

# FRONTIER SCIENCE: BOXING SCIENCE

**DR ALAN RUDDOCK SFHEA FBASES**

Boxing Science | Academy of Sport and Physical Activity, Sheffield Hallam University, UK



# IN THIS PRESENTATION YOU WILL LEARN HOW TO...

1. **Observe** athlete requirements through data collection (e.g., testing);
2. **Analyse** data to explain athlete requirements;
3. **Apply** this information to prescribe individualised training programmes;
4. **Monitor** key outcome variables to optimise training demand; and
5. **Evaluate and revise** processes on a micro, session-by-session, and macro, training phase/camp basis with the support team, boxers, and coaches.

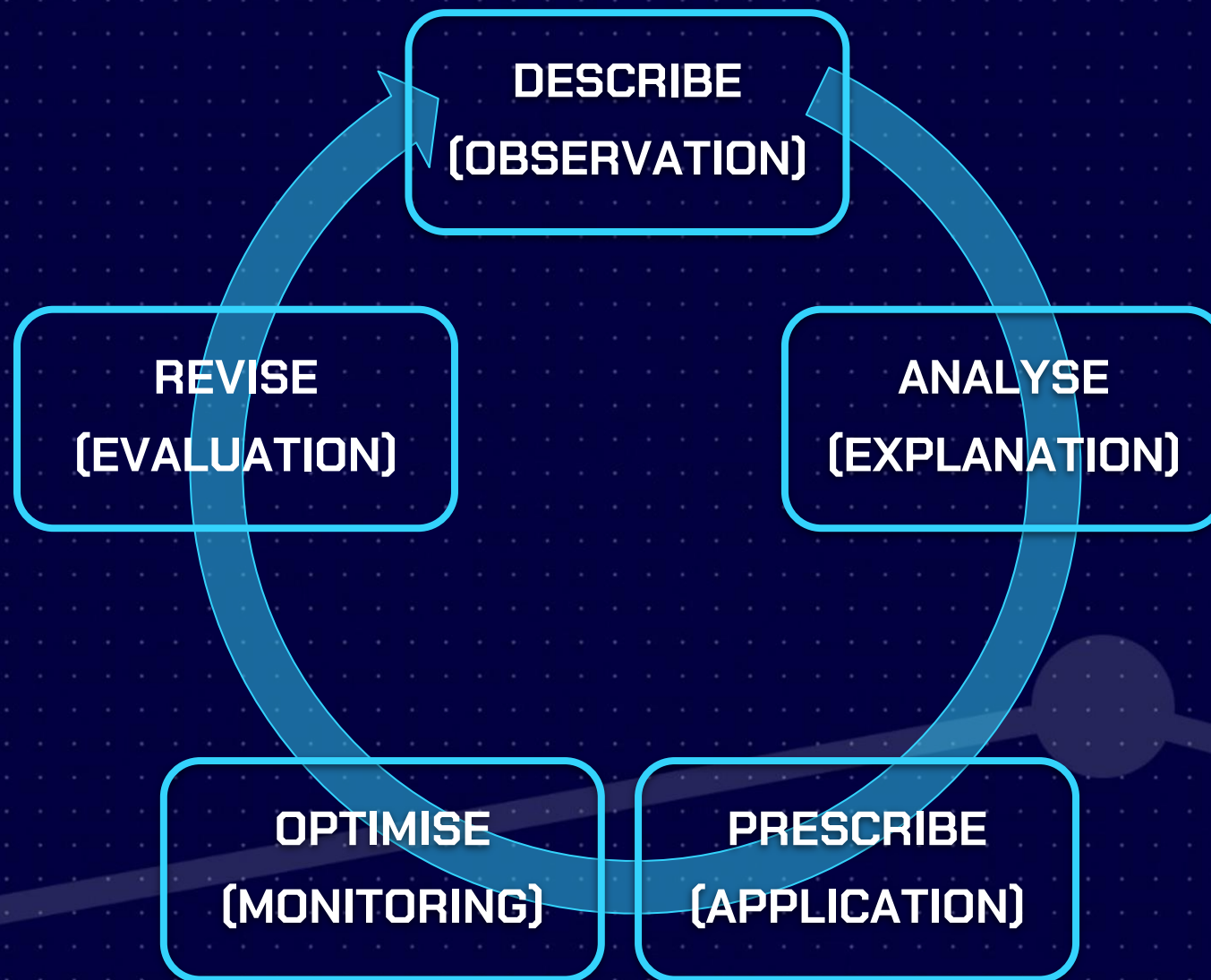


# STEAM APPLICATION

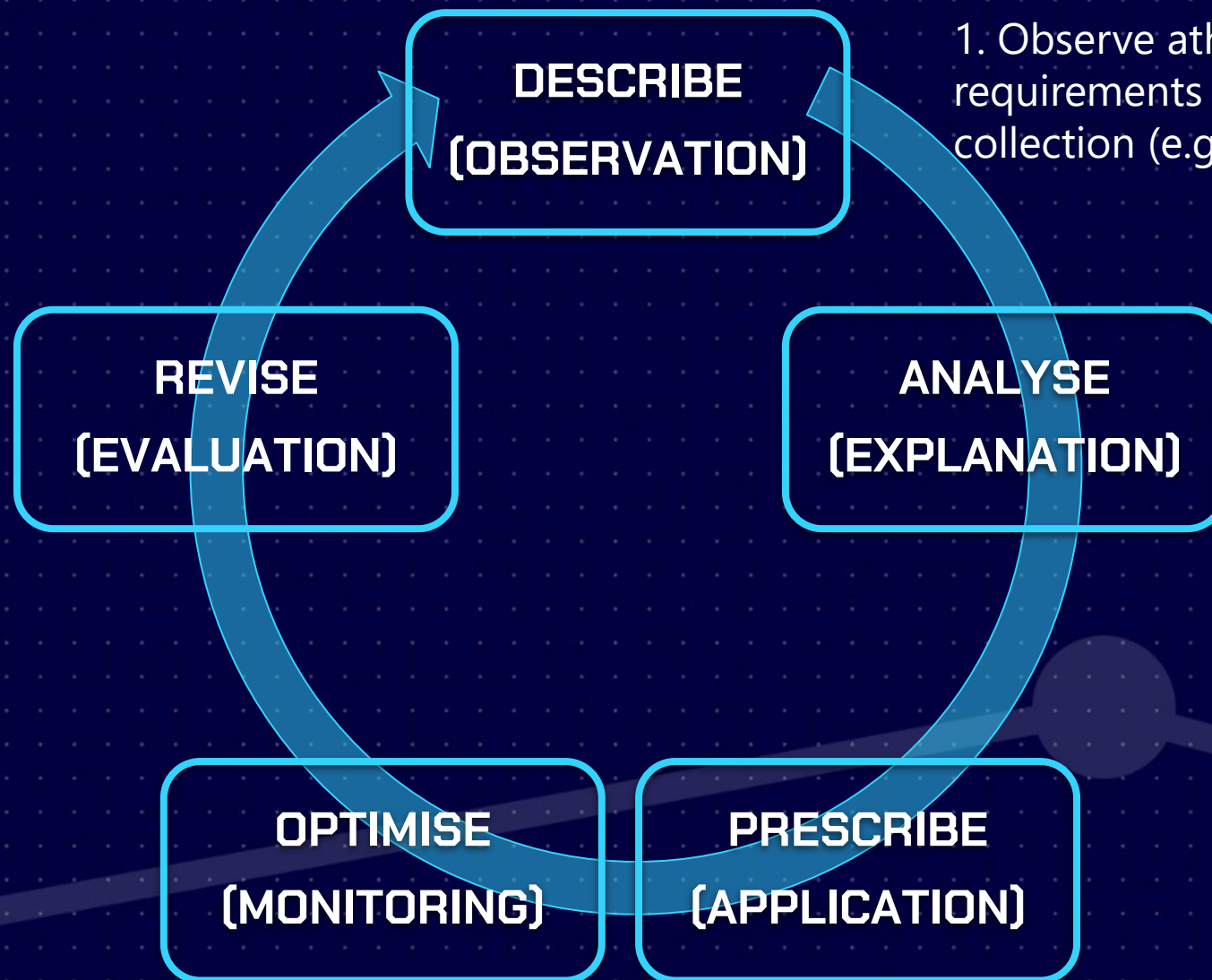
1. **Science** - Scientific method applied to determine a way of working
2. **Technology** - Data collected using sensors and analysed using programmes
3. **Engineering** - Designing structures 'e.g. training' to build 'machines' - athletes
4. **Arts** - Training and scientific concepts communicated via web and social media
5. **Maths** - Data analysis and presentation; understanding of mechanical constructs



# BUILDING AN ATHLETE SUPPORT PROGRAMME

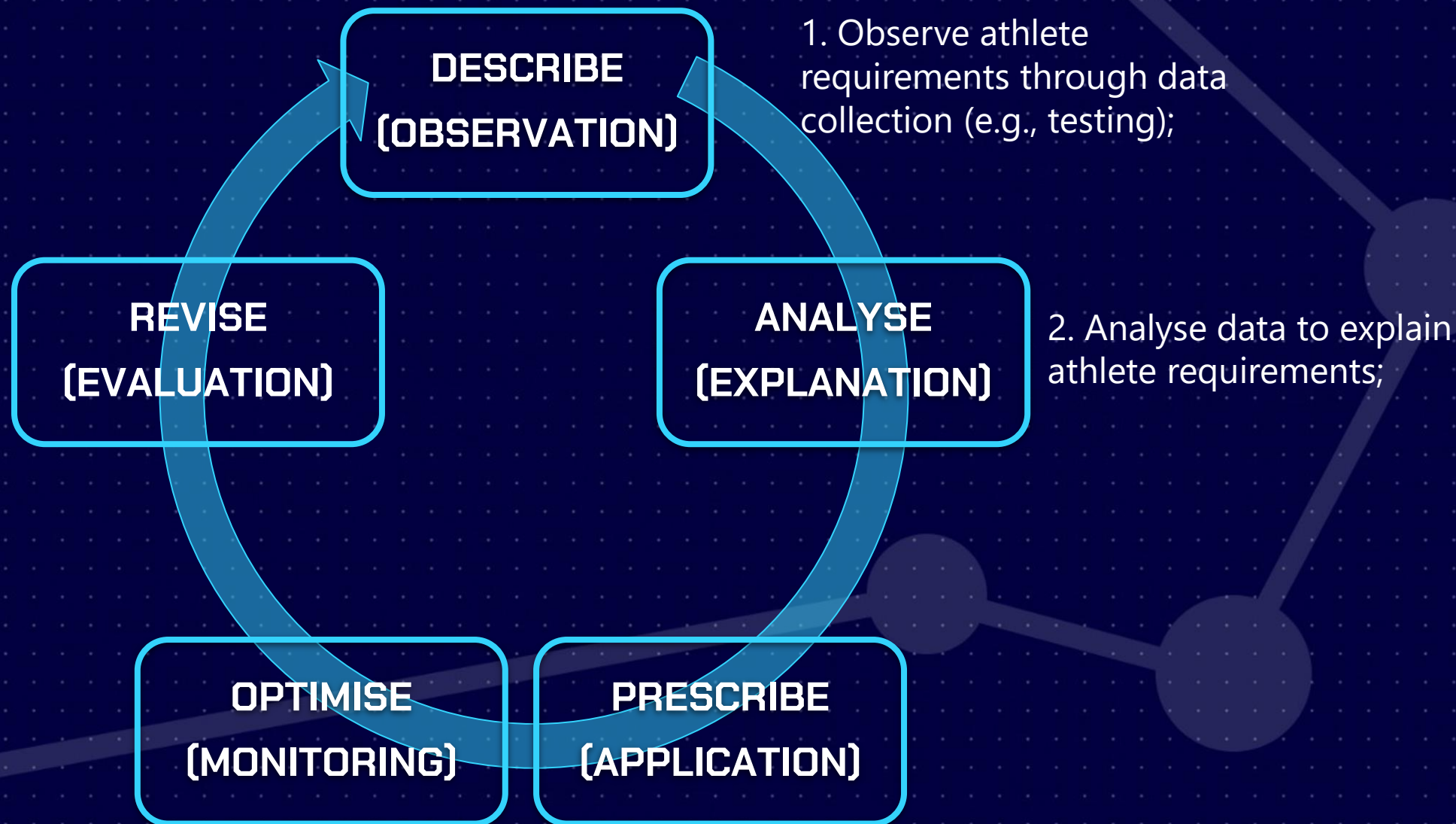


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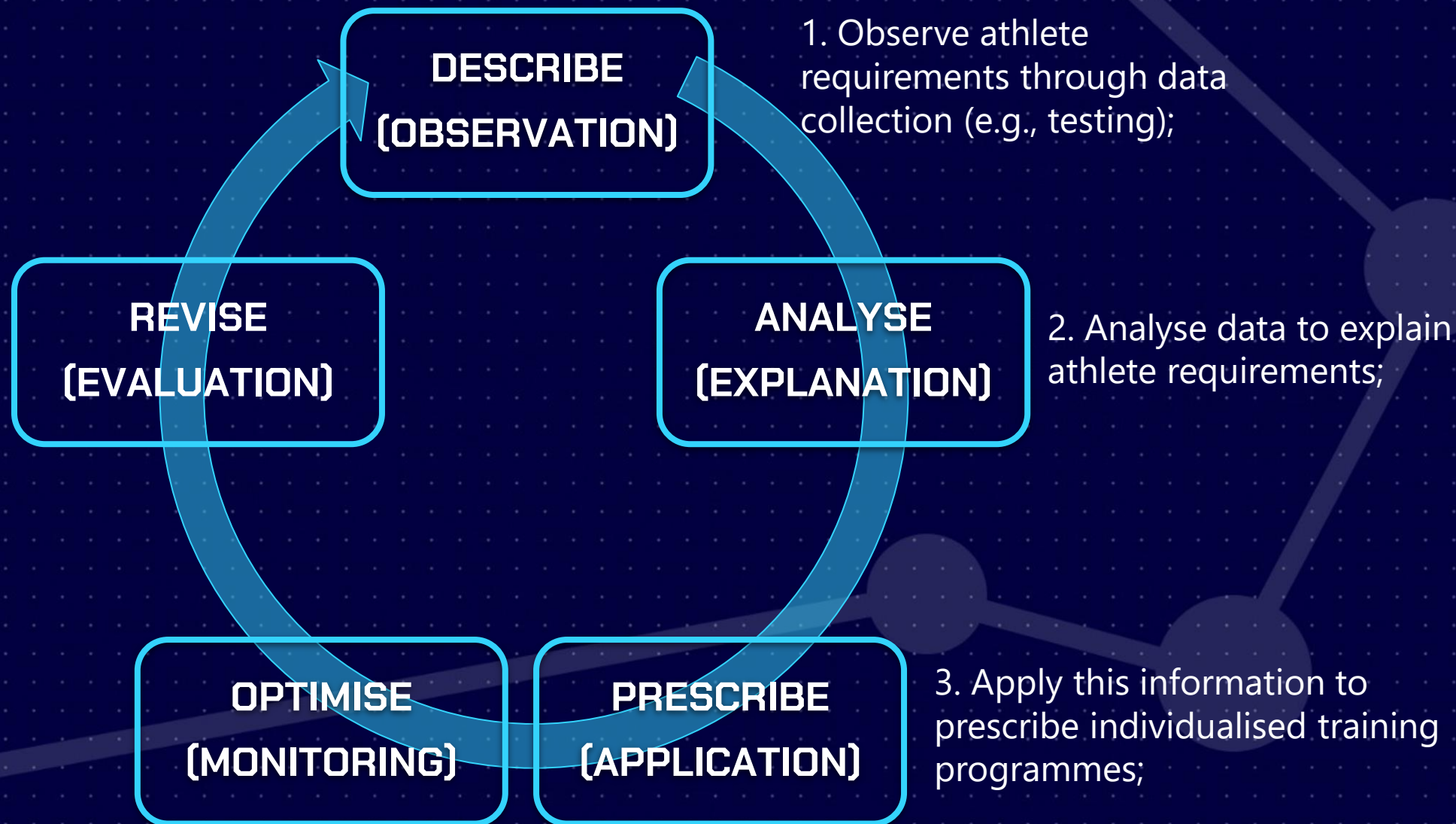


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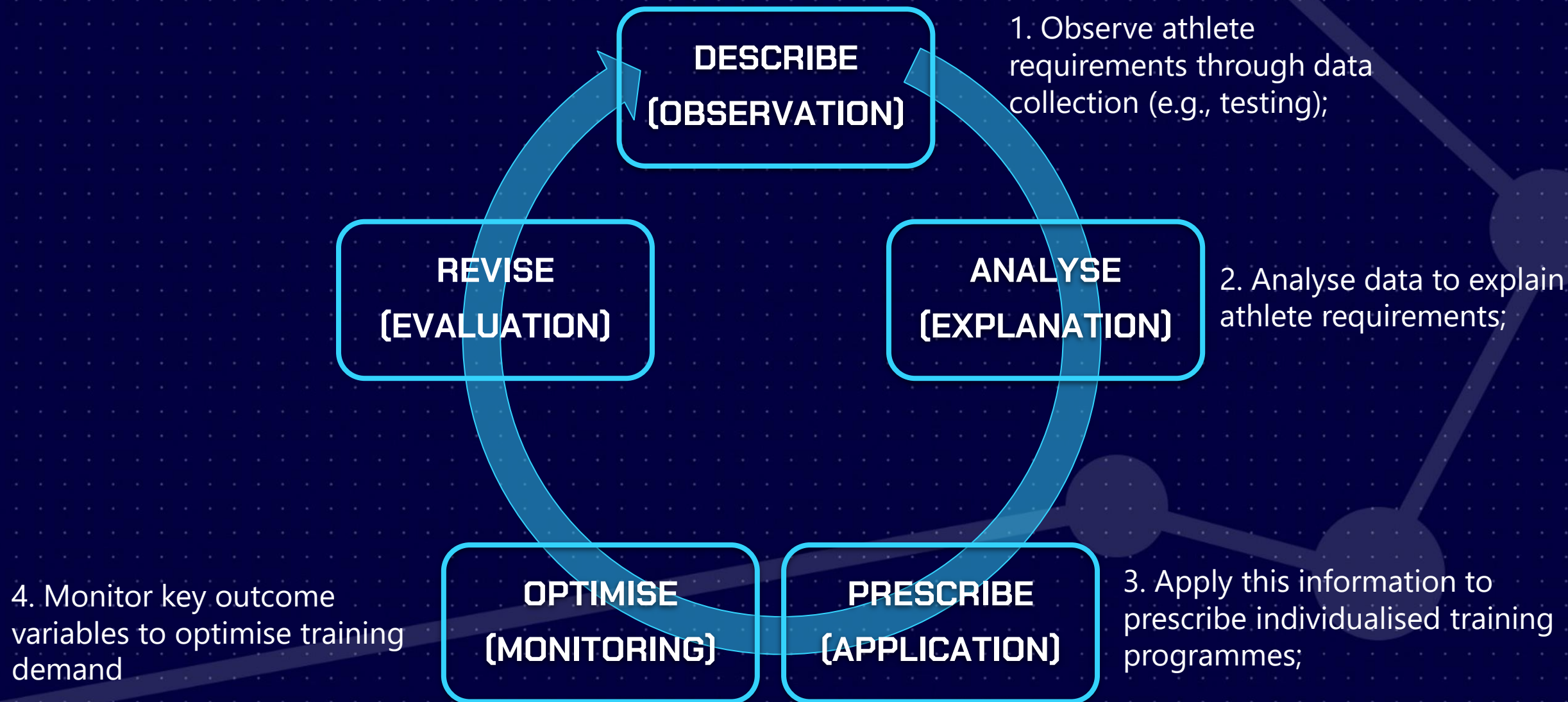
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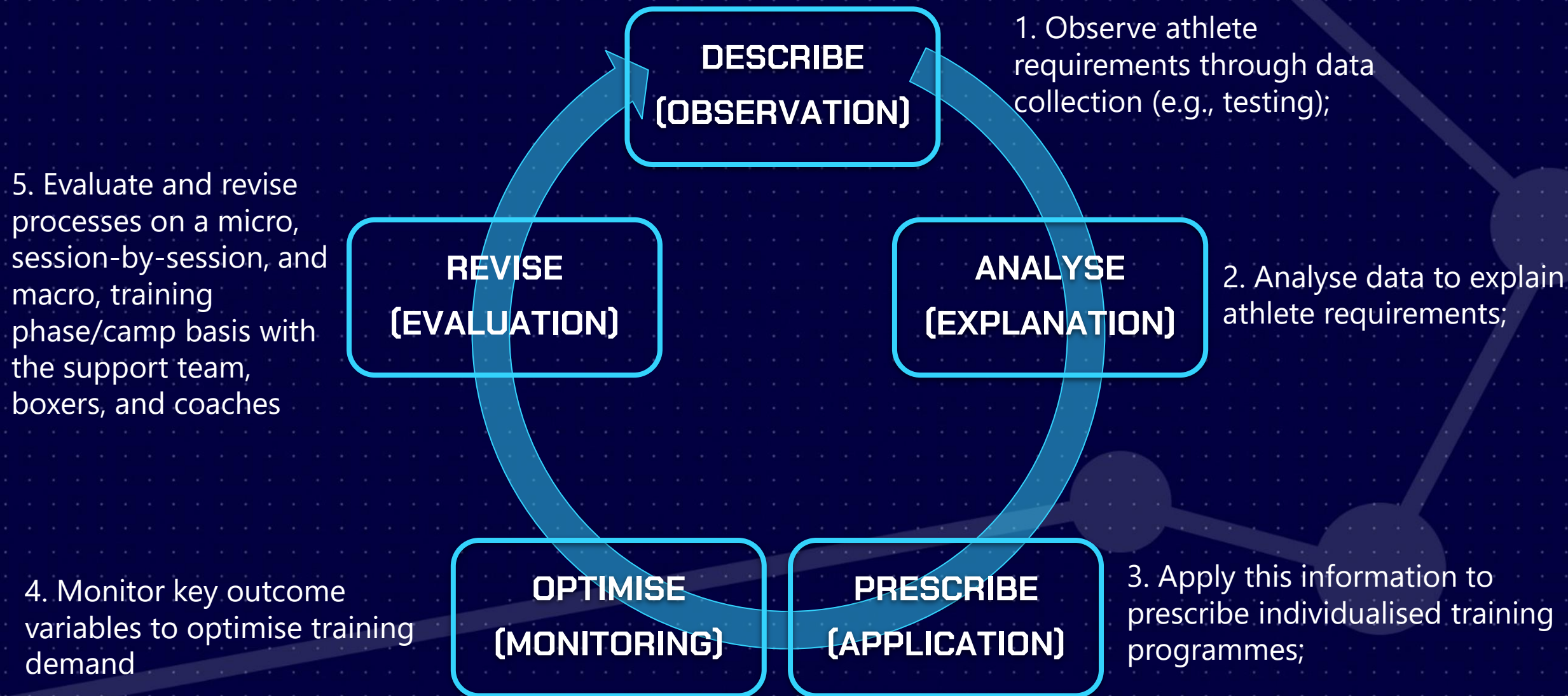


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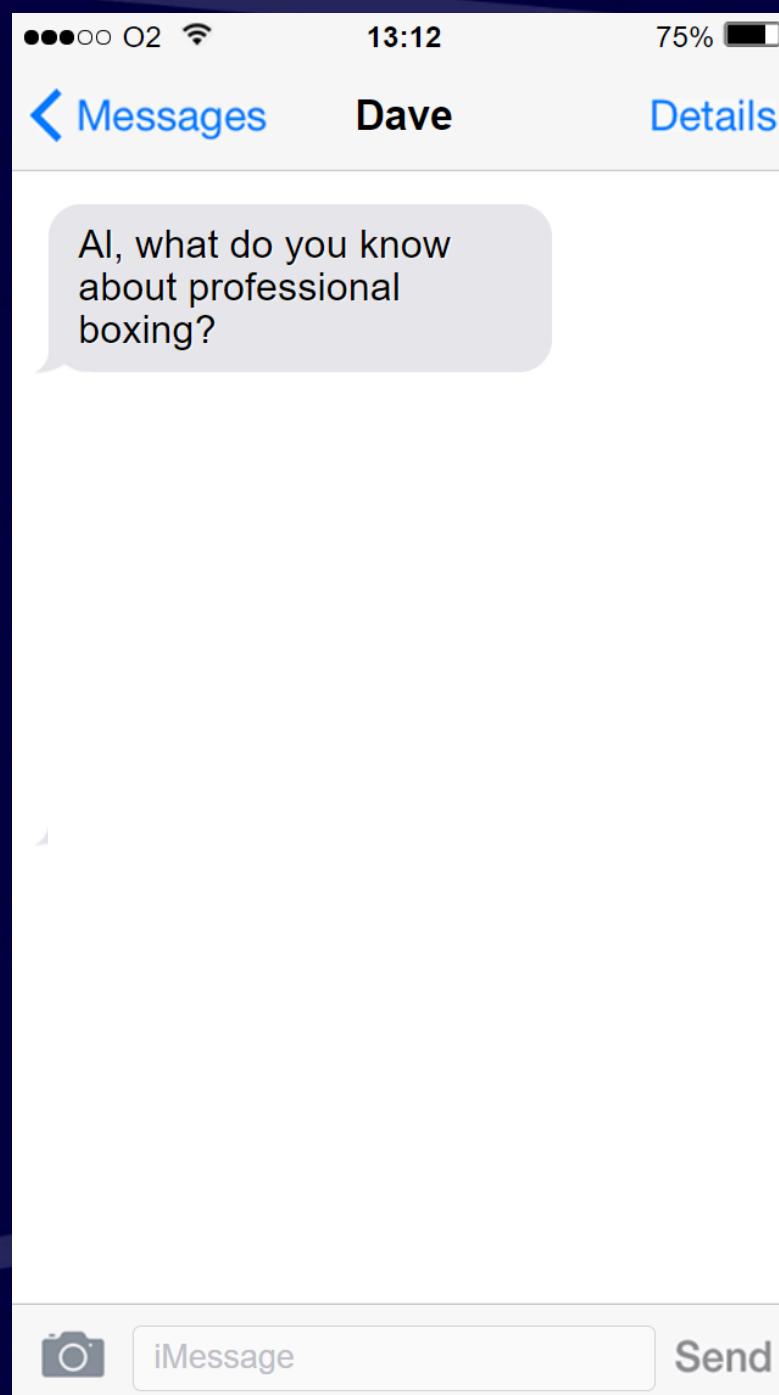




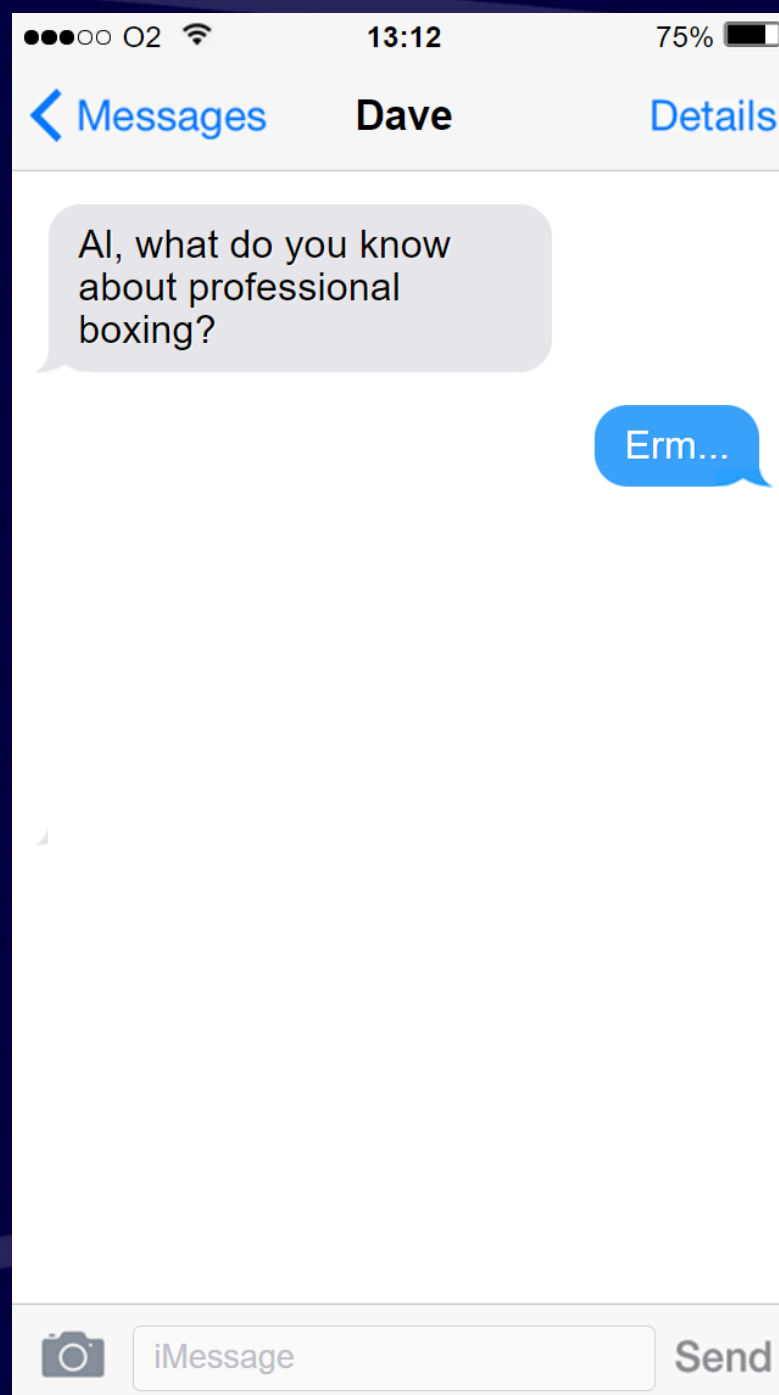
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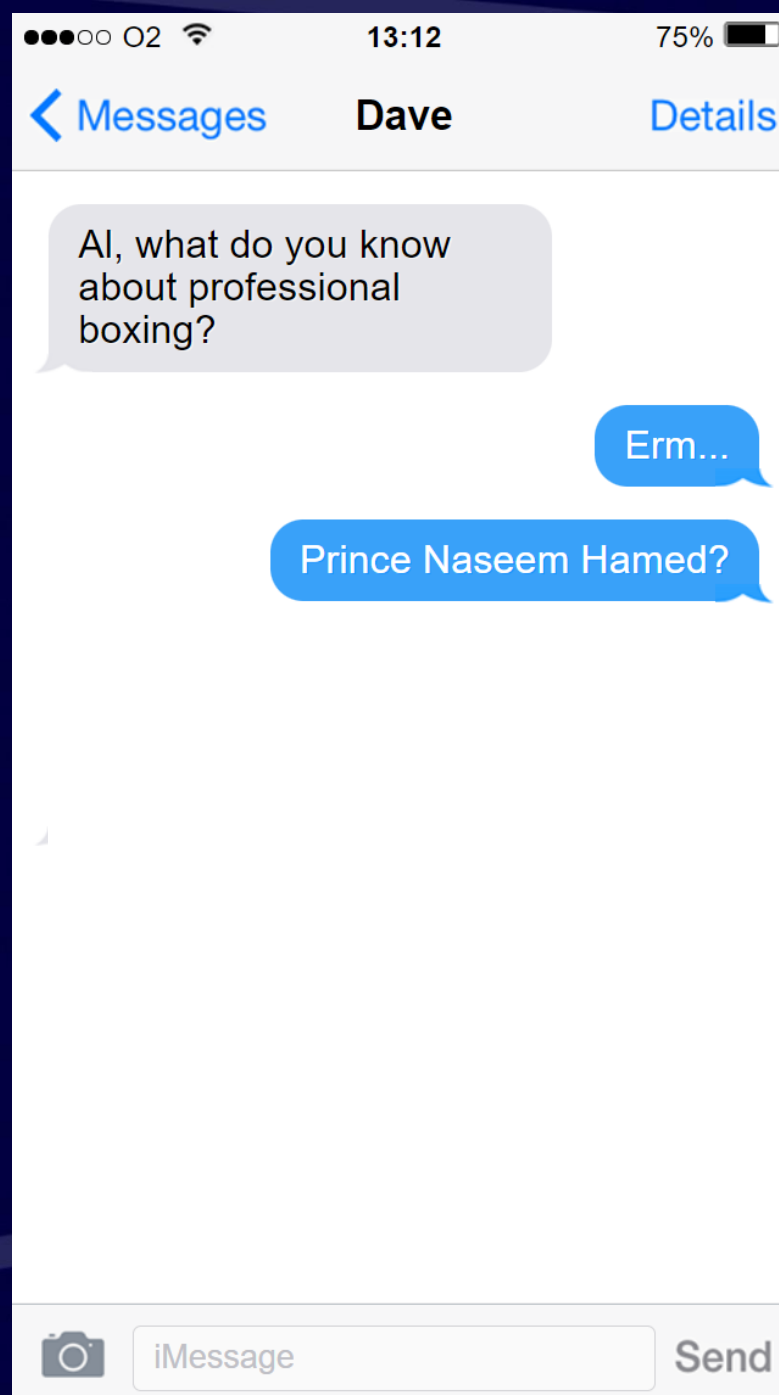
# REWIND 10 YEARS TO 2012...



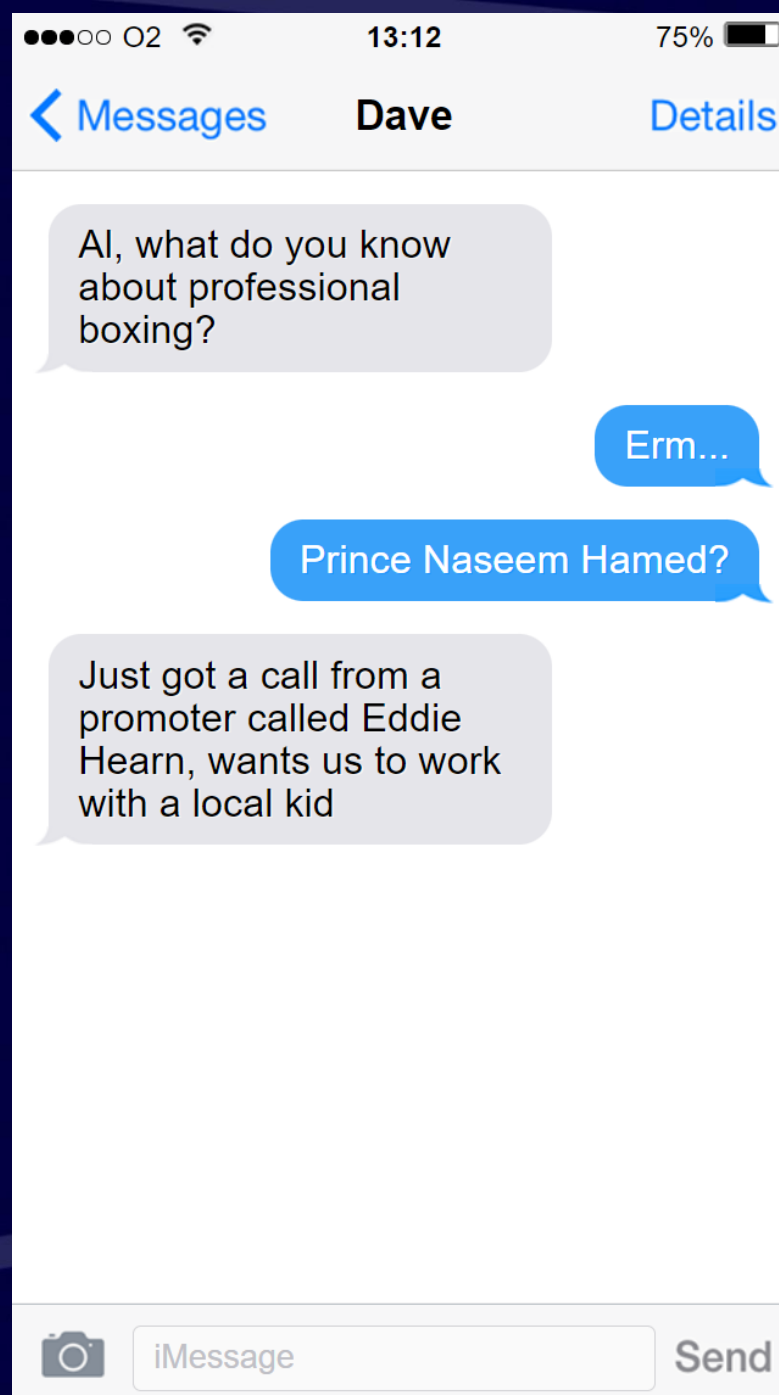
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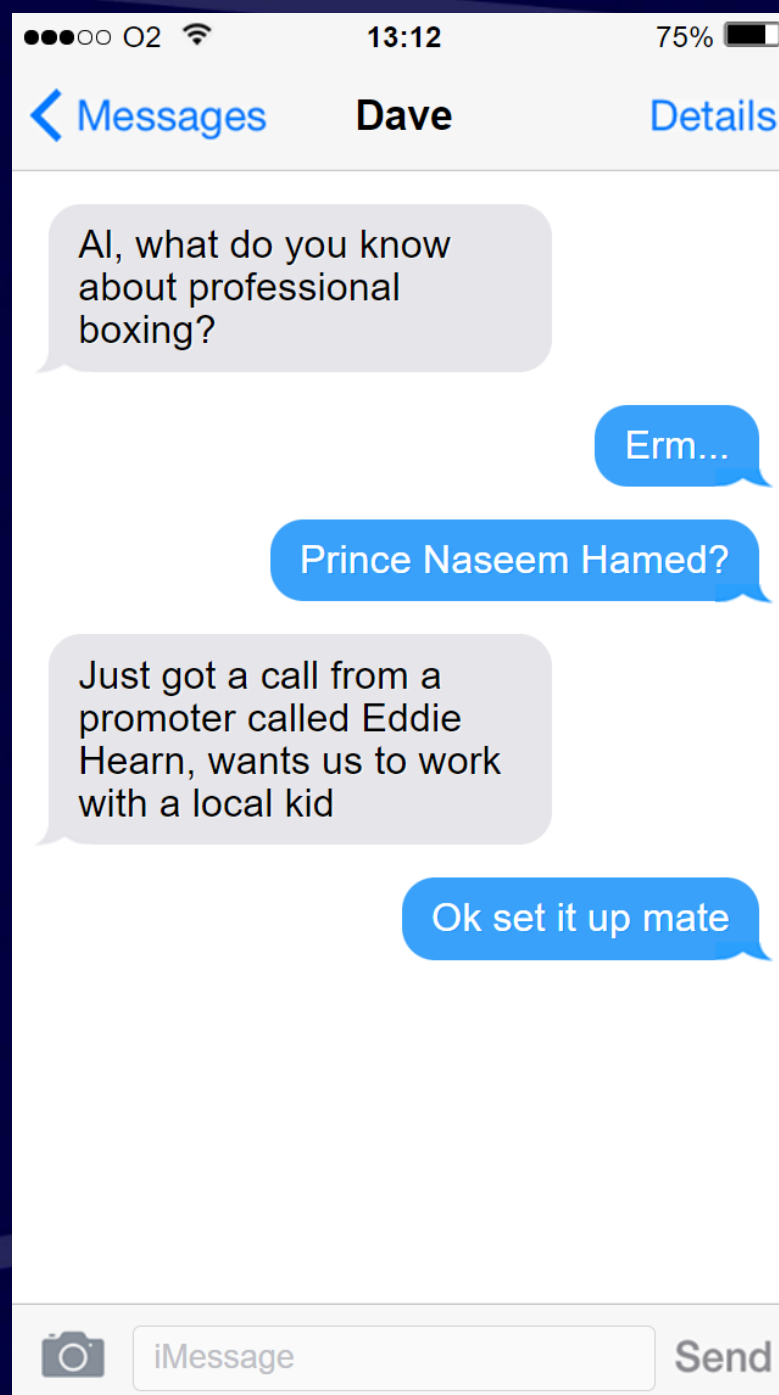
# REWIND 10 YEARS TO 2012...



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# REWIND 10 YEARS TO 2012...



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Boxing sport science



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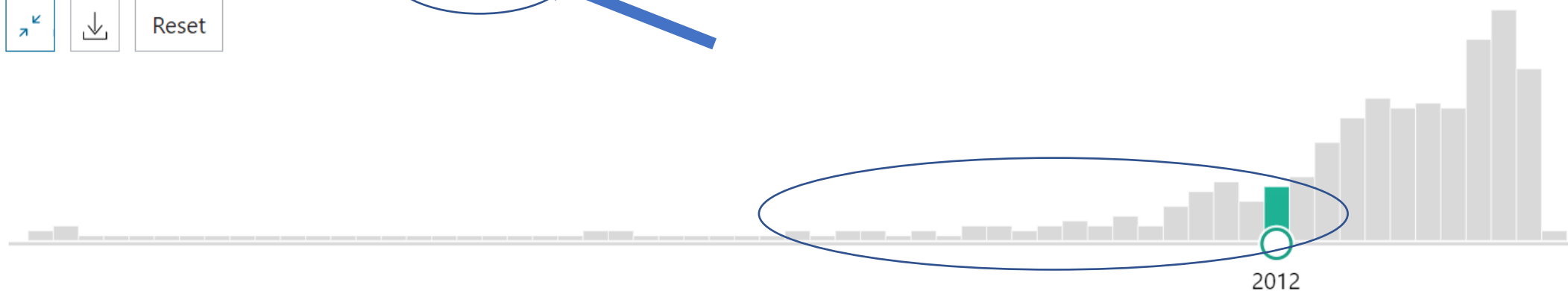
Display options

RESULTS BY YEAR

10 results

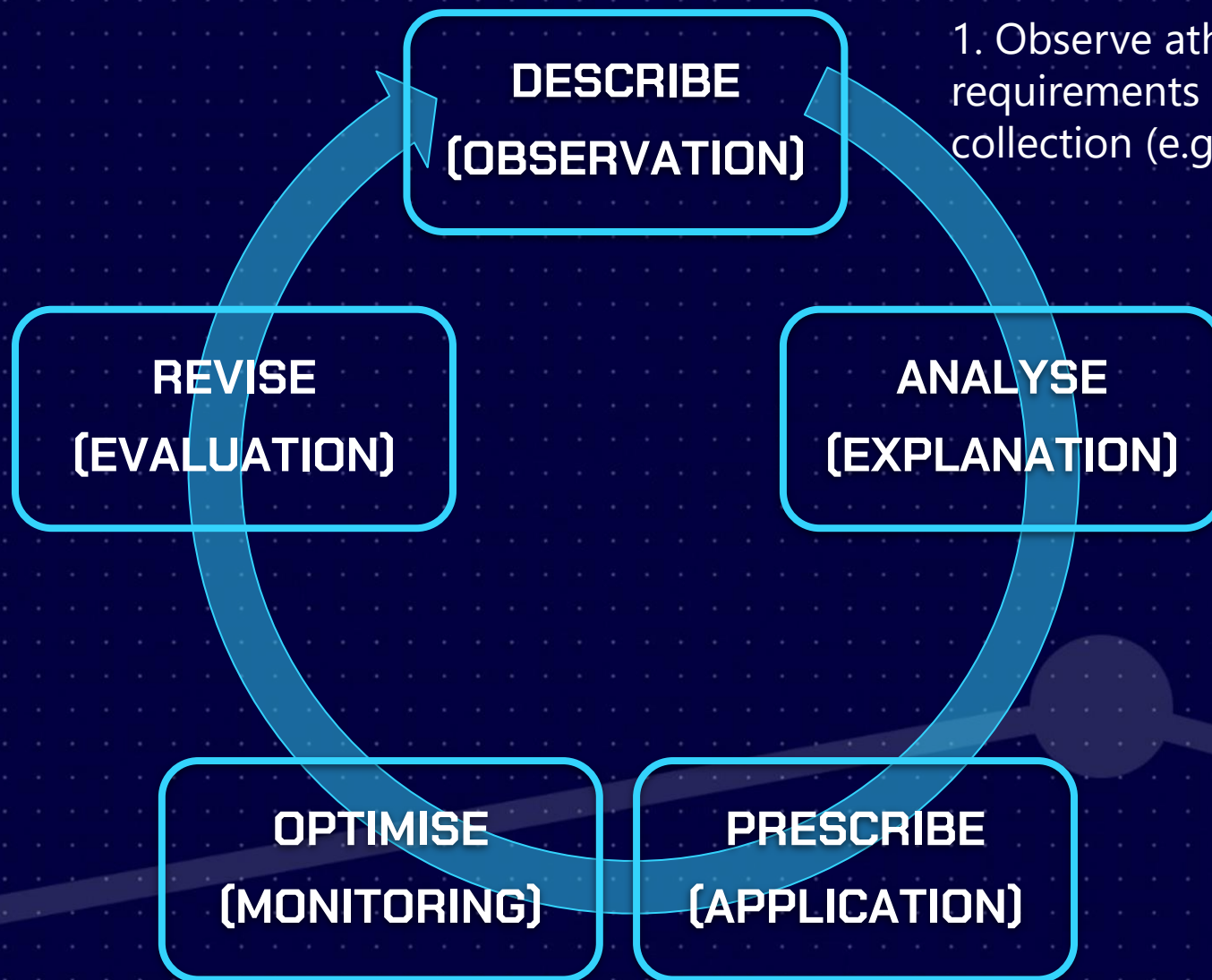
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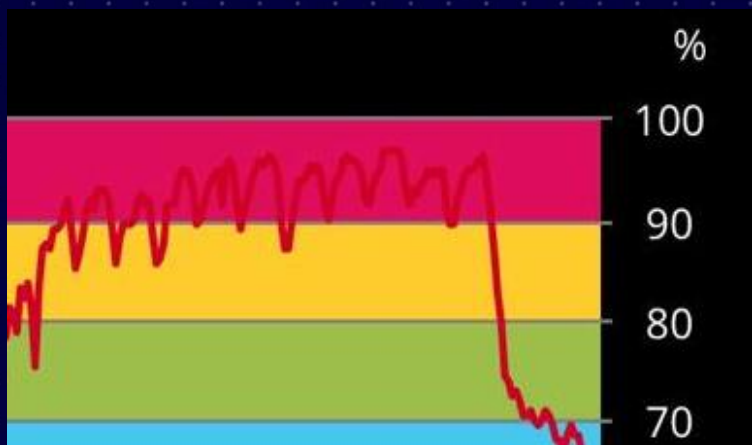




# STEP 1...



# STEP 1 - OBSERVE ATHLETE REQUIREMENTS THROUGH DATA COLLECTION



5		00:31:25
4		00:10:30
3		00:04:37

**6-12**

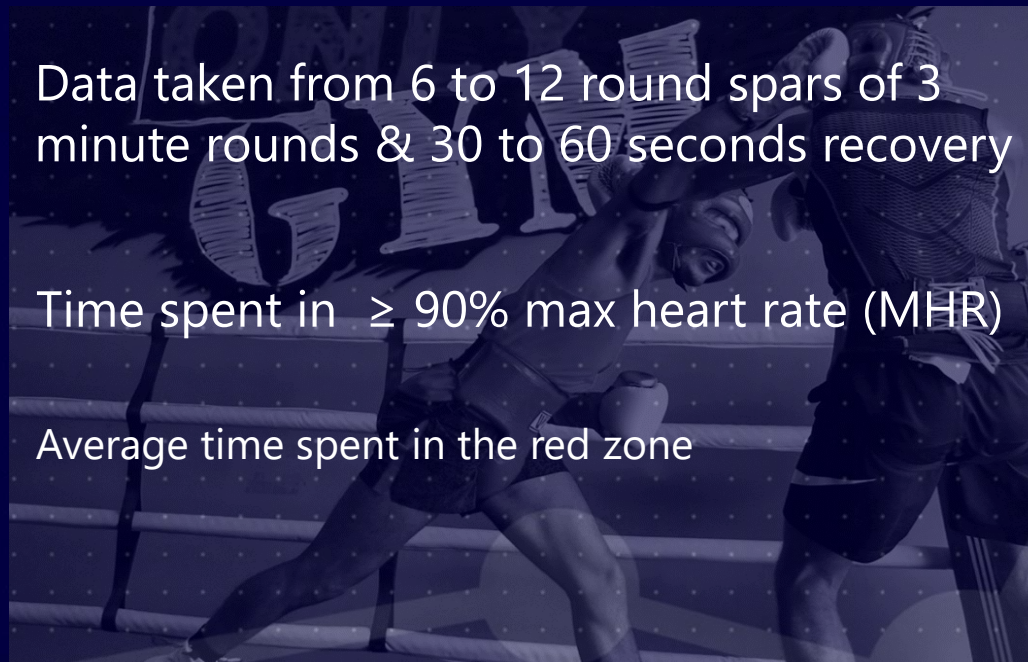
**65%**

**18:16  
mins**

Data taken from 6 to 12 round spars of 3  
minute rounds & 30 to 60 seconds recovery

Time spent in  $\geq 90\%$  max heart rate (MHR)

Average time spent in the red zone



# STEP 1 - OBSERVE ATHLETE REQUIREMENTS THROUGH DATA COLLECTION

**DESCRIBE  
(OBSERVATION)**

1. Boxing is a high-intensity intermittent sport that elicits large demands on the athlete's cardiovascular system

# STEP 1 - OBSERVE ATHLETE REQUIREMENTS THROUGH DATA COLLECTION

**DESCRIBE  
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1. Boxing is a high-intensity intermittent sport that elicits large demands on the athlete's cardiovascular system

**HOW DO WE KNOW THAT A BOXER IS FIT AND  
STRONG ENOUGH? HOW CAN WE TRACK THEIR  
PROGRESS?**

# STEP 1 - OBSERVE ATHLETE REQUIREMENTS THROUGH DATA COLLECTION

*Journal of Physical Education and Sport* ® (JPES), Vol.20 (6), Art 466 pp. 3452 - 3459, 2020  
online ISSN: 2247 - 806X; p-ISSN: 2247 - 8051; ISSN - L = 2247 - 8051 © JPES

## Original Article

### Physical profile of junior and senior amateur boxers

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## Simple Testing

Body composition

Jump tests

Medicine ball throws

Press-up

Sprint tests

Repeated sprint tests

Yo-Yo Intermittent Recovery Test L1

# STEP 1 - OBSERVE ATHLETE REQUIREMENTS THROUGH DATA COLLECTION

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1. Boxing is a high-intensity intermittent sport that elicits large demands on the athlete's cardiovascular system.

# STEP 1 - OBSERVE ATHLETE REQUIREMENTS THROUGH DATA COLLECTION

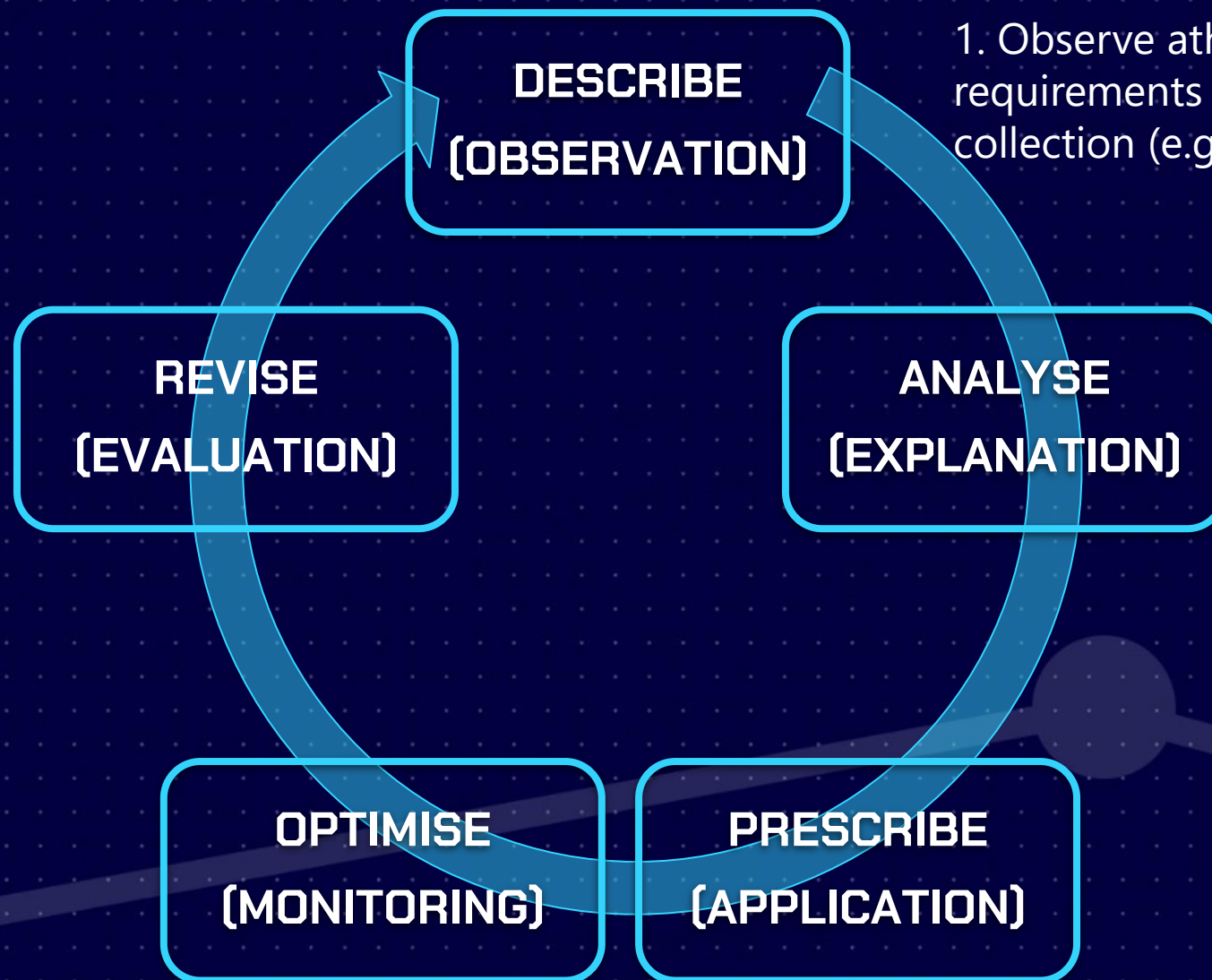
**DESCRIBE  
(OBSERVATION)**

1. Boxing is a high-intensity intermittent sport that elicits large demands on the athlete's cardiovascular system
2. We now had a small but effective database of around 40 boxers to describe their strength and fitness

## TESTING:

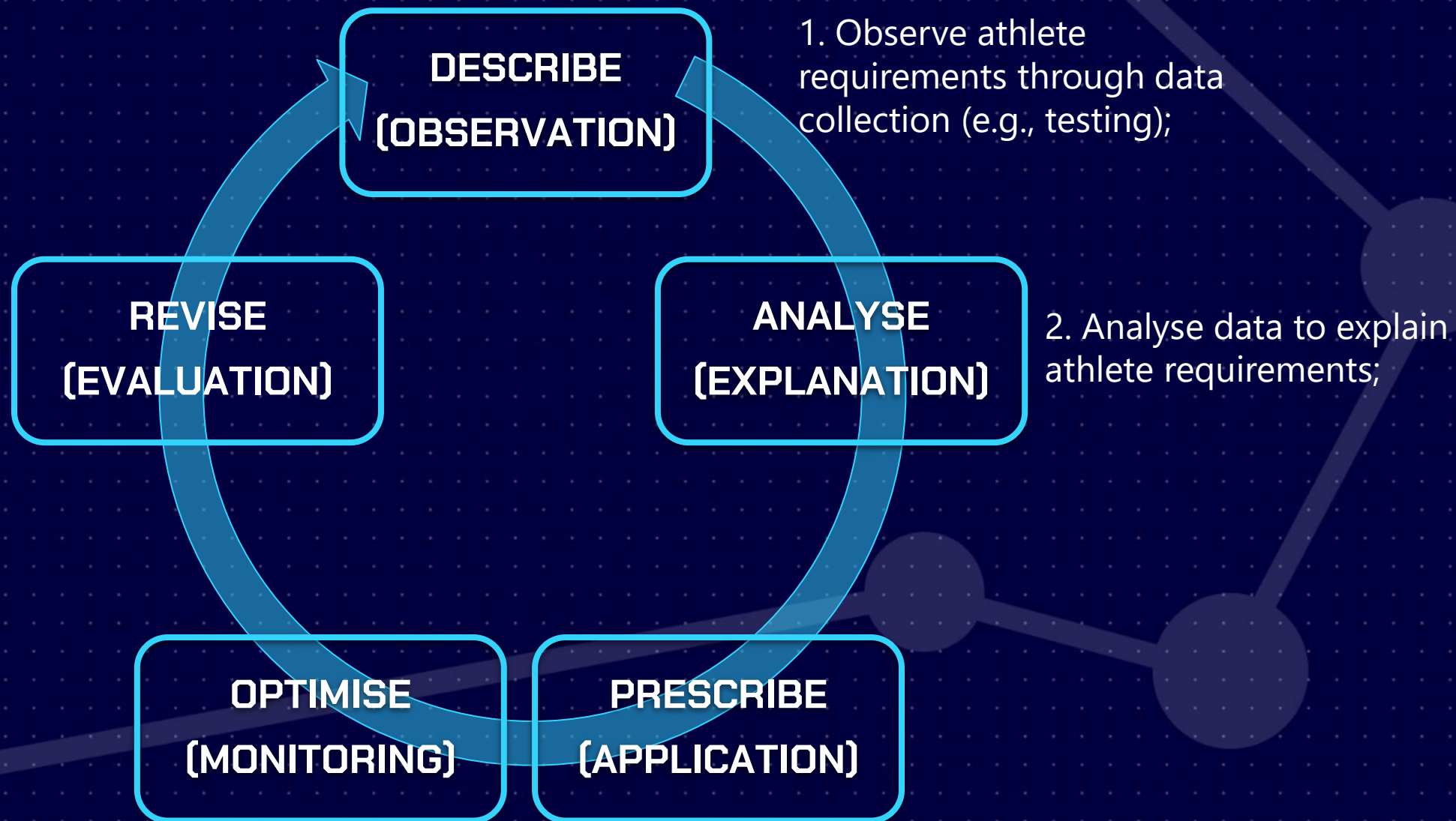
**DOESN'T HAVE TO BE EXPENSIVE OR COMPLICATED  
SIMPLE TESTS ARE RELIABLE  
CAN BE IMPLEMENTED IN A RANGE OF ENVIRONMENTS**

# STEP 1...





# STEP 2...



## STEP 2 – ANALYSE DATA TO EXPLAIN ATHLETE REQUIREMENTS

We use testing data to infer strengths and areas for development

**Remember:** We know that boxing is a high-intensity intermittent sport

So our boxers need to score well on high-intensity fitness tests

But what might be limiting their performance?



Rate of force development?  
Assessed using jumping testing

## STEP 2 – ANALYSE DATA TO EXPLAIN ATHLETE REQUIREMENTS

We use testing data to infer strengths and areas for development

**Remember:** We know that boxing is a high-intensity intermittent sport

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But what might be limiting their performance?



Maximum force production?  
Assessed using strength testing

## STEP 2 – ANALYSE DATA TO EXPLAIN ATHLETE REQUIREMENTS

We use testing data to infer strengths and areas for development

**Remember:** We know that boxing is a high-intensity intermittent sport

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But what might be limiting their performance?



Maximum speed?  
Assessed using sprint testing

## STEP 2 – ANALYSE DATA TO EXPLAIN ATHLETE REQUIREMENTS

We use testing data to infer strengths and areas for development

**Remember:** We know that boxing is a high-intensity intermittent sport

So our boxers need to score well on high-intensity fitness tests

But what might be limiting their performance?



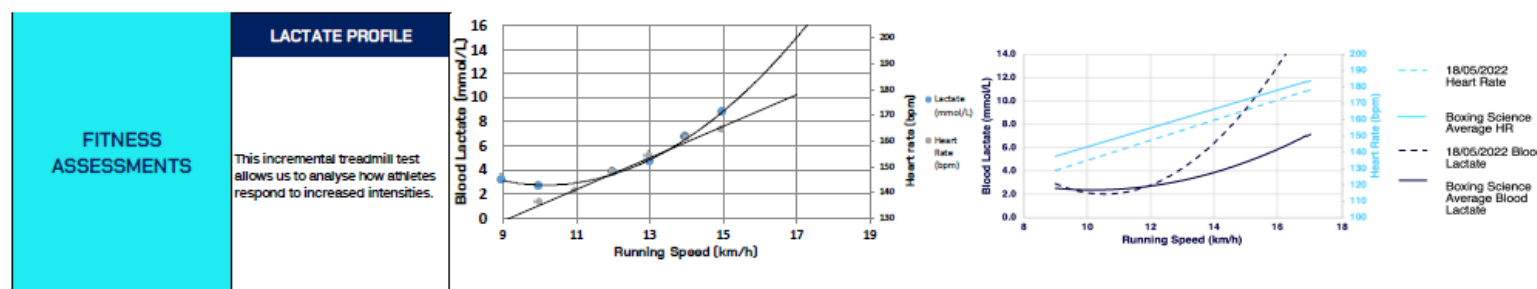
Central cardiovascular capacity?  
Assessed using submaximal tests,  
blood lactate profiling and indirect  
calorimetry

# STEP 2 – ANALYSE DATA TO EXPLAIN ATHLETE REQUIREMENTS

Test data is integrated to form an athlete report that highlights strengths and areas for improvements



		Test	Average (UFC / BS)	18/05/2022	Rating	% vs Mean
<b>JUMP ASSESSMENTS</b>	These tests help assess the ability to produce force from the lower-body.	Squat Jump (cm)	53.0	38.6	Poor	-27%
		Countermovement Jump (cm)	53.0	41.3	Poor	-22%
		SJ - CMJ	2.00	2.7	Average	35%
<b>REACTIVE STRENGTH</b>	This 10-jump pogo test is an assessment of the reactive strength of the calf complex and the ability to absorb and produce force quickly.	RSI Flight Time (ms)	425	456	Average	7%
		RSI Contact Time (ms)	178	184	Below Average	-3%
		RSI	2.89	2.48	Poor	-14%
<b>LOAD-VELOCITY PROFILE (TRAP BAR)</b>	A load-velocity profile helps determine an athletes one rep max (1RM), target lifting velocities and whether they are more suited to heavy or lighter loads to determine how strong or explosive they are.	1RM x BM	2.10	2.00		-5%
		Velocity @ 1 x BM	0.93	0.98		6%
		Velocity @ 1.5 x BM	0.67	0.63		-7%
		Velocity @ 2 x BM	0.46	0.27		-42%
<b>LANDMINE PUNCH ASSESSMENTS</b>	This assesses how much force an athlete can produce in a punching action. 20kg and 30kg loads determine whether an athlete needs to improve on punching speed or strength.	LM Punch 20 kg (R)	3.70	4.17	Excellent	13%
		LM Punch 20 kg (L)	3.70	4.36	Excellent	18%
		LM Punch 30 kg (R)	3.00	3.56	Excellent	19%
		LM Punch 30 kg (L)	3.00	3.27	Average	9%
		LM Punch Peak Power (R) 30kg	1677	2249	Good	34%
		LM Punch Peak Power (L) 30kg	1520	1882	Good	24%
<b>CORE ENDURANCE ASSESSMENTS</b>	These tests are beneficial in assessing an athletes core endurance, and to highlight any anterior/posterior and bi-lateral differences.	Supine Hold (secs)	90	150	Excellent	67%
		Lateral Hold L (secs)	90	90	Good	0%
		Lateral Hold R (secs)	90	90	Good	0%



## STEP 2 – ANALYSE DATA TO EXPLAIN ATHLETE REQUIREMENTS

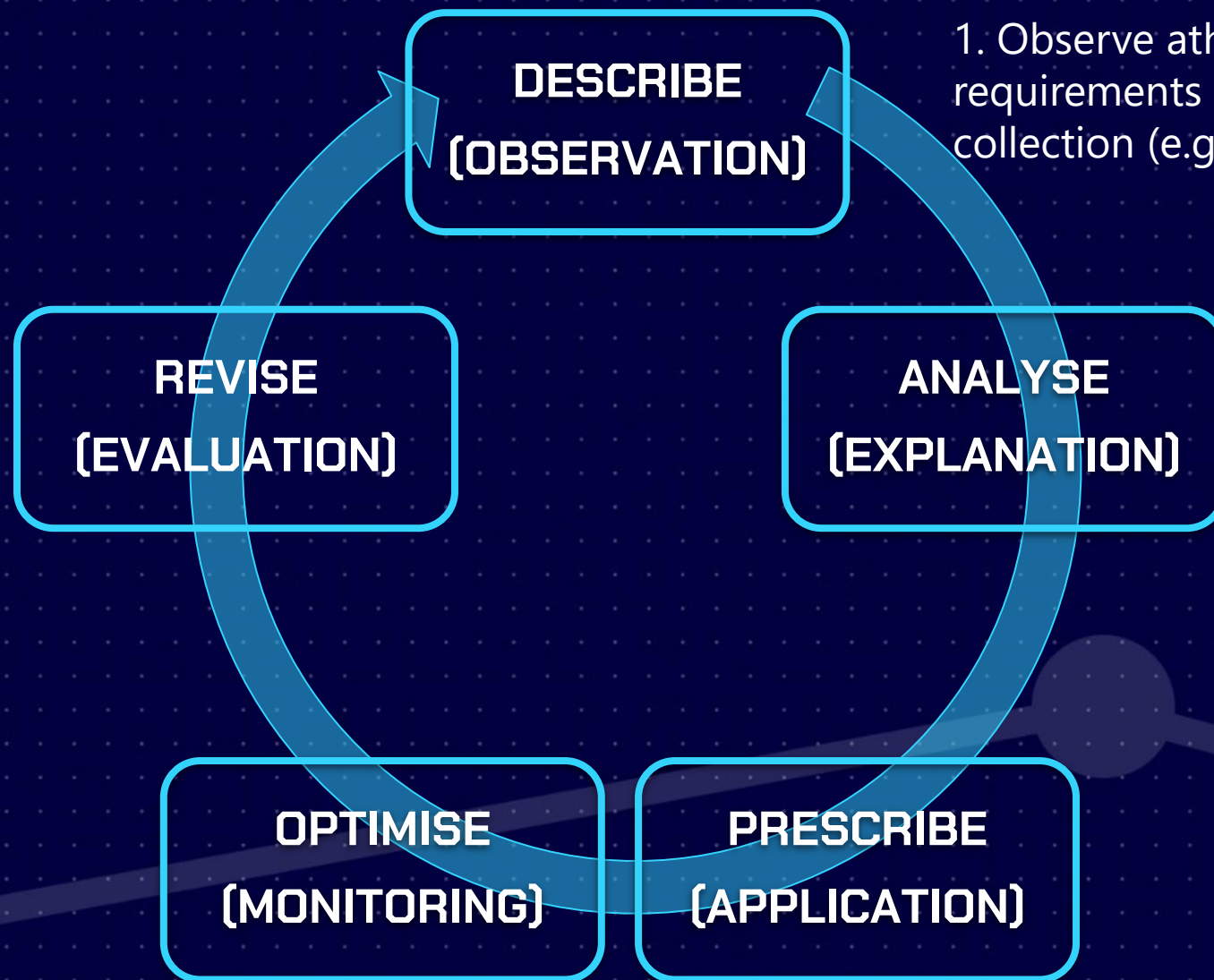
**ANALYSE**  
**(EXPLANATION)**

1. We use our testing database to identify strengths and areas for improvement
2. We *explain* performance limiters by integrating test results and create a performance profile

### **ANALYSIS:**

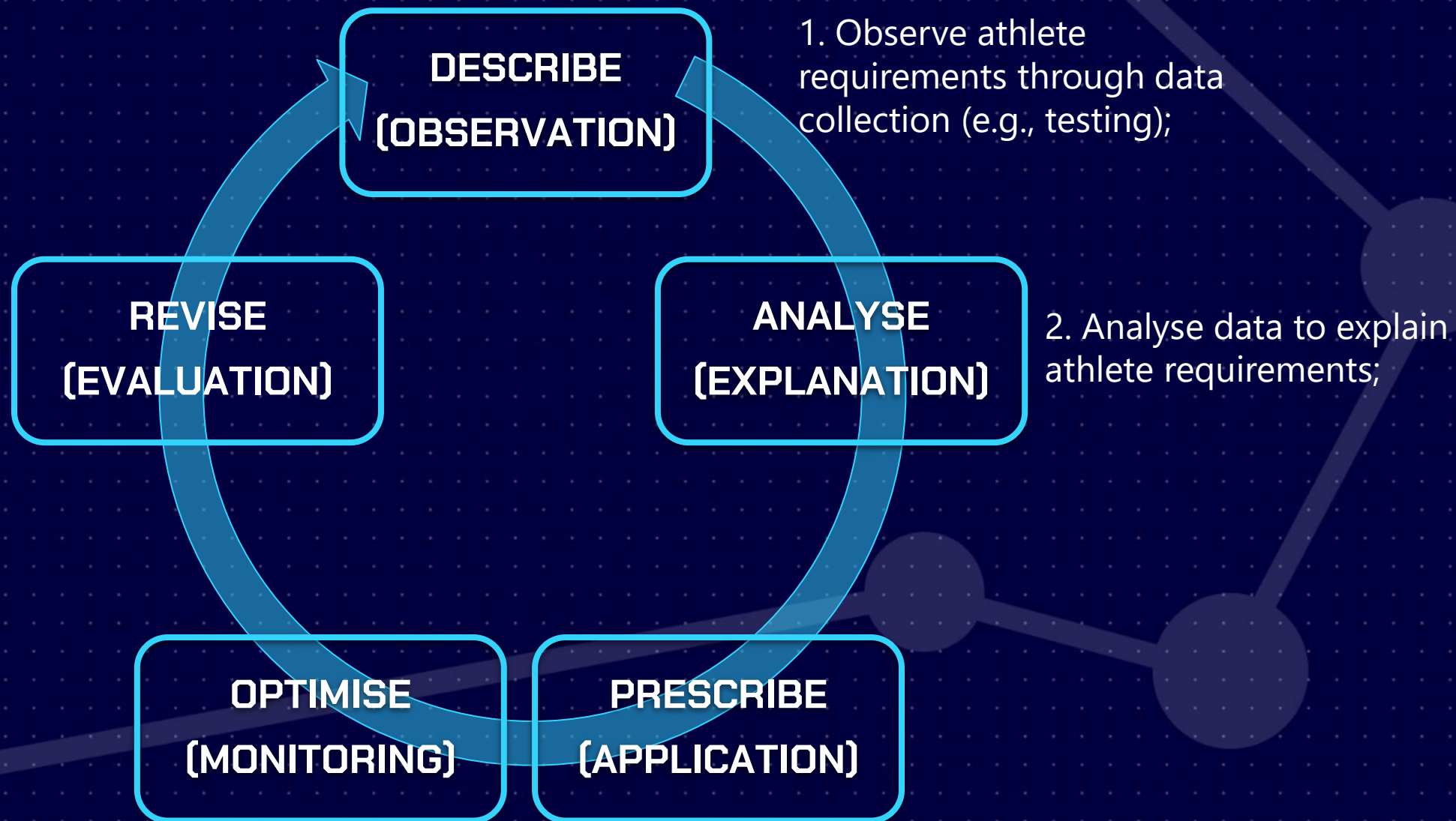
**USE SPREADSHEETS TO CREATE DATABASE**  
**COMPARE ATHLETE PERFORMANCES WITH GROUP MEANS**  
**DETERMINE STRENGTHS AND AREAS FOR IMPROVEMENT**

# STEP 1...

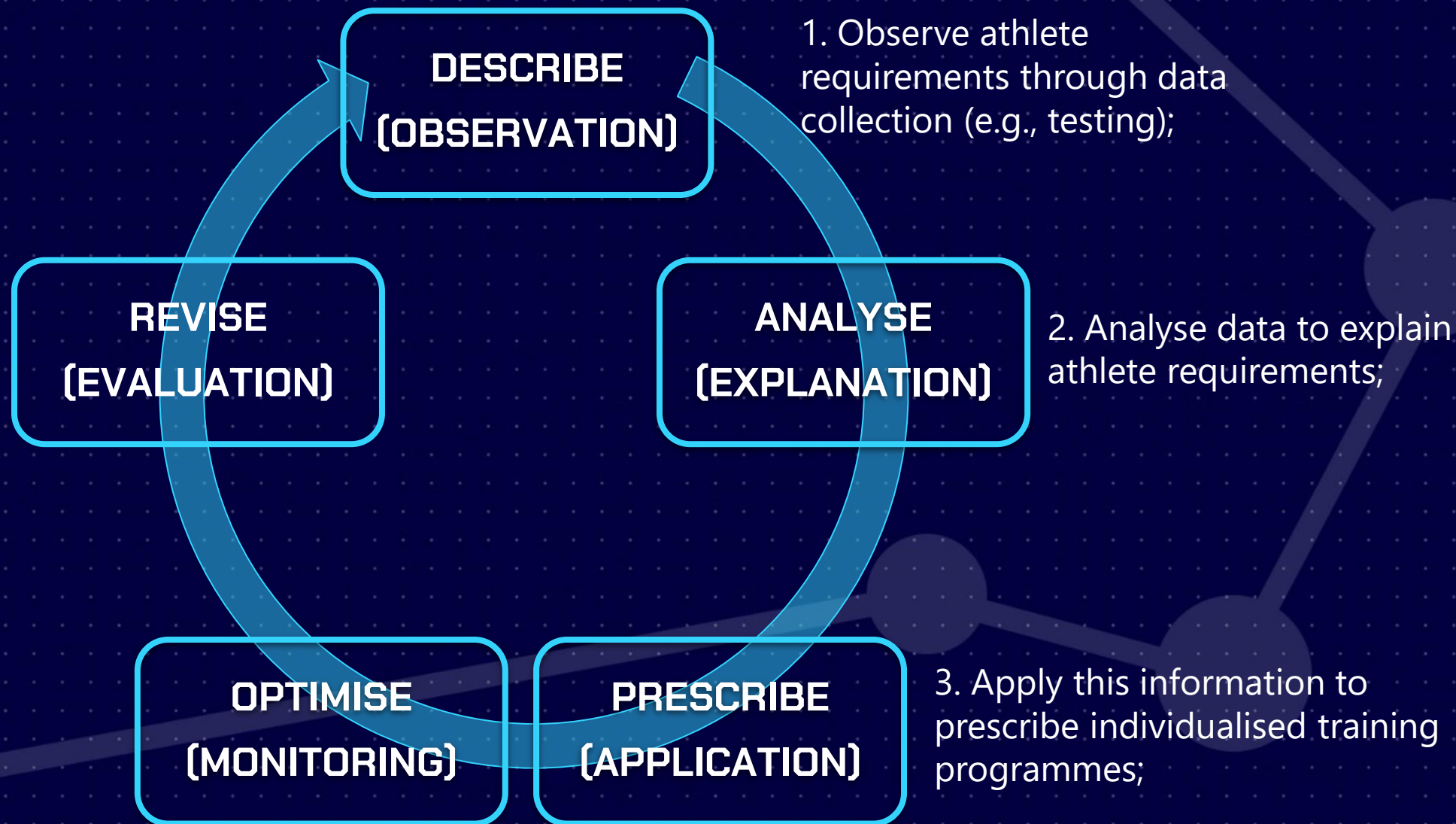




# STEP 2...



# STEP 3...



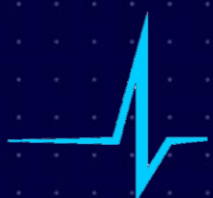
# STEP 3 – PRESCRIBE INDIVIDUALISED TRAINING PROGRAMMES

Depending on strengths and areas for development we target different physiological adaptations



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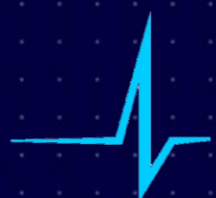


Increase the amount of oxygen rich blood that is delivered to the muscles and returned for re-oxygenation



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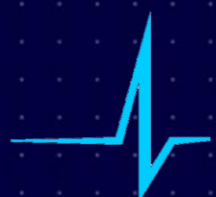


Improve how the muscles extract and utilise oxygen to generate energy



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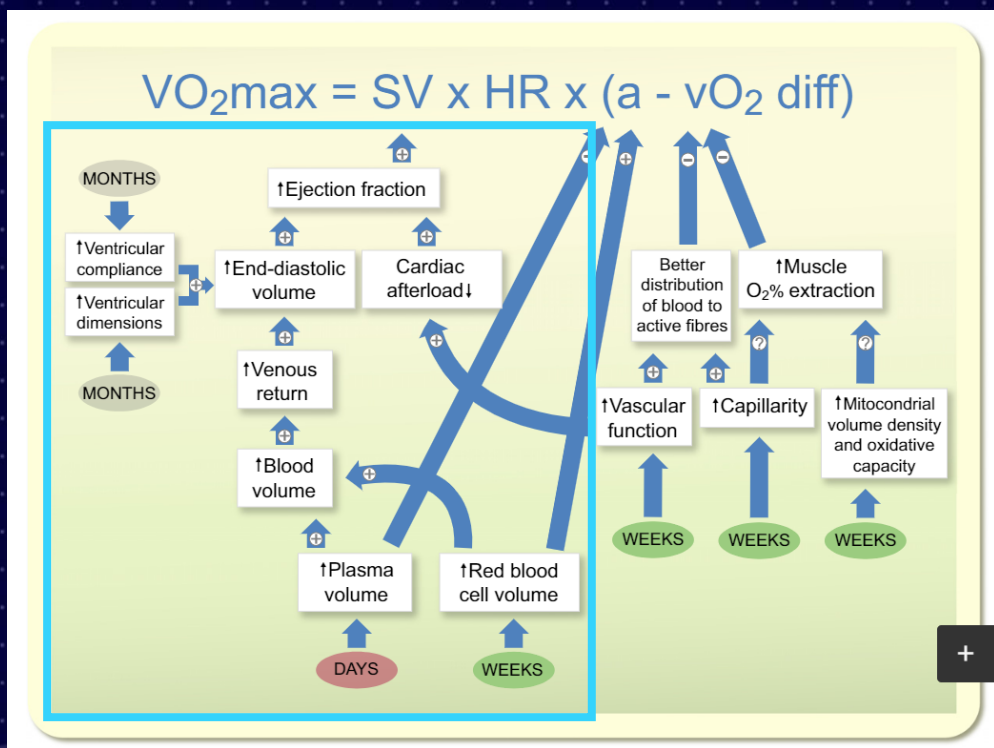


Improve buffering mechanisms to limit the effect of acidosis on force production



# STEP 3 – PRESCRIBE INDIVIDUALISED TRAINING PROGRAMMES

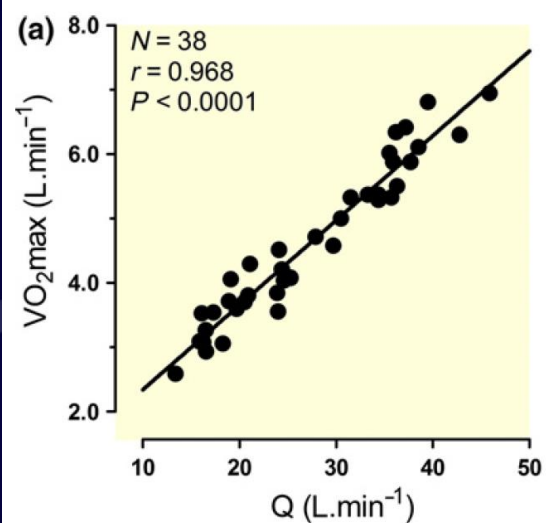
Increase the amount of oxygen rich blood that is delivered to the muscles and returned for re-oxygenation



## REVIEW

### Biology of $VO_{2max}$ : looking under the physiology lamp

C. Lundby,<sup>1</sup> D. Montero<sup>2</sup> and M. Joyner<sup>3</sup>



# STEP 3 – PRESCRIBE INDIVIDUALISED TRAINING PROGRAMMES

## PHYSIOLOGICAL ADAPTATIONS

- Heart size and compliance
- The ability of the heart to relax and fill with blood between beats
- The forcefulness of heart beats
- The amount of blood returned to the heart
- The number and network of capillaries

## STANDARD SESSION

4 MINS ON : 2 MINS OFF X 4-6 REPS

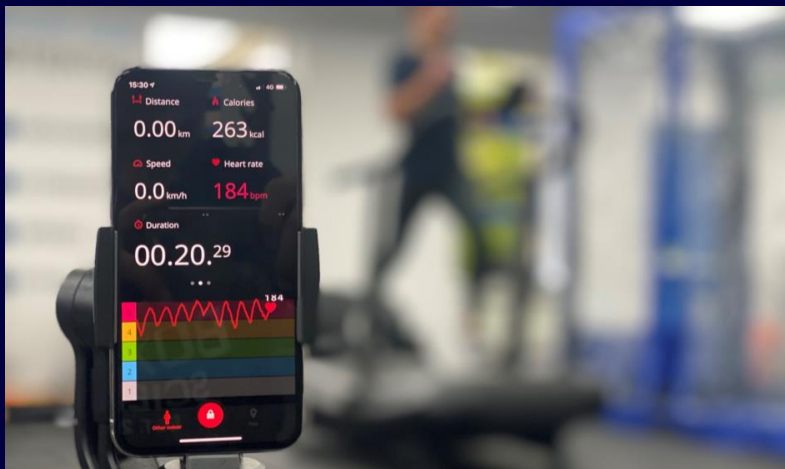




# STEP 3 – PRESCRIBE INDIVIDUALISED TRAINING PROGRAMMES

## STANDARD SESSION

4 MINS ON : 2 MINS OFF X 4-6 REPS



- Training prescribed using a 'time in zone' method
- Determine 90% HR max
- Schedule between 10 and 12 min at 90% HR max
- Run at a speed that elicits 90% HR max after approx. 1 min
- Run interval for 4 min ; 2 min rest; repeat 4 to 6 times

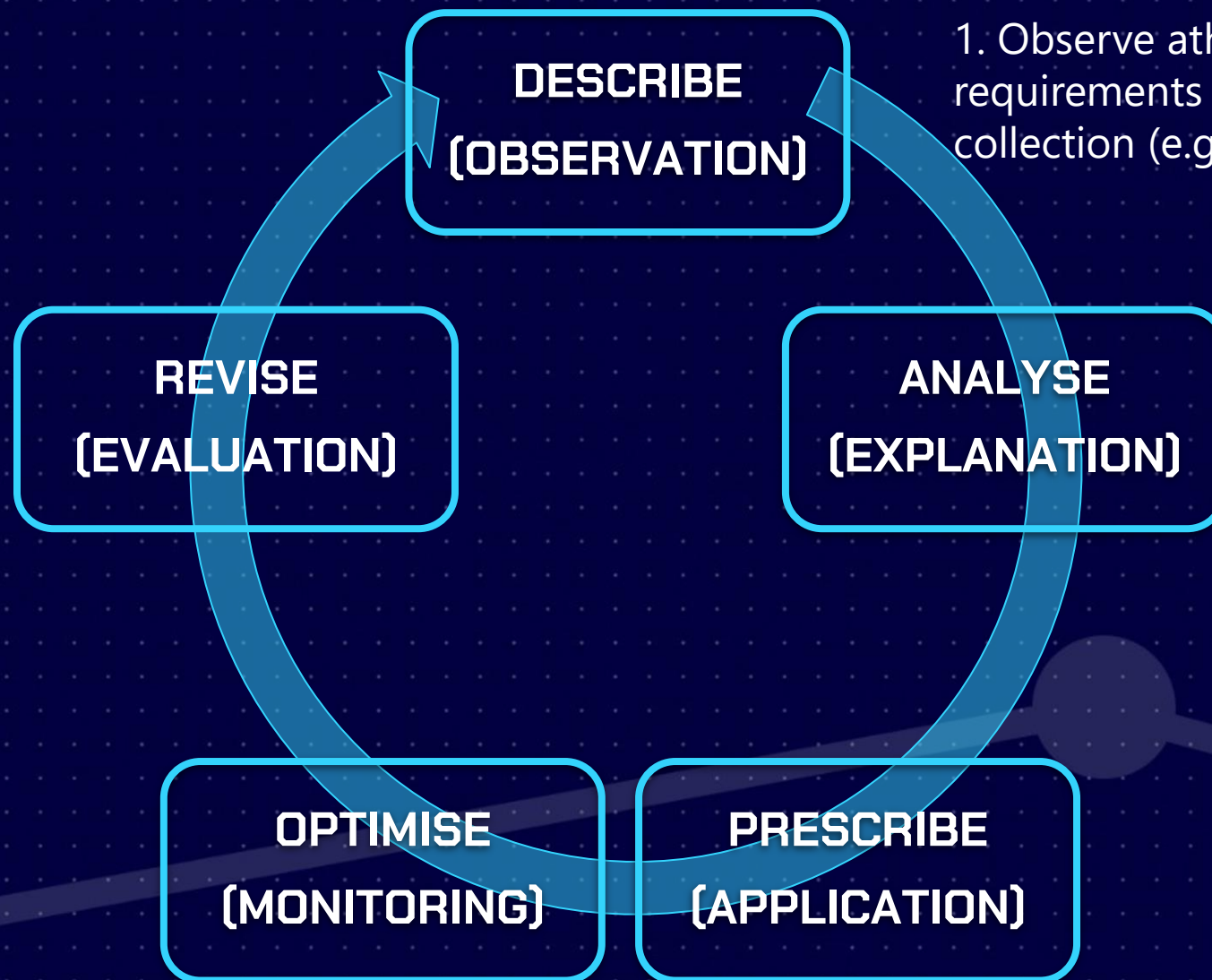
## STEP 3 – PRESCRIBE INDIVIDUALISED TRAINING PROGRAMMES

**PRESCRIBE  
(APPLICATION)**

1. We use our understanding of the sports determinants and areas for development to target specific adaptations
2. We use scientific research and evidence-based practice to prescribe training sessions in a simple and effective way

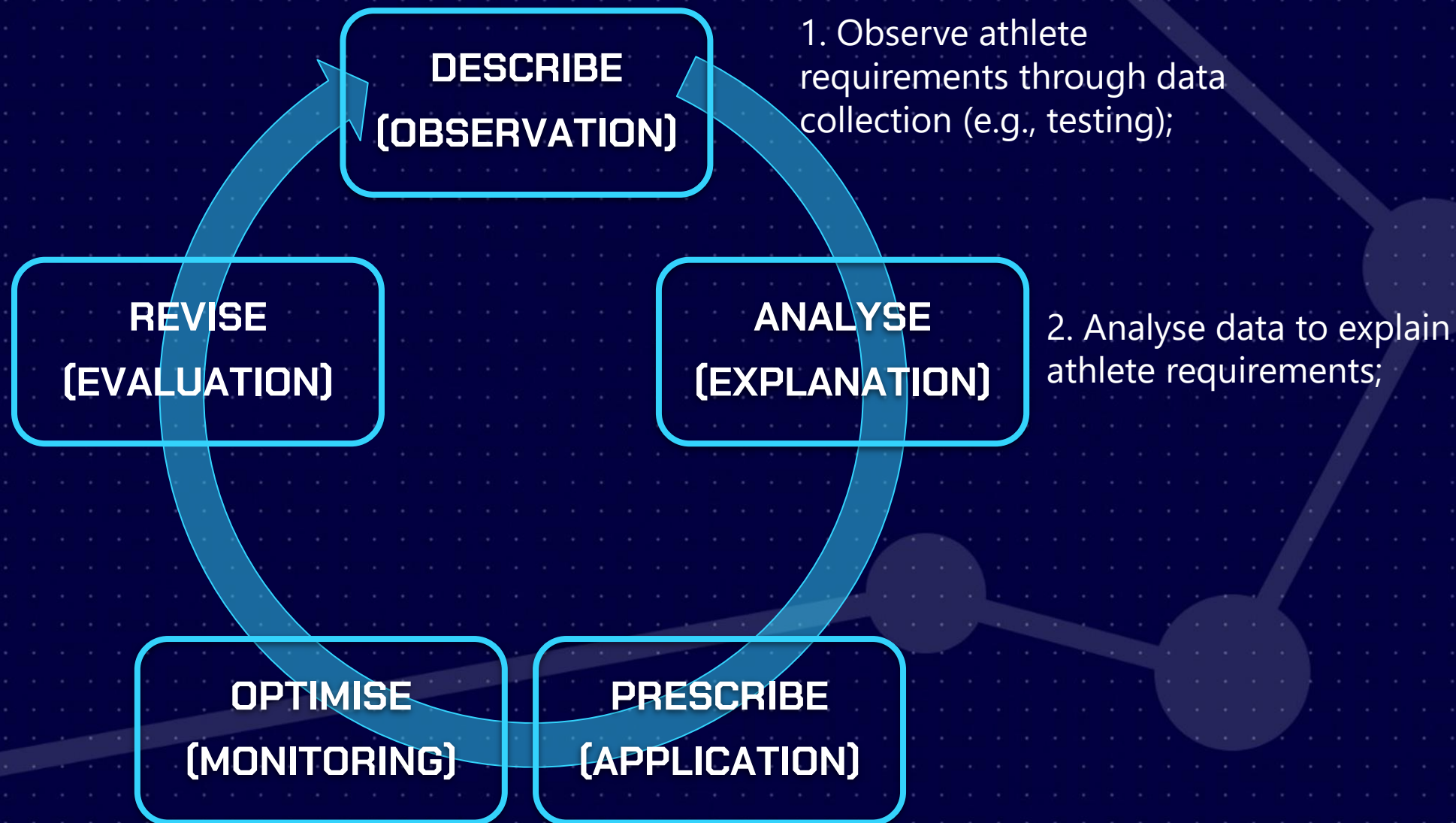
**PRESCRIPTION:  
USE SCIENTIFIC EVIDENCE TO BASE TRAINING AROUND  
THE DETERMINANTS OF THE SPORT AND DESIRED  
ADAPTATIONS**

# STEP 1...

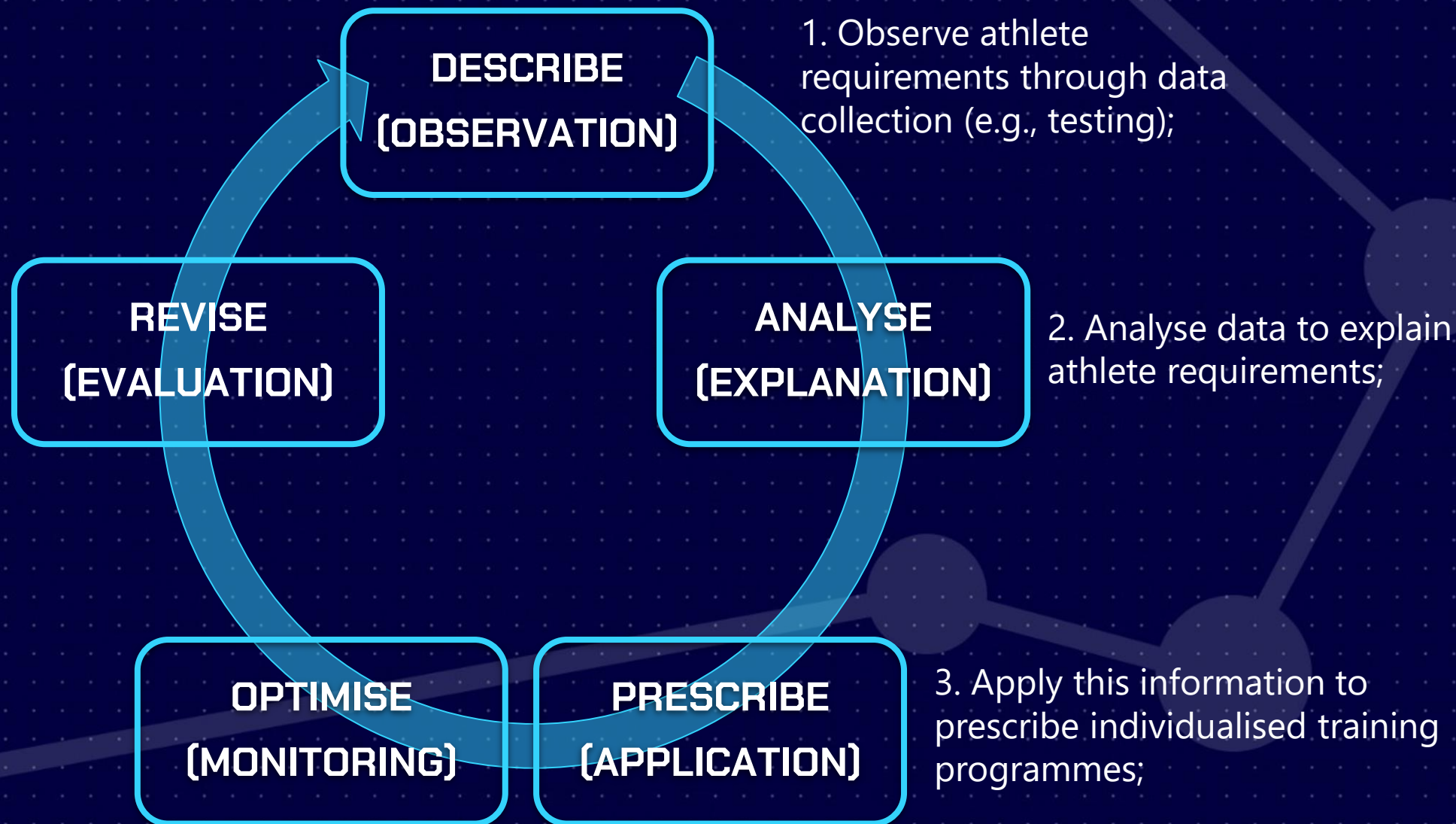


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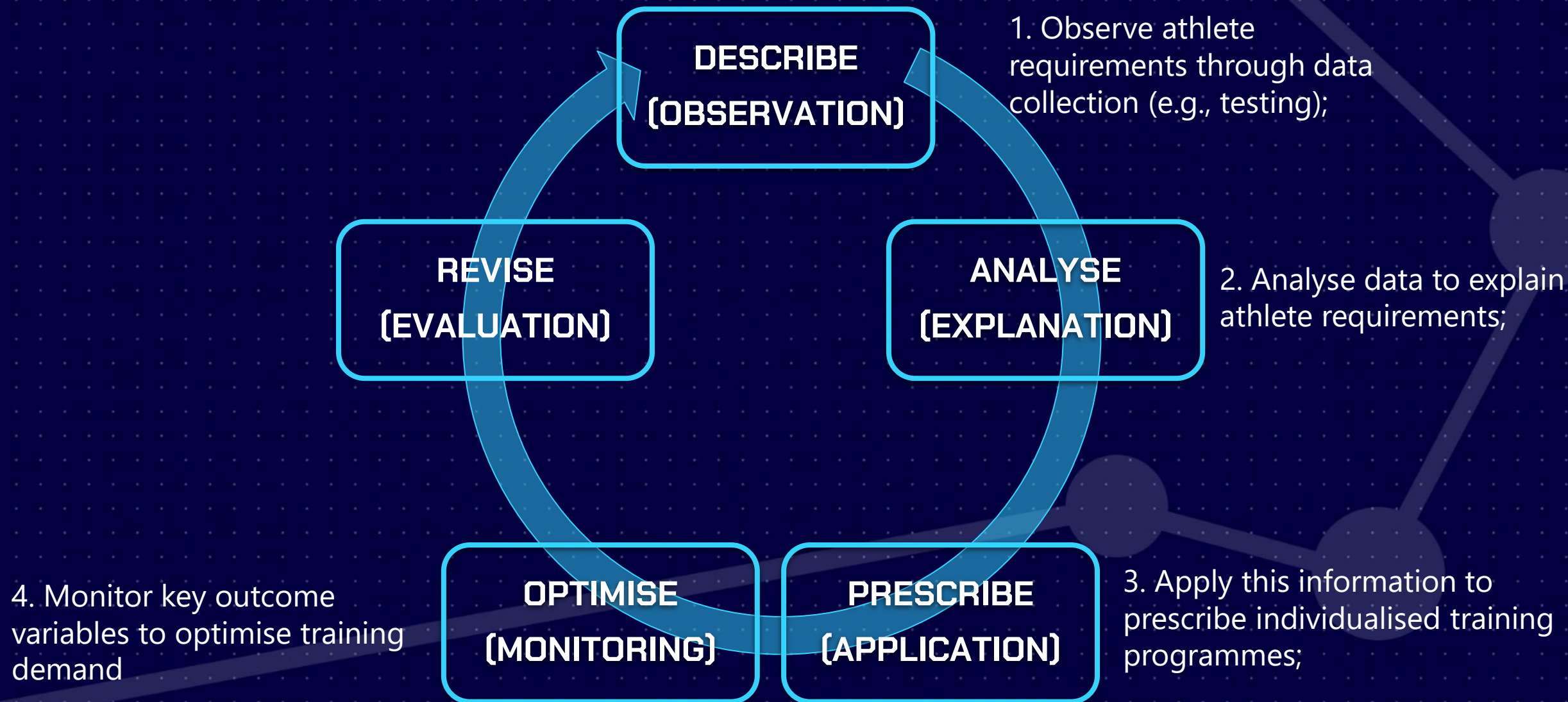
# STEP 2...



# STEP 3...



# STEP 4...



# STEP 4 – MONITOR KEY OUTCOME VARIABLES

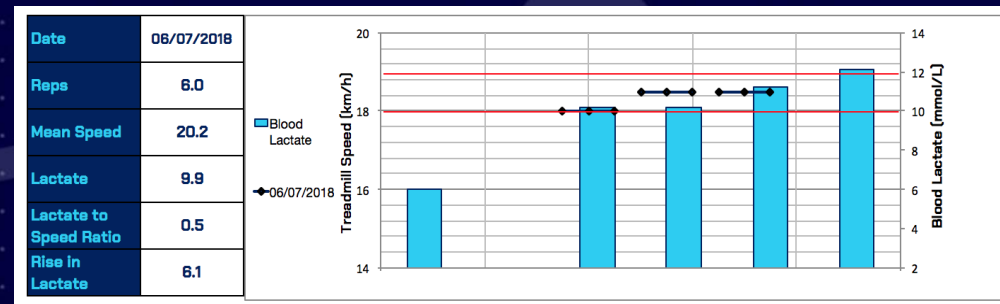
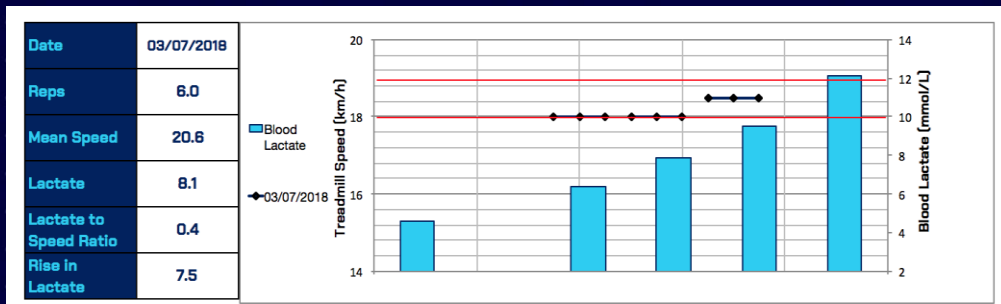
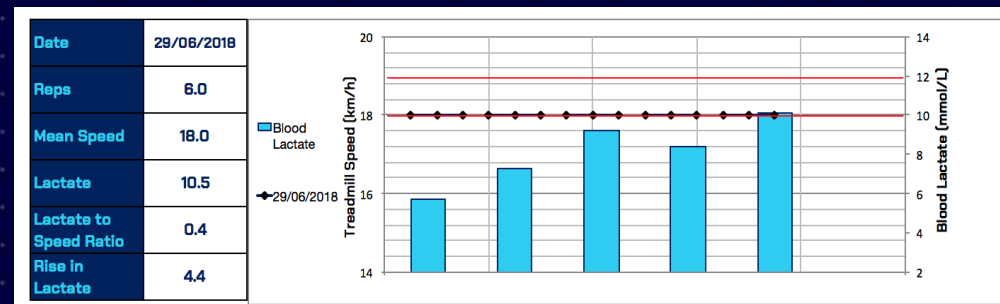
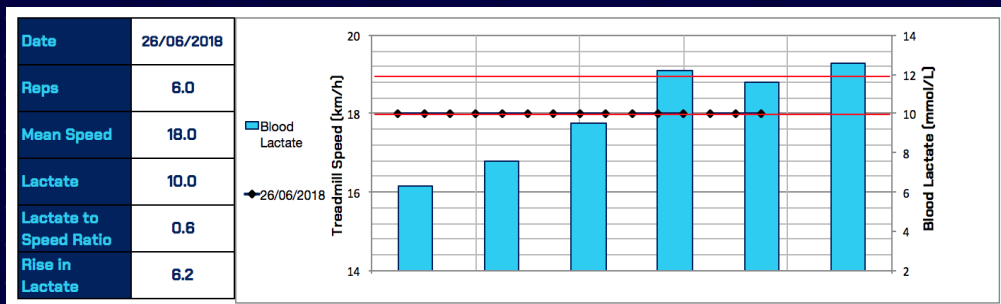
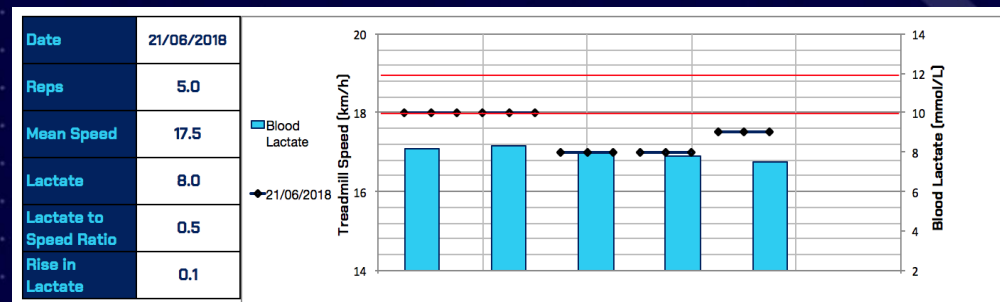
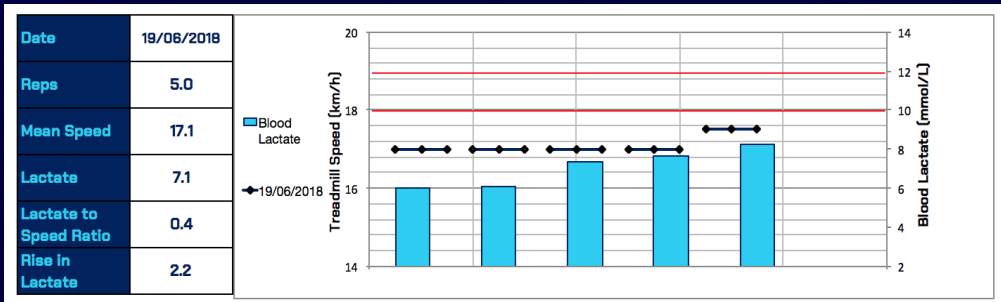
## STANDARD SESSION

4 MINS ON : 2 MINS OFF X 4-6 REPS



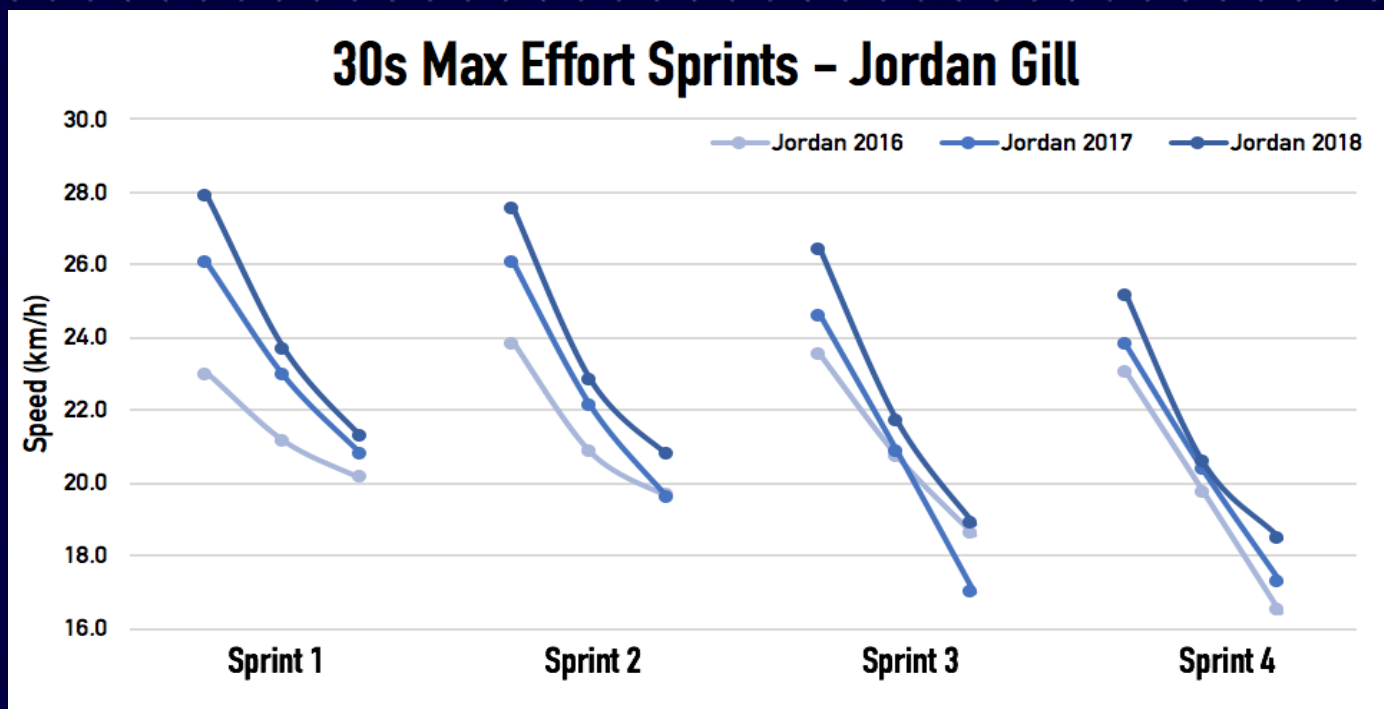
- Time above 90% HR max
- Running speed
- Rating of Perceived Exertion

# STEP 4 – MONITOR KEY OUTCOME VARIABLES





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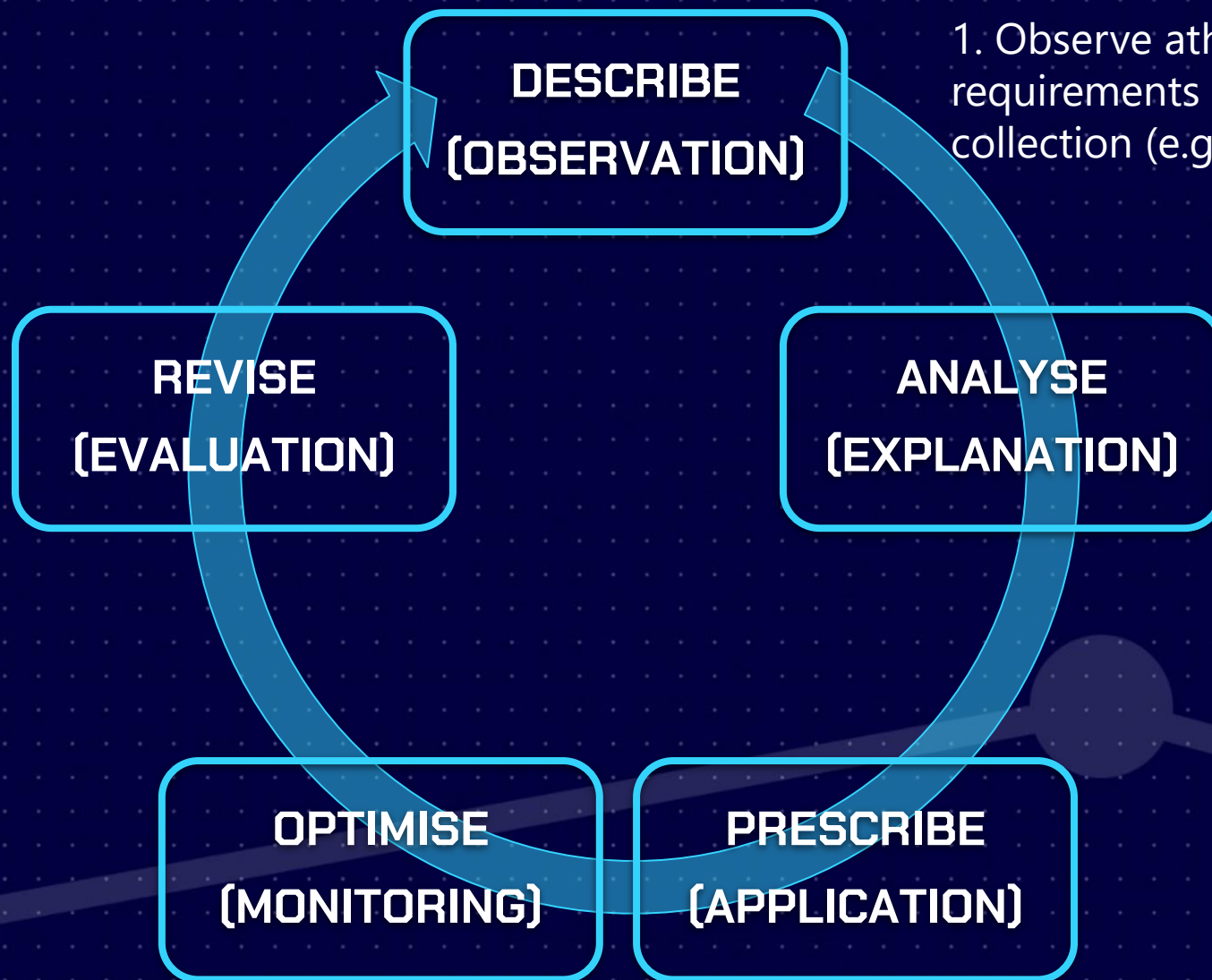
**OPTIMISE  
(MONITORING)**

1. We identify key variables that are linked to our intended target adaption
2. We monitor these variables during training to ensure that our training is being executed in the way we prescribed it

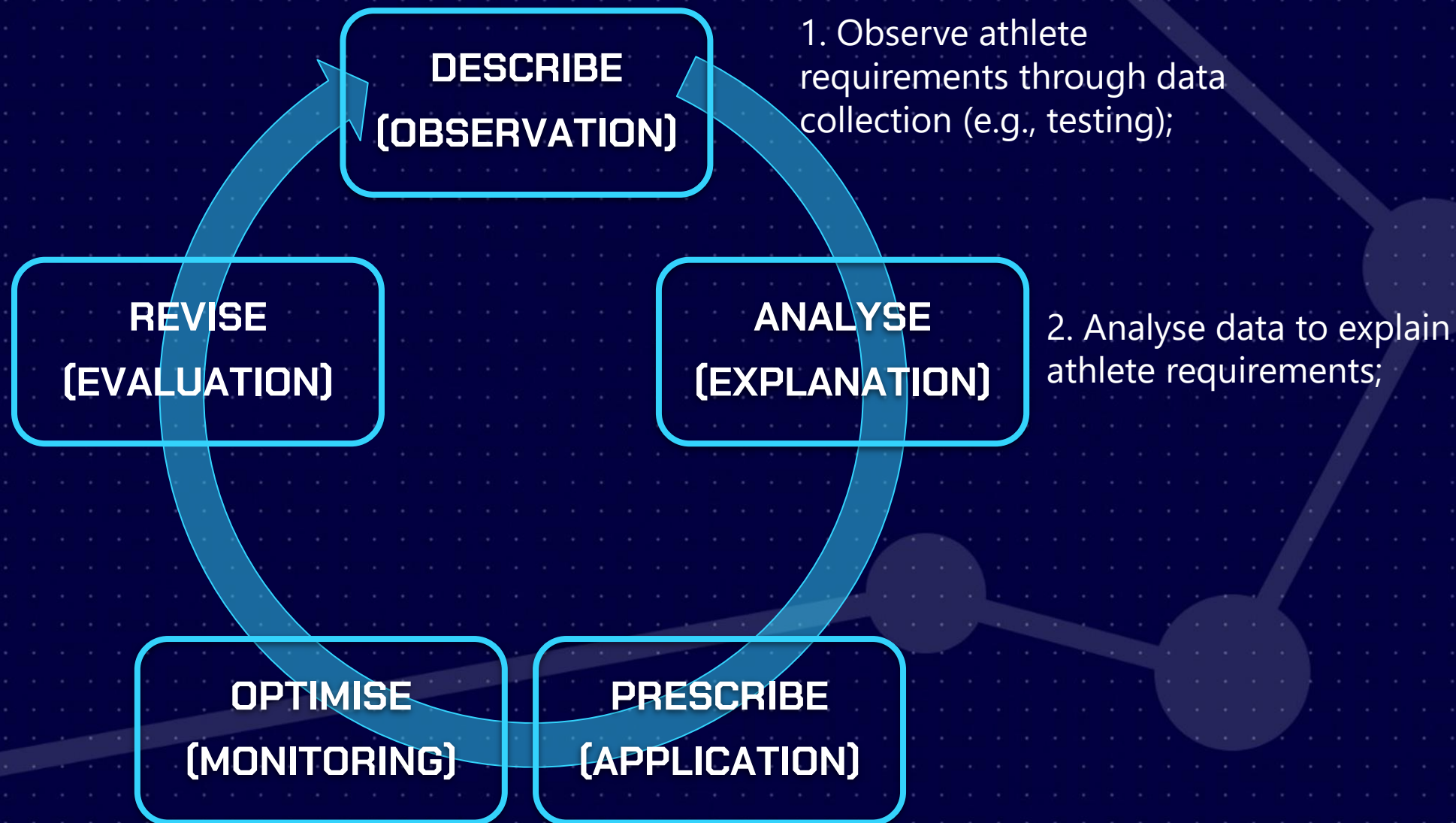
**OPTIMISE:**

**CREATE SIMPLE DATA COLLECTION SHEETS  
TRACK 1 OR 2 KEY VARIABLES WITHIN A SESSION  
ADJUST INTENSITY TO MATCH TARGET OUTCOME**

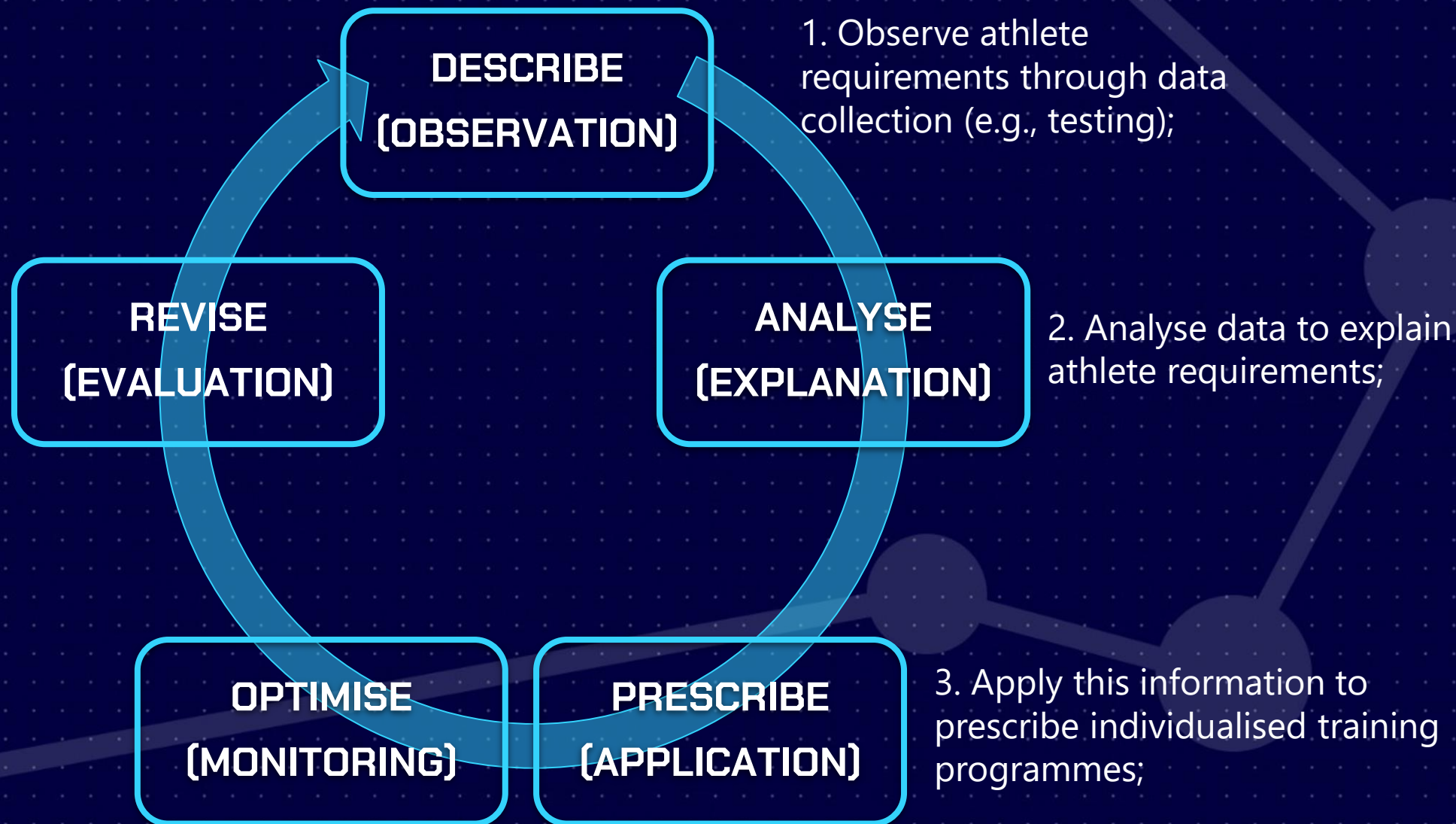
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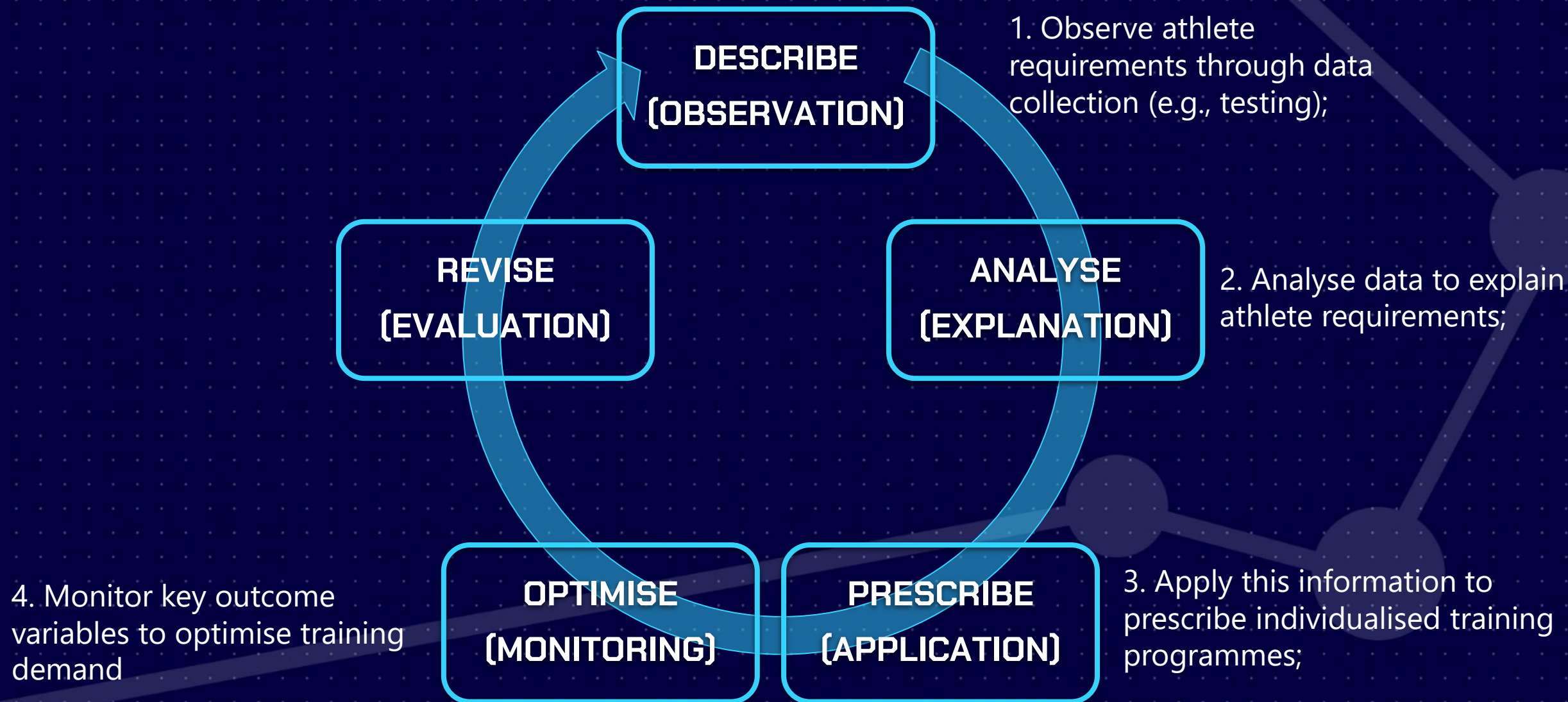
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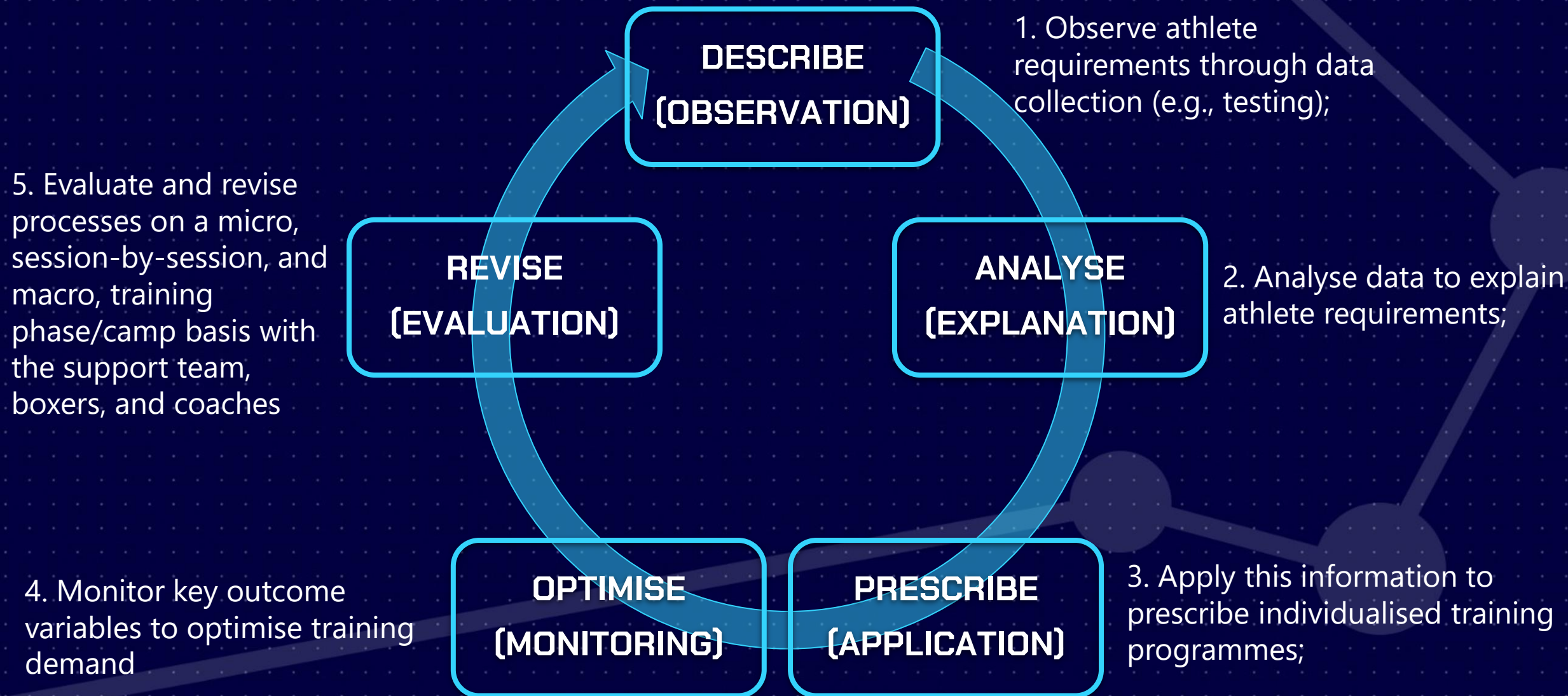
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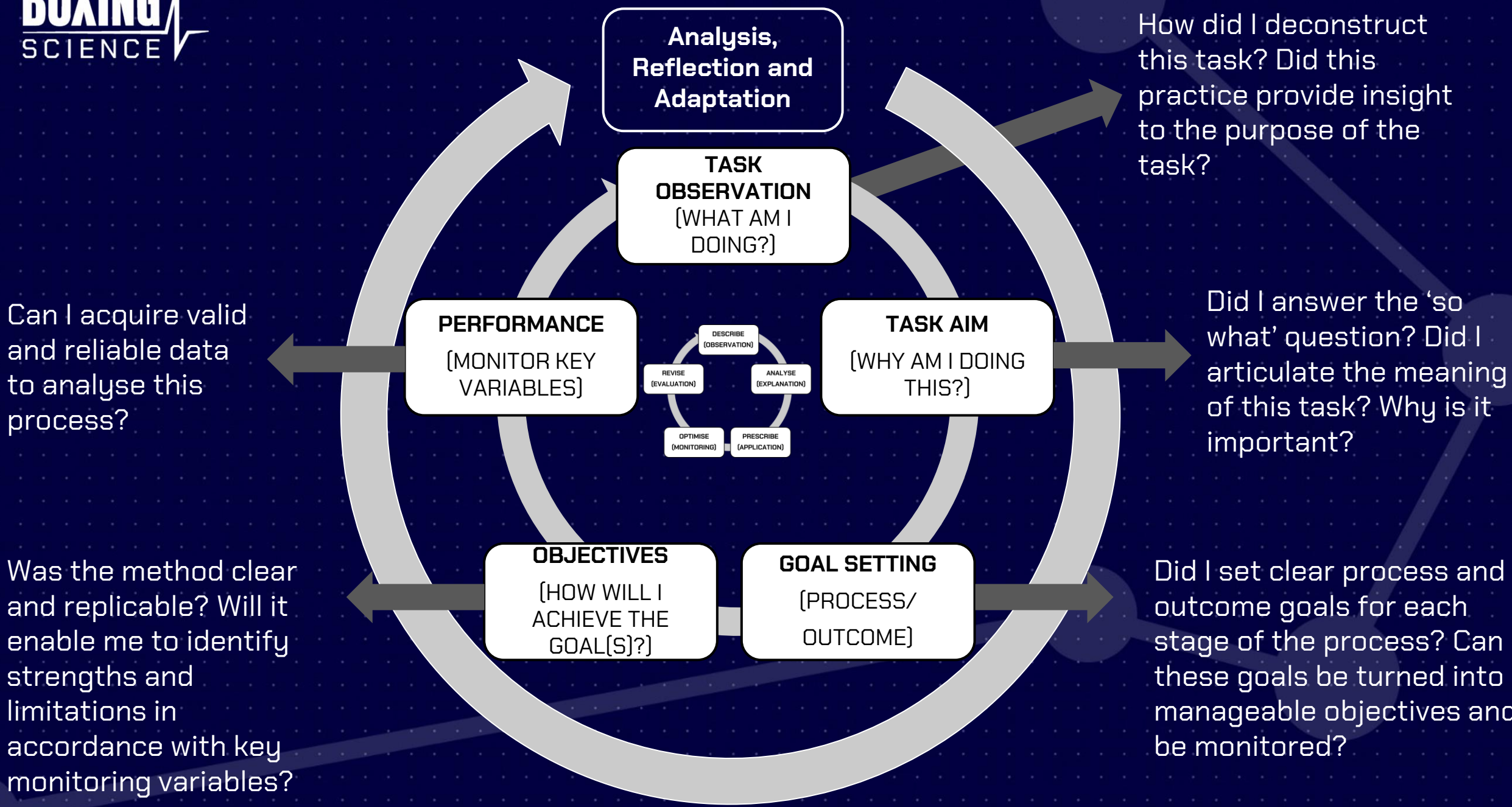
# STEP 5...



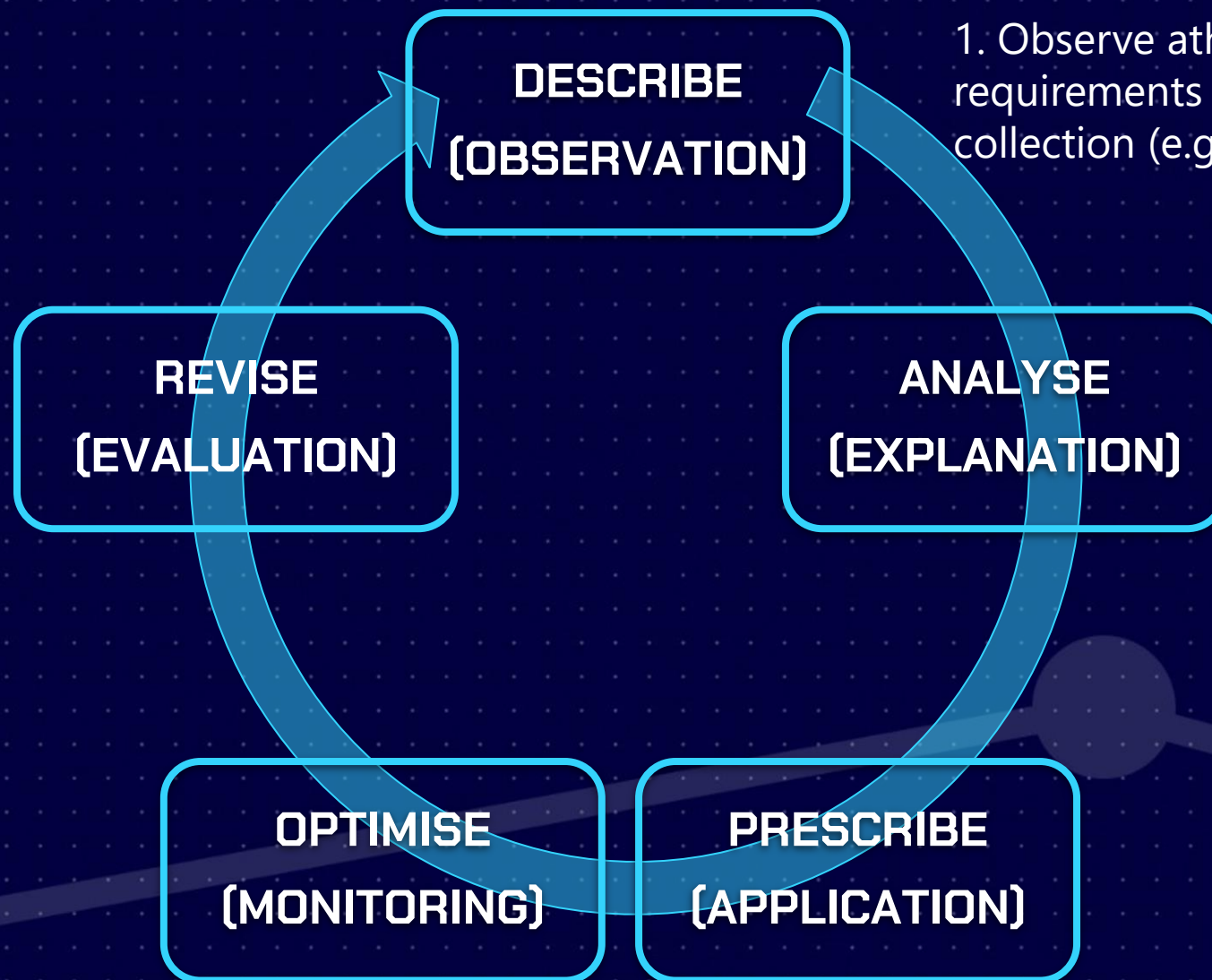
## STEP 5 – EVALUATION AND REVISION

- **SESSION-BY-SESSION**
- **TRAINING PHASE**
- **TRAIN CAMP**
- **SUPPORT TEAM**
- **BOXERS**
- **COACHES**
- **USING DATA AND FEEDBACK**
- **TESTING & MONITORING**
- **INTEGRATION OF DATA & PERFORMANCE ANALYSIS**
- **TEAM MEETINGS**
- **STRONG RELATIONSHIPS**
- **DAY-TO-DAY/WEEK-TO-WEEK**

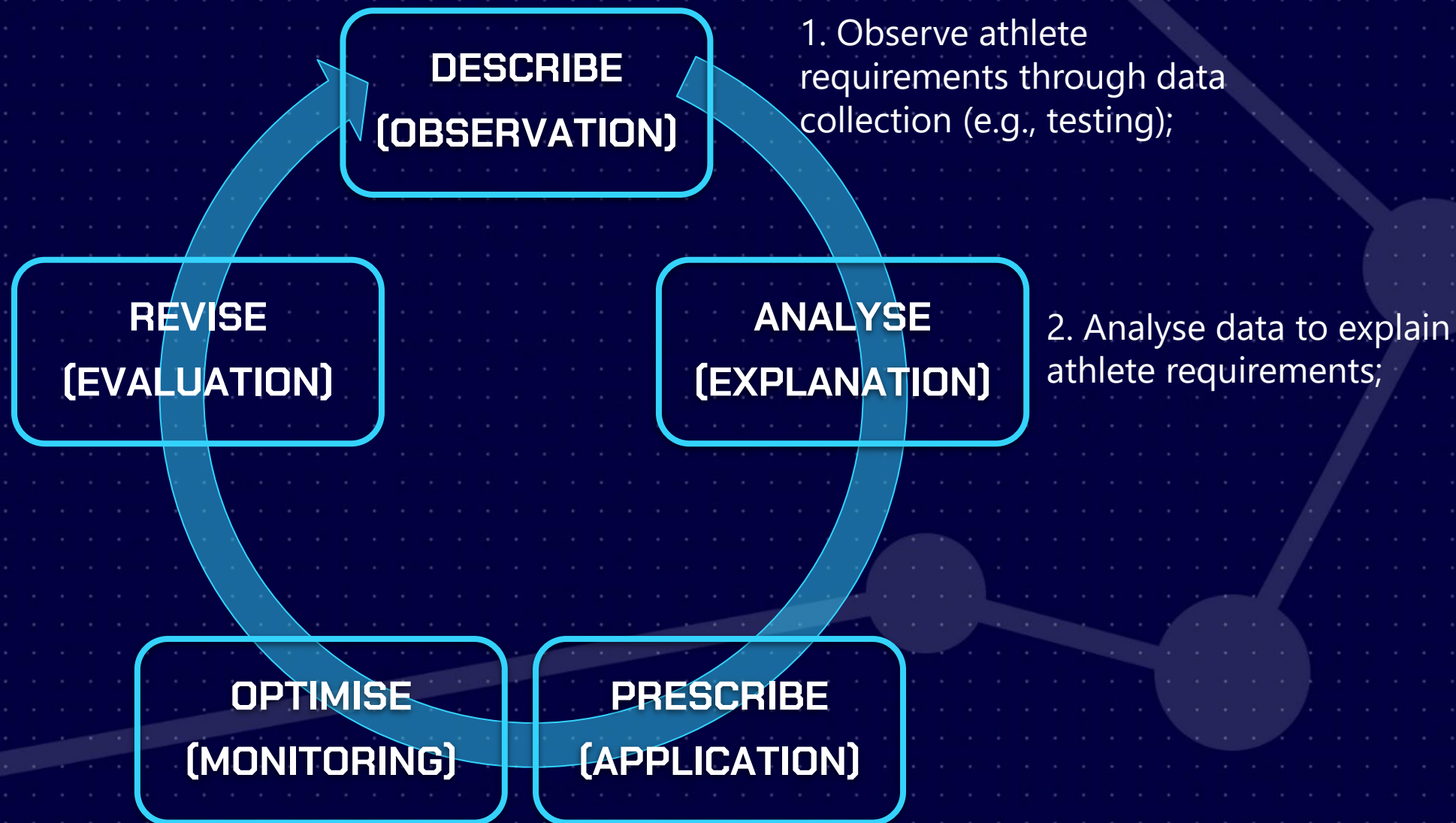




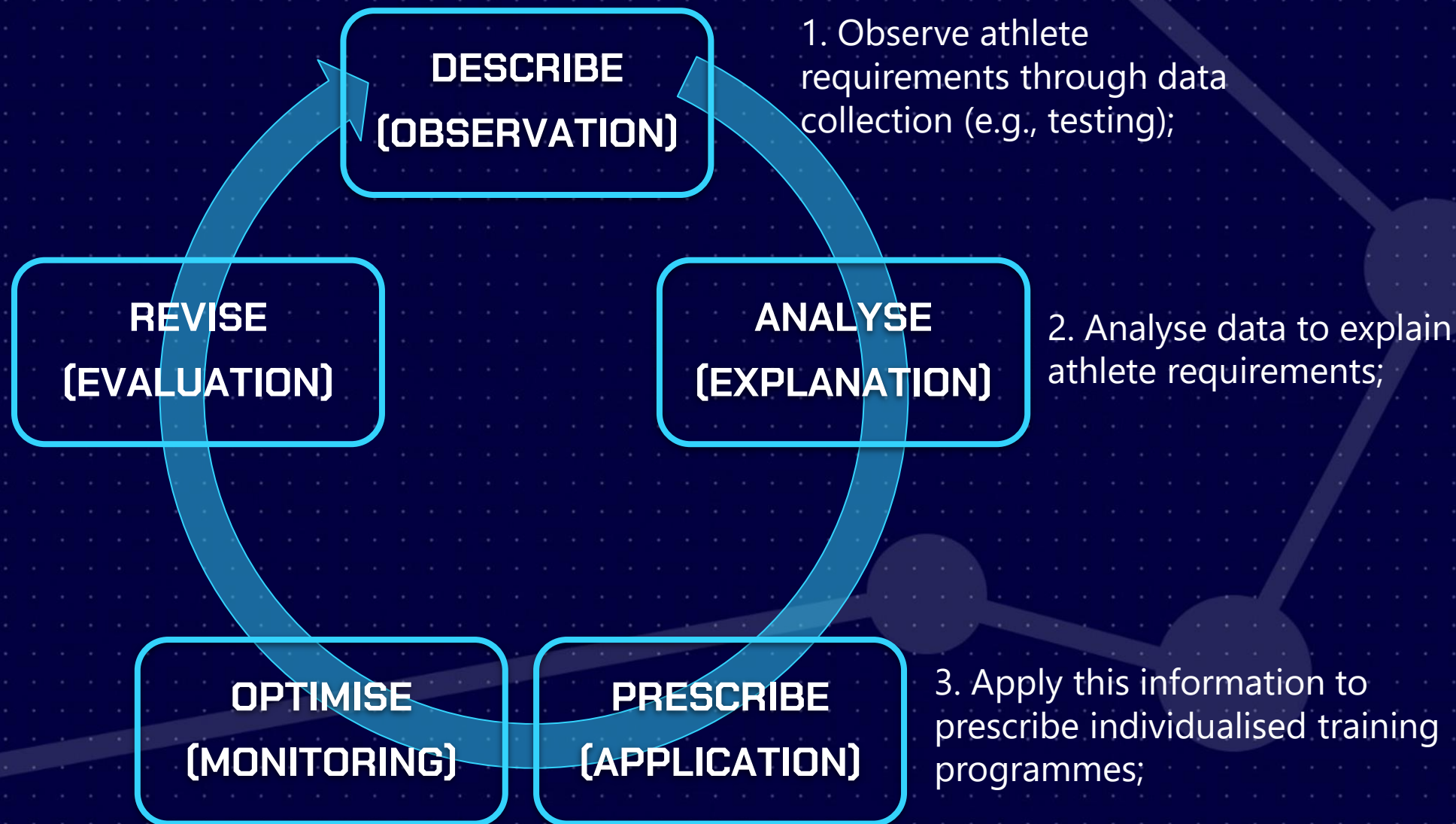
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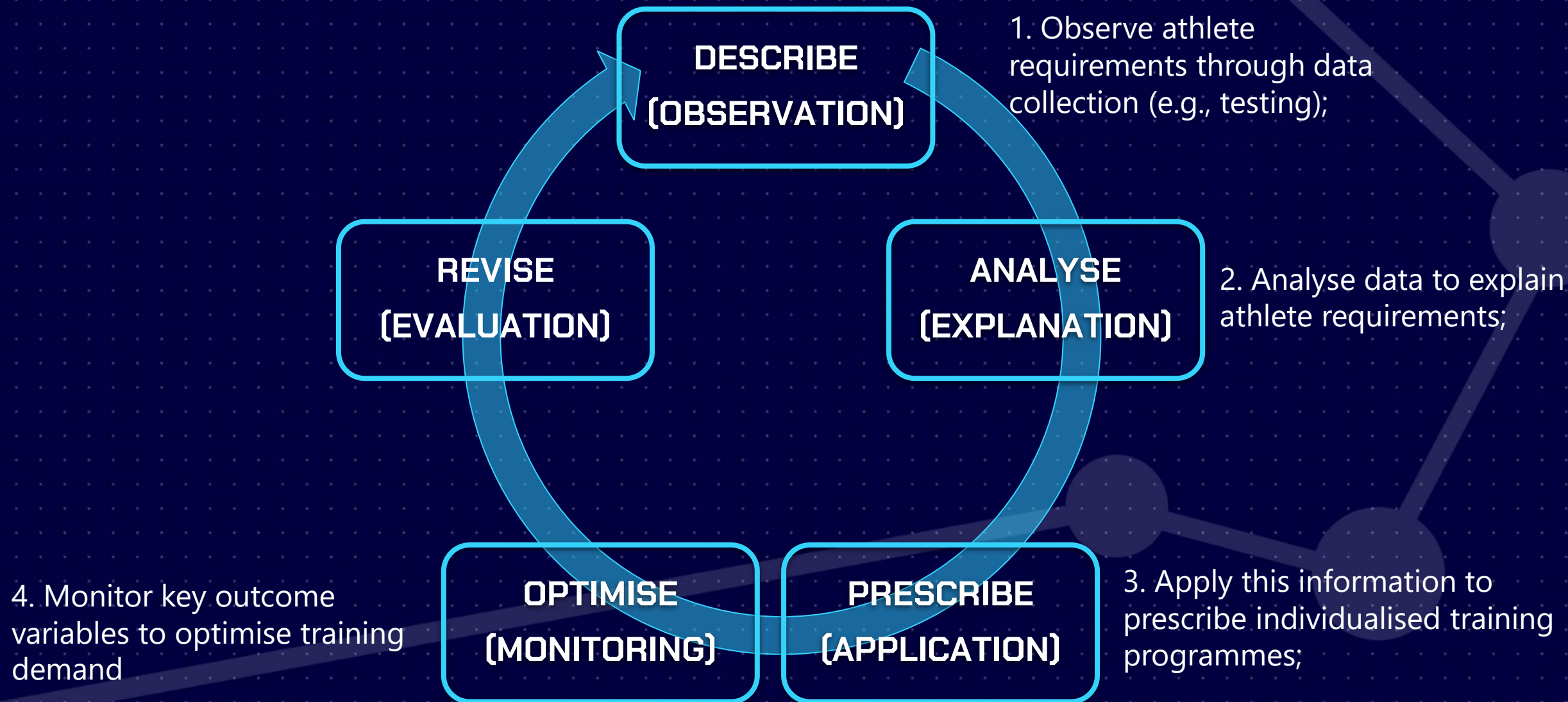
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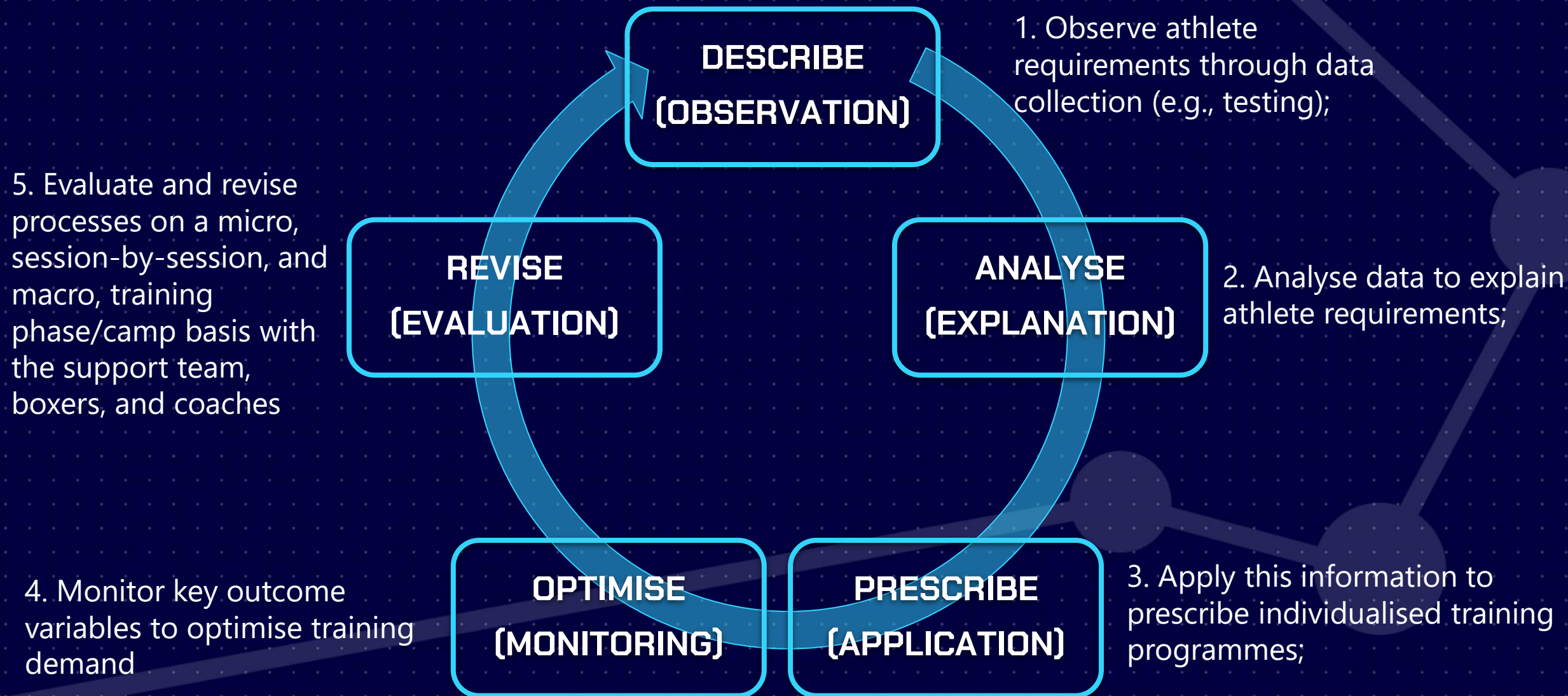
# STEP 3...



# STEP 4...

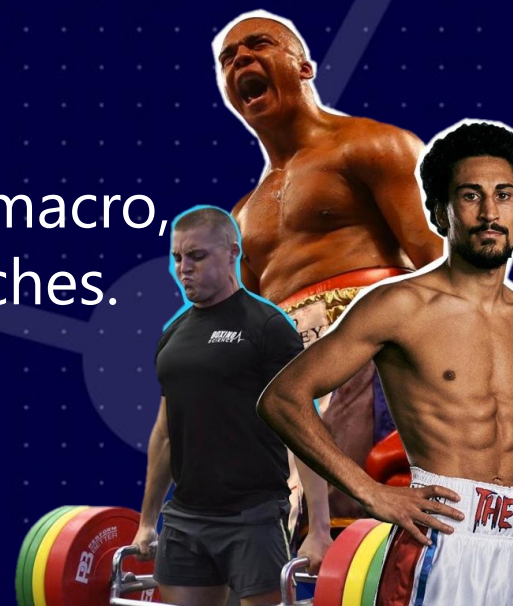


# STEP 5...



# IN THIS PRESENTATION YOU LEARNED HOW TO...

1. **Observe** athlete requirements through data collection (e.g., testing);
2. **Analyse** data to explain athlete requirements;
3. **Apply** this information to prescribe individualised training programmes;
4. **Monitor** key outcome variables to optimise training demand; and
5. **Evaluate** and revise processes on a micro, session-by-session, and macro, training phase/camp basis with the support team, boxers, and coaches.



# STEAM APPLICATION

1. **Science** - Scientific method applied to determine a way of working
2. **Technology** - Data collected using sensors and analysed using programmes
3. **Engineering** - Designing structures 'e.g. training' to build 'machines' - athletes
4. **Arts** - Training and scientific concepts communicated via web and social media
5. **Maths** - Data analysis and presentation; understanding of mechanical constructs

