

ROTTERDAM SCHOOL OF MANAGEMENT
ERASMUS UNIVERSITY

MHF: ORDERVERZAMELEN; MENS OF MACHINE?

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ORDER PICKING EXPERIMENT

METHODEN, MENSEN, EN
BELONINGSSTRUCTUREN IN
ORDERPICKING



The business school that thinks
and lives in the future



1. RESEARCH MOTIVATION

Order picking: the retrieval of a number of products from their storage locations in the warehouse to satisfy orders of specific customers

- Capital intensive, labor intensive
- 55% of costs in typical warehouse
- Increasingly difficult to find suitable employees / shortage!
- Human/system interaction is vital!

Sector luidt noodklok over personeelstekort

Er dreigt een groot tekort aan werknemers in de logistiek. In de komende jaren komen er 50.000 arbeidsplaatsen vrij die opgevuld moet worden. Om de instroom van jongeren te bevorderen, start SOOB een grootschalige campagne.



TLN, de vakbonden CNV en FNV Bondgenoten en VTL hebben verzoekt op de Maasvlakte in Rotterdam gezamenlijk de noodklok geluid over de arbeidssituatie in de logistiek. De partijen, verenigd in SOOB, voorzien een groot probleem voor de sector transport en logistiek in de nabije toekomst. Volgens SOOB, het opleidings- en ontwikkelingsfonds van de sector transport en logistiek, dreigt er de komende jaren een groot tekort aan gekwalificeerd personeel. Mensen die hard nodig zijn omdat de komende jaren vele ouderen met pensioen gaan.

50.000 mensen

Volgens Peter Sierat, directeur van TLN en voorzitter van SOOB zijn er de komende vijf tot tien jaar 50.000 mensen nodig. Alleen al in het transport komen er tot 2015 10.000 arbeidsplaatsen vrij. "De sector is een belangrijke pijler van onze economie en één van de eerste sectoren die mensen nodig heeft zodra de economie weer aantrekt", aldus Sierat. "Als Nederland haar topositie in Europa wil behouden, hebben we meer goed gekwalificeerde werknemers nodig. Bij een topsector hoort ook de top van de arbeidsmarkt."





2. RESEARCH AIMS

Investigating order picking performance (throughput, quality, job satisfaction)...

- Of different manual picker-to-parts order picking methods and tools
- Under different incentive systems
- For different individuals



Aiding companies in choosing the right system for the right context



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3. METHODS



Different tools:

- Pick to light
- Pick by voice
- Handheld RF-terminals
- Paper picking lists



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3. METHODS

Methods/Tools	Paper	Light	Voice	Terminal
Parallel	Green	Red	Green	Green
Zone	Green	Green	Red	Red
Dynamic zone	Green	Green	Red	Red

Incentives

- Competitive
- Cooperative

Measurements

- Productivity, quality & job satisfaction
- Ergonomics & discomfort
- Picker personality (regulatory focus)

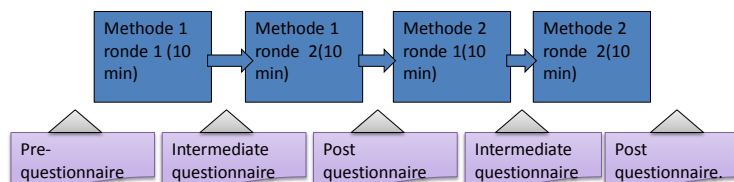
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3. METHODS: SETUP

- 4 person teams (3 pickers, 1 quality inspector)
- 4 x 10 minutes of order picking, duration total experiment = 2h
- 2 different tools or methods
- Questionnaires before/after picking rounds
- Putting products back in place after every picking round





3. METHODS: LAYOUT



Construction of experimental warehouse

Before

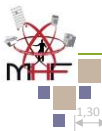


After

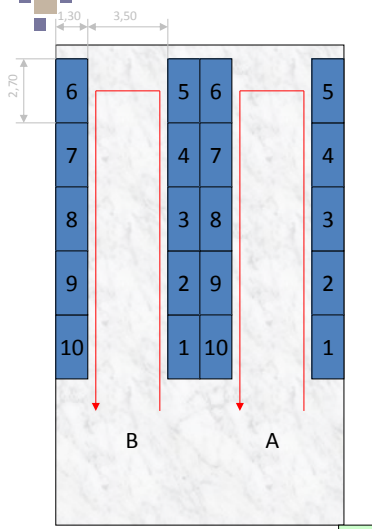


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3. METHODS: LAYOUT



- 2 identical aisles
 - 10 sections per aisle
 - 2 levels per section
 - 5 product locations per level
 - 5 dummy products in stock per location
- = 1000 dummy products in total

- Randomly generated orders (# of lines $\mu=12, \sigma=4$)





3. METHODS

• Filmpje?

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3. METHODS: DATA COLLECTION

- 3 months, 363 participants (26 pilot)
- ±6000 orders completed.
- ±19000 dummy-products picked (and put back...).
- ±1400 questionnaires completed.



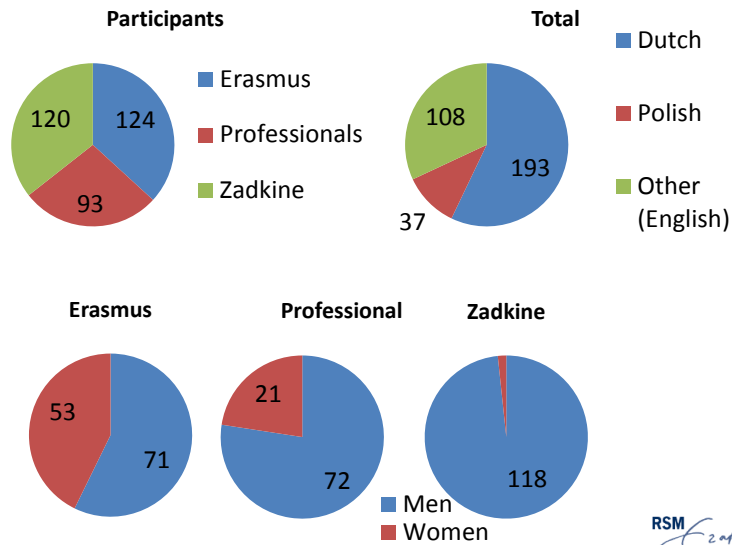
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3. METHODS: PARTICIPANTS



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3. METHODS: AWARDS

- 8 award vouchers of €100 for best performance (quality and productivity)
- Best performing team (3 persons): Tempo Team / Albert Heijn
- Best performing individuals: Zadkine (x2), Nissan, RSM MSc SCM, EU-Flex



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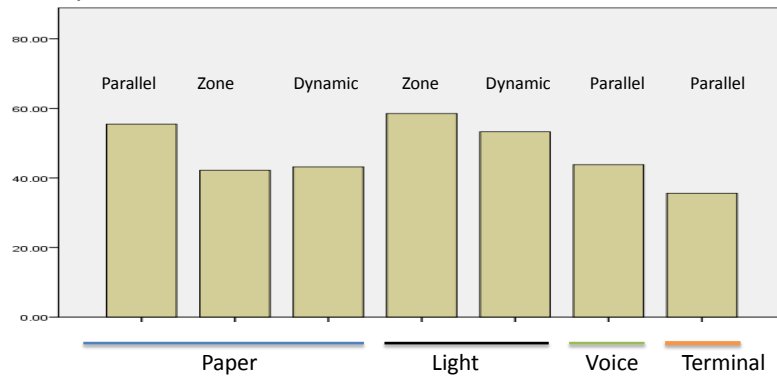
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4. GENERAL RESULTS: PRODUCTIVITY

Lines picked



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4. GENERAL RESULTS: PRODUCTIVITY

General:

- **Pick to Light (zone) most productive**
- **Picking with RF-terminal least productive**

In Paper picking:

- Erasmus students most productive -> **experience does not help!**

In Pick to Light:

- Professionals most productive
- Erasmus students least productive -> **experience makes a difference!**

In Voice & RF-Terminal picking:

- Similar productivity for all groups in voice-picking -> **easy to learn!**

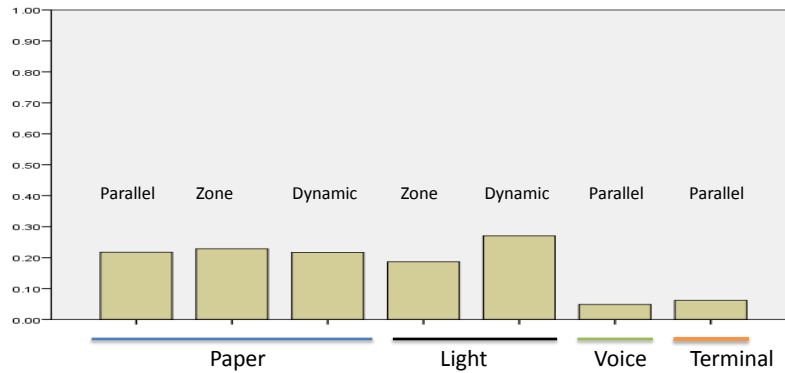
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4. GENERAL RESULTS: QUALITY

Proportion of orders with error(s)



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4. GENERAL RESULTS: QUALITY

General:

- Voice & Terminal Picking substantially less errors -> **Foolproof!**
- **Speed / accuracy tradeoff**

In Paper picking:

- Higher number of errors for professionals (small sample size)

In Pick to Light:

- Substantially higher number of errors for Zadkine students
-> **Focus on speed, accumulation of errors**

In Picking by Voice & RF-Terminal:

- Very low number of errors in general
- Slightly higher number of errors for women (small sample size)

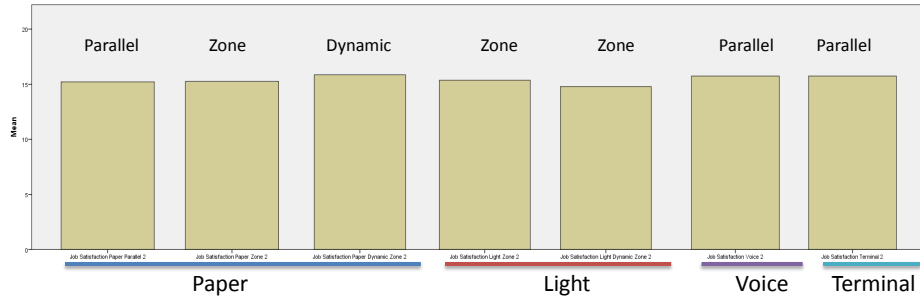
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4. GENERAL RESULTS: JOB SATISFACTION

Job satisfaction score



- Hardly any difference, duration probably too short

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5. FIRST PAPER

Aligning order picking methods, incentives and people for performance: Making the right pick.

1. Investigating picking performance of different methods (all paper picking) in terms of:
 - Throughput
 - Quality
 - Job satisfaction
2. Depending on the method, which incentive system works best?
3. Do individual differences exist that underlie the effect of the method/incentive on performance?



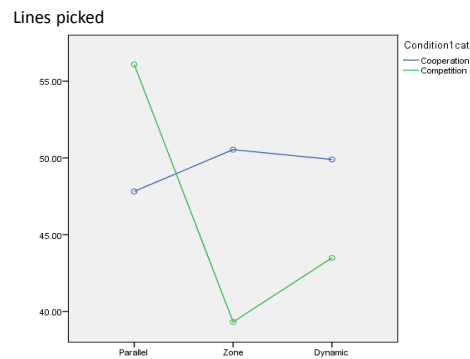
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5. FIRST PAPER: RESULTS

Competitive or cooperative incentive for productivity?



Competition for parallel picking, cooperation for zone picking!

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5. FIRST PAPER: RESULTS

In zone picking

- Cooperation 25% more productive than competition $F(1, 35) = 7.398, p = .010$

In dynamic zone picking

- Cooperation 18% more productive than competition $F(1, 37) = 4.107, p = .050$

In parallel picking

- Competition 21% more productive than cooperation $F(1, 34) = 3.132, p = .086$

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5. FIRST PAPER: CONSTRUCT OPERATIONALIZATION

Regulatory focus

determines motivation and behavior in the decision making process with respect to goals attainment

Two types:

- Promotion oriented (go for positive outcomes; associated with growth, advancement, accomplishment)
- Prevention oriented (avoid negative outcomes; associated with protection, safety, responsibility)

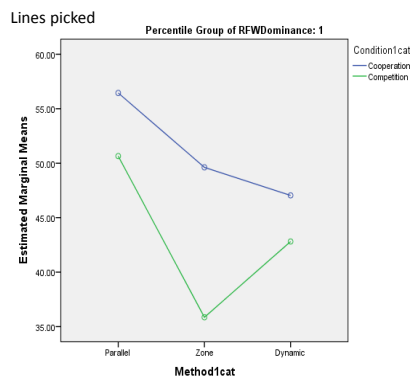
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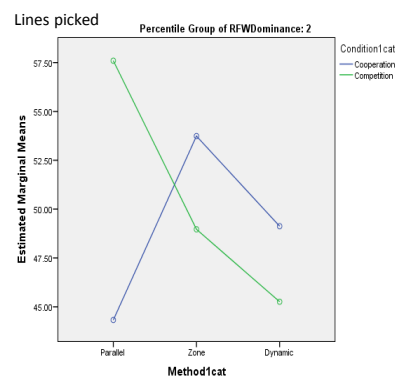


5. FIRST PAPER: REG. FOCUS RESULTS

Relatively high prevention focus



Relatively high promotion focus



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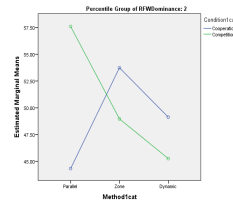
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5. FIRST PAPER: REG. FOCUS RESULTS

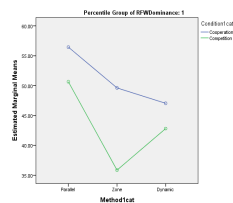
Dominant promotion focus

- Strong difference between coop. and comp. in parallel picking



Dominant prevention focus

- Strong difference between coop and comp in zone picking



5. FIRST PAPER: JOB SATISFACTION RESULTS

- No significant effect of picking method or condition

However

- People with dominant prevention focus are more satisfied in competitive motivational structure than a cooperative motivational structure

→ No pressure from teammates!





5. FIRST PAPER: QUALITY RESULTS

- Surprisingly, no effects found on quality across different methods and motivational structures!

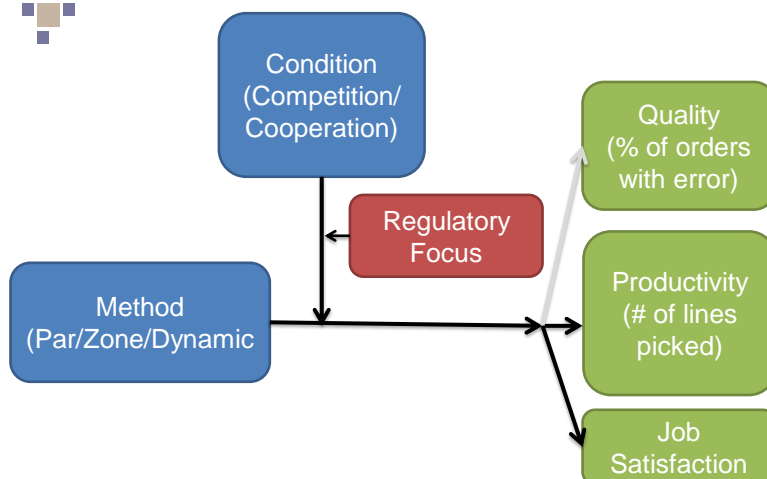


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6. FIRST PAPER: PROPOSED MODEL



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6. CONCLUSIONS

- No universal optimal picking tool/method exists
- Optimal picking tool/method depends on many factors
 - Location density
 - SKU sizes
 - Quality/productivity demands
 - **Compensation scheme**
 - **Pickers**
- Possible to change performance by selecting the right pickers and/or a fitting compensation scheme

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6. UPCOMING RESEARCH

1. Comparison between all picking tools (paper, light, voice, RF-terminal), tradeoffs between different outcomes from this experiment
2. New MHF experiment (Het Nieuwe Heffen): examining tradeoffs between and influence of forklift drivers on productivity, safety and sustainability results (P. Bivol & S. Zahrai)



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6. UPCOMING RESEARCH

3. Optimal order batching in picker to part systems (15-20% travel time reduction) + assigning the right worker to the right pick route (another 10-15% travel time reduction)

