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Sanquin DonORen Logistiek

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- Wie/wat OR
- Rol van / wat is OR
- OR voor Sanquin
- Voorraad BP
- Inzameling

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Wat is OR

- Voorbeeld 1

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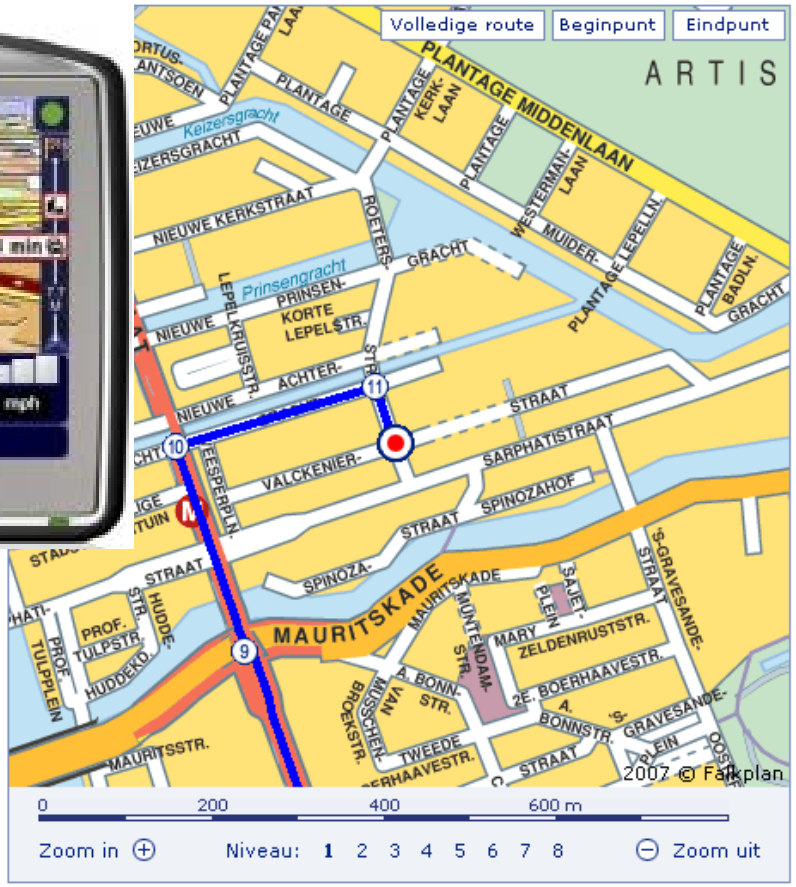
1 Shortest Route planning



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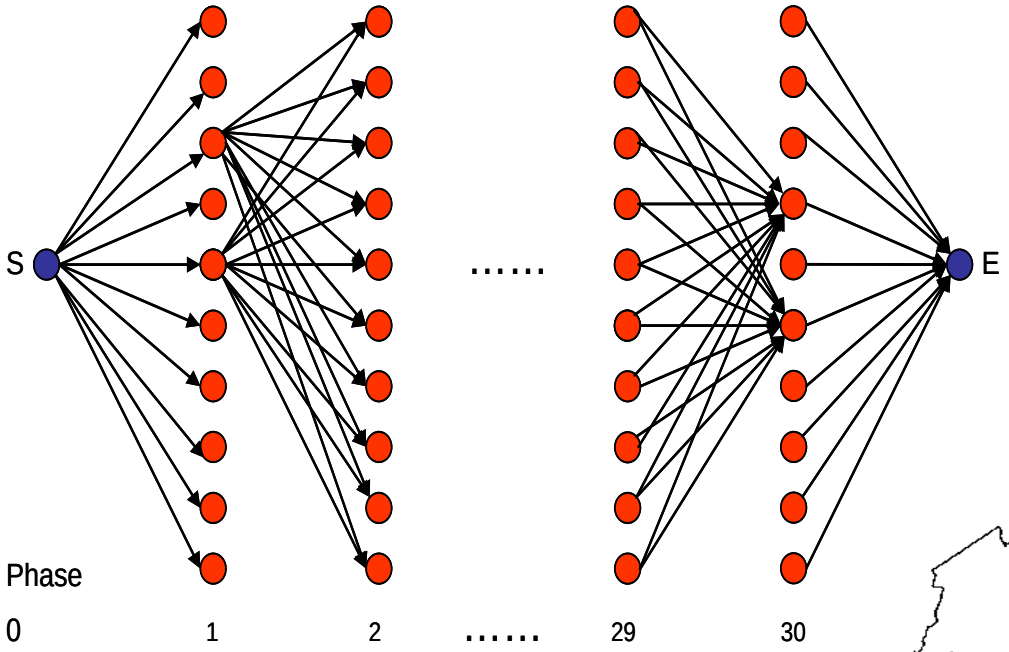

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Wat is OR?

- Voorbeeld 2

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Newsboy problem

- *Q*:
- Q: Inkoop / voorraad - hoeveel?

$$P(X < Q) \quad \Leftrightarrow$$

$$\boldsymbol{E}(\text{Tekort}) = \int_{Q}^{\infty} (x - Q)^{+} f_X(x)\,dx$$

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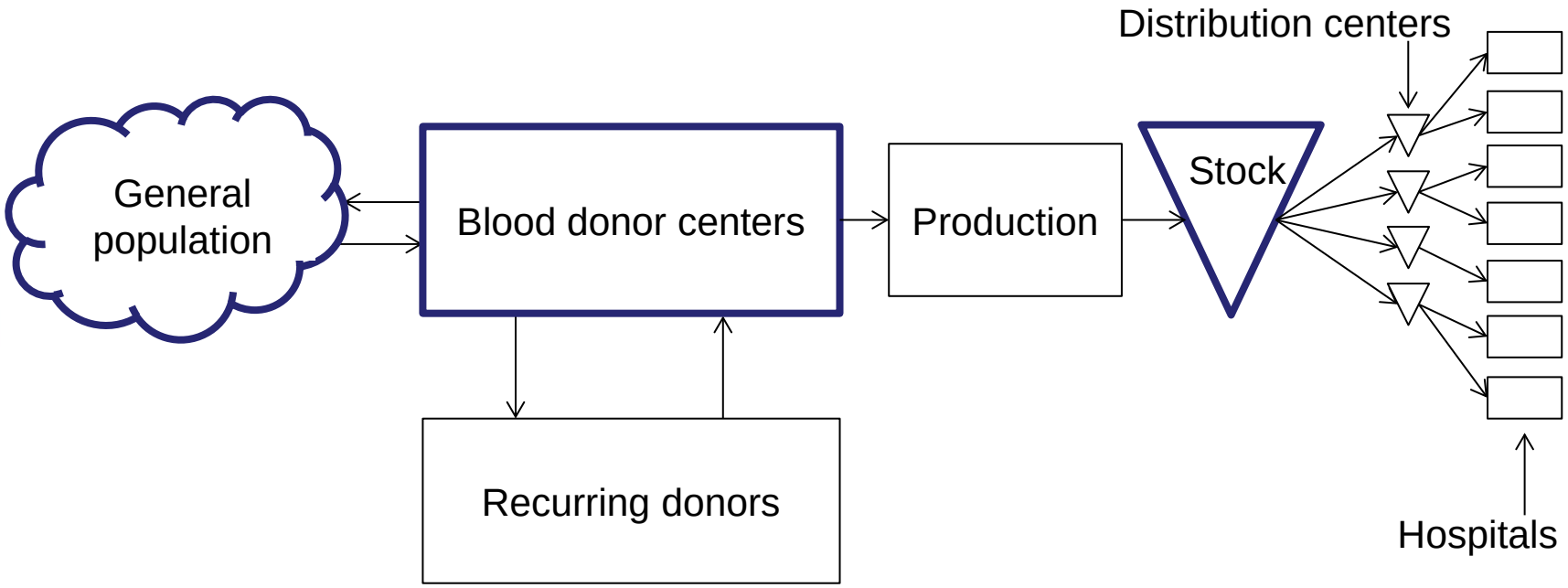
- ABO - R / and other/ - Matching
- Outdating (verloop)
- Availability(donors)

OR for Blood supply Chain



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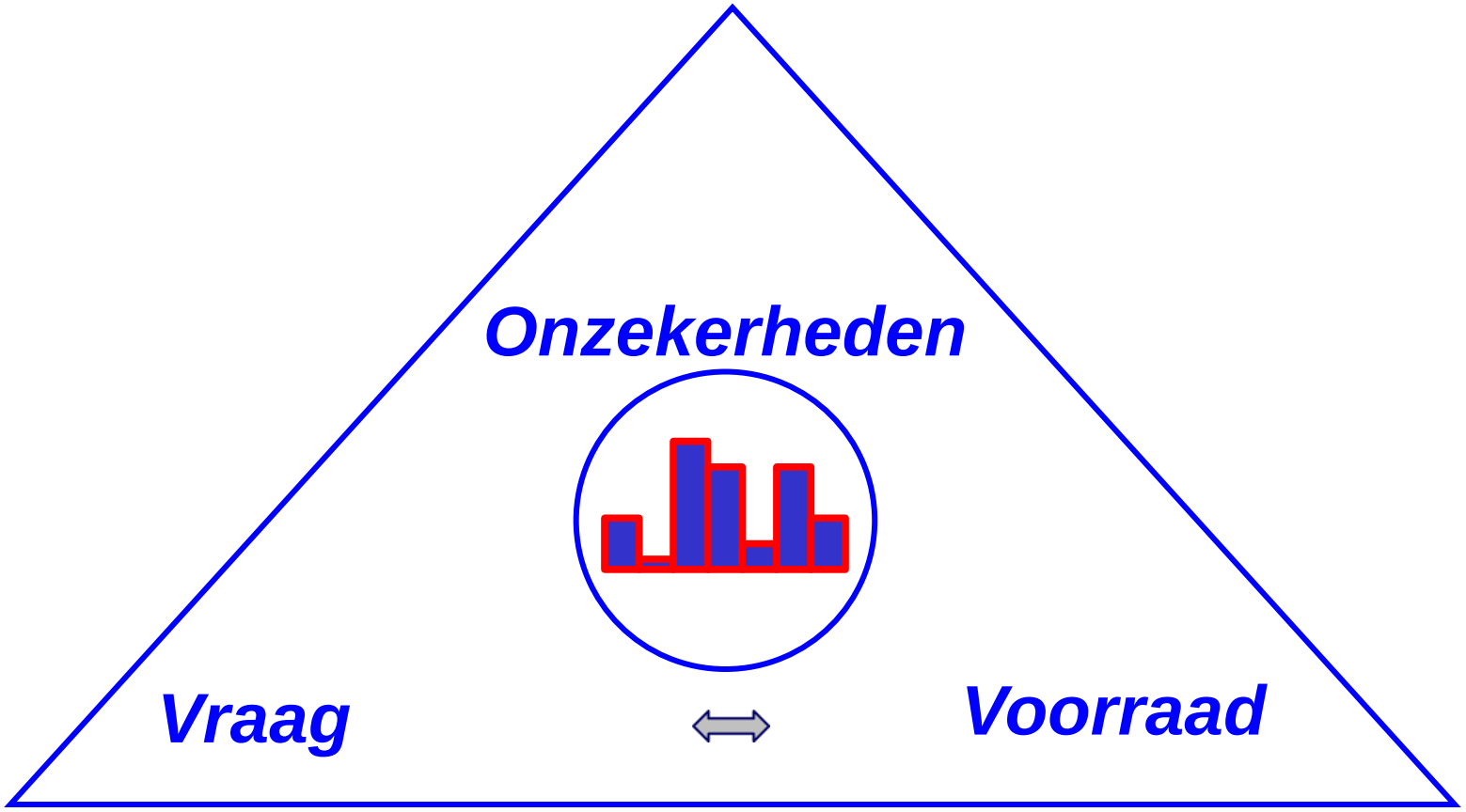

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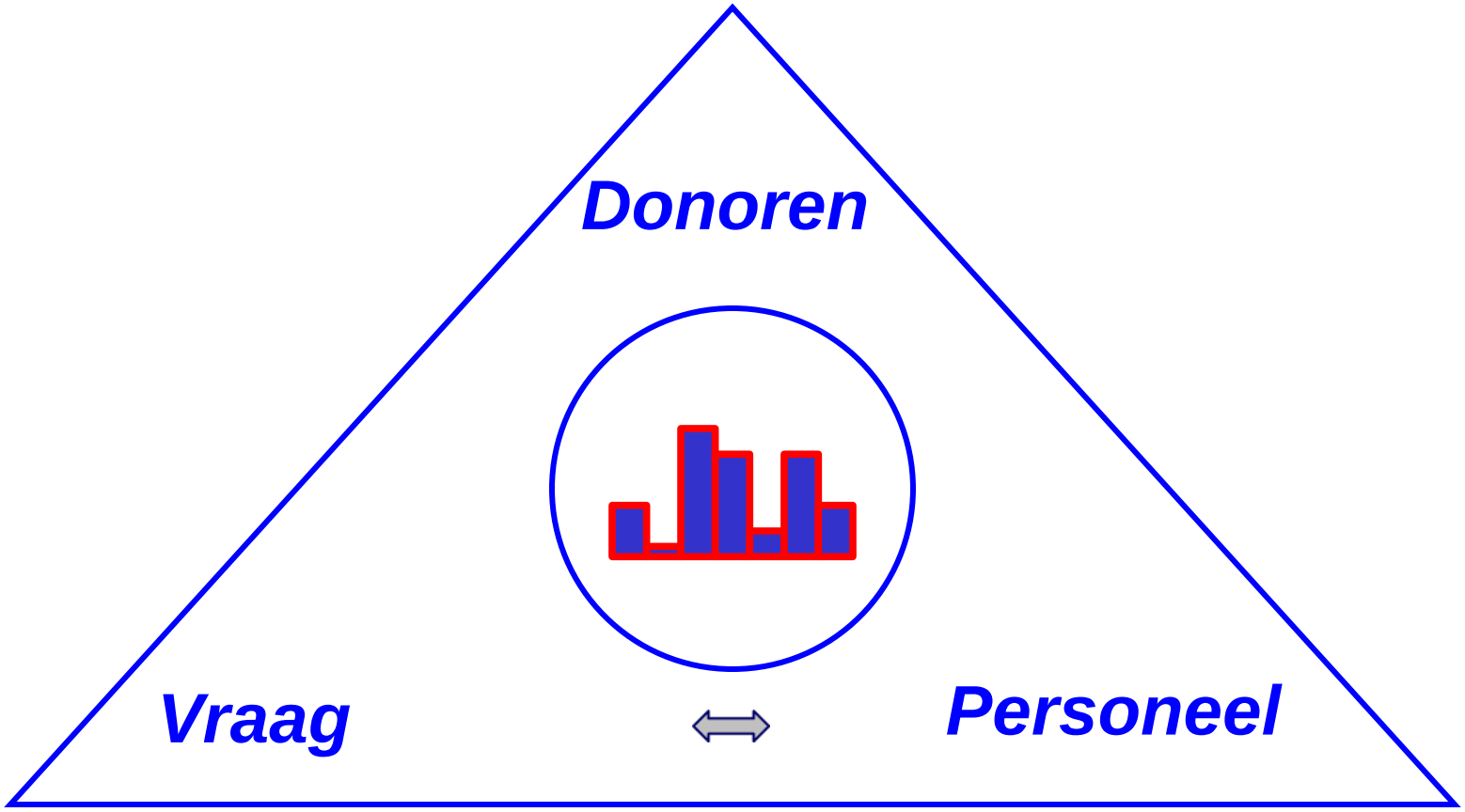

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Vragen

- Voorraden
- Personeelscapaciteit donor centra
- Personeelsinzet tijdens sessie donor centra
- Capaciteits planning en inzet call center
- Werven en benaderen van donors
- Donorsamenstelling
- Distributie / uitgifte centra
- Transport naar ziekenhuizen

1 Blood Platelet Production (BPP):

René Haijema

Nikky Kortbeek

Michiel Janssen

Naud Jansen

Jan van der Wal

Cees Smit Sibinga

Wim de Kort & Nico M. van Dijk

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Blood Platelets

- Highly Perishable (5-7 days)

Minimize Spill

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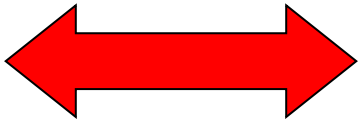
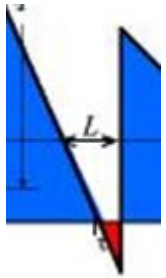
Criteria





Outdating **Shortages**

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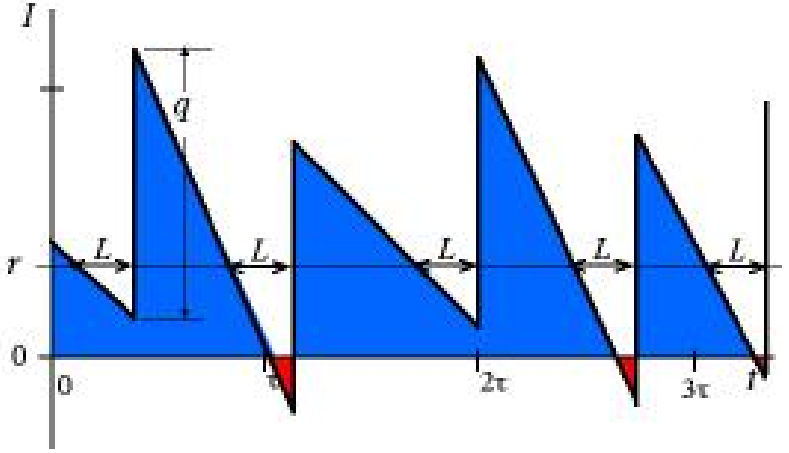
Practice

- USA
  Western Europe

- Shortages ~ 1 %
- Spill (Outdating) ~5 -20 %

- Simple Order-up-to Rules



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OR (DP) modellering (= “Kortste pad”)

- Epochs: each morning
- Decision: production volume = k
  (= 0 on Saturday and Sunday)

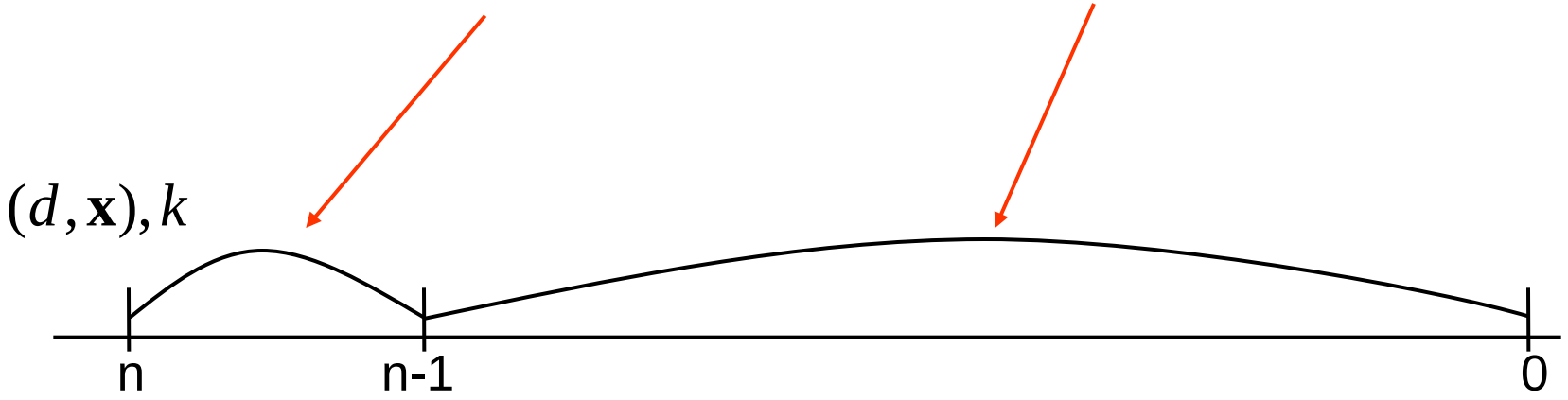
- States: $(d, \boldsymbol{x}) = (d, x_1, x_2, ..., x_m)$

where:
x = inventory state
d = day of the week
x_r = # pools with residual shelf life of r days
m = max. residual shelf life (= 6 days)

OR (SDP) - model

$\mathbf{V}_n^R(d,\mathbf{x})$: minimal expected cost over planning horizon of *n* days when starting at day *d* with inventory **x**

$$\mathbf{V}_n^R(d,\mathbf{x}) = \max_k \left\{ c^R(d,\mathbf{x},k) + \sum_{i,j} p_d^y(j) p_d^a(i) \mathbf{V}_{n-1}^R(d+1, \mathbf{z}^R(\mathbf{x},k,i,j)) \right\}$$



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BUT

No Simple (Practical) Optimal Strategy

Production	Inventory (old,…, young)
7	(0, 0, 5, 0, 0, 9)
8	(0, 0, 6, 0, 0, 8)
9	(0, 0, 8, 0, 0, 6)
10	(0, 6, 2, 0, 0, 6)
10	(5, 0, 3, 0, 0, 6)

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Tuesday morning

Step 3 (and 4): Simulation table

Repl. \ Stock	6	7	8	9	10	11	12	13	14	15	16	17	18	19	total
22														1	1
21									1	2	4	2		1	10
20				759	5481	19706	40627	50741	39344	18762	5391	837	56	3	181707
19	141	3402	35656	92771	165052	206142	174524	97942	34736	7208	708				818282
18															0
0															0
total	141	3402	35656	93530	170533	225848	215151	148683	74081	25972	6103	839	56	5	1000000

Repl. \ Stock	13	14
21		1
20	50741	39344
19	97942	34736
total	148683	74081

Most frequent order-up-to level (82%)

Optimal
5, 6 or 7 units
Age plays a role

Results : Collaborative Research with Dutch Blood Bank Sanquin

- **North East**
  - Outdating & Shortages
- **South East**
  - Age
  - TIMO
  - Transport
  - Real Time Implementation

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Cost component	Rel. freq.
Spill	0.7%
Shortage	0.07%
Mismatches	0.009%

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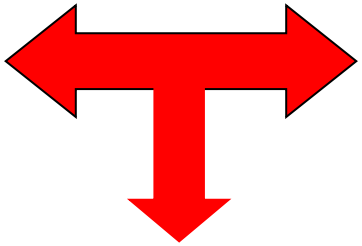

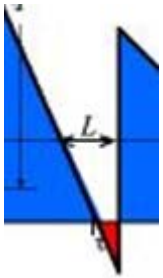

Outdating

Shortages

Age

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Results 3 (South East Case)

Age = **4** (-1.5) days => **3.20** (-1.5) days
(30%)

For young demand => **2.75** (-1.5) days
(50%)

=

Substantial **quality** improvement for **patient**

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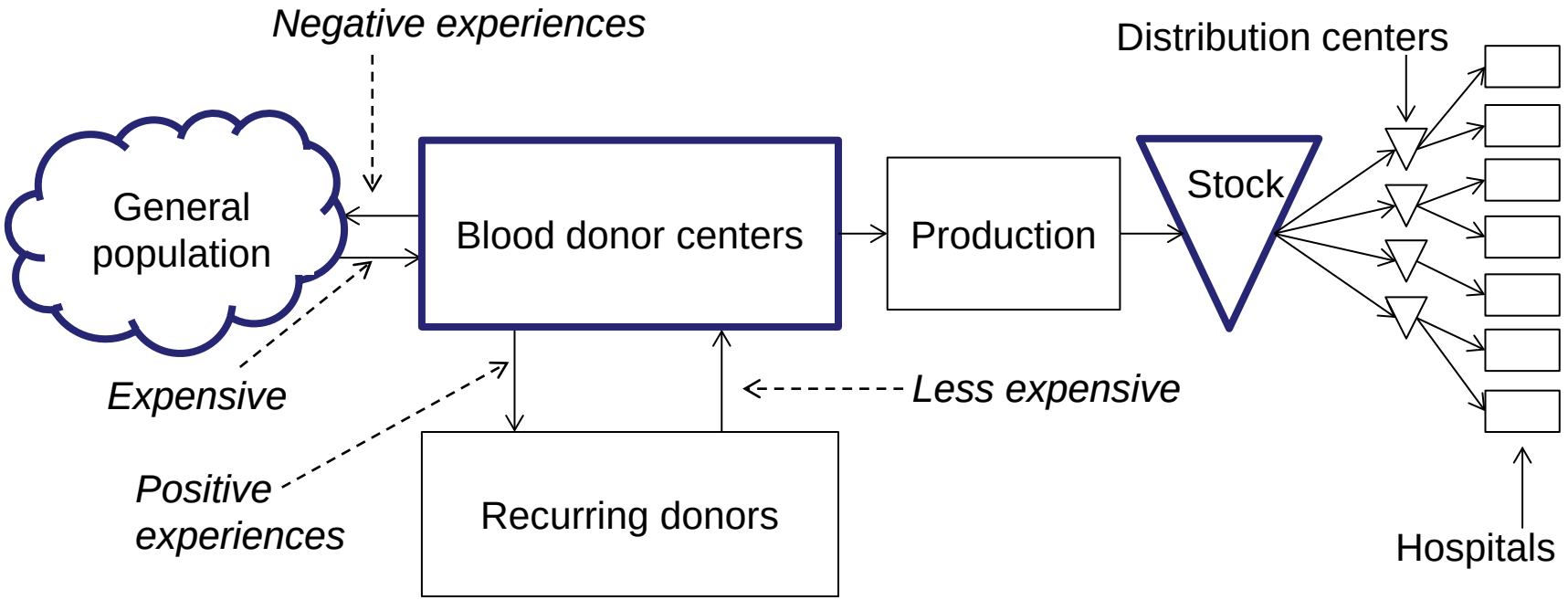
2 Blood Collection Sites

- Patricia Zonneveld
- Ilona van Mechelen
- Luuk Besselink
- Sem van Brummelen
- Wim de Kort & Nico van Dijk


Negative experiences
Distribution centers
General population
Blood donor centers
Production
Stock
Expensive
Less expensive
Positive experiences
Recurring donors
Hospitals

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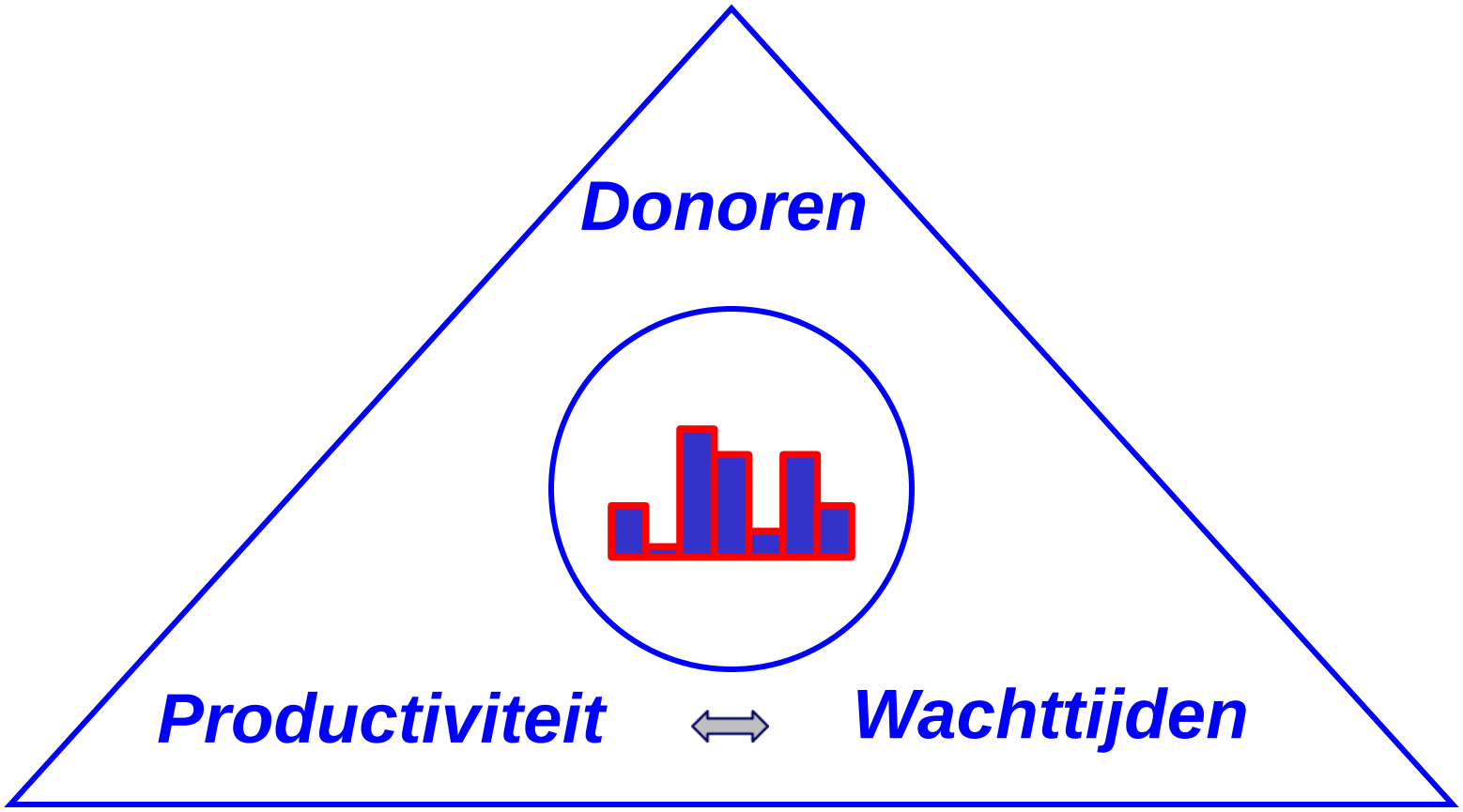

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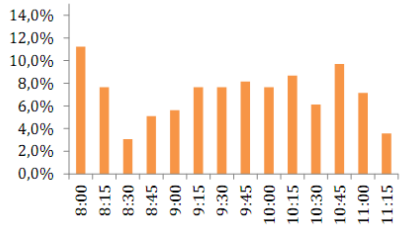
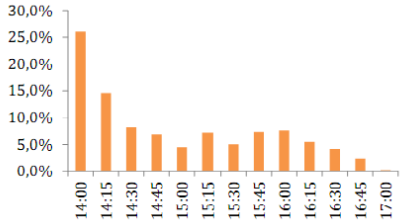
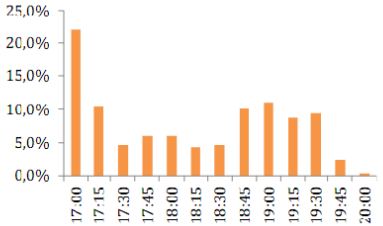
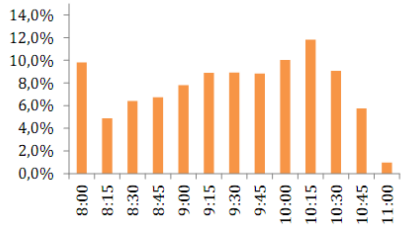
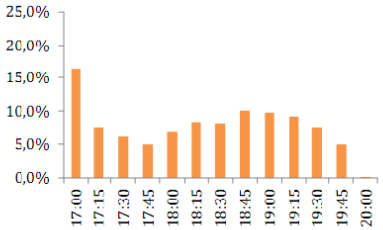
Walk-in Stochastics: Arrival patterns

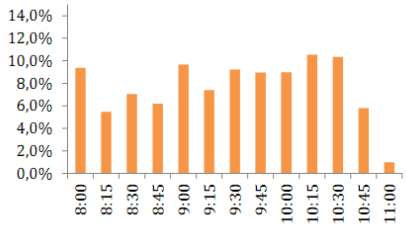


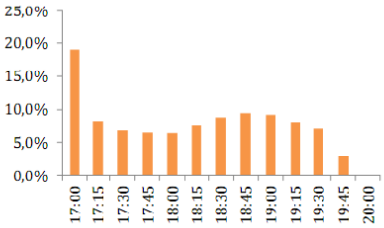












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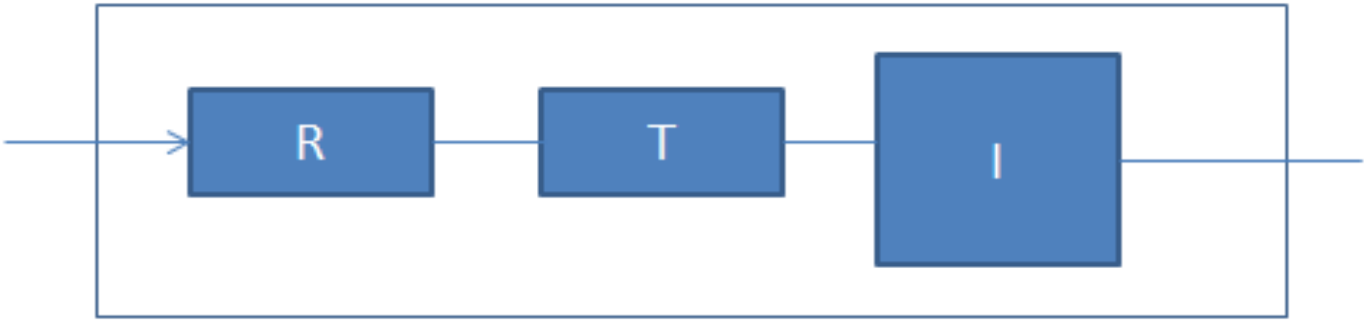
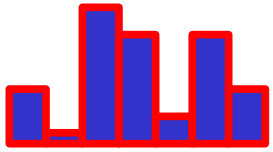
Blood donation process: Stochastics at each stage

R: Register T:Testing I: Blood Intake





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How - Practical

1 Service (WT) norms

2 Allow shorter shifts (2 - 4, 5 , 6 , 8 hours)

3 More flexible allocation (Intake ⇔ Testing)

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How -technical?

I. Linear Programming (1- st OR – Subdiscipline) ⇨ (Luuk)

II. Queueing Theory (2-nd OR – Subdiscipline) ⇨ (Sem)

III. Computer Simulation (3-rd OR – Subdiscipline) ⇨ (Sem)

⇨ Combination To be followed

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Conclusions

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Any Questions Waiting?

Thanks