection

Grid Management Model

Geography Analysis Model

Day 1-2

Week 1

Week 3-4

Week 5-8

Levels of Product Maturity

Descriptive

Predictive

Prescriptive

Week 1

Develop Forecasting Model

Visualize Defect Detections

Grid Management Model

Geography Analysis Model

Day 1-2 | **Week 1** | **Week 3-4** | **Week 5-8**

- Develop model that analyzes the relation between weather measures and power generation
- Feasible in short time period

Week 1

Forecasting Model | **Visualizations for Defect Detection** | **Grid Management Model** | **Geography Analysis Model**

Day 1-2 → **Week 1** → **Week 3-4** → **Week 5-8**

- Create effective visualizations for the detection of faulty equipment
- Communicate ownership for maintenance engineers

Impact:

- Real-time detection of defects
- Enabling fast response
- Mitigating missed revenue previously amounting up to 4,100,000 €

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Week 3-4

Forecasting Model

Visualizations for Defect Detection

Grid Management Model

Geography Analysis Model

Day 1-2 **Week 1** **Week 3-4** **Week 5-8**

Impact:
- Increase efficiency by adjusting grid management to expected power generation
- Decrease operational cost by up to 1,200,000 €

- Implement system for grid management according to short-term forecasts
- Analyze most efficient production settings depending on expected power generation

Week 5-8

Forecasting Model

Visualizations for Defect Detection

Grid Management Model

Geography Analysis Model

Day 1-2 **Week 1** **Week 3-4** **Week 5-8**

Impact:

- Determine capabilities of potential locations
- Enabling data driven decisions for further business development

- Use forecast model as foundation to develop model for analysis of potential locations
- Expand model with assumptions on technical/weather-independent aspects of solar power generation

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Do Good. Do Better.