

# Sprinter Data



# Team Introductions



Dylan Cedeno  
*Project Manager*



Marc Griffiths  
*Design Engineer*



Jordan Noyes  
*Quality Engineer*  
Presenter



Handy A Pierre  
*Research Engineer*  
Presenter

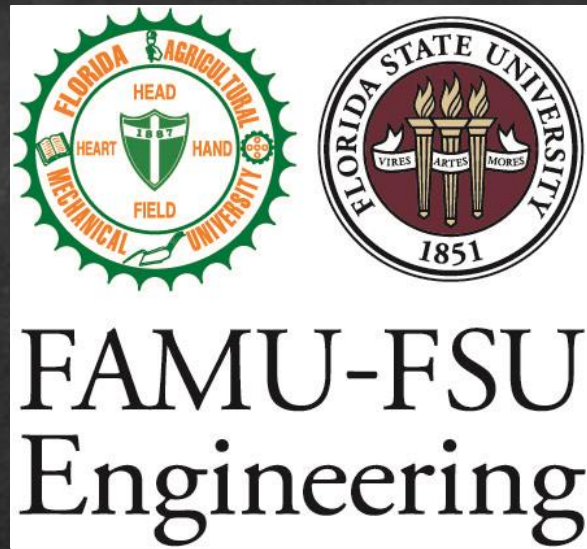


Edwin Ulysse  
*Data Engineer*  
Presenter

Jordan Noyes



# Sponsor and Advisor



## Sponsor

FAMU-FSU College of Engineering  
*Academic Institution*



## Academic Advisor

Jonathon Clark, Ph.D.  
*Associate Professor*

Jordan Noyes

# Summarizing SD1

Jordan Noyes



# Objective



The objective of this project is to create a desirable product that will objectively measure and predict a sprinter's performance.

Jordan Noyes

# Assumptions

- ✦ Range of sprinter heights from 5'6" to 6'4"
- ✦ User has prior experience with sprinting
- ✦ User has access to a laptop or smartphone
- ✦ Sprinter starting in a standard starting block
- ✦ Product will be used on a collegiate approved track
- ✦ Product will be used in fair weather
- ✦ Consumer is more concerned about accuracy than price

Jordan Noyes



# Markets

Collegiate Track Teams

High School Track Teams

Fans/Parents

Professional Running  
Teams

Masters Sprinters

Other Sports

Jordan Noyes

# Key Goals

Objectively measure a sprinter's performance

- ✎ Takeoff form
- ✎ Instantaneous velocity

Predict a sprinter's performance

- ✎ Personalized inputs
- ✎ Creating trends based on inputs and measurements

A product that will be desirable for purchase

- ✎ Cost effective
- ✎ Self-contained
- ✎ Minimal hinderance to performance



# Functions and Targets

## Measure Sprinter's Performance:

- ✎ Gauge line of attack
- ✎ Observe second step and associated stride length
- ✎ Calculate impulse from the block
- ✎ Record starter gun reaction time
- ✎ Track instantaneous velocity

Target: Accurate within 2%

## Predict a Sprinter's Performance:

- ✎ Retrieve personalized inputs
  - ✎ Target: Inputs stored within 5 seconds
- ✎ Create trends
  - ✎ Target: within 15 seconds of request time
- ✎ Store Data
  - ✎ Targets: 720 pixels at 60 frames per second; max 10 MB per trial

## Product is Desirable for Purchase:

- ✎ Make product cost effective
  - ✎ Target: purchase price under \$15,000
- ✎ Product is self-contained
  - ✎ Target: \$0.00 spent outside of product purchase
- ✎ Product has low hinderance on performance
  - ✎ Target: wearable weighs less than 1 kg

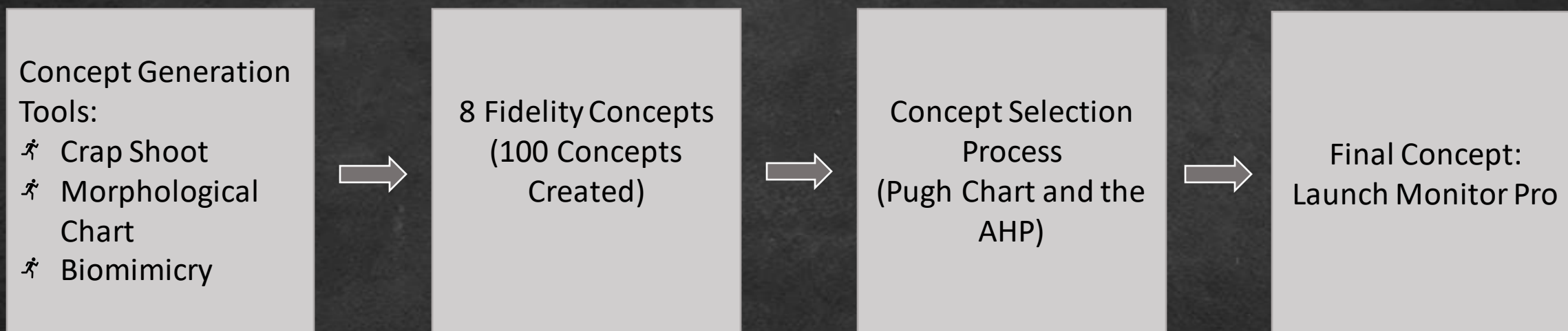
# Other Targets

- ✚ Tool incorporates at least 5 different professionals
- ✚ A measurement greater than 5% difference from professional is a potential weakness
- ✚ A battery life of at least 3 hours

Jordan Noyes



# Concept Generation & Selection



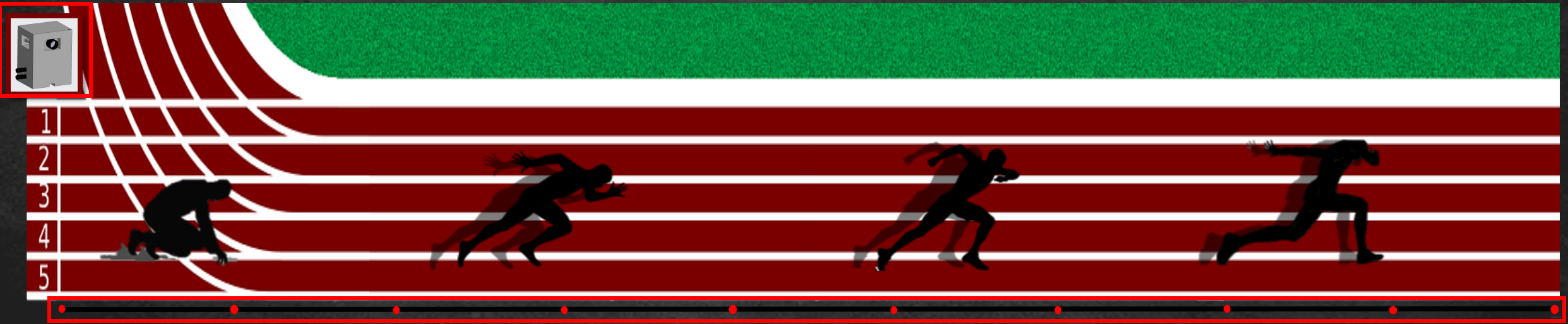
Jordan Noyes

# Concept Breakdown

Handy A Pierre & Edwin Ulysse

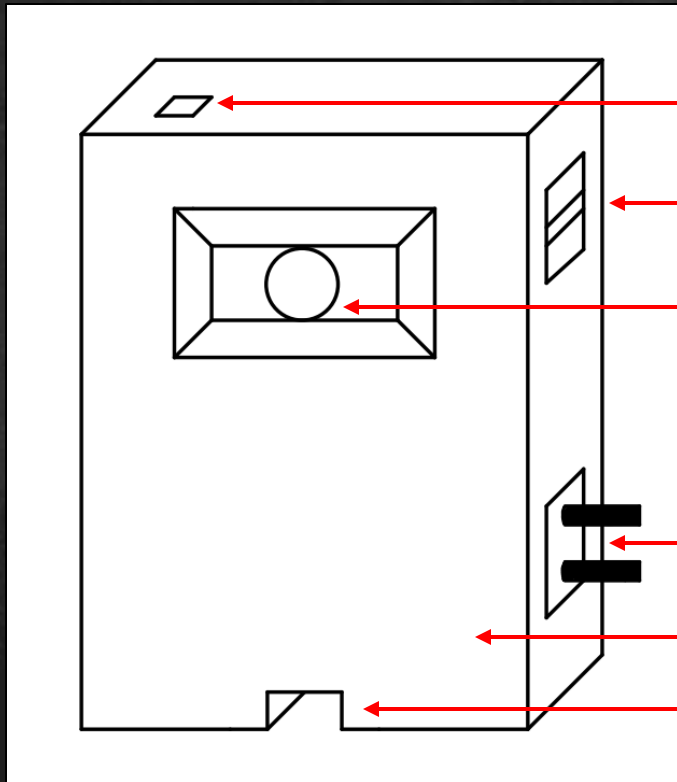


# Launch Monitor Pro Overview



Handy A Pierre

# Base Station Details



Laptop Connection

Carrying Handle

High-Speed Camera

External Connections for Sensors

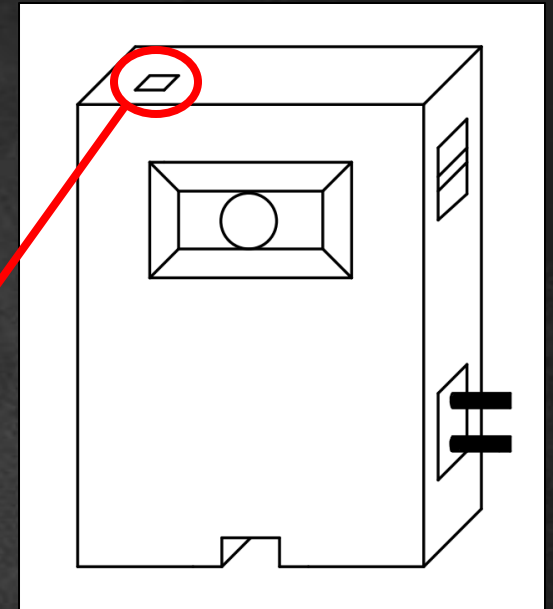
Battery Housing

Alignment Tool for Starting Line

Handy A Pierre

# Laptop Connection

- ✦ USB port embedded in housing for laptop connection



Handy A Pierre

# High-Speed Camera

- ✎ Takes in data from the sprinter in the form of frames which are then analyzed for all desired starting measurements.

Functions: Gauge line of attack; Observe second step and associated stride length

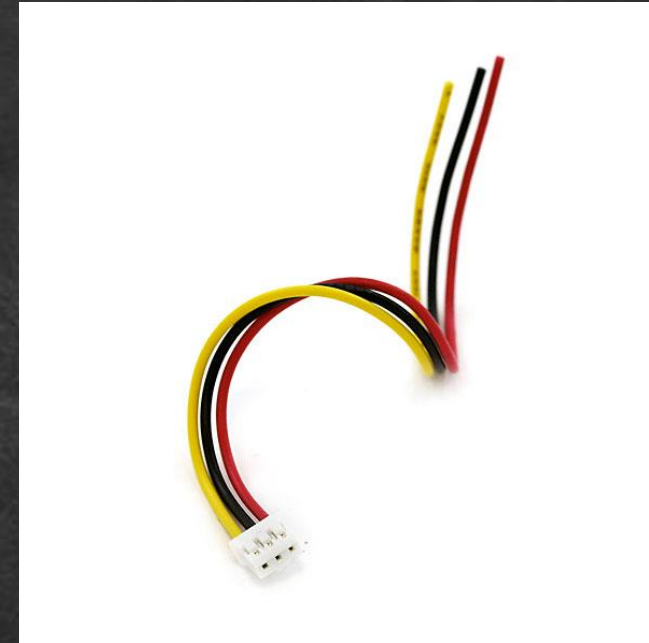


Handy A Pierre



# Housing Sensor Connectors

- ✦ Embedded in housing
- ✦ Used to connect infrared sensors and impulse sensors to the housing



Handy A Pierre

# Arduino

- ✦ Takes in data from the sensors and camera to formulate sets of measurements.
- ✦ Allows interaction between the system and a device.

Functions: Retrieve personalized inputs;  
Product is self-contained; Create trends



Handy A Pierre

# Housing

- \* Stores the camera, Arduino, wires, and power-source.
- \* Establish a medium for the connection of wires.
- \* Protect the electric-components of the Technology from outside effects.

Function: Product is self-contained



Handy A Pierre

# Power Supply

- ✦ Battery used to supply the technology with power

Function: Product is self-contained



Handy A Pierre

# Audio Recorder

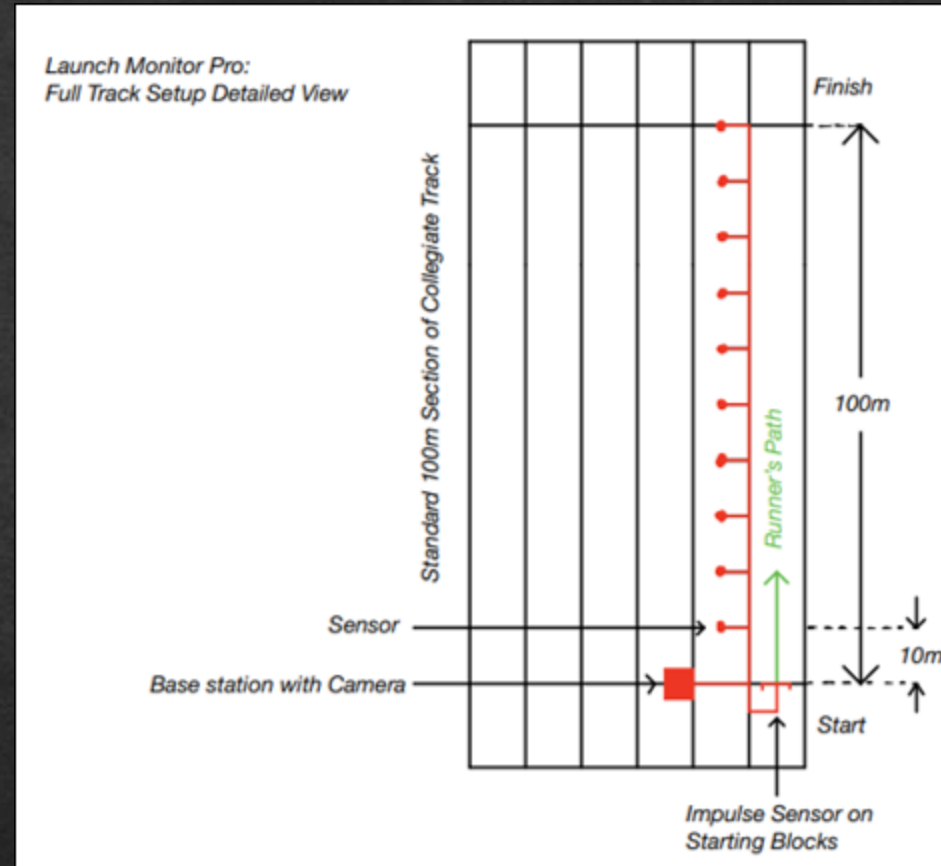
- ✎ Will be used to record the starter gun sound

Function: Starter gun reaction time



Handy A Pierre

# Track Details

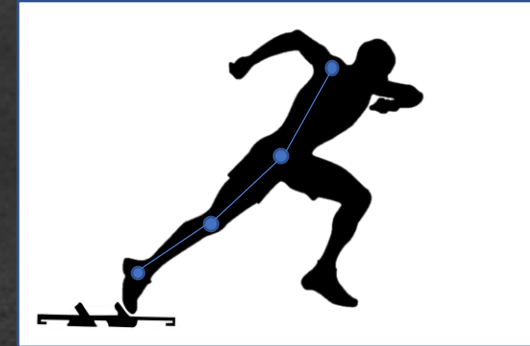


Edwin Ulysse

# Dots on Sprinter

- ✎ Dots placed along the sprinter
- ✎ Will not hinder sprinter's performance

Function: Gauge line of attack;  
Product has low hinderance on performance



Edwin Ulysse

# Impulse Sensor

- ✎ One sensor on front block
  - ✎ This will be the block that experiences the most force



Function: Calculate impulse from the block



\*Standard starting blocks not provided\*

Edwin Ulysse



# Measuring Tape

- ✦ 30m measuring tape
- ✦ Will be placed along the start of the track

Function: Observe second step and associated stride length



Edwin Ulysse

# Infrared Sensors

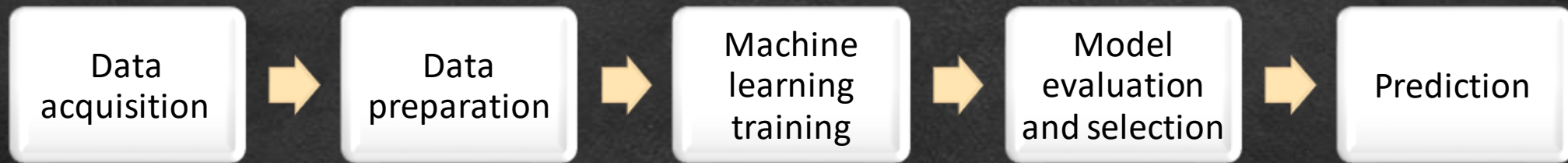
- ✎ Records position of the sprinter as a function of time, to determine their instantaneous velocity in 10m intervals

Function: Track instantaneous velocity



Edwin Ulysse

# Performance Prediction



Edwin Ulysse

# Functions Check



# Functions Covered

## Measure Sprinter's Performance:

- ✎ Gauge line of attack
- ✎ Observe second step and associated stride length
- ✎ Calculate impulse from the block
- ✎ Record starter gun reaction time
- ✎ Track instantaneous velocity

## Predict a Sprinter's Performance:

- ✎ Retrieve personalized inputs
- ✎ Create trends
- ✎ Store Data

## Product is Desirable for Purchase:

- ✎ Make product cost effective
- ✎ Product is self-contained
- ✎ Product has low hinderance on performance

Edwin Ulysse

# Remaining Functions

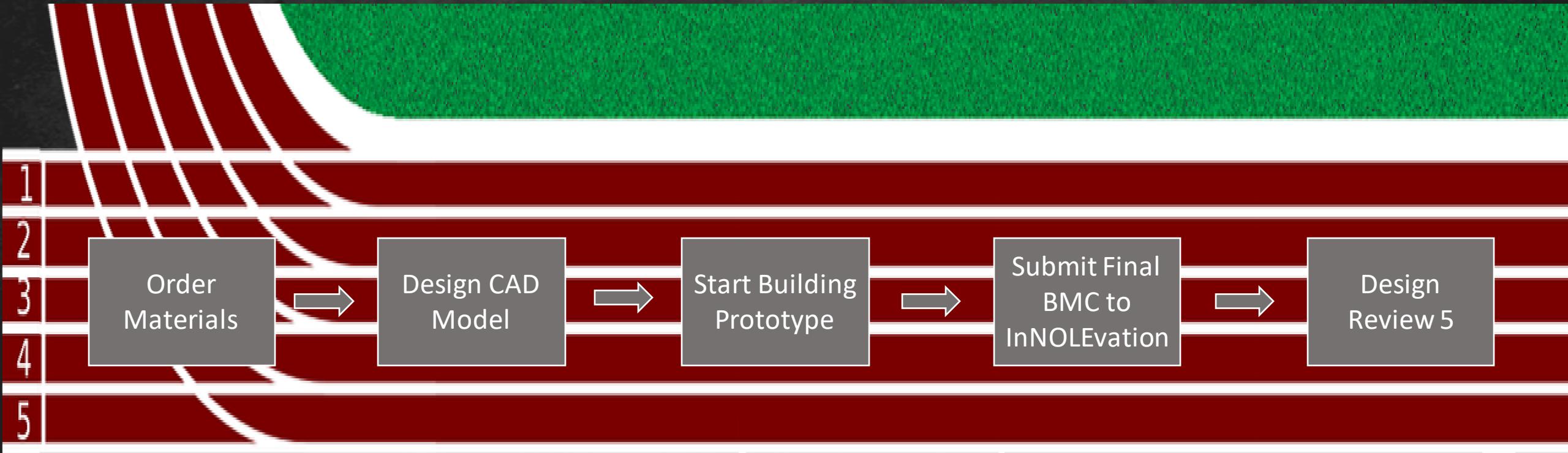
## ✦ Store data

- ✦ Data will be stored in the user interface of the application that will be downloaded on the user's hardware

## ✦ Make product cost effective

- ✦ All parts were selected with a limited budget in mind
- ✦ There will be varying price models available for consumer purchase

# Future Work



Edwin Ulysse

# References

- <https://simplifaster.com/articles/contact-length-sprinting-speed/>
- <https://www.robotshop.com/en/gravity-adjustable-infrared-sensor-switch-0-200cm.html>
- <https://www.uline.com/Product/Detail/S-11441G/Inventory-Labels/Removable-Adhesive-Circle-Labels-Fluorescent-Green-1>
- <https://www.readymadec.com/products/details/runcam-2-orange>
- [https://www.mouser.com/ProductDetail/Measurement-Specialties/FC2331-0000-0250-L?qs=%2Fha2pyFaduJAcSl6CN5plYO6WA8FlwYq8JSEgUbhuaTLavI4ZQOcpKAymRqJ4p0X&utm\\_source=octopart&utm\\_medium=aggregator&utm\\_campaign=824-FC2331-00000250L&utm\\_content=TE%20Connectivity&tetid=R9TeESmvAY](https://www.mouser.com/ProductDetail/Measurement-Specialties/FC2331-0000-0250-L?qs=%2Fha2pyFaduJAcSl6CN5plYO6WA8FlwYq8JSEgUbhuaTLavI4ZQOcpKAymRqJ4p0X&utm_source=octopart&utm_medium=aggregator&utm_campaign=824-FC2331-00000250L&utm_content=TE%20Connectivity&tetid=R9TeESmvAY)
- <http://ontrackandfield.com/measuring-tape-komelon-fiberglass-open-reel/>
- <https://www.dataversity.net/what-is-data-storage/>
- <https://www.google.com/imgres?imgurl=https%3A%2F%2F3dprintingforbeginners.com%2Fwp-content%2Fuploads%2F2013%2F02%2FABS-Filament-Spools.jpg&imgrefurl=https%3A%2F%2F3dprintingforbeginners.com%2Ffilamentprimer%2F&tbid=B6ovlHCFOxhioM&vet=12ahUKewjdsJbJn6nuAhXJQUIHHTuHCc8QMygBegUIARDsAQ..i&docid=RcLAbEe3kgxRfM&w=625&h=375&q=3d%20printing%20material&ved=2ahUKewjdsJbJn6nuAhXJQUIHHTuHCc8QMygBegUIARDsAQ>
- <https://www.sparkfun.com/products/8733>
- <https://www.ametron.com/samson-go-mic-direct-portable-usb-microphone-with-noise-cancellation-technology>
- [https://www.te.com/usa-en/product-6364372-2.html?te\\_bu=Cor&te\\_type=srch&te\\_campaign=ggl\\_usa\\_cor-ggl-usa-srch-selectmktg-fy21-googlefeed\\_sma\\_sma-1735\\_94&elqCampaignId=95278&mkwid=mobaVbvD%7Cpcrid%7C386964346943%7Cpkw%7C%7Cpmt%7C%7Cpdv%7C%7Cslid%7C%7Cproductid%7C6364372-2%7Cpgrid%7C78782457763%7Cptaid%7Cpla-1016296564002%7C&utm\\_content=mobaVbvD%7Cpcrid%7C386964346943%7Cpkw%7C%7Cpmt%7C%7Cpdv%7C%7Cslid%7C%7Cproductid%7C6364372-2%7Cpgrid%7C78782457763%7Cptaid%7Cpla-1016296564002&gclid=Cj0KCQiAkuP9BRcKARIsAKGLE8UM9pHmNco6CE0eNi2BBOQUnXQjsORumOzOVN4a0Bjew\\_HK-VBMHmcaAgo7EALw\\_wcB](https://www.te.com/usa-en/product-6364372-2.html?te_bu=Cor&te_type=srch&te_campaign=ggl_usa_cor-ggl-usa-srch-selectmktg-fy21-googlefeed_sma_sma-1735_94&elqCampaignId=95278&mkwid=mobaVbvD%7Cpcrid%7C386964346943%7Cpkw%7C%7Cpmt%7C%7Cpdv%7C%7Cslid%7C%7Cproductid%7C6364372-2%7Cpgrid%7C78782457763%7Cptaid%7Cpla-1016296564002%7C&utm_content=mobaVbvD%7Cpcrid%7C386964346943%7Cpkw%7C%7Cpmt%7C%7Cpdv%7C%7Cslid%7C%7Cproductid%7C6364372-2%7Cpgrid%7C78782457763%7Cptaid%7Cpla-1016296564002&gclid=Cj0KCQiAkuP9BRcKARIsAKGLE8UM9pHmNco6CE0eNi2BBOQUnXQjsORumOzOVN4a0Bjew_HK-VBMHmcaAgo7EALw_wcB)





# Thank You for Listening!

Our mission is to utilize technology to enhance the performance of athletes and help them maximize their full potential.

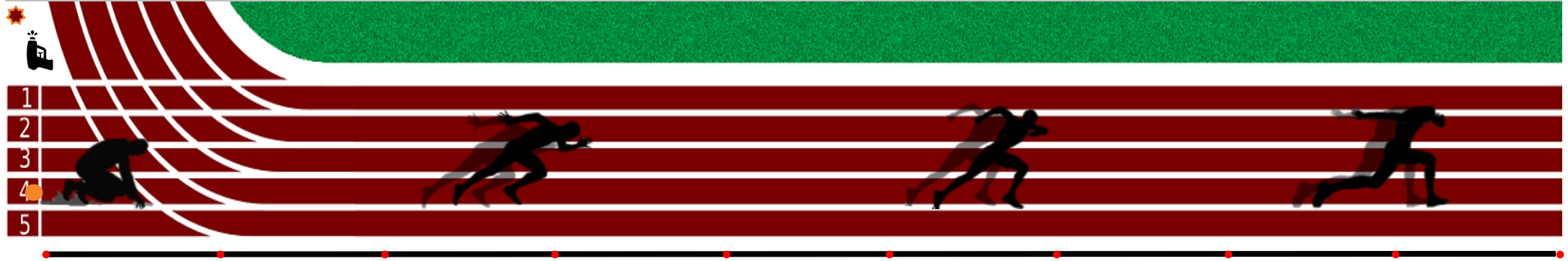


# Backup Slides





**Dylan Cedeno, Marc Griffiths, Jordan Noyes, Handy A Pierre, Edwin Ulysse**



## Objective:

The objective of this project is to objectively measure and predict a sprinter's performance.

## Background:

### Primary Market:

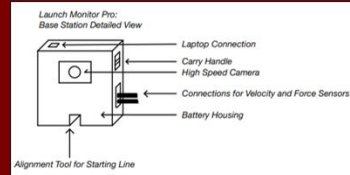
- \* Collegiate Track Teams

### Secondary Markets:

- \* Fans/parents
- \* Professional running teams
- \* Other sports
- \* High school track teams
- \* Master Sprinters

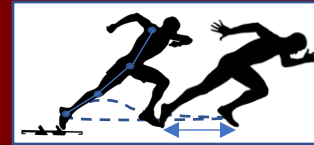
## Experimental Design:

### Base Station



- \* Housing built in 3D printed material
- \* High-speed camera inside housing
- \* USB port in housing for laptop connection
- \* Battery to supply power to technology
- \* On board processor within housing

### Start Measurements

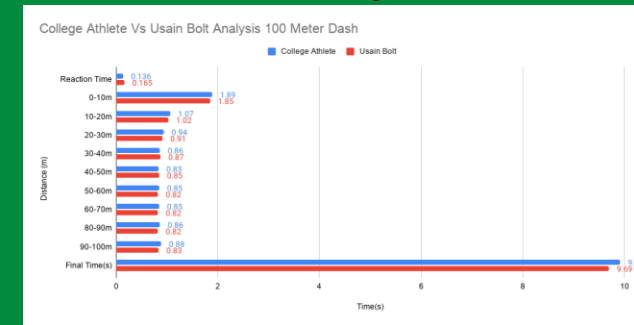


- \* Line of attack
- \* Second step
- \* Impulse off the block
  - \* Sensors on the block
- \* Starter gun reaction time

### Instantaneous Velocity

- \* Use infrared sensors to measure instantaneous velocity
- \* One sensor every 10m

## Data Analysis

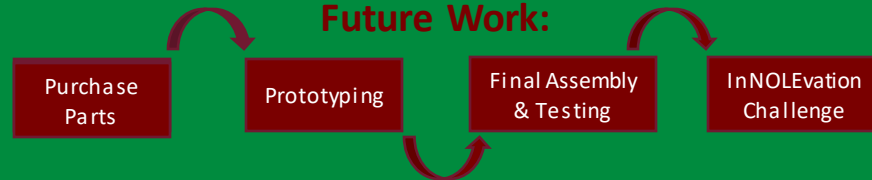


- \* Collect data
- \* Compare data
- \* Capture Trends
- \* Use trends and data for prediction analysis

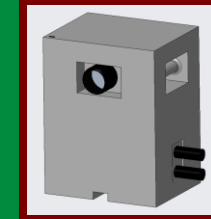
## Acknowledgements:

- \* Dr. Devine
- \* Dr. Clark
- \* Coach Argro
- \* Michael Ormsbee
- \* Dr. McConomy
- \* Ms. Gray
- \* Dr. Hooker

## Future Work:



## CAD Model:



## InNOEvation Team:



# Hierarchy Flow Chart



# Target Catalog

Function/Need	Metric	Target
*Gauge Line of Attack	Accuracy of measuring the angle at the ankle, knee, hip, shoulder	Accurate within 2%
*Observe Second Step	Accuracy of measuring the height off the ground from the blocks	Accurate within 2%
*Measure Stride Length	Accuracy of measuring the length from the second step to the third step	Accurate within 2%
*Calculate Impulse from the Block	Accuracy of calculating the force off the block, with respect to time	Accurate within 2%
*Record Starter Gun Reaction Time	Accuracy of recording the time from the starter gun sound to impulse rise	Accurate within 2%
*Track Instantaneous Velocity	Accuracy of tracking the velocity at every 5 meters	Accurate within 2%
Create Trends	Time it takes to output relationships between measurements	Within 15 seconds of request time
Store Data	Compression and frame rate of videos recorded	720 pixels at 60 frames per second
	Amount of storage taken by data collected	Maximum of 10 megabytes per trial
Retrieve Personalized Inputs	Time it takes to store the inputs of the athlete being measured, given by the athlete	Inputs stored in under 5 seconds
Make Product Cost Effective	Desired cost to keep the purchase price under	Keep purchase price under \$15,000
Product Is Self-Contained	Additional purchase necessary outside of product	\$0.00 spent outside of product purchase
*Product has Low Hinderance on Performance	If a wearable is used, the weight it must stay under	Wearable must weigh less than 1 kilogram (~2 pounds)
The tool incorporates professional sprinters and eases the effort required for sprinter comparisons	Number of professional athletes the technology needs to store statistics for	At least 5 different professionals
The analysis from the product exposes users' fundamental weaknesses	Percent difference between measurements of the user and the compared professional that is pointed out as a potential weakness	A measurement greater than 5% difference from professional is a potential weakness
*The technology needs to be able to be used daily for about two hours at a time	The battery life needed for the technology to hold between charges	A battery life of at least 3 hours

## Crap Shoot

People	Common Activities	Potential Resources
Sprinters	Sprinting	Video
Coach	Competing	Sensors
Scout	Training	Stopwatch
Parents	Performing	Sprinter blocks
Fans	Exercising	Wearable
Athletes	Supporting	Software/ application



# Tension Cord Training Mechanism

## Functions

🏃 Gauge the line of attack

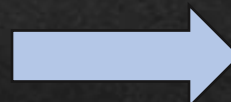
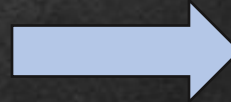
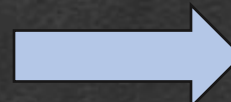
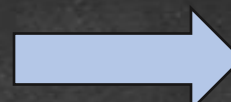
🏃 Instantaneous velocity

🏃 Product has low hinderance on performance

🏃 Collect data

🏃 Create trends

🏃 Make the product cost effective



## Solutions

🏃 Take a video

🏃 Tension cord and encoder

🏃 Lightweight tension cord

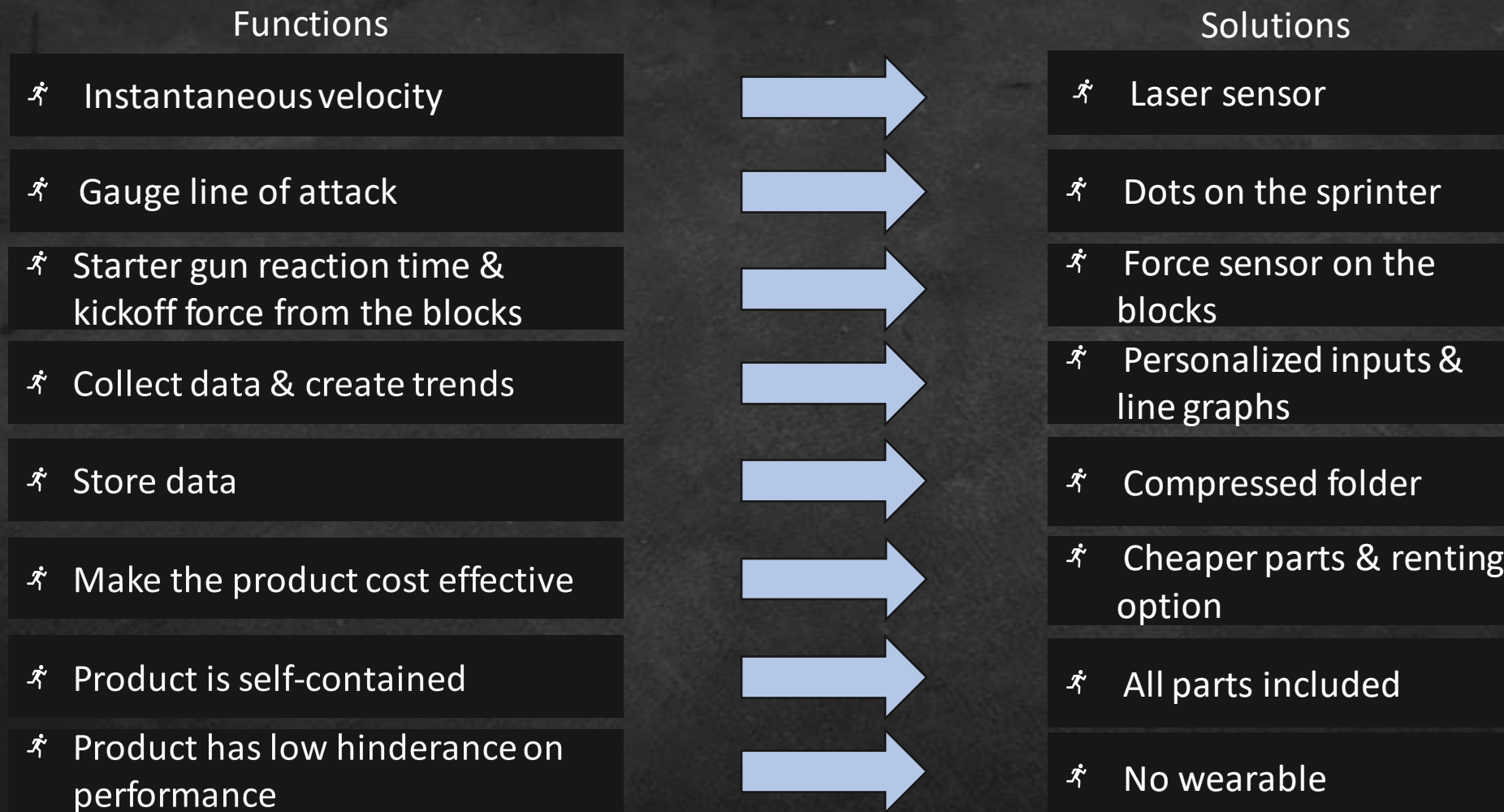
🏃 Server

🏃 Line graphs

🏃 Compare to other markets & lay-away

Marc Griffiths

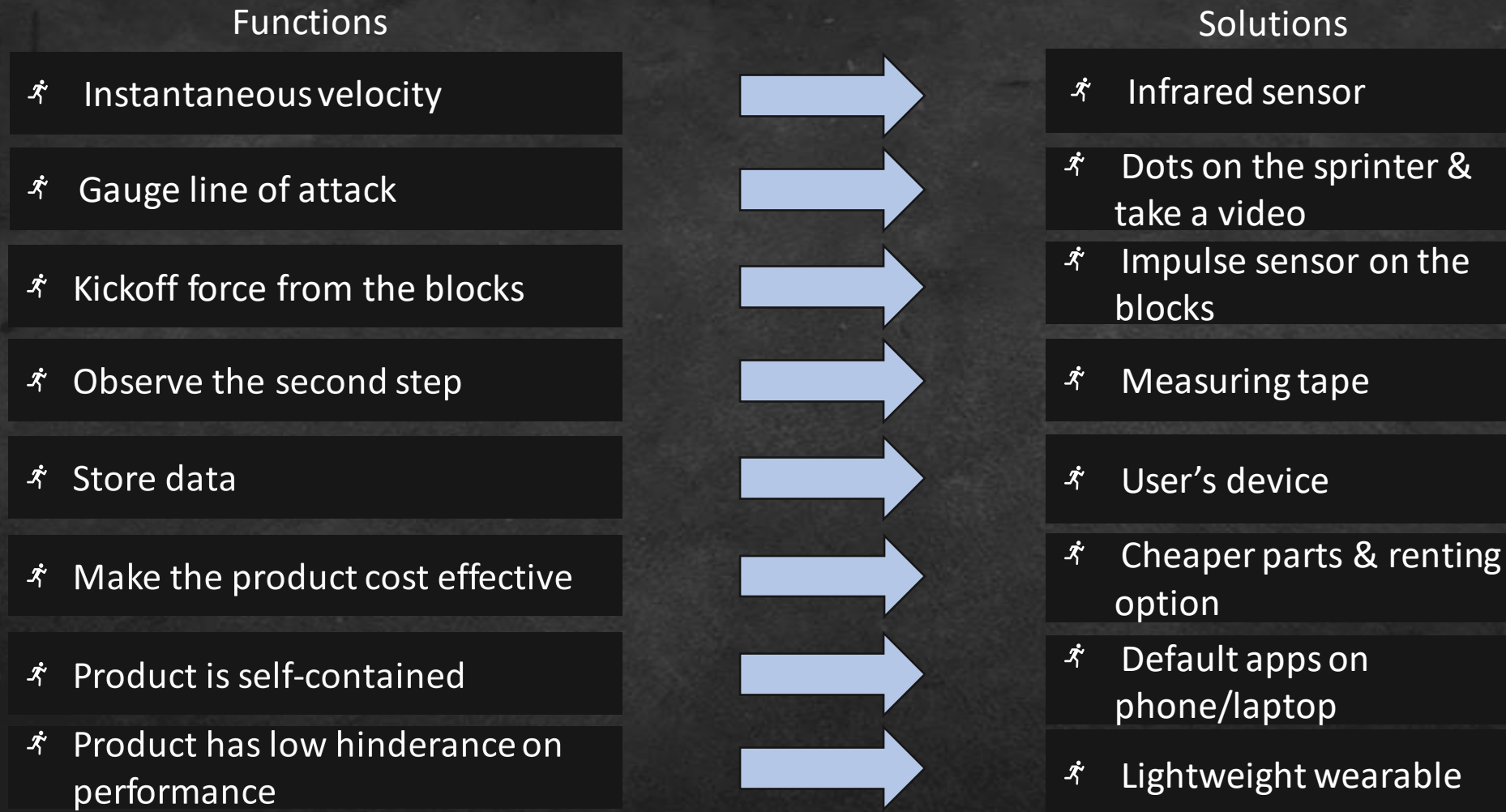
# All Inclusive Technology



Marc Griffiths



# Launch Monitor Pro



Marc Griffiths

# Concept 1: User Based System

Functions

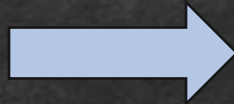
🏃 Gauge Line of Attack

🏃 Collect Data

Solutions

🏃 Take a video

🏃 Accept User Inputs



# Concept 2: Dots and Infrared

## Functions

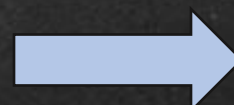
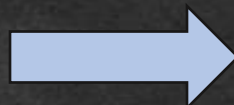
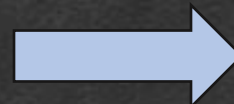
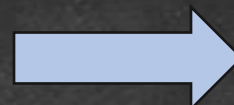
Instantaneous velocity

Starter Gun Reaction Time

Kickoff force from the blocks

Incorporate professionals for comparison

Make the product cost efficient



## Solutions

Infrared Sensors

Take a video

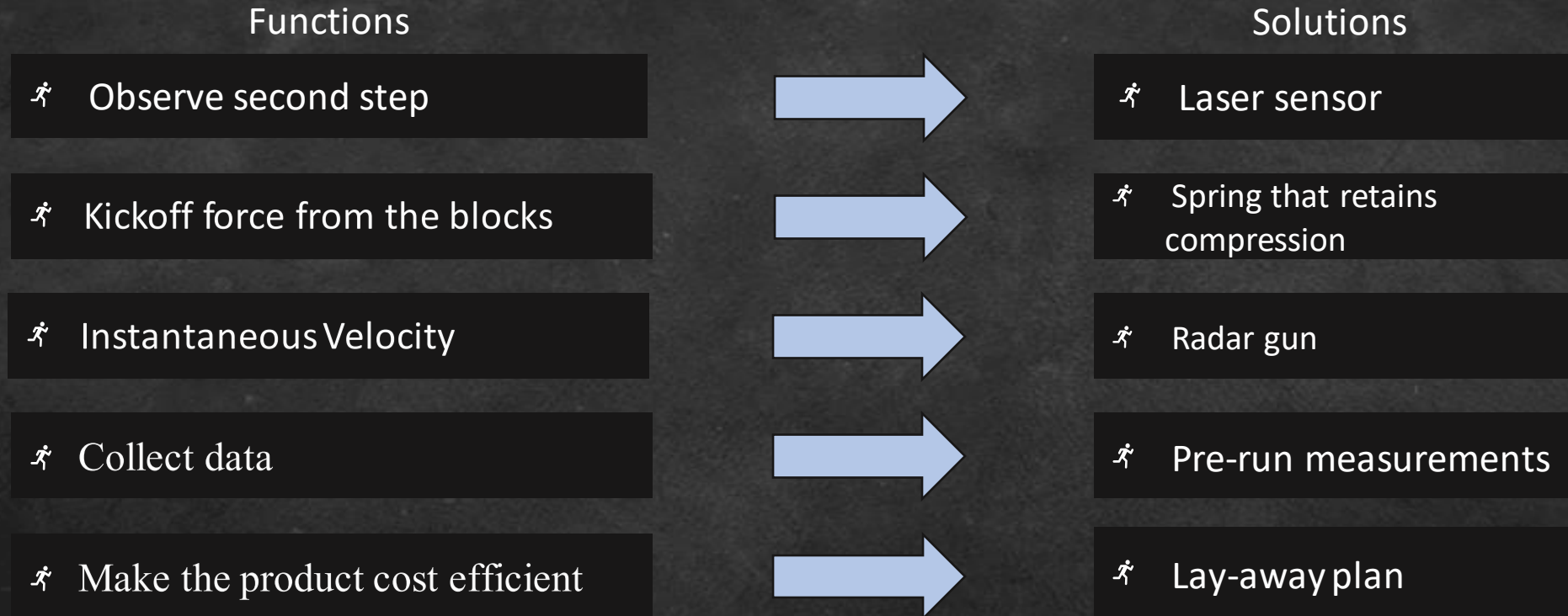
Impulse sensor

Store Data

Subscription plan

Marc Griffiths

# Concept 3: Lasers, Springs, and Radar Guns



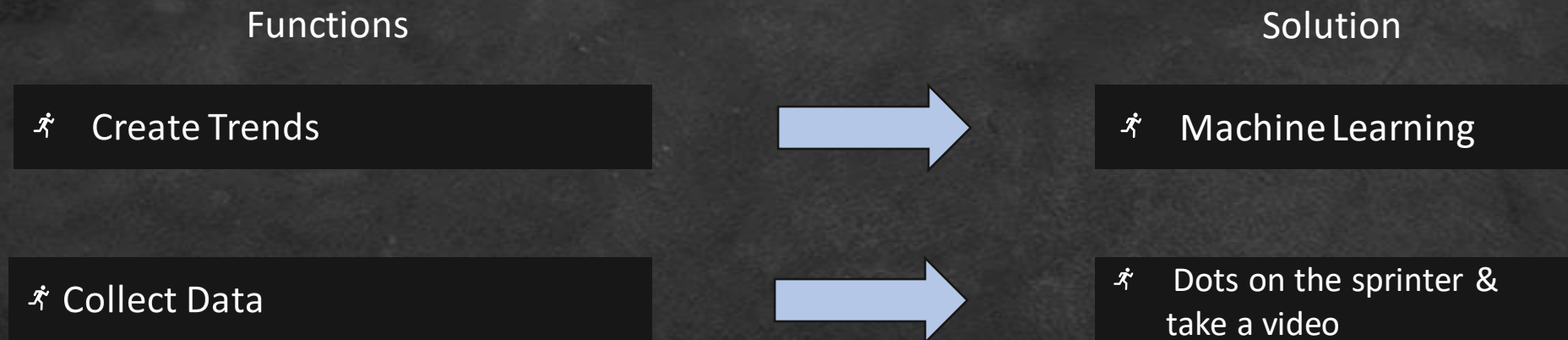
Marc Griffiths

# Concept 4: Lasers, Dots, and Sensors with Professionals



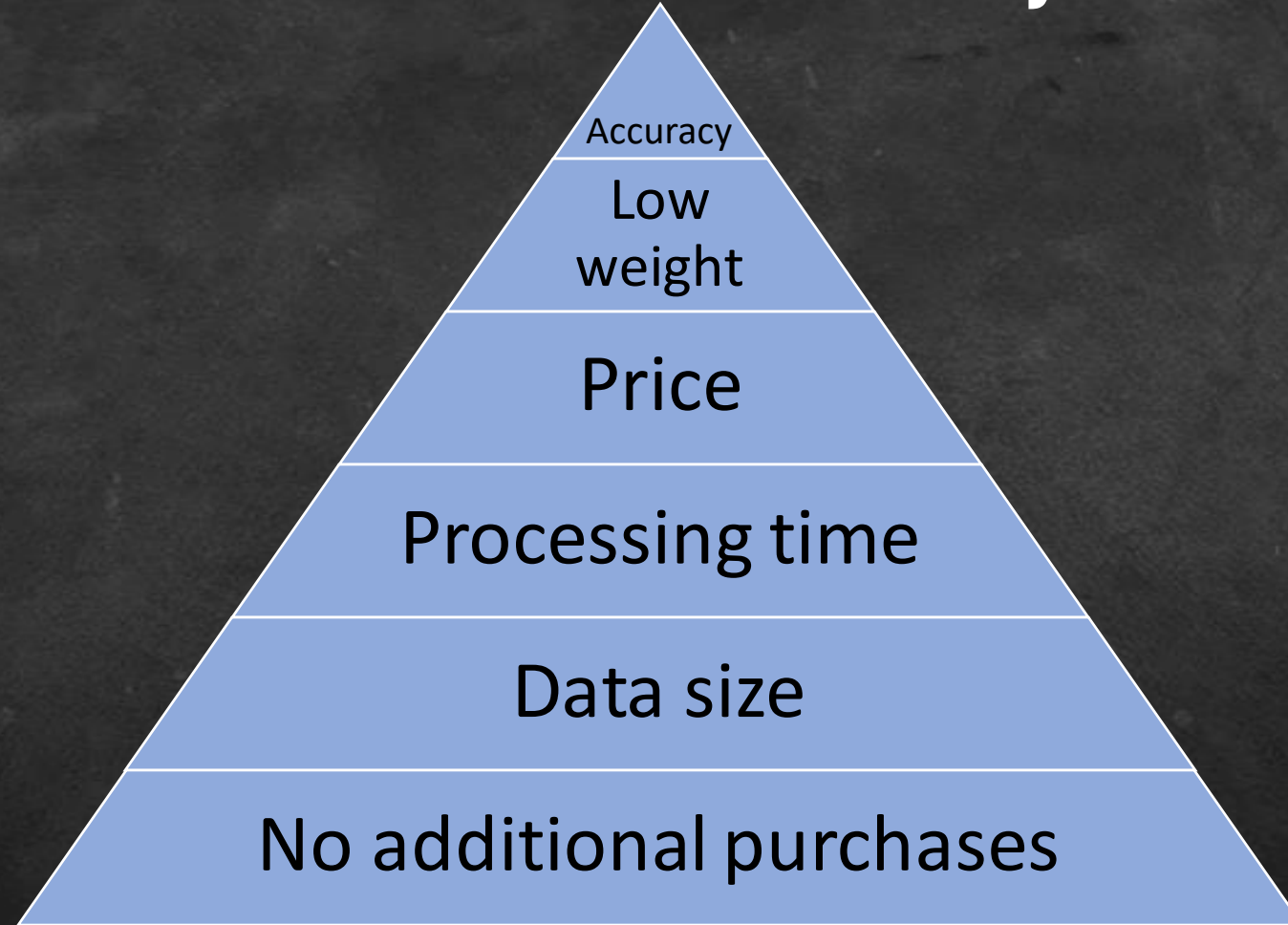
Marc Griffiths

# Concept 5: Machine Learning Prediction



Marc Griffiths

# House of Quality



Marc Griffiths

# Pugh Chart

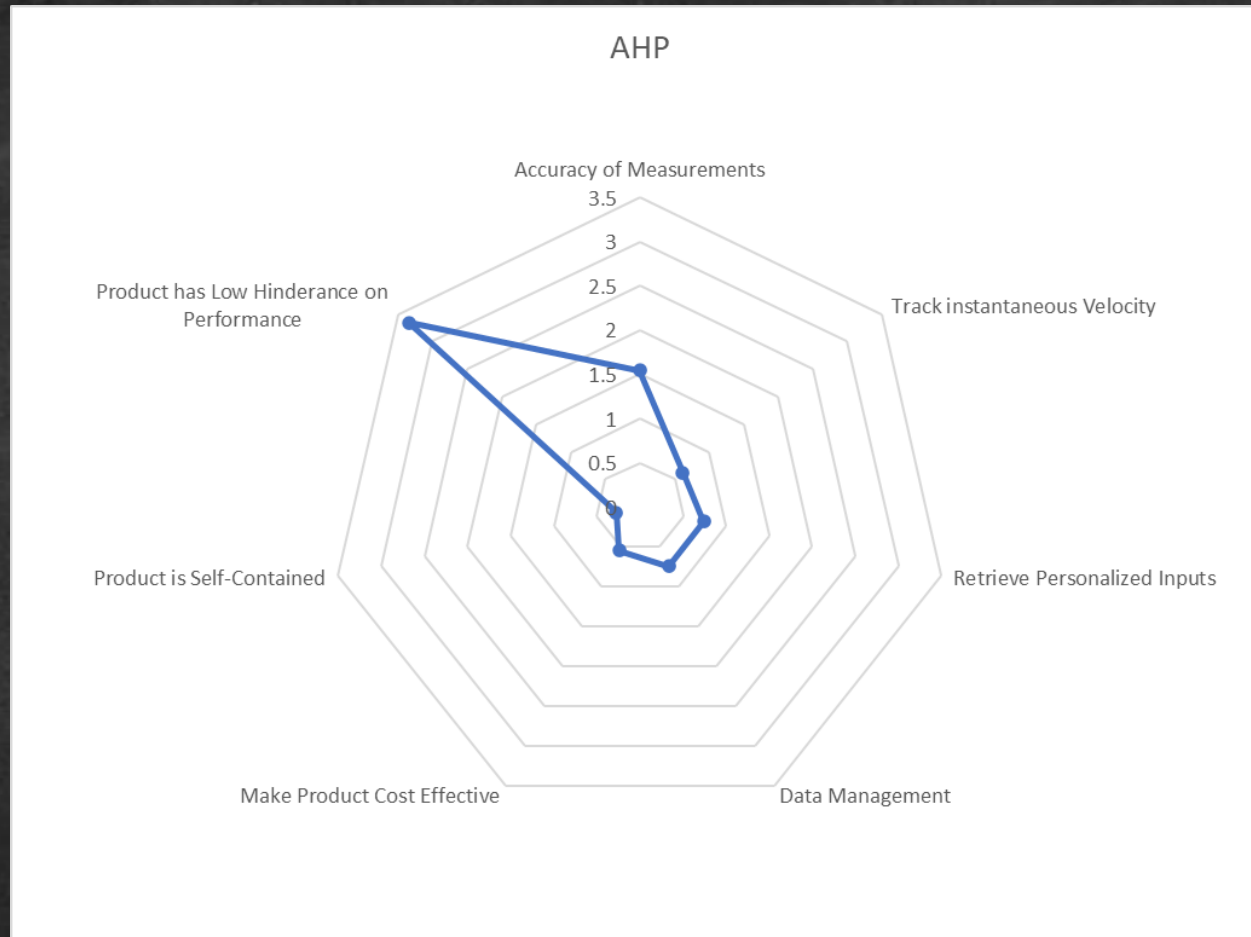
Pugh Chart 3				
Selection Criteria	4	6	7	8
Gauge Line of Attack	DATUM	-	S	S
Observe Second Step		S	S	S
Calculate Kickoff Force from the Block		S	S	S
Record Starter Gun Reaction Time		S	+	+
Track Instantaneous Velocity		-	S	S
Retrieve Personalized Inputs		+	S	S
Collect Data		S	S	S
Store Data		S	-	-
Create Trends		-	S	-
Make Product Cost Effective		+	+	-
Product is Self-Contained		S	S	S
Product has Low Hinderance on Performance		-	S	S
# of pluses		2	2	1
# of Minuses		4	1	3

Marc Griffiths





# AHP



Marc Griffiths

