# Capacity planning at emergency call centers


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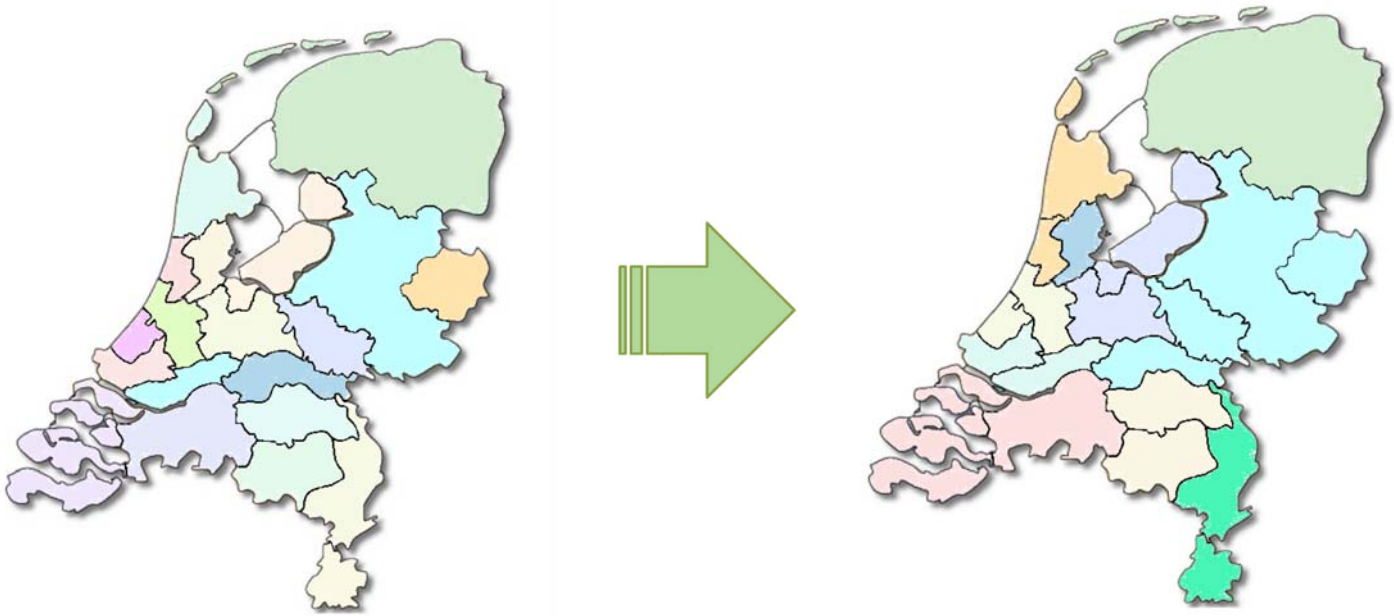
# Introduction

**Why is this research relevant?**

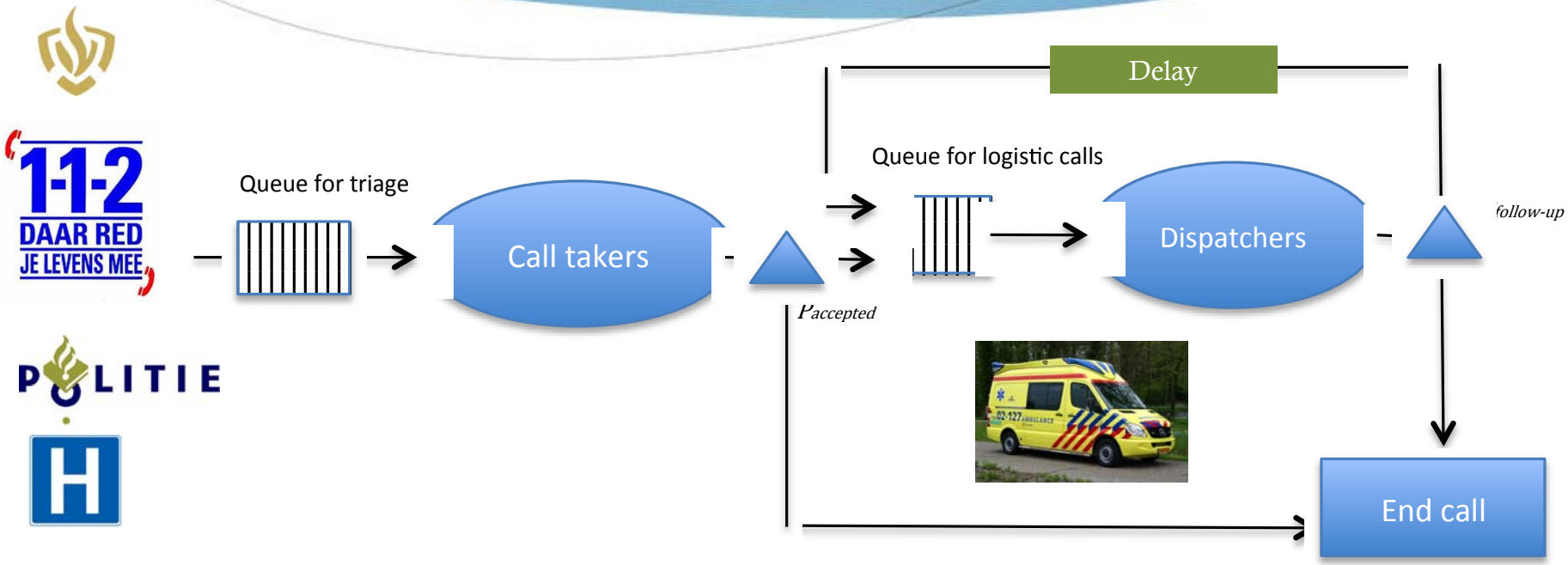
- Merging emergency call centers is a hot topic in the Netherlands.
- Each emergency call center has a different way of operating. Goal is to have more standardized emergency call centers.



# Problem statement

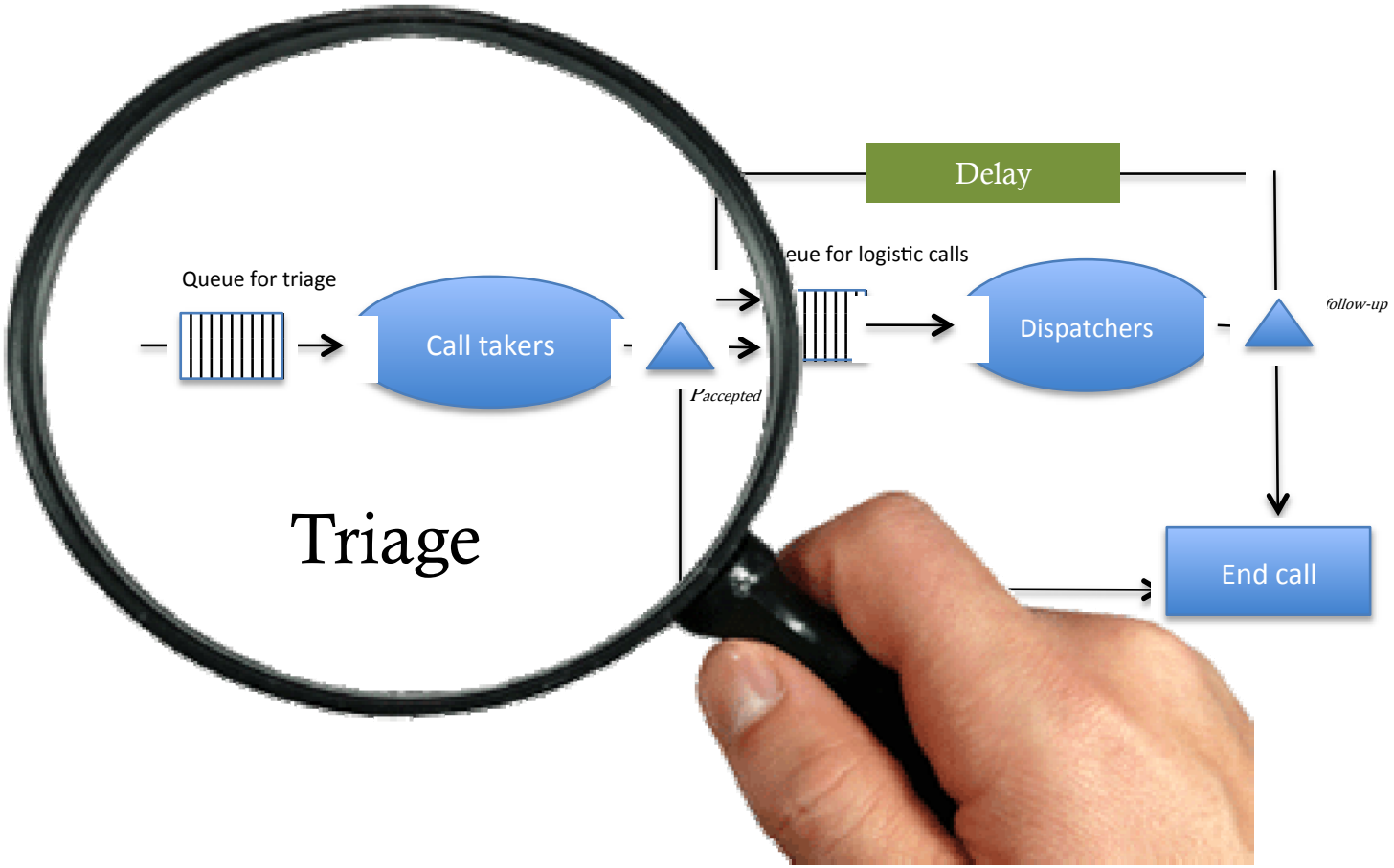
- **What is the impact of staffing on the performance and efficiency of emergency call centers for ambulance services?**
  - What is the impact of different staff combinations on the performance indicators?
  - What is the impact of merging call centers on the efficiency?

# Modeling emergency call centers

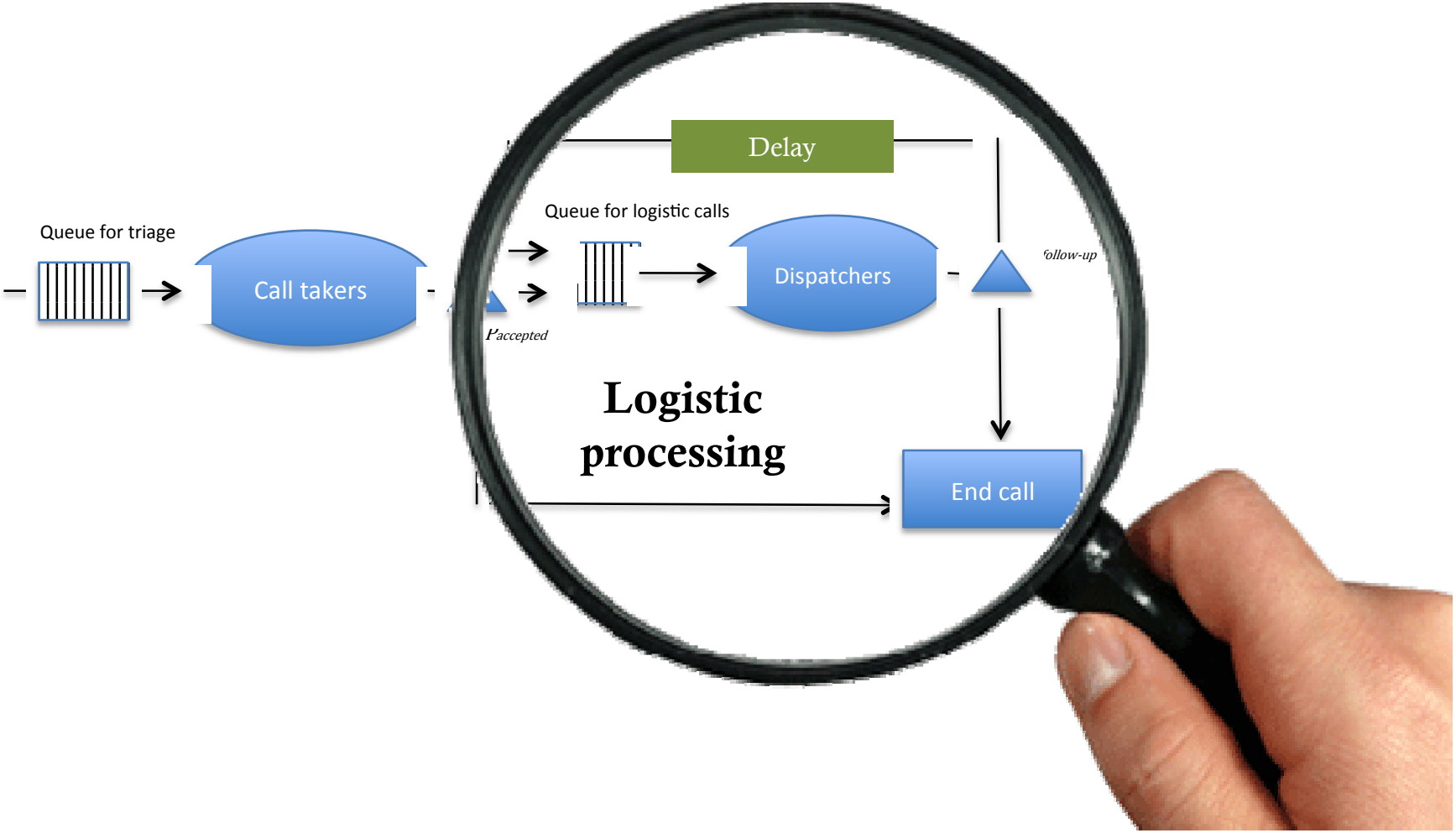



**A1:** Concerns a high urgency and a life-threatening situation.
**A2:** Concerns a high urgency but not a life-threatening situation.
**B:** An order for transportation of patients to and from healthcare institutions.

**Performance indicator:** the percentage calls that have a *total* waiting time less than $X$ seconds.



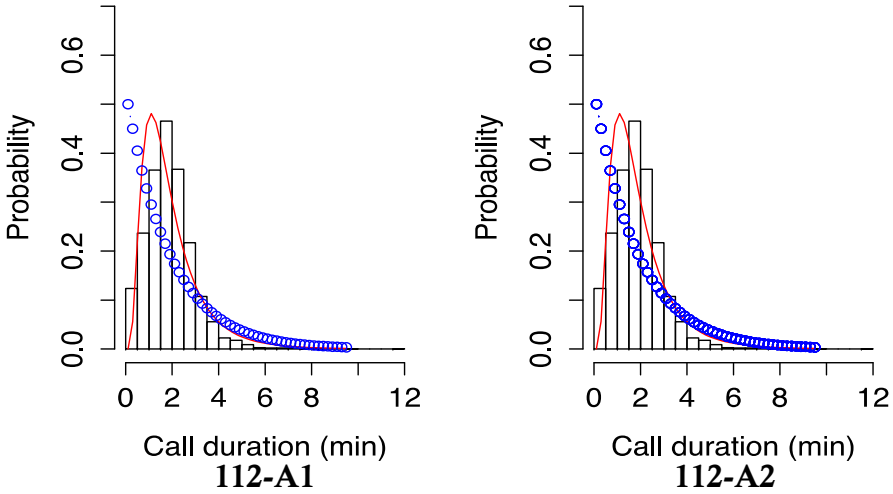

**Arrival process:** homogeneous Poisson process.
**Queue:** priority queue, pre-emptive resume.
**Call durations**: lognormally distributed.
**Fraction calls accepted:** 90%.




**Arrival process:** Unknown.
**Queue:** priority queue, pre-emptive resume.
**Call durations**: exponentially distributed.
**Fraction follow-up calls:** 11.11%.
**Delay**: exponentially distributed, expected duration: 25 minutes.

# Data-analysis

- 20.000 calls of Regionale Ambulance Voorziening Utrecht (RAVU) from 1-3-2011 until 30-6-2011.
- Arriving calls are split according to *origin* and *urgency* and each group has different average call durations.
- Call durations are *approximately* log-normally distributed.



# Simulation

- Discrete Event Simulation (DES) build in Java.
- **DSS**: **D**ecision **S**upport **S**ystem.
- Supporting decisions with regard to *merging* call centers and *staffing* of individual call centers.
- Decision levels: *tactical* and *strategic.*
- Demo of DSS!

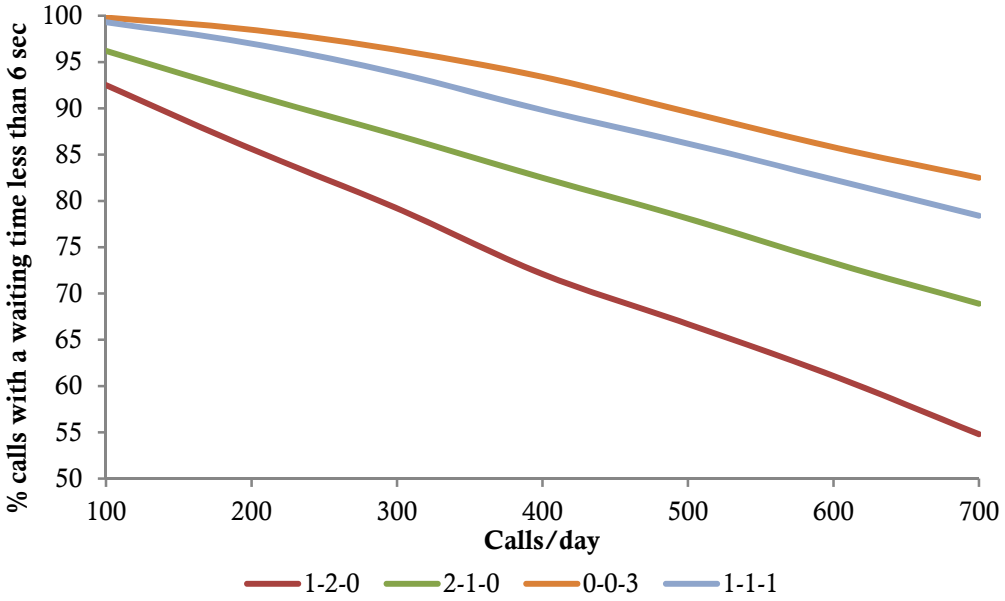
# Staff configurations

'What is the impact of staff combinations on the performance of an emergency call center?'

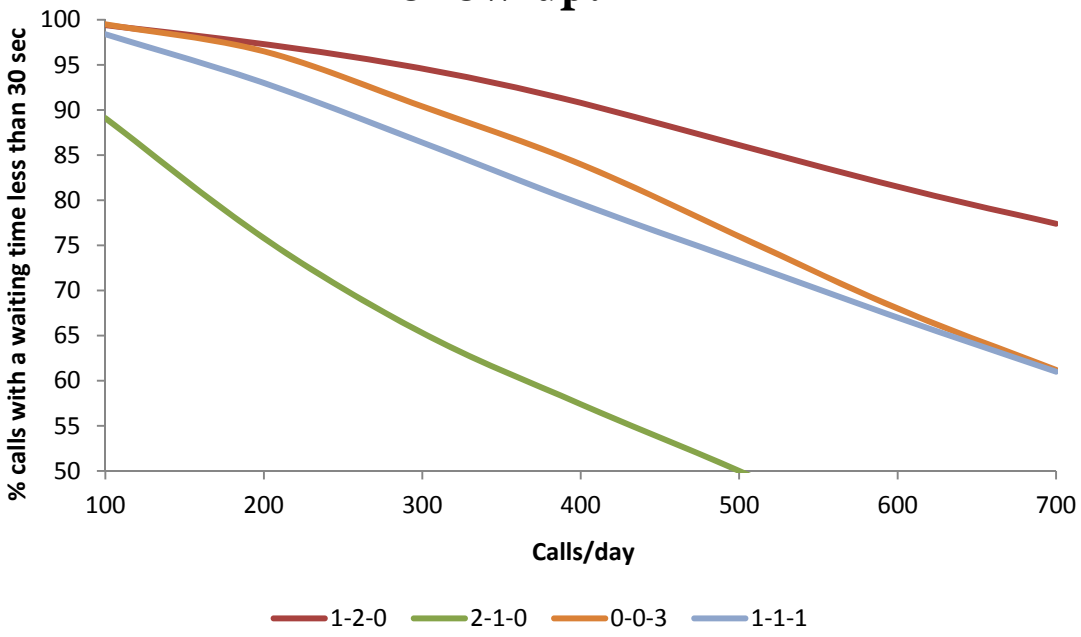
- Three different employees, with different skills:
  - **Call taker:** only performs triage.
  - **Dispatcher:** only does dispatching and handling follow-up calls.
  - **Generalist:** can do both triage *and* dispatching/handling follow-up calls.
- Combinations with only call takers and dispatchers are called *function differentiation*.
- Dispatchers have *lower wages* (in general) because no medical knowledge is required.
- Generalists handles the *overflow* from call takers and dispatchers.

E.g. **1-2-0** = 1 call taker, 2 dispatchers and 0 generalists.

## A-calls:




## Follow-up:



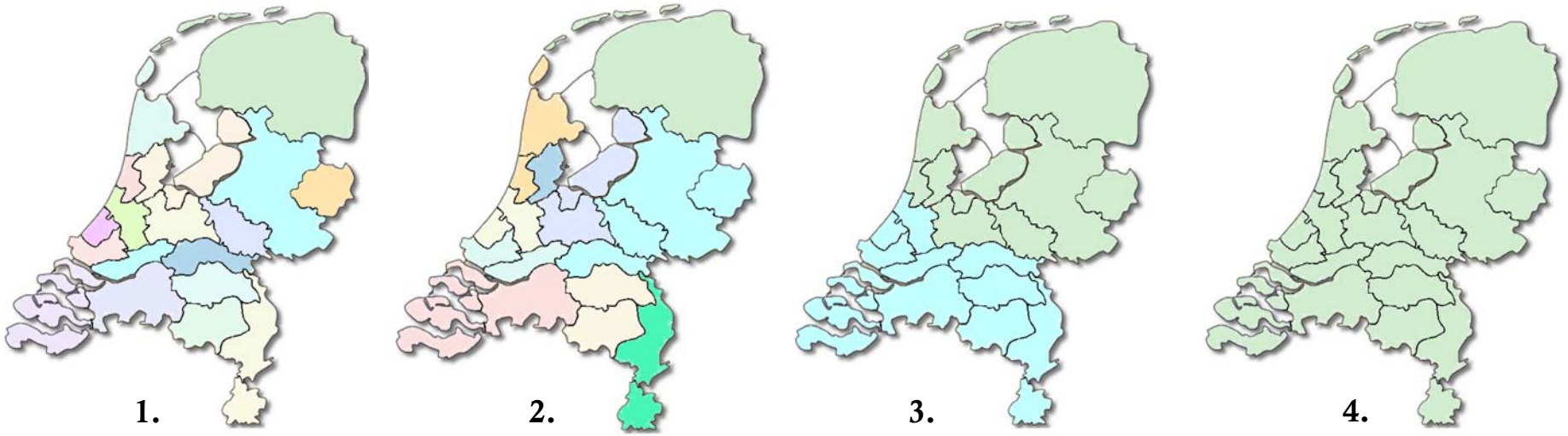
# Merging emergency call centers

'What is the impact of merging call centers on the efficiency?'

- Wet Ambulancezorg (WAZ): More cooperation among 'Regionale Ambulance Voorzieningen' (RAVs) in order to increase *efficiency*.
- 'Project meldkamer van de toekomst' by *Ministerie van Veiligheid en Justitie*: 21 call centers to 10 call centers.

# Four different scenarios:

1. Current situation (21 emergency call centers)
2. Plan of Ministerie van Veiligheid en Justitie (10 emergency call centers)
3. Two emergency call centers
4. A nationwide call center



# Minimum required staffing levels

- The minimum staffing levels have been determined using Service Level Requirements (SLRs) for different urgencies:
  - **A1- and A2- calls**: 95% within 6 seconds (guideline of RIVM).
  - **B- calls**: 90% within 150 seconds.
  - **Follow-up calls:** 90% within 30 seconds.

| Scenario | Number of generalists | Average utilization rate generalists (%). |
|---|---|---|
| 21 call centers | 50 | 28.9% |
| 10 call centers | 36 | 41.9% |
| 2 call centers | 21 | 73.2% |
| 1 call center | 19 | 80.8% |

| | Number of centralists | | | Average utilization rate % | |
|---|---|---|---|---|---|
| Scenario | Call takers | Dispatchers | Total | Call takers | Dispatchers |
| 21 call centers | 44 | 42 | **86** | 18.8% | 15.8% |
| 10 call centers | 26 | 24 | **50** | 32.4% | 28.3 % |
| 2 call centers | 14 | 12 | **26** | 60.7% | 56.8% |
| 1 call center | 11 | 12 | **23** | 77.7% | 56.7% |

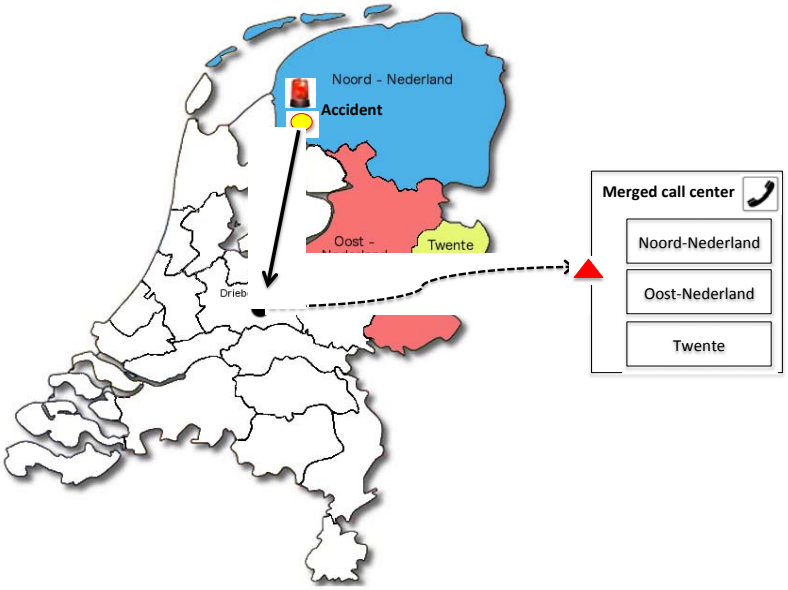
# Including regional knowledge

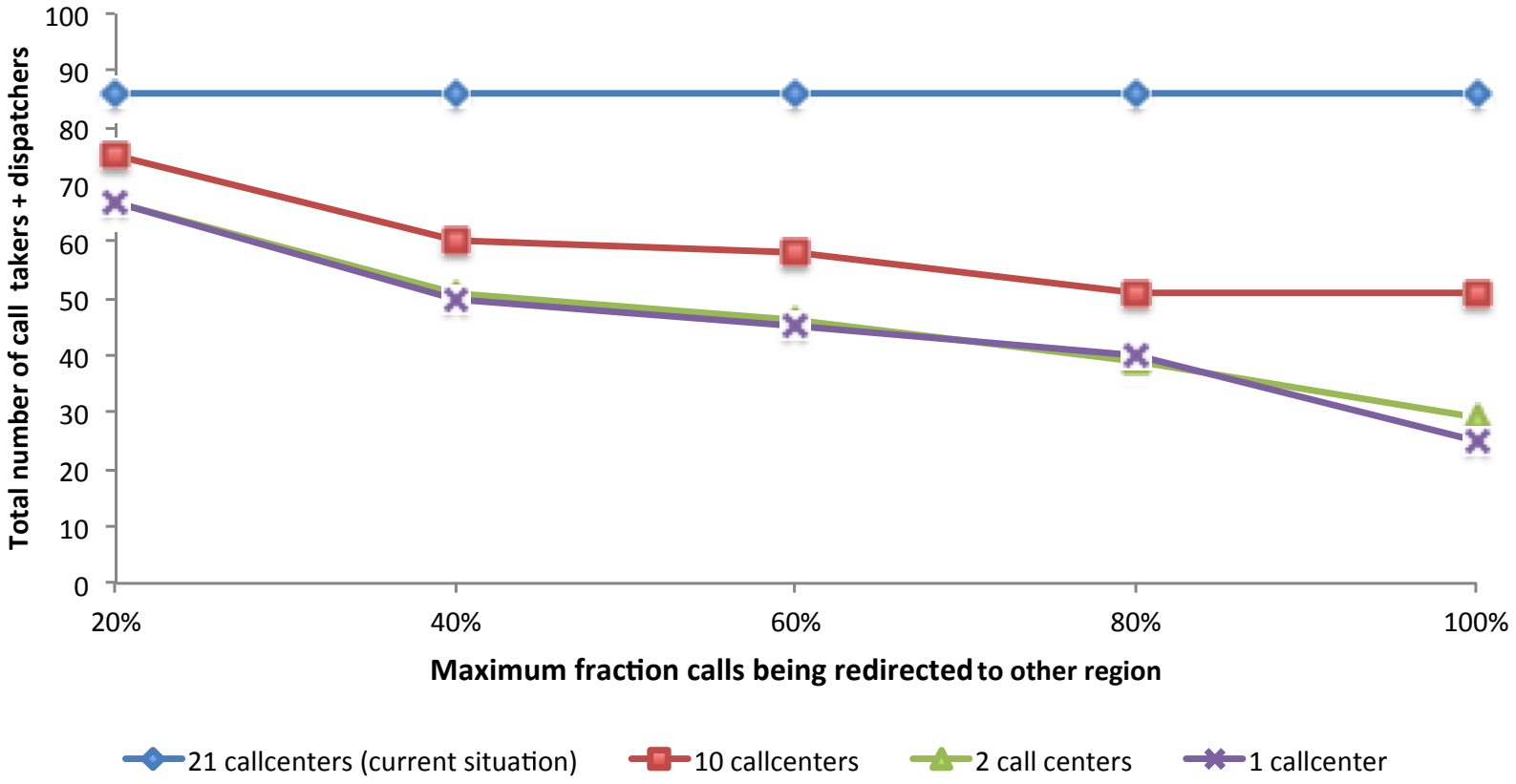
- Regional knowledge enhances the *quality* and *efficiency* of handling 112 calls that arrive by mobile phone and handling logistic calls.

- A simulation model for merging *multiple* call centers.

# Simulation model for multiple emergency call centers

- Regional knowledge is now seen as a *skill*.
- If call is redirected to an employee of another region, a penalty time is added. (expected penalty time of 0.5 minutes for 112 calls and logistic calls.)
- Minimum required staff levels are based upon *the minimum required service* levels and an upper bound on *the max. fraction calls that is allowed to be redirected*.




Total number of call takers + dispatchers
100
90
80
70
60
50
40
30
20
10
0
20%
40%
60%
80%
100%
Maximum fraction calls being redirected to other region
21 callcenters (current situation)
10 callcenters
2 call centers
1 callcenter

# Conclusion and recommendations

- The current emergency call centers have *too* low call volumes to operate *efficiently* with call takers and dispatchers.
- Function differentiation becomes more efficient when emergency call centers become bigger.
- Significant economies of scale can be gained when merging emergency call centers, but *regional knowledge* is lost.
- Including regional knowledge (to some extent) into the model still increases efficiency.

# Questions