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## Efficiency Measurement in Digitalized Work Systems of Transport Logistics

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### Abstract

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Digitalization is a major trend and challenge in most industries and sectors of societies. Still, quantitative insights regarding the impacts of digitalization are missing. This chapter is reporting a first approach using Data Envelopment Analysis (DEA) for measuring efficiency results of digitalization steps in a retail logistics context. Aspiring to quantify the performance of professional truck drivers during a digital turnover related to mobile devices, we evaluate truck loading processes. As inputs we use

loading time and costs. Outputs are load factor of units, invoice charged to shops, and the value of the damages during truck loading. The findings indicate that a change in the level of digitalization entails a loss of the efficiency level in the first instance, which can be compensated and even surpassed later.

When applying linear regression analysis, we prove a low statistical linear relationship of age and efficiency plus a strong statistical linear relationship of employer size and efficiency as well as period of employment and efficiency, always regarding the changing levels of digitalization in the working system of professional truck drivers. For practitioners in retail logistics, we derive the importance of employee retention programs for human resource management, along with a positive working environment provided for truck drivers to reduce fluctuation effects. Furthermore, we advise designing software for truck drivers as commonplace as possible and in the style of widespread smartphone software user interfaces.

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## Notes

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1. See Broy and Geisberger [21] and for the basic architecture of CPS systems, see [64, 65, 76, 82].
2. The basic idea of this concept is the existence of several objects that are able to interact and communicate with each other, see [11]. For basic literature regarding the IoT [3, 41, 75, 107].
3. The umbrella concept AI contains an intelligence created by human skills and was first-ly named by McCarthy et al. [74]. A wide range of existing definitions can be categorized in four main approaches [85] (1) thinking humanly [43], (2) acting humanly [61], (3) thinking rationally [24] and (4) acting rationally [81].
4. See Kagermann et al. [51, 52], Forschungsunion

[37, 38], Forschungsunion and Acatech [39].

Industry 4.0 is also mentioned as

“Industrialization of a new type”, see [18], as

“Second Machine Age” see [22], as “Third

Industrial Revolution”, see [72, 84] and as

“Distributed Capitalism”, see [110].

5. See [40, 50, 68, 78, 87, 94, 103].
6. The concept drafts of Retail 4.0 are e.g. anticipatory shipping through big data analytics see Lee [63] and consumer's purchase prediction [14, 73].
7. In the original version “...for use in evaluating activities of not-for-profit entities participating in public programs”; Charnes et al. [23, p. 429].
8. The bibliography of Tavares lists with 3.203 analyzed publications of 2.152 authors from 49 countries a comprehensive overview of publications on the topic of the DEA, see [96].
9. For an overview see [83].

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