

Sustainable Circularity

Sectoral differences in the circular economy implementation of Austrian manufacturing firms

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- Research on the role of companies in the circular economy (CE) transition has gained traction in recent years (Stumpf et al. 2021)
- Considerable number of conceptual works propose frameworks for corporate engagement with the CE e.g., regarding circular product design, circular business models (Bocken et al., 2016) or circularity assessment
- Empirical research is still comparably seldom (Govindan & Hasanagic, 2018) and consists mainly of single (Akemu et al., 2016) or multiple case studies (Bressanelli et al., 2019; Santa-Maria et al., 2021)
- Larger empirical surveys are rare, especially in Austria (Schöggl et al. 2021)
- So far only Holzer et al. (2020) conducted a survey with 183 SMEs and identified six relevant topics and possibilities for the implementation of a CE

Research aim and question



Research aim:

Assessing the state of implementation of specific CE practices in Austrian manufacturing firms empirically

Research questions:

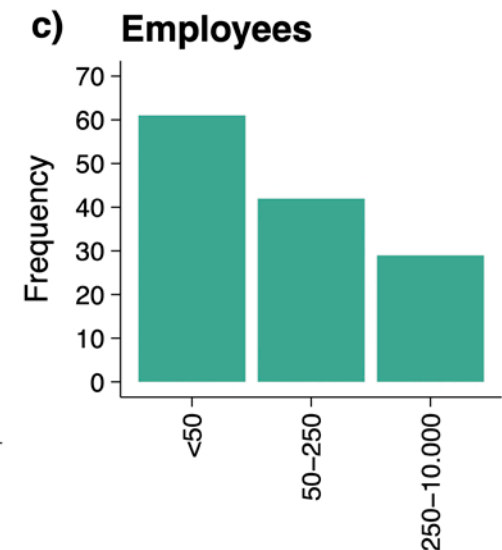
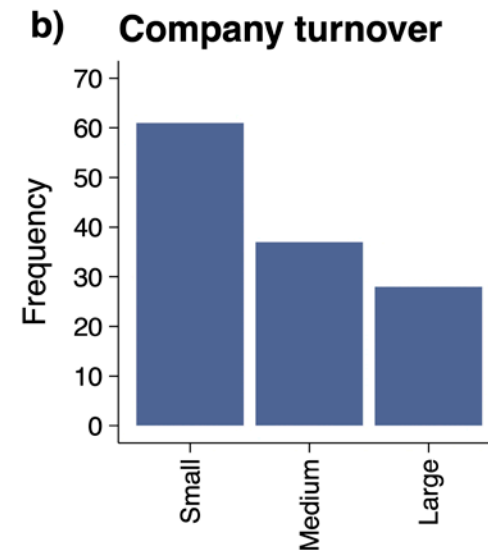
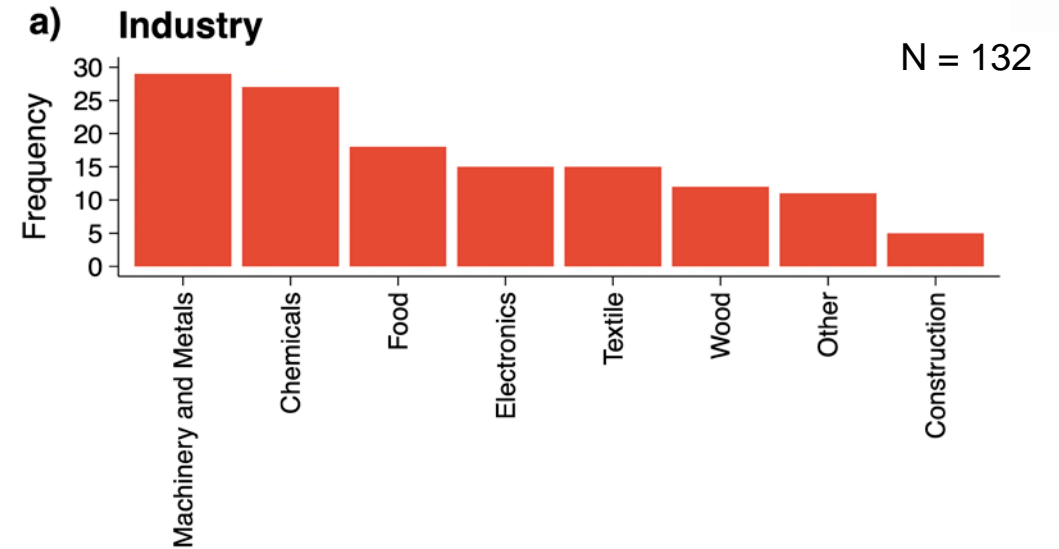
RQ1: What is the degree of implementation of different sustainable and circular product management practices in Austrian manufacturing companies?

RQ2: Do CE practices significantly differ between industries and company sizes?

RQ3: Which role do new digital technologies play?

Study design and sample

- 297 structured telephone interviews with Austrian manufacturing companies
- Conducted during summer/fall 2021
- Two interviews per company to alleviate potential response bias
- 132 sustainability executives; operational CE/sustainability performance, collaboration, digitalization
- 165 CEOs; questions on sustainability/firm performance, CE market situation

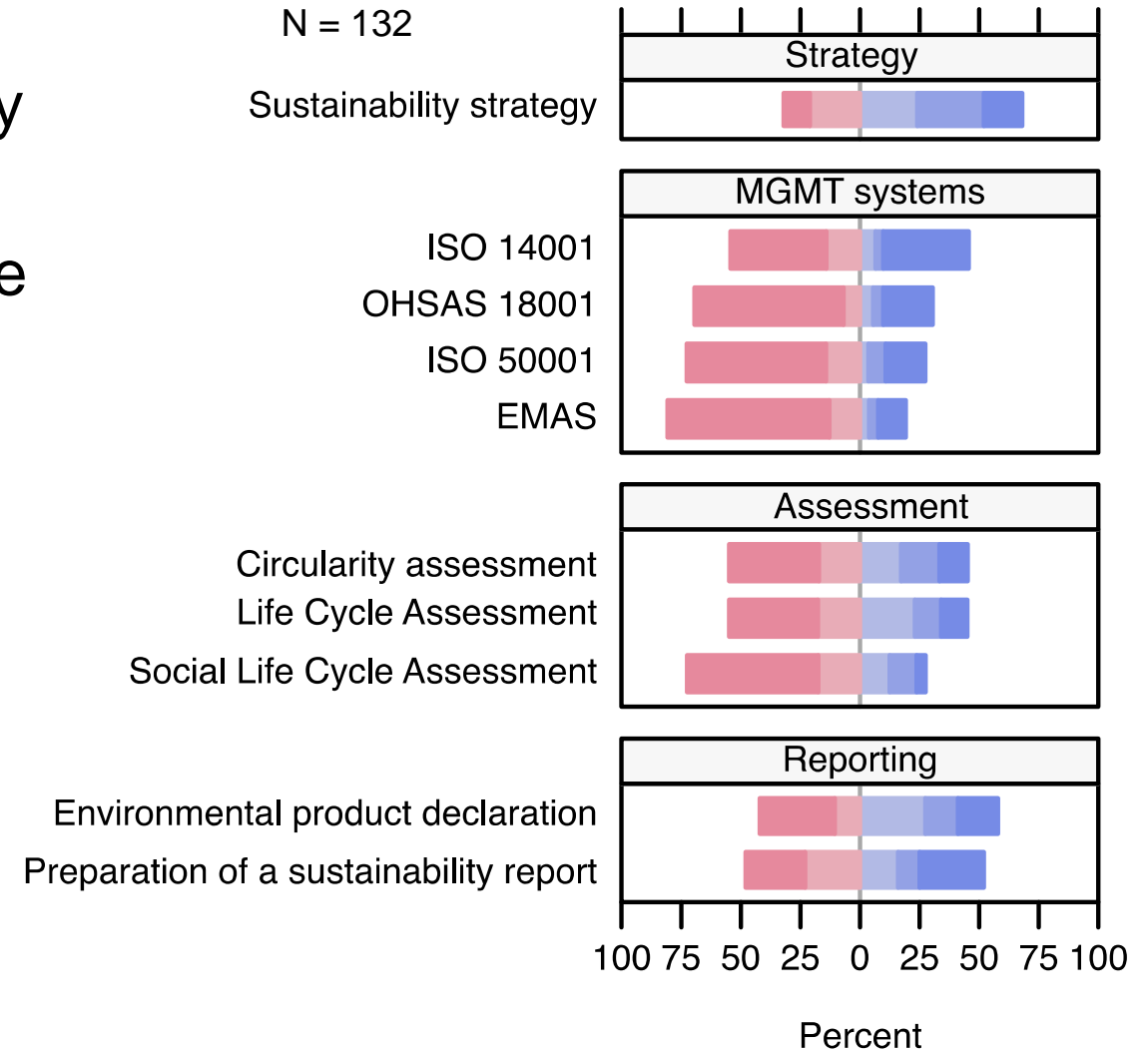


Sustainability management in Austrian manufacturing companies



- 2/3 have defined a sustainability strategy
- Environmental management systems according to ISO 140001 (35%) have the highest company-wide implementation level, followed by sustainability reports (27%) and OHSAS 18001 (20%)
- Almost 50% conduct circularity and/or life cycle assessments
- Lowest degree of implementation of EMAS (19%), ISO 50001 (27%) and SLCA (27%)

N = 132



Not considered, considering it, implementation in pilot project, company-wide implementation underway, company-wide implemented

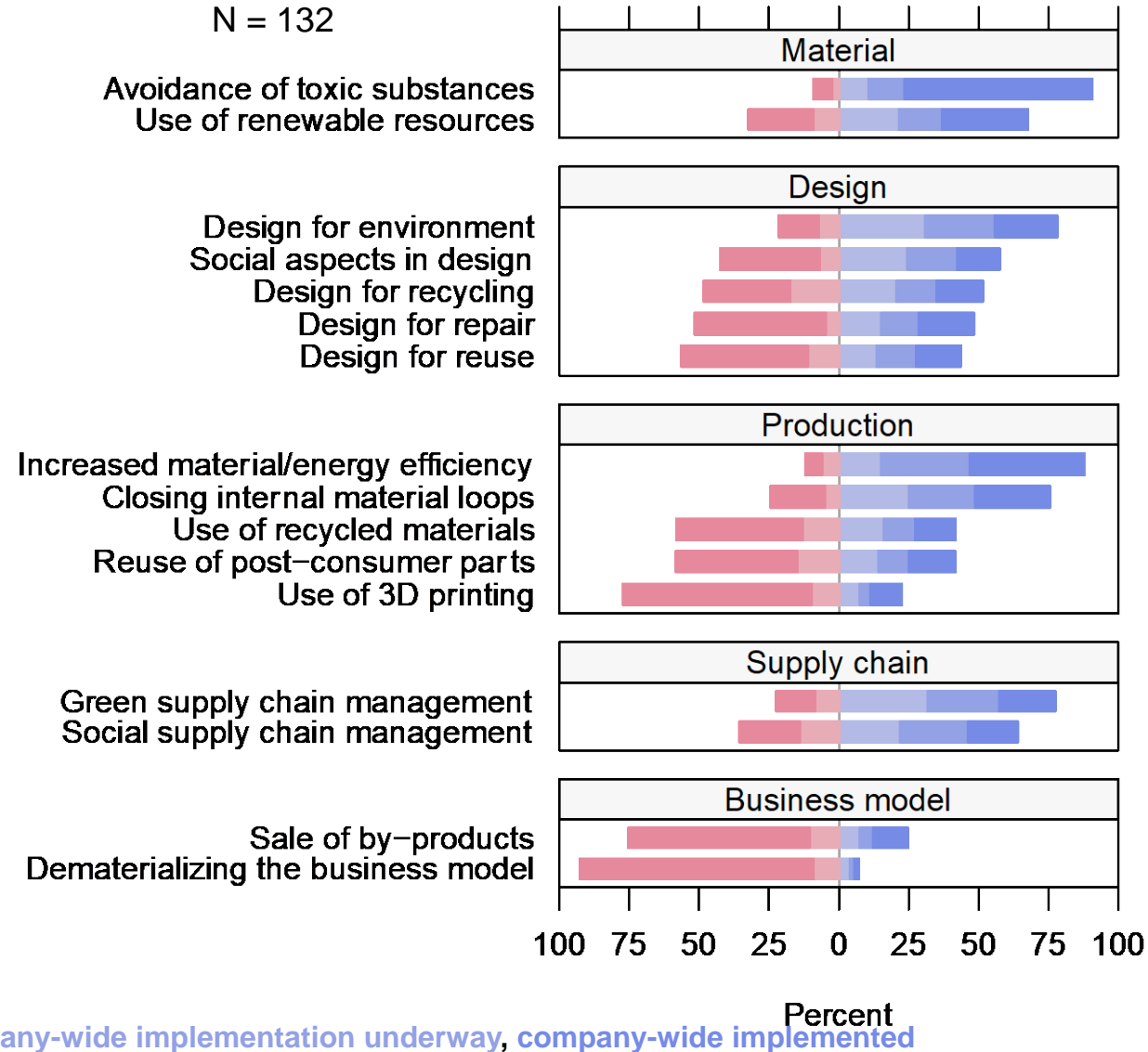
Implementation of sustainability and CE practices



N = 132

- Avoidance of toxic substances (70% fully implemented), material and energy efficiency (44%) and closing internal material loops (30%) most widely implemented CE practices
- 48 % have implemented design for recycling at least partly
- 45 % reuse post-consumer parts
- 43% use recycled materials
- Radical, circular economy-oriented changes to business processes and models are rare (e.g., 1% dematerialized their business model)

Practice



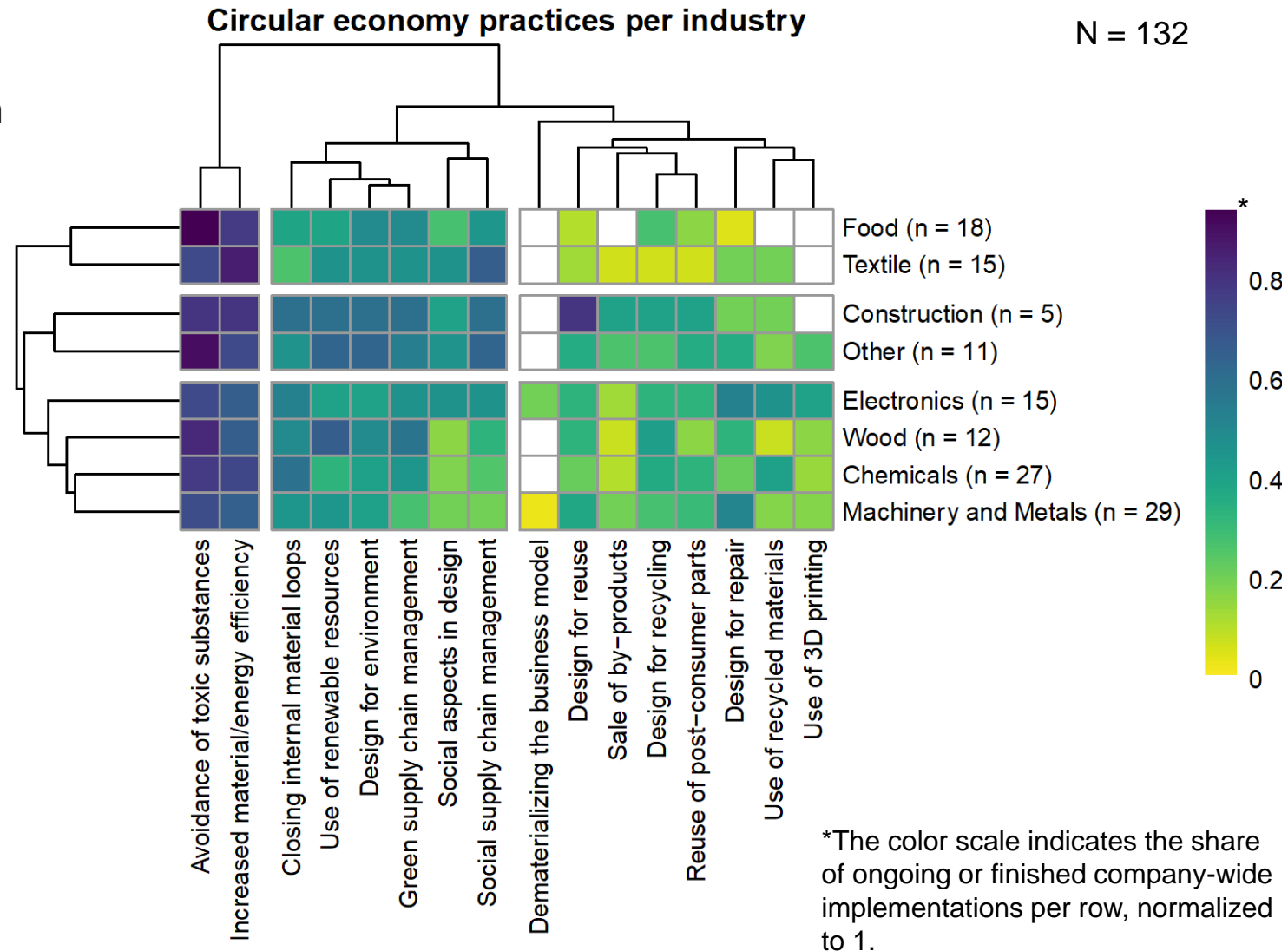
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Sectoral differences in the implementation of CE practices



N = 132

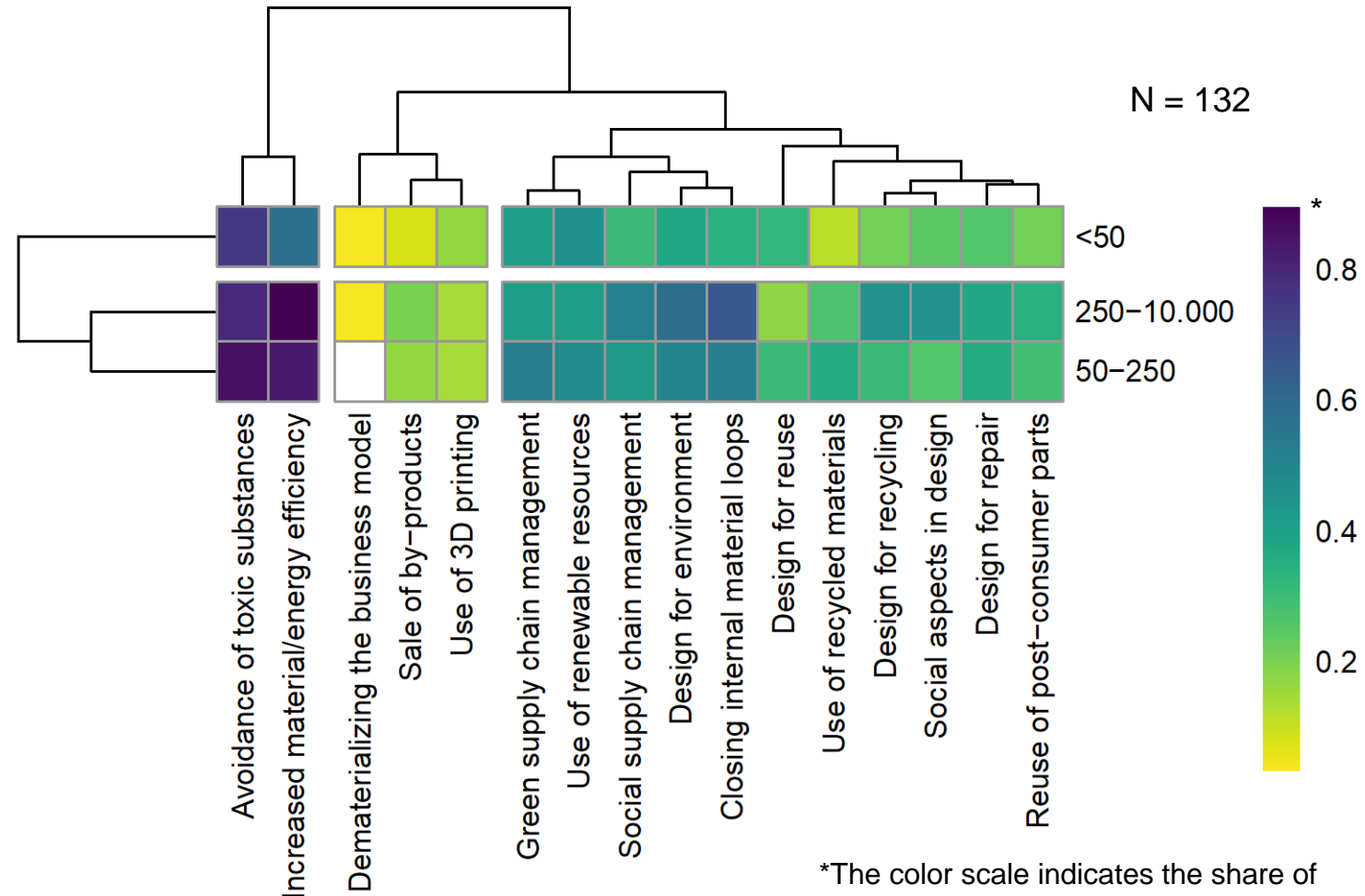
- Most common CE practices form their own cluster (65-94%); second most common cluster focuses on internal material loops, environmental and social SCM and design (17-67%); least common cluster entails more radical changes to a company's processes and business model
- Two industries with the lowest (food, textile) and two industries with the highest aggregated degree of CE implementation (construction, other) are separated from the four industries in between
- No significant difference (Kruskal-Wallis test) was found between industries using a mean construct (Cronbach's alpha = 0.789) for CE implementation ($\chi^2(7) = 7.032, p = 0.426$)



CE practices per company size



Circular economy practices per company size (number of employees)



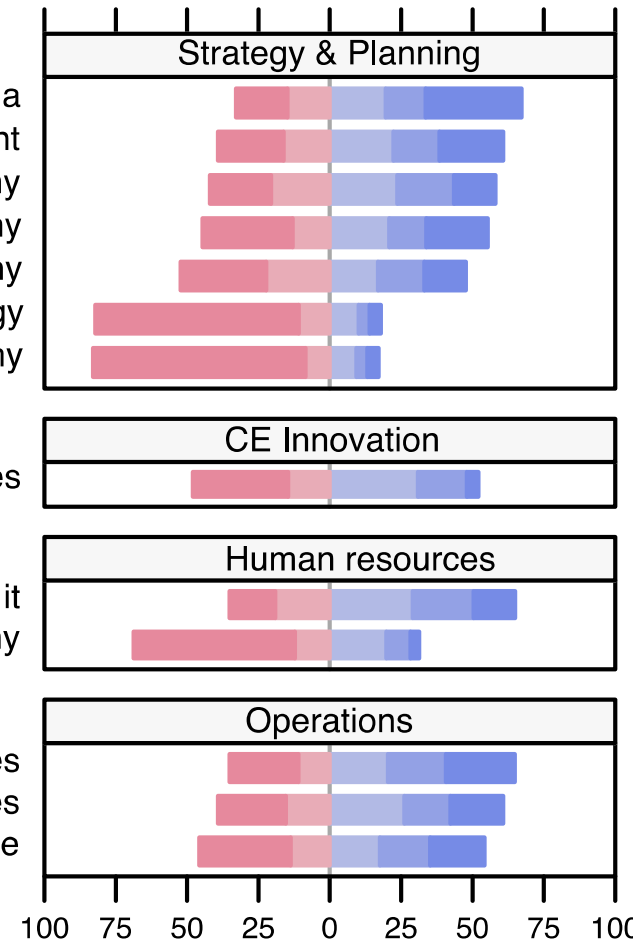
- Large and medium-sized companies are more similar to each other in the CE implementation than small companies
- A Kruskal-Wallis test furthermore showed that the differences between company sizes regarding the degree of CE implementation are statistically significant ($\chi^2(2) = 8.794, p = 0.012$)
- The effect size was determined to be small ($\epsilon^2 = 0.067$)
- Post-hoc tests (Dunn-Bonferroni) showed that only small companies (<50 employees) and large companies (250-10.000 employees) differ significantly from each other (adjusted $p = 0.009$).

Companies' strategic orientation towards a CE



(N = 132)

- Centrality of circular economy on the management agenda
 - Embedding circular economy issues in risk management
 - Strategic alignment is oriented to the circular economy
 - There are concrete measurable targets in the area of circular economy
 - Existence of an implementation plan for circular economy in the company
 - Publicly available circular economy strategy
 - Publicly accessible and measurable goals in the area of circular economy
- Extent to which innovation capacity is aligned with the creation of a circular business model, or circular products and services
- Internal communication of a circular economy strategy and activities to implement it
 - Circular economy oriented further training offers within the company
- We own suitable plants, equipment and property to support circular economy business models, products or services
 - Existence of processes to support circular economy business models, products, or services
 - Availability of appropriate IT and other digital systems to support a circular economy business model, product, or service



Not considered, considering it, implementation in pilot project, company-wide implementation underway, company-wide implemented

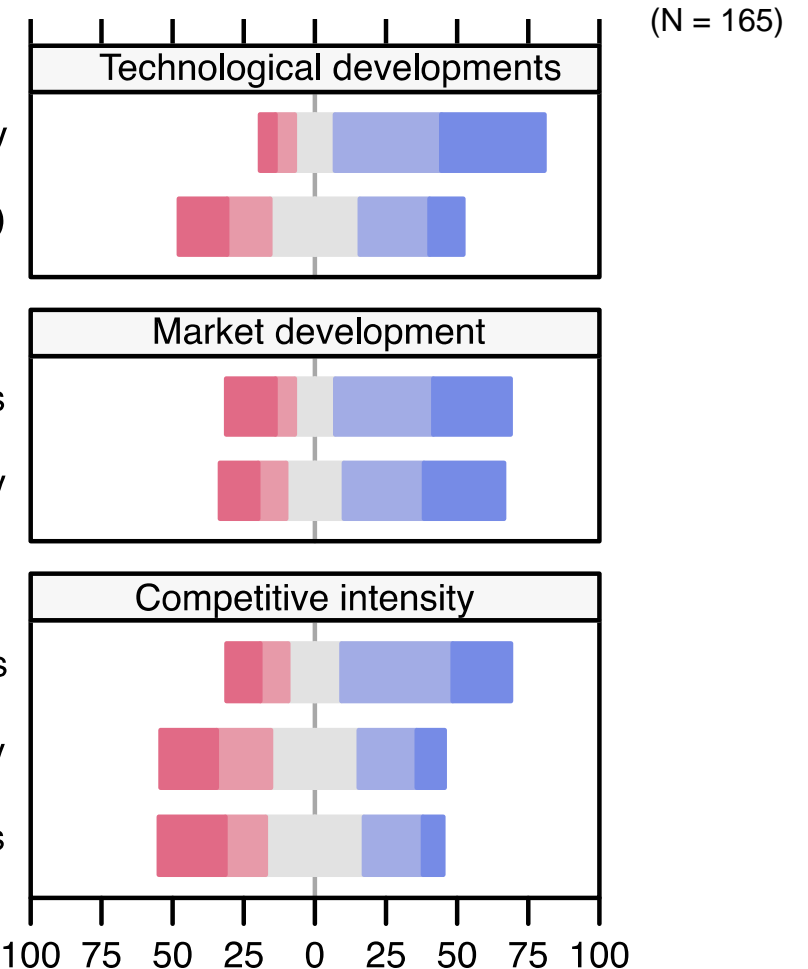
Percent

CEOs' market perception with respect to the CE



Technological developments offer great opportunities for the circular economy

Many circular product ideas were made possible by technological breakthroughs (in our industry)

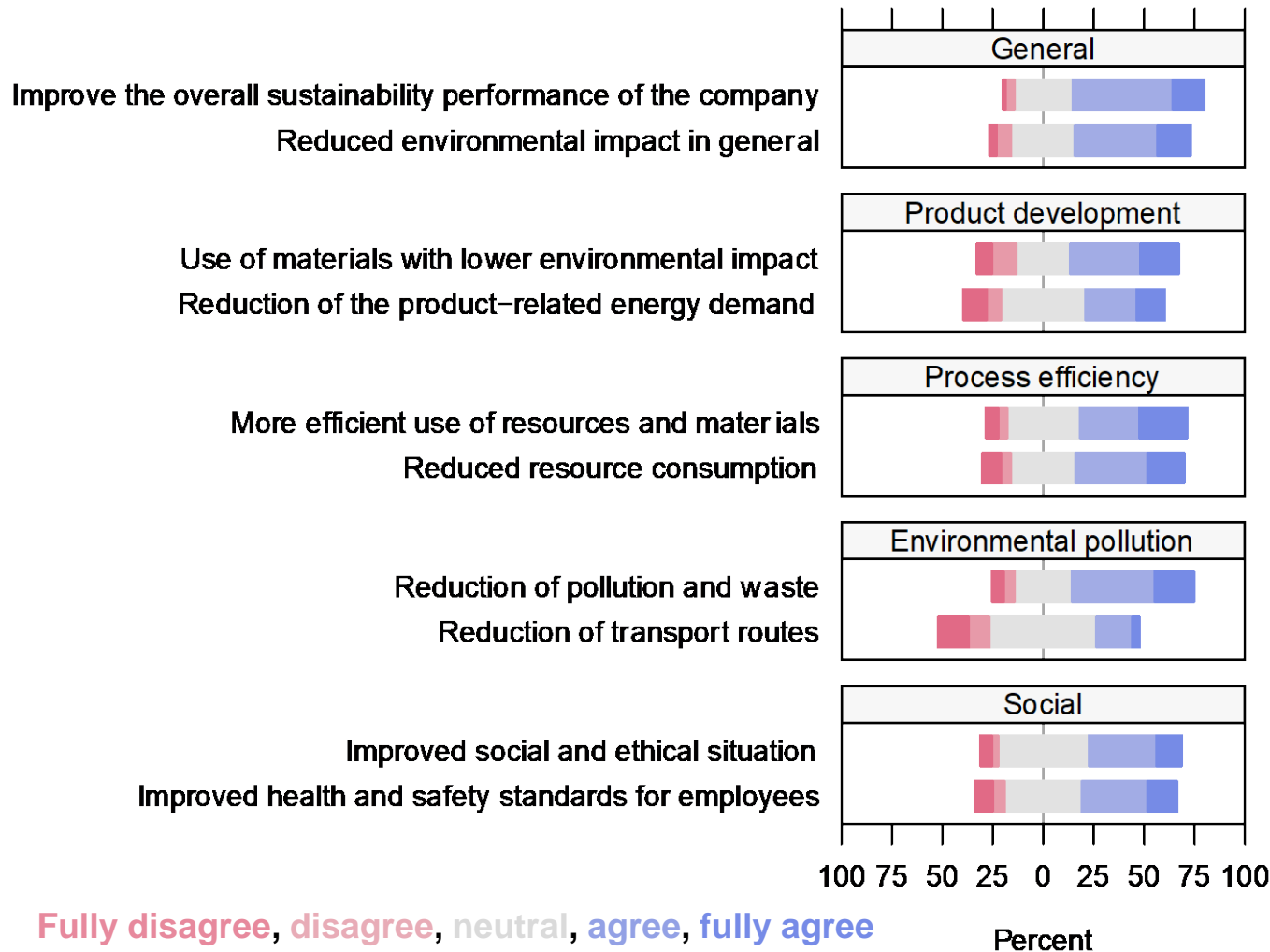


Fully disagree, disagree, neutral, agree, fully agree

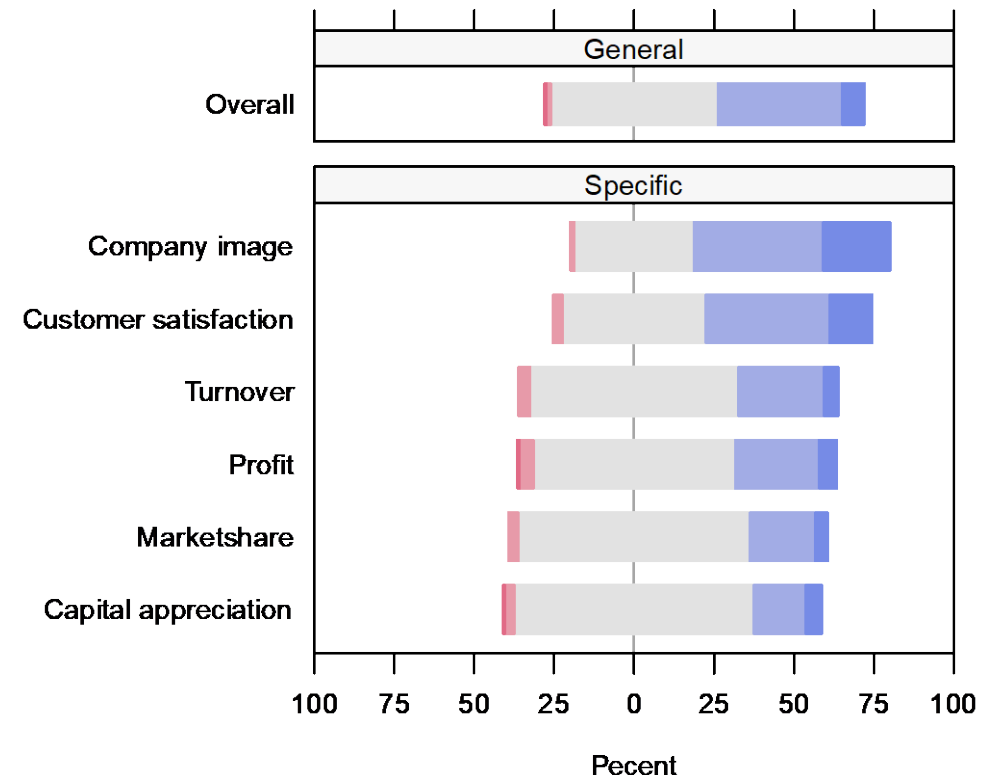
Effect of sustainability/CE practices on ...



...sustainability firm performance (N = 165)



... economic firm performance (N = 165)

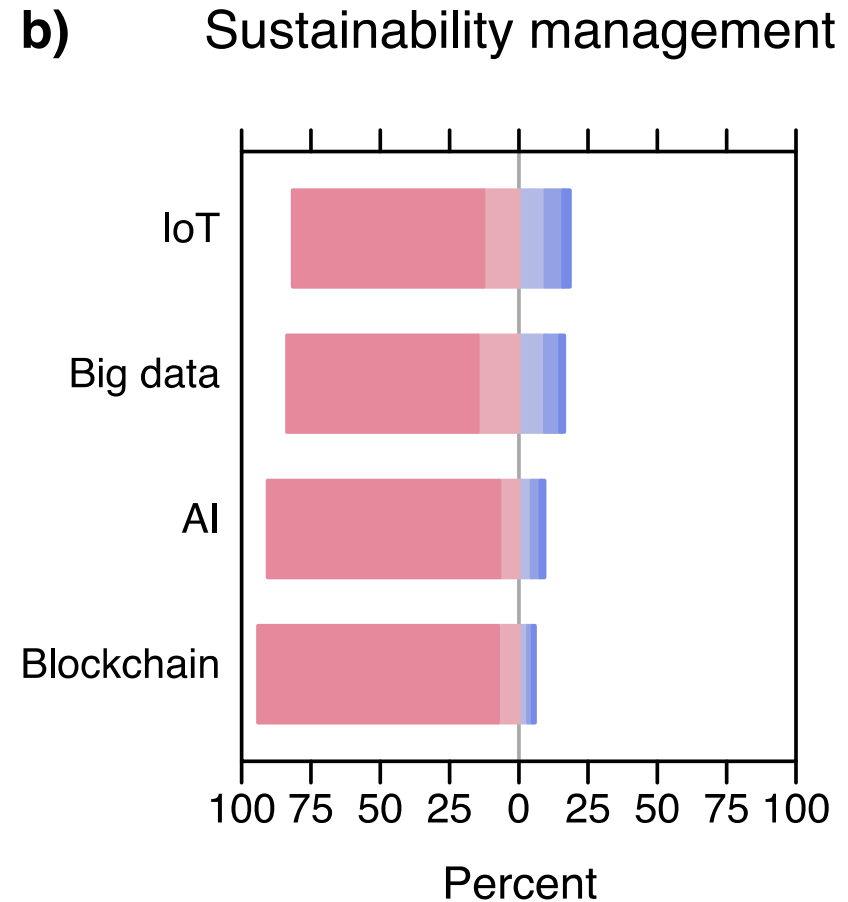
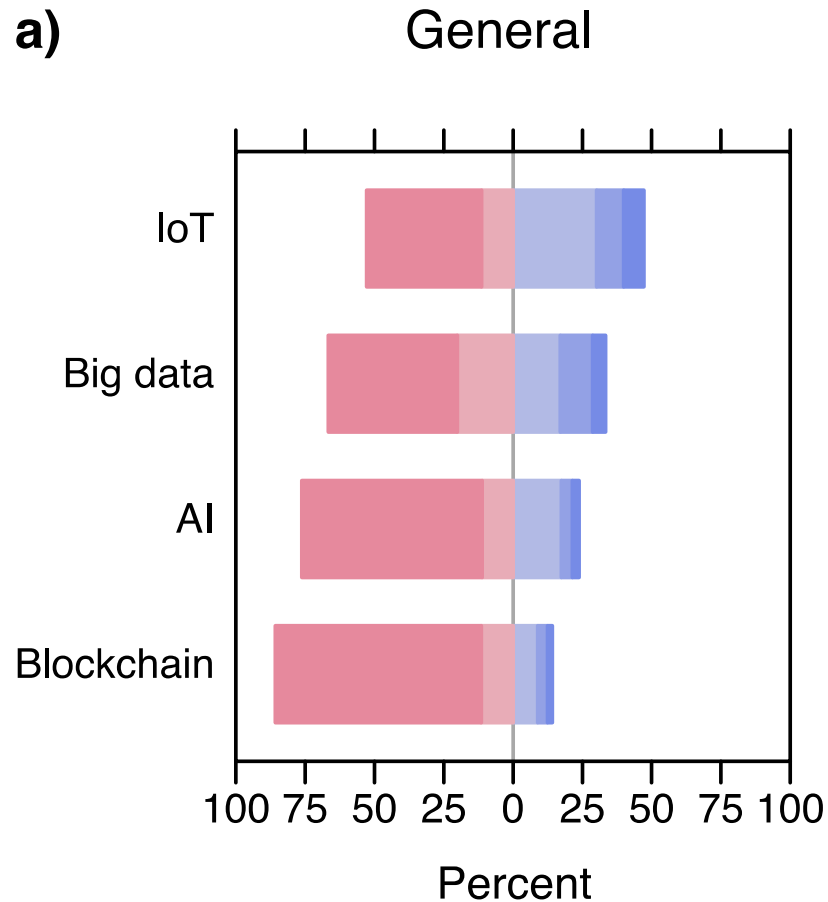


- CEOs see a largely positive effect (53% agree, 12% fully agree) on the sustainability performance of their companies, and
- in fewer cases, a positive effect on the economic success of the company (41% agree, 7% fully agree)

Implementation of digital technologies in general and for sustainability management

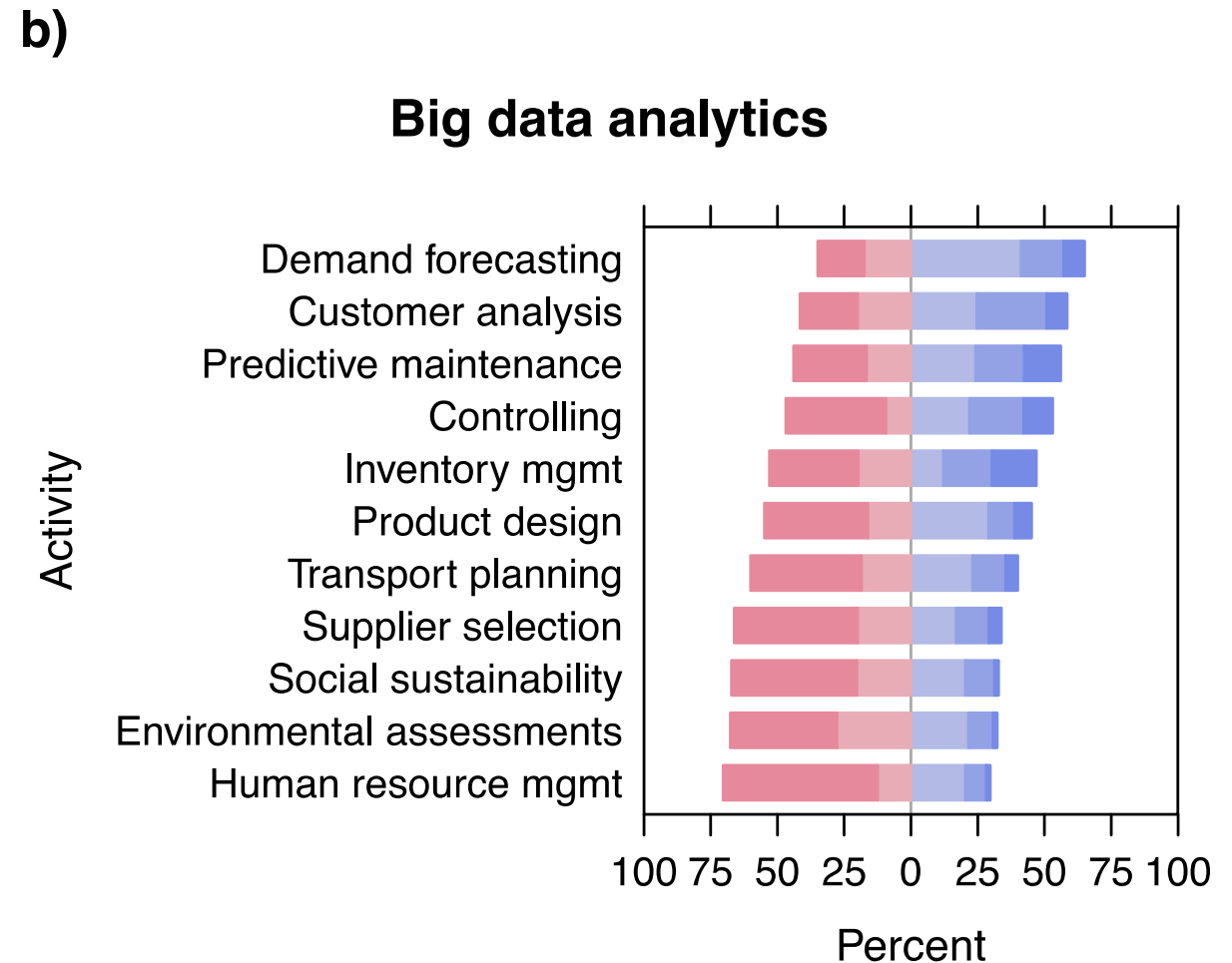
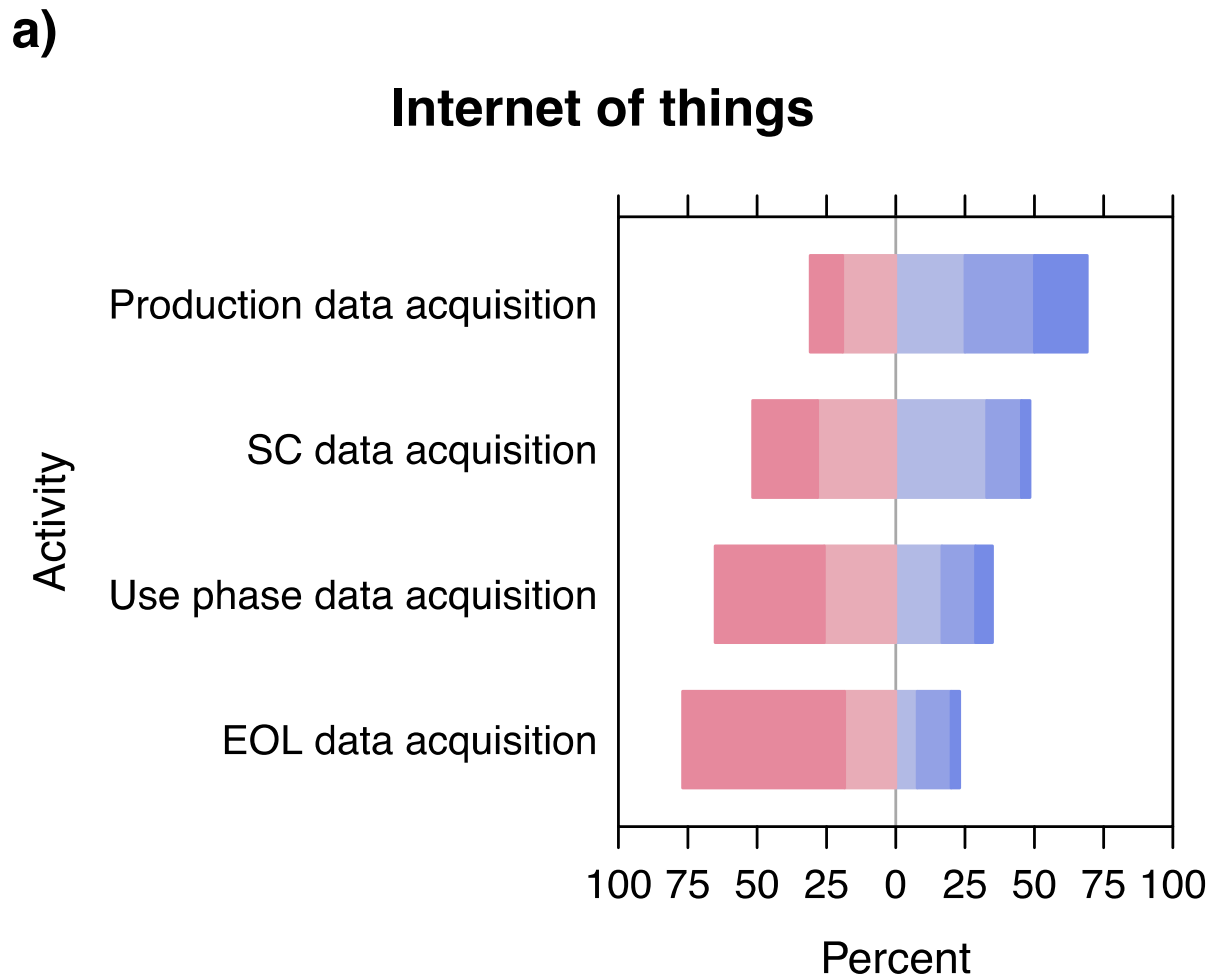


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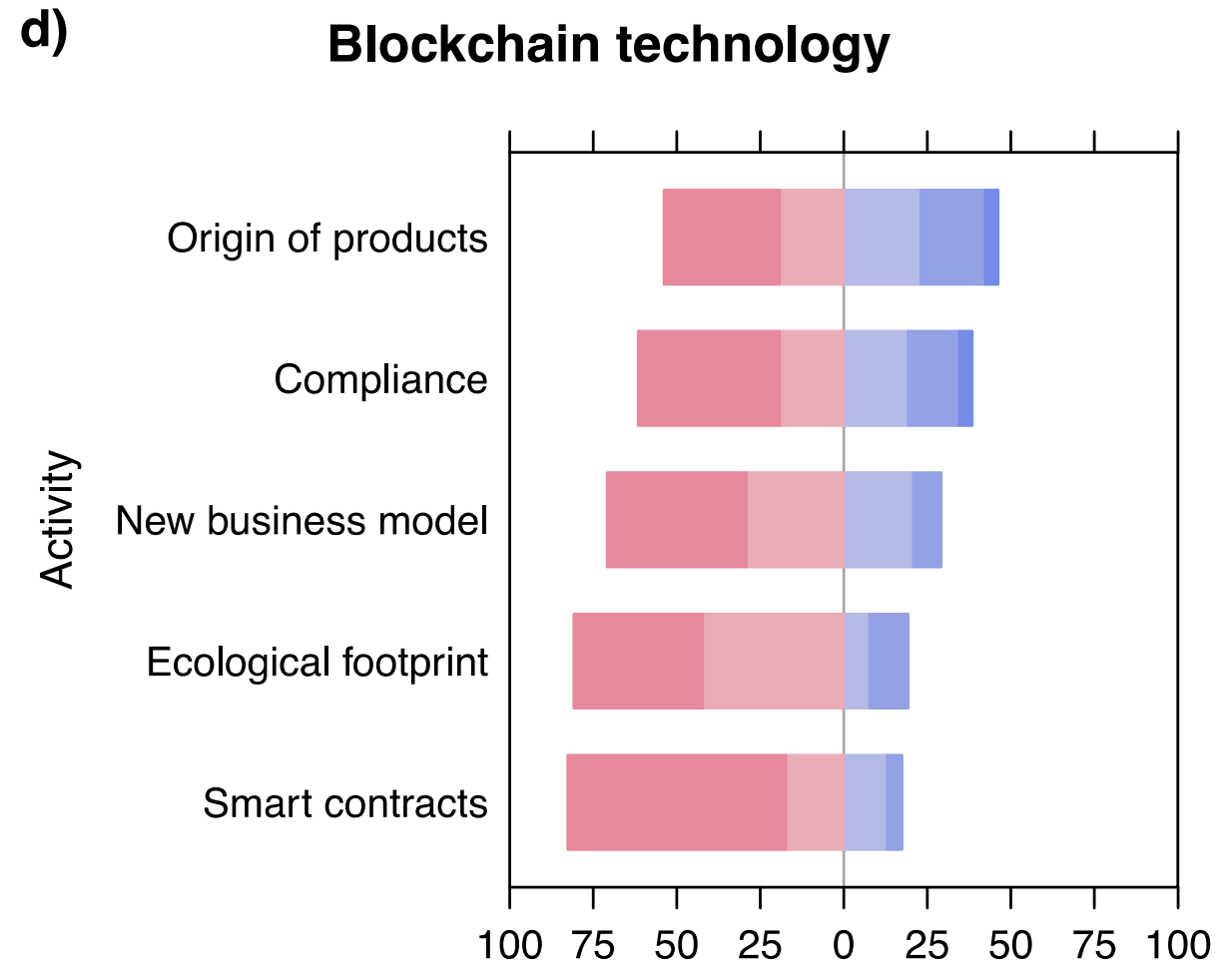
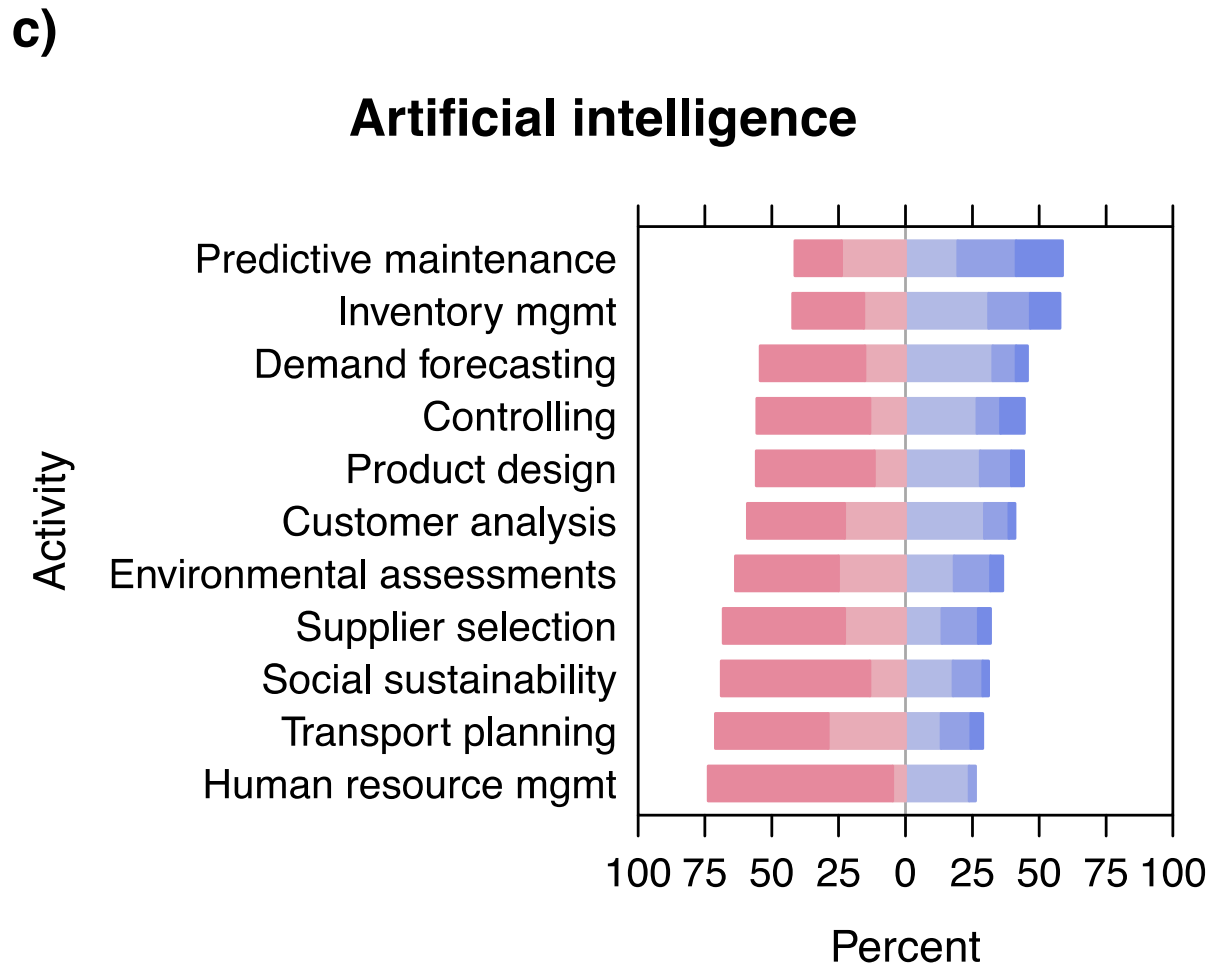
Not considered, considering it, implementation in pilot project, company-wide implementation underway, company-wide implemented

Degree of implementation of IoT and blockchain technology



Not considered, considering it, implementation in pilot project, company-wide implementation underway, company-wide implemented

Degree of implementation of artificial intelligence and big data analytics



Conclusions



- Around 2/3 have a defined sustainability strategy
- Avoidance of toxic substances (70% fully implemented), material and energy efficiency (44%) and closing internal material loops (30%) most widely implemented CE practices
- Radical, CE-oriented changes to business processes and models are rare (1% dematerialized their BM)
- Large proportion of companies that report ongoing company-wide implementation or CE-related pilot projects indicate a strong development
- Significant differences in the degree of CE implementation between company sizes (i.e., small and large companies) but not between industries
- CEOs see a largely positive effect on the sustainability performance of their companies and, in some cases, a positive effect on its economic success

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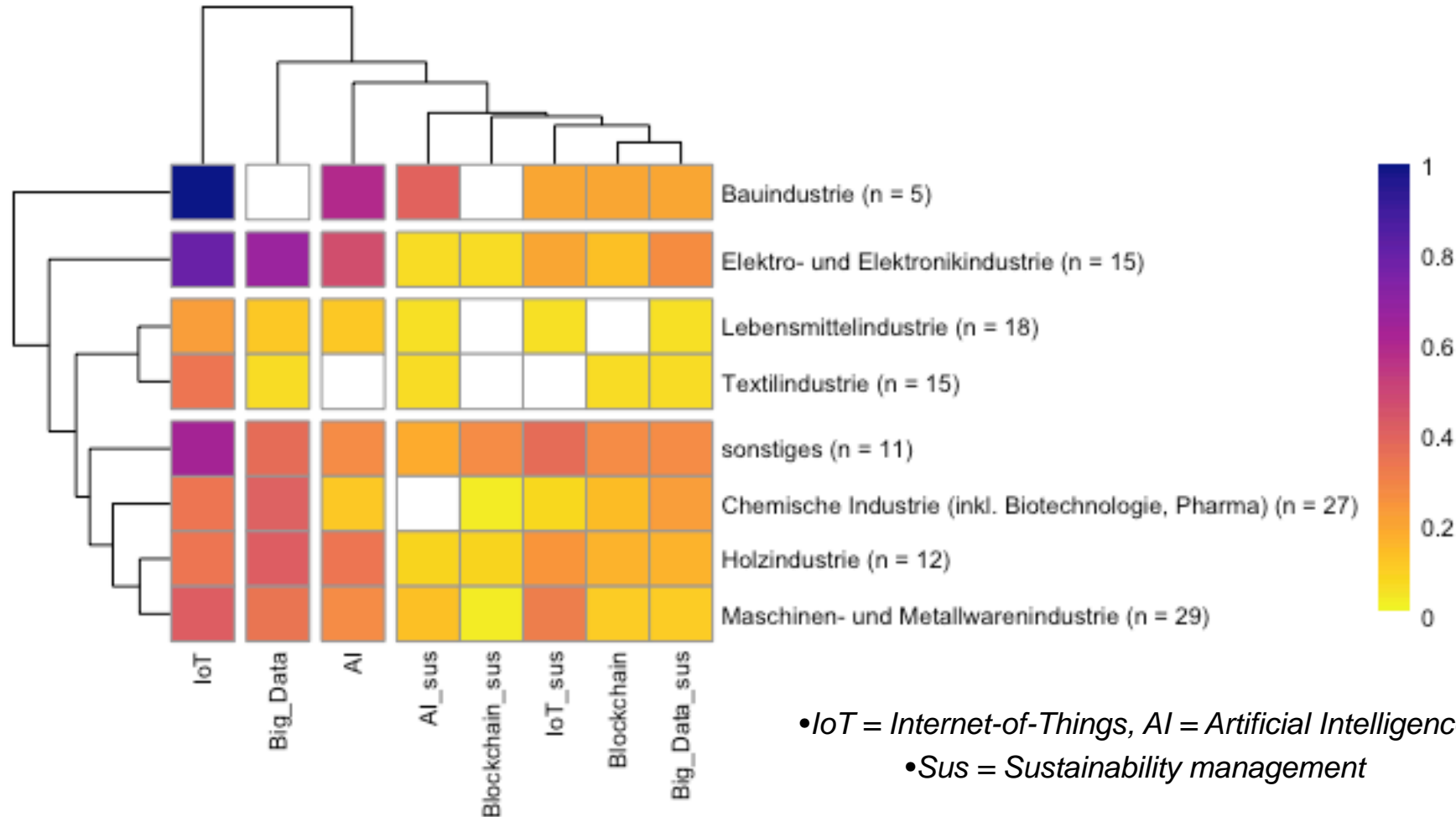


BACKUP

Implementation of digital technologies in general and for sustainability management



(N = 132)



Schögl, J-P, Rusch, M., Stumpf, L., & Baumgartner, R.J. (2022). Implementation of digital technologies for a circular economy and sustainability management in the manufacturing sector. Sustainable Production and Consumption (under review).