Dependencies and resource constraints in opportunistic maintenance modeling

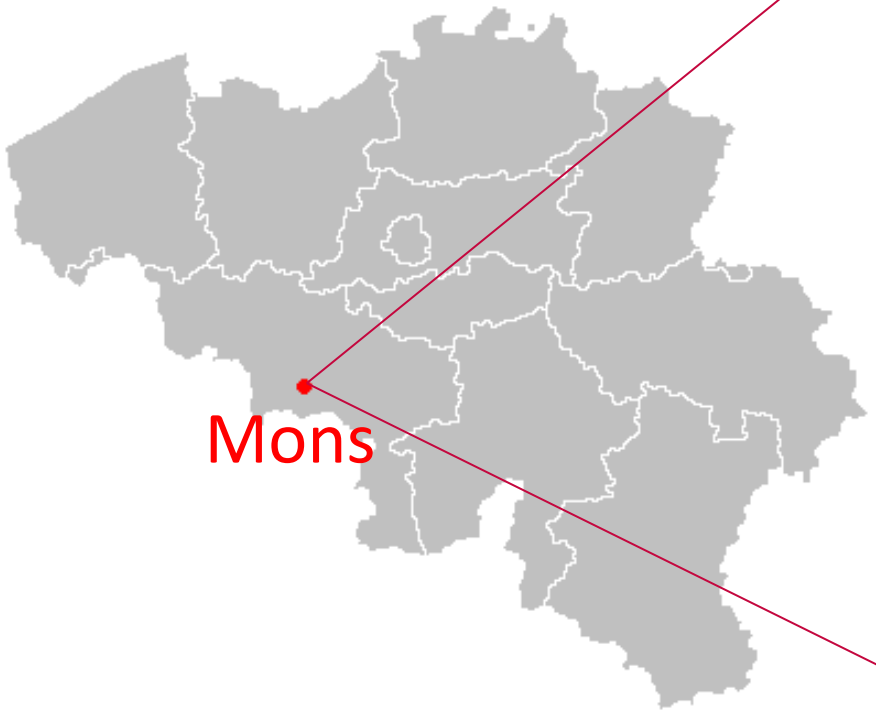
A systematic literature review

L. Equeter[1], P. Do[2], P. Dehombreux[1], B. Iung[2]

1 Machine Design and Production Engineering, University of Mons, Belgium
2 CRAN, UMR CNRS 7039, Lorraine University, France

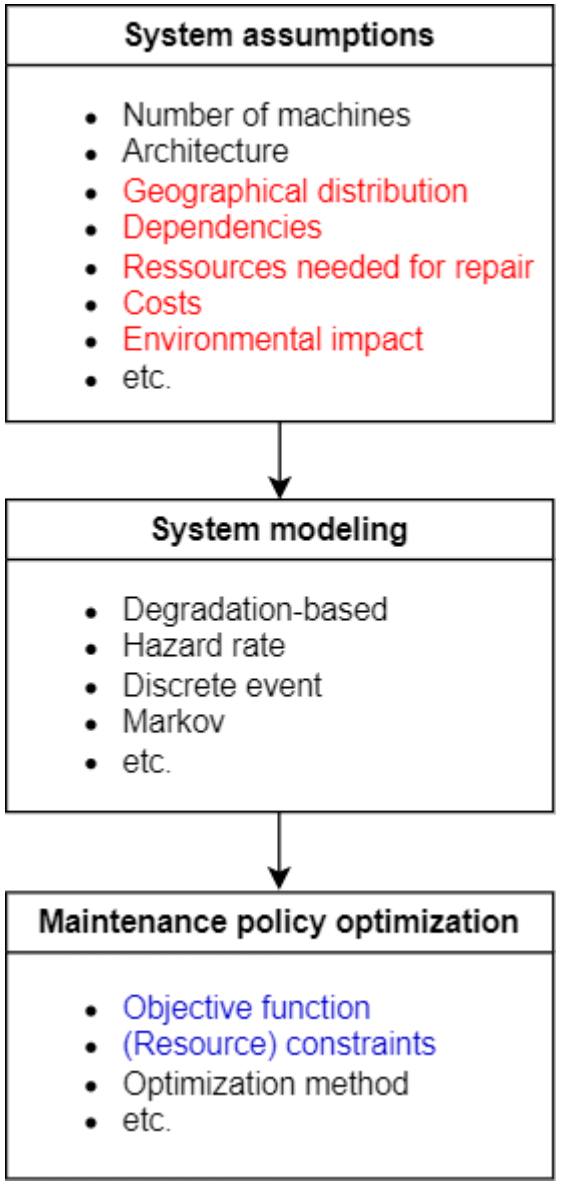
Lucas.EQUETER@umons.ac.be

Faculty of Engineering of Mons in Belgium
Machine Design and Production Engineering Lab



Context

- Opportunistic maintenance modeling
- Meta level of analysis
- Lack of reviews on the current hypotheses
- Existing reviews mainly focus on modeling[1], policies[2, 3], inventory[3], optimization method[3]



1 R. Dekker, Applications of maintenance optimization models: a review and analysis, Reliab Eng Syst Safe (1996)
2 H. Wang, A survey of maintenance policies of deteriorating systems, Eur J Oper Res (2002)
3 A. Van Horenbeek et al., Joint maintenance and inventory optimization systems: A review, Int J Prod Econ (2013)

Methodology

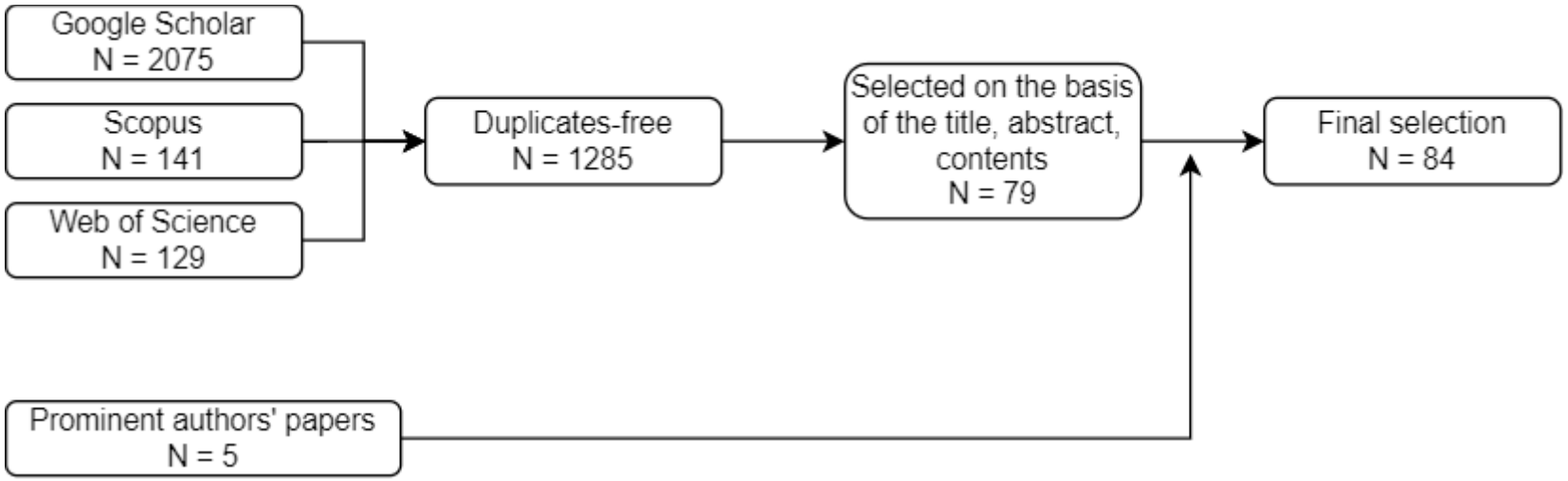
- Systematic literature review (SLR)[4]
- Publish or Perish software[5]
- Databases: Google Scholar, Scopus, Web of Science
- Data visualisation: VOS Viewer software[6]

4 B. Kitchenham, Procedures for performing a systematic reviews, Keele University, Keele, Staffs, UK, 2004.
5 A. W. Harzing, « Publish or Perish ». 2007. https://harzing.com/resources/publish-or-perish
6 N. J. Van Eck and L. Waltman, VOSviewer Manual version 1.6.16 (2020).

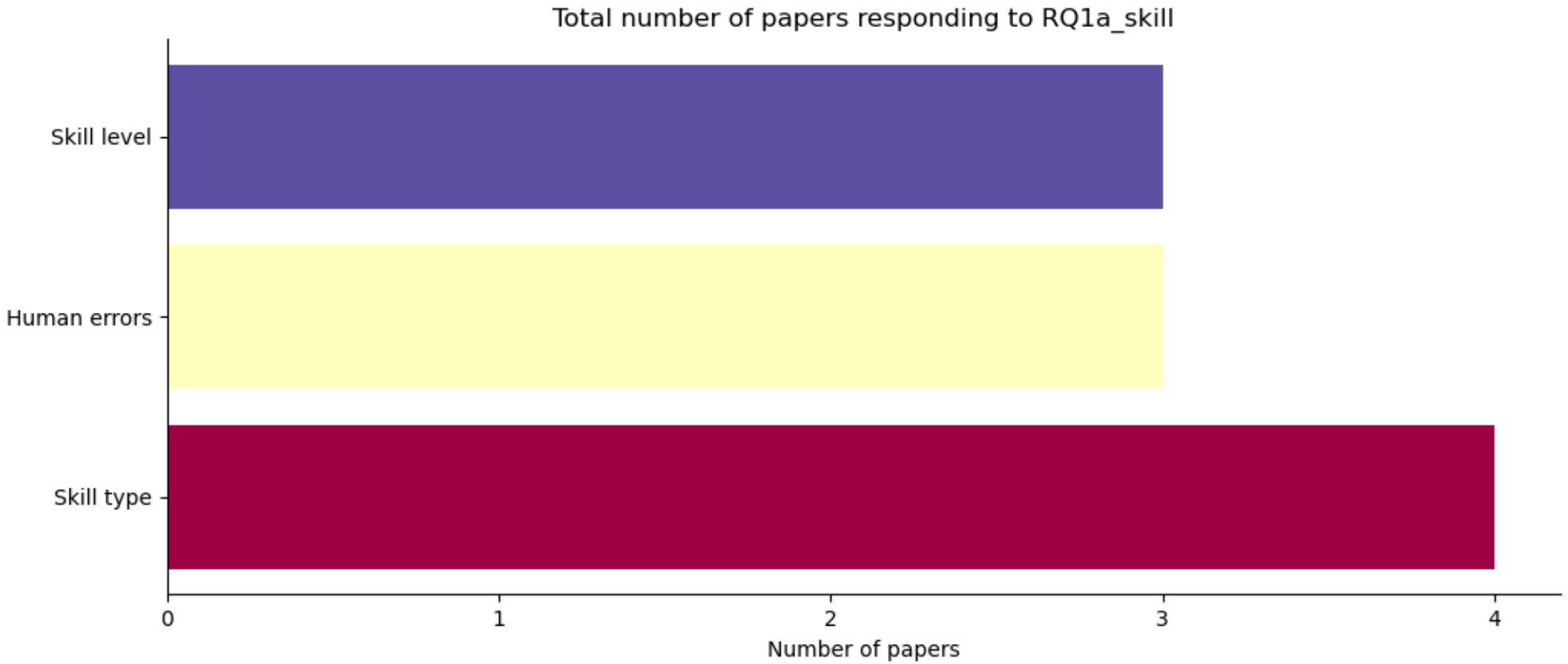
Research questions

- RQ1. What are the current **hypotheses** regarding workers' skills, dependencies and resource constraints made in opportunistic maintenance research modeling?
- RQ2. Among the papers identified to answer RQ1, how is opportunistic maintenance defined?
- RQ3. Among the papers identified to answer RQ1, how is economic dependence modeled?
- RQ4. Among the papers identified to answer RQ1, what are the optimization objectives?

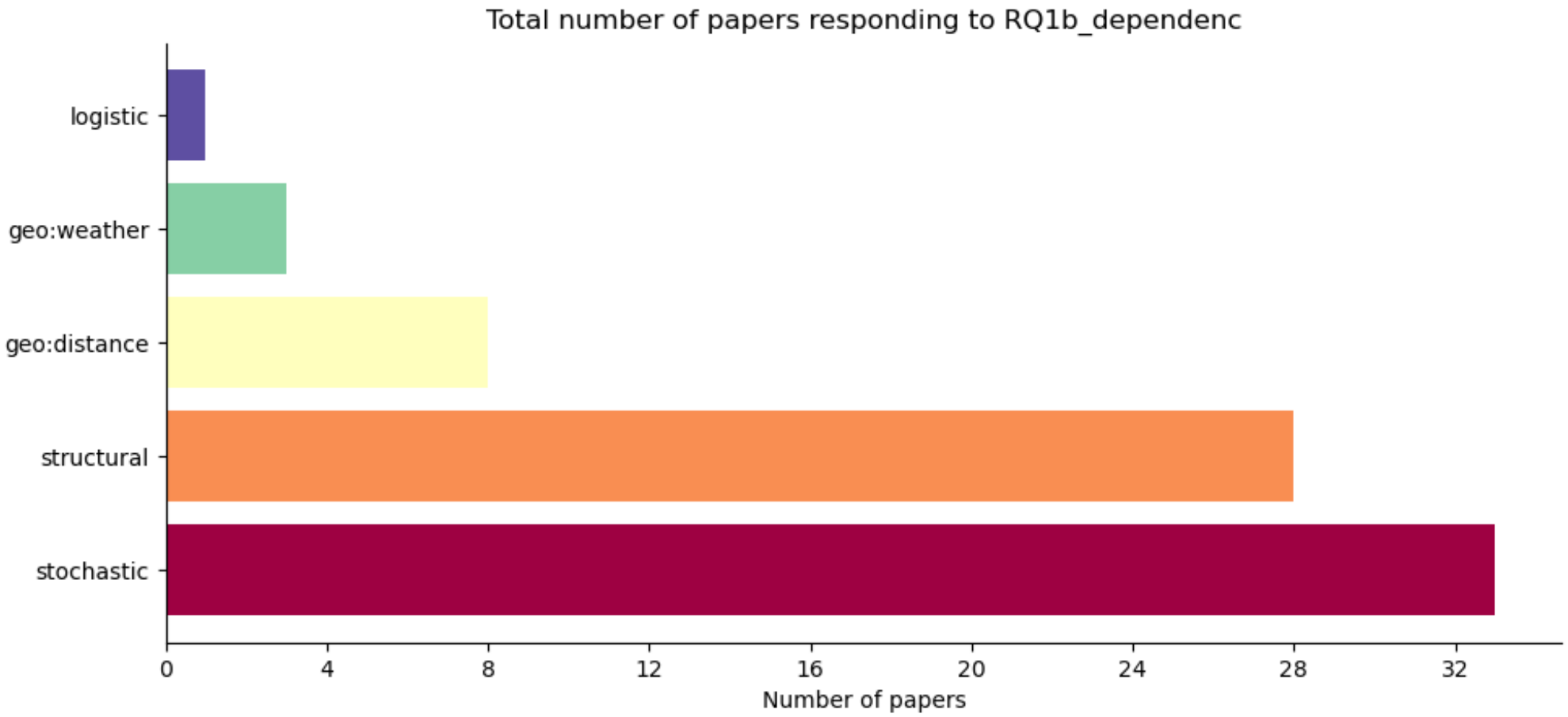
Bibliometric results (1)
Quantitative overview of the results



Bibliometric results (2)
Hypotheses on operators' skills in literature

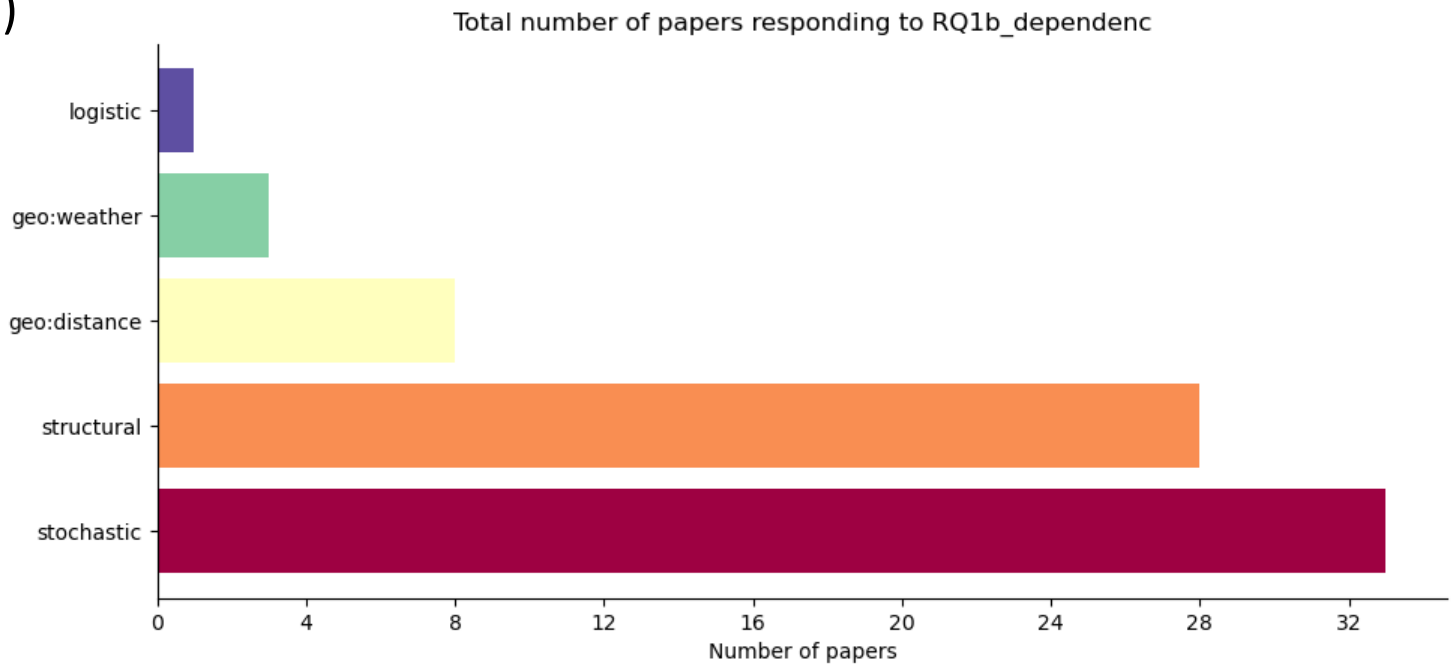


Bibliometric results (3) (1/3)
Hypotheses on dependencies in literature



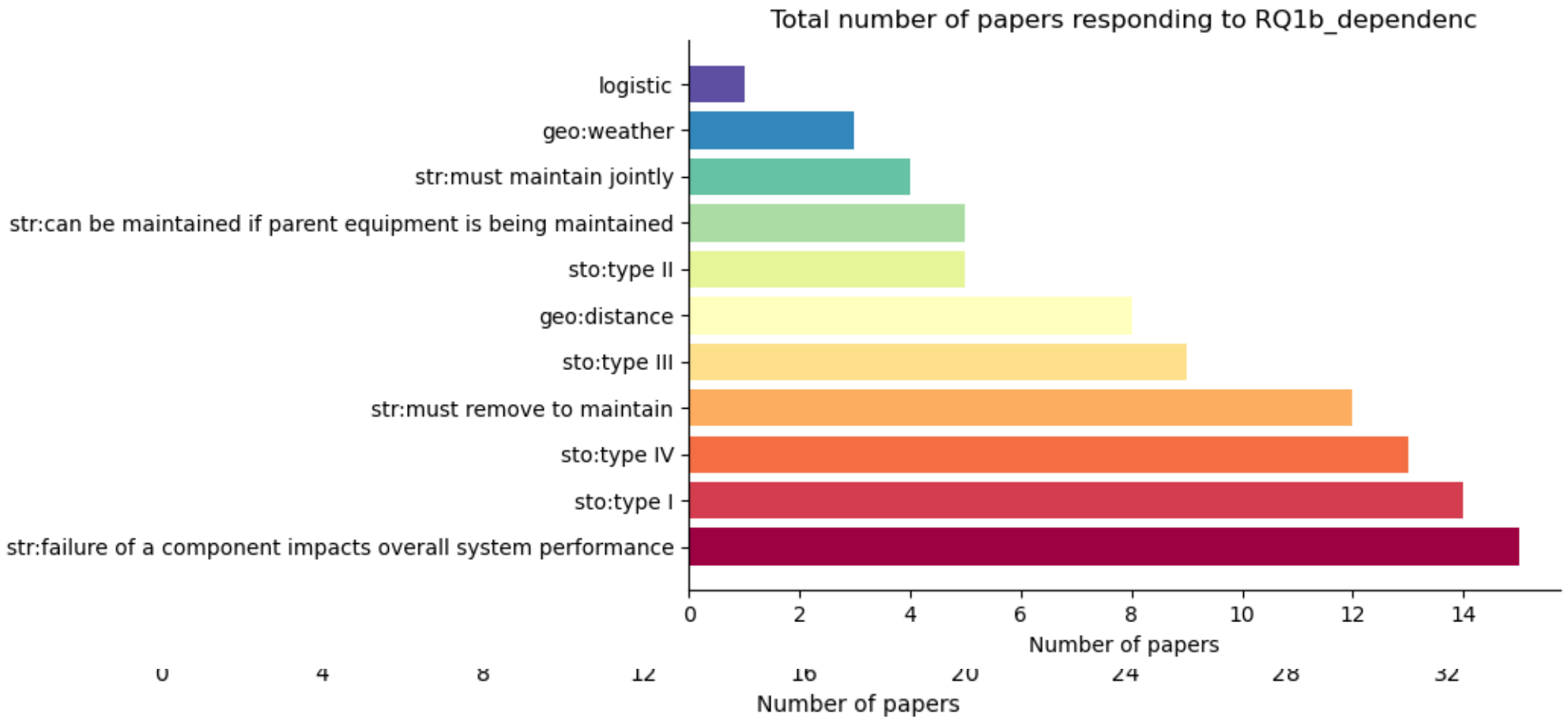
Bibliometric results (3) (2/3)
Hypotheses on dependencies in literature

- Logistic dependency (same skill/spares)[7]
- Geographical dependency
- Structural dependency
- Stochastic dependency (types I through IV)
  - I. Failure of A → Pr(Failure of B)
  - II. Failure of B → Pr(Failure of A) AND Failure of A → h(B) ↗
  - III. Failure of B → h(A) ↗ AND Failure of A → h(B) ↗
  - IV. Degradation impacts the performance of other equipment

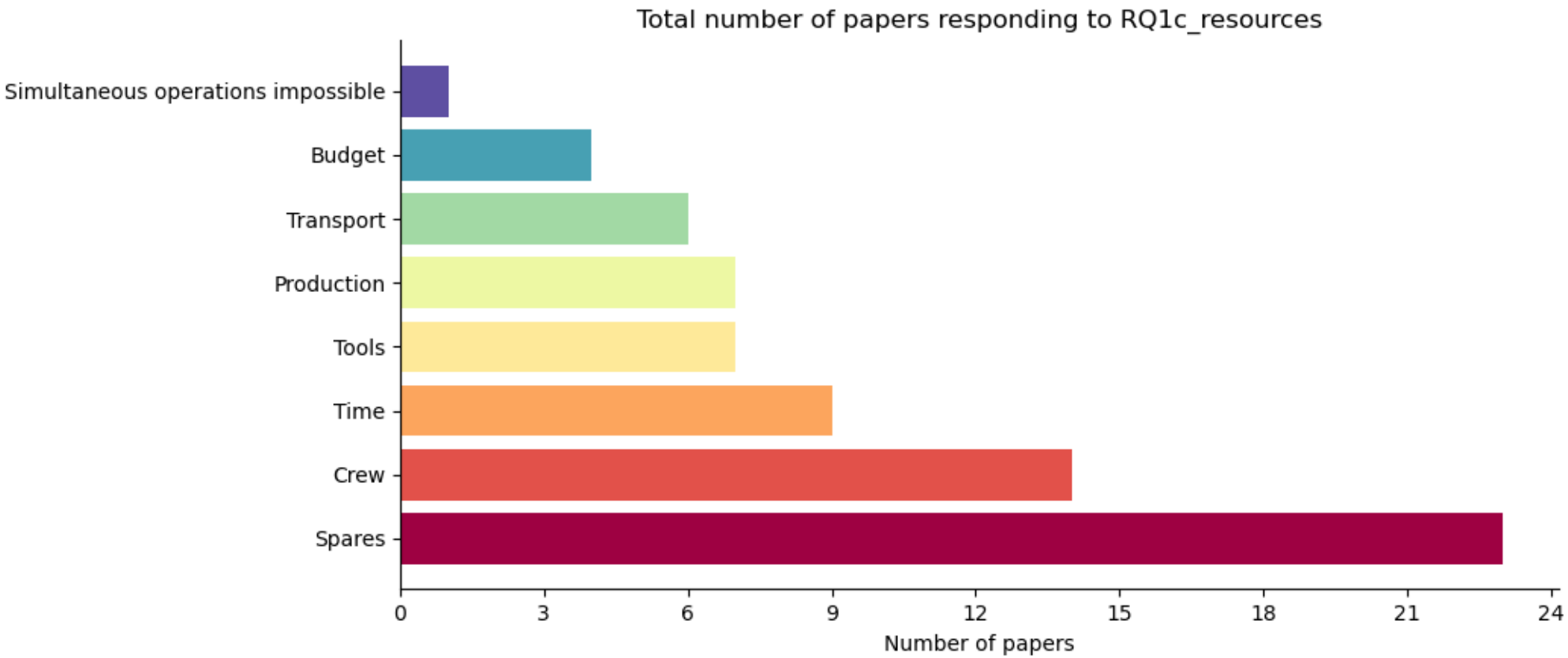


7 M. C. A. Olde Keizer et al., Condition-based maintenance policies for systems with multiple dependent components: A review, Eur J Oper Res (2017)

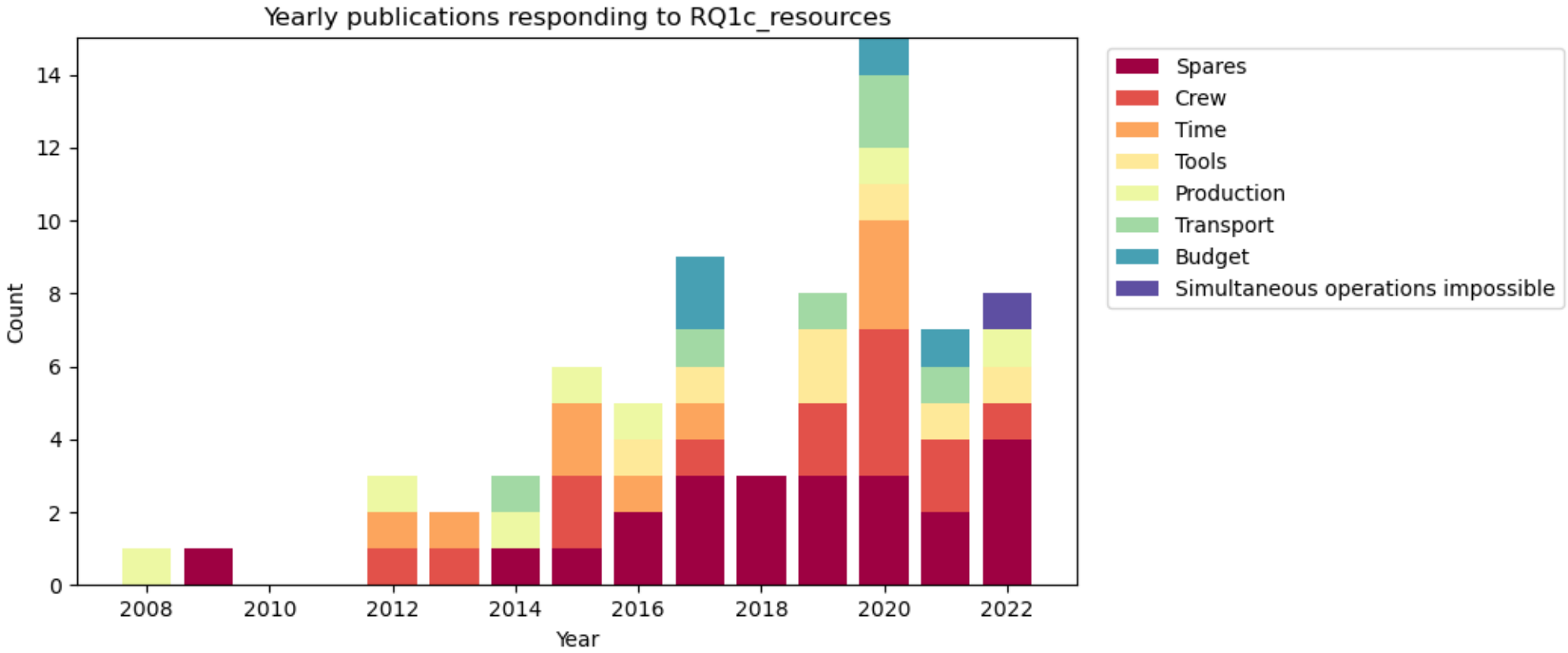
Bibliometric results (3) (3/3)
Hypotheses on dependencies in literature



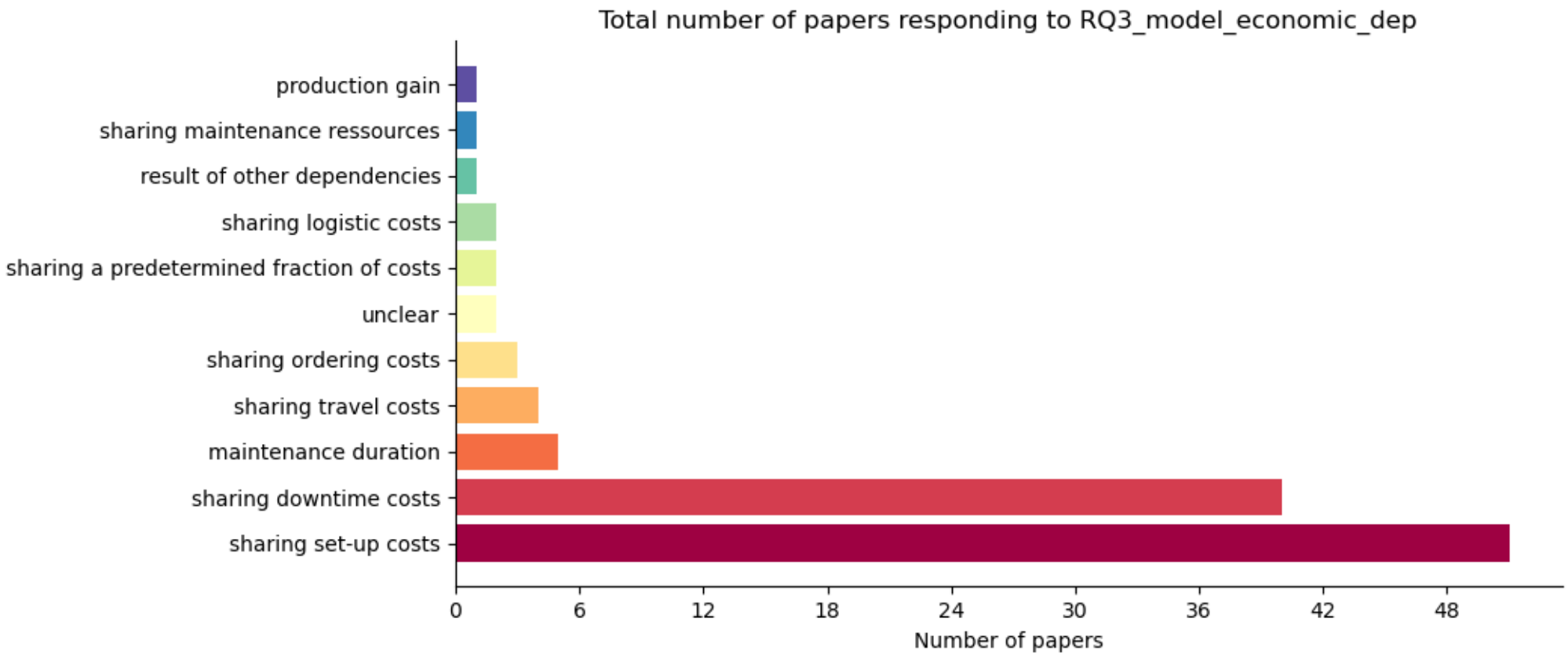
Bibliometric results (4)
Hypotheses on resource constraints in literature



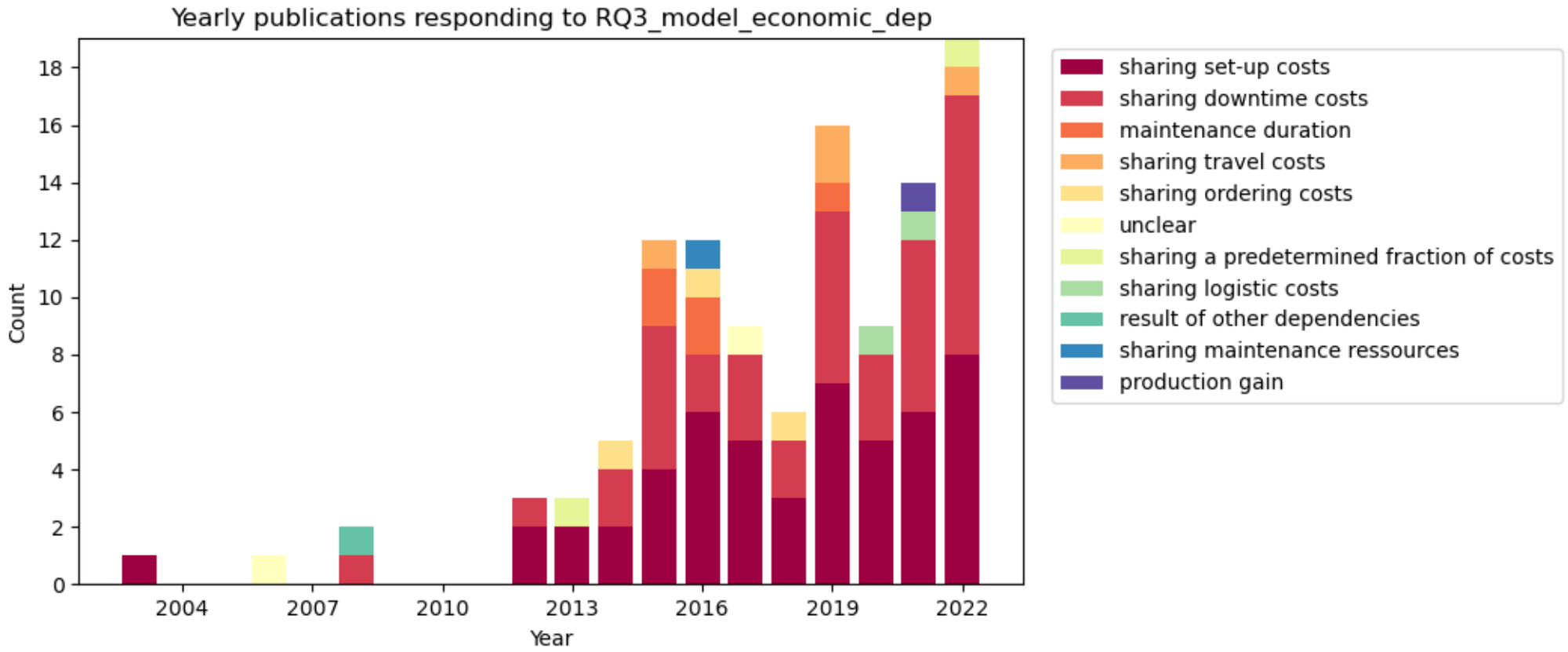
Bibliometric results (5)
Hypotheses on resource constraints - timeline



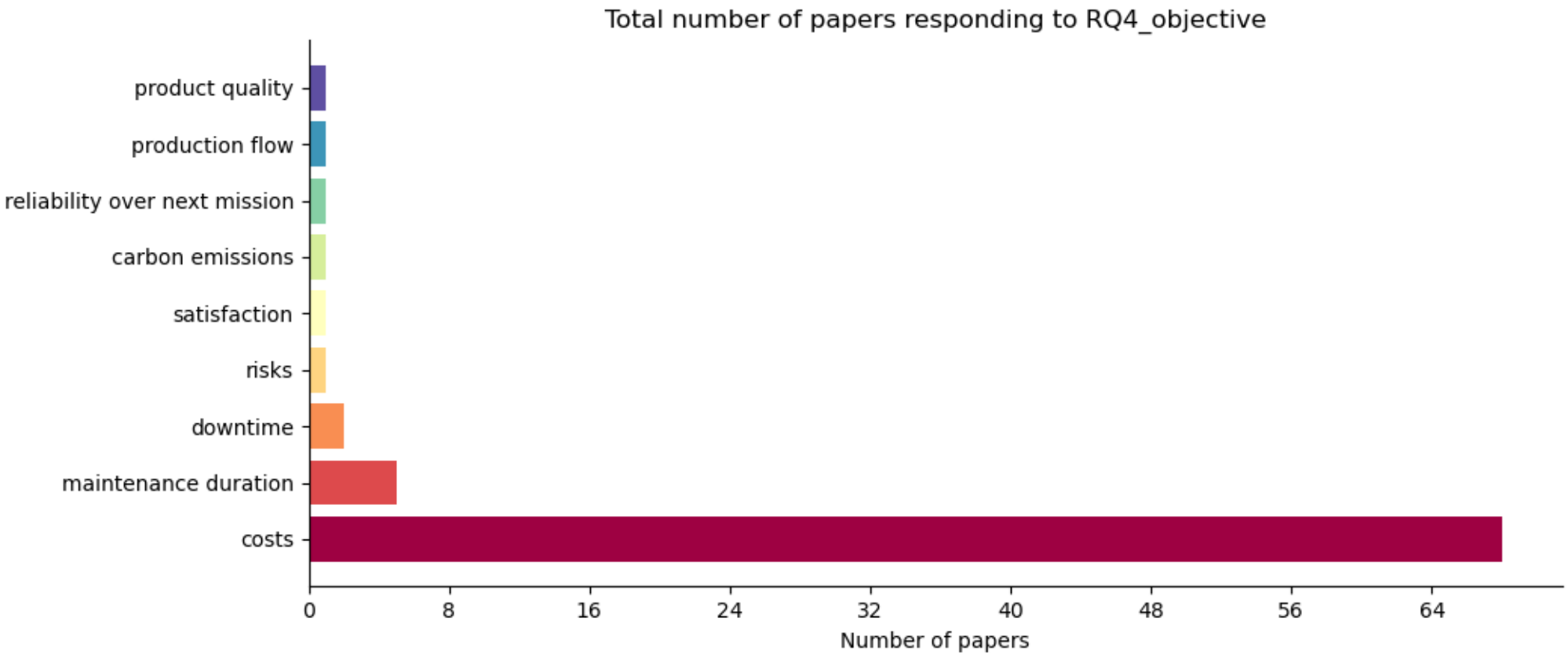
Bibliometric results (6)
Economic dependency definition



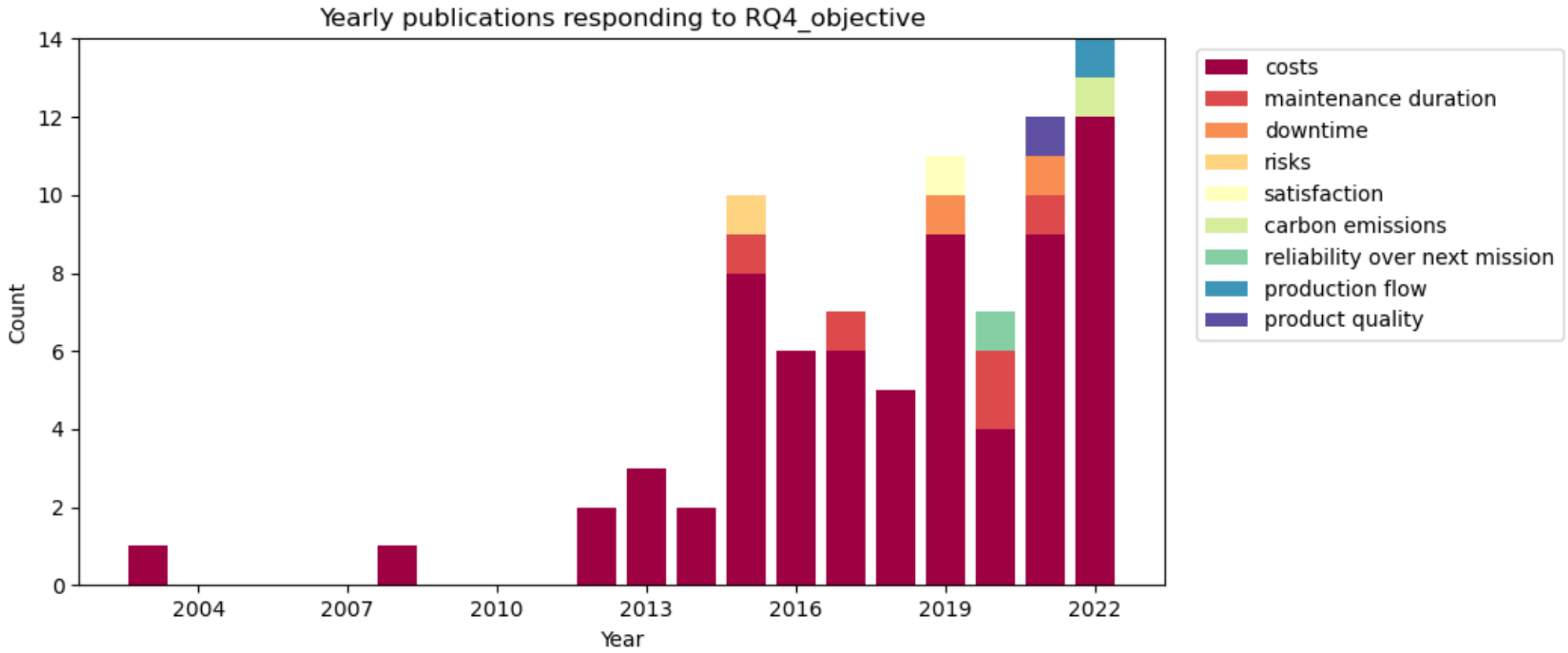
Bibliometric results (7)
Economic dependency definition - timeline



Bibliometric results (8)
Objective function of optimization research papers

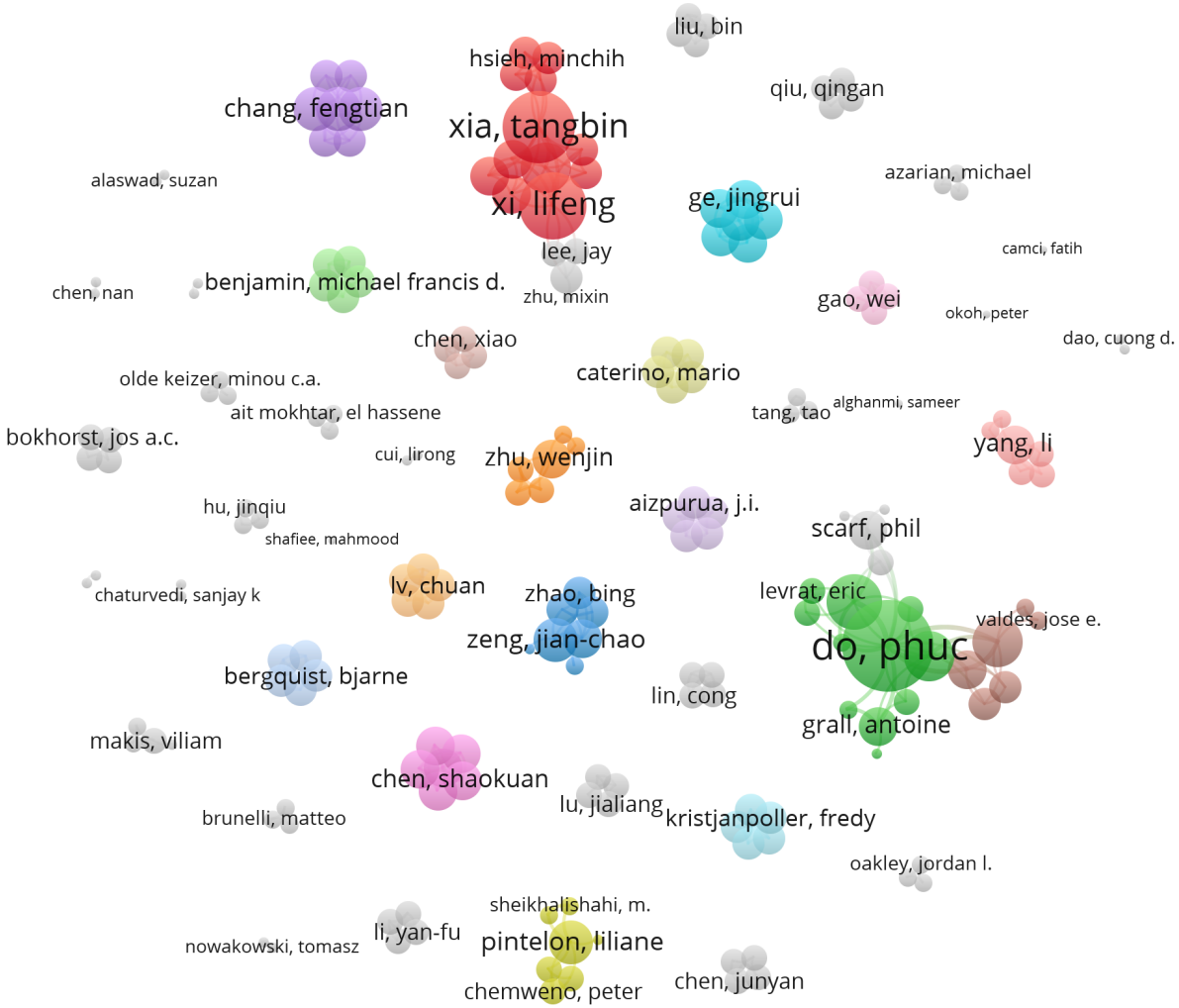


Bibliometric results (9)
Objective of research papers - timeline



Bibliometric results (10)
Teams' collaboration

- Circle size = number of different co-authors



Bibliometric results (11)
Prominent journals (2 or more articles)

Journal	Number of articles	Impact factor (as of 2023)
Reliability Engineering & System Safety	26	7,247
European Journal of Operational Research	6	6,363
Process Safety and Environmental Protection	4	7,926
Computers & Industrial Engineering	4	7,18
Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability	2	2,021
IMA Journal of Management Mathematics	2	2,095
Renewable Energy	2	8,634
CIRP Annals	2	4,482

Conclusions and perspectives

- To the authors' knowledge, first SLR on the topic
- Little consideration for environmental issues in selected papers
- Few mentions of production quality
- No clear trends or fads; strong reliance on structural & stochastic dependencies; spare parts; cost
- Stay tuned for our upcoming paper (RQ2 & much more! ☺)

Home-take message: need to adjust research toward a sustainable maintenance modeling

Thank you!
Any thoughts?

Acknowledgements
This research was partially funded by the Belgian Fund for Scientific Research (FNRS-FRS) through mobility grant #40015776.

This presentation was partially funded by the Belgian Fund for Scientific Research (FNRS-FRS) through mobility grant #40020216

Reach out to me

Lucas.EQUETER@umons.ac.be