Frontier Science: Boxing Science

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BOXING SCIENCE

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...

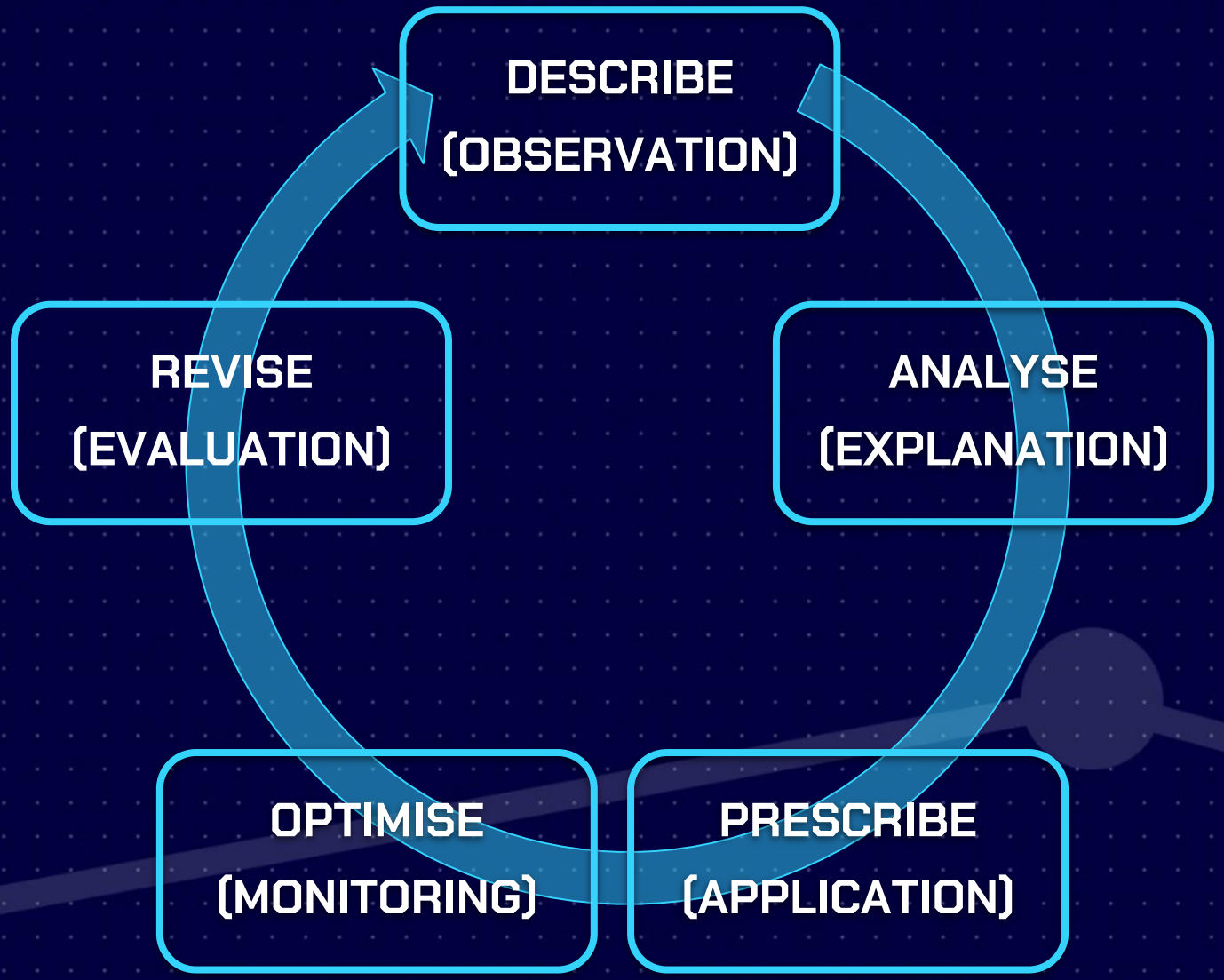
1. Observe athlete requirements through data collection (e.g., testing);
2. Analyse data to explain athlete requirements;
3. Apply this information to prescribe individualised training programmes;
4. Monitor key outcome variables to optimise training demand; and
5. Evaluate and revise processes on a 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

BOXING SCIENCE

BUILDING AN ATHLETE SUPPORT PROGRAMME



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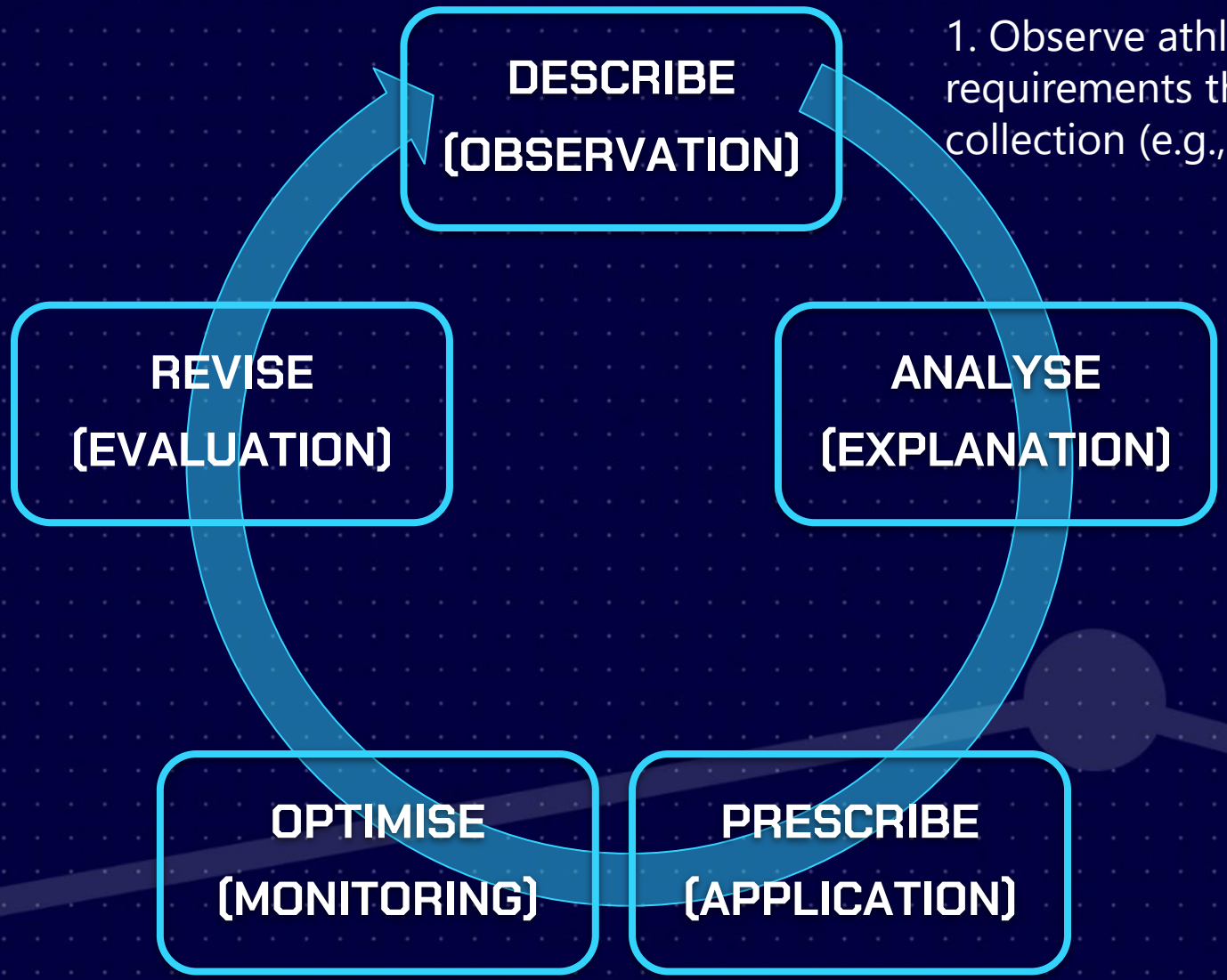

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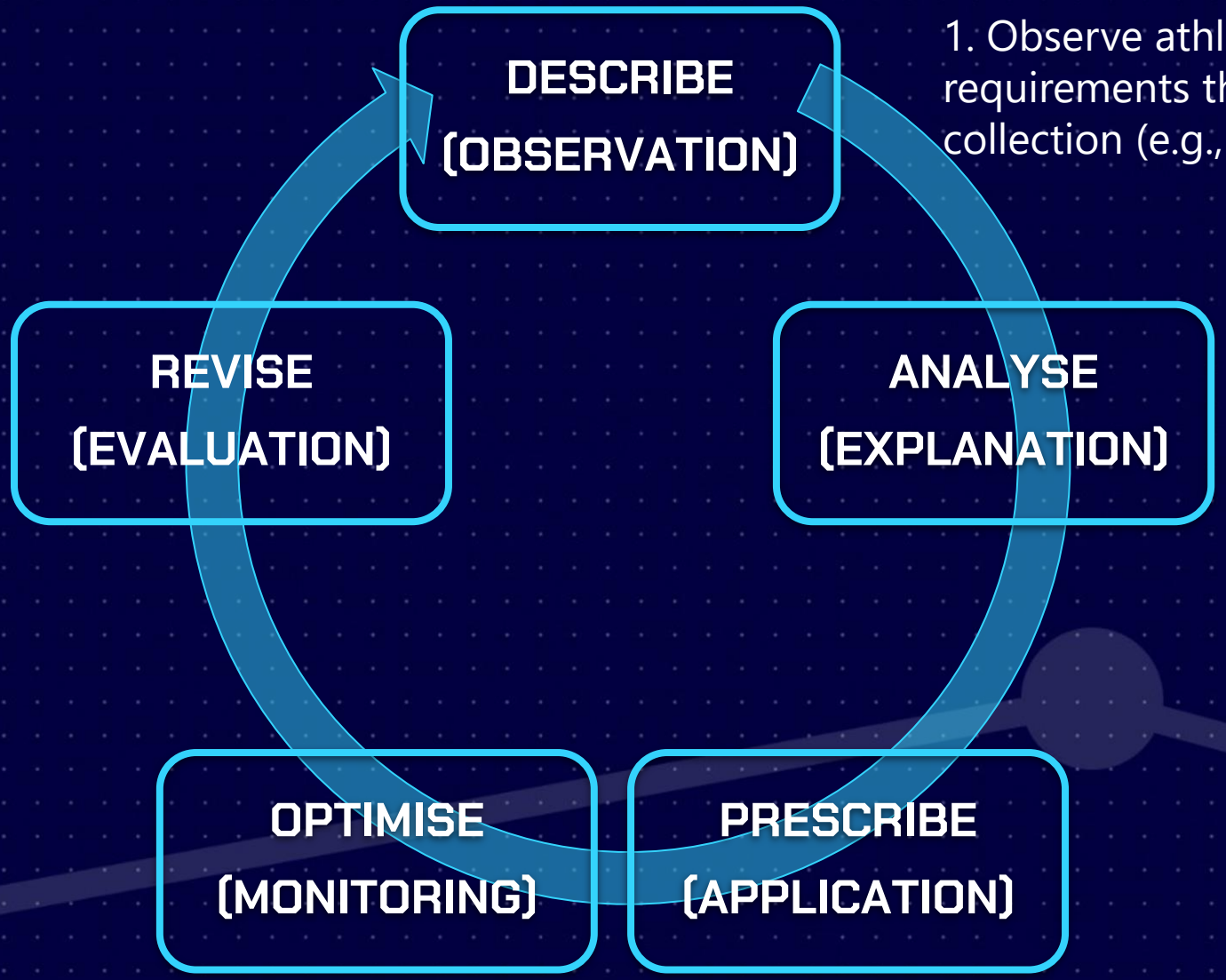

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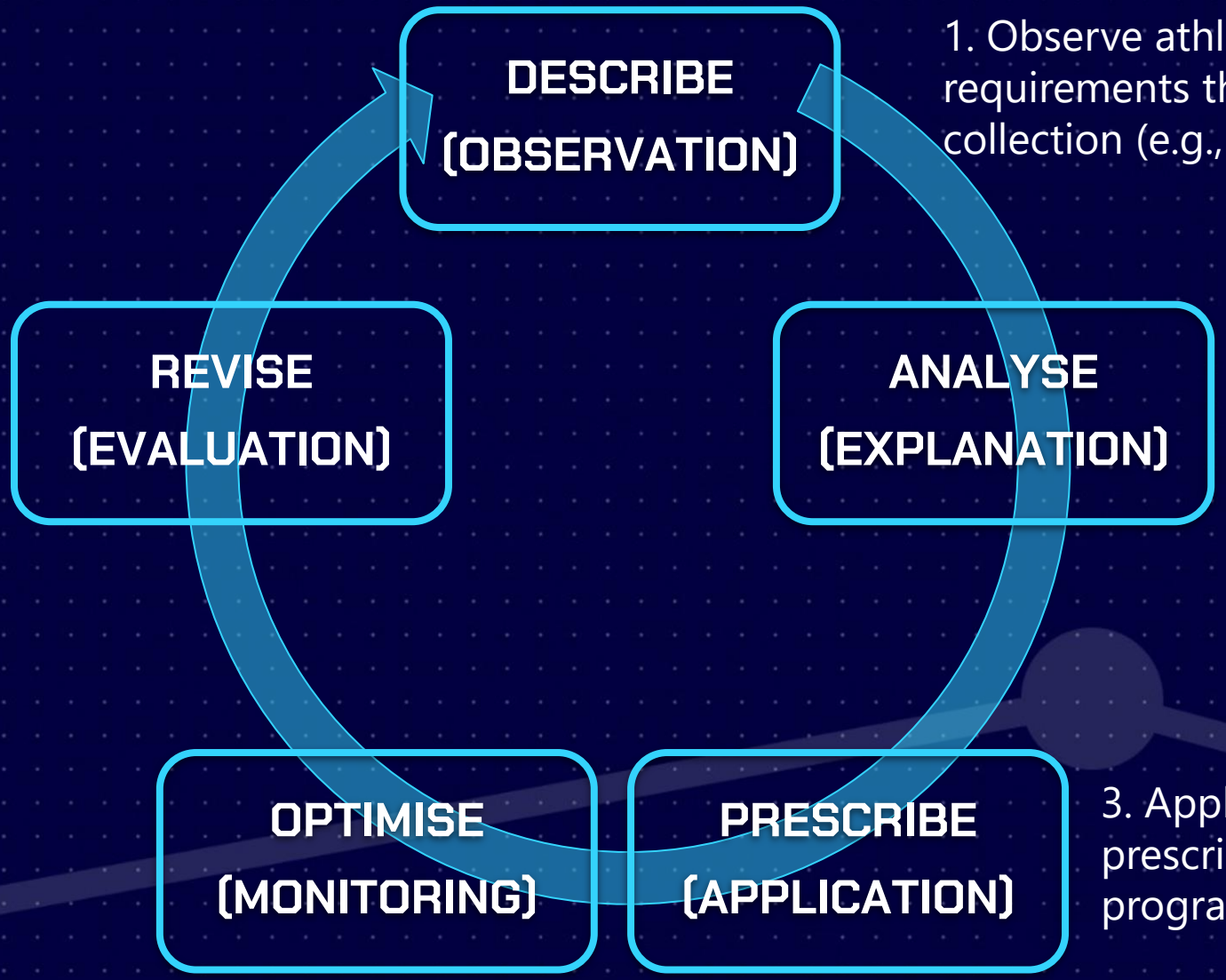

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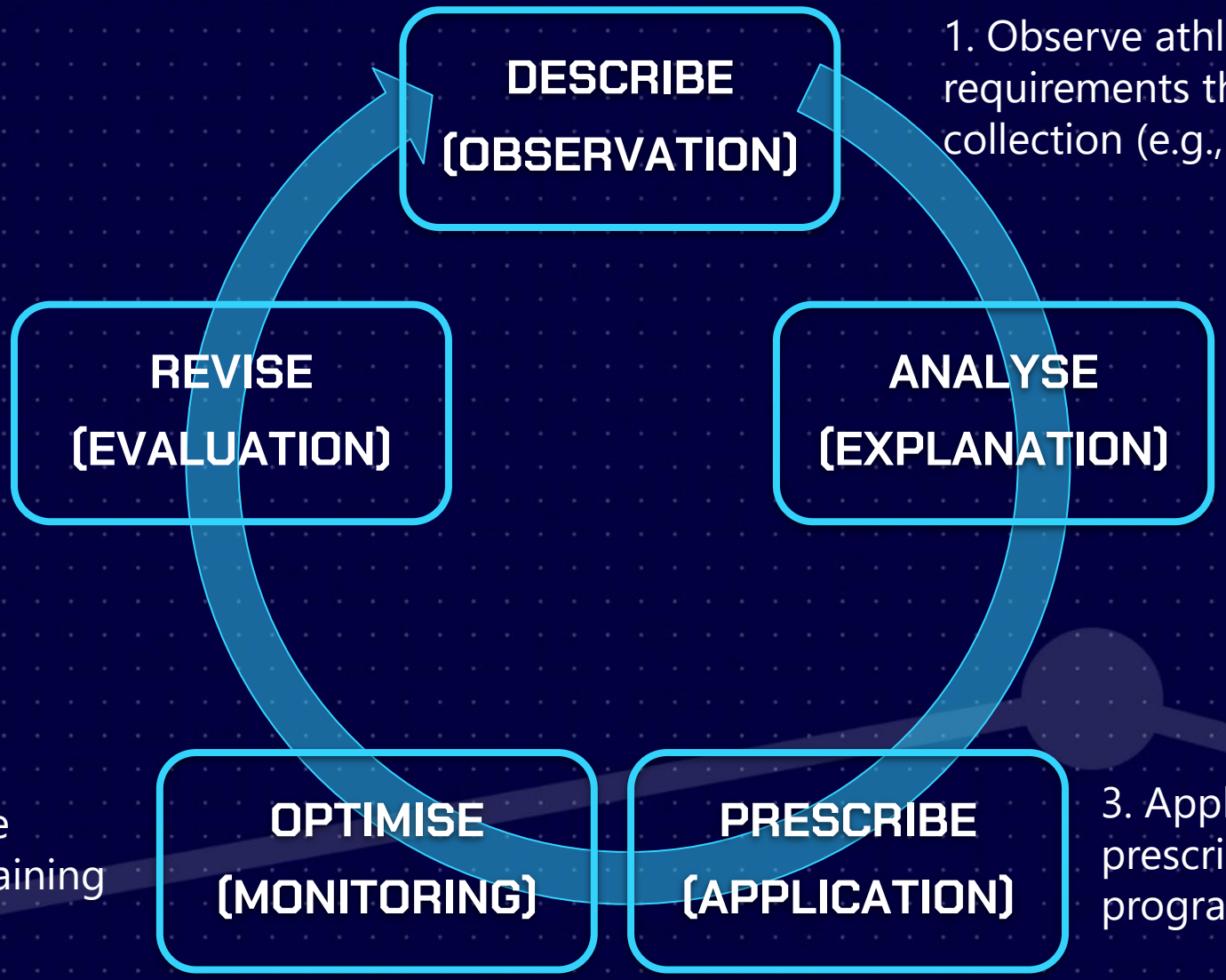

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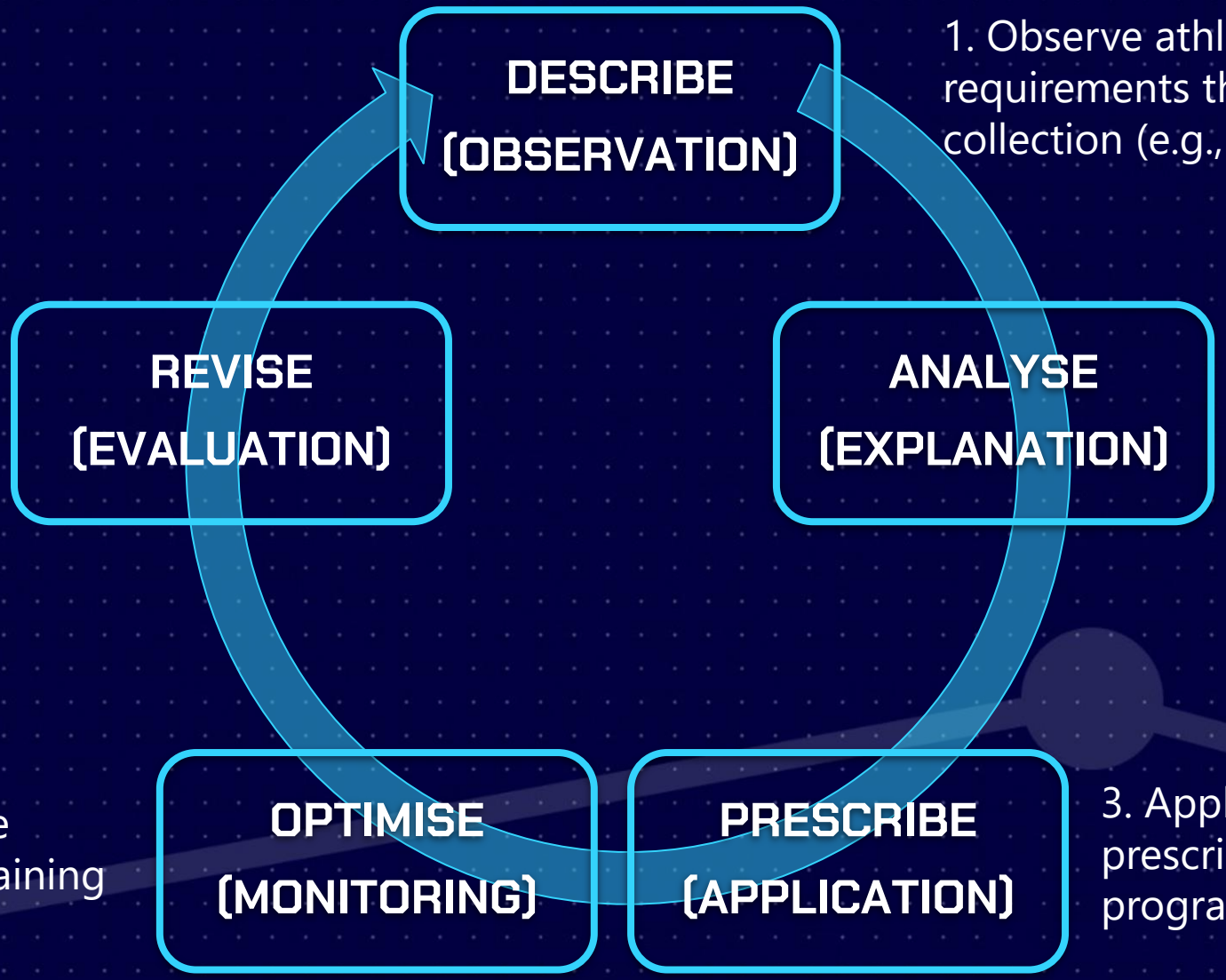

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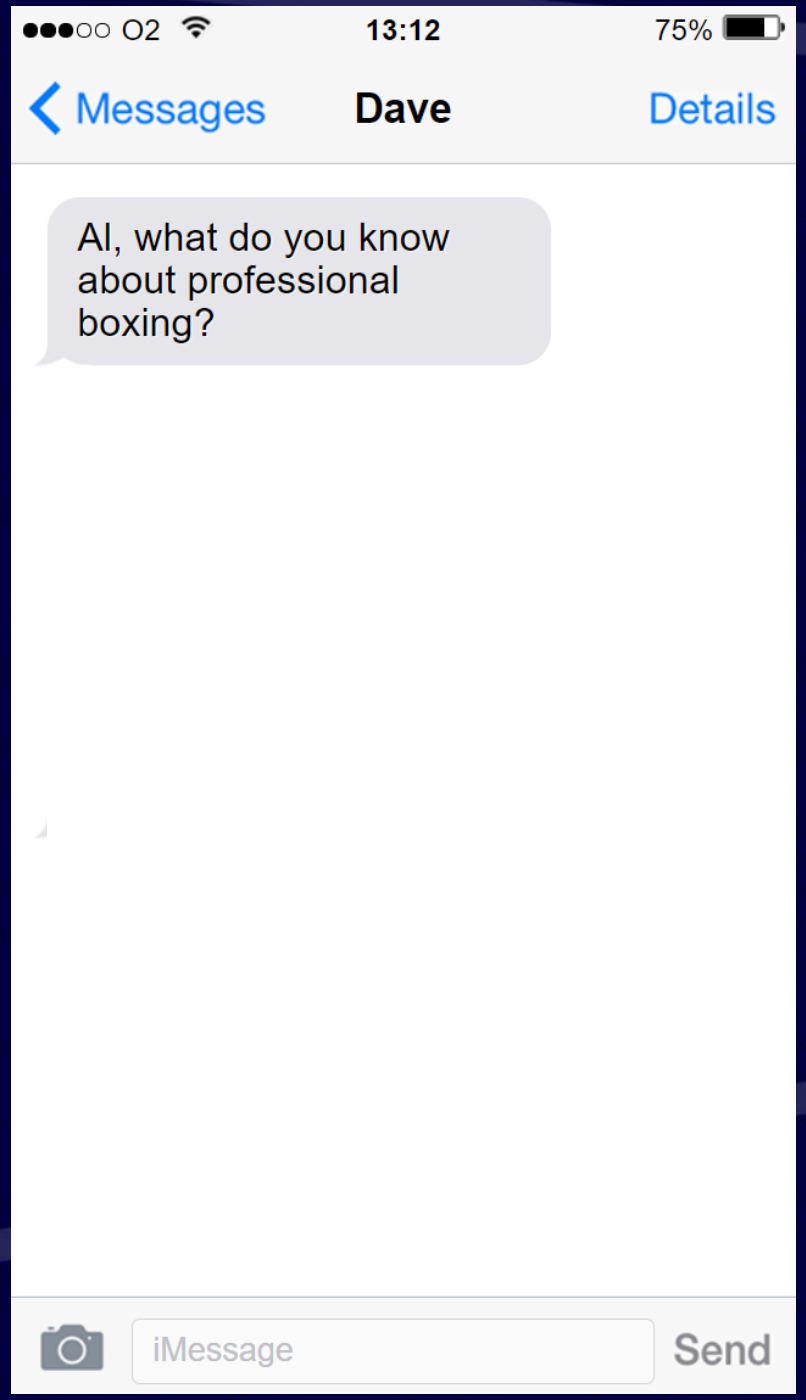
REWIND 10 YEARS TO 2012...



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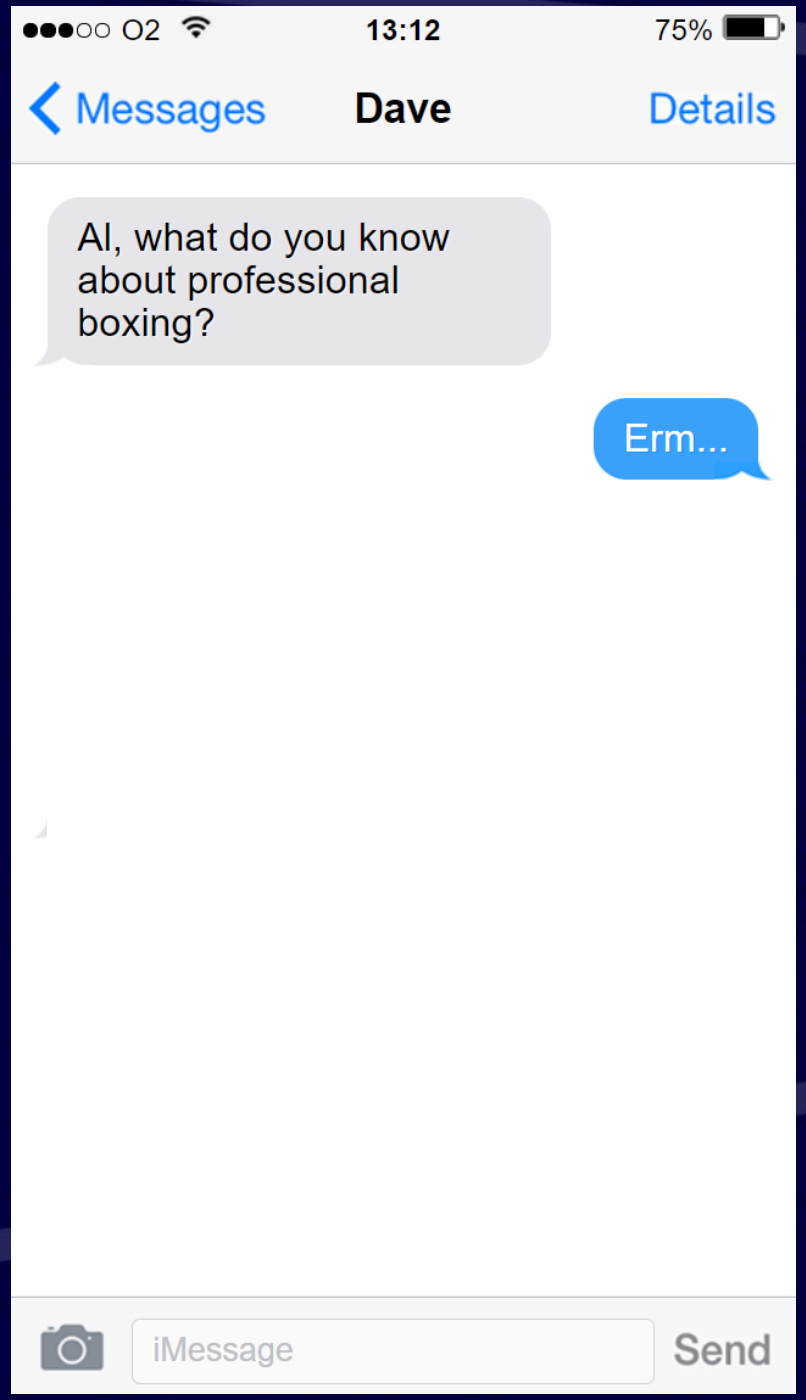

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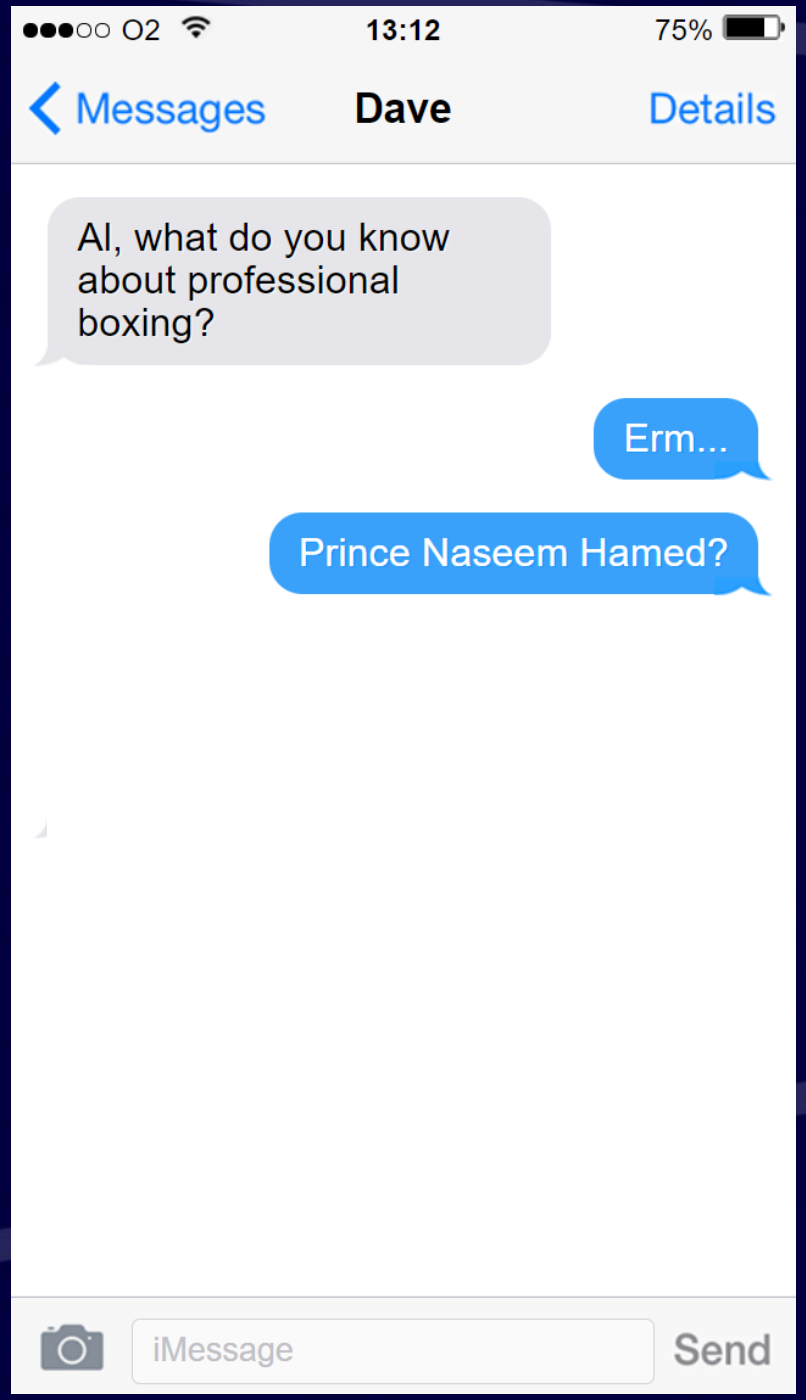

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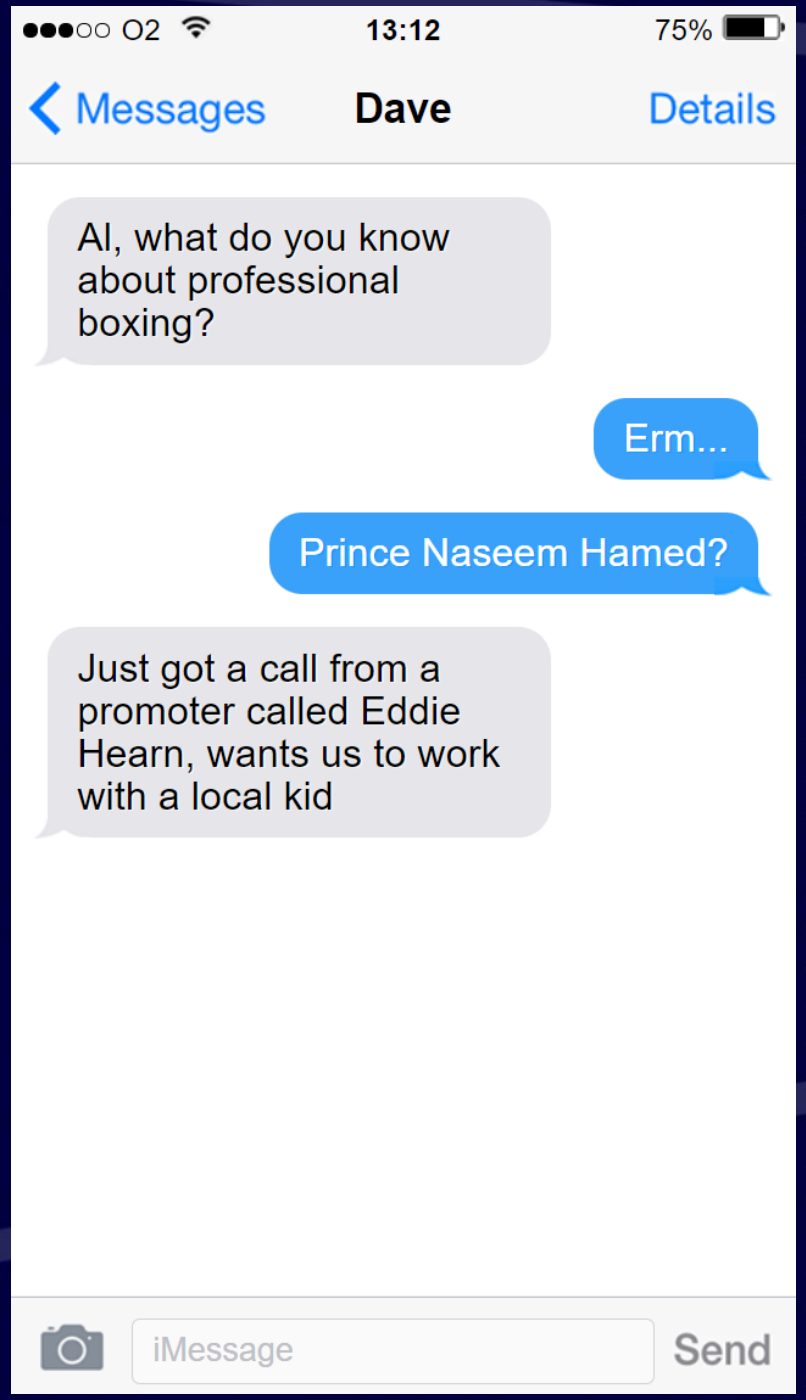

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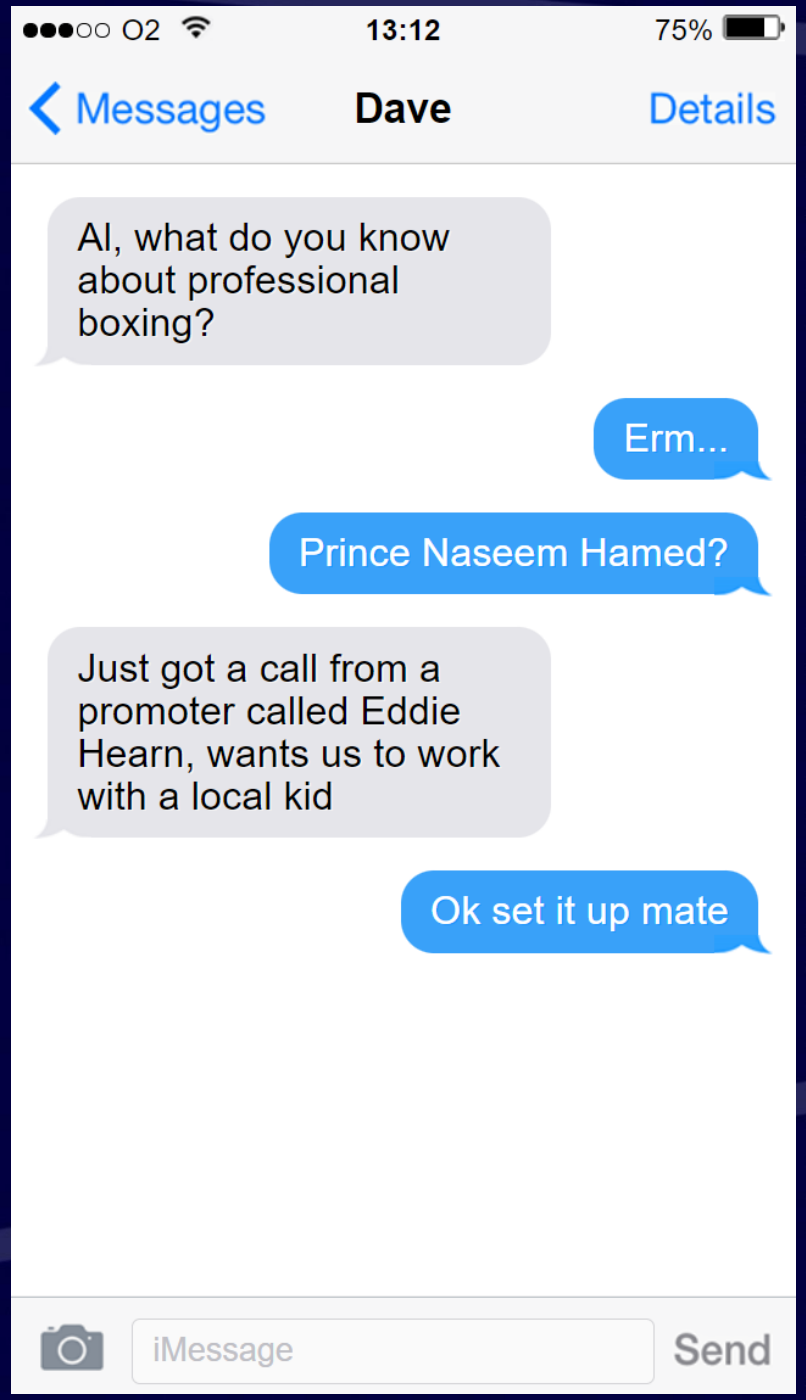

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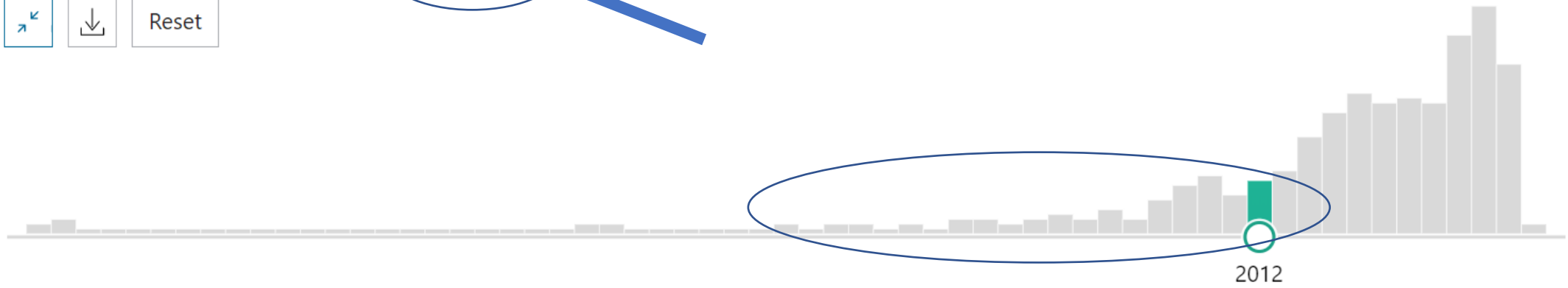

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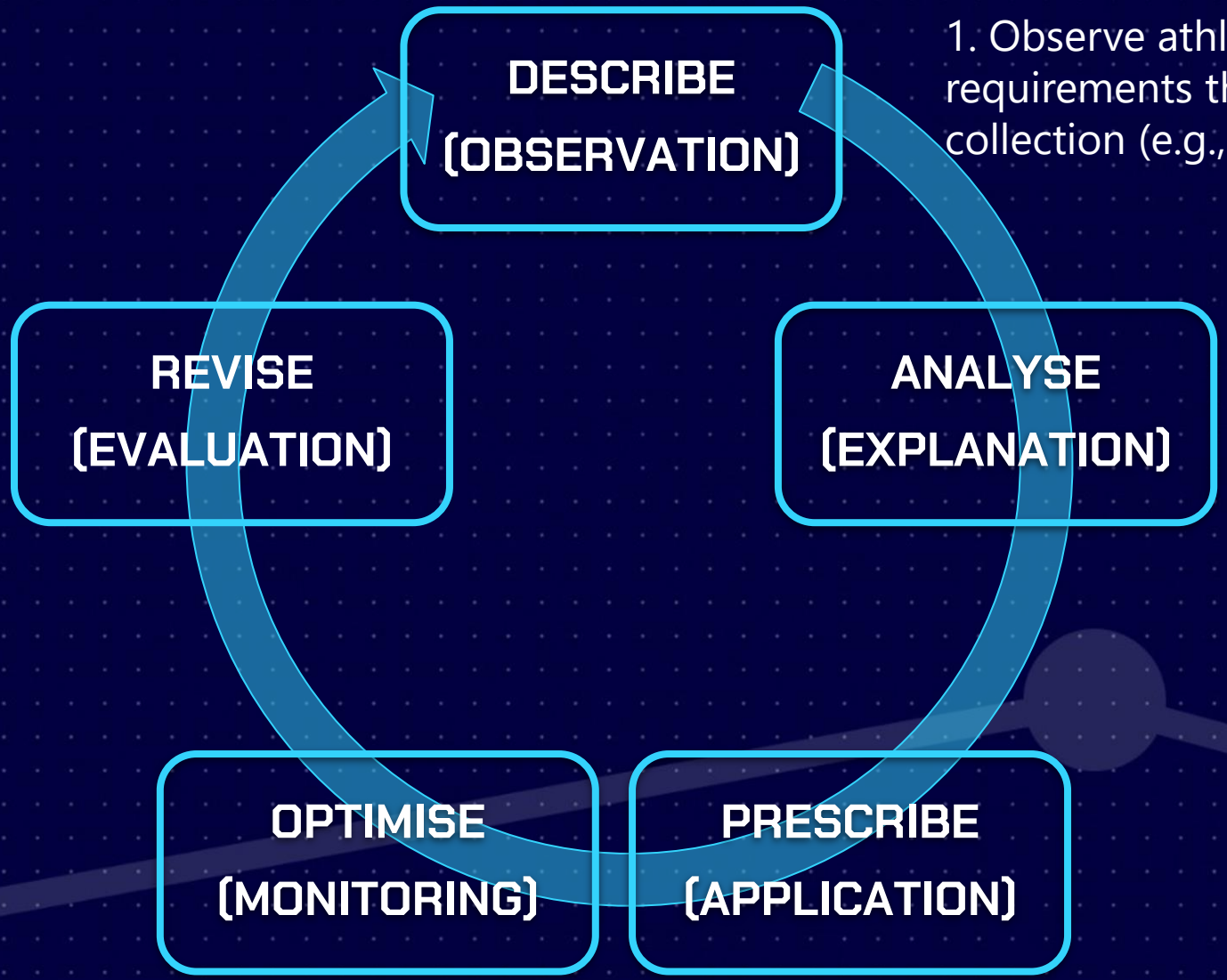
STEP 1...



1. Observe athlete requirements through data collection (e.g., testing);

STEP 1 - OBSERVE ATHLETE REQUIREMENTS THROUGH DATA COLLECTION

6-12

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

65%

Time spent in ≥ 90% max heart rate (MHR)

18:16 mins

Average time spent in the red zone

STEP 1 - OBSERVE ATHLETE REQUIREMENTS THROUGH DATA COLLECTION

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

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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

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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

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

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STEP 1 - OBSERVE ATHLETE REQUIREMENTS THROUGH DATA COLLECTION

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 EXPENSIVE OR COMPLICATED

SIMPLE TESTS ARE RELIABLE

CAN BE IMPLEMTED IN A RANGE OF ENVIRONMENTS

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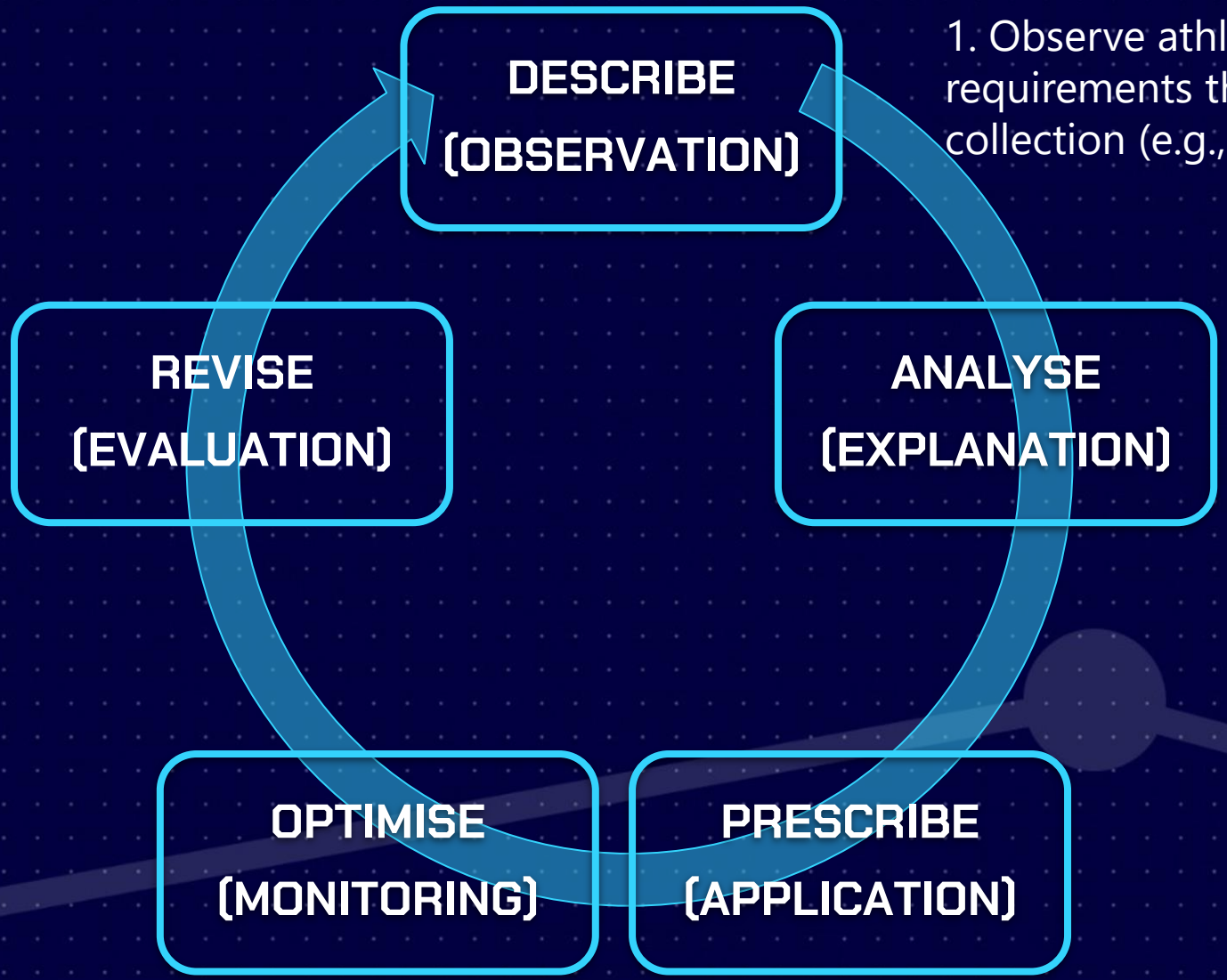
STEP 1...



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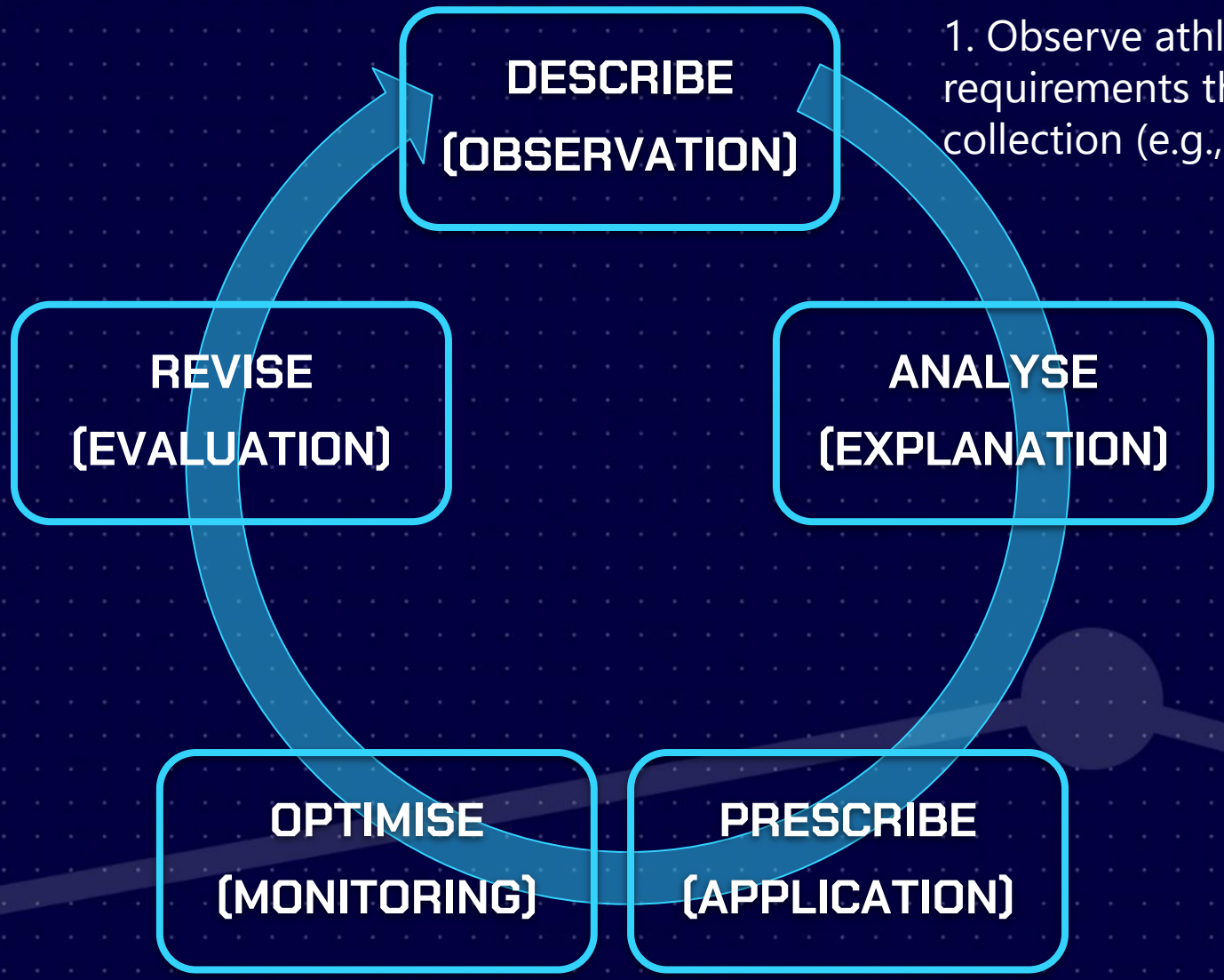
STEP 2...



1. Observe athlete requirements through data collection (e.g., testing);

2. Analyse data to explain athlete requirements;

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

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

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

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

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

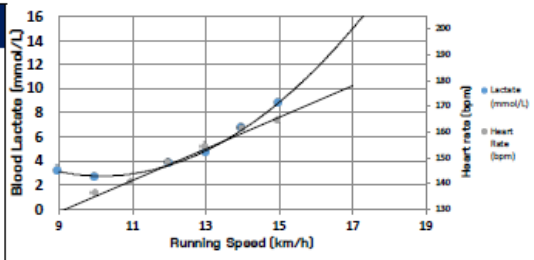
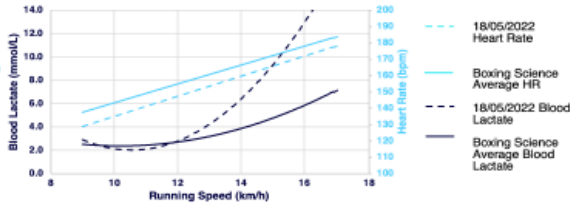
But what might be limiting their performance?

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
JUMP ASSESSMENTS	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%
REACTIVE STRENGTH	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%
LOAD-VELOCITY PROFILE (TRAP BAR)	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%
LANDMINE PUNCH ASSESSMENTS	This is 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%
CORE ENDURANCE ASSESSMENTS	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%

FITNESS ASSESSMENTS	LACTATE PROFILE This incremental treadmill test allows us to analyse how athletes respond to increased intensities.	 

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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

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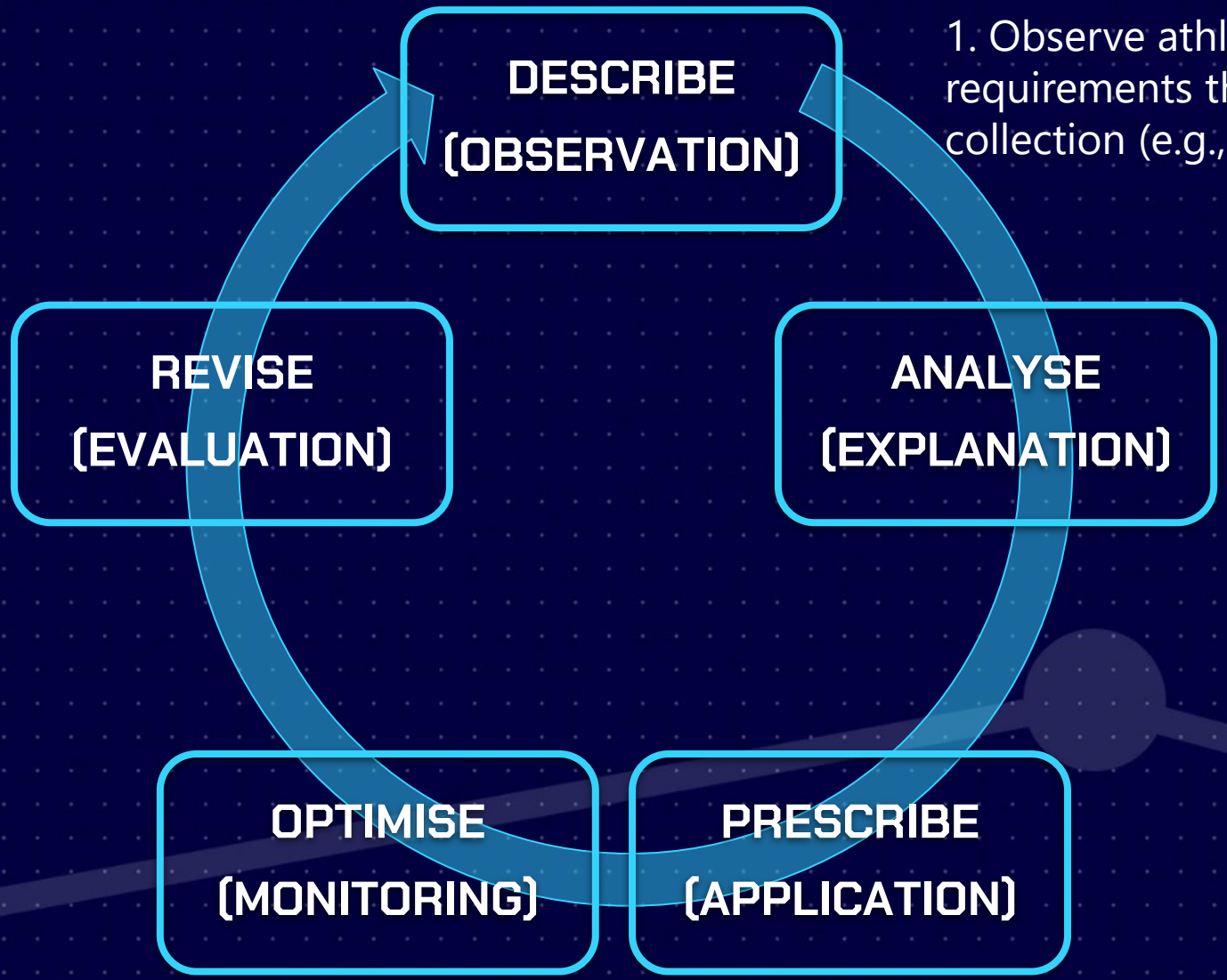
STEP 1...



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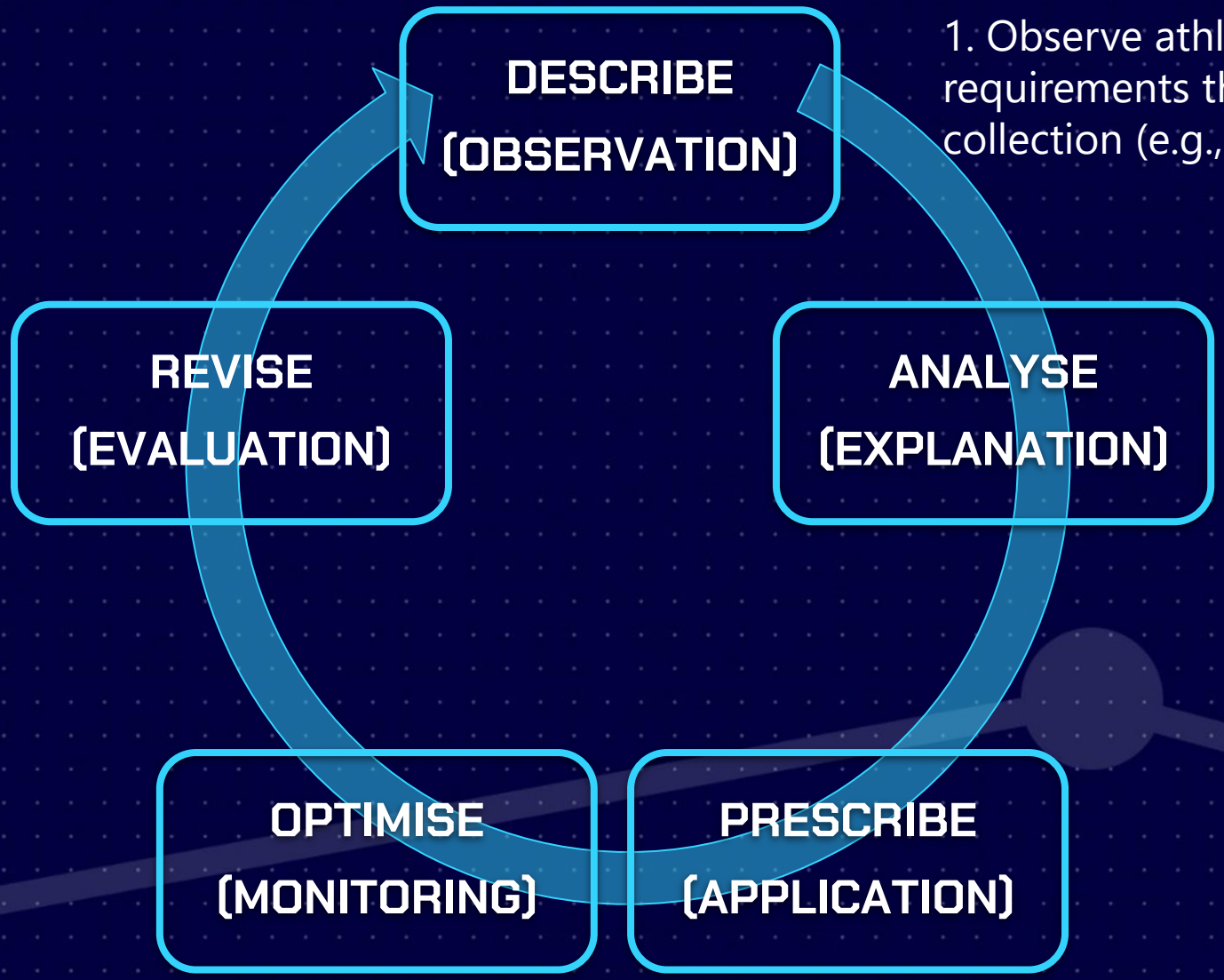

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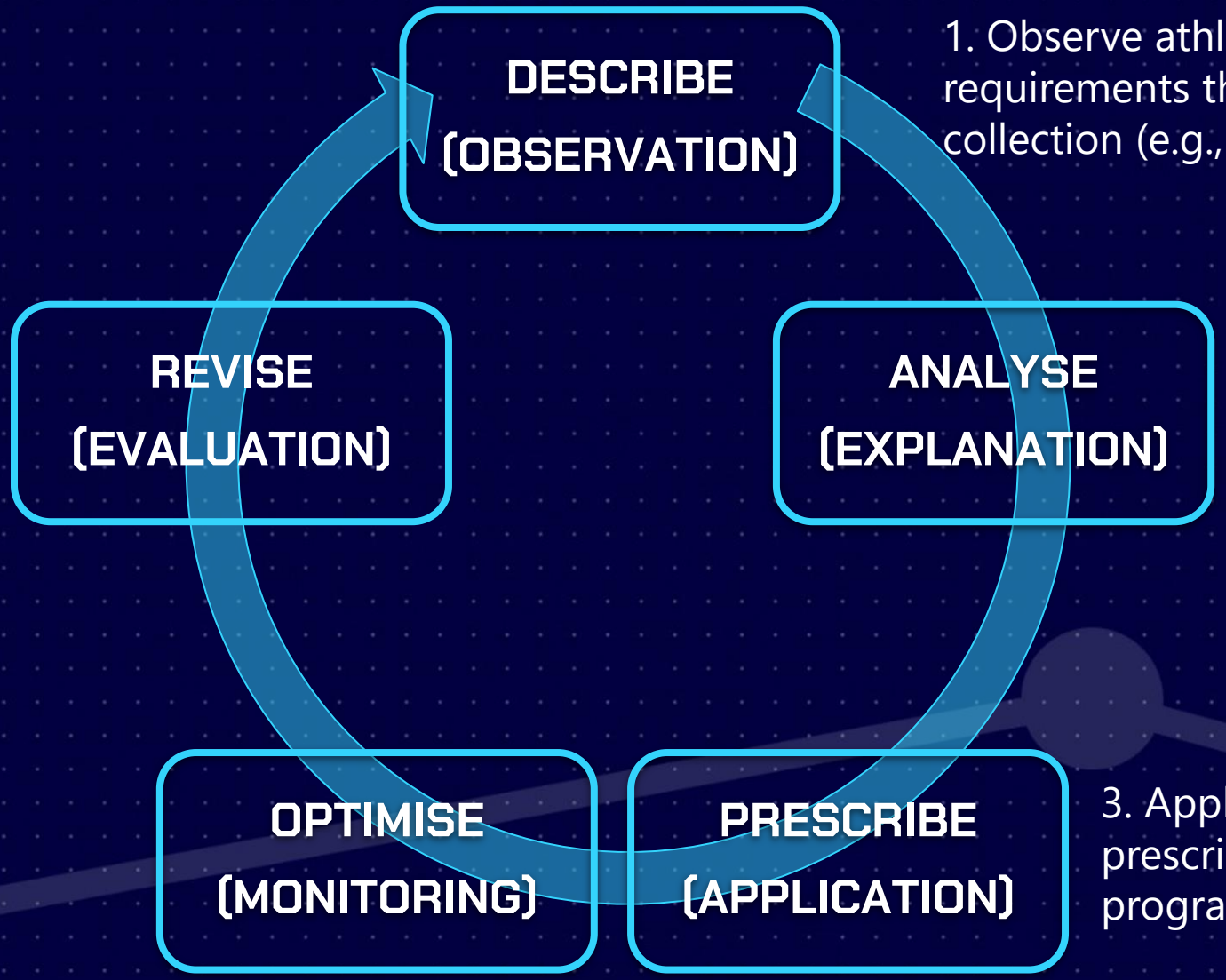
STEP 3...



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

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

- Increase the amount of oxygen rich blood that is delivered to the muscles and returned for re-oxygenation
- Improve how the muscles extract and utilise oxygen to generate energy

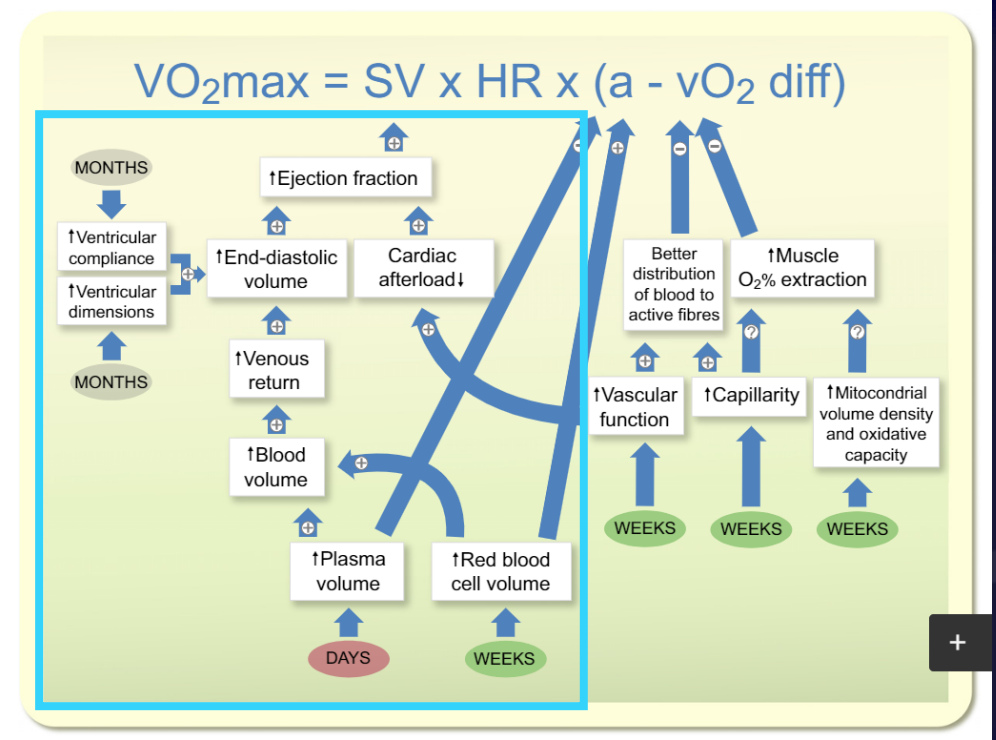
STEP 3 – PRESCRIBE INDIVIDUALISED TRAINING PROGRAMMES

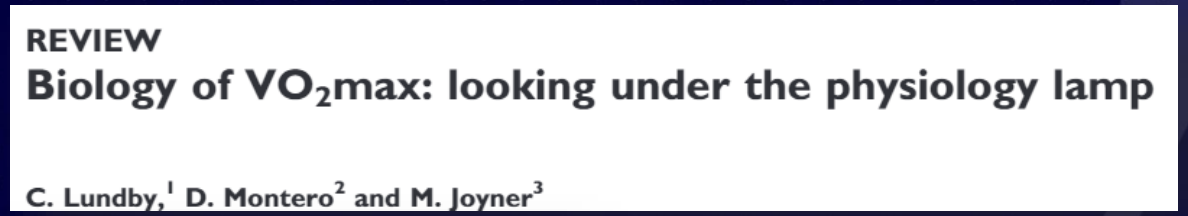
Depending on strengths and areas for development we target different physiological adaptations

- Increase the amount of oxygen rich blood that is delivered to the muscles and returned for re-oxygenation
- Improve how the muscles extract and utilise oxygen to generate energy
- Improve buffering mechanisms to limit the effect of acidosis on force production

STEP 3 – PRESCRIBE INDIVIDUALISED TRAINING PROGRAMMES

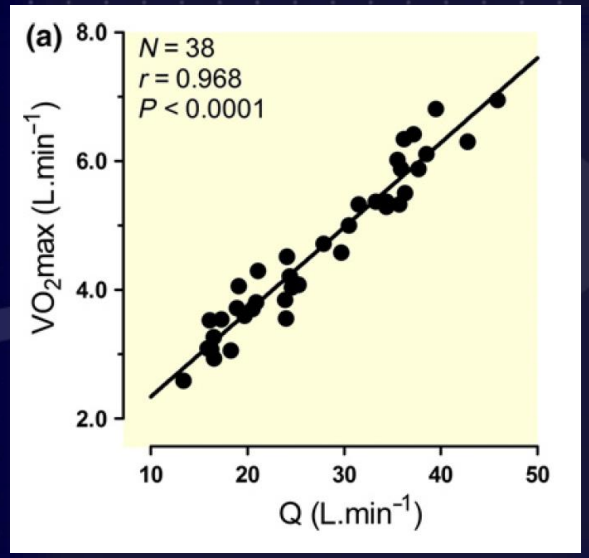
Increase the amount of oxygen rich blood that is delivered to the muscles and returned for re-oxygenation




REVIEW

Biology of VO_2max: looking under the physiology lamp

C. Lundby,[1] D. Montero[2] and M. Joyner[3]



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

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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

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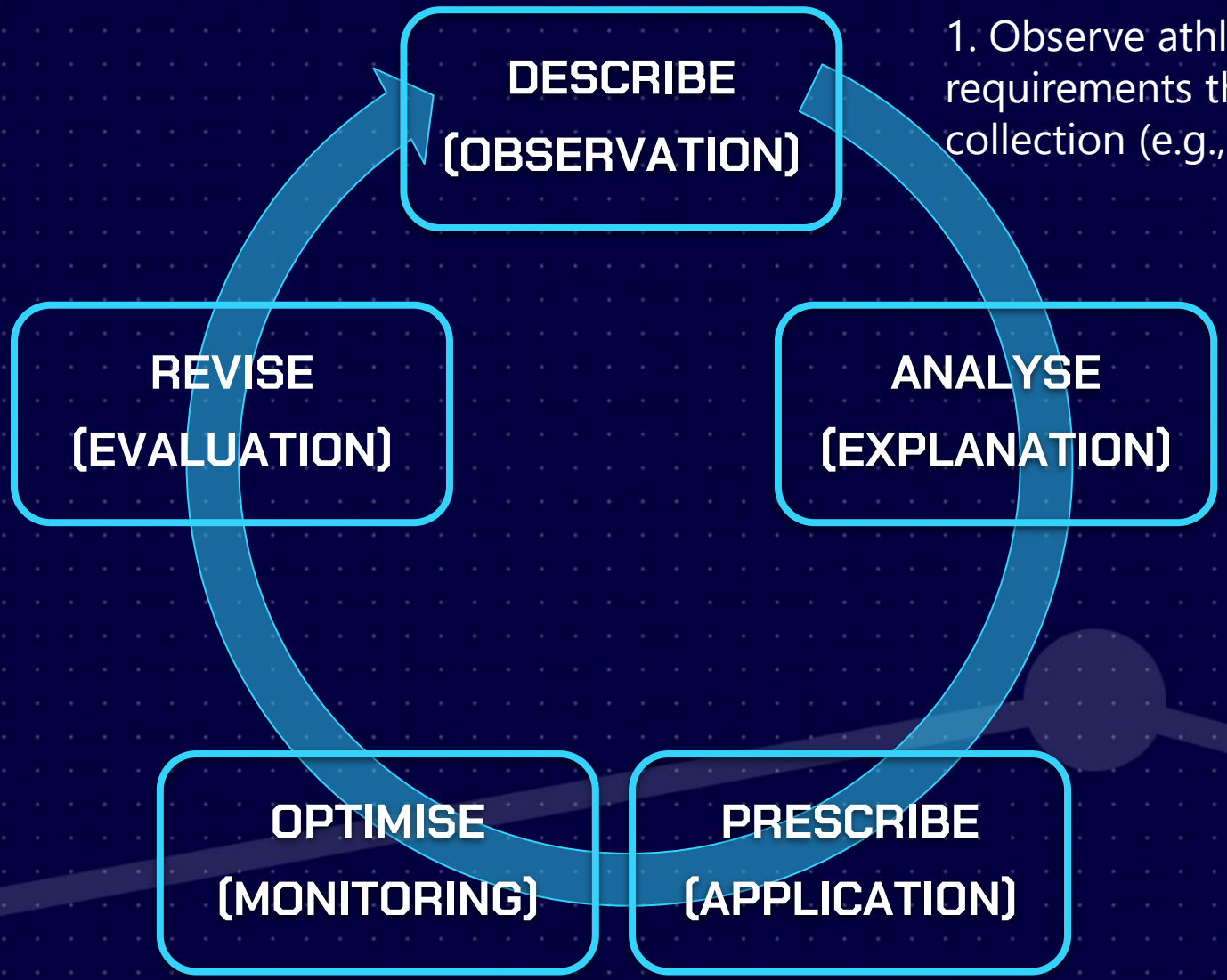
STEP 1...



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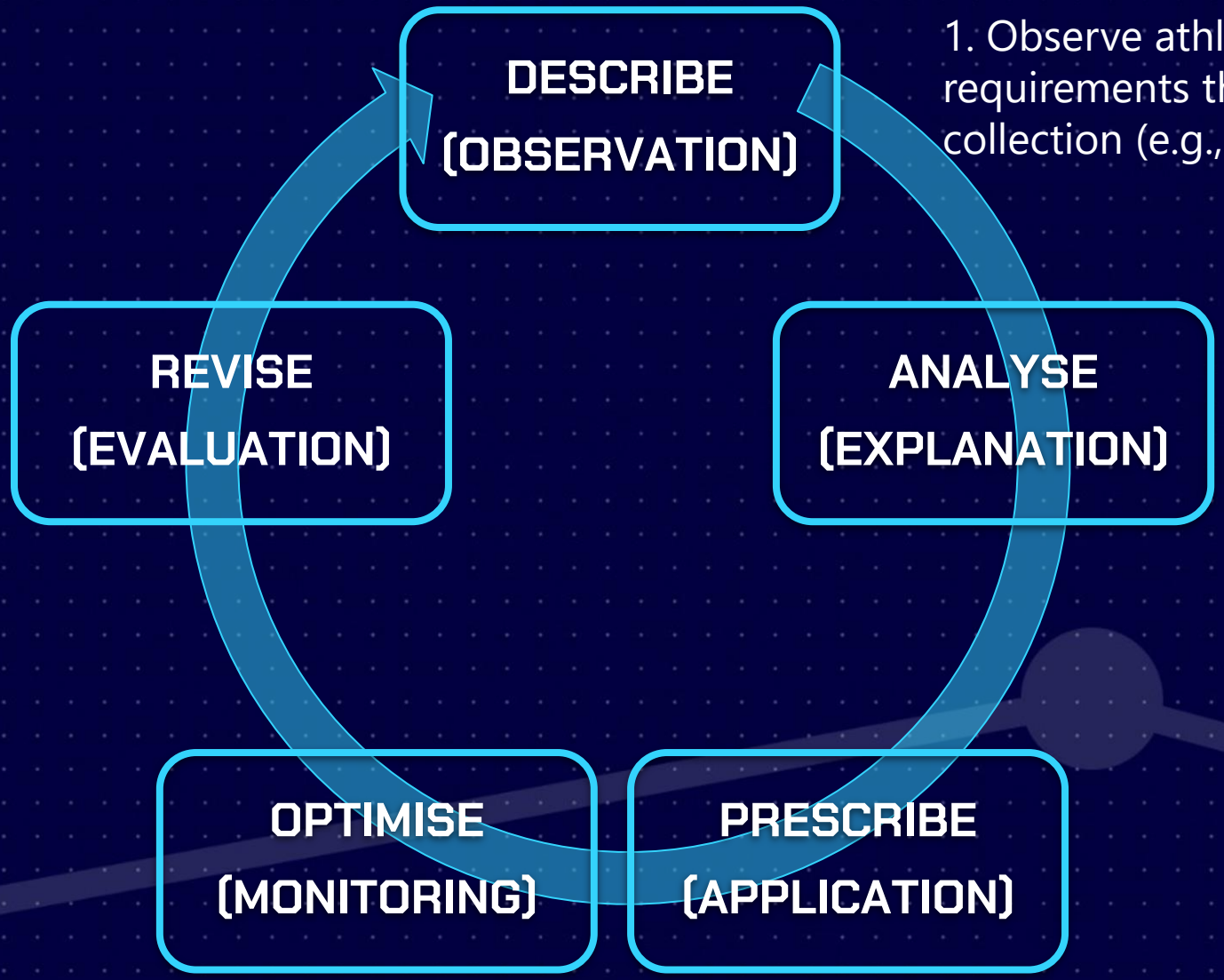

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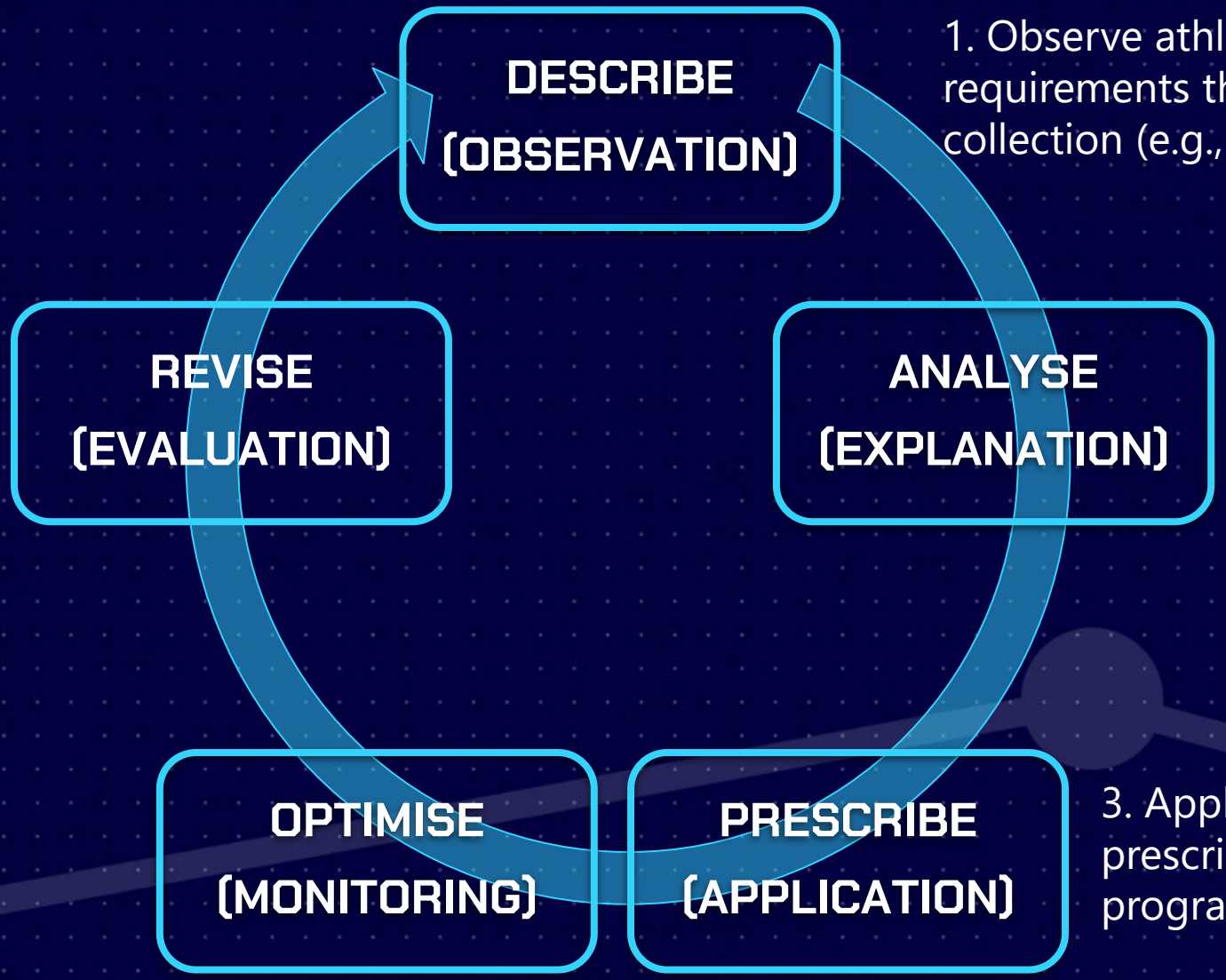

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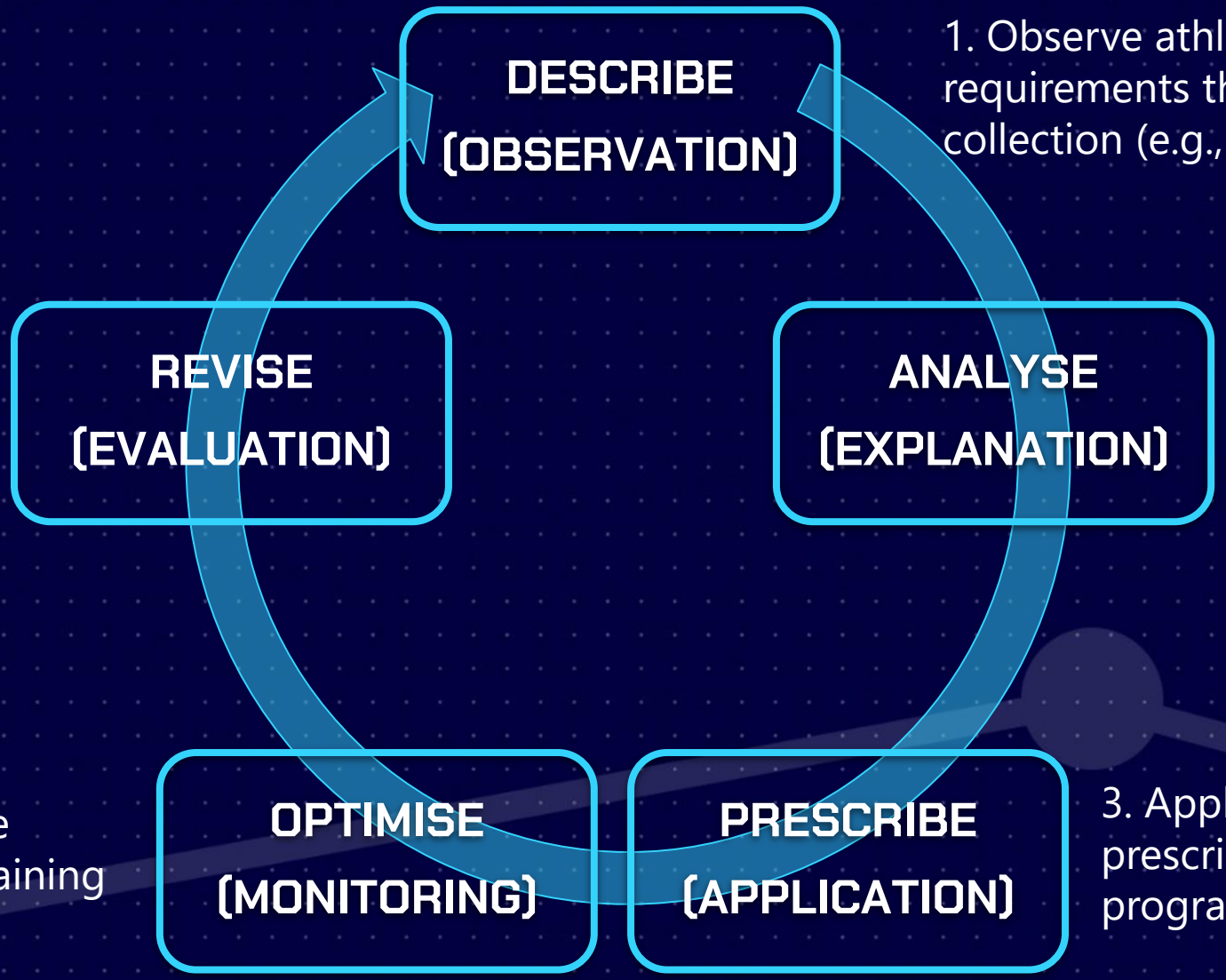

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STEP 4 – MONITOR KEY OUTCOME VARIABLES

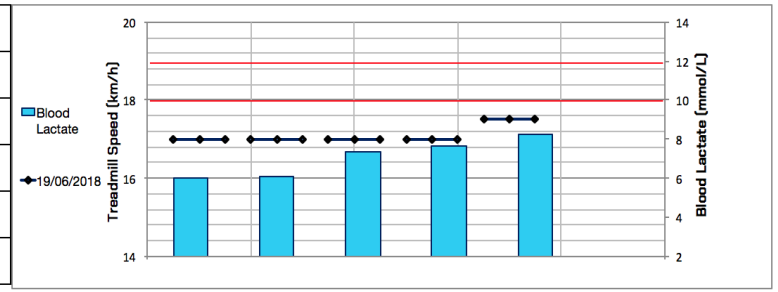
STANDARD SESSION

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

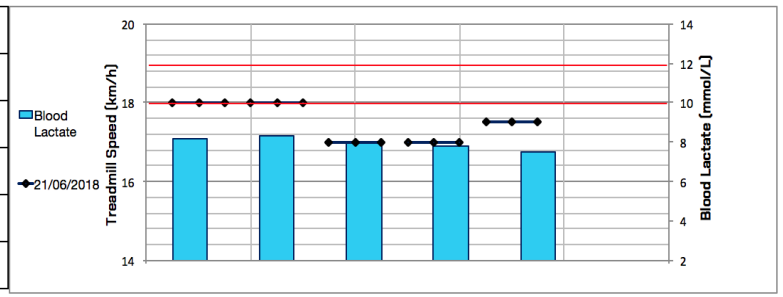
- Time above 90% HR max
- Running speed
- Rating of Perceived Exertion

STEP 4 – MONITOR KEY OUTCOME VARIABLES

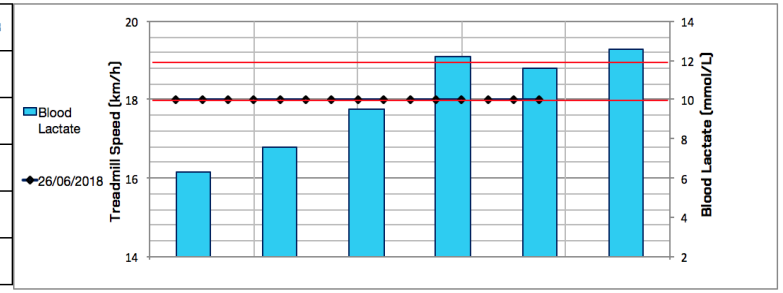
Date	19/06/2018
Reps	5.0
Mean Speed	17.1
Lactate	7.1
Lactate to Speed Ratio	0.4
Rise in Lactate	2.2



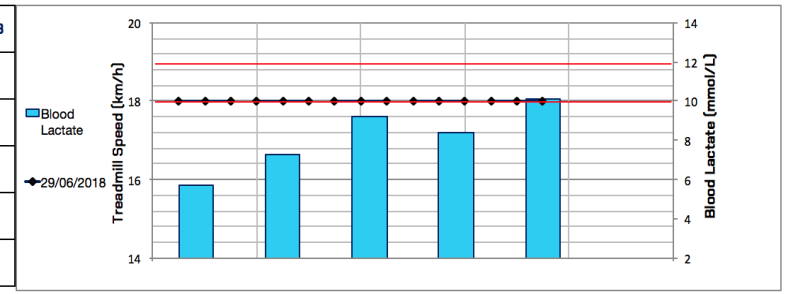
Date	21/06/2018
Reps	5.0
Mean Speed	17.5
Lactate	8.0
Lactate to Speed Ratio	0.5
Rise in Lactate	0.1



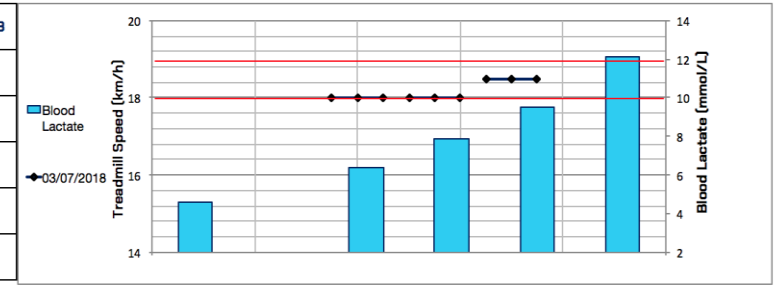
Date	26/06/2018
Reps	6.0
Mean Speed	18.0
Lactate	10.0
Lactate to Speed Ratio	0.6
Rise in Lactate	6.2



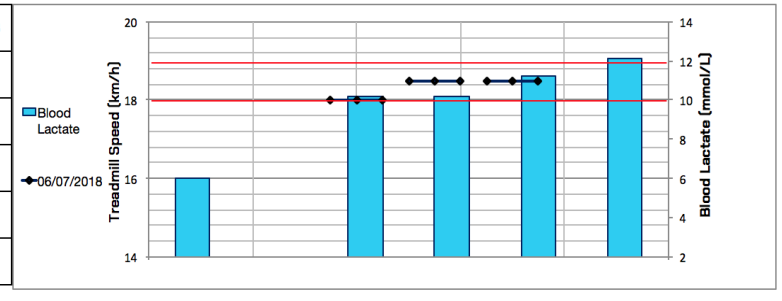
Date	29/06/2018
Reps	6.0
Mean Speed	18.0
Lactate	10.5
Lactate to Speed Ratio	0.4
Rise in Lactate	4.4



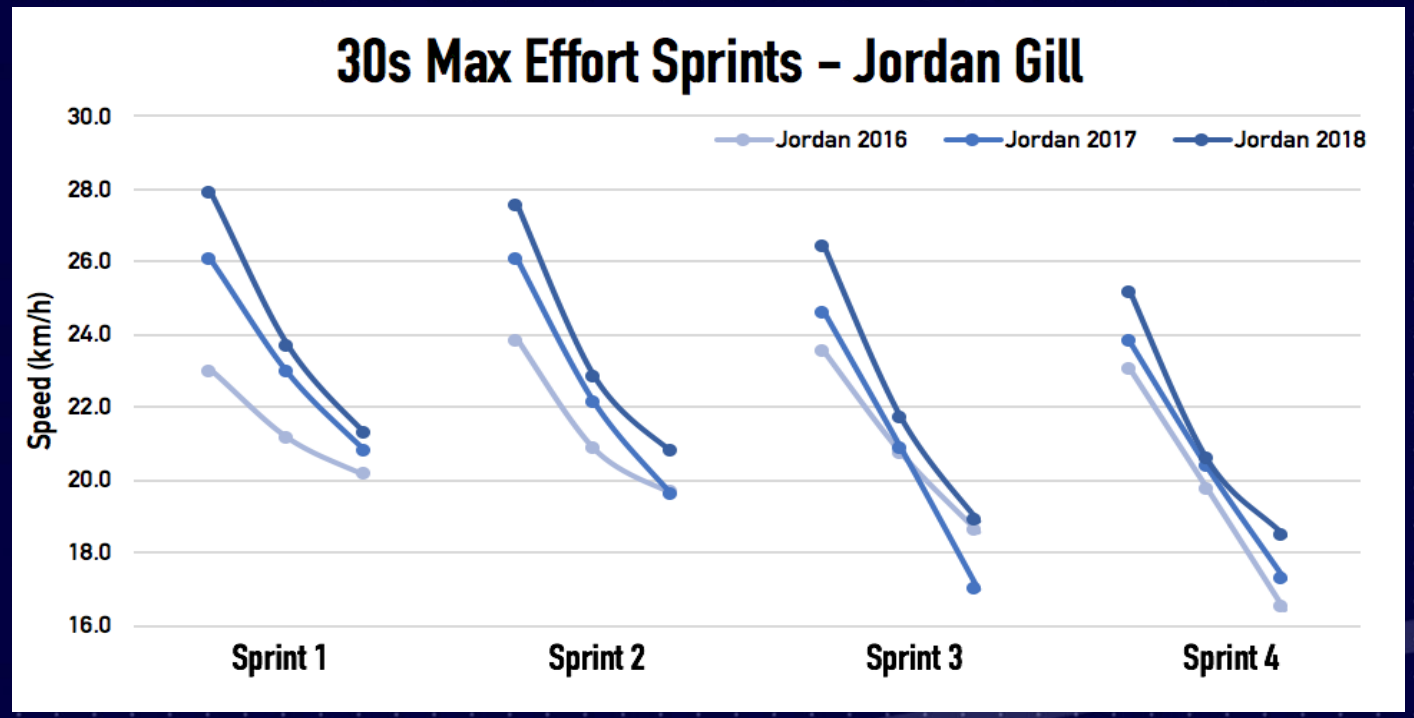
Date	03/07/2018
Reps	6.0
Mean Speed	20.6
Lactate	8.1
Lactate to Speed Ratio	0.4
Rise in Lactate	7.5



Date	06/07/2018
Reps	6.0
Mean Speed	20.2
Lactate	9.9
Lactate to Speed Ratio	0.5
Rise in Lactate	6.1



STEP 4 – MONITOR KEY OUTCOME VARIABLES



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STEP 4 – MONITOR KEY OUTCOME VARIABLES

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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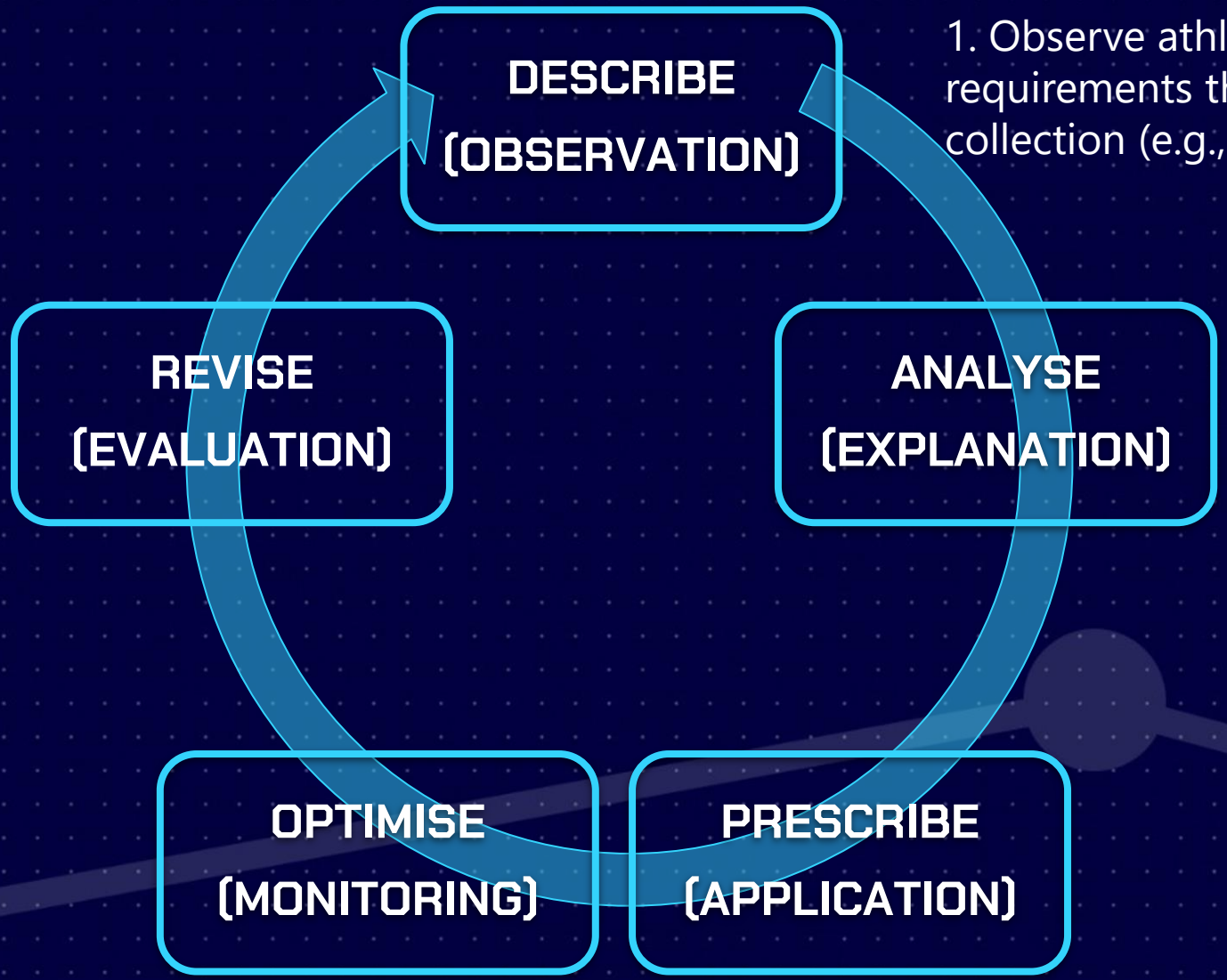
STEP 1...



1. Observe athlete requirements through data collection (e.g., testing);

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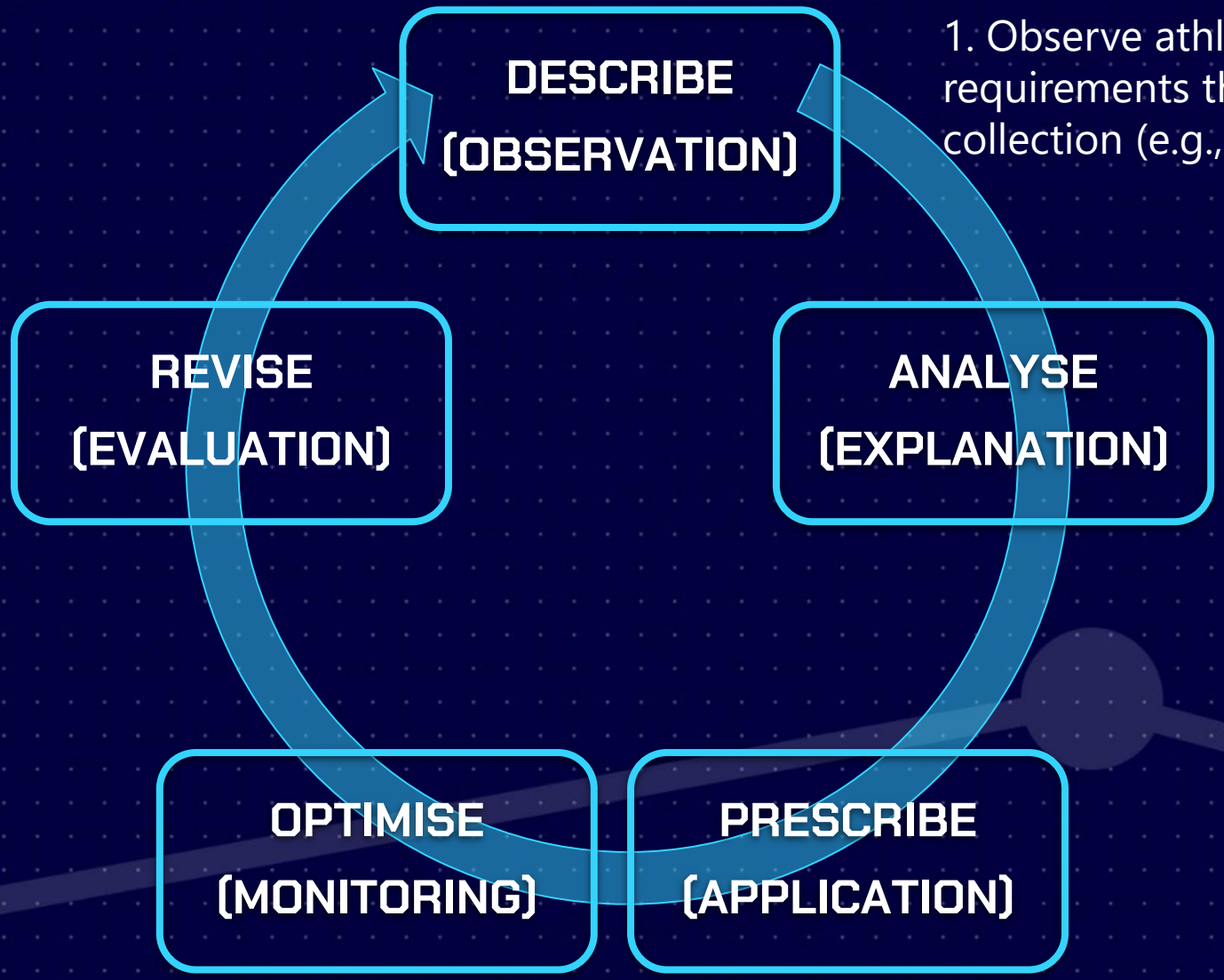
STEP 2...



1. Observe athlete requirements through data collection (e.g., testing);

2. Analyse data to explain athlete requirements;

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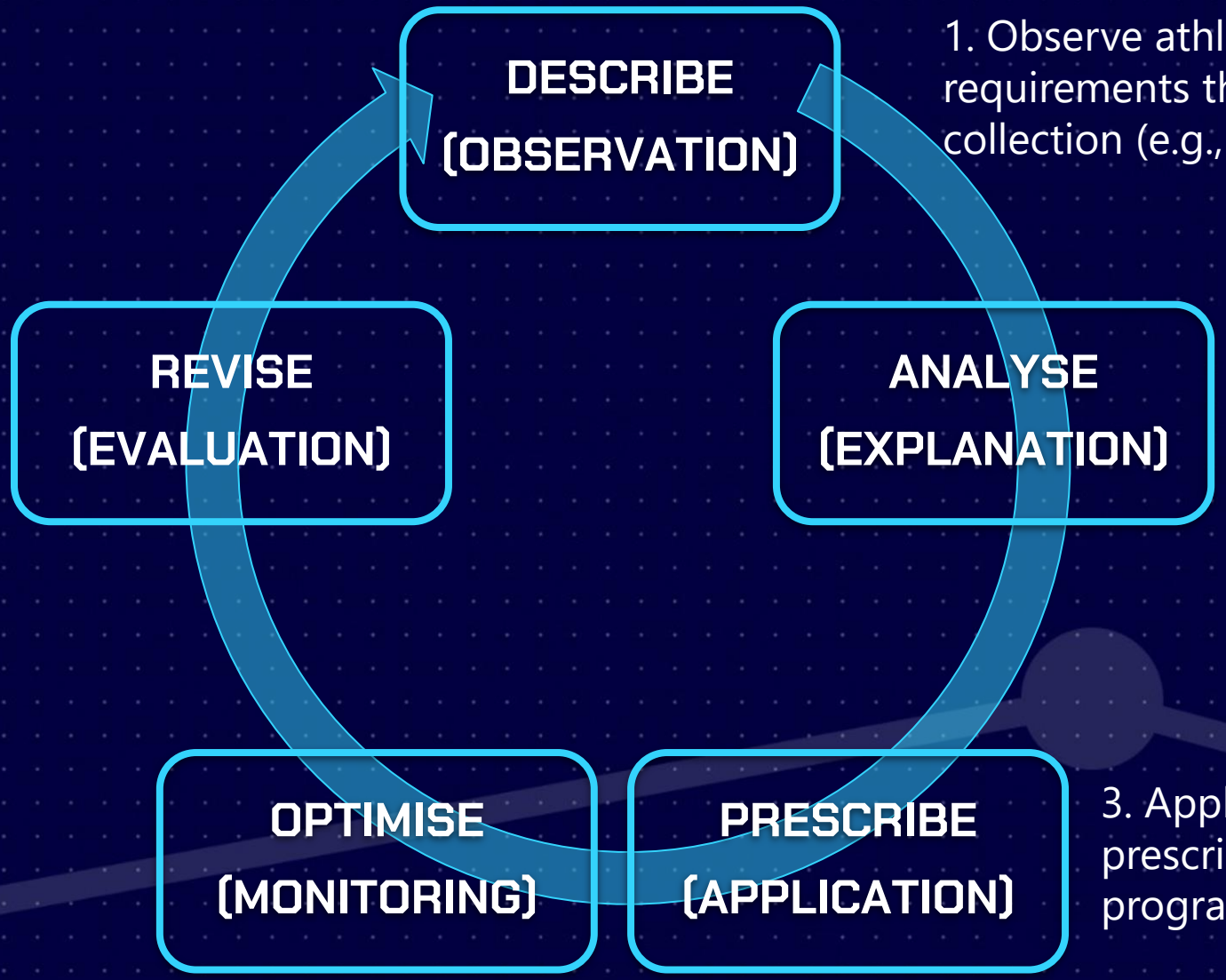
STEP 3...



1. Observe athlete requirements through data collection (e.g., testing);

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3. Apply this information to prescribe individualised training programmes;

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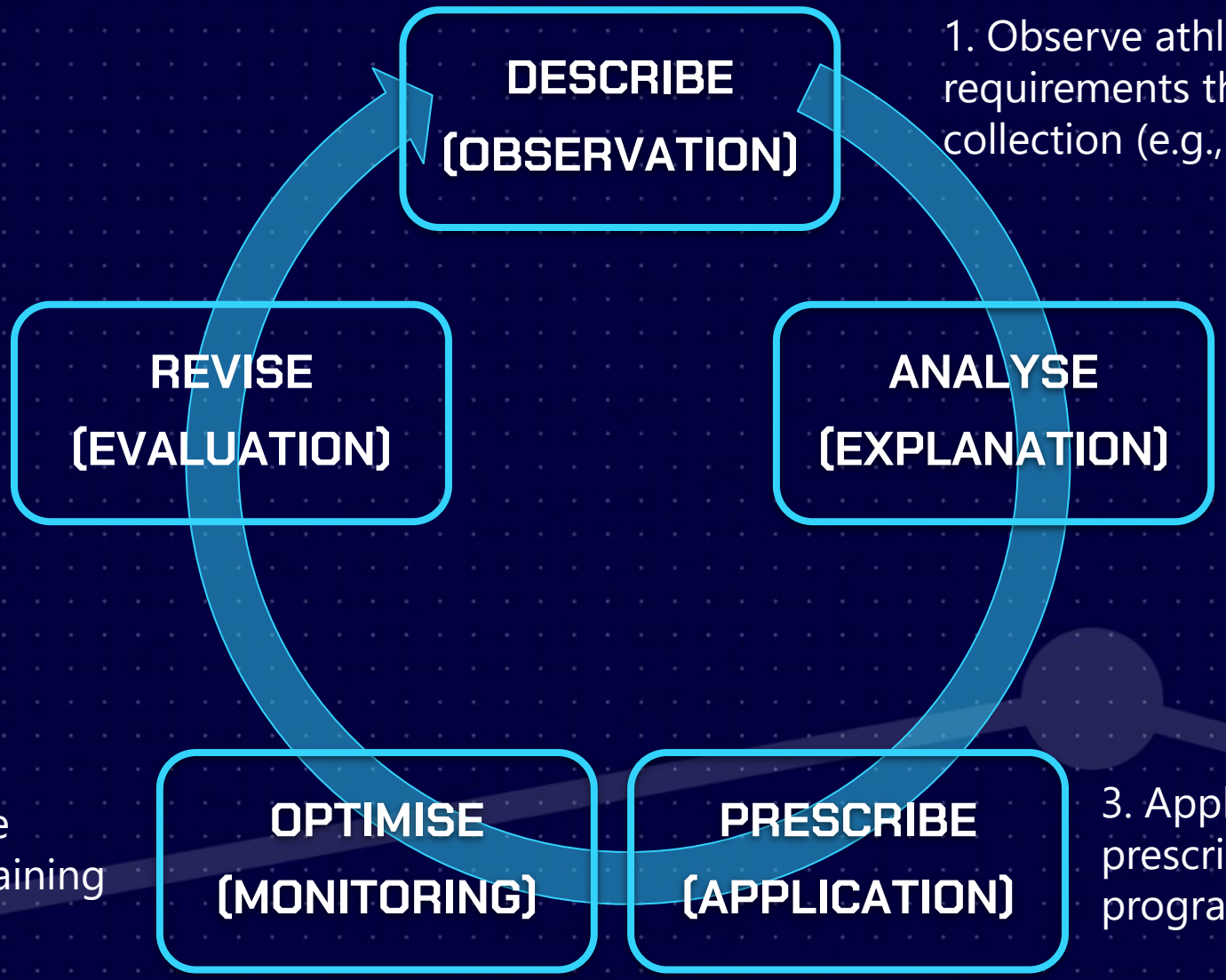
STEP 4...



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

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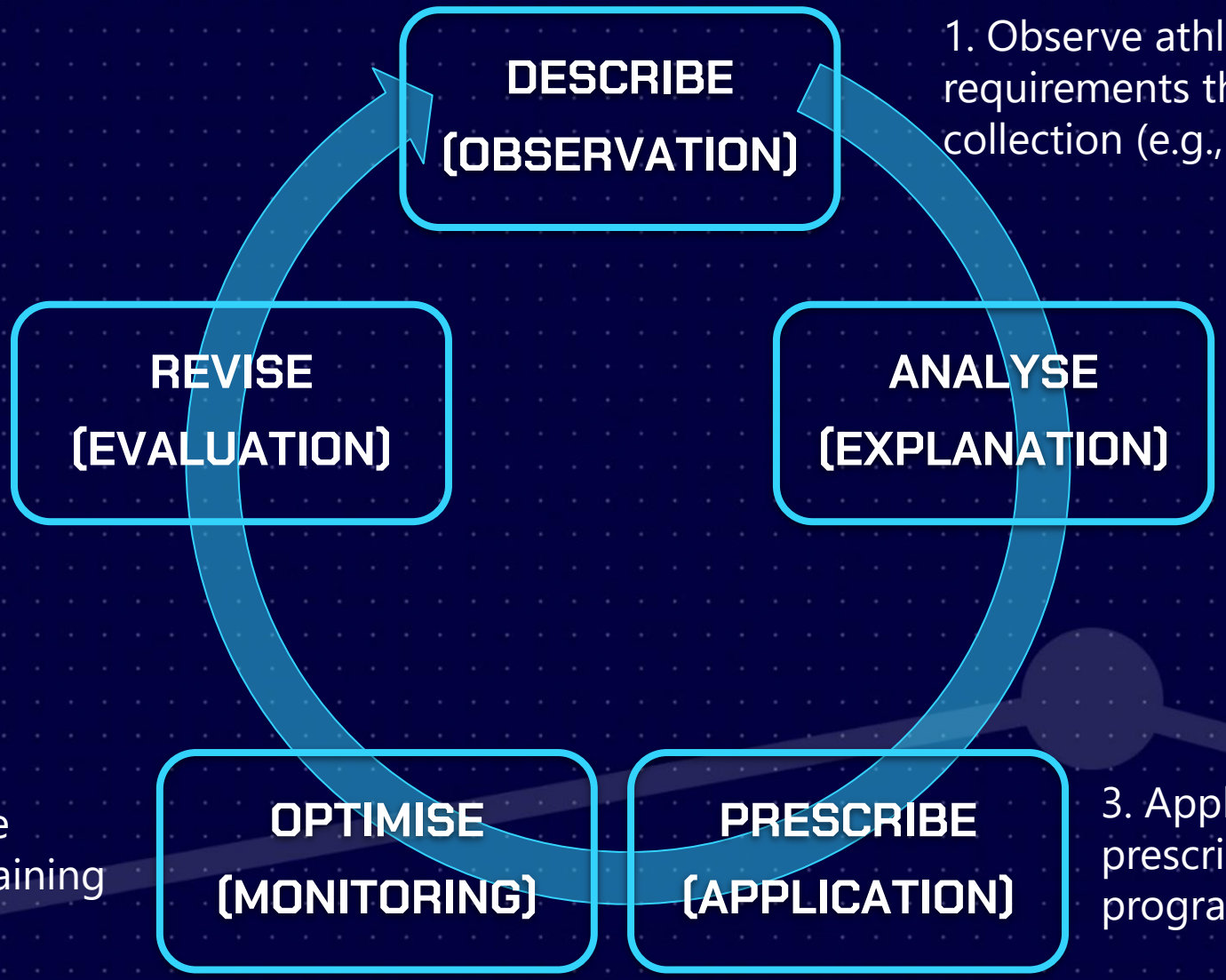
STEP 5...



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3. Apply this information to prescribe individualised training programmes;

4. Monitor key outcome variables to optimise training demand

5. Evaluate and revise processes on a micro, session-by-session, and macro, training phase/camp basis with the support team, boxers, and coaches

STEP 5 – EVALUATION AND REVISION

- SESSION-BY-SESSION
- TRAINING PHASE
- TRAIN CAMP

- USING DATA AND FEEDBACK
- TESTING & MONITORING
- INTEGRATION OF DATA & PERFORMANCE ANALYSIS

- SUPPORT TEAM
- BOXERS
- COACHES

- TEAM MEETINGS
- STRONG RELATIONSHIPS
- DAY-TO-DAY/WEEK-TO-WEEK

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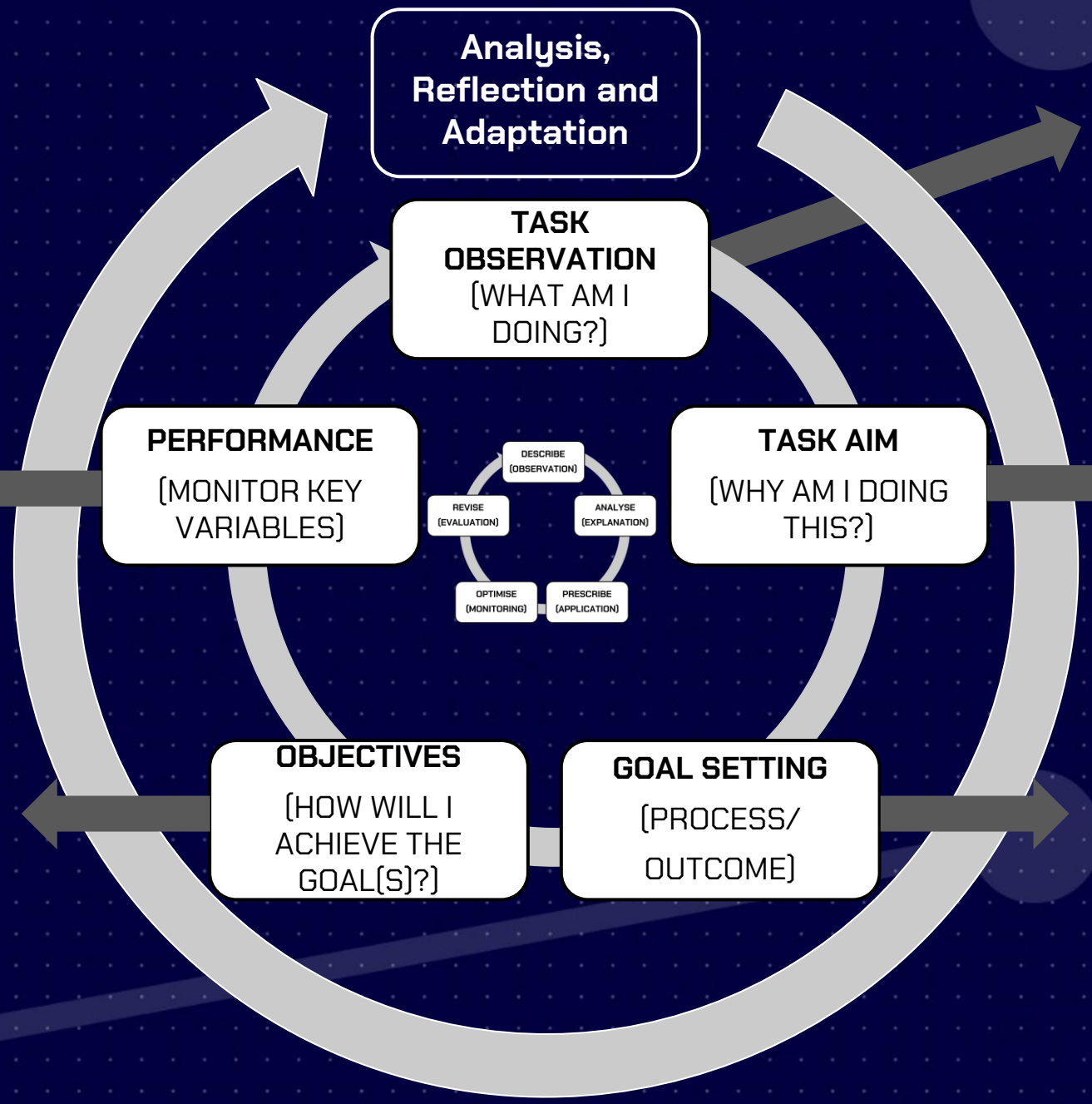

How did I deconstruct this task? Did this practice provide insight to the purpose of the task?

Did I answer the 'so what' question? Did I articulate the meaning of this task? Why is it important?

Did I set clear process and outcome goals for each stage of the process? Can these goals be turned into manageable objectives and be monitored?

Was the method clear and replicable? Will it enable me to identify strengths and limitations in accordance with key monitoring variables?

Can I acquire valid and reliable data to analyse this process?

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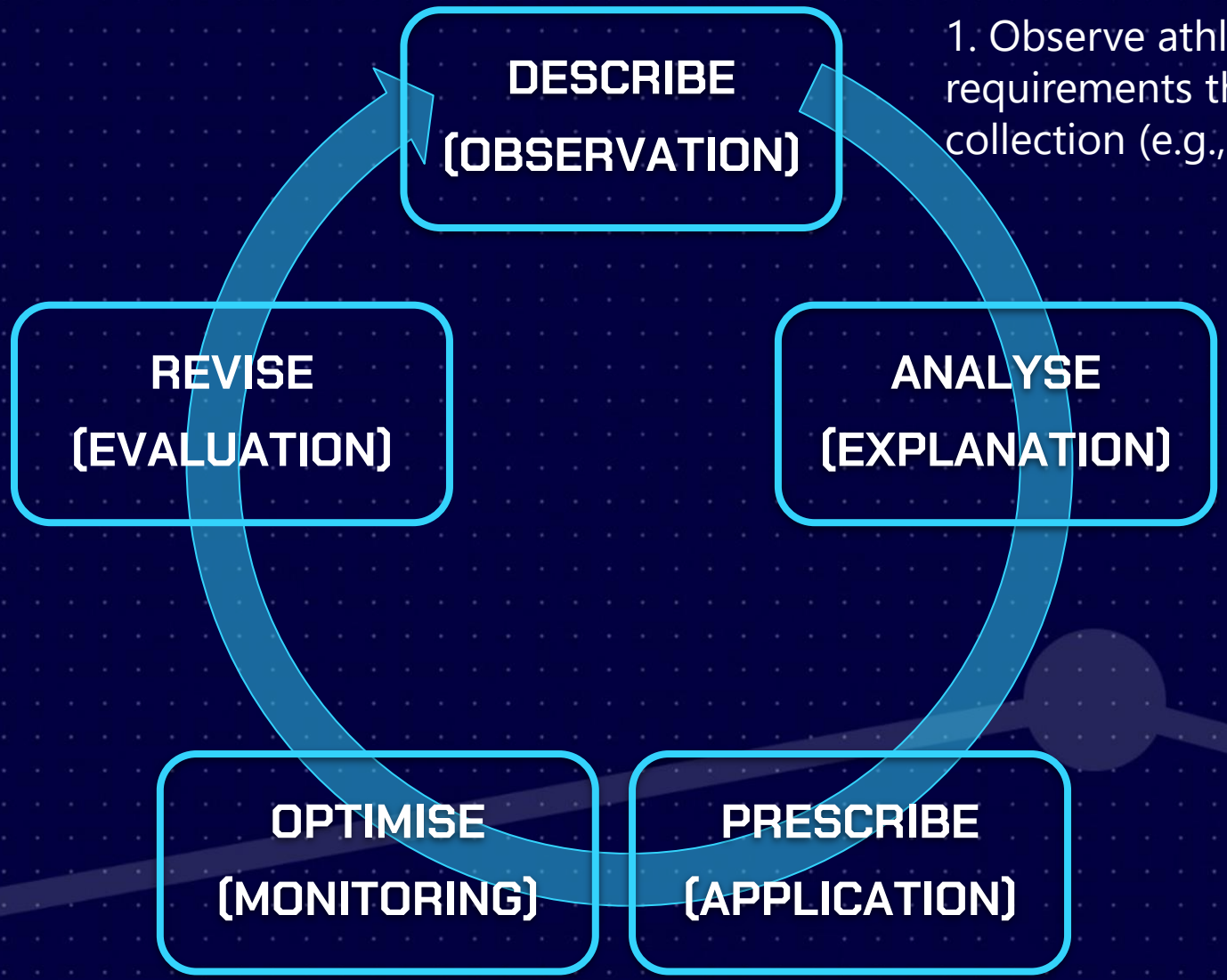
STEP 1...



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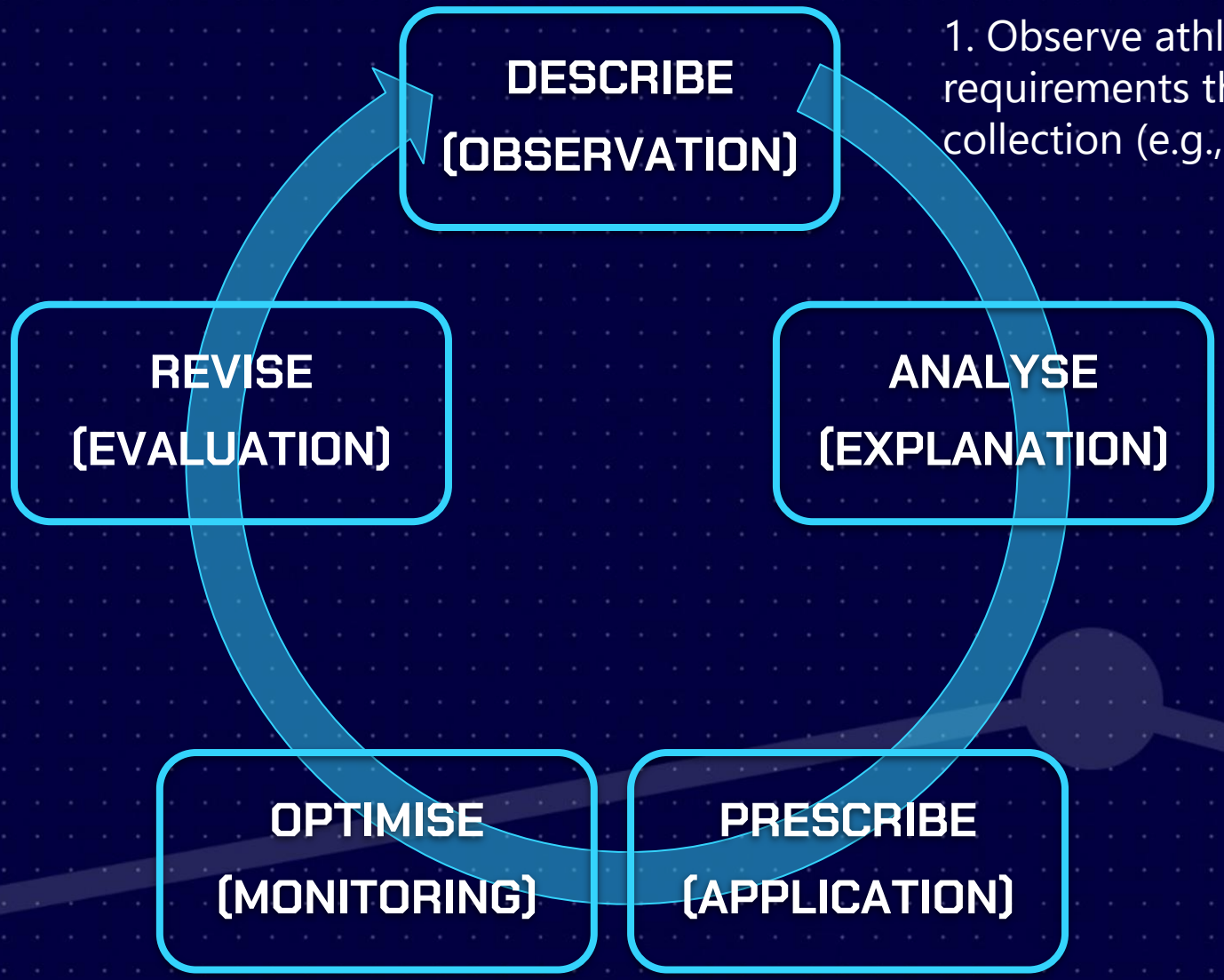

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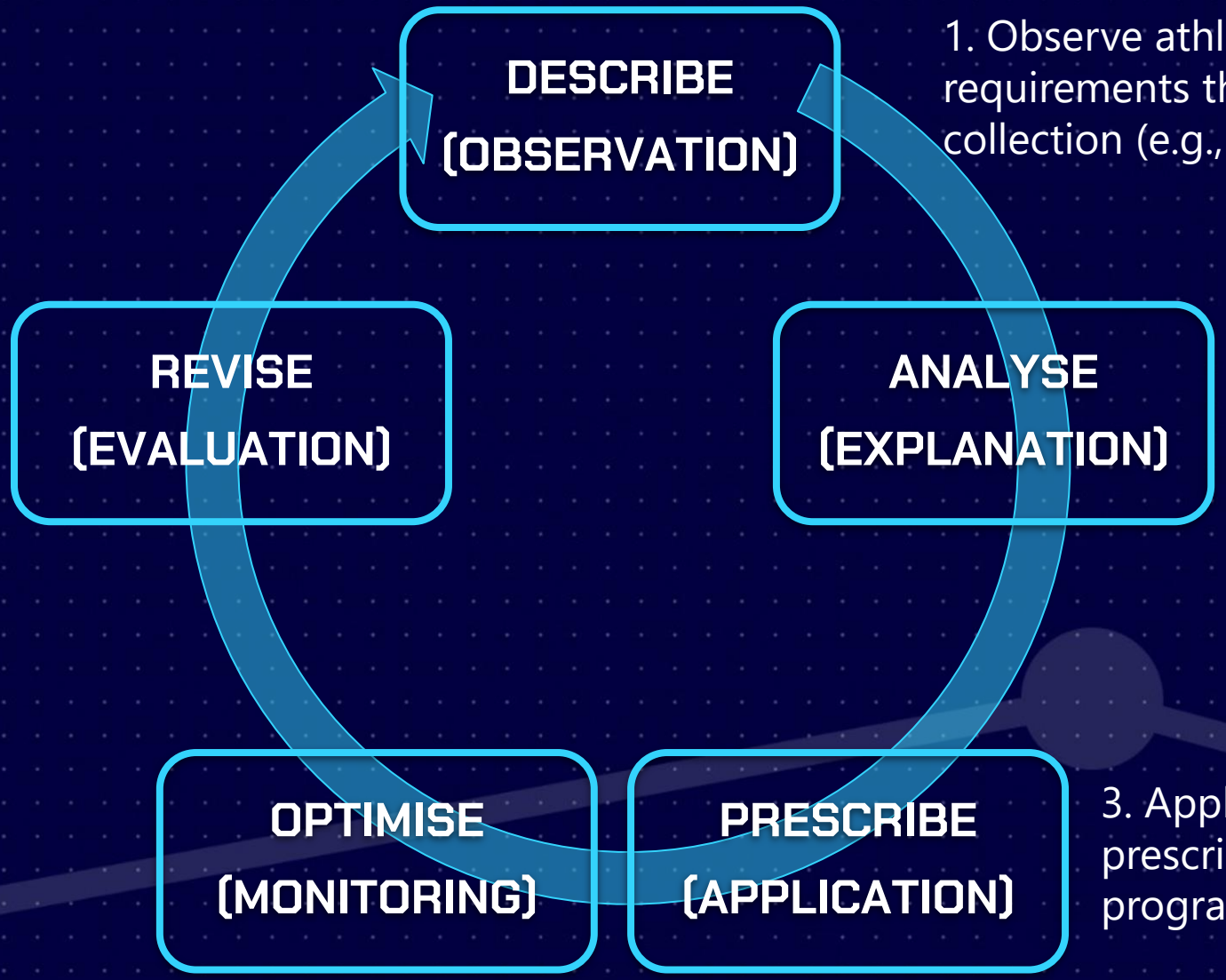

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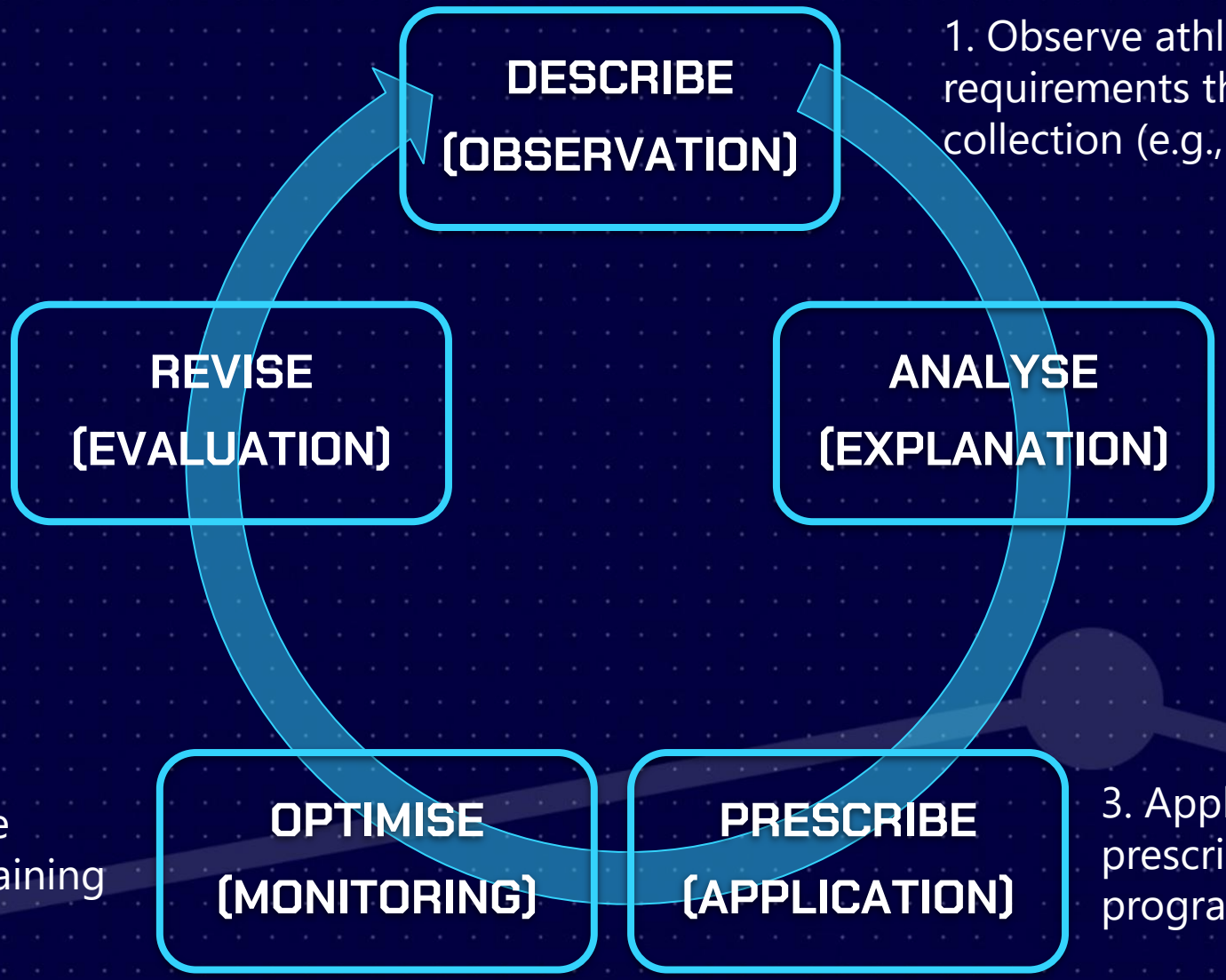

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BOXING SCIENCE

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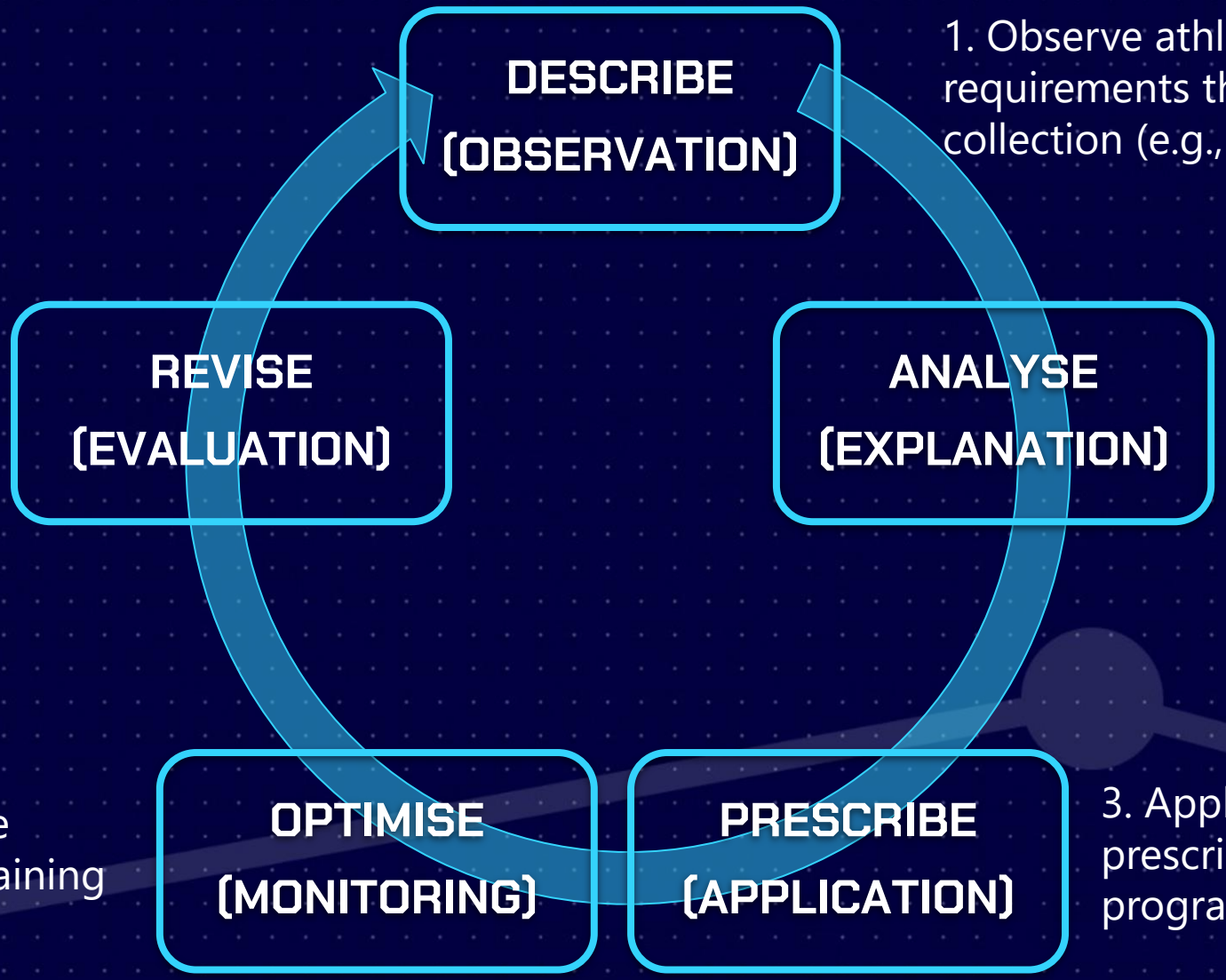

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5. Evaluate and revise processes on a micro, session-by-session, and macro, training phase/camp basis with the support team, boxers, and coaches

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