

Citizen-Powered Air & Water Quality Improvement

Final Deliverable

ASRB Consulting

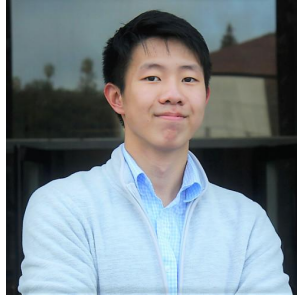
May 2018



Introductions



Osman Mansur, PM



Siyuan Liu, PM



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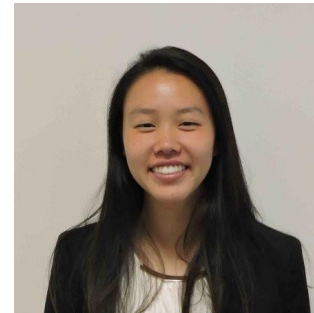
Ansel Deng



Winson Truong



Sydney Pon

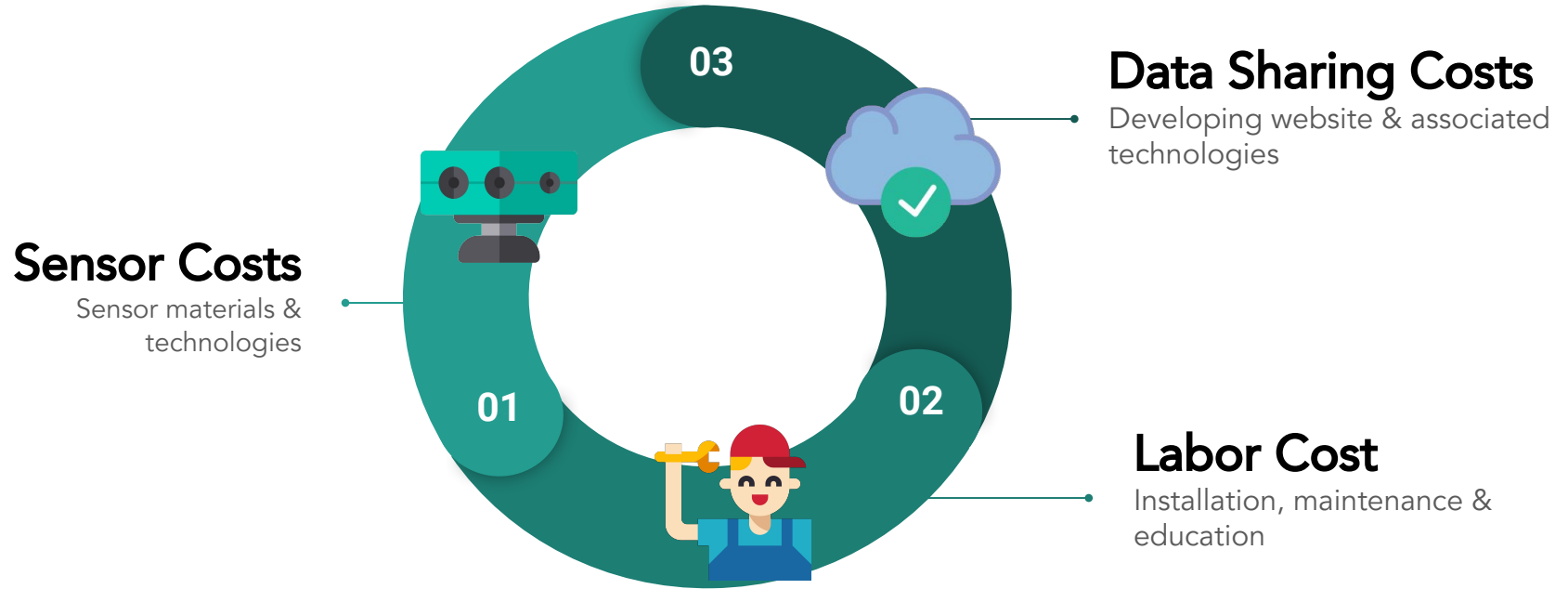


Heather Zhang

Part 2:

Pricing Model

Total Cost



Market Sensor Inputs



LOW END



\$170

EX: AirVisual Pro

MIDDLE END



\$1,733

EX: Dylos DC
1700

HIGH END



\$5,500

EX: BeACON
Sensor Node

LOW END



\$45

EX: Indian Water
Quality Sensor

MIDDLE END



\$930

EX: SweetSense
Sensor

HIGH END



\$5,304

EX: 600XL Water
Quality Analyzers

Case Study

Pricing Model

Pricing Example

Market Sensor Inputs (Spreadsheet)



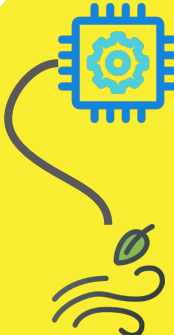
Seen on "**Sensor Inputs**" tab in spreadsheet

Inputs (Air Project Using Market Sensors)		
Items	Options	Value
Type of Market Sensor	Low End	\$169.79
Quantity of Sensors		40
Inputs (Water Project Using Market Sensors)		
Items	Options	Value
Type of Market Sensor	Low End	\$44.83
Quantity of Sensors		40

Can be adjusted to reflect desired **quantity** of sensors

Can be adjusted to reflect desired **quality** of sensors

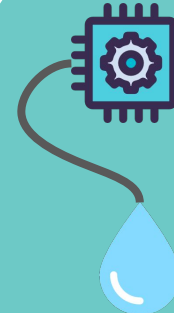
DIY Sensor Inputs



- Arduino Mega Board
- LCD Display
- O₃ Sensor
- O₂ Sensor
- Gas Sensor
- CO₂ Sensor
- NO Sensor
- NO₂ Sensor
- PM_{2.5} Sensor
- PM₁₀ Sensor
- GSM Shield w/ antenna, SIM card, and roaming plan
- Enclosure, LED, breadboard, and battery

TOTAL UNIT COST

Air Sensor



- Arduino Mega Board
- LCD Display
- pH Sensor
- Temperature Sensor
- Conductivity Sensor
- Ammonium Sensor
- ORP Sensor
- Dissolved Oxygen Sensor
- TDS Sensor
- GSM Shield w/ antenna, SIM card, and roaming plan
- Enclosure, LED, breadboard, and battery

TOTAL UNIT COST

Water Sensor

DIY Sensor Inputs (Spreadsheet)

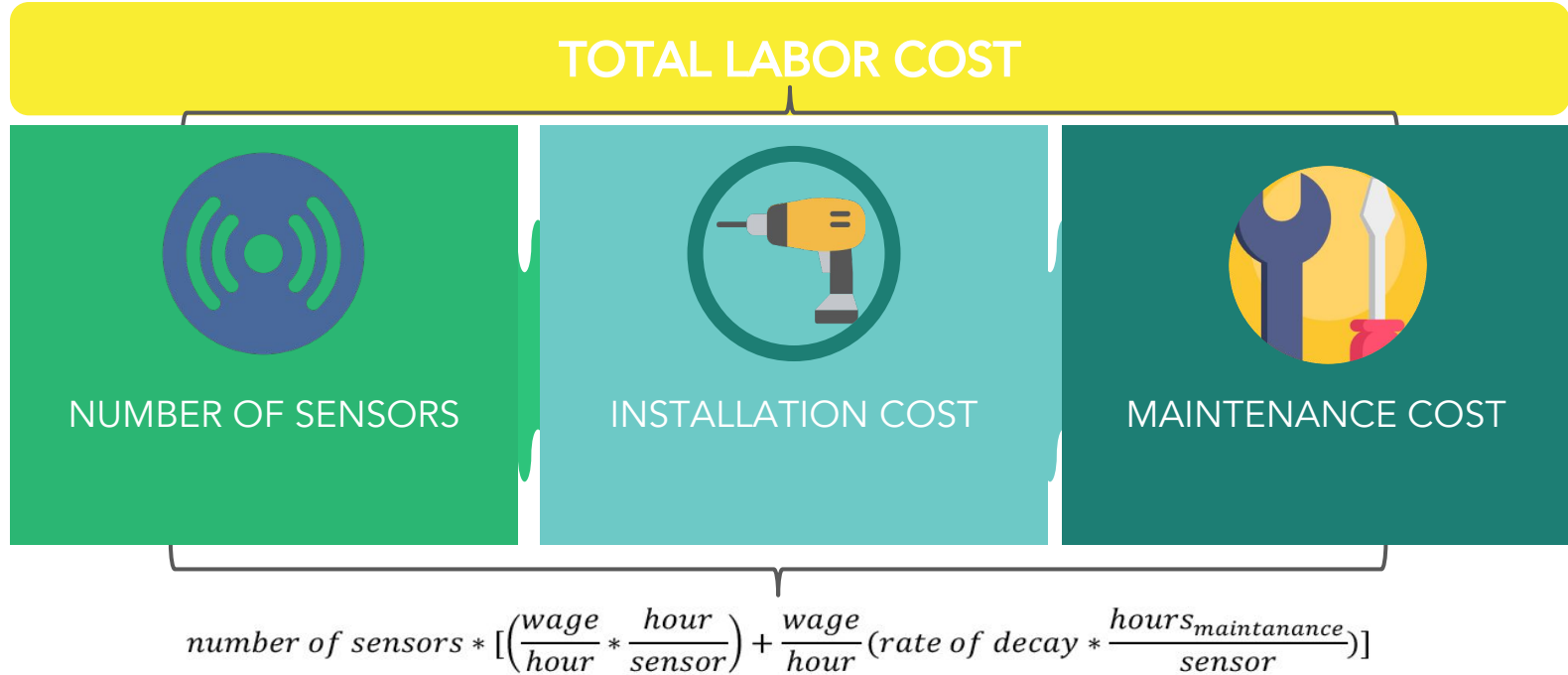
Seen on **"Sensor Inputs"** tab in spreadsheet

Can be toggled
between **Yes** and **No**
to reflect desired
capabilities of sensors

Inputs (Air Project Using DIY Sensors)		
Items	Options	Value
Functions		
PM2.5	Yes	\$30.00
PM10	Yes	\$20.00
Gas	Yes	\$10.00
CO2	Yes	\$56.00
NO	No	\$0
NO2	No	\$0
O2	No	\$0
O3	No	\$0
Extra Material Costs		\$240.00
Unit Cost		\$356.00
Quantity of Sensors		40

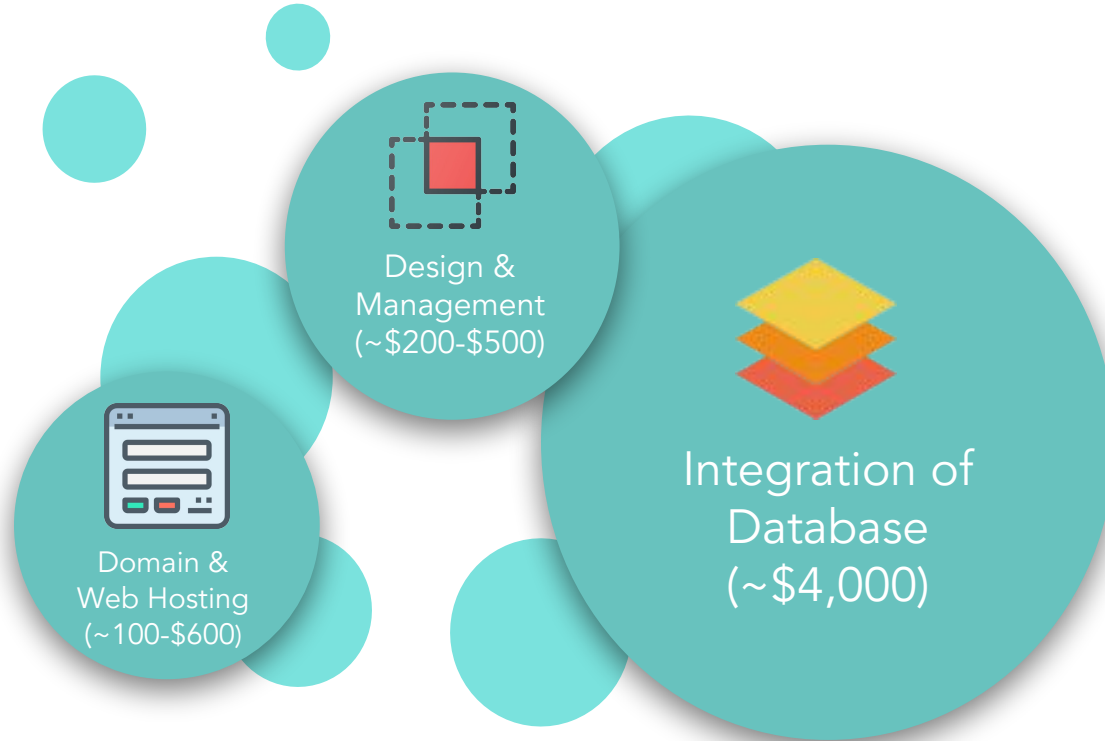
Inputs (Water Project Using DIY Sensors)		
Items	Options	Value
Functions		
pH	Yes	\$50.00
Temperature	Yes	\$10.00
Conductivity	Yes	\$20.00
Ammonium	Yes	\$15.00
ORP	No	\$0
Dissolved Oxygen	No	\$0
TDS	No	\$0
Extra Material Costs		\$240.00
Unit Cost		\$335.00
Quantity of Sensors		40

Can be adjusted to
reflect desired
quantity of sensors



(Additional labor costs may be incurred from advertising, education and training)

Data Sharing Inputs



Final Price Prediction



Seen on "Cost Analysis" tab in spreadsheet

Cost Analysis (Air Project Using Market Sensors)	
Items	Input
Sensors	
Sensor Units	\$6,791.76
Labor	
Installation and Maintenance	\$2,160.00
Advertising, Education and Training	\$1,000.00
Data Sharing	
Website	\$5,000.00
Total Project Cost	\$14,951.76

Dependent on inputs from
"Sensor Inputs" tab

Fixed costs based on
assumptions (can be adjusted)

Prediction for **"Total Project Cost"**

(3 additional tables for other types of projects are also found in "Cost Analysis" tab)

Part 3:

Pricing Example

Project Scenario



PROBLEM



Community is affected by **CO₂** and **particulate matter** from diesel emissions from **Port of Oakland**



APPROACH



Using CO₂ and PM sensors to update real-time air quality data on community website



IMPLEMENTATION



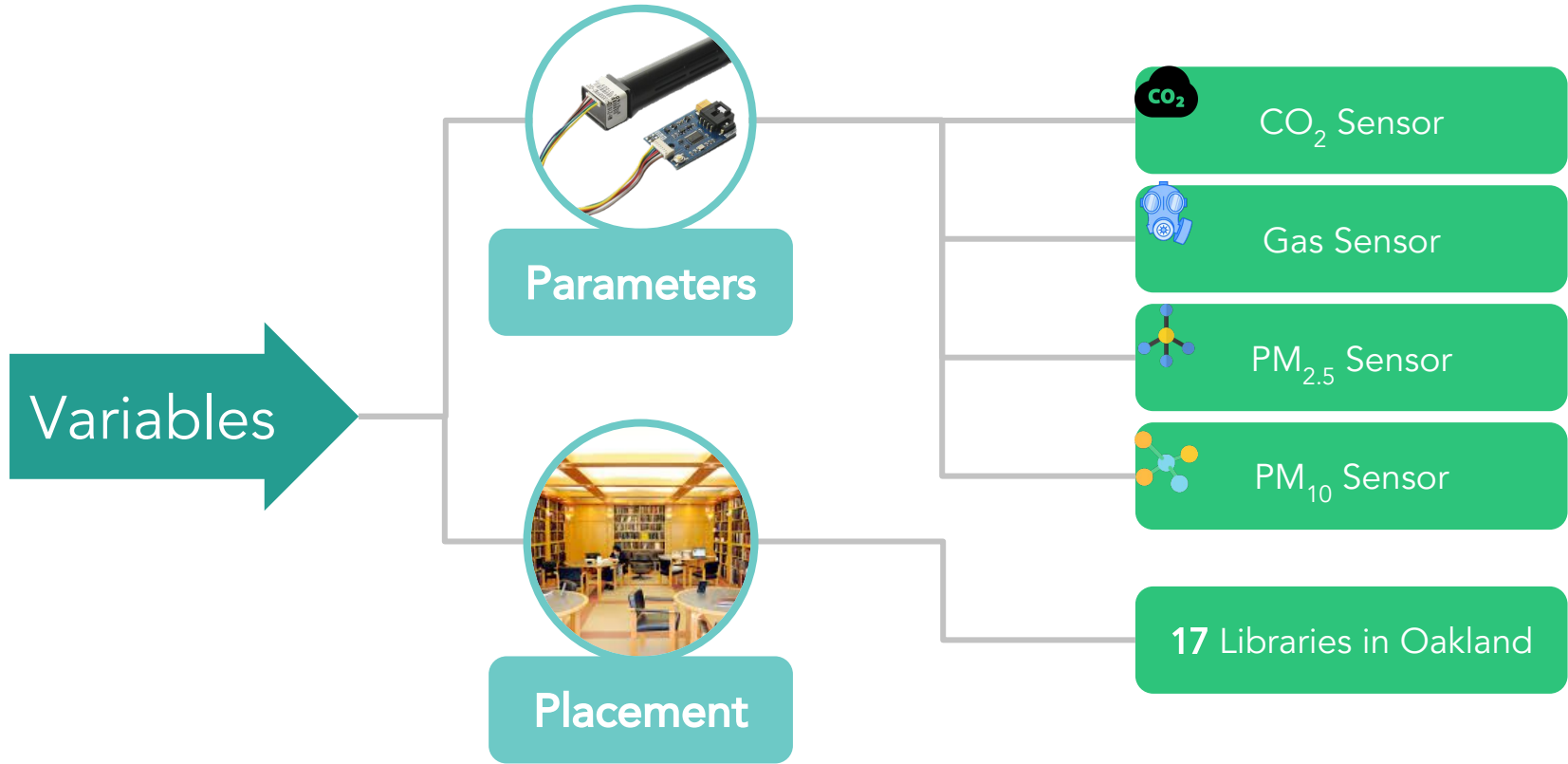
Installing sensors around public libraries to monitor sensitive parameters

Case Study

Pricing Model

Pricing Example

Inputs



Inputs (Spreadsheet)



Parameters for DIY Sensor: PM2.5, PM10, Gas, CO2

Number of sensors: 17 (# of branches of Oakland Public Library)

Inputs (Air Project Using DIY Sensors)		
Items	Options	Value
Functions		
PM2.5	Yes ▼	\$30.00
PM10	Yes ▼	\$20.00
Gas	Yes ▼	\$10.00
CO2	Yes ▼	\$56.00
NO	No ▼	\$0
NO2	No ▼	\$0
O2	No ▼	\$0
O3	No ▼	\$0
Extra Material Costs		\$240.00
Unit Cost		\$356.00
Number of Sensors		17

Price Prediction

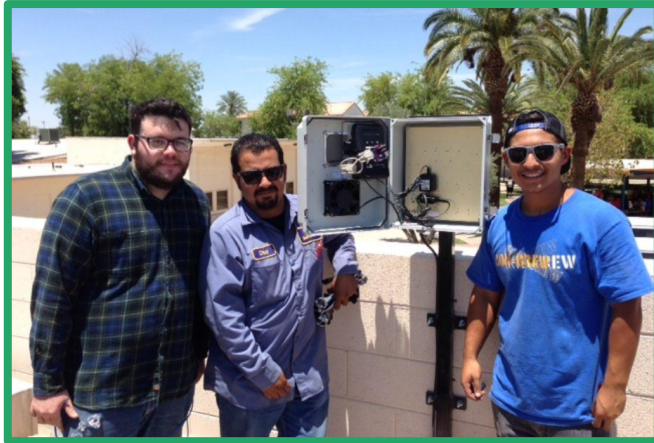


Total Project Cost: \$12,970

- May be underestimate due to potential overhead costs

Cost Analysis (Air Project Using DIY Sensors)	
Items	Input
Sensors	
Sensor Units	\$6,052.00
Labor	
Installation and Maintenance	\$918.00
Advertsing, Education and Training	\$1,000.00
Data Sharing	
Website	\$5,000.00
Total Project Cost	\$12,970.00

Appendix: Imperial County Project



In 2014, The California Environmental Health Tracking Program partnered with community organization [Comite Civico del Valle \(CCV\)](#) to track air quality in Imperial County, an area where pollution has been a pressing issue. Community members helped inform the placement of 40 air quality monitors in locations throughout the area. While the CCV oversees the installation and maintenance of the sensors, they meet regularly with a [committee of 15 local residents to gain community insight and analysis](#).

A data-sharing network between the monitors has been developed by PhD candidates at the University of Washington, and the data is publicly available at www.ivanair.org.



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Appendix: Air Quality Sensors



Grove O2 Gas Sensor	Grove O3 Gas Sensor	Gravity CO2 Gas Sensor	Aquapina NO Gas Sensor	Adafruit PM2.5 Air Quality Sensor	Honeywe II HPM 150S0 Series
O2	O3	CO2	NO	PM 2.5	PM 10
\$62	\$43	\$56	\$36	\$30	\$20

Appendix: Water Quality Sensors



Gravity: Analog pH Sensor	Gravity: Analog TDS Sensor	Gravity: Analog Conductiv ity Sensor	SainSmart Ammonia Sensor	Redox Probe ORP Sensor	Atlas Scientific DO Circuit
pH	TDS	Conduct ivity	NH4	ORP	DO
\$50	\$15	\$20	\$15	\$40	\$40

Case Study

Pricing Model

Pricing Example

Appendix: Median Wage



\$15.74	Installation Technician
\$25.43	Fire Alarm Technician
\$15.31	Helpers-Installation
\$18.11	Maintenance and Repair Workers, General
\$21.40	Maintenance and Repair Workers, Major Group



Association for Socially Responsible Business

"ASRB is a student group at University of California, Berkeley with a mission to systematically advance corporate social responsibility and inspire the next generation of socially responsible professionals through mentorship, education, and professional development."



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