Monitoring – Best Practices

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http://www.aspire.qa/trainingload2016/sessions.html?day=2

Where are we going?

A story about monitoring in three interconnected parts

1. **Not why, but how…**
2. **Methods**
3. **What to do with the data**

Enhancing Preparedness

- Prepare to Win…
  - It isn't the will to win that's important. Everyone has the will to win. What's important is the will to prepare to win.
    - Bobby Knight

Training is Complicated

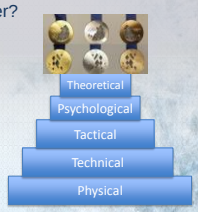
- Evidence-based Coaching
  - Requires ongoing assessment
  - Coaches are in the best position to know.
  - But, information is often hidden, subtle, fragile, and subject to bias.

The Covenant of Coaches

- Coaches and physicians – same covenant
- Single athletes, patients, subjects
- How about a thought experiment?
  - 20 elite athletes
  - Pre-test, post test design
  - No control group
  - Treatment is designed to improve strength/power
  - Statistically significant improvement – pre/post
  - What do you think about …

Where do you start

- What is a recipe for a good/great skier?
  - Age and Maturation
  - Size and Shape
  - Physical ability
  - Technical ability
  - Tactical ability
  - Psychological ability
  - Theoretical understanding
  - Let's see if we can decide



Recipe for a Complete Program

- Time
- Access to Facility - Mountain
- Talent ID, Recruitment, Athletes
- Talented and Motivated Coaches
- Ancillary Staff
  - Medicine, nutrition, psychology, S&C
- R&D
  - Monitoring, technique, feedback
- Supportive and funded stakeholders

Modeling your needs and resources

- Allocating time/resources
- What are your goals/activities/objectives?
- How much total time do you have?
- What percentage would you assign to each objective/activity?
  - To make a 100% complete athlete
- Allocate your time/resources based on your goals/activities/objectives.

P.E.R.T Charts and Prioritizing

A Simple Example

Name	Physical	Technical	Tactical	Psychological	Theoretical	Sum
AB	4	3	6	8	4	25
CD	2	4	5	6	4	21
EF	2	5	4	5	3	19
GH	5	7	2	6	6	26
IJ	2	4	2	3	5	16
KL	5	7	5	8	7	32
Sum	20	30	24	36	29	139/300
139-Column	129	118	124	112	119	602
Percentage Of Need	21.4	19.6	20.5	18.6	19.8	100

Let's Get Organized

Dryland Training		4d/wk	
		2h/session	
	Percent	Min/wk	Min/d
		480	120
Warm up	10	48	12
Mobility	10	48	12
Strength	20	96	24
Speed-Strength	25	120	30
Strength-Endurance	10	48	12
Reactive-Agility	15	72	18
Relaxation	10	48	12
Total	100	480	120

Brute Force

Graphic Information
AI - Rules

Monitoring Gymnastics Training
Strength/Power/Flexibility/Leanness

- **Dosage Variables**
  - Volume = total number of elements
    - Vault
    - Uneven bars
    - Balance beam
    - Floor exercise
    - Tumbling
    - Conditioning
  - Intensity
    - Elements per minute
  - Training time

Sands,WA (1990): National women's tracking program pt. 2 - response. Technique 10(1), 23-27.

Monitoring Gymnastics Training

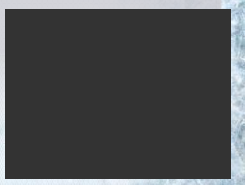
- Response Variables
  - Pre-practice resting heart rate
  - Scale weight
  - Sleep duration
    - Sleep disturbances
  - Illness symptoms
  - Injury
    - Sands WA, Shultz BB, and Newman AP. Women's gymnastics injuries. A 5-year study. Am J Sports Med 21: 271-276, 1993.
  - Psychological mood state

Sands WA. Monitoring the elite female gymnast. Nat Strength Cond Assoc J 13: 66-71, 1991

Sands,WA (1990): National women's tracking program pt. 2 - response. Technique 10(1), 23-27.

Monitoring Gymnastics Training
Computerized Diary

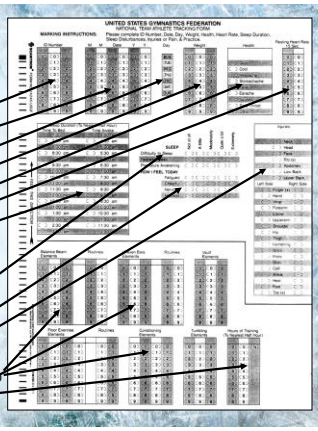
- Direct to Computer
- Design "Dot-Sheet"
  - Dosage Information
  - Response Information
  - Simplify < 1 Minute
- Develop computer software
  - Data acquisition and storage
- Develop analysis software
  - Identify trends and aberrant data.



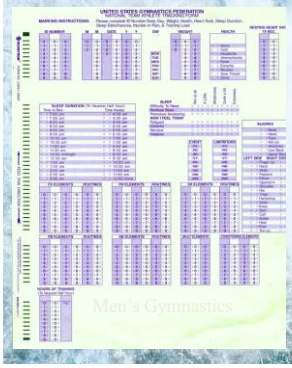
- Sands,WA (1991): Monitoring the elite female gymnast. Nat. Strength Conditioning Assoc. J. 13(4), 66-71.
- Sands WA. Monitoring elite gymnastics athletes via rule based computer systems, in: Masters of Innovation III. Northbrook, IL: Zenith Data Systems, 1991, p 92.
- Sands WA. AI and athletics. PC AI 6: 52-54, 1992.

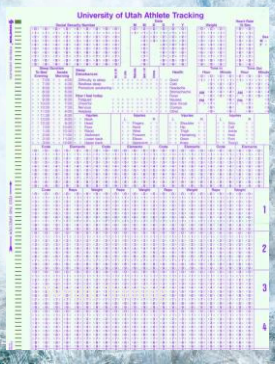
-Daily -
Training Monitoring via Computer Dot Sheet

Athlete ID
Date
Weekday
Weight
Health
Resting Heart Rate
Time to Bed/Awake
Sleep Disturbances
Mood State
Injuries
Training Load (elements/routines)
Training Duration



Other Examples – Dot Sheets





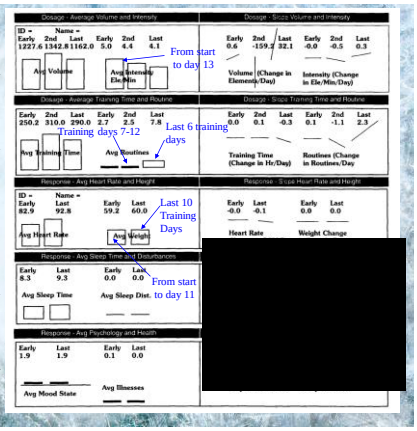
Collect, Store, Display, and Analyze

- Direct computer entry
- Scanned dot-sheets

Training Data Feedback Report

Dosage Variables

Response Variables



The AI Part… an Expert System

Over 200 Prolog Rules

USGF Athlete Tracking Program – Expert System

ID Number = 620
Name =

Response Information

The athlete's average heart rate has(have) remained near baseline levels.
The athlete's recent heart rate is(are) stable (I.e., not changing)
The athlete's average weight has (have) remained near baseline levels.
The athlete's recent weight is(are) stable (I.e., not changing).
. . .
The athlete's recent psychological state is decreasing.
This may indicate maladaptation/overtraining
The athlete's average health has(have) decreased.
This may indicate maladaptation/overtraining

Warnings

Dosage Information

The athlete's recent volume is(are) stable (I.e., not changing).
The athlete's average intensity has increased.
. . .

Sands, W.A. (1991). Monitoring elite gymnastics athletes via rule based computer systems. Masters of Innovation. Zenith Data Systems. 92

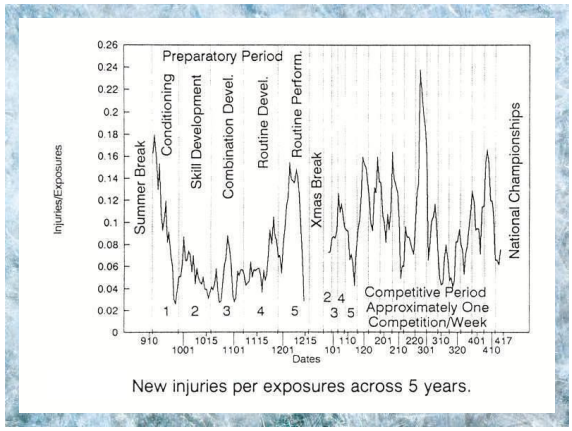
Sands, W.A. (1992). AI and Athletics. PC-AI 6(1), 52-54.

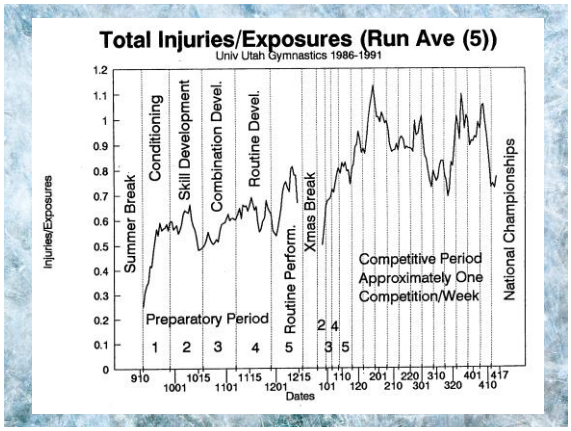
Injury Trends

- Five years of injury records
- Collapsed over one year and displayed relative to the training program phases.
- Running average to smooth the longitudinal data

In order to get published, I had to resort to group data.

Sands, WA, Shultz, BB, Newman, AP (1993). Women's gymnastics injuries. American Journal of Sports Medicine, 21(2), 271-276
Stone MH, Stone ME, and Sands WA. Monitoring resistance training, in: Principles and Practice of Resistance Training. Champaign, IL: Human Kinetics, 2007, pp 181-199.





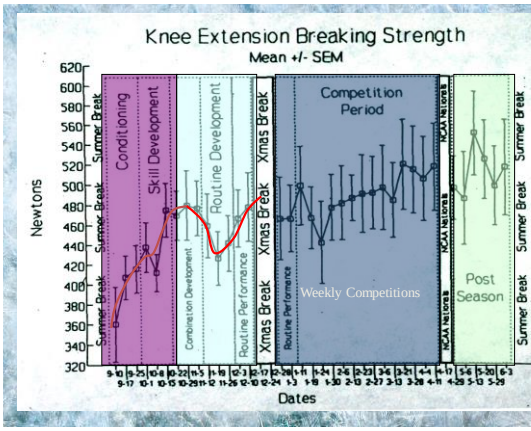
Monitoring Isometric Breaking Strength and Body Composition

Isometric knee extension breaking strength
Sum of Four Skinfolds

University of Utah Women's Gymnastics Team (2nd NCAA)

1. Weekly tests
2. One academic year
3. Entire team

Sands,WA; Irvin,RC; Major,JA (1995): Women's gymnastics: The time course of fitness acquisition. A 1-year study. J. Str. and Cond. Res. 9(2), 110-115.



Skinfold Sums




Four sites
Sum the mm

Reflective of Change in body composition

Wilmore, JH (1985). Ross Conferences on Medical Research 6. Body-composition assessments in youth and adults, Ross Laboratories, Columbus, OH. 6. 78-86.

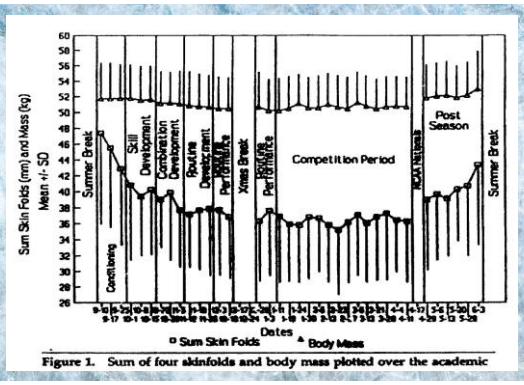
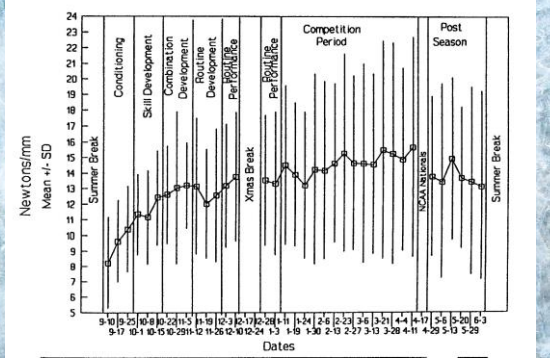


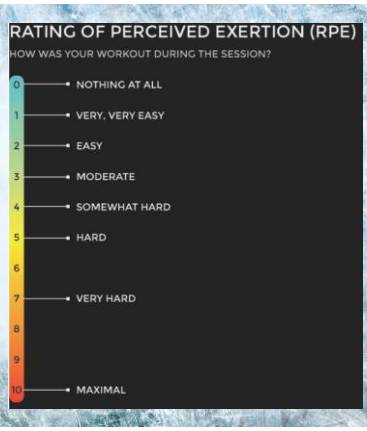
Figure 1. Sum of four skinfolds and body mass plotted over the academic

Sands,WA; Irvin,RC; Major,JA (1995): Women's gymnastics: The time course of fitness acquisition. A 1-year study. J. Str. and Cond. Res. 9(2), 110-115.

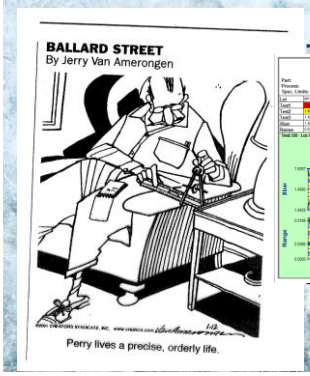


Sands,WA; Irvin,RC; Major,JA (1995): Women's gymnastics: The time course of fitness acquisition. A 1-year study. J. Str. and Cond. Res. 9(2), 110-115.

Session RPE



Statistical Process Control



Analyzing Process Data

- "lies, damned lies, and statistics" (Mark Twain)
- Enumerative Statistics
  - Quantify and compare populations
    - Populations is a "model" used by statisticians to simplify the "real world."
    - Scientists don't find truth – they test models…
- Process Statistics
  - Many "populations" are really processes repeated over time.
  - "Every activity, every job, is a part of a process" (Deming, 1986)

Analyzing Process Data

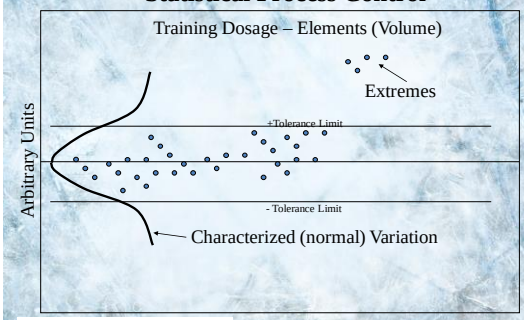
- A Human Factor
  - Insert a human and you get variation
    - Actually you get variation with machines too.
  - If there was no human variation
    - 100% of putts, 100% of at-bats, 100% free throws, etc.
- 100% consistency is not always desirable
  - Improvisation can be an important attribute
    - Anticipation – military, police, research, parenting, etc.
      - Coaching!!!!!

Statistical Process Control Identifying Outliers

- Identifying discrepant, extreme, or outlier data (ie, cause for concern)
- Useful for training diary or periodic test
- Useful for determining how the training program is progressing…
- Based on simple descriptive statistics and probability

Sands WA. Monitoring gymnastics training. Presented at 3èmes Journées Internationales d'Etude de l'AFRAGA, Lille, France, 7-9 November 2002
Shewhart WA. *Statistical methods from the viewpoint of quality control. New York, NY: Dover, 1986.*

Statistical Process Control



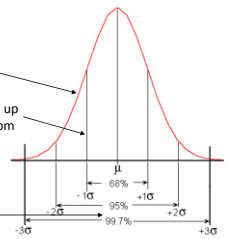
Shewart, WA (1986). Statistical method from the viewpoint of quality control. Dover. New York, NY
Sands WA and Stone MH. Monitoring the elite athlete. Olympic Coach 17: 4-12, 2006.

"Normal" bell shaped curve

Add up about 30 of most things and you start to be "normal"

Normal distributions are divided up into +/-3 standard deviations from the mean.

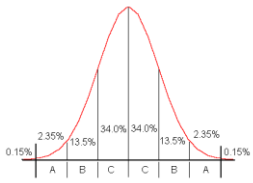
Once your here, you know a lot about what is going on



What is a standard deviation good for ?

Usual or unusual?

1. One observation falls outside 3 standard deviations?
2. One observation falls in zone A?
3. 2 out of 3 observations fall in one zone A?
4. 2 out of 3 observations fall in one zone B or beyond?
5. 4 out of 5 observations fall in one zone B or beyond?
6. 8 consecutive points above the mean, rising, or falling?



Causes of Variability

- Common Causes:
  - Random variation (usually, at least we can't account for it)
  - No pattern
  - Inherent in process
  - Adjusting the process increases its variation
- Special Causes
  - Non-random variation (unusual, doesn't "look" random)
  - May exhibit a pattern
  - Assignable, explainable, controllable
  - Adjusting the process decreases its variation

SPC uses samples to identify that special causes have occurred

Second Key to Understanding SPC

Control Charts

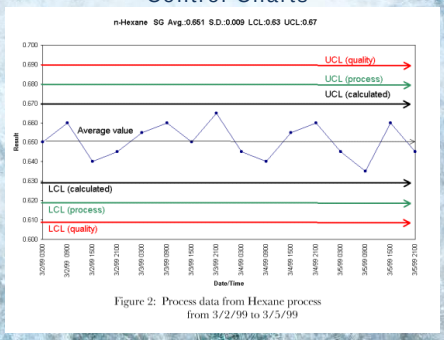


Figure 2: Process data from Hexane process from 3/2/99 to 3/5/99

• <u>In statistical control</u>: a process operating with only chance causes of variation

• <u>Out of control</u>: a process operating in the presence of assignable causes

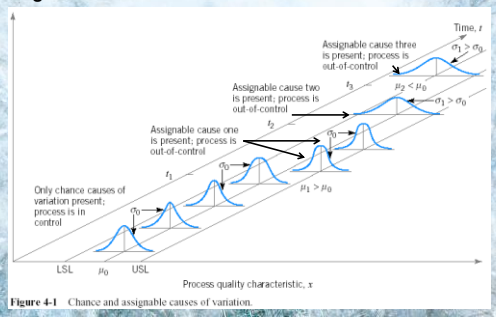
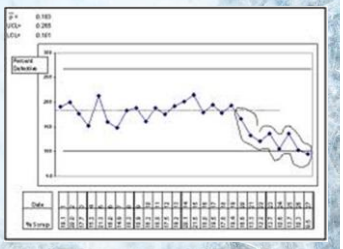


Figure 4-1 Chance and assignable causes of variation.

Control Charts

- X-axis is time-ordered sequence with consistent time scaling
- Y-axis is scaled to the statistic charted for each point in time
- Statistical control limits are defined for the plotted statistic based on process data.
  - Upper control limit (UCL)
  - Lower control limit (LCL)
- Control limits are based on short-term variation of the process under study



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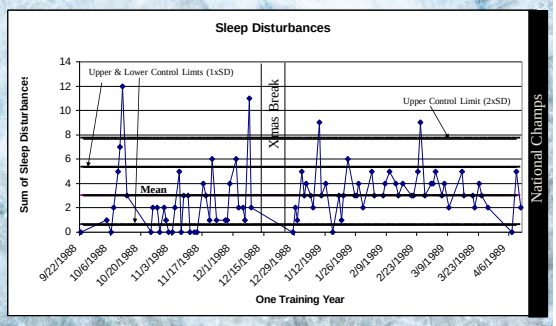
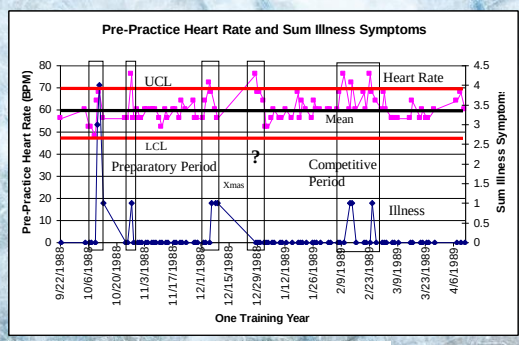


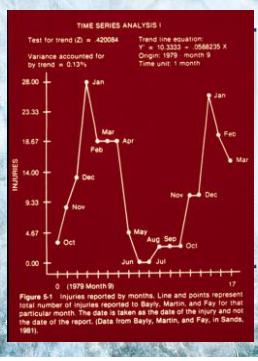
Sands WA and Stone MH. Monitoring the elite athlete. Olympic Coach 17: 4-12, 2006.

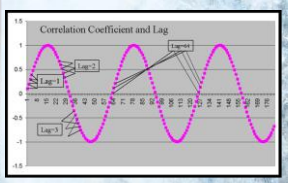
SPC - What can extreme data reflect?



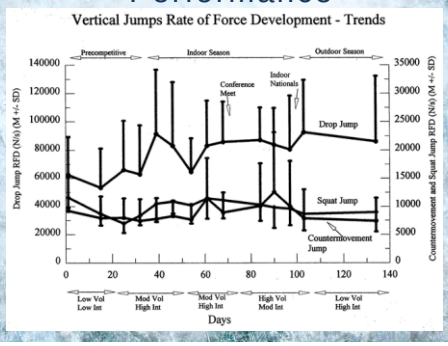
Sands WA and Stone MH. Monitoring the elite athlete. Olympic Coach 17: 4-12, 2006.

Trend Analysis





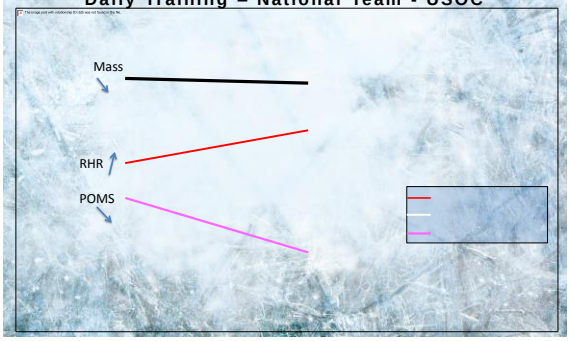
Trend of Vertical Jump Performance



Response: Weightlifting

(Female)

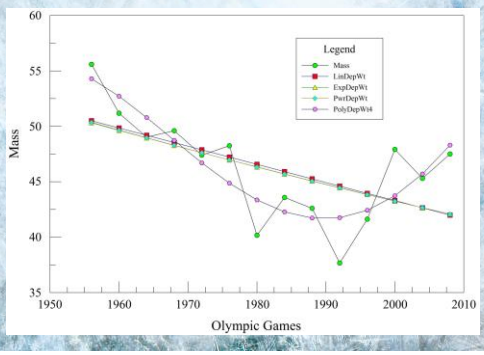
Daily Training – National Team - USOC



Nutrition for Recovery

- Hand over your heart…
  - Hydration
  - CHO
  - Protein
  - Creatine

Size Changes



Obesa contavit

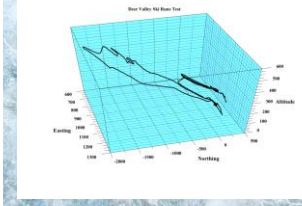
Questions?

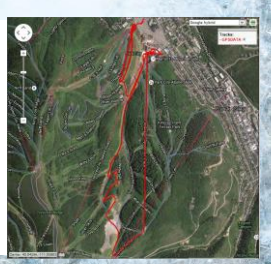
The Future

WHAT AM I LOOKING AT NOW?

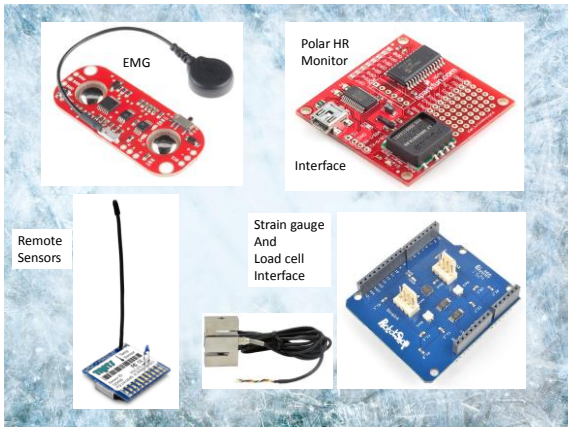
Thermal Imaging

GPS






Arduino
Raspberry pi
Beagle Bone


EMG
Polar HR
Monitor
Interface
Remote
Sensors
Strain gauge
And
Load cell
Interface