Comparison of rolling athletes' leg times to runners' in a running relay – a multivariate approach
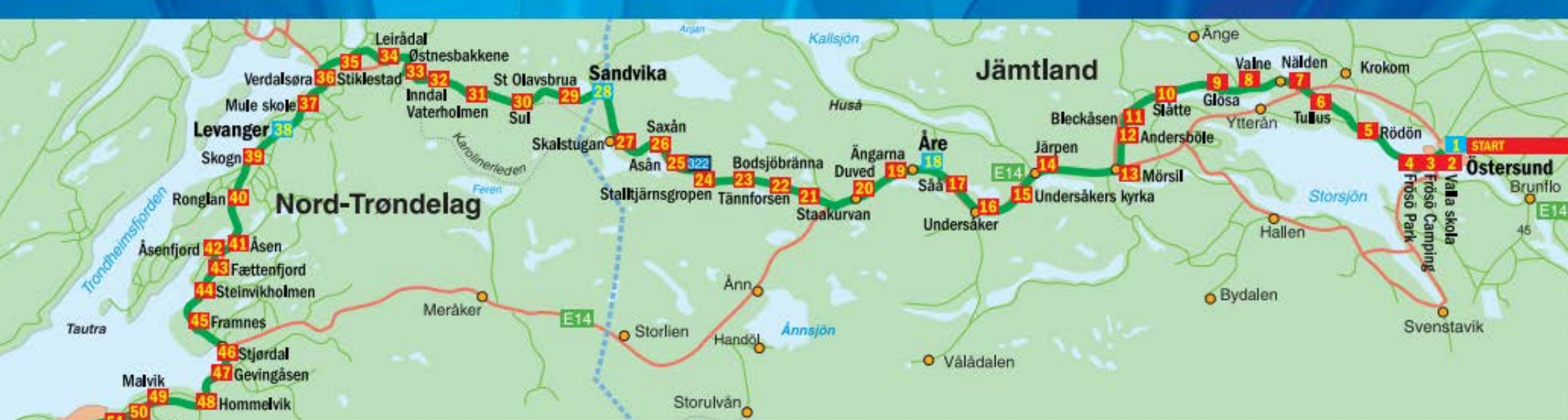
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[3] Parasport Sweden and Swedish Paralympic Committee

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Map labels:

Leirådal · Østnesbakkene · Valne · Nälden · Krokom · Ånge · Jämtland · Sandvika · St Olavsbrua · Verdalsøra · Stiklestad · Inndal · Vaterholmen · Sul · Saxån · Huså · Åre · Slåtte · Glösa · Bleckåsen · Andersböle · Ytterån · Tullus · Rödön · START · Östersund · Mule skole · Levanger · Skogn · Ronglan · Skalstugan · Asån · Bodsjöbränna · Ängarna · Duved · Järpen · Mörsil · Undersåkers kyrka · Valla skola · Frösö Camping · Frösö Park · Brunflo · Nord-Trøndelag · Stalltjärsgropen · Tännforsen · Staakurvan · Såå · Undersåker · Storsjön · Hallen · Åsenfjord · Åsen · Fættenfjord · Steinvikholmen · Meråker · Ånn · Ånnsjön · Bydalen · Svenstavik · Framnes · Tautra · Storlien · Handöl · Våladalen · Stjørdal · Gevingåsen · Malvik · Hommelvik · Ranheim · Lade · MÅL · Trondheim · Storulvån

Dag 1: onsdag 28 juni

Östersund – Åre   **110,5 km**

1	Badhusparken Östersund – Valla skola	4,5 km
2	Valla skola – Frösö Camping	2,0 km
3	Frösö Camping – Frösö Park	3,5 km
4	Frösö Park – Rödön	8,5 km
5	Rödön – Tullus	8,9 km
6	Tullus – Nälden	6,1 km
7	Nälden – Valne	7,2 km
8	Valne – Glösa	5,9 km
9	Glösa – Slåtte	8,3 km
10	Slåtte – Bleckåsen	5,5 km
11	Bleckåsen – Andersböle	4,6 km
12	Andersböle – Mörsil	5,7 km
13	Mörsil – Järpen	11,7 km
14	Järpen – Undersåkers kyrka	6,2 km
15	Undersåkers kyrka – Undersåkers by	6,7 km
16	Undersåkers by – Såå	7,6 km
17	Såå – Åre	7,6 km

Dag 2: torsdag 29 juni

Åre – Sandvika   **61,9 km**

18	Åre - Ängarna	3,8 km
19	Ängarna - Duved	3,9 km
20	Duved - Staakurvan	7,9 km
21	Staakurvan - Tännforsen	4,2 km
22	Tännforsen - Bodsjöbränna	7,0 km
23	Bodsjöbränna - Stalltjärsgropen	7,9 km
24	Stalltjärsgropen - Asån	3,9 km
25	Asån - Saxån	7,4 km
26	Saxån - Skalstugan	4,9 km
27	Skalstugan - Sandvika	11,0 km

Dag 3: fredag 30 juni

Sandvika – Levanger   **63,4 km**

28	Sandvika - St Olavsbrua	5,4 km
29	St Olavsbrua - Sul	9,0 km
30	Sul - Vaterholmen	8,8 km
31	Vaterholmen - Inndal	7,3 km
32	Inndal - Østnesbakkene	4,0 km
33	Østnesbakkene - Leirådal	6,1 km
34	Leirådal - Stiklestad	6,0 km
35	Stiklestad - Verdalsøra	5,1 km
36	Verdalsøra - Mule skole	6,7 km
37	Mule skole - Levanger	5,0 km

Dag 4: lördag 1 juli

Levanger – Trondheim   **101,2 km**

38	Levanger - Skogn	7,5 km
39	Skogn - Ronglan	6,5 km
40	Ronglan - Åsen	7,9 km
41	Åsen - Åsenfjord	4,1 km
42	Åsenfjord - Fættenfjord	7,7 km
43	Fættenfjord - Steinvikholmen	8,1 km
44	Steinvikholmen - Framnes	7,2 km
45	Framnes - Stjørdal	9,2 km
46	Stjørdal - Gevingåsen	6,7 km
47	Gevingåsen - Hommelvik	8,7 km
48	Hommelvik - Malvik	10,7 km
49	Malvik - Ranheim	7,7 km
50	Ranheim - Lade	5,6 km
51	Lade - Trondheim	3,6 km
	Totallängd	**337,0 km**

Världens vackraste landsvägsstafett – Alla kan vara med!

Objective

- Adjust rolling athletes' leg times to be comparable with runners' times by multivariate prediction modelling.

Method

- 51 legs over 337 km and 15 athletes (12 male, 3 female)

- Mix of physical status
  - uni-lateral leg amputation (*wheelchair or double-poling on a skate-board*)
  - bi-lateral leg amputation (*hand bike*)
  - spinal cord injury (*hand bike or wheelchair*)
  - uni-lateral partial paralysis on both leg and arm (*three wheel bicycle*)
  - able-bodied (*hand bike*)

- Polar RS800CX with a G3 GPS sensor

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Method

- 31 X-variables

- 1 Y-variable (estimated leg time, 3.5 min/km to 6.5 min/km)

- Multivariate data analysis
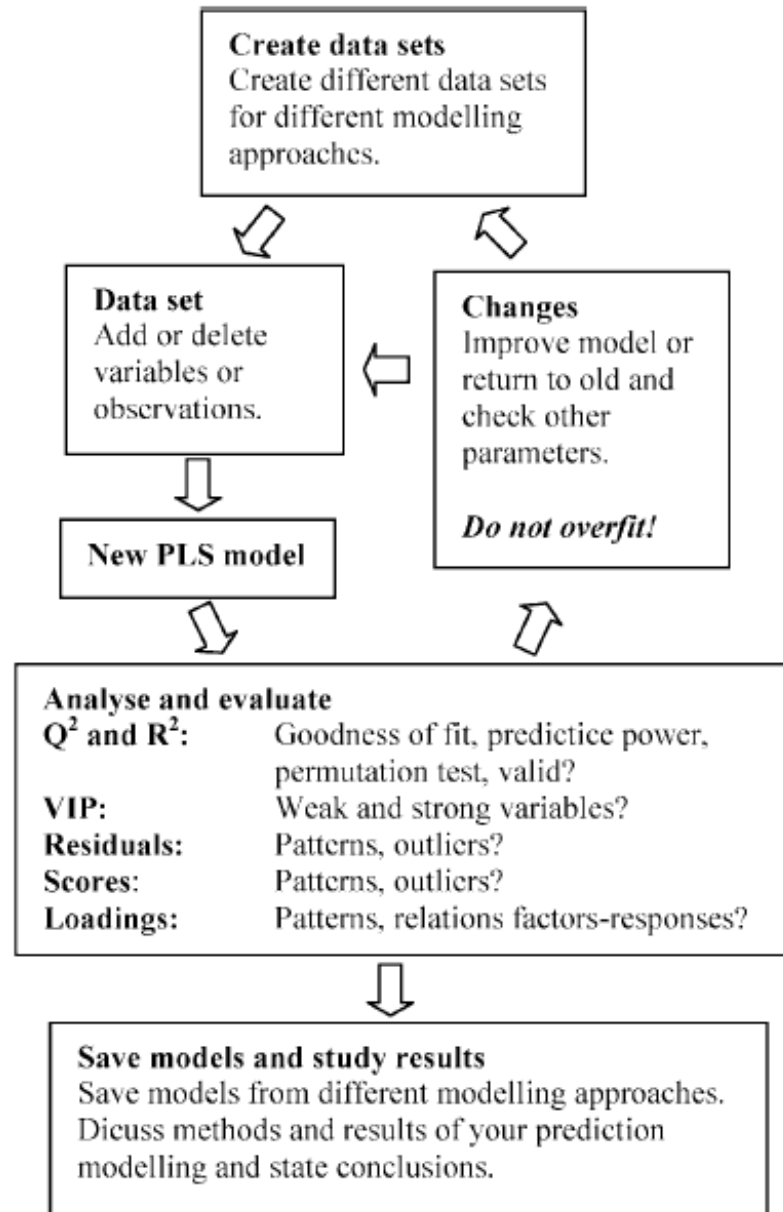 - PLS –Partial Least Squares regression
  - SIMCA P-11 by Umetrics AB

PLS prediction as a tool for modeling wood properties

J. Danvind

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Method

Create data sets
Create different data sets for different modelling approaches.

Data set
Add or delete variables or observations.

Changes
Improve model or return to old and check other parameters.

Do not overfit!

New PLS model

Analyse and evaluate

Q^2 and R^2: Goodness of fit, predictice power, permutation test, valid?

VIP: Weak and strong variables?

Residuals: Patterns, outliers?

Scores: Patterns, outliers?

Loadings: Patterns, relations factors-responses?

Save models and study results
Save models from different modelling approaches. Dicuss methods and results of your prediction modelling and state conclusions.

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Results

Variable of Importance Plot
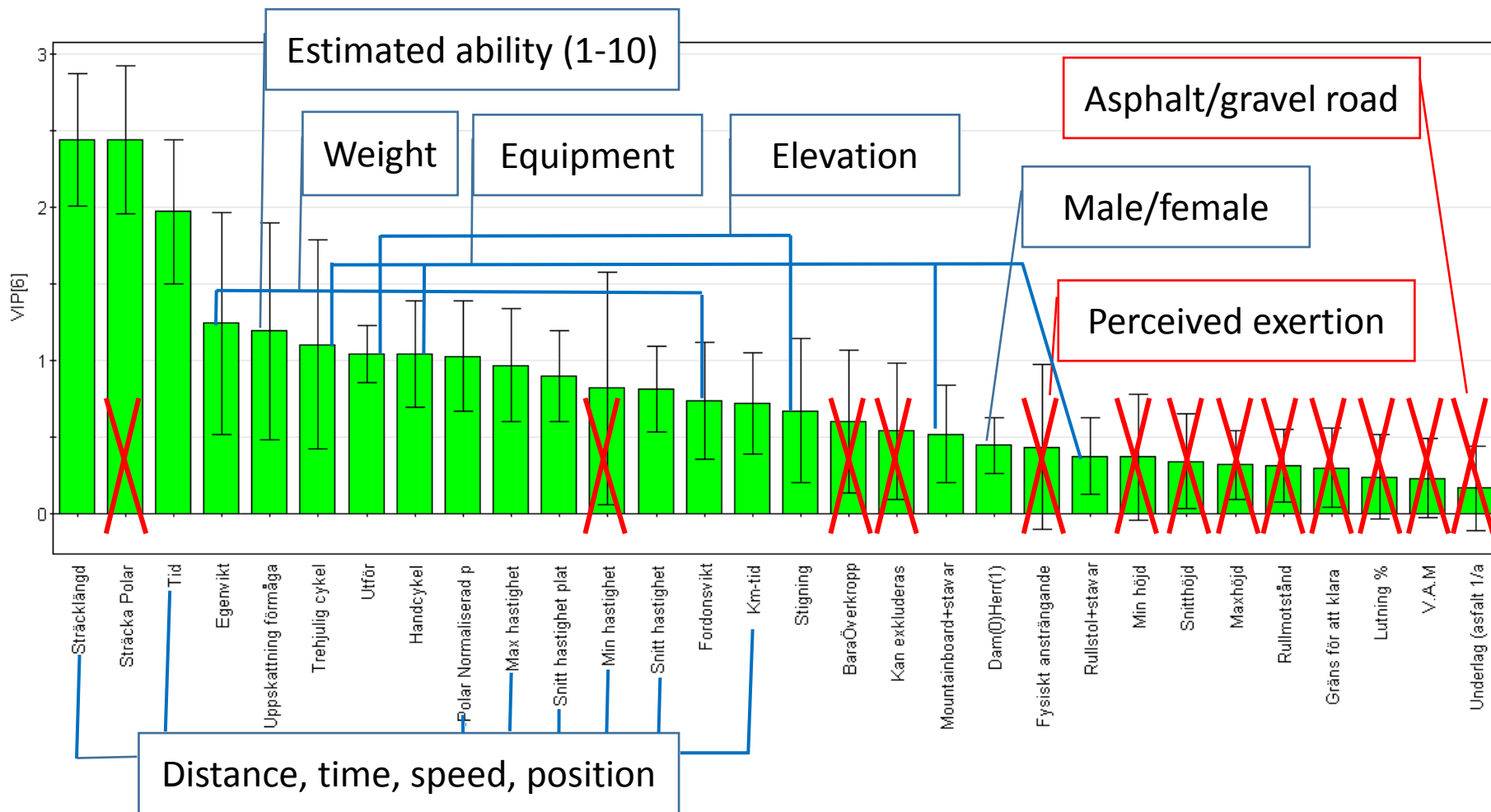
Results

PLS prediction model

Variable	Coefficient
Constant	11,2855
Female(0)Male(1)	-1,07548
Time	0,315519
km-time (min/km)	-1,70686
Average speed flat sections	-0,0443407
Average speed	0,413901
Maximum speed	-0,0667564
Elevation, ascending	0,0164948
Elevation, descending	0,0219297
Distance	3,35324
Weight of athlete	0,110577
Estimated ability (1-10)	-2,38432
Final position in leg	-0,264877
Three-wheel bike	-0,890294
Mountainboard+poles	-0,574698
Handbike	0,158263
Wheelchair+poles	2,73805
Weight of equipment	-0,0049382

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Results

KlassificeringStOlavsModell_5 - M4

Type: PLS Observations (N)=45, Variables (K)=18 (X=17, Y=1)

Components:

A	R2X	R2X(cum)	Eigenva...	R2Y	R2Y(cum)	Q2	Limit	Q2(cum)	Signifi...	It...
0	Cent.			Cent.						
1	0,302	0,302	5,14	0,701	0,701	0,65	0,05	0,65	R1	1
2	0,159	0,461	2,7	0,173	0,874	0,465	0,05	0,813	R1	1
3	0,137	0,598	2,33	0,0604	0,934	0,359	0,05	0,88	R1	1
4	0,13	0,728	2,2	0,0242	0,958	0,237	0,05	0,908	R1	1
5	0,0539	0,782	0,917	0,0151	0,973	0,0966	0,05	0,917	R1	1

$R^2Y = 0.973$
Explained variance

$Q^2 = 0.917$
Predicted variance

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Results

Observed vs Predicted

Subjective estimation (classification) of individuals' running times (performance)

y=0,9983*x+0,07117
R2=0,9733

Running time used for calibration of model (min)

Predicted running time (min)

RMSEE = 1,87337
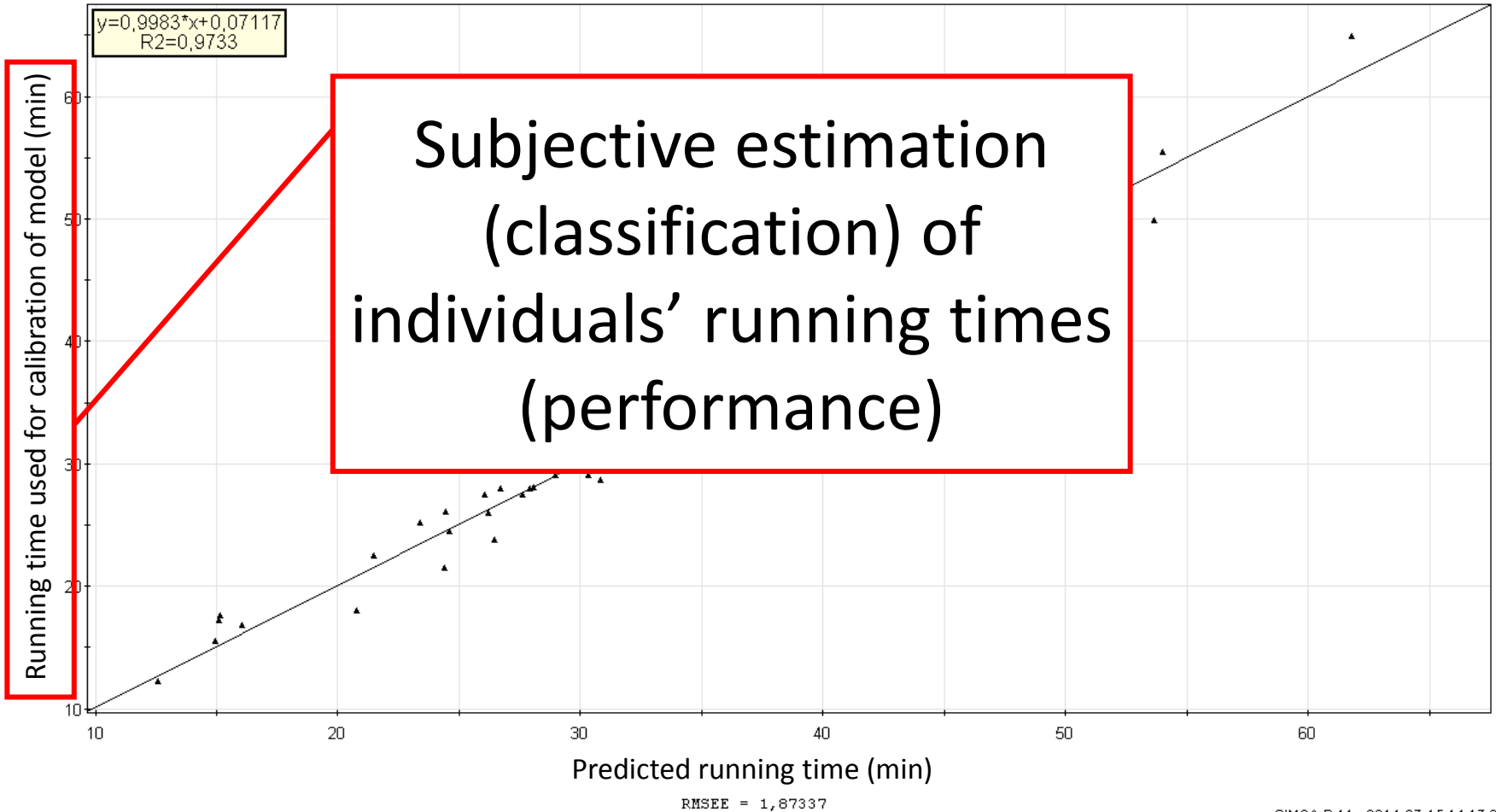
SIMCA-P 11 - 2014-07-15 14:17:21

Results

Total rank (200 teams in total)
    Original: 90th Adjusted: 140th

Best ranking on individual leg
    Original: 1st Adjusted: 17th

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Concluding remarks
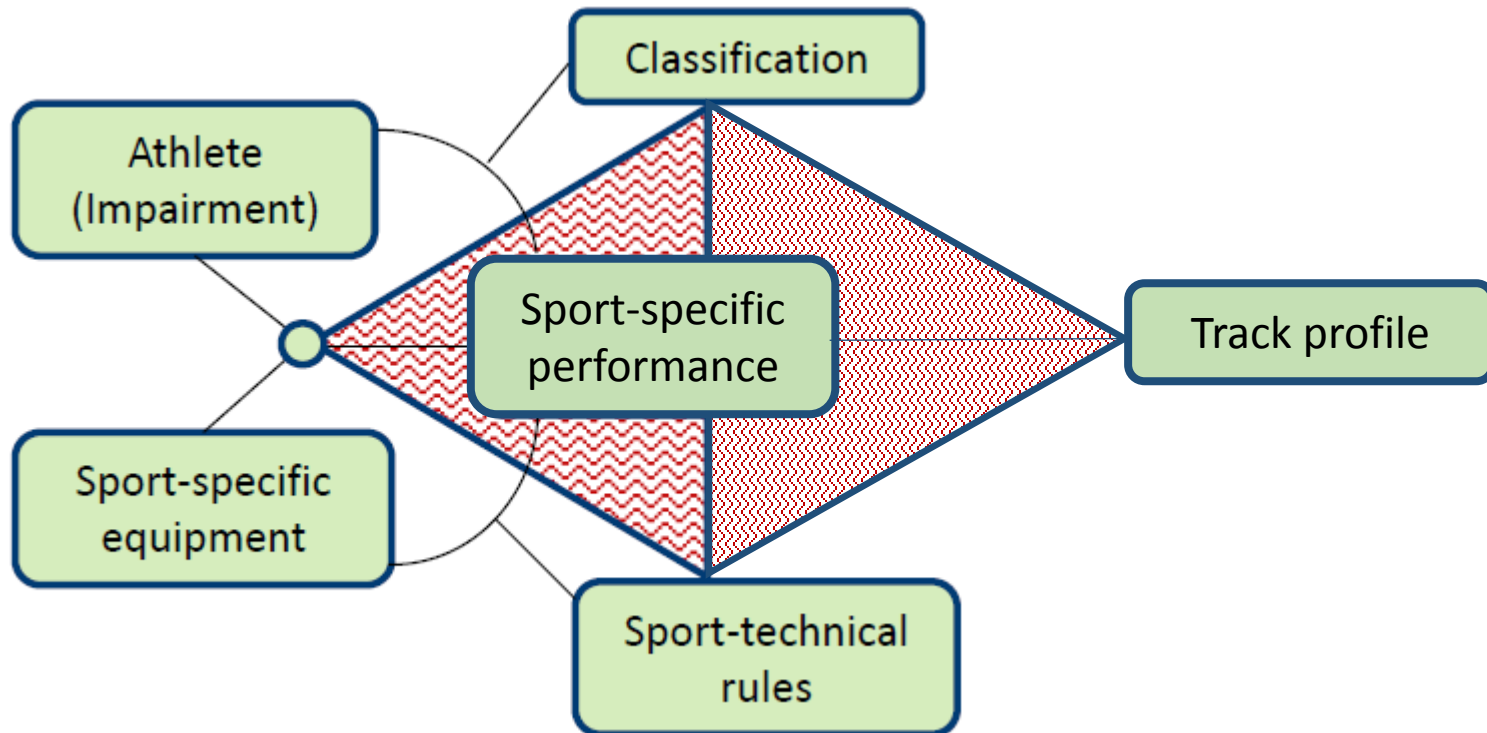
Personal reflections:
For inclusion on the grass-root and leisure level in this relay competition -this system is not needed

However

For individual races it might be of interest to compare times with runners

Concluding remarks

Copied from Peter van de Vliet

Thanks for your attention!

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