The After Salesman Problem

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From sales to after sales

Binnen 48 uur uw eigen installatiemonteur aan huis

+

Uw PC krijgt een complete installatie en configuratie en geeft u waar nodig nog enkele instructies en tips. Ook softwarematige configuratie van internet behoort tot het pakket. Hierna kunt u direct zelf aan de slag! Dit alles in nog geen uurtje van uw tijd!

- HP AG151AW#ABH
- Central Point WIZKIT001

€ 867.23
(excl. BTW)
€ 1032.01
(incl. BTW)

Bestel

We are living in a service economy: (2007: +/- 74 %)

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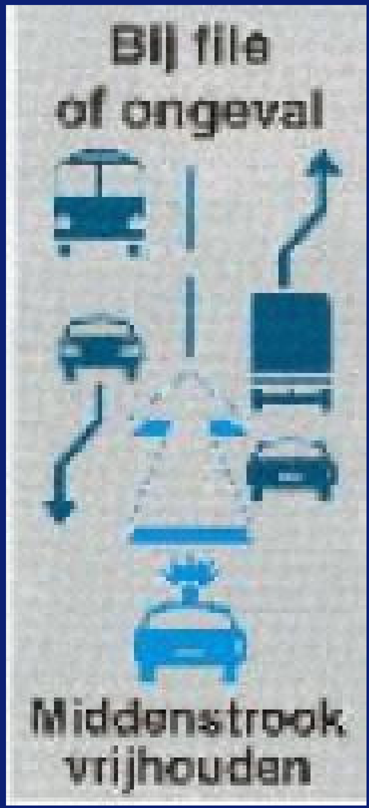
After sales = service

5 dimensions of service

- Tangibles
- Empathy
- Assurance
- Reliability
- Responsiveness

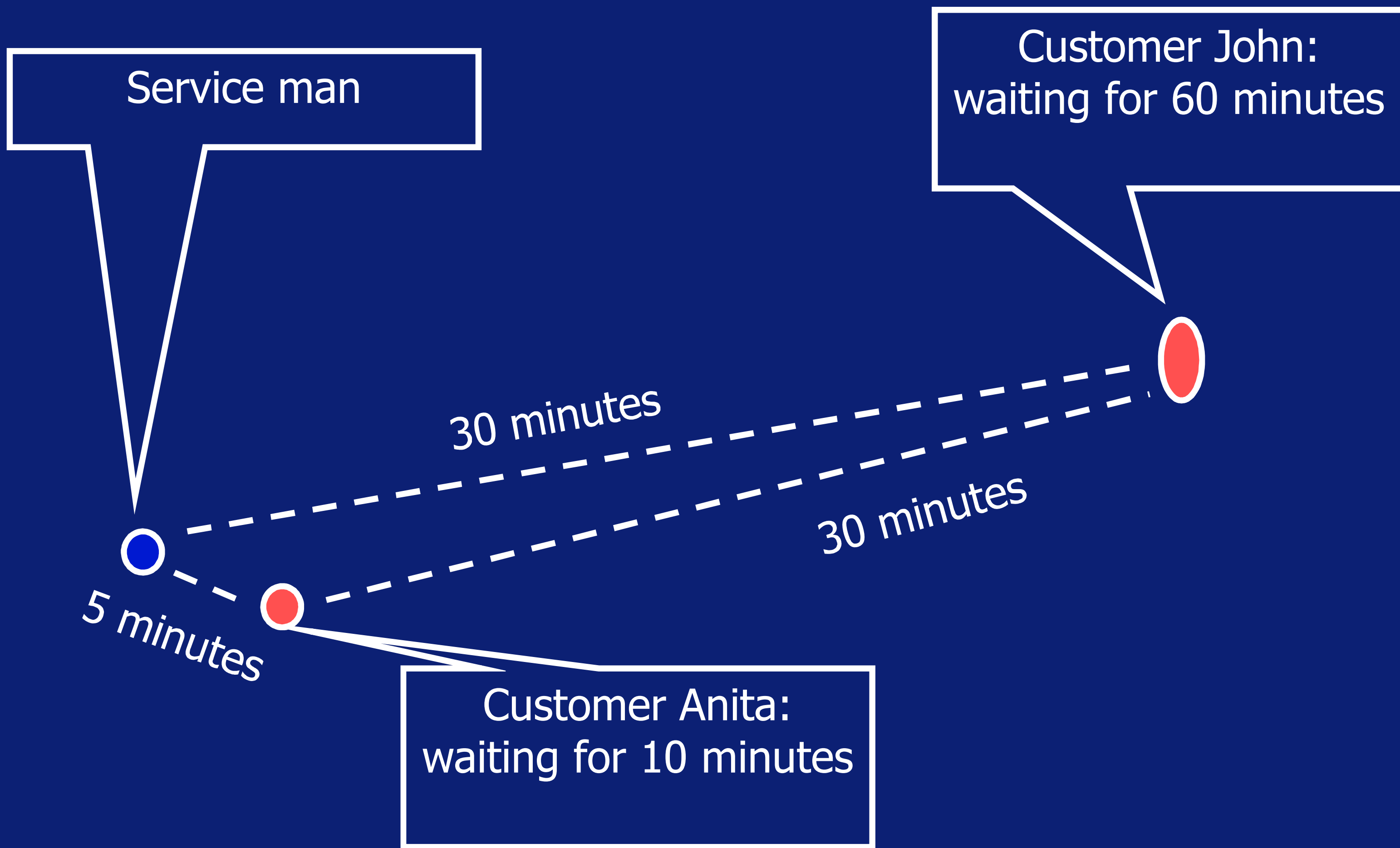
(Parasuraman 1985)



More responsiveness

- Johnston (1995): Responsiveness influences customer satisfaction and dissatisfaction.
- Davis & Heineke (1998) Actual waiting time is a key driver of customer satisfaction
- (Collier & Wilson 19970, Brady & Cronin 2001)…..
- Footnote: *perception* of responsiveness determines satisfaction

How to measure responsiveness?



By average waiting time?

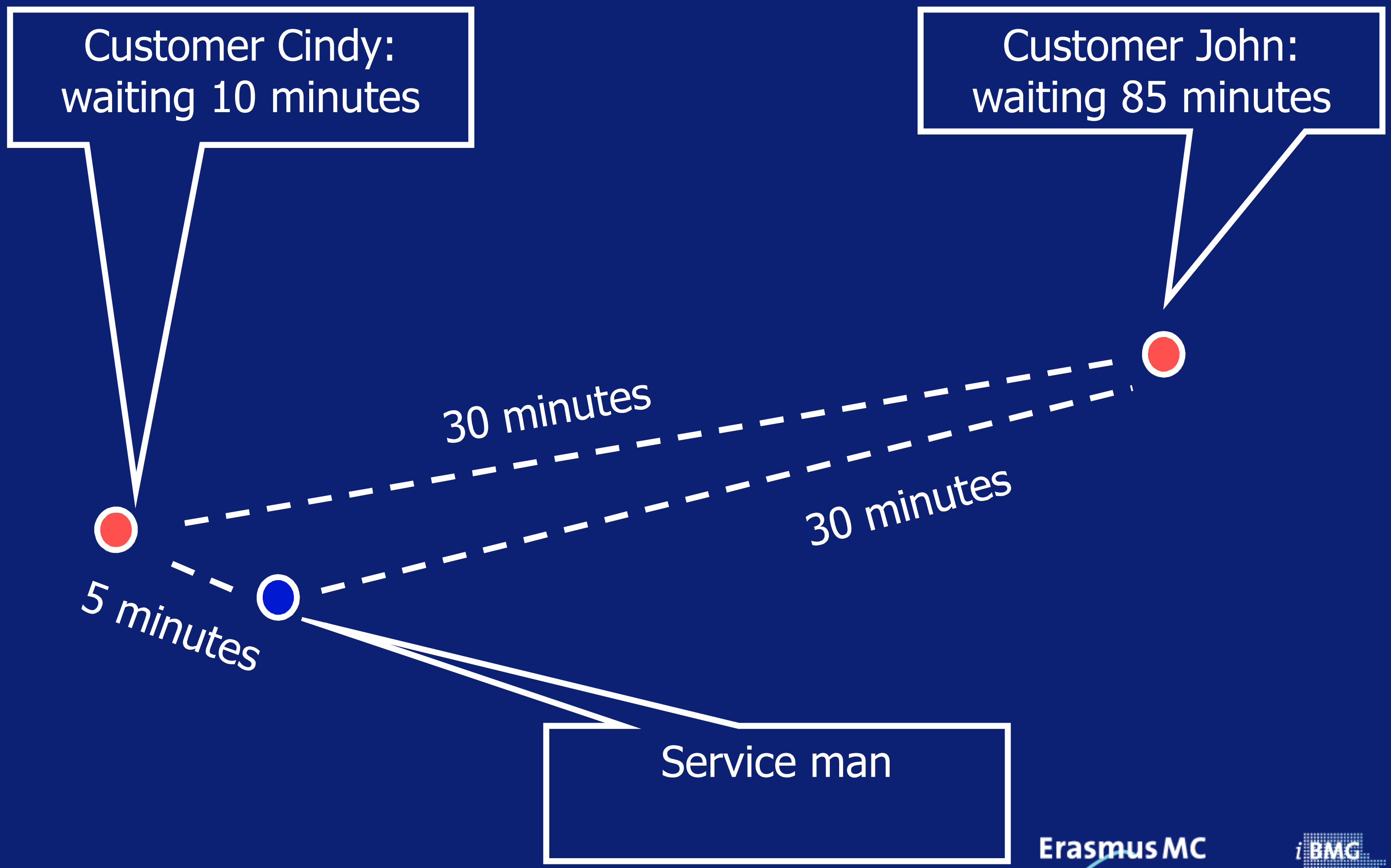
1. Go to John, service, John, go to Anita service Anita

Waiting time John :	60+30=	90
Waiting time Anita :	10+30+20+30=	90
Average waiting time:		90

2. Go to Anita, service Anita, go to John service John

Waiting time Anita:	10+5=	15
Waiting time John:	60+5+20+30=	115
Average waiting time:		65

25 minutes later (how to measure responsiveness)



By average waiting time?

1. Go to John, service, John, go to Cindy service Cindy

Waiting time John:	85+30=	115
Waiting time Cindy:	10+30+20+30=	90
Average waiting time:		102.5

2. Go to Cindy, service Cindy, go to John service John

Waiting time Cindy:	10+5=	15
Waiting time John:	85+5+20+30=	140
Average waiting time:		77.5

performance indicators/ objectives

Unfit:

- Travel distance
- Idle time
- Travel cost
- Fuel usage

- Average waiting time
- Maximum waiting time
- Number of late services…..

Fit: Service Level Agreement on:

- Waiting time treshhold per service request
- Time til repair treshhold per request
- Treshhold on total time out of service per month
- ……

Related literature

- Queuing Models (Bertsimas & Van Ryzin (1991), Irani et al. (2001)
  - Focusses on theoretic properties
  - Different objectives
- Dynamic pick up and delivery models (Gendreau et al. 1998, Ichoua et al. 2006)
  - Many based on local search
  - Focus on transportation applications, different objectives
- Work in road side service industry
  - Practical work (AA, ADAC, ANWB,….)
  - Krumke et al. (ZIBB) (2001 onwards)

Background for remainder of work

Sketch for remainder of presentation

- Introduction of 3 models
- Solution methods for the 3 models
- Discussion of problem characteristics and assumptions, through solution of models:
  - Basic model
  - Reoptimization frequency
  - On line objectives versus end of day responsiveness
  - Diversion
  - Value of service time information
- Conclusions

Modelling concept

The service problem reveals itself in real time:

Every *t* time units (30 seconds),

- See whether new requests or service man have arrived
- See whether current services are being complete
- Make new dispatch decisions if possible

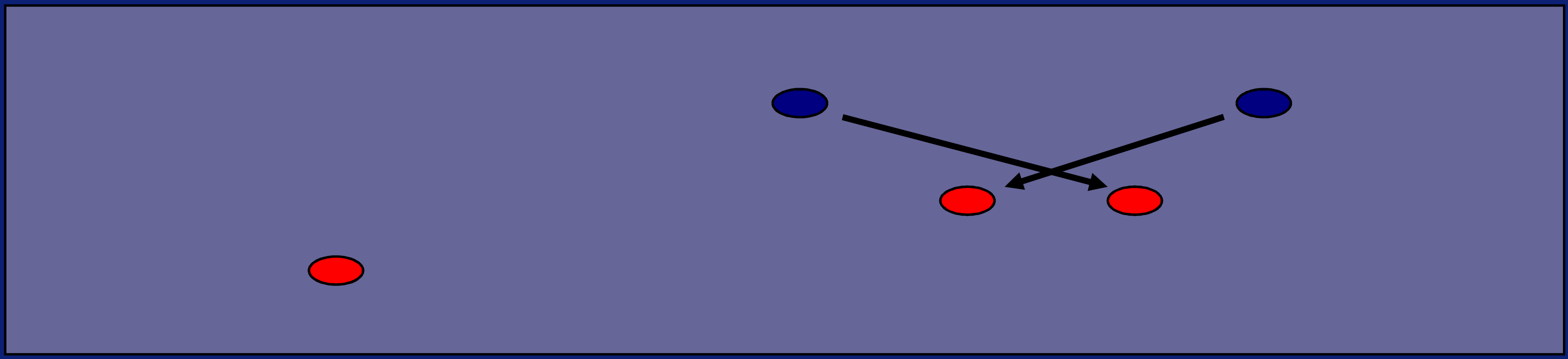
The real time problem instances will be modelled and solved using a *real time objective* function

Thus, we gradually obtain a solution for the problem stretching over the entire planning period (day), and an end-of-day solution, measured by an *end of day objective* function.

3 real time models – I : FCFS

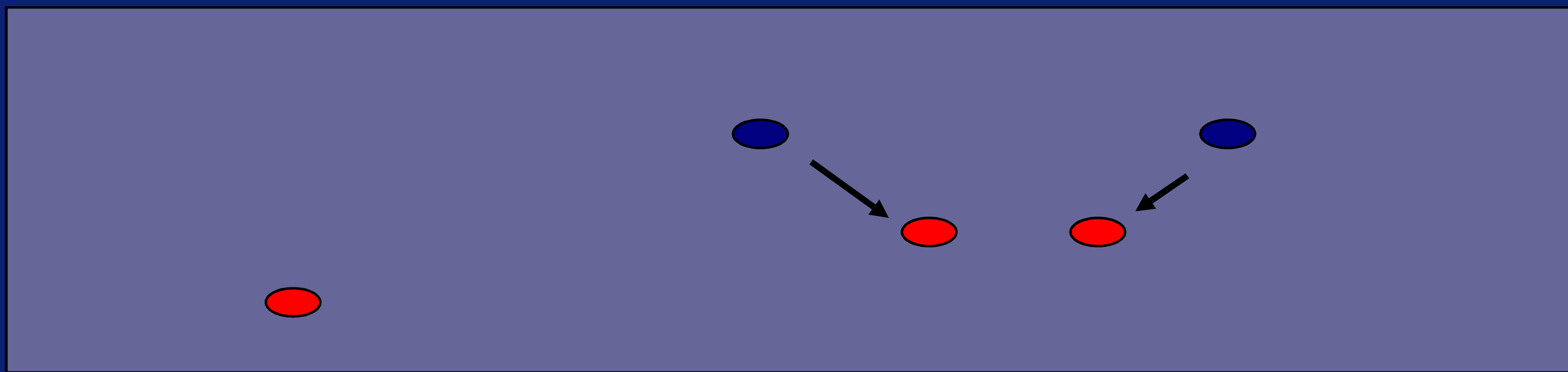
Repeatedly consider requests in order of arrival and assign the service man which maximizes the selected objective function

- ‘fair’ : customers will be serviced in order of arrival.

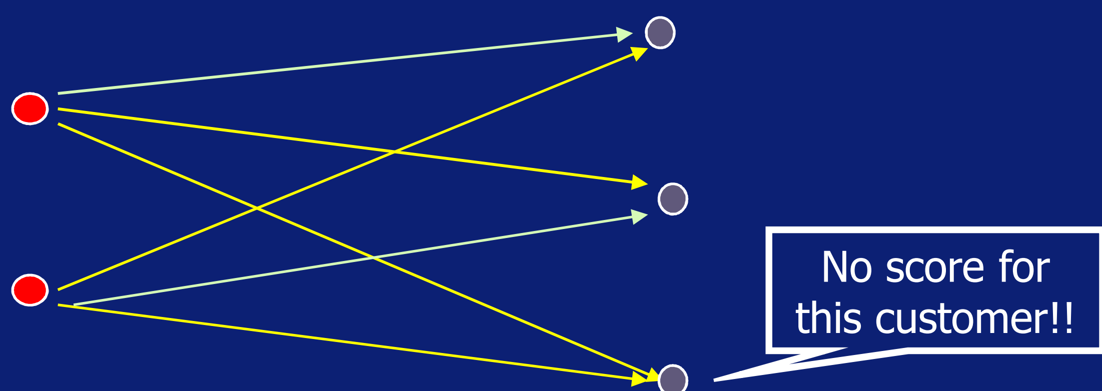


Solution: sorting (polynomial)

3 real time models – II: Matching



Find an optimal matching in the bipartite graph below



Solution: Hungarian algorithm $O(N^3)$

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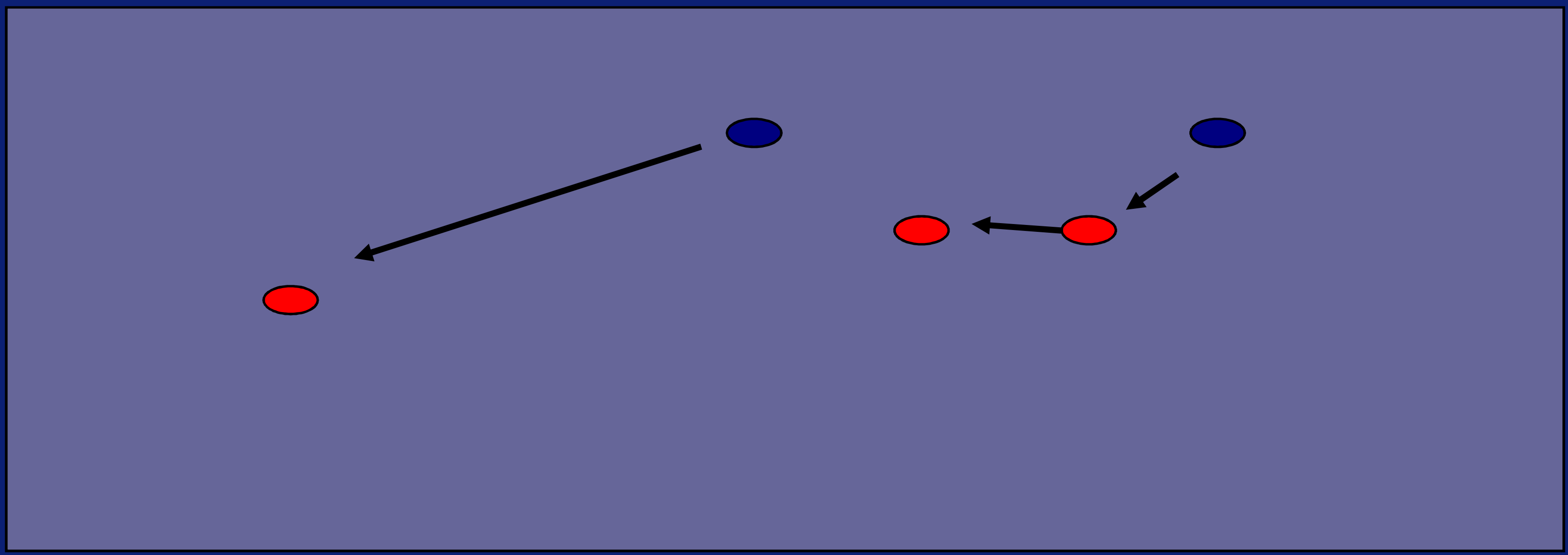
3 real time models - III: Set partitioning



Partition the set of all customers into tours such that the selected objective is optimized

Solution of the Set Partitioning Model (Krumke et al.)

1. Solve LP relaxation (which has exponentially many columns) using column generation
2. Proceed using branch & bound

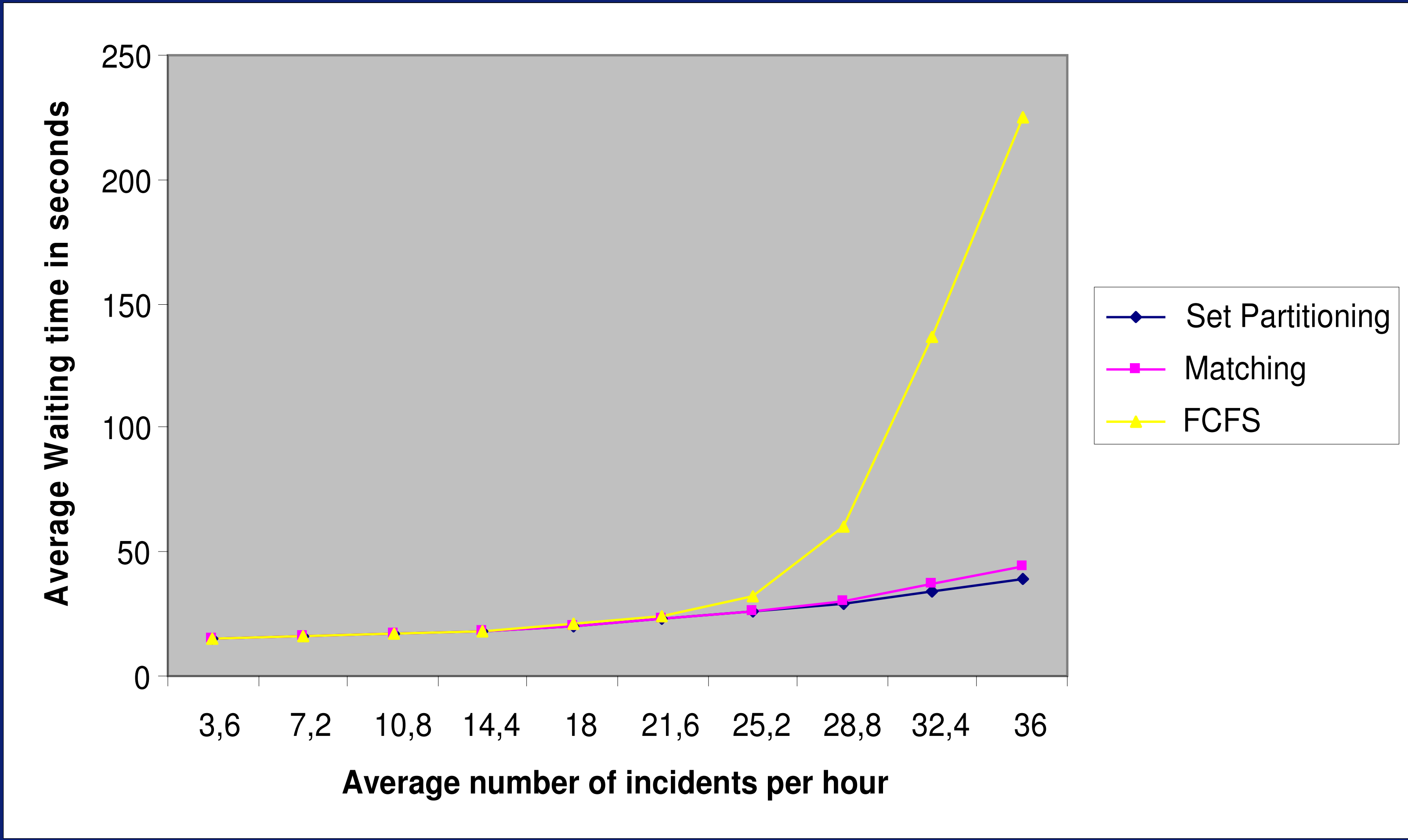
- Not guaranteed to be optimal, but computational experiments show that solutions are very close to optimal.

Each of the dispatch models can be solved ‘to optimality’. Hence we can compare the models, not the algorithms

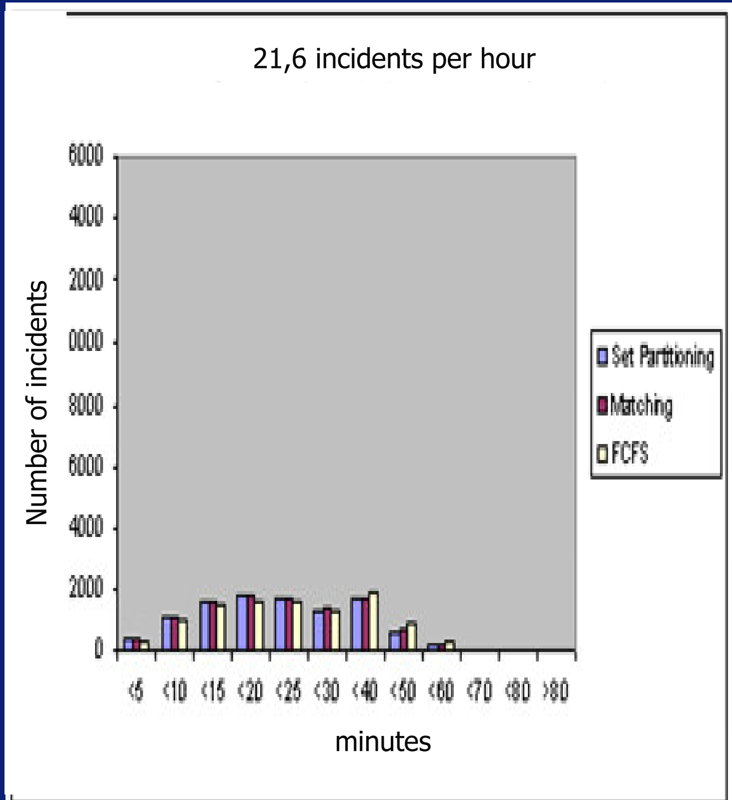
Simulation setting (modelled after practice)

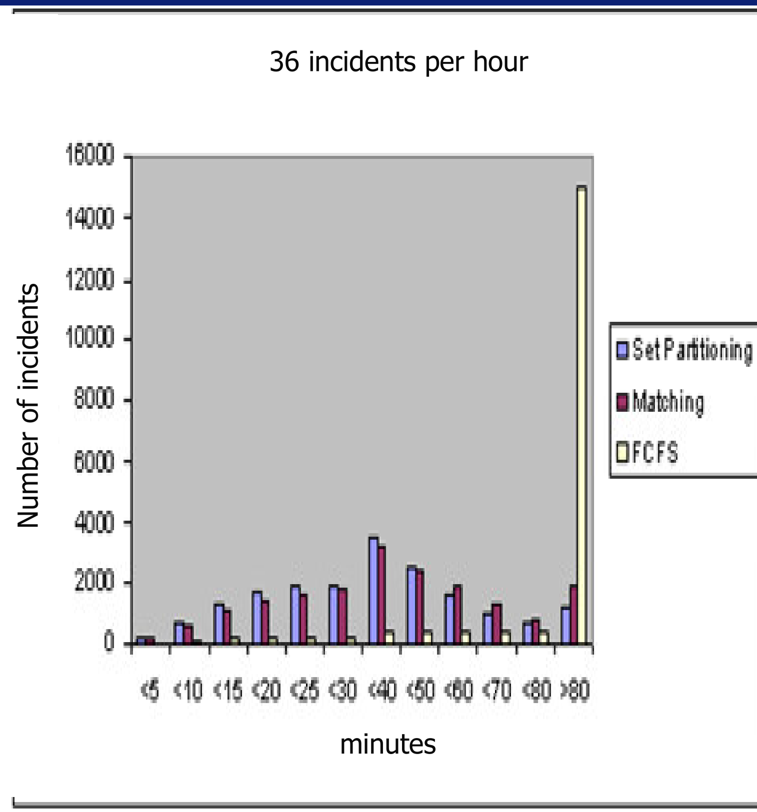
- Poisson arrival process, interarrival time average varies from 100 (heavy) to 1000 seconds (light) .
- Exponentially distributed service times, average 15 minutes.
- Unformly distributed service request locations in R^2.
- Domain of 125 × 125 km,
- 20 service men
- Average travel speed = 60km/h.
- SLA treshhold: 60 minutes

Basic computational results

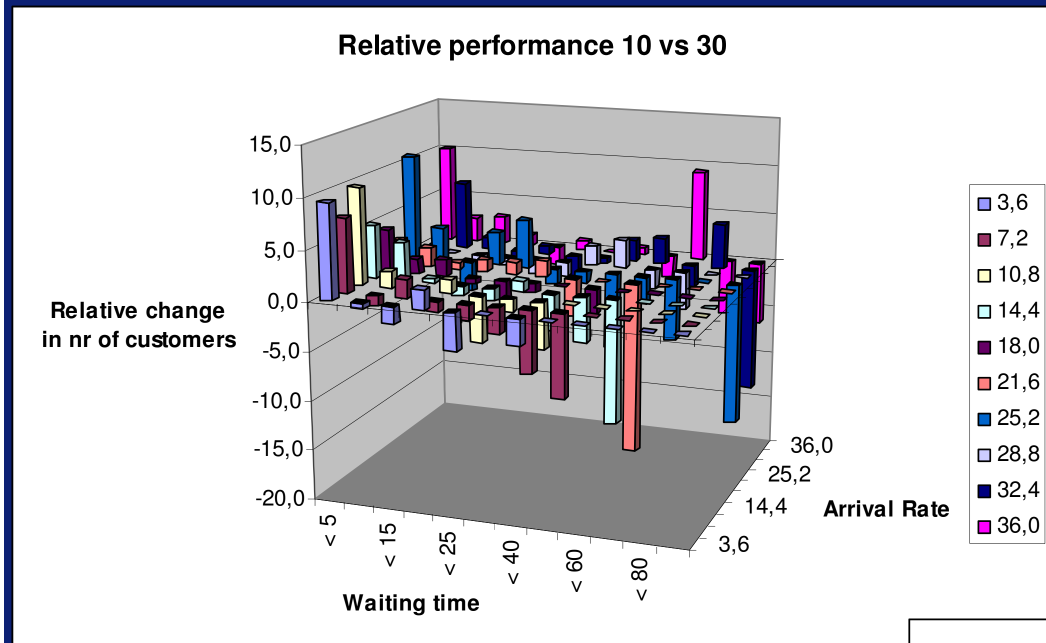


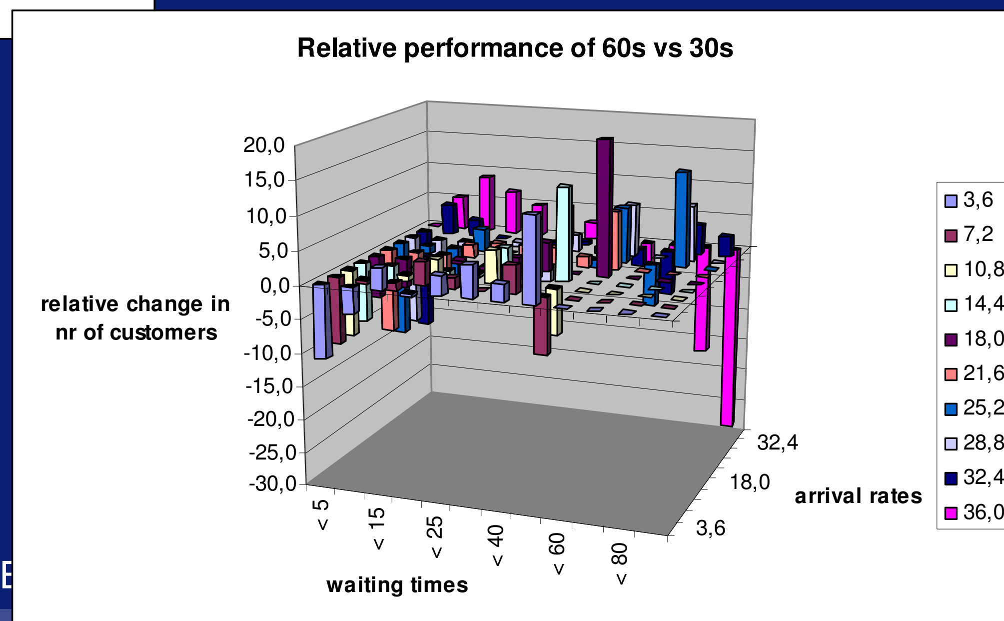
Waiting time distribution



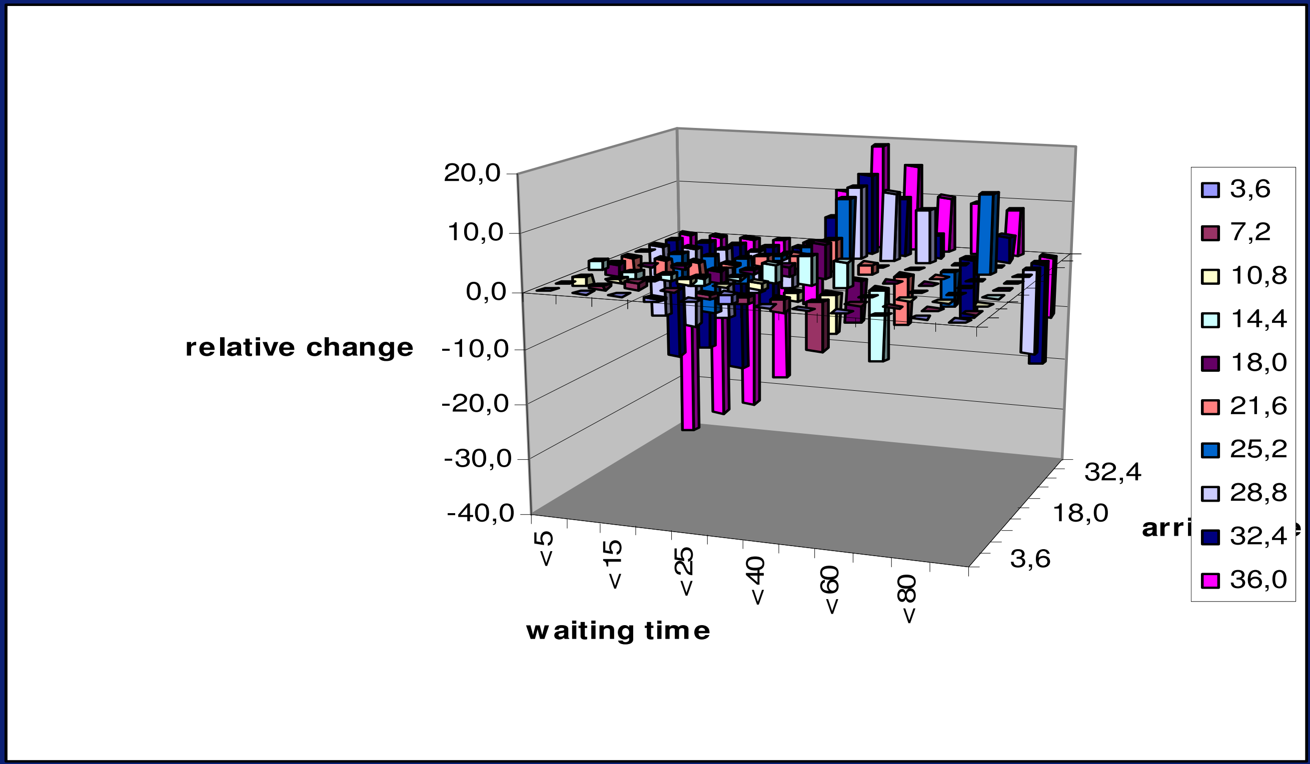


Reoptimization Frequency





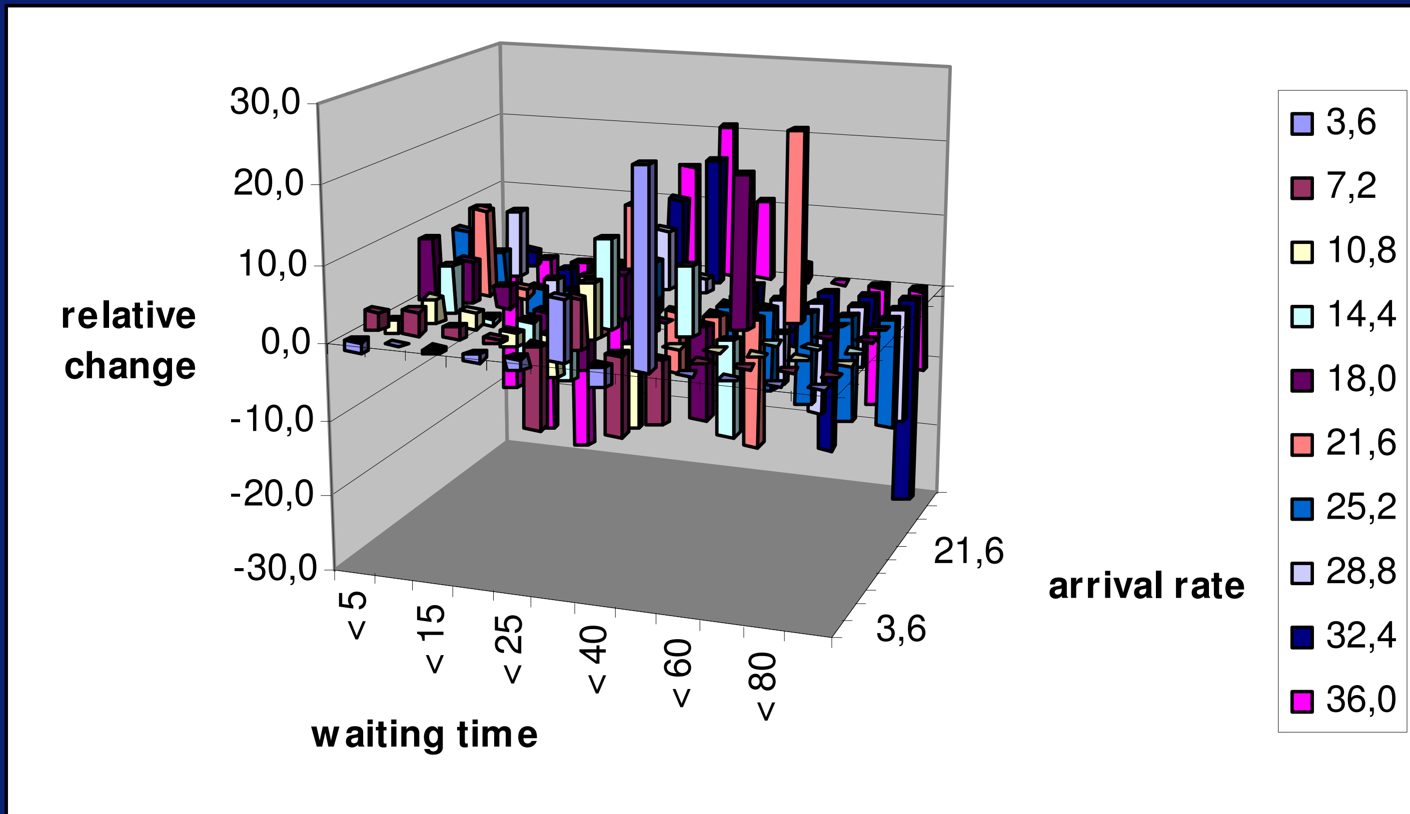
End of day objectives through real time objectives



SLA (+ waiting time) real time

compared to average waiting time

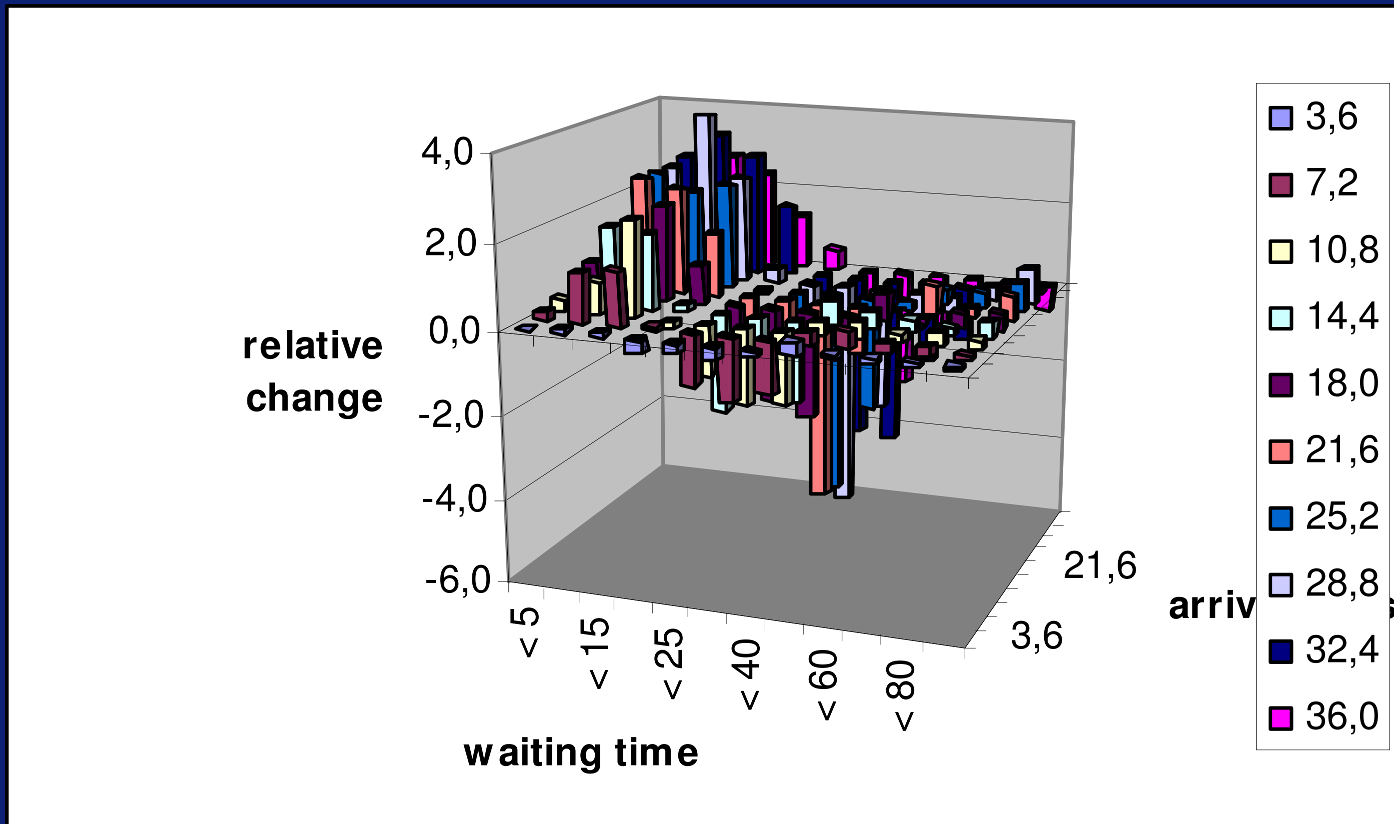
End of day objectives through real time objectives



SLA (+ travel time)

compared to average waiting time

End of day objectives through real time objectives



Average waiting time + average travel time

compared to average waiting time

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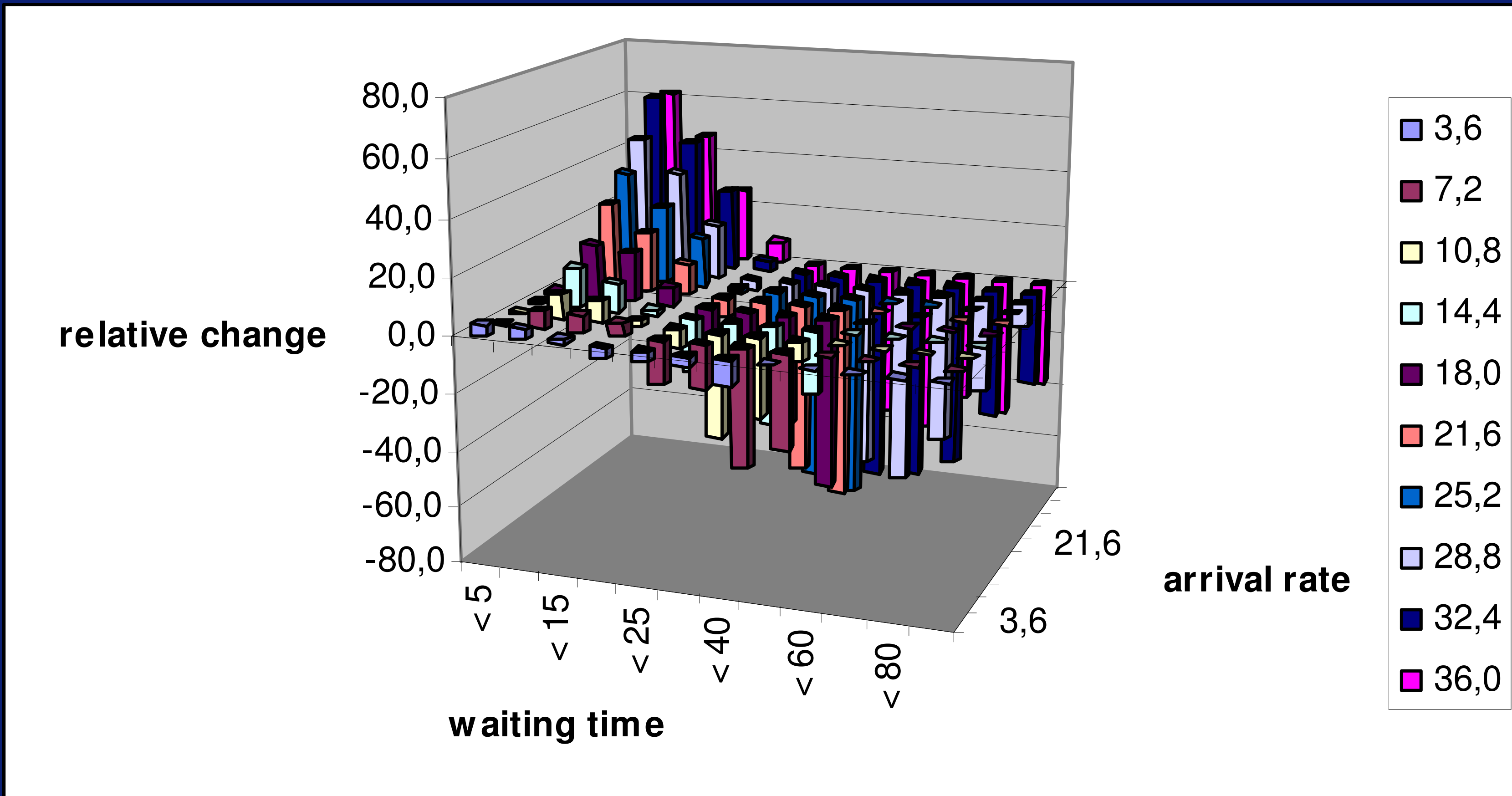
Lesson learned so far

- FCFS is fair but not beneficial (on the contrary for heavy traffic scenarios)
- Matching is comparable to Set Partitioning, but the latter is significantly better under heavy traffic scenarios (the more competitive scenarios).
- Reoptimization frequency matters, it is better to reoptimize frequently under light traffic, and less frequently under heavy traffic
- Handle objectives with care: relation between real time and end of day performance is non obvious.

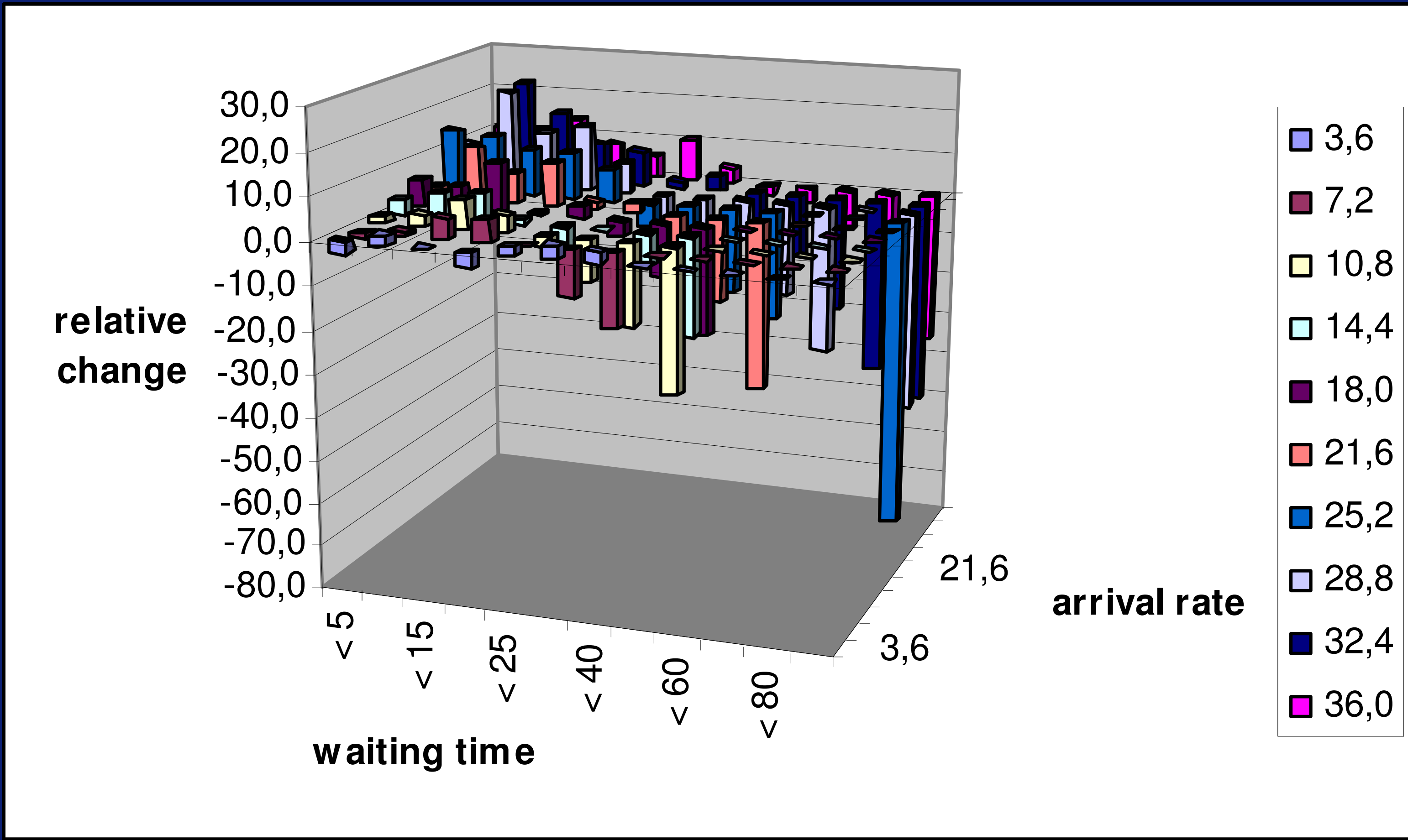
Diversion helps!



Note: Only allowed when more than 7.5 minutes travel remaining

Note: Total end of day travel distance reduced as well

Perfect information on service duration



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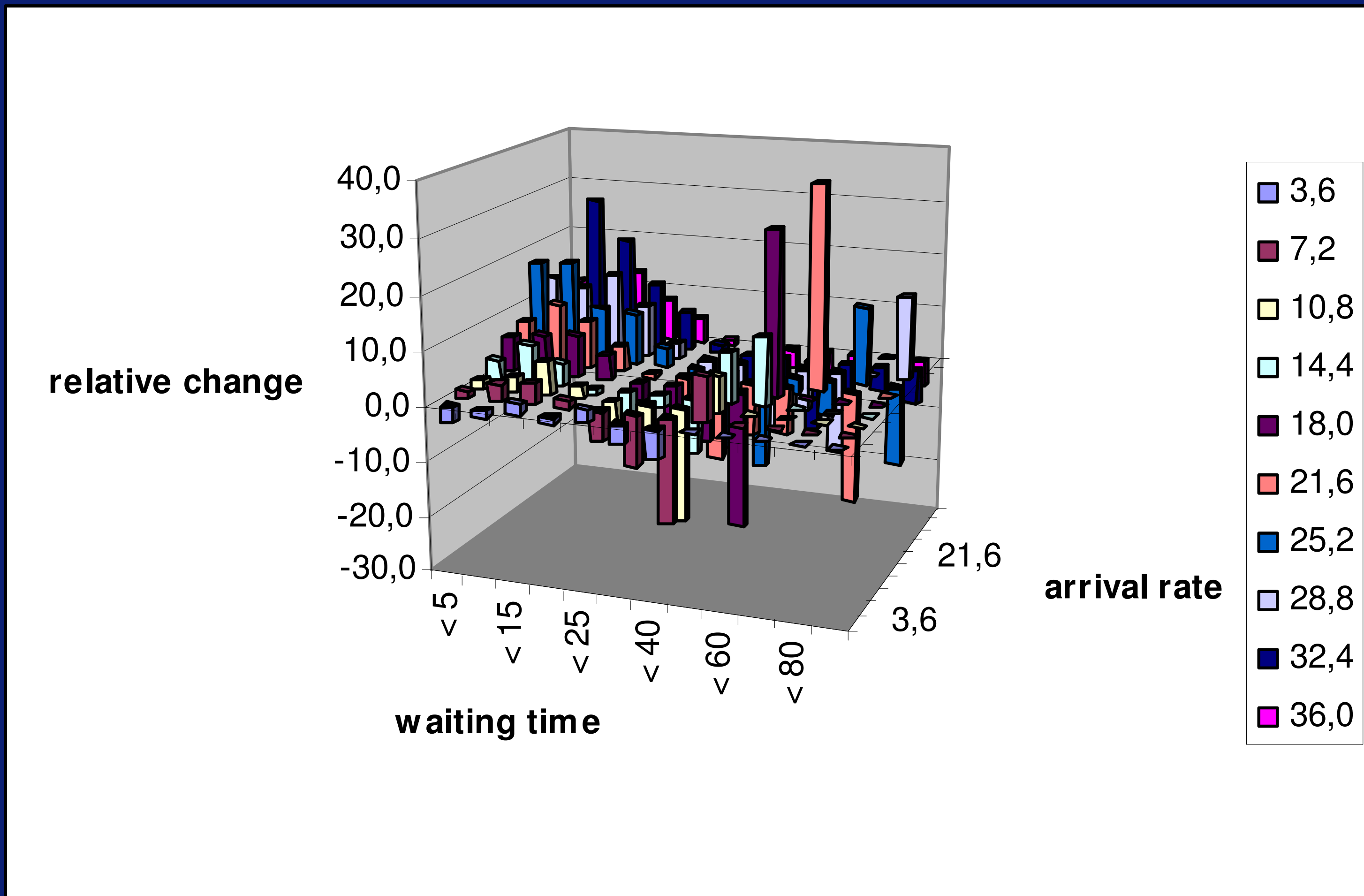
Median duration instead of expected duration

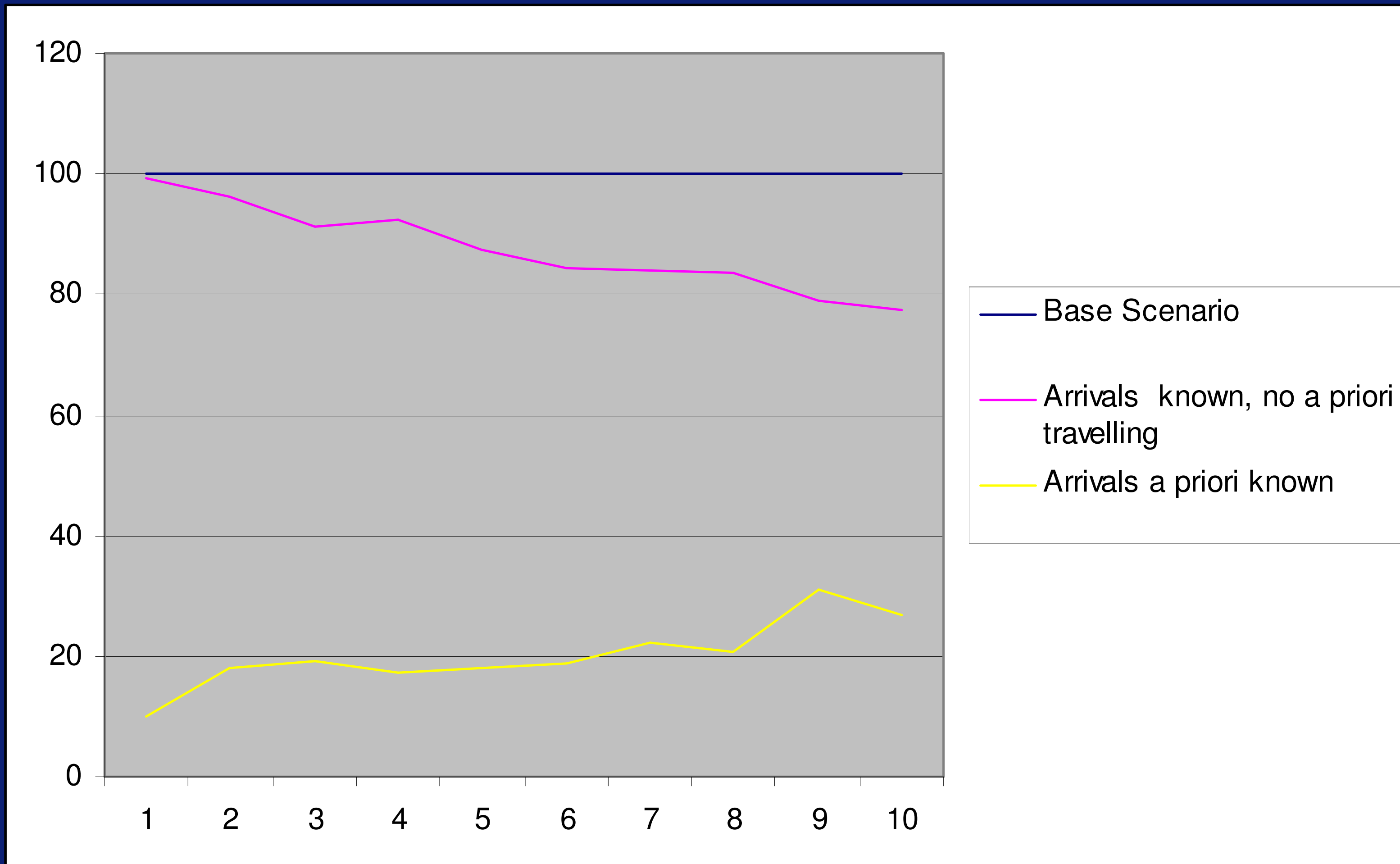


Lessons learned

- Median works better than average duration
- Knowing service durations perfectly is valuable
- More valuable is allowing for diversion (to use the real time visibility of the business process).

The difficulty appears to be in the stochastics of the arrival process rather than in the stochastics of the service processes.

Knowing events in advance



Conclusions

Practice: Use of ICT + OR can tremendously advance customer responsiveness

Practice: Optimization requires more than intuition and common sense

Theory: Theoretically largely unexplored area, many questions open

Theory: Deal with arrival stochastics (Larsen et al. 22004, Hvattum et al. 2006,2007, Van de Klundert & Otten 2007) – e.g. via scenario based methods

Theory: Work on problems where locations of customers are given.

Questions?