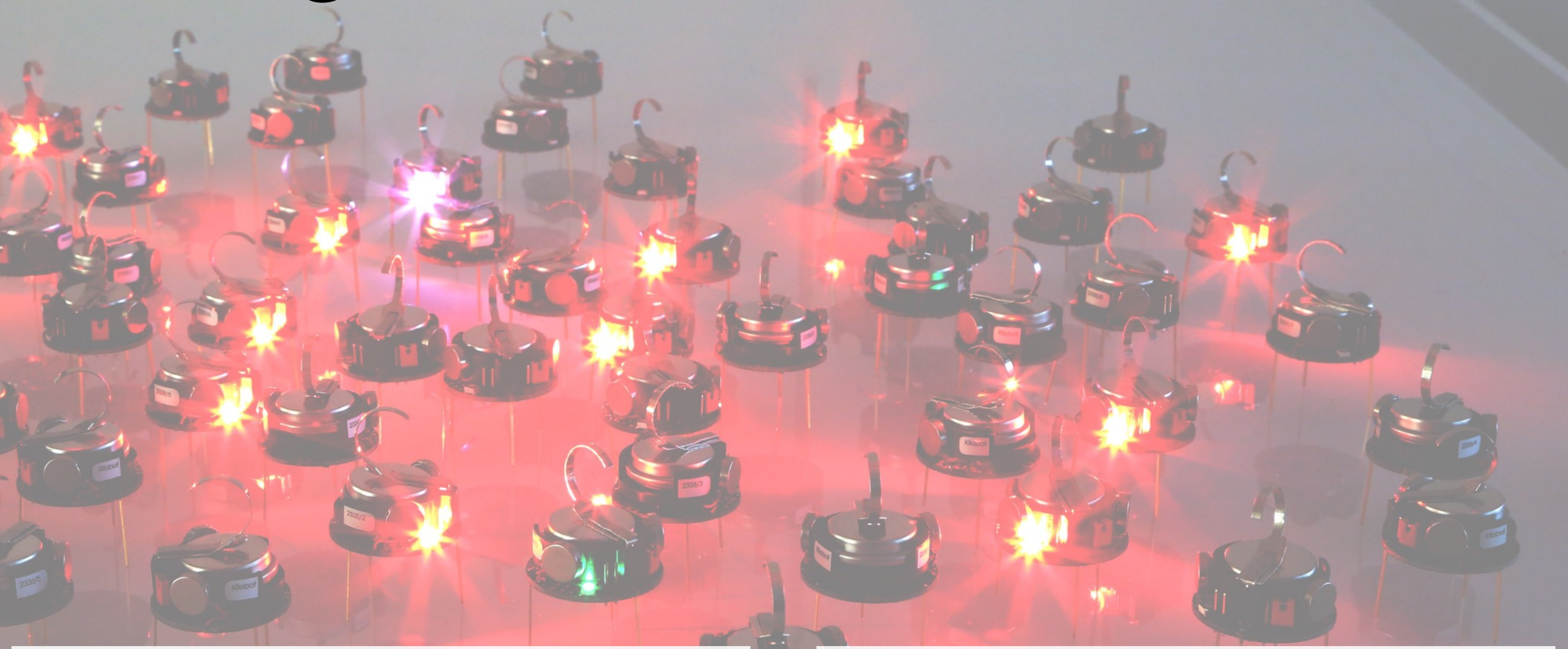
Teams & Roboter
gemeinsam mehr erreichen

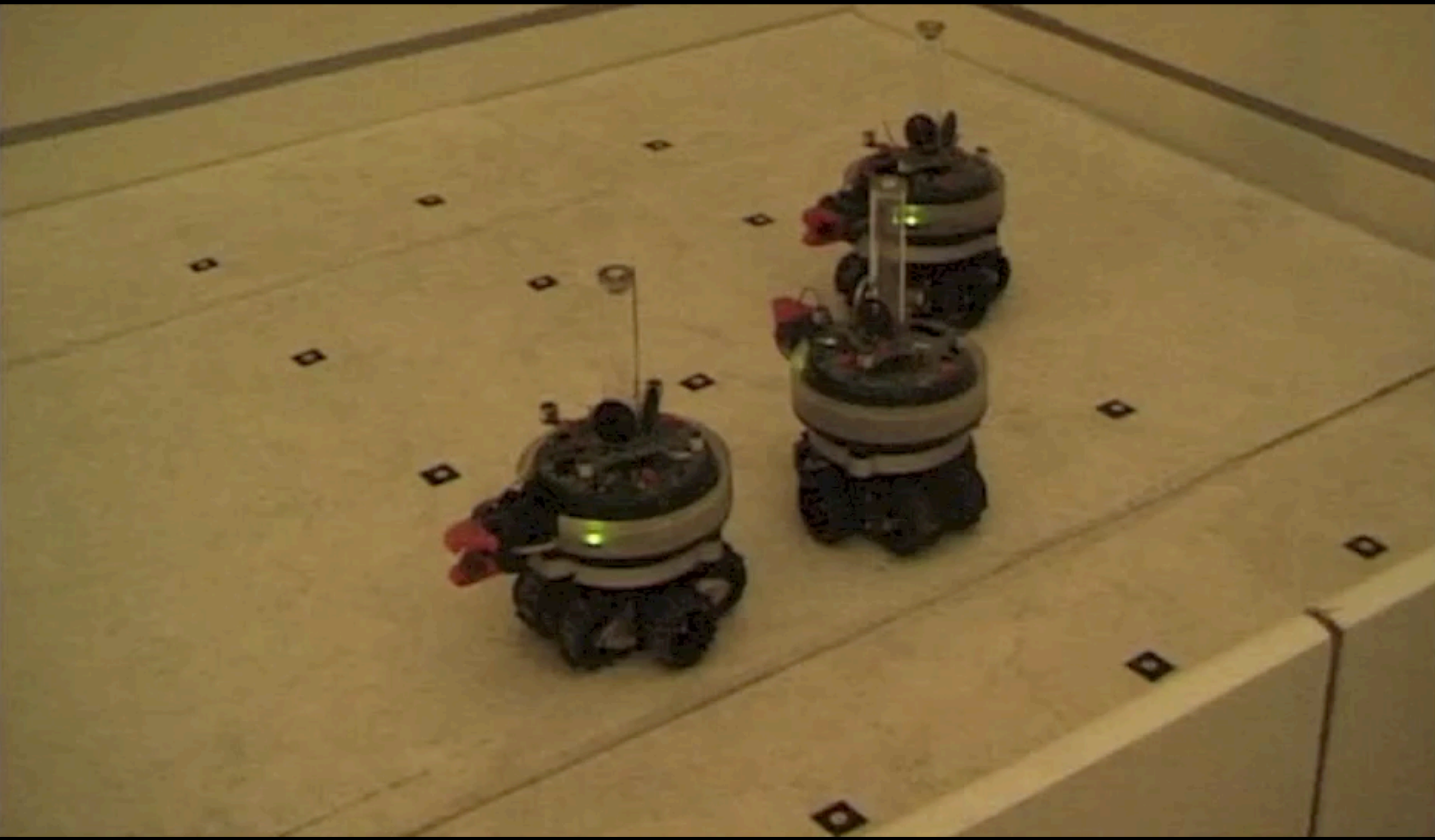


UNIVERSITÄT ZU LÜBECK
INSTITUTE OF COMPUTER ENGINEERING

Prof. Dr.-Ing. Heiko Hamann
Institut für Technische Informatik
Universität zu Lübeck


gemeinsam ist man
weniger allein…

…get the
job done

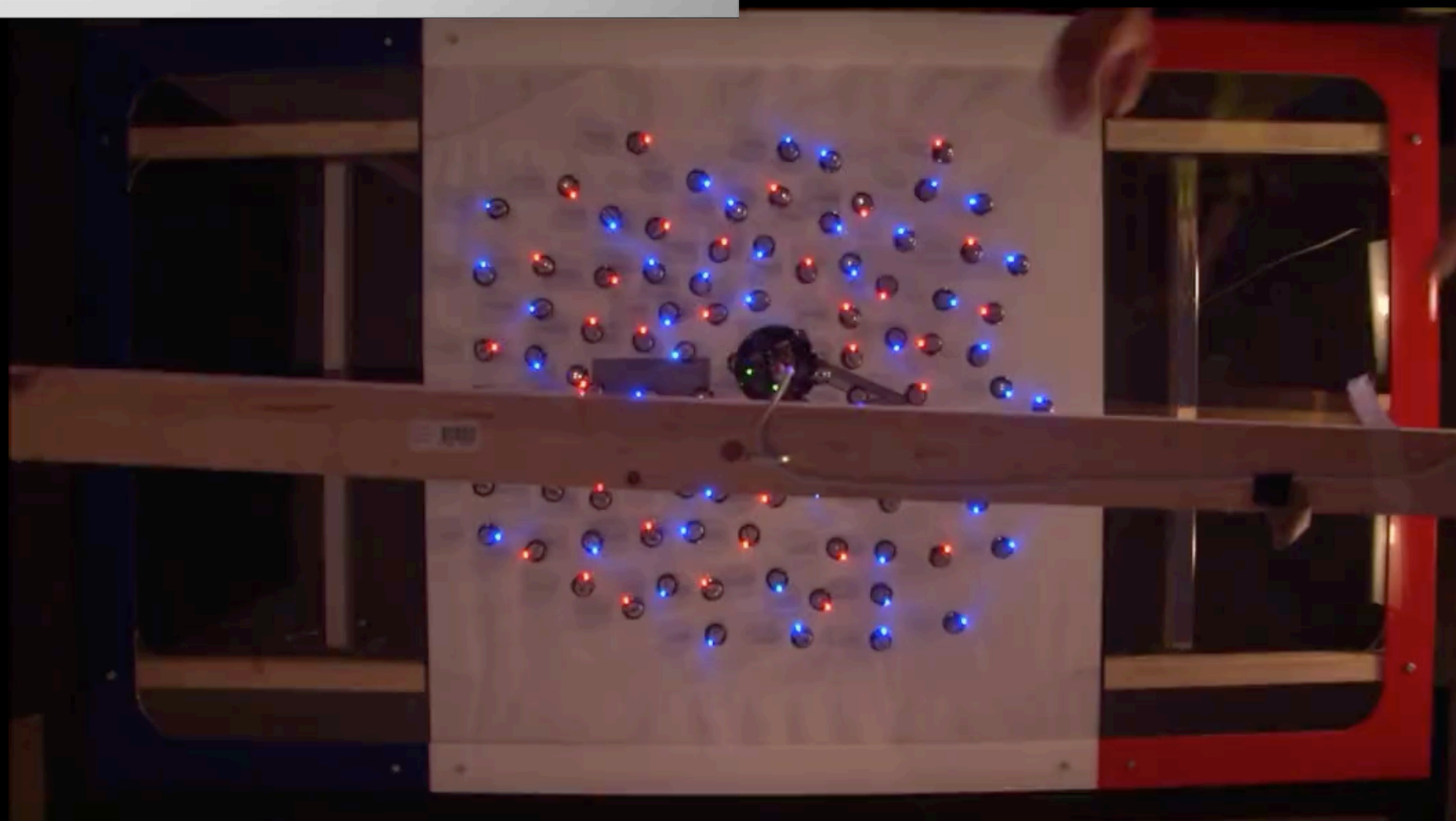


Marco Dorigo et al., ULB

HARVARD
UNIVERSITY

VE RI TAS

Radhika Nagpal et al., Harvard



SE

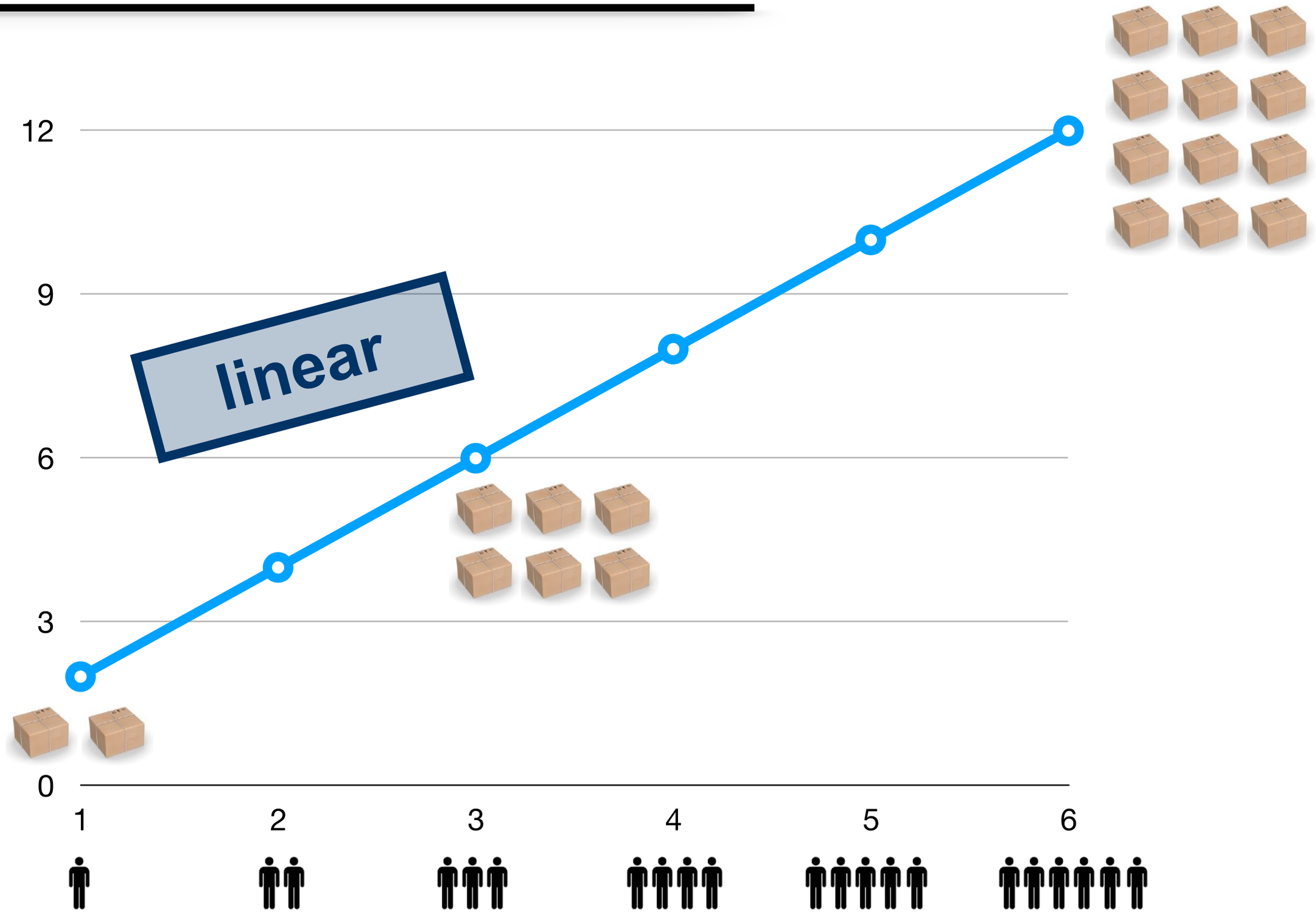
PARALLEL PROCESSING

https://www.youtube.com/watch?v=__k1sWqoO7I

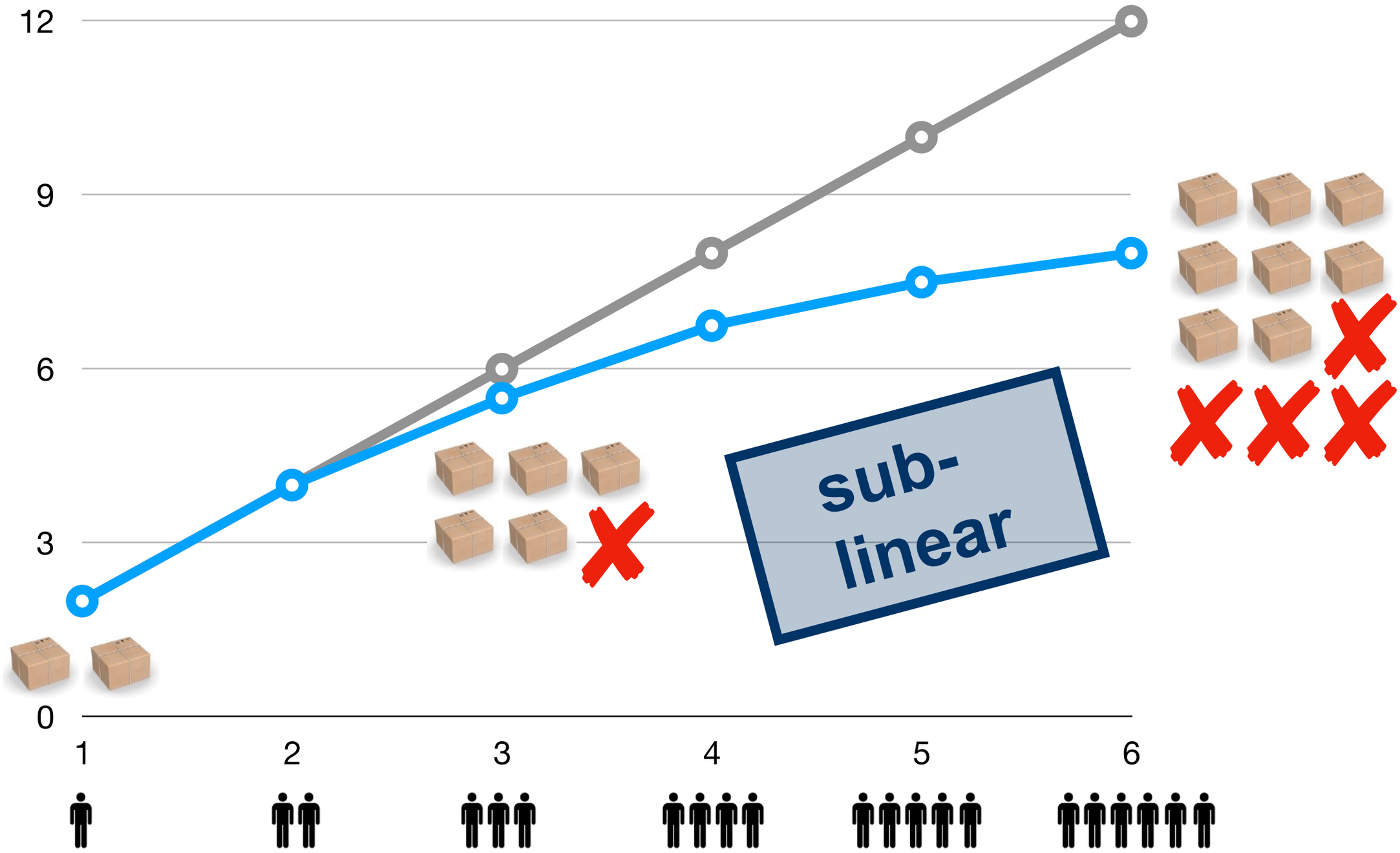
https://www.youtube.com/watch?v=gnQci4rvWn4


SWNS

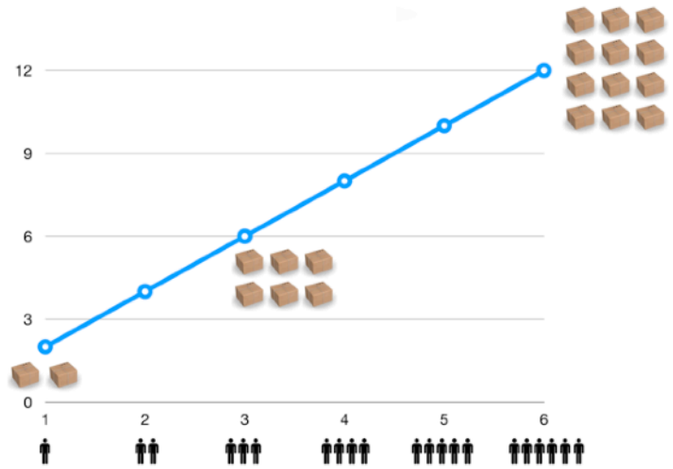
Gruppenleistung

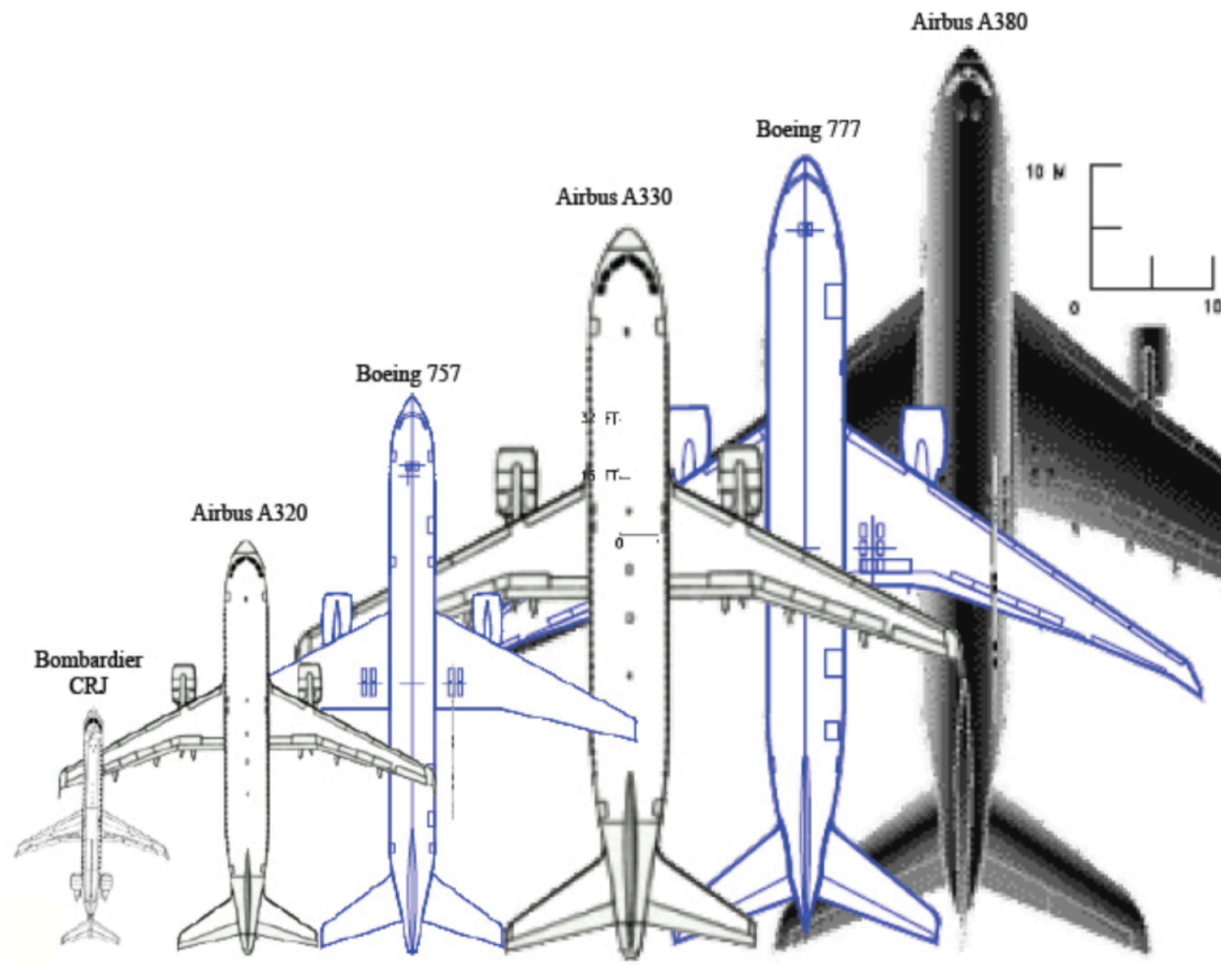


Gruppenleistung - Variante B

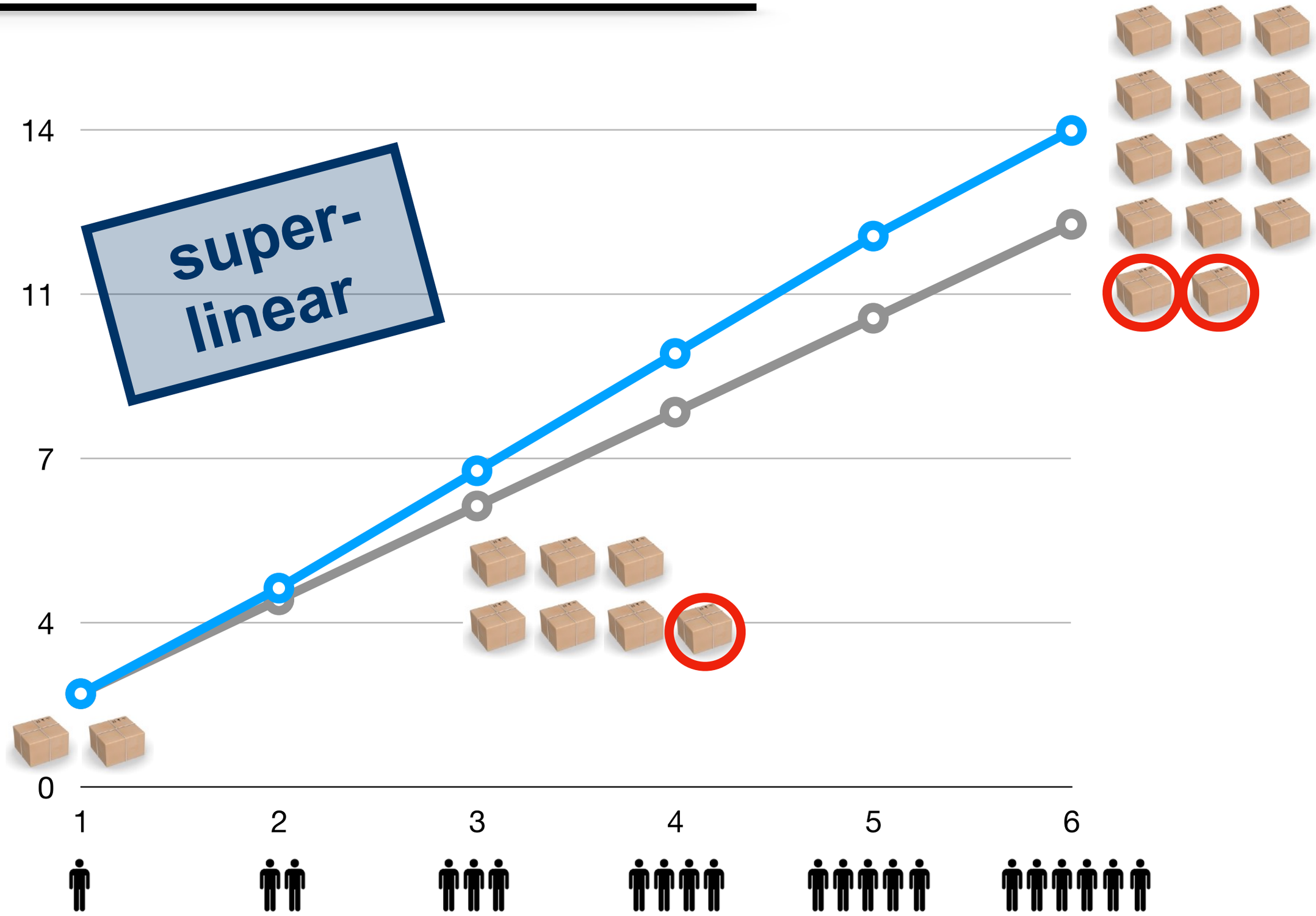


Skalierbarkeit

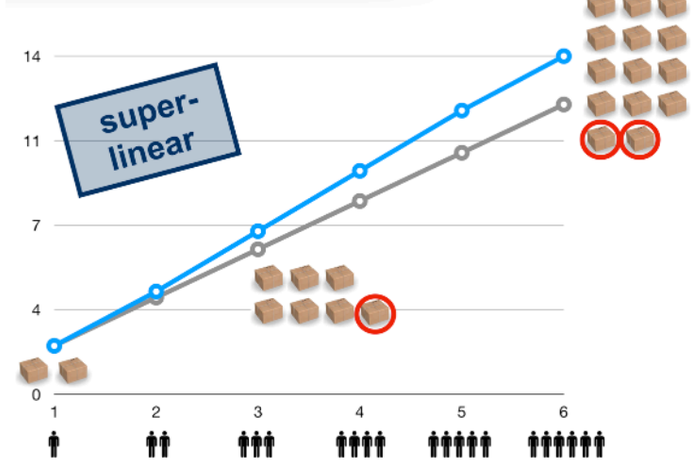




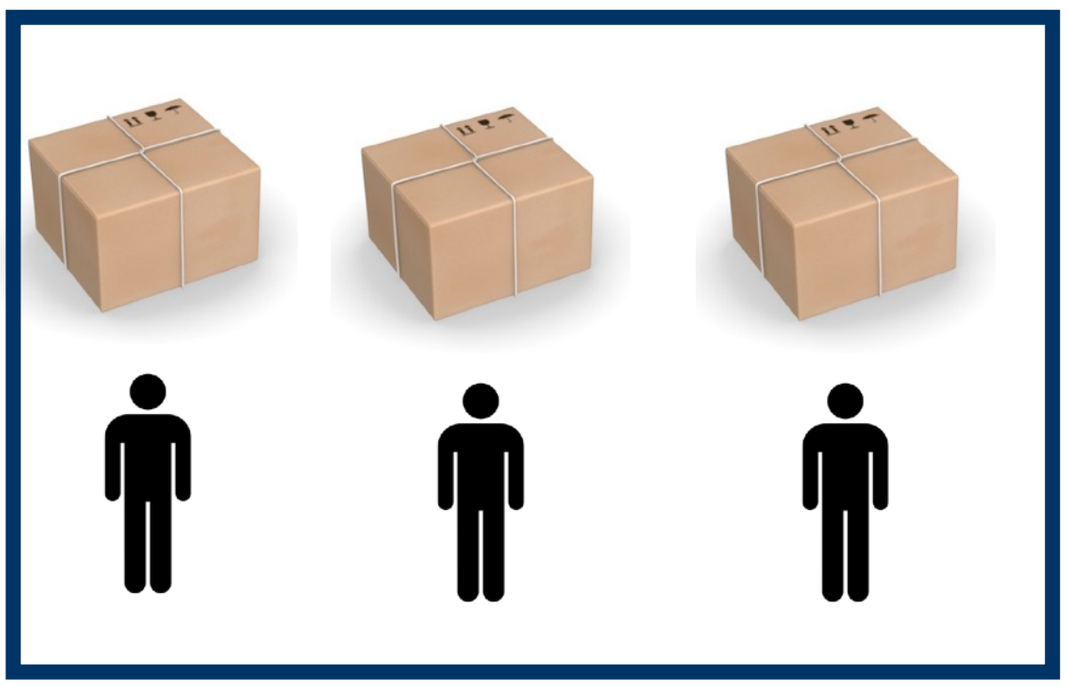
Gute Nachricht: super-lineare Leistung

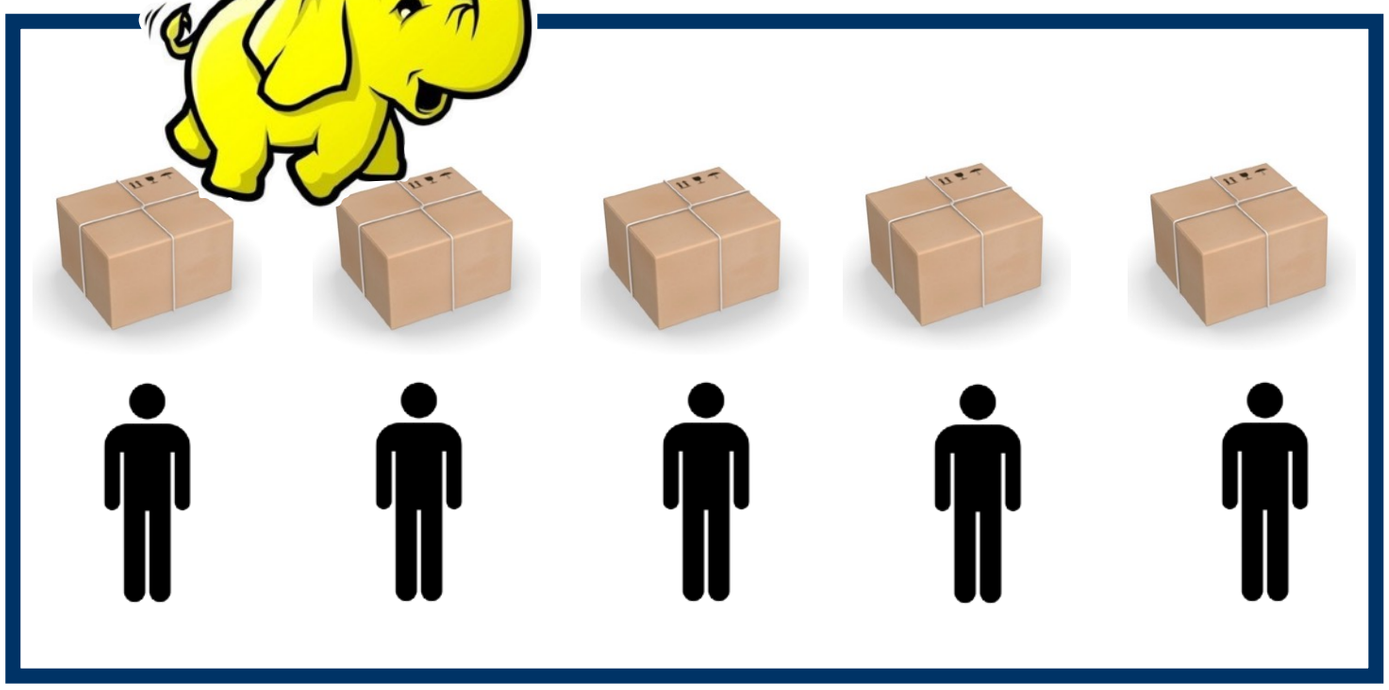


Schwarze Magie? Perpetuum mobile?

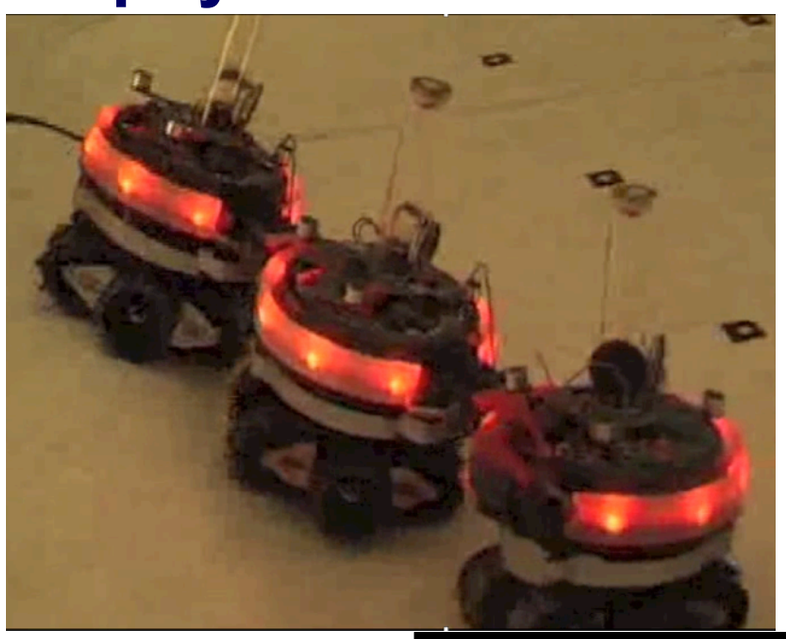


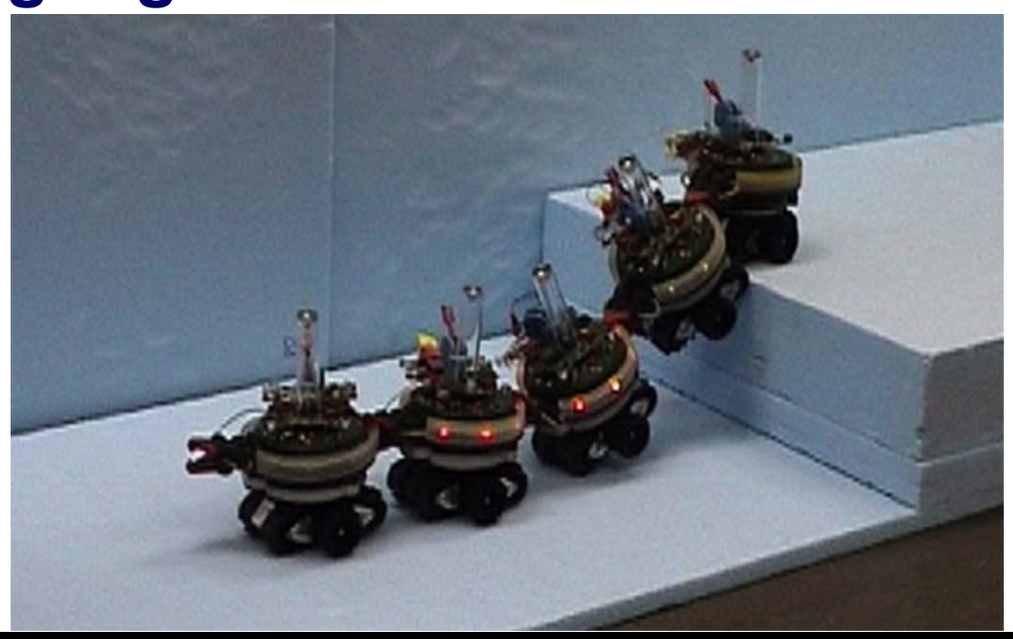
1 - Größe der Arbeitspakete

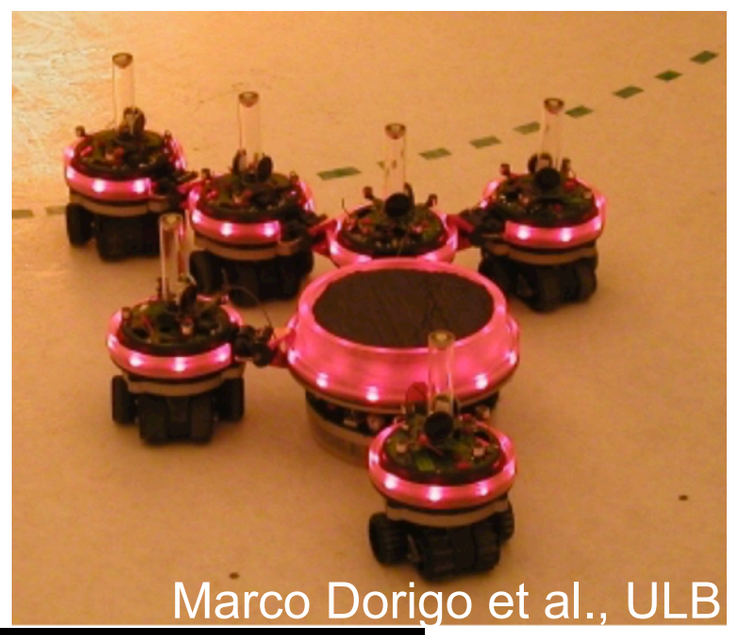




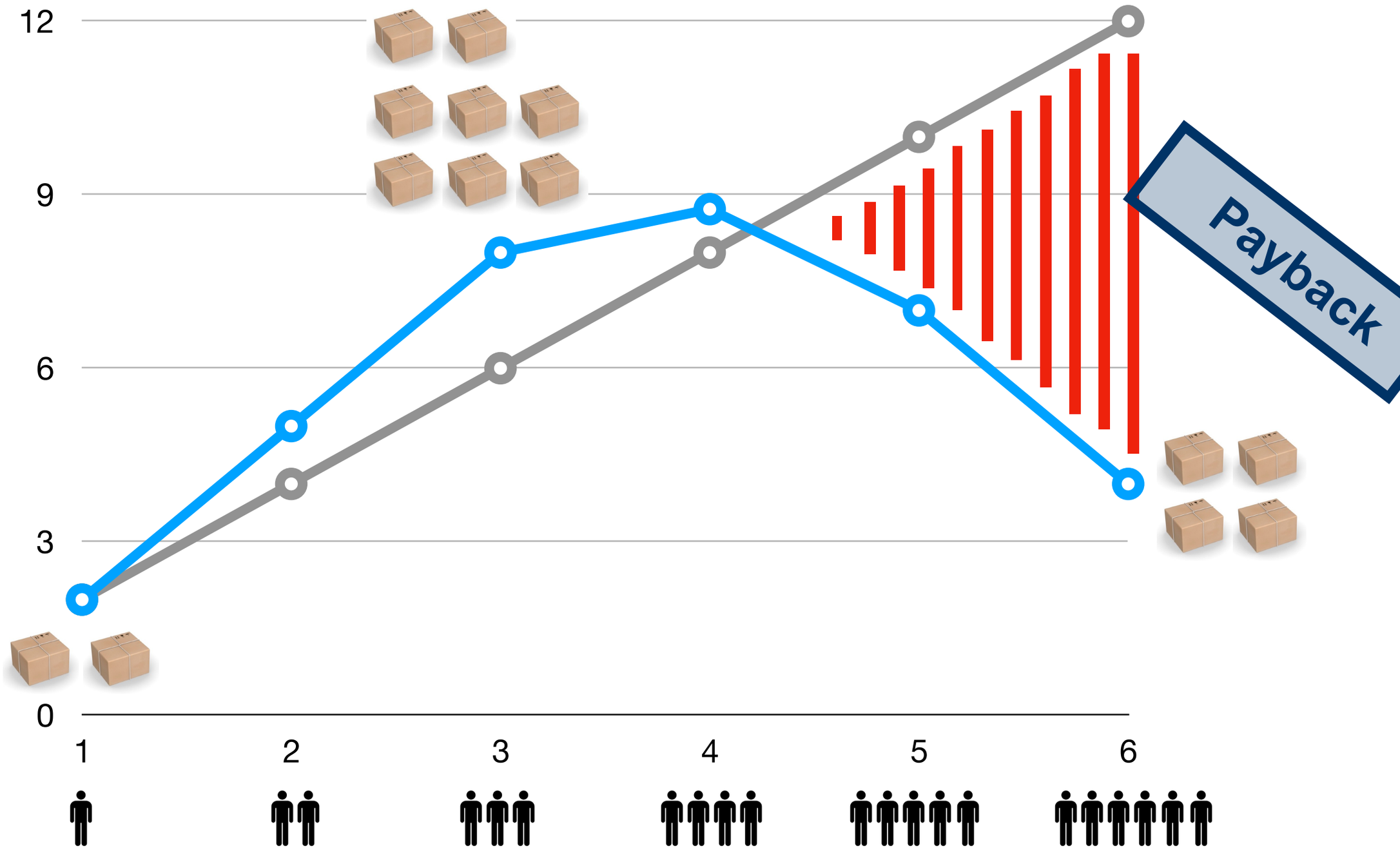
2 - physikalische Bedingungen



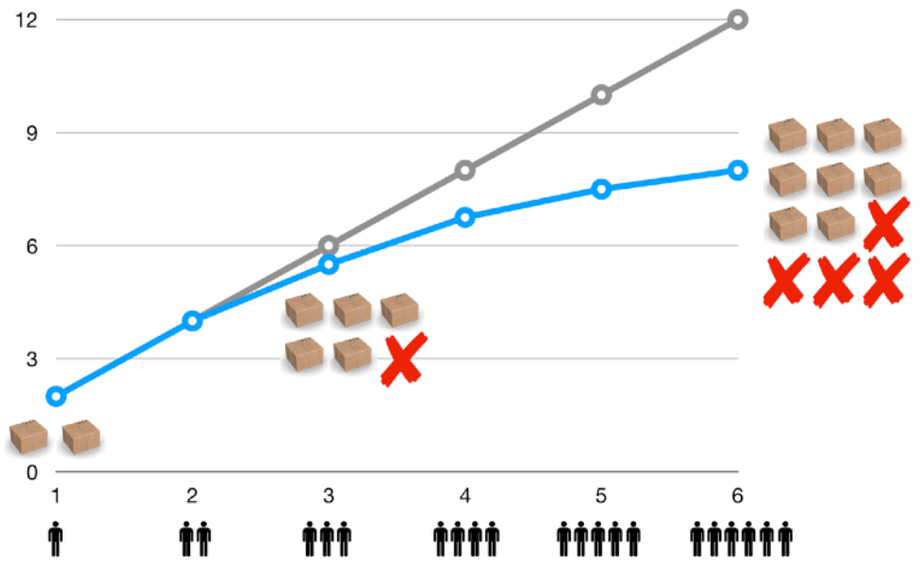




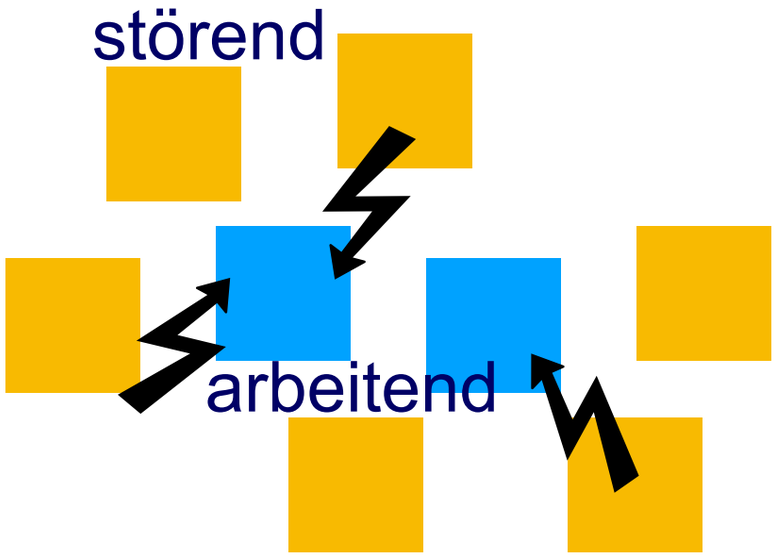
Schlechte Nachricht: Payback!

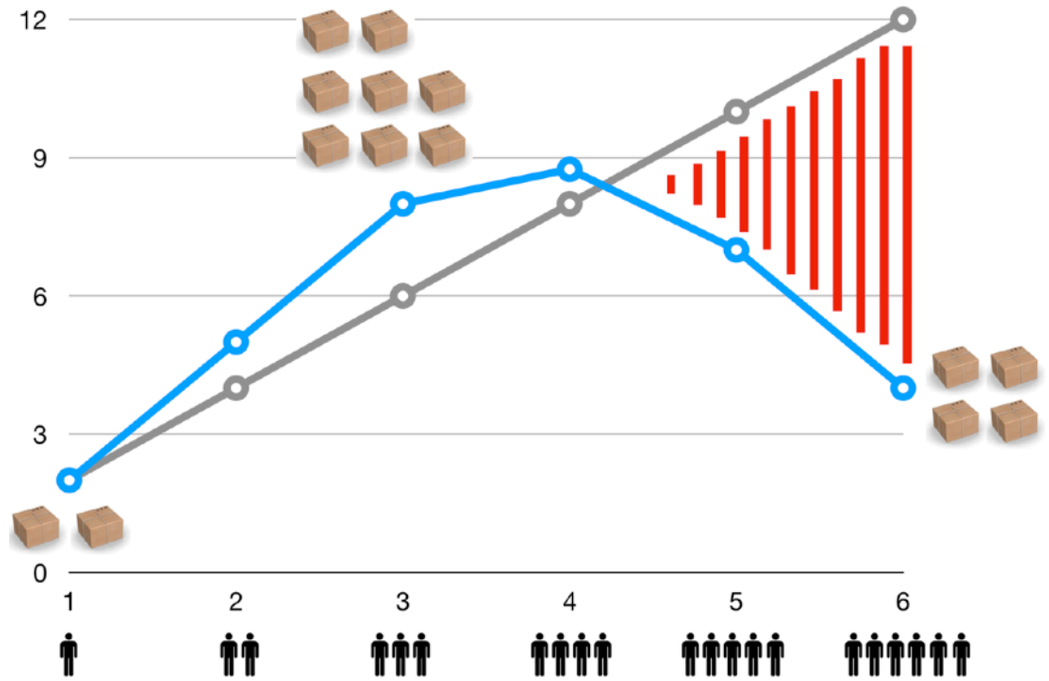


Geteilte Ressourcen und Warteschlangen

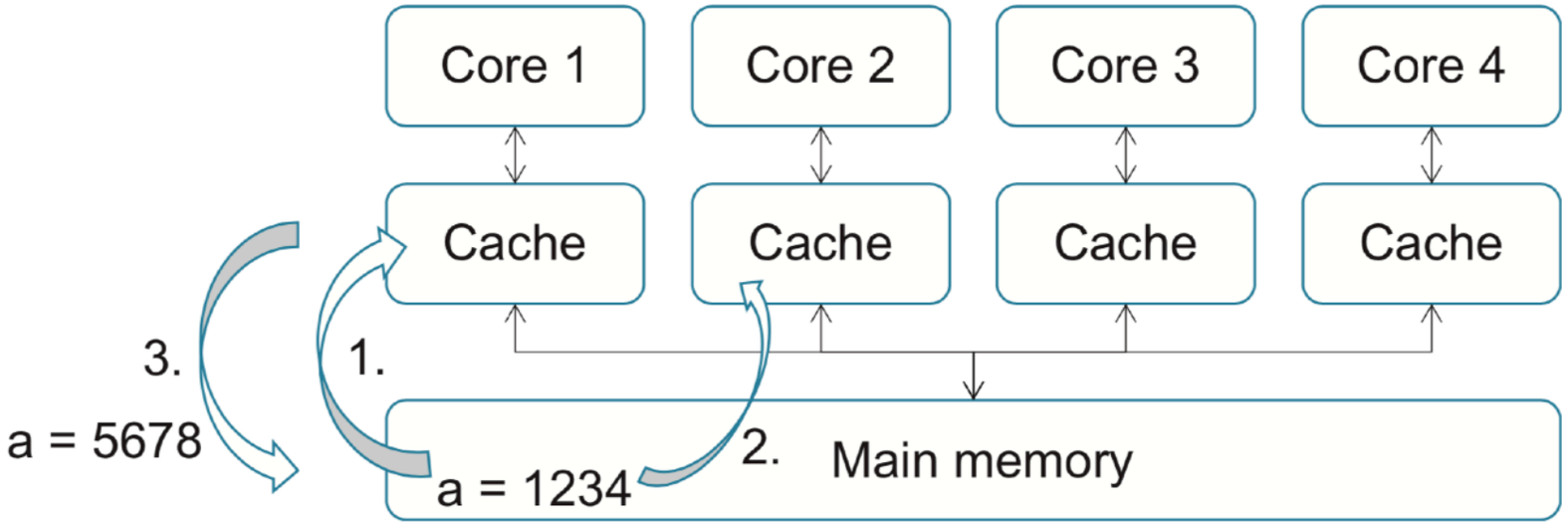


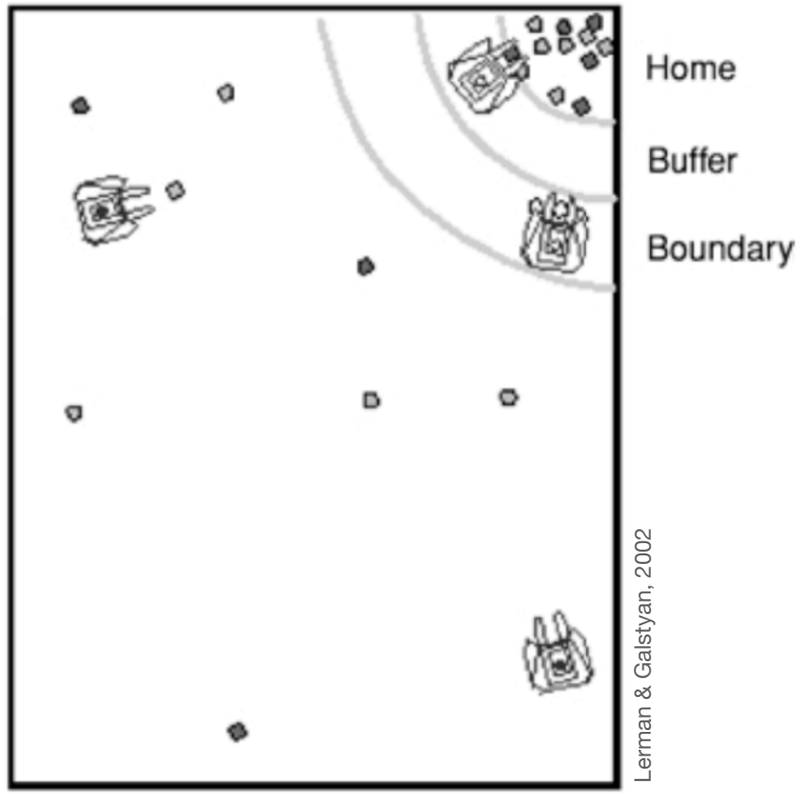
Kosten für Warteschlangen/Systemgröße

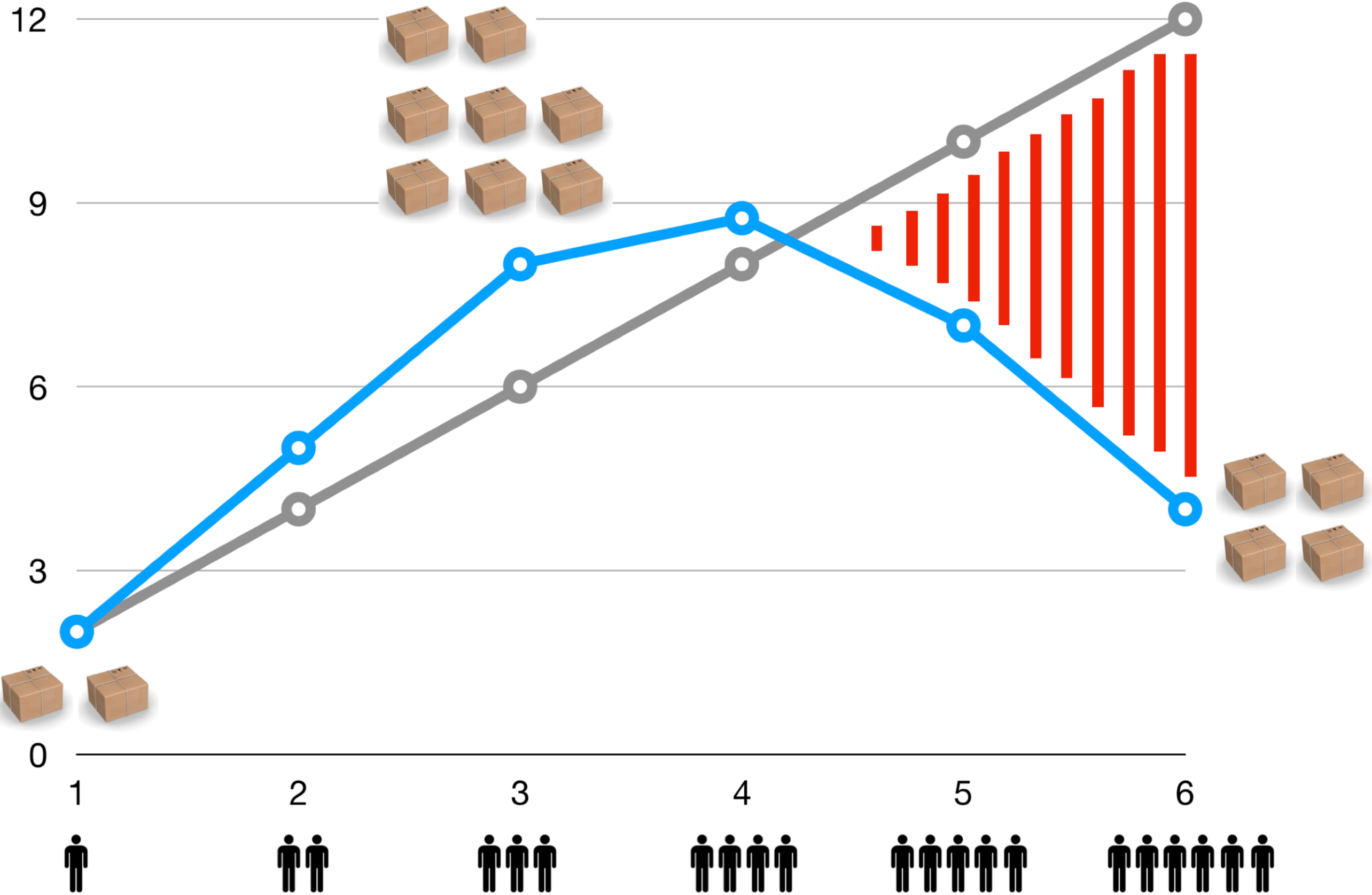




Aufwand für Speicher-Kohärenz:






12
9
6
3
0
1
2
3
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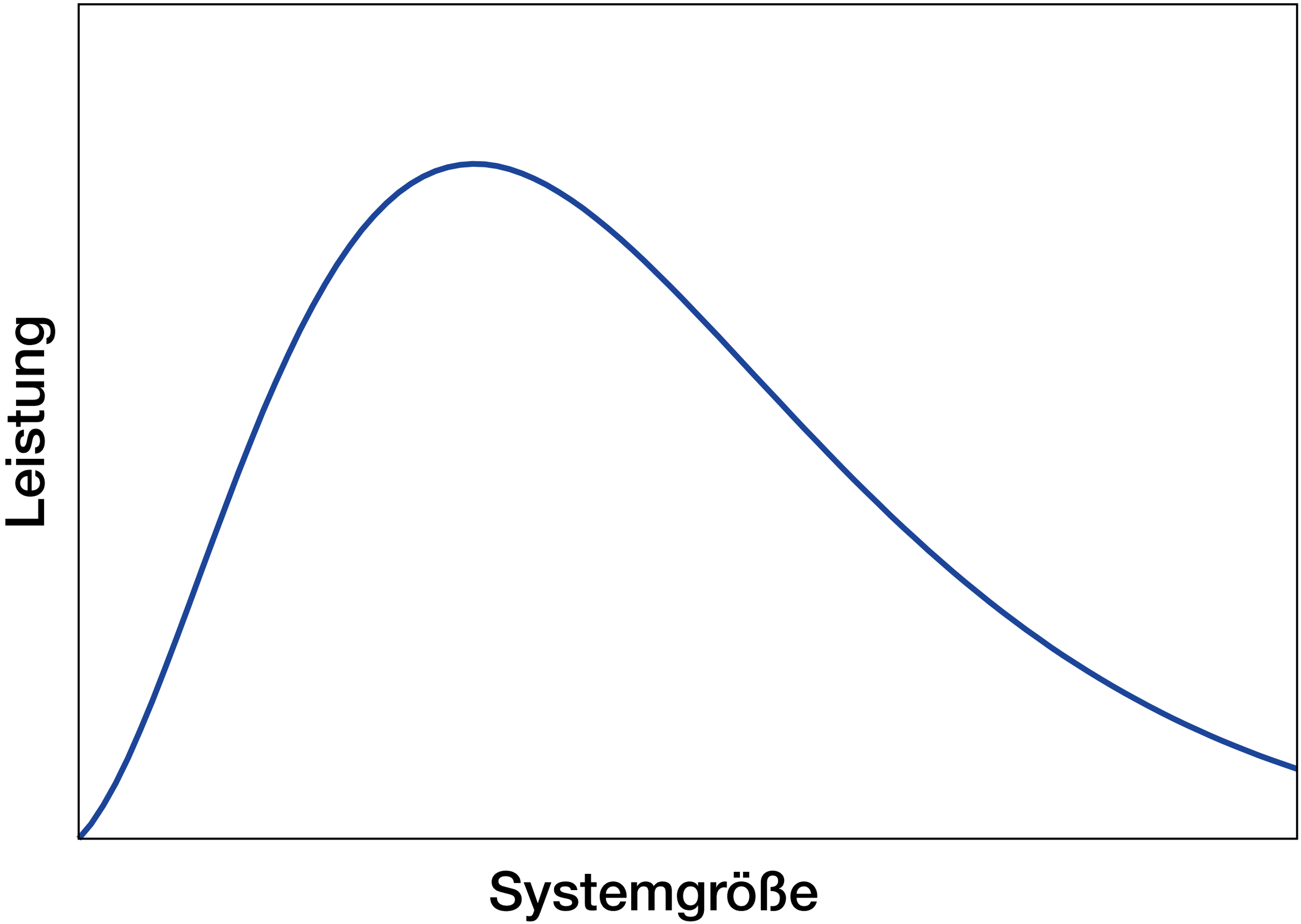
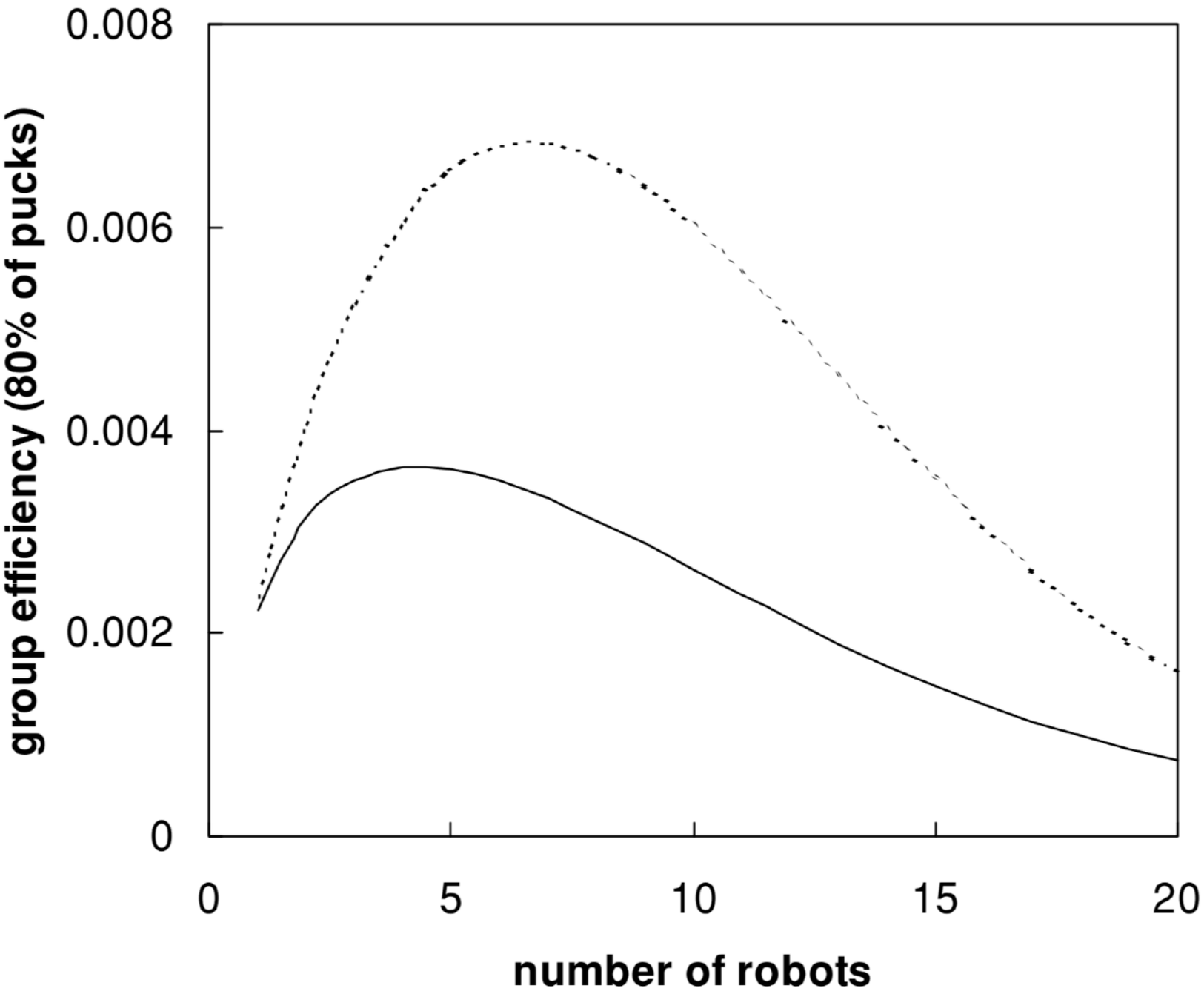
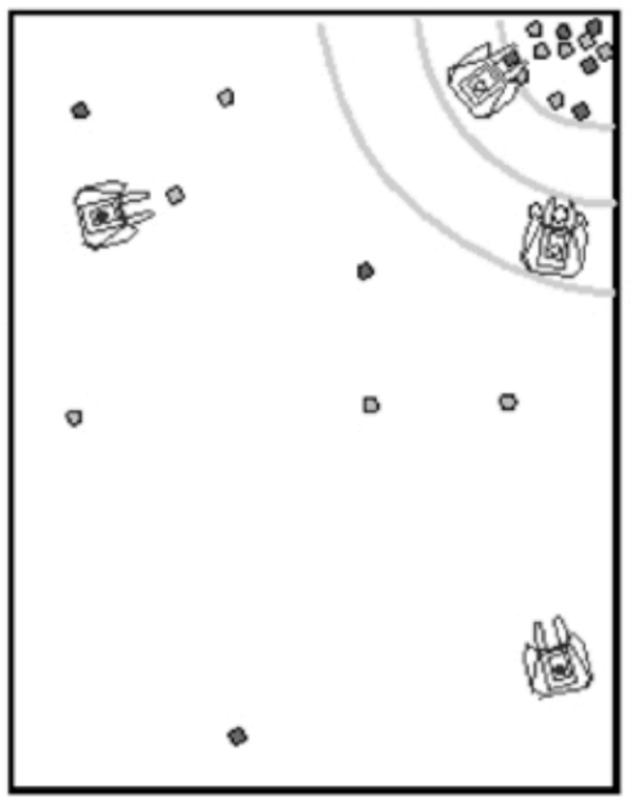
5
6


Leistung
Systemgröße

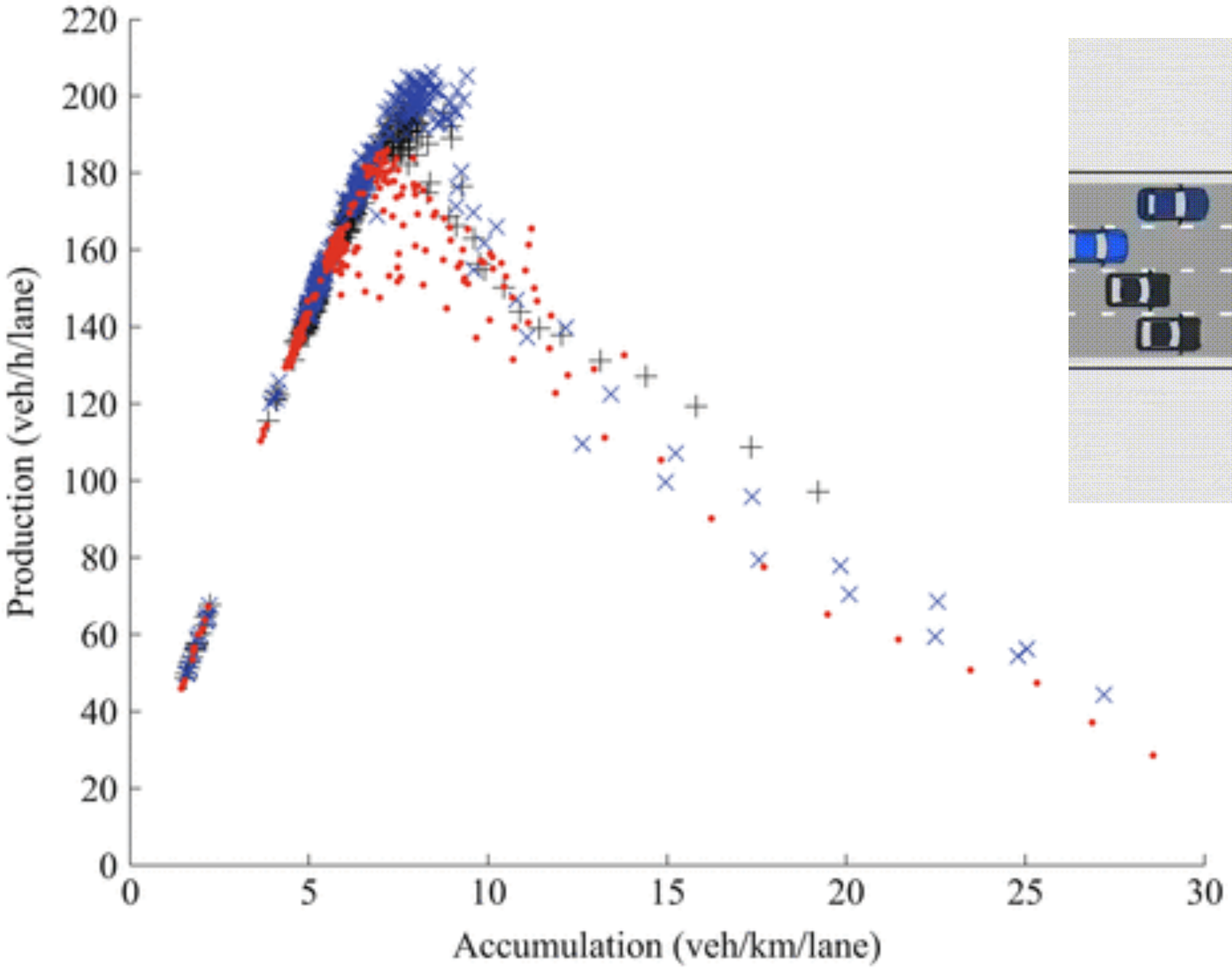
Beispiel: Roboter-Team

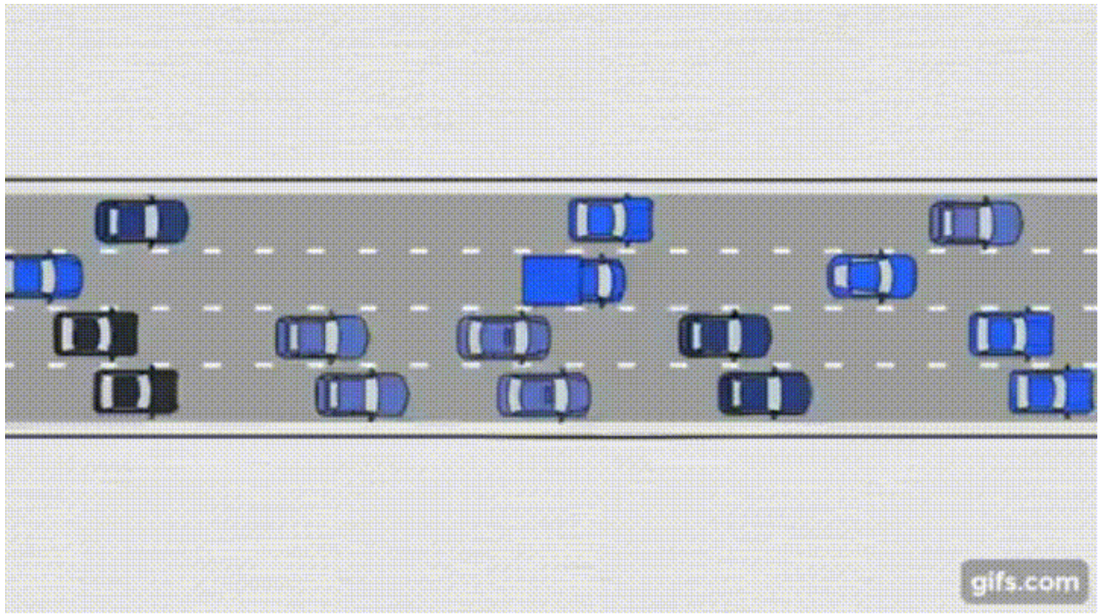




Lerman & Galstyan, 2002

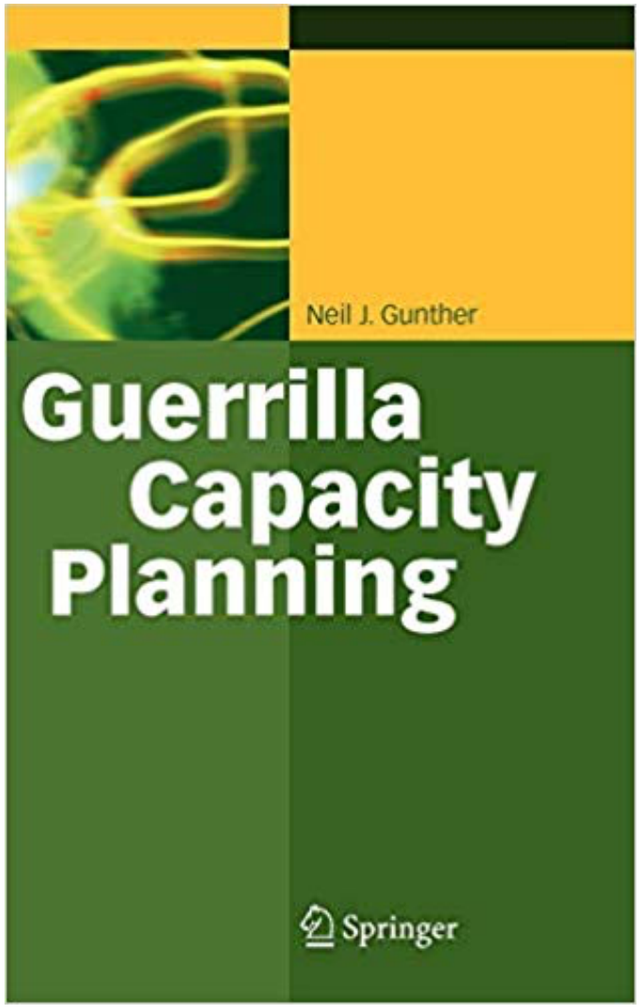
Beispiel: Straßenverkehr





Stamos et al., Int. Journal of Traffic and Transp. Eng., 2015

gesucht: Skalierungsgesetz



Universal Scalability Law

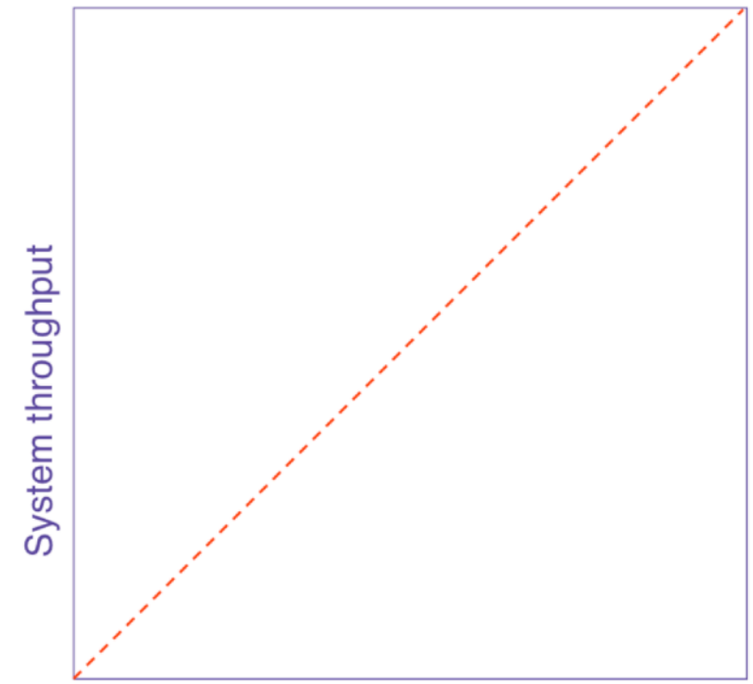
- Neil J. Gunther

$$L(N) = \frac{N}{1 + \alpha(N-1) + \beta N(N-1)}$$

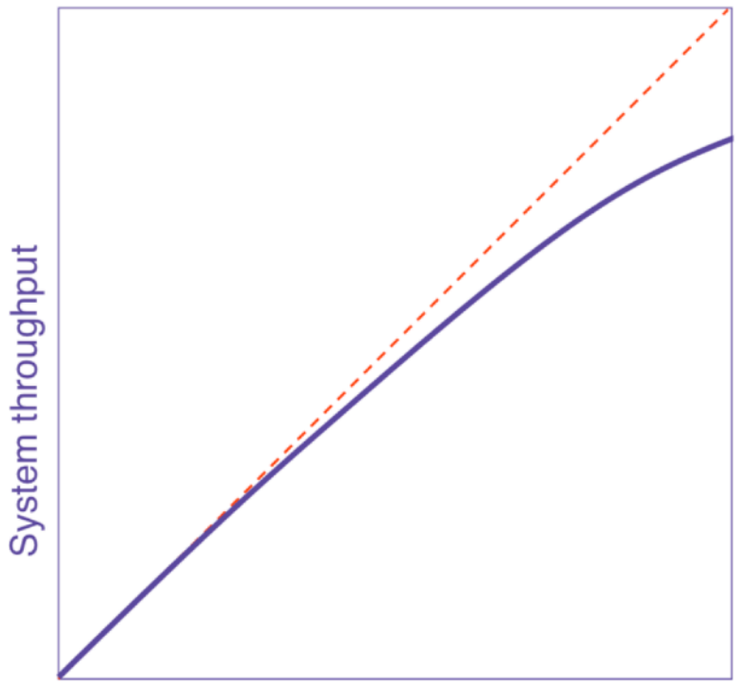
L: Leistung
N: Systemgröße
α: Wettstreit um Zugriff auf geteilte Ressourcen
β: Aufwand durch mangelnde Kohärenz

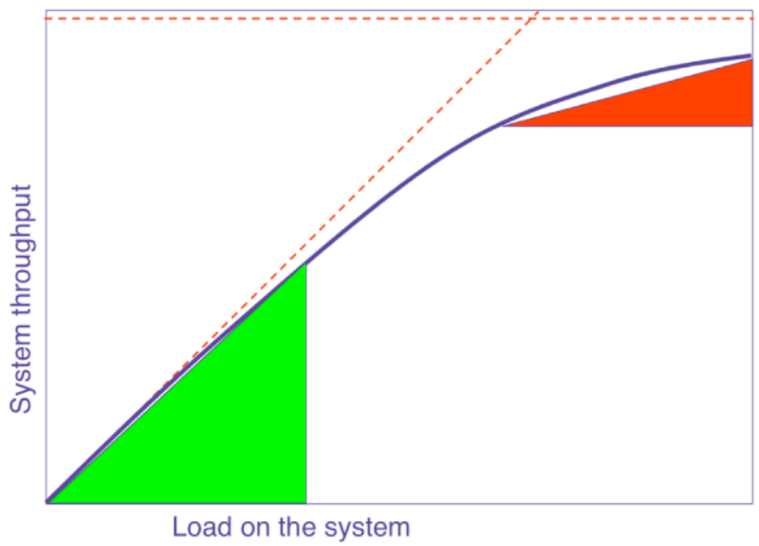
4+1 Szenarien

$\alpha = 0, \beta = 0$

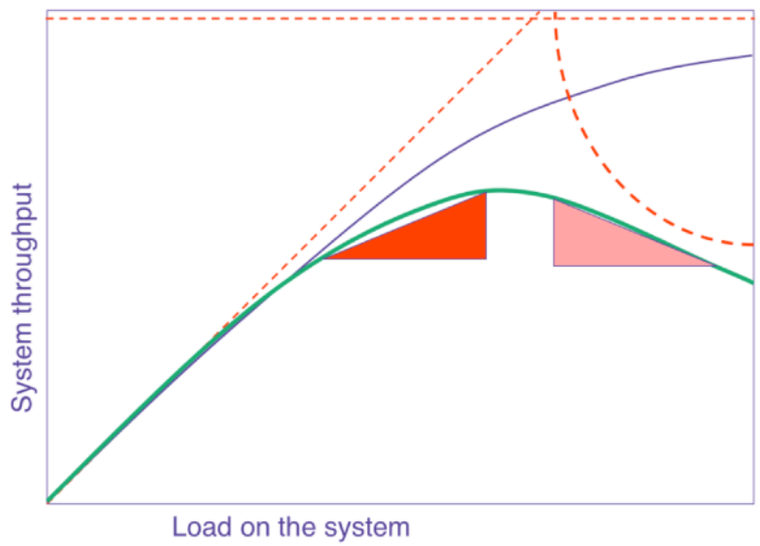


$\alpha > 0, \beta = 0$





$\alpha \gg 0, \beta = 0$



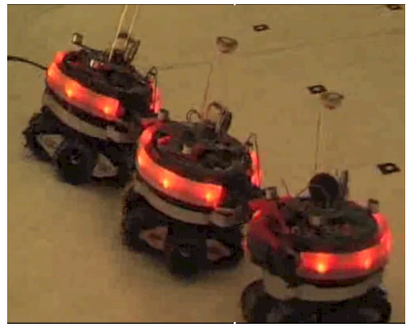
$\alpha \gg 0, \beta > 0$

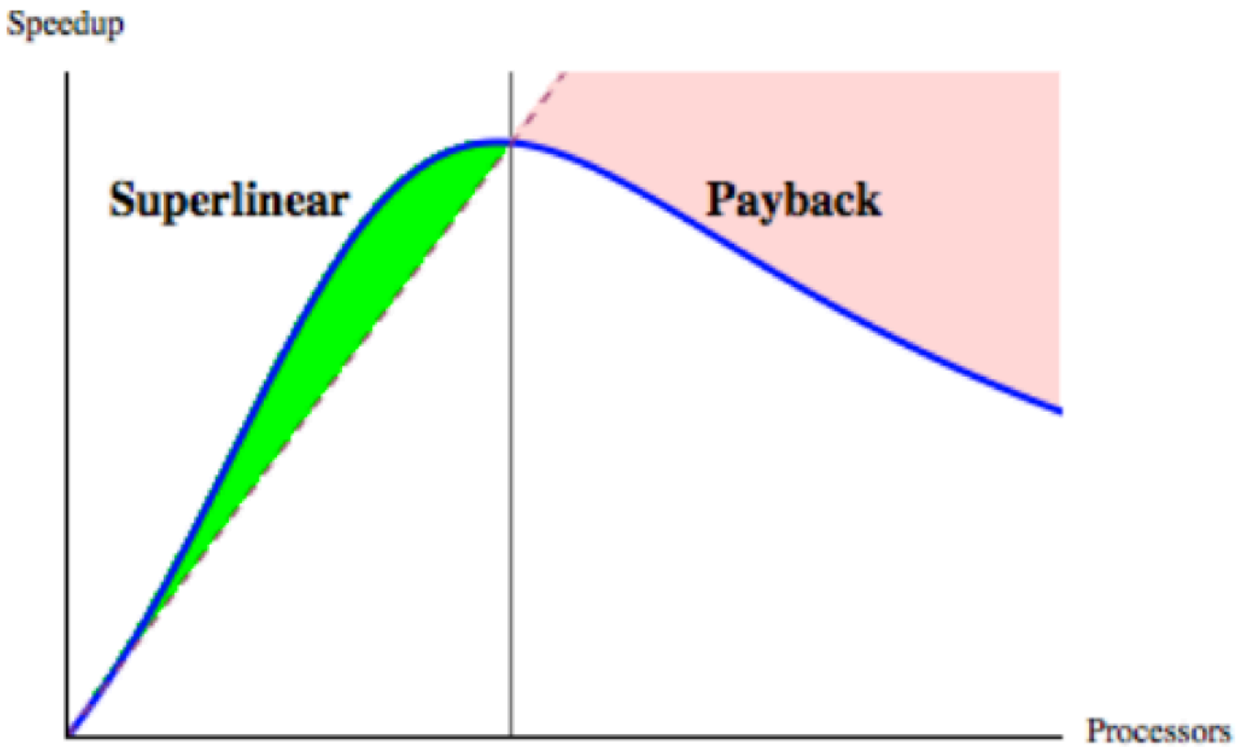
Szenario 5: super-linear

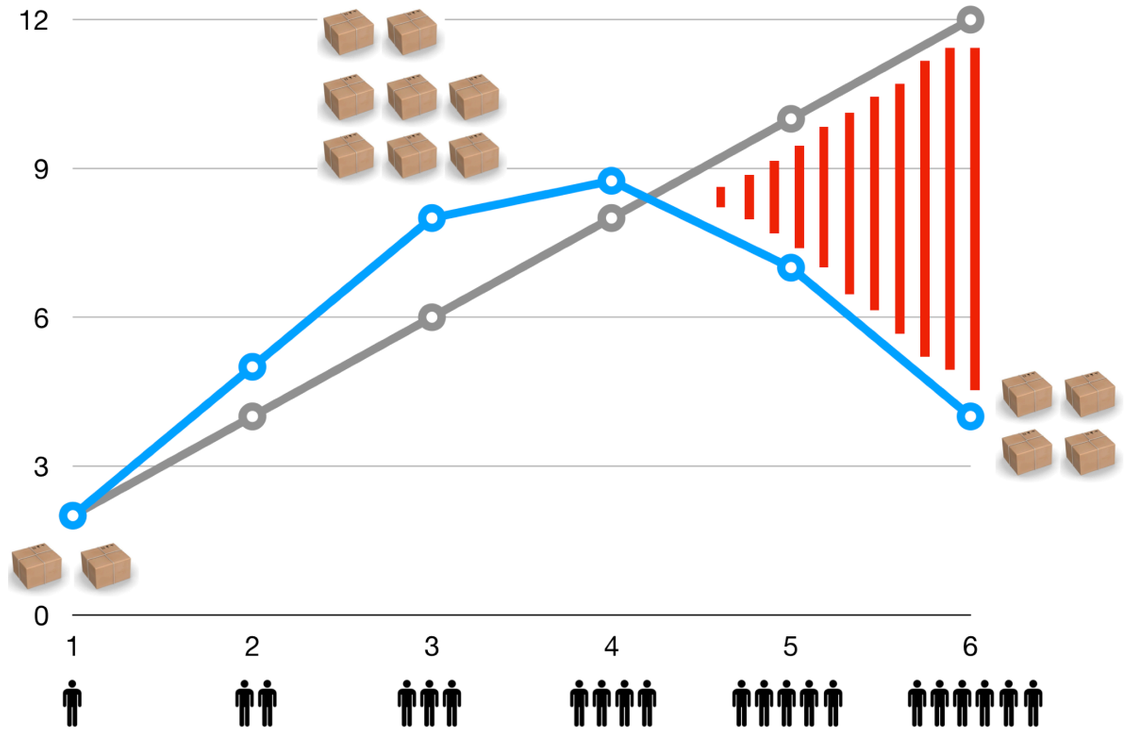
$$\alpha < 0,\ \beta > 0$$

negatives α: “negativer Wettstreit”

➡ **Kooperation**







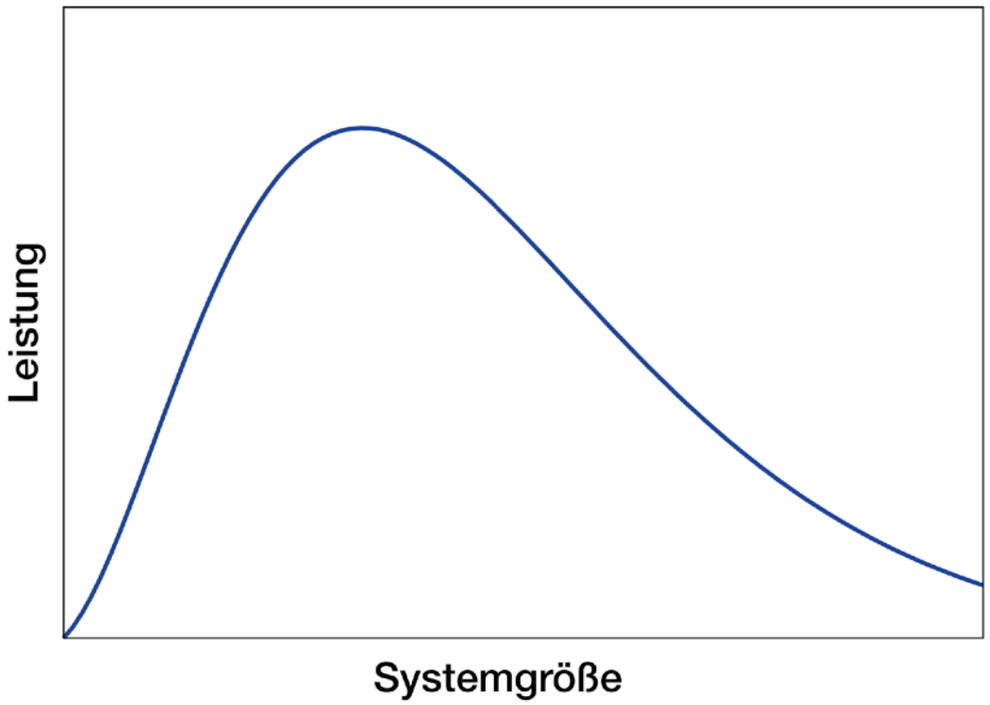
“Dort zahlen wir die Zeche für die (scheinbar) kostenlose super-lineare Fahrt.”

- Neil J. Gunther

“That’s where you pay the piper for (apparently) getting a super-linear ride for free.”

- Neil J. Gunther

Fazit



Gruppe ermöglicht **Kooperation**

zu viel ist zu viel (Interferenz und Payback)

Skalierbarkeit

Potential für **super-linearen** Leistungsanstieg

Arbeitspakete in **idealer Größe**