

Agricultural Work Sciences

- Work Time Calculation in LISL -

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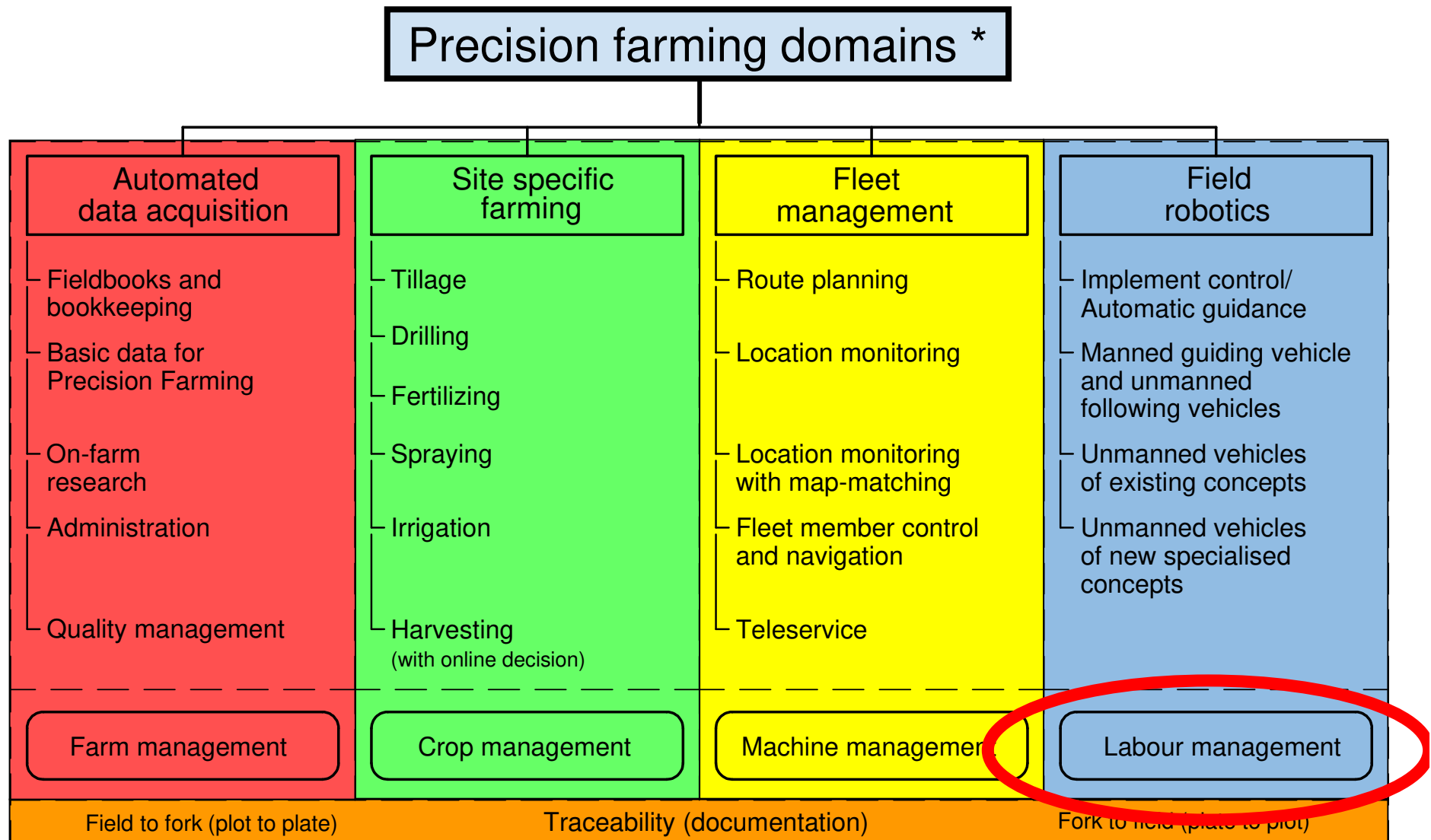
Congresso Brasileiro de Agricultura de Precisão ConBAP 2010
September 28, 2010
Ribeirão Preto
Brazil

Not the real
world of today !



(The Harvesters, Bruegel 1565)

„Precision Farming“ more than “Site-specific Farming”



*) First draft established 2001, Dec 4 by the author

Labor requirement is a very important part of the production costs

Still some manual work in agriculture forces a high work load

So for planning purposes we need an evaluation method to

- **improve** the work process at all
- **reduce** the work load above the continuous power rating
- **detect** the work sequences with a too high work load
- **substitute** those sequences with alternative technologies

But how can we do this ?

What's the working capacity ?



Established through calculation !

Travel time to field

- Distance, speed, type of road, ...

Preparation time before plowing

- Removal of safety devices, settings, ...

Plowing

- Speed, working width, turning time , ...

Preparation time after plowing

- Mounting of safety devices, ...

Travel time to farm



Established through calculation ?

Preparation of milking plant

- Parlor type, no. of milking units, ...

Collection of cows

- Type of barn, no. of cows...

Milking

- Type of milking unit, no of stalls, milk yield, average milk flow, ...

Cleaning of parlor

- Size, material, ...

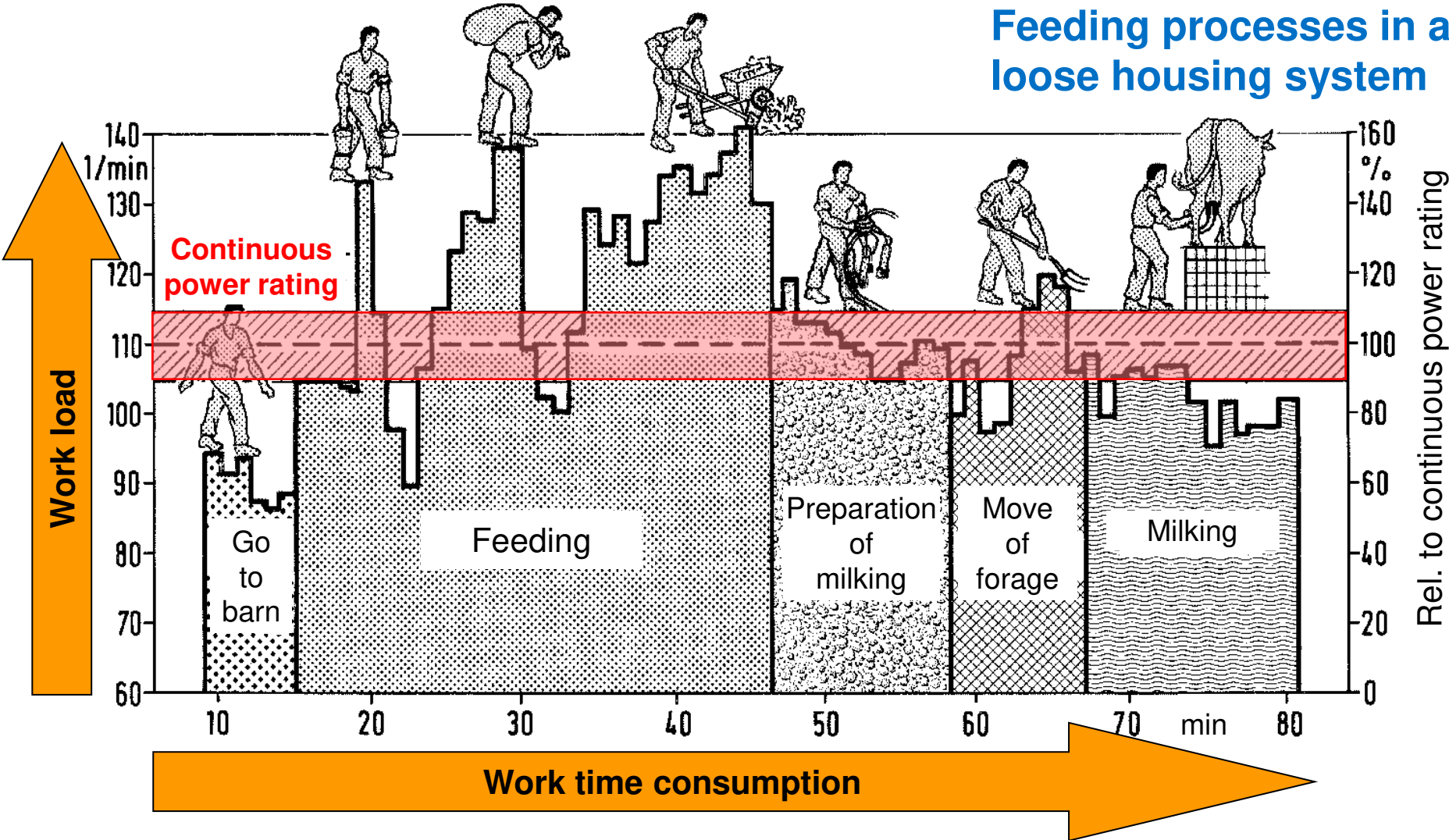
...

And what's about the work load ???

Doing the jobs e.g. in dairying



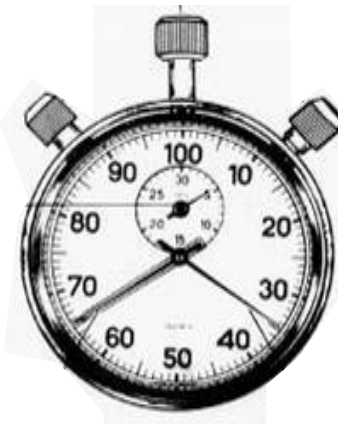
Feeding processes in a loose housing system



Work time measurement

Time measurement
(Taylor)

Methods measurement
(Gilbreth)



Work studies

Statistical analysis of working elements

Standardized work elements $t_n = \dots$

Method description

Allocation of standard times to motions

Standardized work elements $t_n = \dots$

MTM-Normzeitwertkarte
Deutsche MTM-Vereinigung e. V.,
2 Hamburg 55, Ferdinandshöh 1
Ausgabe 1971

Ohne gründliche Ausbildung können der Gebrauch dieser MTM andere Anwendung von MTM zu falschen Resultaten führen.

Die Zeitwerte dieser Karte entsprechen einer Leistung von 100% nach LMS

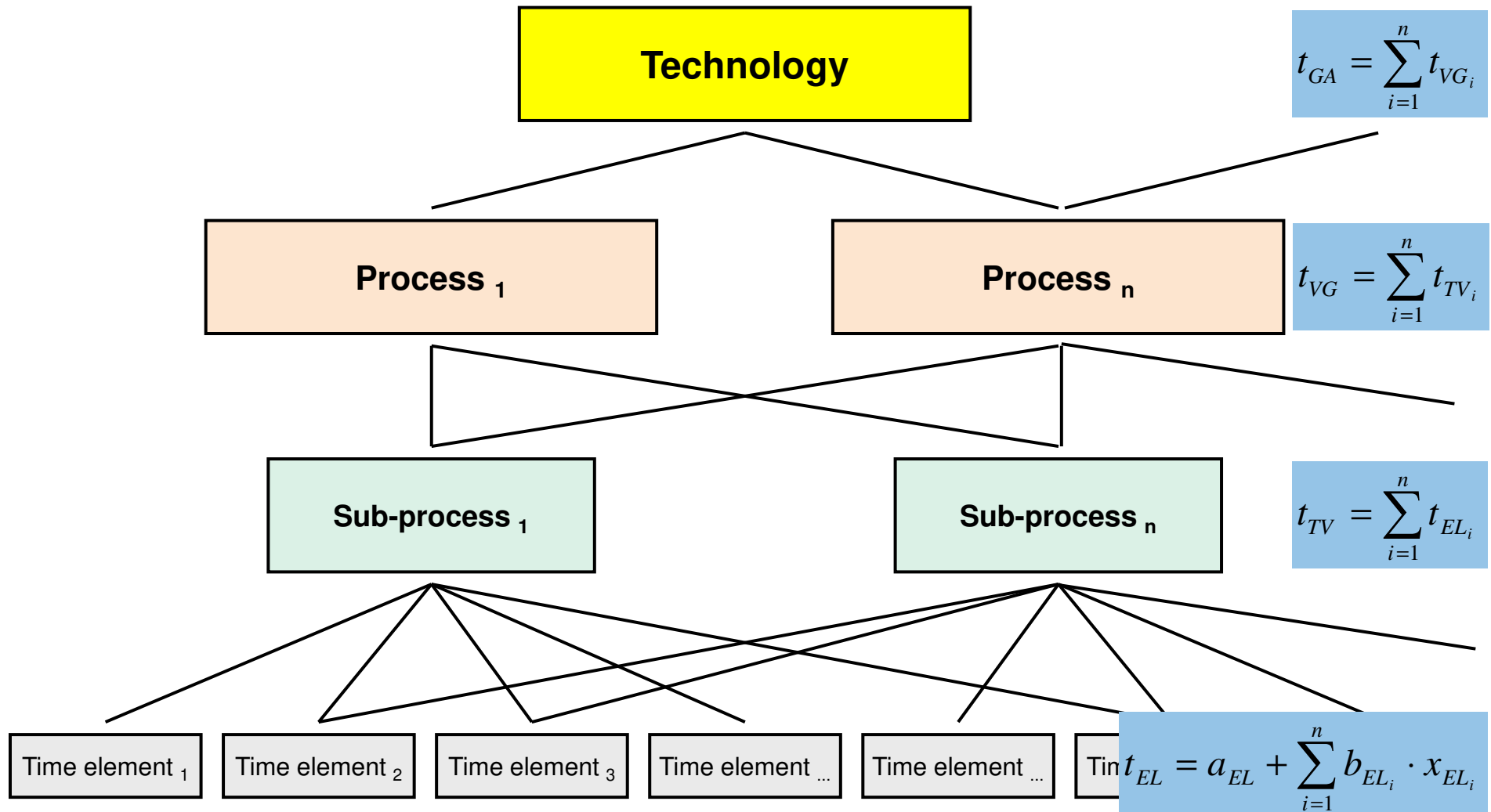
TMU	:
1	0
27,8	
1664,7	
100.000	

Einheiten — E — (Rechts)

Arbeits- länge in cm	Normzeitwerte in TMU								Bemerkungen
	E.A.	E.B.	E.C.	E.D.	E.E.	mE.A.	mE.B.	mE.C.	
2	2,0	2,0	2,0	2,0	1,6	1,6	0,4		A. Hin- und Gegen- genau der and- die and-
4	3,4	3,4	5,1	3,2	3,0	2,4	1,0		
6	4,5	4,5	6,5	4,4	3,9	3,1	1,4		
8	5,5	5,5	7,5	5,3	4,6	3,7	1,8		
10	6,1	6,3	8,4	6,4	4,9	4,3	2,0		B. Hin- und Gegen- Arbeits- distanz C
12	6,4	7,4	9,1	7,3	5,2	4,8	2,4		
14	6,8	8,2	9,7	7,8	5,5	5,4	2,8		
16	7,1	8,8	10,3	8,3	5,8	5,9	3,2		
18	7,5	9,4	10,8	8,7	6,1	6,5	3,6		C. Hin- und mit glei- stärken gewichte
20	7,8	10,0	11,4	9,2	6,5	7,1	3,9		
22	8,1	10,5	11,9	9,7	6,8	7,7	4,2		
24	8,5	11,1	12,5	10,2	7,1	8,1	4,5		
26	8,8	11,7	13,0	10,7	7,4	8,8	4,9		D. Hin- und klein- Vor- sicht
28	9,2	12,2	13,6	11,2	7,7	9,4	5,2		
30	9,5	12,8	14,1	11,7	8,0	9,9	5,5		
32	10,4	14,2	15,5	12,9	8,8	11,4	5,9		
40	11,3	15,8	16,8	14,1	9,6	12,8	6,5		E. Ver- le- ge- ste- m- de- G- ung- de- um- die- zu- er- f-
45	12,1	17,0	18,2	15,3	10,4	14,2	7,1		
50	13,0	18,4	19,6	16,5	11,2	15,7	7,7		
55	13,9	19,8	20,9	17,8	12,0	17,1	8,3		
60	14,7	21,2	22,3	19,0	12,8	18,5	8,9		
65	15,6	22,6	23,6	20,2	13,5	19,9	9,5		
70	16,5	24,1	25,0	21,4	14,3	21,4	10,1		
75	17,5	25,5	26,4	22,6	15,1	22,8	10,7		
80	18,2	26,9	27,7	23,8	15,9	24,2	11,3		

Basic model structure “Work Time Calculation” in LISL

(LISL = Landwirtschaftliches Informations-System Landtechnik)




```
DOS-Box - caldoc
L I S L   AgEng Systems Engineering Weihenstephan, 10-08-09   C A L D O C (V7A)
-----
          (C) Dr. H. Auernhammer, Weihenstephan 2009 (Run    15)

Data Source: Work-time elements and models Animal-Production (Weihenstephan)

This program enables the simulation of work time requirements of Animal and
Plant Production Systems in accordance with several influencing parameters
either by their defaults or by user-defened parameters.

The programm may be used in four different ways :

D i a l o g (DIAL)           Program controlled interactions

B a t c h  by File-Input (PARM)   Controlled from user named batch-file with
DOS-Command  .:\> caldoc <Parameter_file

B a t c h  by Line-Input (PADI)   Program controlled Batch-line input through
the screen (no protocol)

B a t c h  by Line-Input (PADIDRUC) Program controlled Batch-line input through
the screen with protocol in print file

Please make your choice (DIAL, PARM, PADI, PADIDRUC or END) !
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+
dial_
```

→ Program usage !

→ **Interactive
input/output
selection**

```

DOS-Box - caldoc
Choose next activity :
-----

 1 = Calculation of one or more models
 2 = Iteration of one parameter in a model
 3 = Show Headlines (titles) of models on screen
 4 = Show Parameters of one model on screen
 9 = End of Session

What is your code (0=1) !

How many models should be addet together (0=1) ?

Output of the results into a print file (y/n) ?                y
Model-description also into print file (y/n) ?
What is your type of Protocol (0=2) ?                        1
(1=all, 2=to TV, 3=to VG, 4=to GA, 5=Result only)

What is the number of the Model you want !                    22
Read model-description (y/n) ?

Use of parameters :
 0 ==> No change
 1 ==> Change all parameters
 2 ==> Change only the most important ?

What is your Code !

```

```
DOS-Box - C:\EDT\EDT liste.014
.....1.....2.....3.....4.....
Sequence of Simulation in Program      C A L D
=====
  calculation is done with surcharge (malfunction)

Model no.      22: Dairy farming in cubicle houses
-----

Allocations to the model parameter:
-----
1. Frequency of occurrence . . . . . 1.000 Occurance(s)
2. Haltungsdauer . . . . . 365.000 Days
3. Herd size . . . . . 60.000 Kuehe
4. Fuetterungen je Tag . . . . . 2.000 Fuetterungen
5. Anzahl der Arbeitspersonen (ohne Melken) . . . . . 1.000 Personen
6. Anzahl Trogreihen . . . . . 2.000 Reihen
7. Freßplatzbreite je Kuh . . . . . 1.100 Meter
8. Futtertischbreite . . . . . 3.000 Meter
9. Nachzucht vorhanden: (0=Nein, 1=Ja) . . . . . 1.000
10. Anteil Kaelber als Nachzucht . . . . . 50.000 Prozent
11. Mittlere Freßplatzbreite je Faerse . . . . . .550 Meter
12. Winterfuttertage . . . . . 180.000 Days
13. Trogabfall je Kuh und Tag . . . . . 1.000 Kilogramm
14. Menge Kraftfutter je Tier und Tag . . . . . 6.000 Kilogramm
Buffer: MAIN      File:<ltw/caldoc/liste.014 |Insert |Adv |[1,1]
```

→ Interactive adoption to the work process by model-specific defaults !

→ Results at a glance
 - *Work time*
 - *Work load*

```

C:\DOS-Box - caldoc
TV 2096 Assistance during calf birth

The total results taken from the print-file are :
-----

Working time per animal/day          9.4 Mmin =      .16 Mh
Working time per day total          566.6 Mmin =     9.44 Mh
Duration of work per day            539.3 Mmin =     8.99 Mh

Related to a keeping time of          365      Days
Working time per animal              57.44 Mh
Working time of the whole herd       3446.7 Mh

Average working person body load from energy consumption      13.8 kJ/min
rel. to DLG of women (11.4 kJ/min)  121.4 %
" " " " men (17.3 kJ/min)          80.0 %

Simulation finished (y/n) ?
    
```

CalDoc – “Dairy Housing Systems” – Created Files



```
DOS-Box - C:\EDT\EDT files
.....1.....2.....3.....4
Verzeichnis von C:\LISL\LTW\CalDoc
10.11.2009 18:09 <DIR> .
10.11.2009 18:09 <DIR> .
05.04.2010 13:29 120.210 C
05.04.2010 13:29 121.330 C
12.12.2009 15:17 376 Dairy.prm
16.12.2009 14:16 376 Dairy-TV.prm
09.08.2010 16:11 152 DIALPRM.014
03.09.2005 20:39 98.982 DOKLIS.EXE
14.04.2010 10:44 3.438.752 IDD
09.08.2010 16:15 682.062 IDDR
16.12.2005 14:09 779 InnBATCH.BAT
14.04.2010 10:41 2.363 KALINN.INI
16.11.2009 15:33 67 KILL.BAT
09.08.2010 16:11 51.363 LISTE.014
30.11.2009 09:56 1.570 Melken.prm
09.08.2010 16:11 128 RESULTS.014
12.12.2009 12:48 19 Test.bat
09.08.2010 16:11 45.839 WLOAD.014

16 Datei(en) 4.916.052 Bytes
2 Verzeichnis(se), 2.289.098.752 Bytes frei
[EOB]
Buffer: MAIN File:<isl\ltw\caldoc\files |Insert |Adv |[25,38]
```

→ **Creation of specific files ***

- **DIALPARM** (Input batch-file)
- **LISTE** (Calculation protocol)
- **WLOAD** (Work load file)
- **RESULTS** (Main results in line output)

* File extension from run #

CalDoc – “Dairy Housing Systems” – Work Sequence



→ **Comprehensive calculation output**

Defined to

- *Instruction*
- *Schooling*
- *Model test*

```

DOS-Box - C:\EDT\EDT LISTE.014
.....1.....2.....3.....4.....5.....6
-----
Structure of work sequence (Coding: GA=Total work, VG=w'ing)
-----
Model-
Code Number          Model description
-----
GA    22  Dairy farming in cubicle houses, herringbone mi
VG    200  Setup-work at feeding begin                      1.00
TV    2000  Setup-work at feeding begin                    1.00
EL    20000  Go to barn door                                       1.00   .2
EL    20001  Open door                                           1.00   .1
PL   100905  Turn switch(es) on/off                               1.00   .1
EL    20002  Close door                                           1.00   .1
EL    20003  Go to origin of feeding trough                       1.00   .1
EL    20004  Go to barn gate                                     4.00   .1
EL    20005  Open gate                                           2.00   .6
-----
                                           1.3
TV    2001  Cleaning of feeding trough                            1.00
EL    20010  Retrieve hand tool for feeding trough cleaning       1.00   .1
PL   100200  Clean feeding trough                                1.00   5.2
EL    20011  Go to next feeding trough                            1.00   .0
-----
Buffer: MAIN          File:<ltw/caldoc/liste.014 |Insert |Adv |[126,1/caldoc/liste.014 |Insert |Adv |[126,1]
    
```

CalDoc – “Dairy Housing Systems” – Work Sequence



		1	2	3	4	5	
VG	217	Milking in herringbone or rotary milking					
TV	2070	General preparation work before milking					
EL	20700	Go to dairy room					
EL	20001	Open door					
PL	100905	Turn switch(es) on/off					1,00 .1
EL	20701	Retrieve apron					1,00 .2
EL	20702	Tie apron around					1,00 .4
						----- .9	
TV	2271	Set-up work before milking in milking parlour					1,00
EL	20711	Fit milk pipe line to milk tank					1,00 .3
EL	20713	Do additional preparation work in dairy room					1,00 .8
EL	20714	Turn milking plant on					1,00 .1
EL	20710	Incorporate milk filter					1,00 .5
EL	22710	Go to milking parlour					1,00 .1
PL	100446	Melkzeuge von Spuelleitung abnehmen und vorbereiten					1,00 1.1
EL	22711	Additional preparation work in milking parlour					1,00 .5
						----- 3.3	
TV	2270	Push cows in loose housing system to waiting room					1,00
EL	20490	Go to first barrier					3,00 .2
EL	22700	Durch Absperrung hindurchtreten und wieder schliessen					1,00 .1
EL	20491	Establish barrier					12,00 3.1

→ Work sequence

- Work time element
- Frequency (repetitions)
- Man minutes (Mmin)

CalDoc – “Dairy Housing Systems” – Work Sequence



→ **Reduced protocol**

- *Total work*
- *Processes*
- *Sub processes*

```

DOS-Box - C:\EDT\EDT LISTE.016
.....1.....2.....3.....4.....5.....6.....
-----
Structure of work sequence (Coding: GA=Total work, VG=W'instance,
-----
Model-
Code Number          Model description
-----
GA    22  Dairy farming in cubicle houses, herringbone milking par  1.00
VG    200  Setup-work at feeding begin                               1.00
TV    2000  Setup-work at feeding begin                               1.00          1.3
TV    2001  Cleaning of feeding trough                                   1.00          5.4
TV    2002  Load trash from feeding trough and move it away                 1.00          7.4
-----          14.2

VG    211  Filling of concentrate feed into barrow and distributio  1.00
TV    2013  Fill feeding barrow with conc. feed from silo / unload          1.00          2.3
TV    2111  Distribute conc. feed with feed barrow with outlet              1.00          7.7
-----          10.0

VG    252  Frontl./bunker sil. unloader feed mixing wagon, distrib  .49
TV    2120  Unload silage from bunker silo with rotary unloader           .49          4.0
TV    2123  Distribute silage with feed mixing wagon                       .49          2.0
-----          6.0

Buffer: MAIN          File:<|tw/caldoc/liste.016 |Insert |Adv |[126,1]caldoc/liste.016 |Insert |Adv |[126,1]
    
```


CalDoc – “Dairy Housing Systems” – Work Sequence



→ **Reduced protocol**
 - *Total work*
 - *Processes*

DOS-Box - C:\EDT\EDT LISTE.017

.....1.....2.....3.....4.....5.....6.....

Structure of work sequence (Coding: GA=Total work, VG=W'instance, ...)

Code	Number	Model description	Frequency	working time (MPminutes) related to				
				PL/EL	TV	VG	GA	HV
GA	22	Dairy farming in cubicle houses, herringbone milking par	1.00					
VG	200	Setup-work at feeding begin	1.00			14.2		
VG	211	Filling of concentrate feed into barrow and distributio	1.00			10.0		
VG	252	Frontl./bunker sil. unloader feed mixing wagon, distrib	.49			6.0		
VG	252	Frontl./bunker sil. unloader feed mixing wagon, distrib	.49			4.3		
VG	252	Frontl./bunker sil. unloader feed mixing wagon, distrib	.51			6.0		
VG	203	Feeding of roughage	.49			11.0		
VG	214	Summer barn-feeding	.10			4.0		
VG	204	Pasturing work	.51			51.7		
VG	225	Cleaning & bedding of cubicle boxes in loose housing sy	.49			2.3		
VG	206	Refinishing work at feeding end	1.00			8.0		
VG	217	Milking in herringbone or rotary milking parlour	1.00			144.7		
VG	208	Extra work (windows cleaning, barn painting etc.)	1.00			13.5		
VG	209	Service work according to animals	1.00			2.7		
VG	219	Special work for reproduction (pregnancy, birth)	1.00			5.1		
						-----	283.3	

Buffer: MAIN File:<ltw/caldoc/liste.017 |Insert Adv |[109,1/caldoc/liste.017 |Insert Adv |[109,1]

CalDoc – “Dairy Housing Systems” – Iteration



1

Sequence of Simulation in Program

=====
 Calculation is done with surcha

→ **Iteration of one Parameter**
 - *important results*
 - *average work load only*

Model no. 217: Milking in herringbone or rotary milking parlour

Initial situation : 40 Animals, 365 Days of support, 2 Feedings/day
 Iteration of no. : 3. Herd size
 from 40.00 to 60.00 Cows , Step width = 5.00

Variable no. 3 (Cows)	Working time per day (Mmin)	Work load (kJ/min)	W o r k t i m e requirement per day and herd (Mmin) (Mh)		husbandry time animal (Mh)	herd (Mh)	animal and year (Mh)
40.000	171.0	13.1	195.9	3.3	29.79	1191.6	29.79
45.000	183.6	13.5	217.0	3.6	29.33	1320.1	29.33
50.000	196.2	13.8	238.1	4.0	28.97	1448.5	28.97
55.000	208.8	14.1	259.2	4.3	28.67	1577.0	28.67
60.000	224.6	14.1	277.7	4.6	28.16	1689.6	28.16

Final model results (milking with a pipeline milking system)

Result of calculation for a stock size of	15	cows
Time consumption per cow and day	7.9 Mmin*	= 0.13 Mh**
Time consumption per day and stock size	119.0 Mmin	= 1.98 Mh
Working duration per day	119.0 Mmin	= 1.98 Mh
Rearing period of	365	days
Time consumption per cow and period	48.3	Mh
Time consumption for full stock and period	723.8	Mh

Average work load from energy consumption	15.9	kJ/min
Rel. work load "female" (11.4 kJ/min)	139.8	%
Rel. work load "male" (17.3 kJ/min)	92.1	%

* Mmin = Man minutes

** Mh = Man hours

Part 1 **Title**

Measurement points
Author(s)
Modifications

Part 2 **Work content**

Work flow
Restrictions

Part 3 **Parameters**

Number of parameters
Parameter definition
Default value of parameters
Dimension

Part 6 **Work element with statistics / Sub model concatenation**

either **Mean / Regression**
with: Distribution
Probability
Test values
Transformations (log)

or **Concatenation rules**
with: Calculated parameters
Number of sub models
Parameters of sub model

Part 7: Energy consumption with

- Working posture (partly)
- Working type (partly)
- Energy consumption



Work load = Energy consumption (working postures & types of work)

Working posture	kJ/min		
Sitting	1.0		
Kneeing	3.0		
Croching	5.0		
Standing	2.5		
Ducked standing	4.0		
Walking	7.0		
Moving up/down	3,0 per meter		
Type of Work	kJ/min		
Simple handwork	1.0	- 1.8 -	2.5
Medium handwork	2.5	- 3.3 -	4.0
Haevy handwork	4.0	- 4.8 -	5.5
Simple one arm work	2.5	- 3.8 -	5.0
Medium one arm work	5.0	- 6.3 -	7.5
Haevy one arm work	7.5	- 8.8 -	10.0
Simple two arm work	6.0	- 7.3 -	8.5
Medium two arm work	8.5	- 9.8 -	11.0
Haevy two arm work	11.0	- 12.3 -	13.5
Simple body work	11.0	- 14.0 -	17.0
Medium body work	17.0	- 21.0 -	25.0
Haevy body work	25.0	- 30.0 -	35.0
Very haevy body work	35.0	- 42.5 -	50.0

The overall energy consumption is generated through addition of working posture and type of work e.g. for tractor driving

Sitting = **1.3 kJ/min**

Simple two arm work = **7.3 kJ/min**

Total energy consumption = 8.6 kJ/min

Reasonable energy consumption across a working day of 8 hours:

Male 8.500 kJ/8h = **17.3 kJ/min**
 Female 5.500 kJ/8h = **11.4 kJ/min**

Source: Hettinger und Spitzer, 1982

Document of process element „Walking without load“ in LISL



Dokument-Inn 100900 11. 7.05 12 0 0 0

PL 100900 Walking without load (load < 20kg)

Beginning: Lift foot for first step

End: Hit the ground with foot after last step

Created: 01.06.77 by H.Auernhammer, J.Reinholz, H.Zaeh

----- end of section -----

Content...

Walking with loads of max. 20kg.

----- end of section -----

Changeable variables = 2

- 1. Frequency 1.0
- 2. Walking distance 20.0 Meter

----- end of section -----

Data acquisition scheme for 1 mandatory and 0 exploratory variables

- 1. Walking dist Meter 25-29 1 0 1.00

----- end of section -----

Function 2652 measured values with 1 factors.; supplement = .90%

B = .928 average-Y = 29.0 S = .700 F=3433.0
 Distance 19.900 1.3113 .0060 225.863 .975 .000

----- End of section -----

Work load function

Energy- Posture 0.0 0.0 0.0 0.0 0.0 0.0 1.0 0.0
 Energy- Work type 0.0 0.0 0.0 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

----- End of document -----

Working posture

- Sitting
- Kneeing
- Croching
- Standing
- Ducked standing
- Walking
- Moving up/down

Type of Work

- Simple handwork
- Medium handwork
- Haevy handwork
- Simple one arm work
- Medium one arm work
- Haevy one arm work
- Simple two arm work
- Medium two arm work
- Haevy two arm work
- Simple body work
- Medium body work
- Haevy body work
- Very haevy body work

$$e_{EL} = \sum_{i=1}^n r_{EL_i} \cdot c_{EL_i} \cdot t_{EL_i}$$

DOS-Box - C:\EDT\EDT wload.016																									
		1	2	3	4	5																			
Model:	GA	22 Dairy farming in cubicle houses, her																							
TV	2000	Setup-work at feeding begin																							
EL	20000	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.077	9.3	3.8	13.1
EL	20001	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.040	11.0	3.8	14.8
PL	100905	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.220	2.5	14.0	16.5
EL	20002	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.077	9.3	3.8	13.1
EL	20003	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.072	9.6	13.3	22.9
EL	20004	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.699	2.5	11.9	14.4
EL	20005	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.484	9.6	13.3	22.9
TV	2001	Cleaning of feeding trough																							
EL	20010	.0	.0	.0	.2	.0	.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.753	9.6	13.3	22.9
PL	100200	.0	.0	.0	.0	.3	.7	.0	.0	.0	.0	.0	.0	.0	.4	.0	.0	.6	.0	.0	.0	1.206	9.6	13.3	22.9
EL	20011	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.132	11.0	3.8	14.8
EL	20013	.0	.0	.0	.2	.0	.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.095	2.5	3.3	5.8
TV	2002	Load trash from feeding trough and move it away																							
EL	20020	.0	.0	.0	.0	.2	.8	.0	.0	.0	.0	.0	.0	.1	.0	.0	.9	.0	.0	.0	.0	.053	11.0	3.8	14.8
EL	20024	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.5	.0	.5	.0	.0	.0	.0				
EL	20021	.0	.0	.0	.0	.2	.8	.0	.0	.0	.0	.0	.0	.1	.0	.0	.9	.0	.0	.0	.0				
PL	100231	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0				
EL	20022	.0	.0	.0	.0	.2	.8	.0	.0	.0	.0	.0	.0	.1	.0	.0	.9	.0	.0	.0	.0				
EL	20023	.0	.0	.0	.0	.2	.8	.0	.0	.0	.0	.0	.0	.1	.0	.0	.9	.0	.0	.0	.0				
TV	2013	Fill feeding barrow with conc. feed from silo / unload screw																							
EL	20130	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0				
PL	100030	.0	.0	.0	1.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0				
EL	20132	.0	.0	.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0				

→ File “WORKLOAD

Values per work element

- #
- Coding of energy consumption
- Working time
- E-consumption “Working posture”
- E-consumption “Type of work”
- Sum of E-consumption

Example of a work load file in LISL



Model: VG 207 Milking in a tied-up stall with bucket milking system																						
TV	2070	General preparation work for milking																				
EL	20700	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.132	
EL	20001	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.125	
PL	100905	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.090	
EL	20701	0.0	0.0	0.0	0.2	0.0	0.8	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.166	
EL	20702	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.4	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.357	
TV	2071	preparation work for milking in a tied-up stall																				
PL	100441	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	2.000	
...																						
EL	20712	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.000	
EL	20717	0.0	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.383	
TV	2072	Milking in a tied-up stall with bucket milking system																				
EL	20720	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.190	
EL	21701	0.0	0.0	0.0	0.3	0.0	0.7	0.0	0.0	0.6	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.760	
...																						
EL	20722	0.0	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	4.109	
EL	20723	0.0	0.0	0.0	0.3	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	10.656	
EL	20724	0.0	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	2.370	
TV	2073	Finishing work after milking in a tied-up stall																				
EL	20732	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.090	
PL	100919	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.277	
...																						
Rel. share		0.0	0.0	20.4	44.0	12.3	23.3	0.0	0.5	5.4	0.0	11.5	1.7	1.1	10.0	40.0	0.0	0.0	0.0	0.0	9.500	
				100% Working posture												100% Type of work						total time

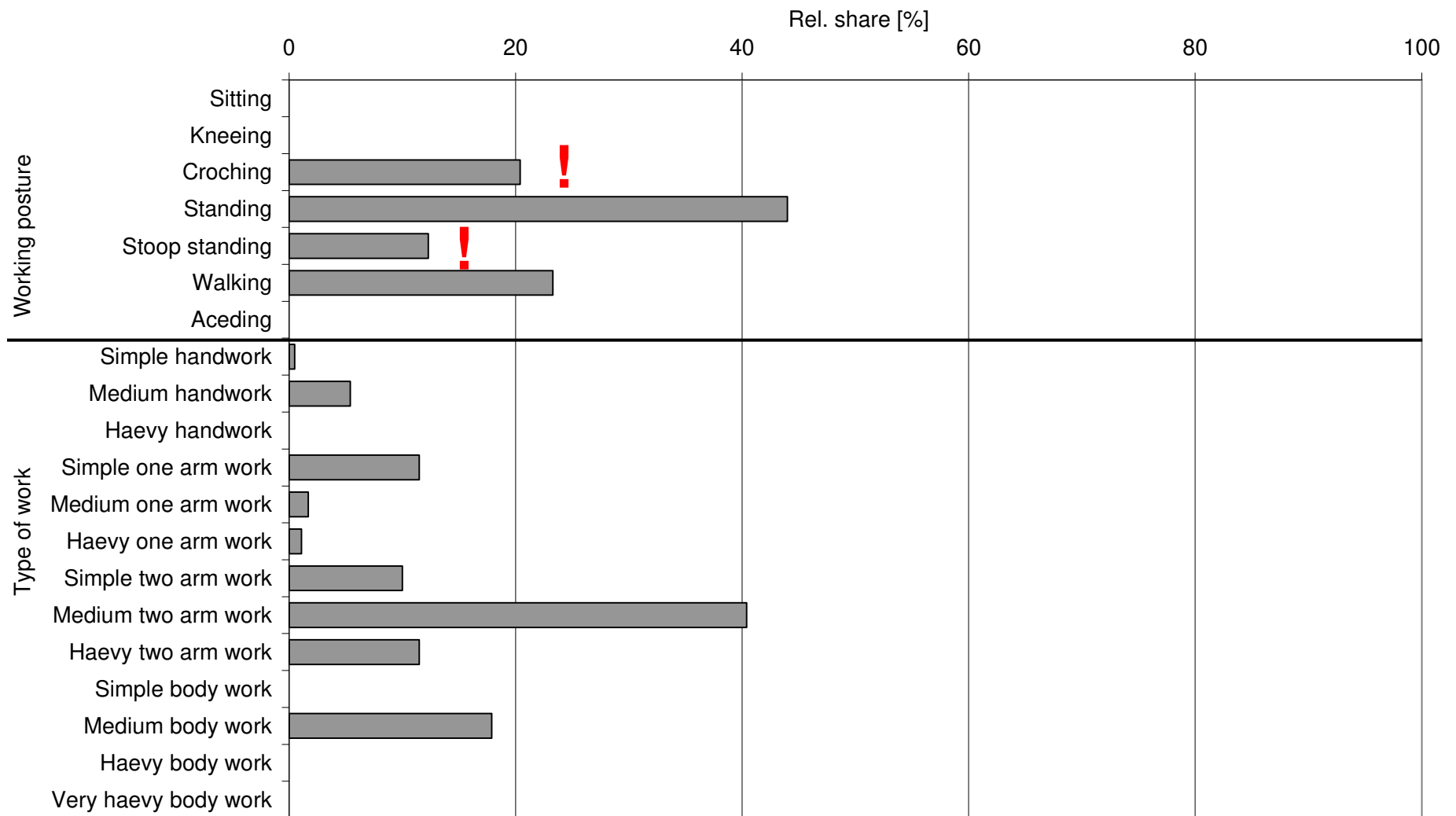
Working posture

- Sitting
- Kneeing
- Croching
- Standing
- Ducked standing
- Walking
- Moving up/down

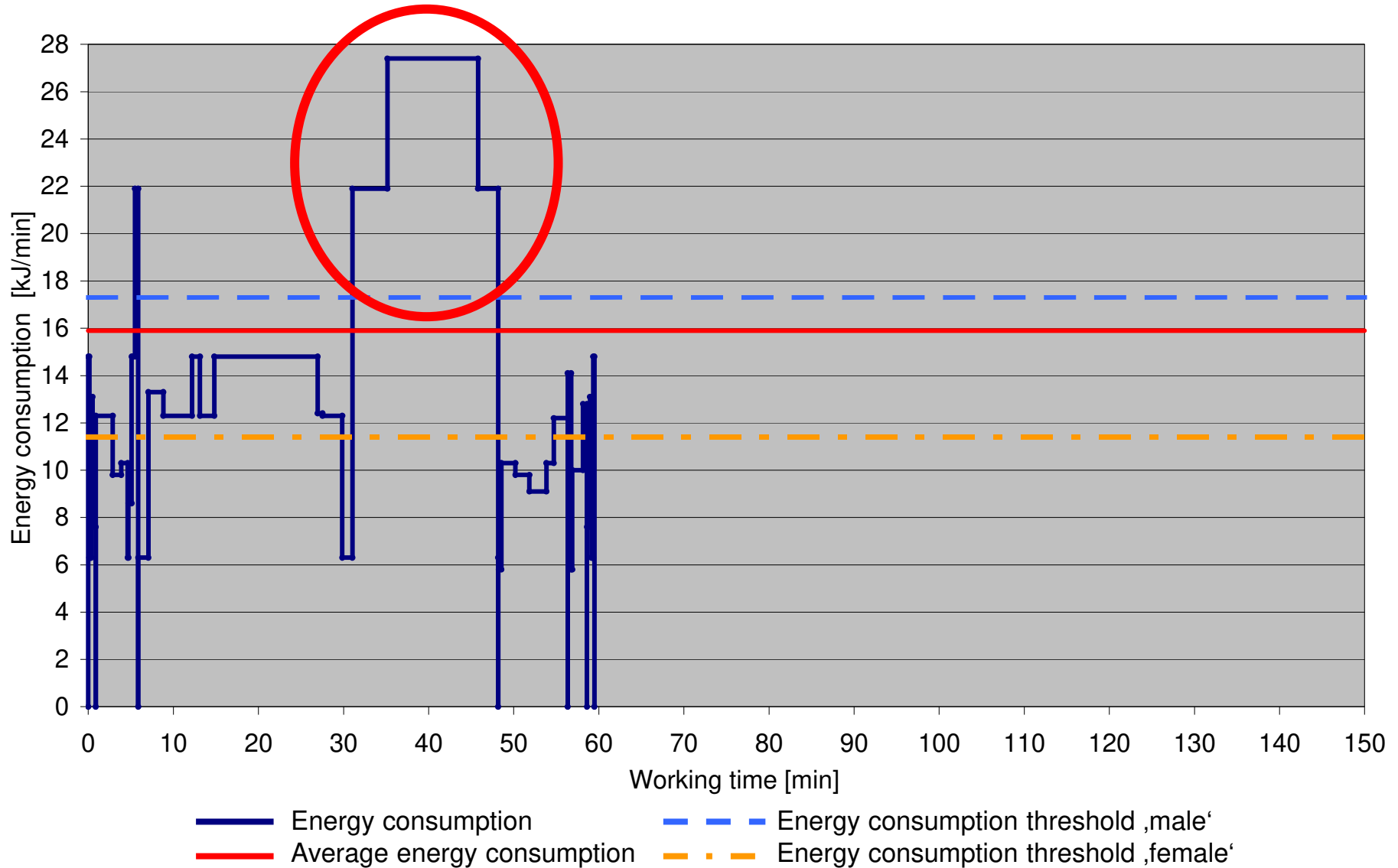
Type of Work

- Simple handwork
- Medium handwork
- Haevy handwork
- Simple one arm work
- Medium one arm work
- Haevy one arm work
- Simple two arm work
- Medium two arm work
- Haevy two arm work
- Simple body work
- Medium body work
- Haevy body work
- Very haevy body work

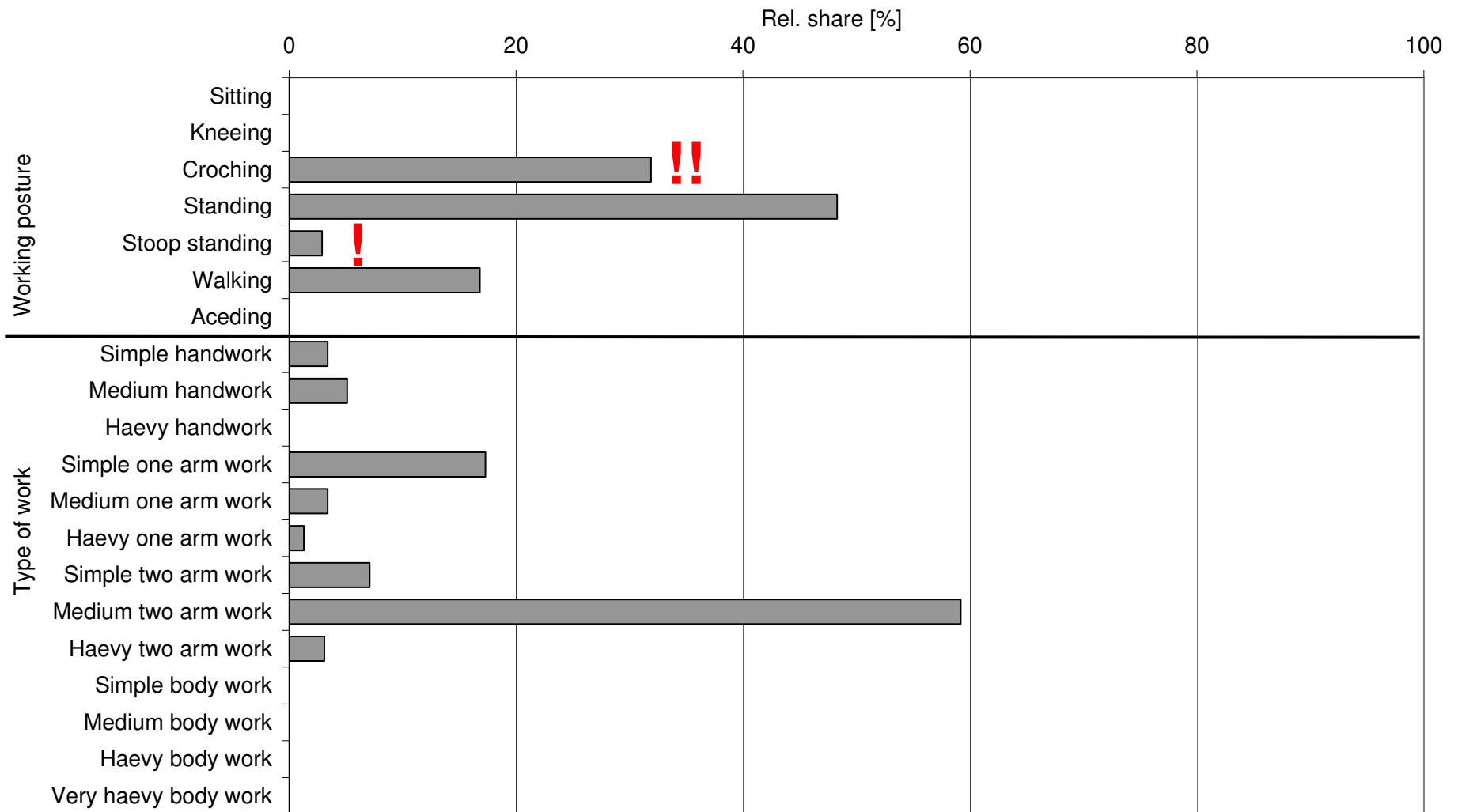
Bucket milking system



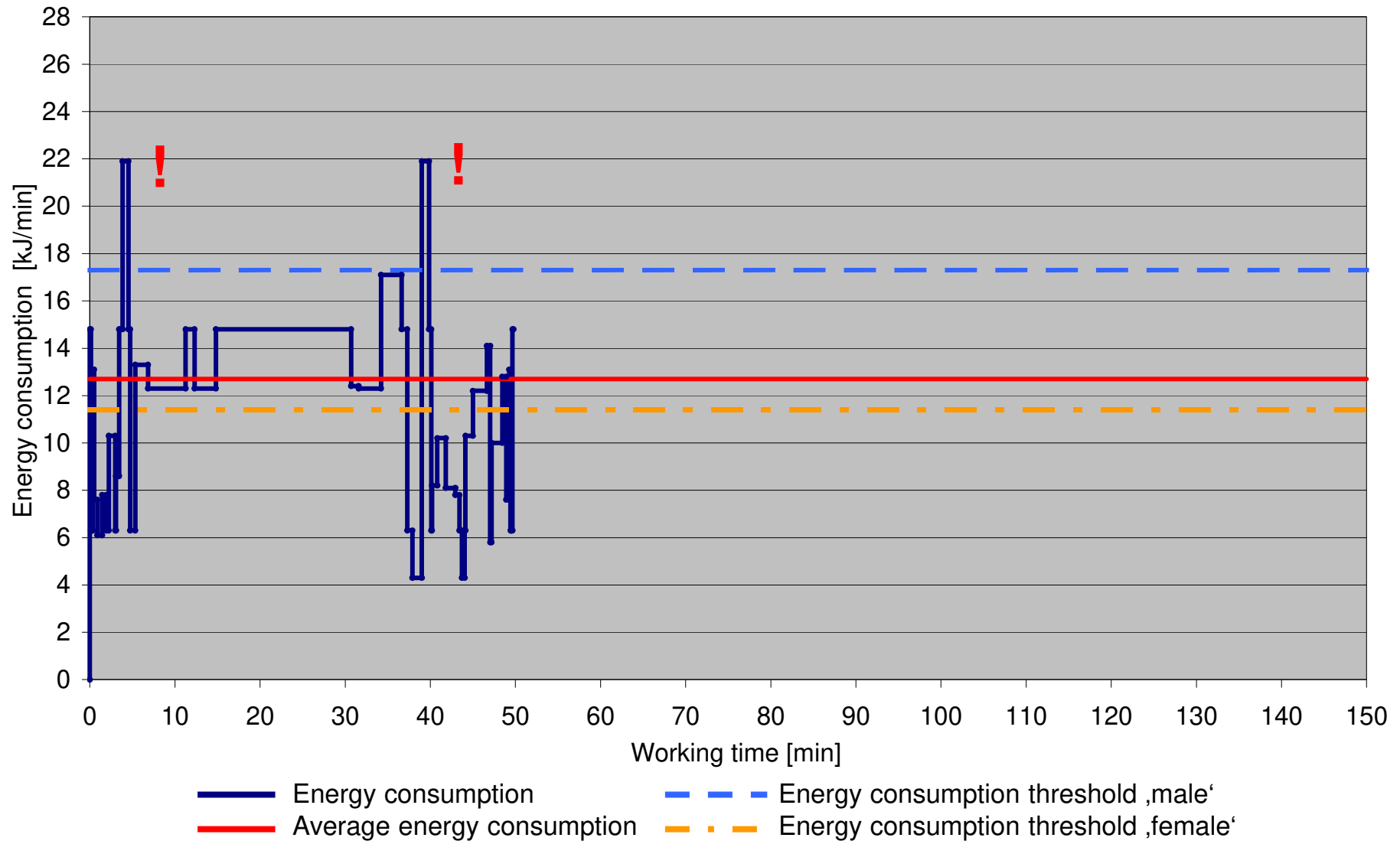
Bucket milking system



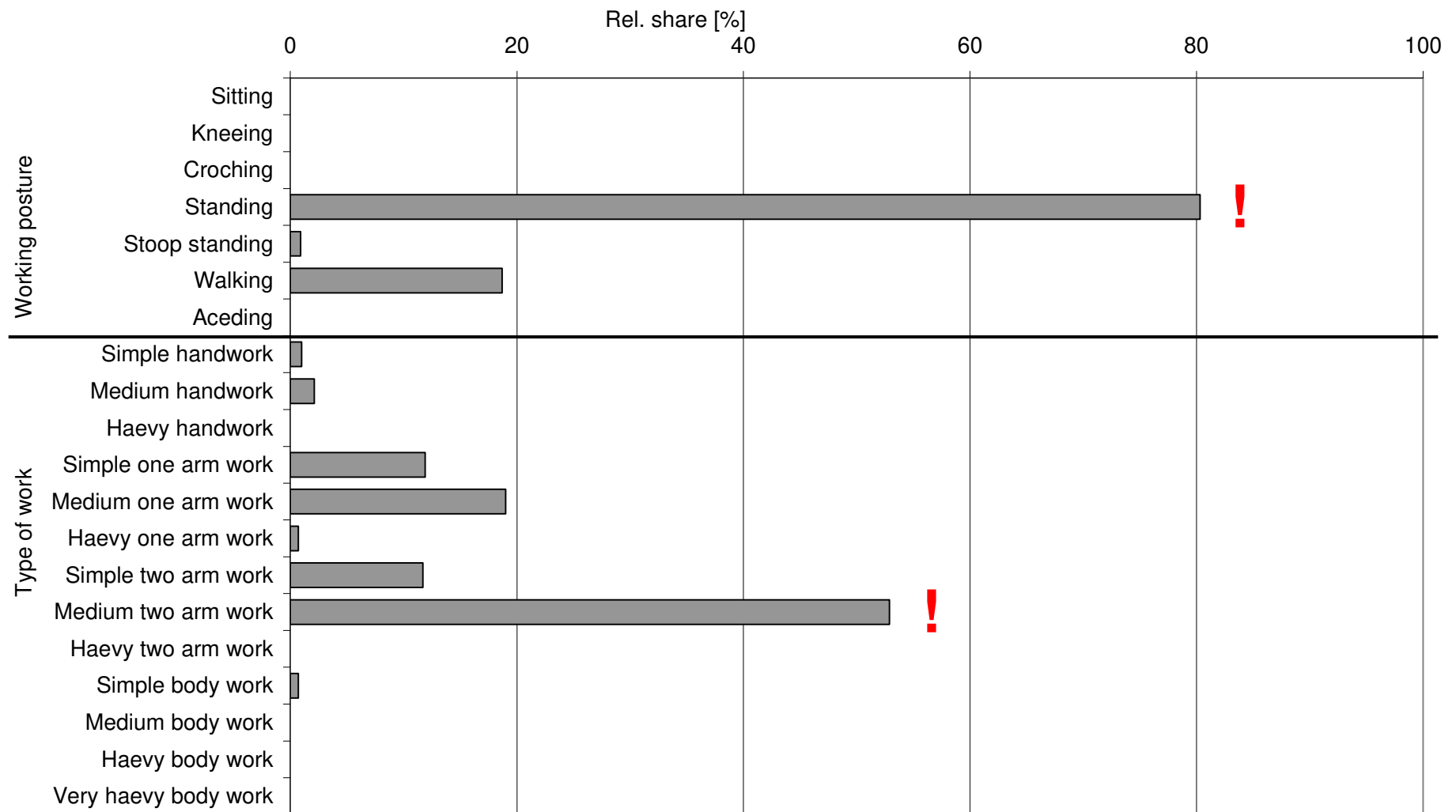
Pipeline milking system



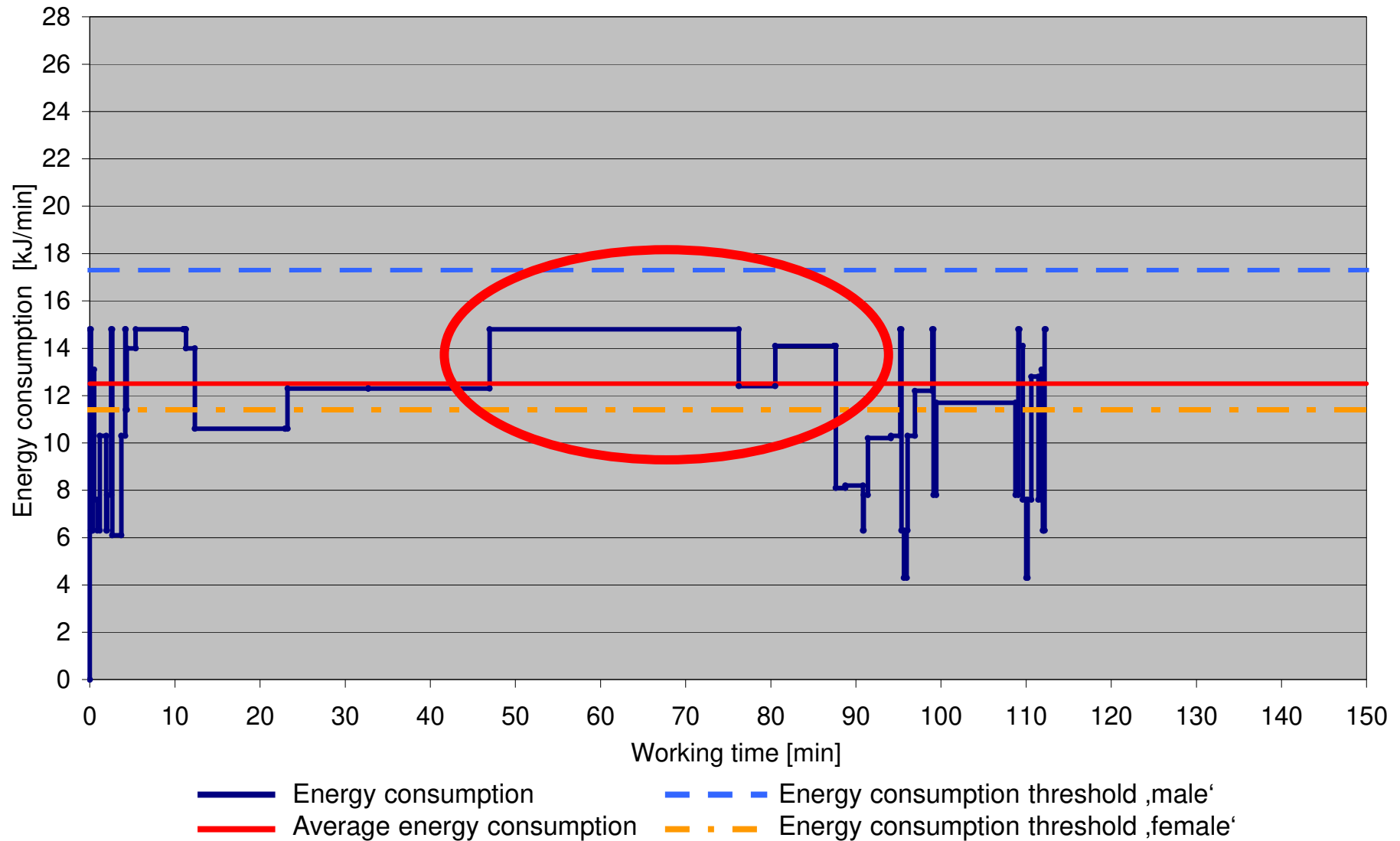
Pipeline milking system



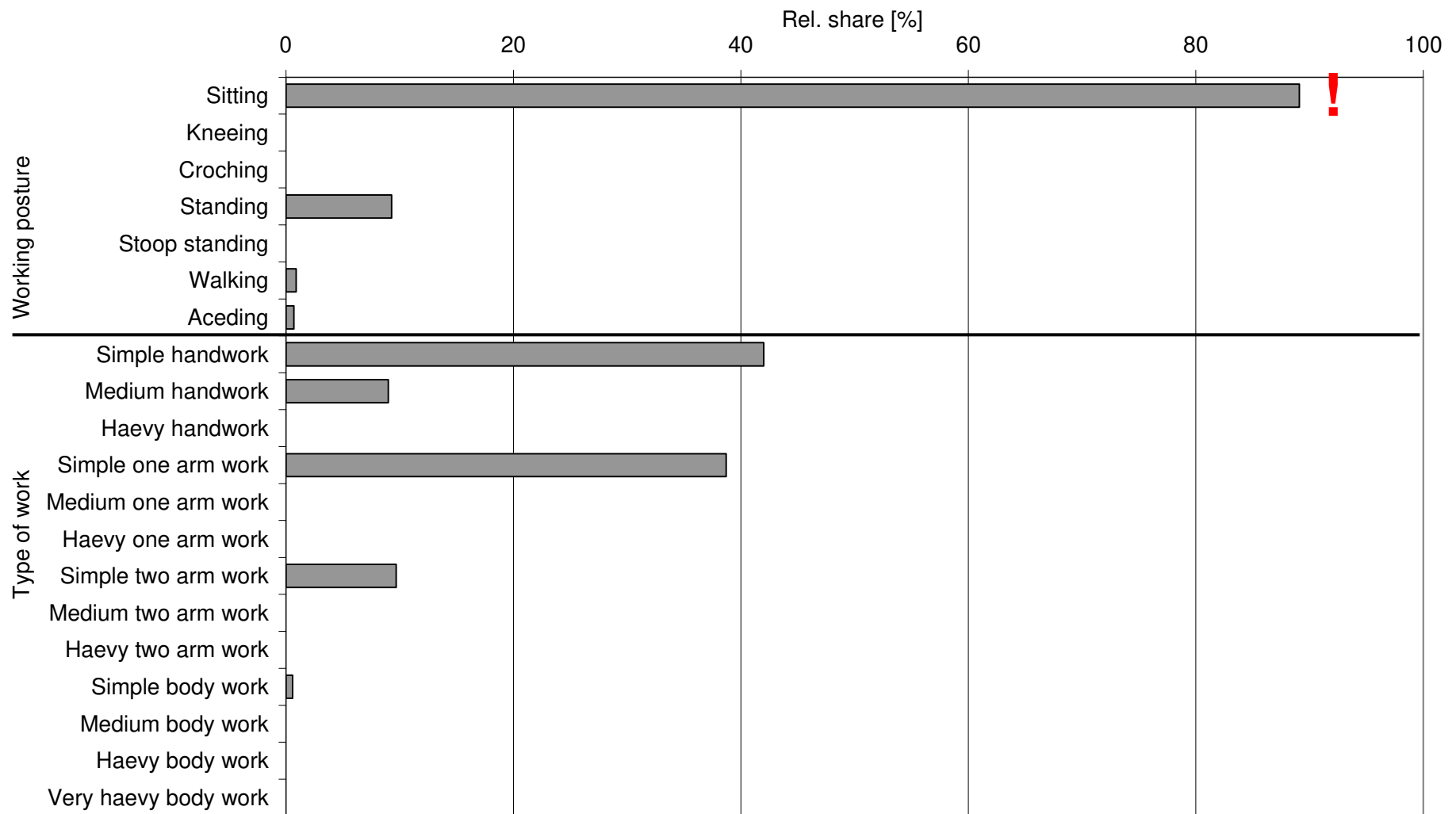
Herringbone milking parlour



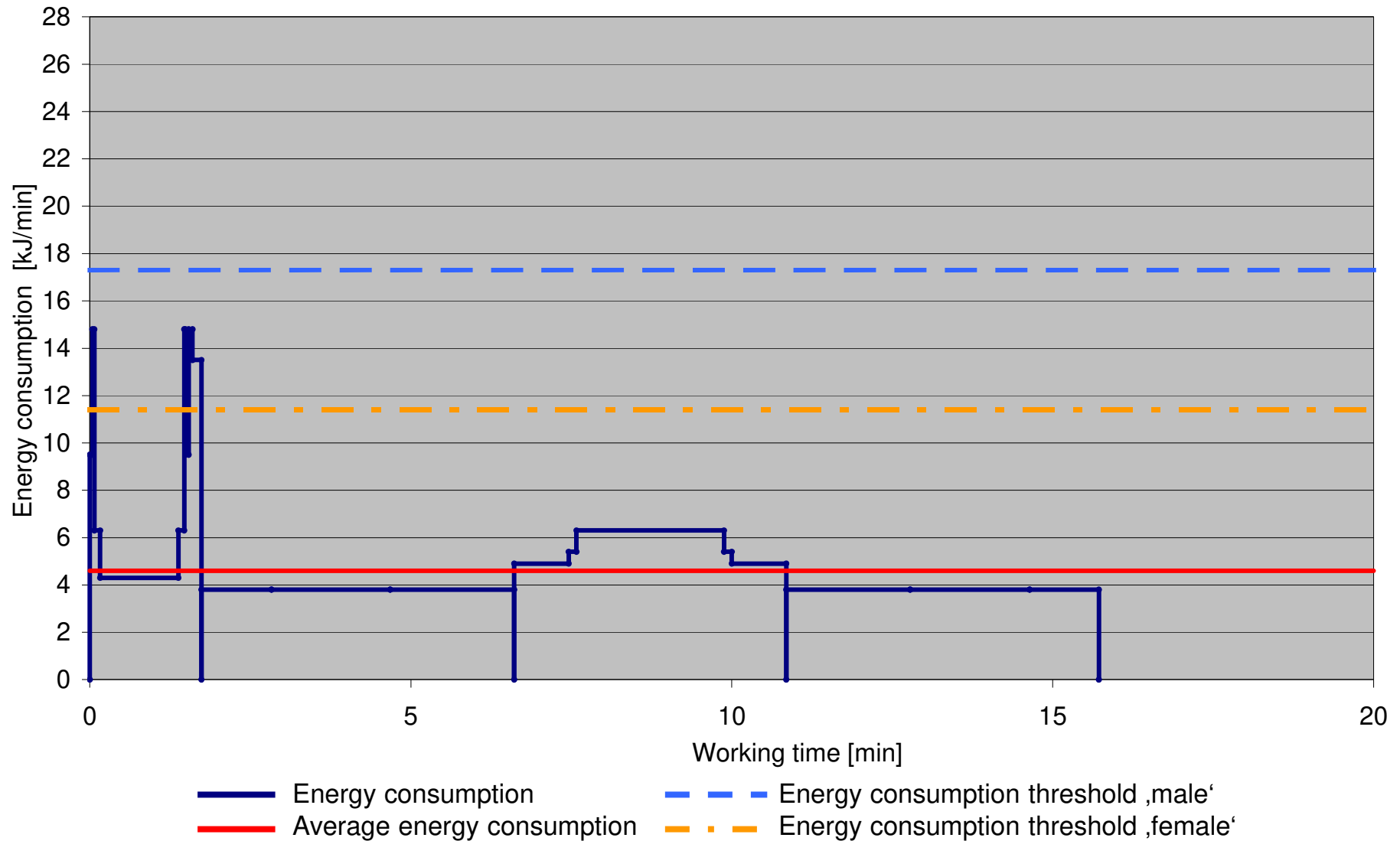
Herringbone milking parlour



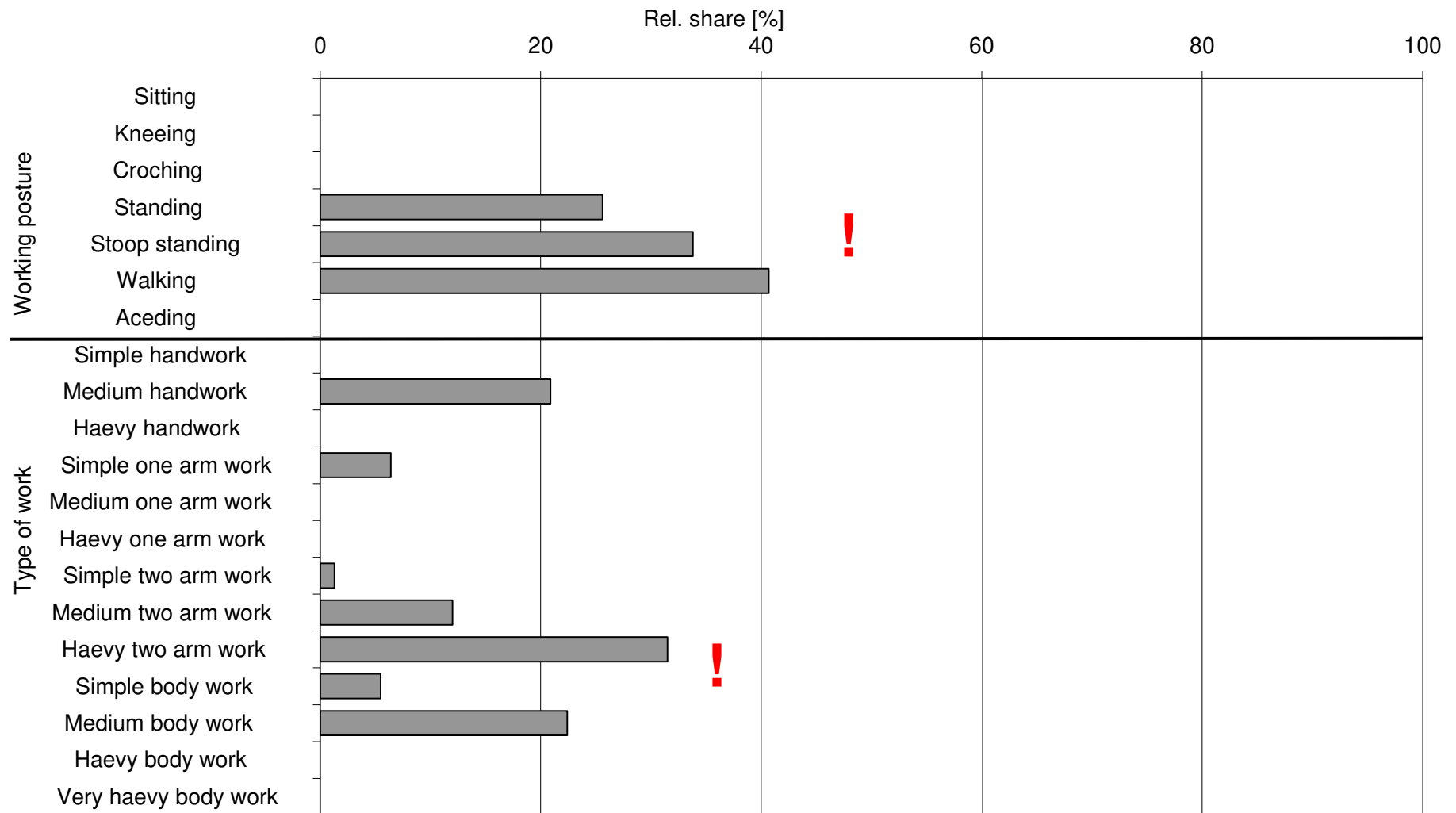
Slurry spreading



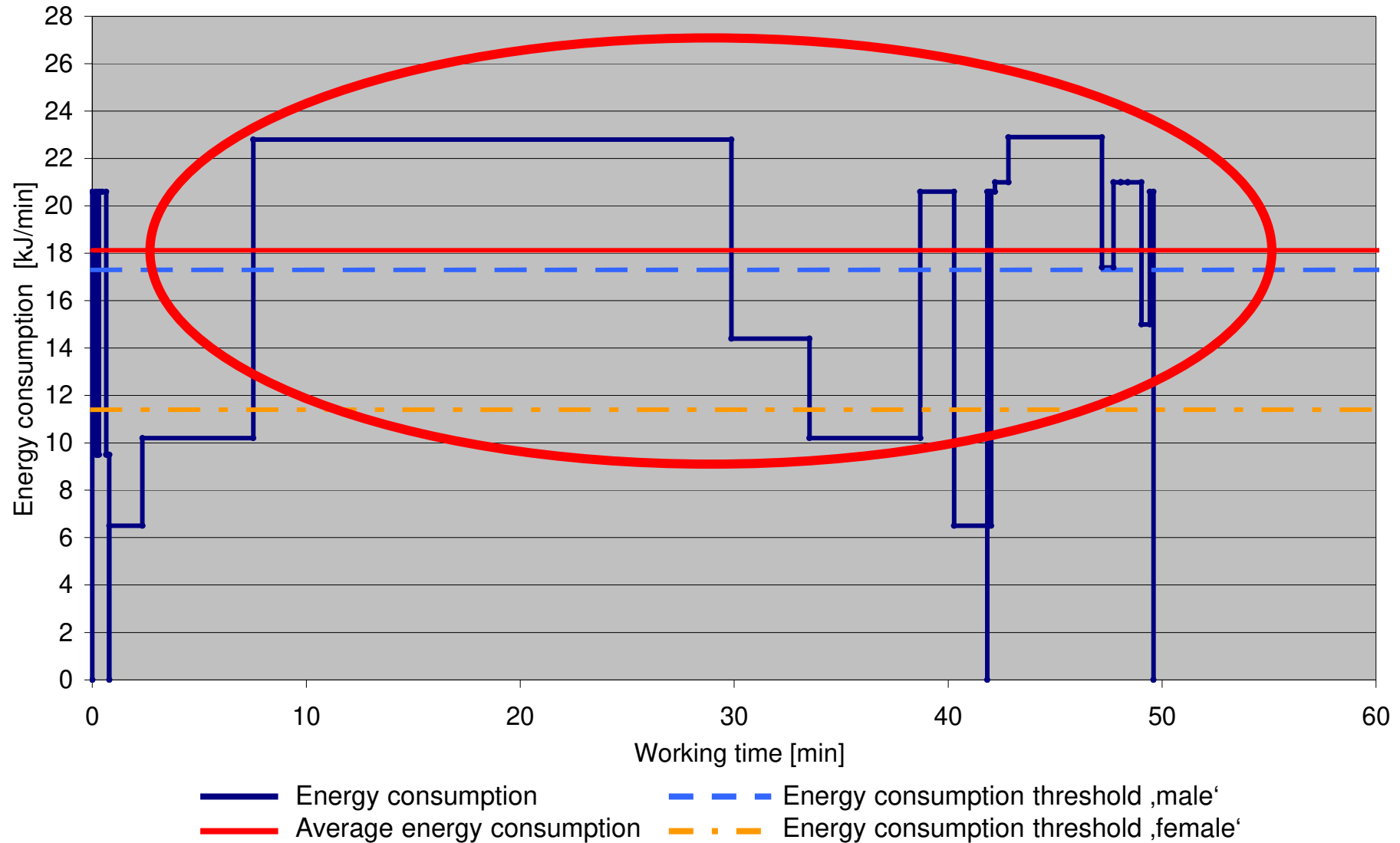
Slurry spreading



Muck out in pig farming



Muck out in pig farming



Rel. shares in different milking systems



Unfavourable working postures and energy consumption above thresholds

	Milking system				Pig farming
	Bucket	Pipeline	Herringbone	Rotary	Muck out
	15 dairy cows	20 dairy cows	60 dairy cows	100 dairy cows	30 sows
	2 milking units	3 milking units	2x5 milking units	13 milking units	Litter
Unfavourable working posture [%]	32.8	34.9	27.0	36.0	33.8
Unfavourable type of work [%]	12.6	4.4	0.7	0.9	31.5
Over female energy consumption threshold [%]	77.0	75.3	76.7	87.7	72.1
Over male energy consumption threshold [%]	29.5	3.1	0.0	0.0	64.0

1. Several working procedures in agriculture cause a **high or even to high work load**
2. With the energy consumption model from **HETTINGER & SPITZER** **working postures, types of work** and the **consumption of energy** can be analyzed
3. Based on a **detailed work time calculation** system like LISL working postures, types of work and energy consumption profiles along the working duration can be predicted
4. For **different milking systems** these method shows **impressive results**
5. The use of this method in extension as well as in the education of students gives an **additional benefit of work time calculations** and it opens the eyes for **labor improvements**
6. (And it gives an indication about the **necessary nutrition** of the laborers)

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[http://www.ergos.nl/home/paper task rotation within jobs.pdf](http://www.ergos.nl/home/paper_task_rotation_within_jobs.pdf)