
2nd Conference on Production Systems and Logistics

Tasks and Hurdles of Digital Transformation in Companies – a Literature-Review

Hanna Middendorf¹, Sandra Kaczmarek², Natalia Straub¹, Alexander Kreyenborg¹,
Maximilian Austerjost³, Michael Henke²

¹Chair of Enterprise Logistics, TU Dortmund University, Dortmund, Germany

²Chair of Enterprise Logistics, TU Dortmund University / Fraunhofer Institute of Material Flow and Logistics IML, Dortmund, Germany

³Institute of Material Flow and Logistics IML, Dortmund, Germany

Abstract

Digital Transformation in logistics and supply chain management is a challenge and a big chance for companies at the same time. It can open new business areas by providing new products and services. However, as promising as the digital transformation looks, the challenges for a successful transformation are not to underestimate. Many companies fail during the digital transformation process.

This paper aims to shed light on why some companies have difficulties with digital transformation and others not by looking at the hurdles and responsibilities involved. By comparing the limitations and obligations, this paper identifies gaps and ambiguities that might lead to failure.

A structured qualitative literature review presents the status quo of the actual scientific discourse in digital transformation, sums up tasks and barriers of the digital transformation in companies, and derives initial recommendations for action.

This paper shows that a digital transformation's hurdles and barriers are multifaceted and can be located on different enterprise levels. Enterprise culture and the top management's awareness and capabilities are essential for digital transformation. The same applies to the tasks of a digital transformation.

Keywords

Digital Transformation; Logistics; Supply Chain Management; Barriers; Tasks; Recommended Action

1. Digital Transformation in Logistics and Supply Chain Management

Digital transformation (DT) is a phenomenon that occurs equally in all industries. It offers companies the opportunity for new product and service innovations and the optimization of processes and workflows by using new means of digital technologies. This rapid technological progress affects all areas of a company, including logistics and supply chain management (LSCM). As a result, companies are under enormous pressure to change, which means that DT is no longer an optional process, but rather an obligation for management to address and implement to an appropriate degree. [1–3]

DT is becoming a strategic factor for competitive business purpose [4–7]. It is assumed that only those companies will survive in the new business environment that prepare for and accept the transformation process [8]. For LSCM, this means transforming value creation through digital technologies, changing and adapting strategies and techniques, and integrating enablers such as innovation and leadership to increase agility and realize higher productivity and customer-centric supply chains [9]. Due to the financial volume

and the high number of employees, LSCM is one of the most important economic sectors in Germany [10,11], and is therefore considered in this paper. One challenge is the increasing complexity along supply chains, which requires a structured approach to support digital transformation management [12,13].

DT is a continuous and complex undertaking that offers opportunities to change a company and its operations significantly [4,6], and it is argued in [14] that very few conventional techniques will be sustainable in the future to support this radical change process. For this reason, it is also necessary to examine the critical capability of entrepreneurial thinking and action with regards to modern working methods and new technical possibilities.

According to Bucy et al., many companies will fail on this path because 70% of all DT are not successfully implemented [15]. The implementation process takes much longer and is more complex than expected, although technological inventions are made and corresponding roadmaps for implementation of innovations are planned [16–18].

By comparing and analyzing tasks and hurdles from scientific papers, it is possible to draw first conclusions as to why a successful DT is perceived as such a challenge. This paper then gives practical conclusions for LSCM. Specifically, the question was explored as to why the majority of companies (70%, see above) is having difficulties implementing DT while a significant share (30%) is successful.

2. Tasks and Barriers of Digital Transformation

To achieve a comprehensive understanding of the complex phenomenon of DT in the field of LSCM, this paper uses a structured qualitative literature review according to Xiao and Watson [19]. Table 1 shows the information on how the literature review was conducted.

Table 1: Overview of literature review

Platforms used		Google Scholar, EBSCOhost, database of the University library			
Search string		“digital transformation” OR “digitization” OR “digitalization” AND “barriers” OR “hurdles” OR “obstacles” OR “challenges” AND/OR “task” OR “mange” OR “navigate”			
Publication period		2000 till now			
Initial paper volume		1.210			
Selection criteria		Ranking (A+ to D); impact factor, German or English language; relevance for the topic			
Papers on Digital Transformation		Models	Studies	Framework	Literature Reviews
A	[20,4,21–25]		6		1
B	[26–38]		6	6	1
C	[39–43]	2		5	
D	[44–49]	2	1	3	
Impact Factor	[50–59]		4	5	1
Without Ranking	[60–70]	3	3	5	
Overall	54	7	20	23	3

The literature review served to approach the topic of managing DT and to identify why some companies successfully implement this change and others do not. The findings, mainly from management research, are focused on the field of LSCM in the discussion in order to systematically prevent misleading interpretation due to specific challenges in other sectors. Based on the extensive literature review, eight categories were identified that reflect the digital change in companies comprehensively: Corporate culture, business model,

strategy, organisation, employees, technology and data, resources (monetary) and top management. These categories were summarized with a focus on brevity.

Corporate Culture: An important task is the adaptation of the corporate culture [39,4,27,28,61,46,47,35,36,48,70] to meet the requirements and implementation of the DT. At the same time, however, this is also a major hurdle, because many companies find it challenging to implement the change successfully [54,63,64,31,47,37,68,69]. Besides, a risk-averse corporate culture is an obstacle to successfully implementing the DT [28,57].

Business Model: The business model plays an essential role in the tasks of a DT, because it (often) needs to be adapted and changed to address new tasks and processes of the DT. It is recommended to make the business model more agile and leaner. [44,39,26,40,30,32,43,47,34,70] The barriers that need to be overcome in the business model are described by changing customer needs and expectations and outdated business models [44,39,45].

Strategy: In this category, several tasks need to be addressed for a successful management of the DT: Companies have to formulate and implement a resilient digital/DT strategy – at the best, the digital strategy is embedded in the corporate strategy [39,26,40,28,32,65,42,66,47,35,37,24,25,70]. A clear and understandable and transparent DT vision is defined [27,40,28,61,58,33]. Governance should be established for constant reflection and evaluation [30,47]. The role of a Chief Digital Officer (CDO) or Digital Leader should be introduced or at least considered as well as a DT team to strengthen the digital strategy [40,21,30,62,31,47,37,24,48,25]. One hurdle listed in this context is that it is a hindrance if there is no strategy and no understanding of a DT [54,28,57,45,68].

Organisation: Within an organization's framework, the company has to be leaner and more flexible to meet the DT requirements [51,39,4,52,56,40,31,36]. One task is to actively promote cooperation within the organization, especially with cross-departmental and cross-team work. The silo mentality of departments must be reduced or eliminated. [39,26–28,61,31] The orientation of the organization, as well as processes, interfaces and role and job profiles of the employees must be adapted within the company so that a digital ecosystem can emerge. [20,44,30,65,67,34,48]. The following barriers could be identified in this category: The DT challenges the organization's fundamental and grown structure [20,48]. On the other hand, the existing organisational structure may hinder change. If a company is digitally inexperienced, a DT can be a major challenge by itself [55,45,63,23]. In general, the organization must be willing to embrace change [39,54,57,65,37]. Strict separation of teams and tasks is a hindrance as interdisciplinary work is identified to necessary [53,41,59].

Employees: The tasks related to employees for the management of a DT are identified in the literature as follows: Employees must be involved in the transformation process from the start to, e.g., convert their curiosity into new ideas or suggestions [4,56,40,43,33,48,70]. Companies should promote, develop and gain digital skills and optionally implement new professional roles [52,26,40,28,30,61,58,24]. Furthermore, workplaces, working hours and work content changes (lifelong learning, data processing, remote work) and training must be adapted accordingly [50,39,52,60,31,46,65,43,47]. Barriers are reluctance to changes of the staff [27,59], missing digital skills, know-how and expertise [54,28,57,63–65,59,68], and fundamental new requirements for the qualification of employees [52,55].

Technology and Data: In technology and data, the following tasks for a DT have been identified: The development of an IT infrastructure, e.g. by setting up a platform and/or database [26,40,31,65,35,70]. The management and asset-oriented use of data [26,40,31]. Big data analysis, data mining and data analytics [40,28]. A suitable technology selection, management, implementation, and process integration [30,31,70]. The main hurdles are as follows: Data security [53,57,63,59,47], uncertainty what technology to choose [53,45,66], and an insufficient IT structure [71,63,64].

Resources (monetary): In the field of resources there are some tasks to address; Budget for advancing a DT (testing new ideas, new forms of software etc.) should be reserved [4,28] and investments must be designed to suit the company [31,32,70]. Therefore, the main obstacle is the lack of insufficient financial resources [71,57,63,68,69], lack of resources [53,59], and also when companies misconceive a DT for a one-time investments and thus do not budget corresponding resources [55,42,35].

Top management: In the category of top management, the following tasks for a DT were identified: Top management should define and communicate a digital strategy and also name the most important activities [41,42,48,49,70]. The top management should regularly reflect on the necessity of their own mindset and thinking [50,52,29,22,67,34,38,25]. The top management team has to involve internal and external support and consultancy for a proper DT [34,24,25]. The management should encourage and support employees and act as a role model (live and support digital vision) [29,61,23,33,67,38]. Entrepreneurial action (prioritizing tasks, allocating resources, weighing up opportunities and risks) should be actively taken up and pursued [27,29,23,34,25]. Two major aspects were mentioned in the literature as obstacles to DT: Feeling powerless, overwhelmed with deciding what to do – Leadership for DT differs from conventional change [71,29,57,30,63,23,48]. If leadership does not drive DT, it will fail [71,63,68].

3. Why do some companies face hurdles

The tasks and barriers of a DT management are multidimensional and affect the technical decisions and the entire organization's change, including the corporate culture [39,4,27,28,61,46,47,35,36,48,70]. Companies embarking on the path of DT are leaving familiar tracks behind and have to reinvent themselves [44,40,30,32,34].

According to Schoemaker et al. ordinary skills used in established companies are not suitable for the implementation of a DT [34]. Since the DT has a disruptive character, it cannot be adequately responded to with conventional skills. Therefore, there is a need to approach the phenomenon of DT through dynamic capabilities [72].

Based on the MTO concept according to Ulich [73], a design approach is characterised here that encompasses the characteristics of “role of man”, “technology” and “organization” (the so called MTO model). DT increases the quality and quantity of real-time data available to companies and offers them new opportunities. Using analytical methods and artificial intelligence, fundamental information about one's own business processes can be provided, e.g., process, environmental and status data, which is a valuable asset. This can lead to a self-optimised organisation that enables autonomous and timely adaptation to changing conditions in the business environment. [74] For this reason, the MTO model is extended by the feature “information”. Based on the results of the literature review and the MTOI approach, critical factors that lead to hurdles of a DT can be discussed.

For the successful implementation of the DT, it is important to set targets for a realisation in the application domain of supply chain management, among others suitable production and logistics systems. If no or unsuitable targets are set, this can hinder the exploitability and development of a successful new business model. It is necessary to design new business models with the permanent business processes and value creation processes. Their design should enable the company to exploit technological means economically [39,40,30]. However, this can only be achieved if the customers' new requirements and needs are correctly recognized and appropriately interpreted [39,66].

After defining the targets companies can enter the planning. This is where the characteristics of the MTOI approach become relevant for detailed consideration, because all four features have a significant influence on the processes of designing and planning production and logistics systems. *Technology:* In this phase, decisions regarding the technology should be made. Logistics and supply chain companies need to adapt

their IT infrastructure and make a choice of appropriate technologies to go into the design and planning of production and logistics systems. This is already the first major challenge, as digitally inexperienced companies have difficulties making the right choice of technologies to strengthen their business model [31,70]. *Information:* When considering the IT infrastructure, initial thoughts should be given to how the (newly available) data should be used and exploited. *Organisation:* To successfully realize and implement a DT, the organisation's fundamental structures must change. Just because the previous structure has proven to work in the past, a change of the organization towards an agile, flexible and lean structure [4,31,36] is now necessary to identify changes early on and to be able to react to them flexibly and appropriately [34] to design and plan production and logistics systems. Likewise, the division of work by (organizational) departments should be dissolved, and interdisciplinary work should be promoted instead [39,27] in order to be able to react more quickly to changes. All this requires a change in corporate culture. The impact of the DT on corporate culture is just as radical as in all other areas. The corporate culture must change in order to promote flexibility and innovation [46,48]. *People:* Radical change can only be implemented successfully if employees are also willing to change. Therefore, employees should be involved in the transformation process and actively participate with curiosity and ideas [4,56,40,43,33,48,70]. The rejection and mistrust of employees [27,59] can represent an insurmountable hurdle for the company concerning the successful implementation of the DT. Employees must be willing to build digital skills and expertise and embrace the journey of change out of their conviction [52,56,61]. The role of employees is changing, as they are required to work in a more self-determined way and also to network independently with other employees and departments [52,56].

Planning is followed by the decision-making phase. This is about deciding whether and how the plans should be realised. To do this, the future technology portfolio, the role of people, organisational models, and the integration of information for the company must be developed. The initial use cases should be modelled explicitly, because companies that do not formulate detailed business cases are known to have difficulties describing and evaluating the exact economic benefits. [75]

The next step is the realization - the integration of new technologies into existing business processes. At this point critical factors like lack of data security [53,57,63,59,47] and an insufficient IT structure [71,63,64] can occur. Interfaces to the customer must be defined and technologies from different manufacturers need to be brought together. The organisational change needs to be driven actively and the radical change of a DT must be addressed appropriately. This also means well-structured human resource management to drive personal development and employee competencies along with organizational change and thus implement necessary changes in the work system.

Monitoring DT is necessary to measure its success and to keep an eye on the strategic fit of a company's entire structure. Companies will have difficulties if they assume that the DT can run alongside day-to-day business like conventional projects. Monitoring is an integral part of company-wide strategic early detection. The aim of this early detection is to provide timely information about changes in the entire field of the company in order to identify possible opportunities and risks at an early stage. Governance should be established for constant reflection and evaluation [30,47].

To engage in the process of DT, there are several factors that accompany the entire process and contribute significantly to its success or failure. It is necessary to have a well-developed, resilient and clearly formulated digital strategy, which in the best case is integrated into the overall corporate strategy [39,40,28,32,65,42,66,47,35,37,24,25,70]. Companies make the biggest mistake by viewing the DT as a project and therefore lack an understanding of the DT and accordingly no strategy is formed [28]. Another factor is the allocation of resources, which can be challenging for companies. This is because the distribution of financial resources does not follow the standard project approach. Funds must be made available to test, try out and implement new ideas without a defined business case in the beginning. Furthermore, companies need to be aware that the decision for a DT means a long-term investment [55,42,35]. A third factor is the

top management. The leadership of a DT is different from that of a normal change [76]. Due to all the changes and new requirements of a DT, the role of leadership also changes. They need to become drivers of the DT [71,63,68]. A particularly great challenge for leadership is to reflect on themselves constantly and to change their own mind-set and thinking [50,52,29,22,67,34,38,25].

4. Theoretical and managerial implications and further research

The reasons why companies have difficulties with DT are many and varied and are manifold and based primarily on the disruptive nature of the change. In short, the extent of the DT is simply underestimated by the more struggling companies. Based on the literature review, it can be tentatively (!) concluded that companies with a successful DT reshape the purpose and the setup of their venture. This hypothesis has to be confirmed, and findings of management research in the field of LSCM should be investigated in depth. One approach that should be considered further is the concept of dynamic capabilities. With the help of this theoretical approach, further recommendations for action can be derived, explained and defined. Further research should look more closely at roles and hierarchies of companies in LSCM because a radical change process means that traditional job profiles will also change. In LSCM, the extent to which roles change or are replaced by other roles must be examined at this point. It also should be investigated how top management acts more entrepreneurially because this could be a key capability in DT and organizational change. It makes sense to look at how established and structurally set companies can realize change and which influencing factors play a key role. Long-term studies that accompany the process of change in LSCM would be useful to obtain valid results.

Acknowledgements

This research and development project was funded by the German Federal Ministry of Education and Research (BMBF) within the “Zukunft der Arbeit” Program (02L18A190) and implemented by the Project Management Agency Karlsruhe (PTKA). The authors are responsible for the content of this publication.

References

- [1] Grivas, S.G., Graf, M., 2020. Digitale Transformation – Transformation der Unternehmen im digitalen Zeitalter, in: Gatzju Grivas, S. (Ed.), *Digital Business Development*, vol. 31. Springer Berlin Heidelberg, Berlin, Heidelberg, pp. 143–166.
- [2] Moufaddal, M., Benghabrit, A., Bouhaddou, I., 2019 - 2019. Industry 4.0: A roadmap to digital Supply Chains, in: *2019 1st International Conference on Smart Systems and Data Science (ICSSD)*. 2019 1st International Conference on Smart Systems and Data Science (ICSSD), Rabat, Morocco. 03.10.2019 - 04.10.2019. IEEE, pp. 1–9.
- [3] Preindl, R., Nikolopoulos, K., Litsiou, K., 2020. Transformation strategies for the supply chain: the impact of industry 4.0 and digital transformation. *Supply Chain Forum: An International Journal* 21 (1), 26–34.
- [4] Berghaus, S., Back, A., 2017. Disentangling the fuzzy front end of digital transformation: Activities and approaches. *Thirty Eighth International Conference on Information Systems*.
- [5] Gassmann, O., Sutter, P., 2016. *Digitale Transformation im Unternehmen gestalten: Geschäftsmodelle, Erfolgsfaktoren, Handlungsanweisungen, Fallstudien*. Hanser, München, 282 pp.
- [6] Singh, A., Hess, T., 2017. How Chief Digital Officers promote the digital transformation of their companies. *MIS Quarterly Executive* 16 (1).
- [7] Vetter, H.M., 2017. *Dynamic Capabilities for the Digital Transformation: Scale Development and Empirical Investigation of Performance Implications*. Apprimus.

- [8] Marmolejo-Saucedo, J., Hartmann, S., 2020. Trends in digitization of the supply chain: A brief literature review. *EAI Endorsed Transactions on Energy Web* 7 (29), 1–7.
- [9] Junge, A.L., Straube, F., 2020. Sustainable supply chains – digital transformation technologies’ impact on the social and environmental dimension. *Procedia Manufacturing* 43, 736–742.
- [10] Kübler, A., Distel, S., Veres-Homm, U., 2015. *Logistikbeschäftigung in Deutschland: Vermessung, Bedeutung und Struktur*. Fraunhofer Verlag, Stuttgart, 97 pp.
- [11] Schwemmer, M. (Ed.), 2016. *Die Top 100 der Logistik: Marktgrößen, Marktsegmente und Marktführer in der Logistikdienstleistungswirtschaft*, Ausg. 2016/2017 ed. DVV Media Group Dt. Verkehrs-Verl., Hamburg, 400 pp.
- [12] Clauss, A.-M., Schumann, C.-A., 2020 - 2020. A Systems Theory and Action Design Research Perspective on Supply Chain Collaboration in the Context of SCM 4.0, in: 2020 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC). 2020 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), Cardiff, United Kingdom. 15.06.2020 - 17.06.2020. IEEE, pp. 1–8.
- [13] Hompel, M. ten, Henke, M., 2017. Logistik 4.0 – Ein Ausblick auf die Planung und das Management der zukünftigen Logistik vor dem Hintergrund der vierten industriellen Revolution, in: Vogel-Heuser, B., Bauernhansl, T., Hompel, M. ten (Eds.), *Handbuch Industrie 4.0 Bd.4*. Springer Berlin Heidelberg, Berlin, Heidelberg, pp. 249–259.
- [14] Mohr, T., 2020. *Der Digital Navigator: Ein Modell für die digitale Transformation*. Springer.
- [15] Bucy, M., Finlayson, A., Kelly, G., Moye, C., 2016. The ‘how’ of transformation.
- [16] Balakrishnan, R., Das, S., 2020. How do firms reorganize to implement digital transformation? *Strategic Change* 29 (5), 531–541.
- [17] Glaser, B., Strauss, A.L., 1967. *The Discovery of Grounded Theory*. Aldine, Chicago.
- [18] Zinder, E., Yunatova, I. Synergy for digital transformation: person's multiple roles and subject domains integration, in: , *International Conference on Digital Transformation 2016*, vol. 2016, pp. 155–168.
- [19] Xiao, Y., Watson, M., 2019. Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research* 39 (1), 93–112.
- [20] Baptista, J., Stein, M.-K., Klein, S., Watson-Manheim, M.B., Lee, J., 2020. Digital work and organisational transformation: Emergent Digital/Human work configurations in modern organisations. *The Journal of Strategic Information Systems* 29 (2).
- [21] Haffke, I., Kalgovas, B.J., Benlian, A., 2016. The Role of the CIO and the CDO in an Organization’s Digital Transformation.
- [22] Li, L., Su, F., Zhang, W., Mao, J.-Y., 2018. Digital transformation by SME entrepreneurs: A capability perspective. *Info Systems J* 28 (6), 1129–1157.
- [23] Ohain, B.P. (Ed.), 2019. *Leader Attributes for Successful Digital Transformation*.
- [24] Soh, C., Yeow, A., Goh, Q., Hansen, R., 2019. Digital Transformation: Of Paradoxical Tensions and Managerial Responses.
- [25] Yeow, A., Soh, C., Hansen, R., 2018. Aligning with new digital strategy: A dynamic capabilities approach. *The Journal of Strategic Information Systems* 27 (1), 43–58.
- [26] Correani, A., Massis, A. de, Frattini, F., Petruzzelli, A.M., Natalicchio, A., 2020. Implementing a Digital Strategy: Learning from the Experience of Three Digital Transformation Projects. *California Management Review* 62 (4), 37–56.
- [27] Eden, R., Jones, A.B., Casey, V., Draheim, M., 2019. Digital transformation requires workforce transformation. *MIS Quarterly Executive* 18 (1).
- [28] Gurbaxani, V., Dunkle, D., 2019. Gearing Up For Successful Digital Transformation. *MISQ* 18 (3), 209–220.

- [29] Hansen, A.M., Kraemmergaard, P., Mathiassen, L., 2011. Rapid Adaptation in Digital Transformation: A Participatory Process for Engaging IS and Business Leaders. *MIS Quarterly Executive* 10 (4), 175–185.
- [30] Heavin, C., Power, D.J., 2018. Challenges for digital transformation – towards a conceptual decision support guide for managers. *Journal of Decision Systems* 27 (1), 38–45.
- [31] Lindner, D., Ludwig, T., Amberg, M., 2018. Arbeit 4.0 – Konzepte für eine neue Arbeitsgestaltung in KMU. *HMD* 55, 1065–1085.
- [32] Matt, C., Hess, T., Benlian, A., 2015. Digital Transformation Strategies. *Bus Inf Syst Eng* 57 (5), 339–343.
- [33] Reijnen, C., Overbeek, S., Wijers, G.M., Sprokholt, A., Haijenga, F., Brinkkemper, S., 2018. A Shared Vision for Digital Transformation: Codification of The Operating Model Canvas Approach.
- [34] Schoemaker, P.J.H., Heaton, S., Teece, D., 2018. Innovation, Dynamic Capabilities, and Leadership. *California Management Review* 61 (1), 15–42.
- [35] Sebastian, I., Ross, J., Beath, C., Mocker, M., Moloney, K., Fonstad, N., 2017. How big old companies navigate digital transformation. *MIS Quarterly Executive* 16 (3), 197–213.
- [36] Shaughnessy, H., 2018. Creating digital transformation: strategies and steps. *SL* 46 (2), 19–25.
- [37] Singh, A., Klarner, P., Hess, T., 2020. How do chief digital officers pursue digital transformation activities? The role of organization design parameters. *Long Range Planning* 53 (3).
- [38] Solberg, E., Traavik, L.E.M., Wong, S.I., 2020. Digital Mindsets: Recognizing and Leveraging Individual Beliefs for Digital Transformation. *California Management Review* 62 (4), 105–124.
- [39] Berghaus, S., Back, A., 2016. Gestaltungsbereiche der Digitalen Transformation von Unternehmen: Entwicklung eines Reifegradmodells. *Die Unternehmung* 70 (2), 98–123.
- [40] Gimpel, H., Hosseini, S., Huber, R.X.R., Probst, L., Röglinger, M., Faisst, U., 2018. Structuring Digital Transformation: A Framework of Action Fields and its Application at ZEISS. *J. Inf. Technol. Theory Appl.* 19 (1), 31–54.
- [41] Horlacher, A., Hess, T., 2016 - 2016. What Does a Chief Digital Officer Do? Managerial Tasks and Roles of a New C-Level Position in the Context of Digital Transformation, in: 2016 49th Hawaii International Conference on System Sciences (HICSS). 2016 49th Hawaii International Conference on System Sciences (HICSS), Koloa, HI, USA. 05.01.2016 - 08.01.2016. IEEE, pp. 5126–5135.
- [42] North, K., Aramburu, N., Lorenzo, O.J., 2020. Promoting digitally enabled growth in SMEs: a framework proposal. *JEIM* 33 (1), 238–262.
- [43] Poethke, U., Klasmeier, K.N., Diebig, M., Hartmann, N., Rowold, J., 2019. Entwicklung eines Fragebogens zur Erfassung zentraler Merkmale der Arbeit 4.0. *Zeitschrift für Arbeits- und Organisationspsychologie A&O* 63 (3), 129–151.
- [44] Baumöl, U., Bockschecker, A., 2018. Steuerung im Zeitalter der Digitalisierung mit dem Digital Business Management-Modell. *CON* 30 (5), 4–11.
- [45] Hess, T., Barthel, P., 2017. Wieviel digitale Transformation steckt im Informationsmanagement? Zum Zusammenspiel eines etablierten und eines neuen Managementkonzepts. *HMD* 54 (3), 313–323.
- [46] Mayer, J.H., Eßwein, M., Hornung, K., Steigner, M., 2019. The MENSCH in the Digital Age - Are next-generation managers triggering basic changes? *CON* 31 (5), 57–63.
- [47] Reinhard, H., Rentz, R., Sommerfeld, T., 2020. Digitalisierung steuerbar machen. *Control Manag Rev* 64 (2), 46–51.
- [48] Stöger, R., 2017. Umsetzung der Digitalisierung. *zfo-zeitschrift für organisationsentwicklung* 1.
- [49] Walchshofer, M., Riedl, R., 2017. Der Chief Digital Officer (CDO): Eine empirische Untersuchung. *HMD* 54 (3), 324–337.

- [50] Ameln, F. von, Wimmer, R., 2016. Neue Arbeitswelt, Führung und organisationaler Wandel. *Gr Interakt Org* 47 (1), 11–21.
- [51] Bendel, A., Latniak, E., 2020. Soziotechnisch – agil – lean: Konzepte und Vorgehensweisen für Arbeits- und Organisationsgestaltung in Digitalisierungsprozessen. *Gr Interakt Org* 51 (3), 285–297.
- [52] Boes, A., 2017. Qualifizieren für das Arbeiten im globalen Informationsraum. *WSI* 70 (2), 155–157.
- [53] Cichosz, M., Wallenburg, C.M., Knemeyer, A.M., 2020. Digital transformation at logistics service providers: barriers, success factors and leading practices. *IJLM* 31 (2), 209–238.
- [54] Fitzgerald, M., Kruschwitz, N., Bonnet, D., Welch, M., 2013. Embracing Digital Technology: A New Strategic Imperative. *MIT Sloan Management Review*, Massachusetts.
- [55] Frank, M., Koldewey, C., Rabe, M., Dumitrescu, R., Gausemeier, J., Kühn, A., 2018. Smart Services – Konzept einer neuen Marktleistung. *ZWF* 113 (5), 306–311.
- [56] Gergs, H.-J., 2019. Agilität und Organisationsentwicklung – Ziemlich beste Freunde? *Gr Interakt Org* 50 (2), 101–110.
- [57] Harvard Business Review (Hrsg.), 2016. What is holding back the digital Revolution? Copyright © 2016 Harvard Business School Publishing. A Harvard Business Review Analytic Services Report, 1–8.
- [58] Ivanov, D., Tang, C.S., Dolgui, A., Battini, D., Das, A., 2020. Researchers' perspectives on Industry 4.0: multi-disciplinary analysis and opportunities for operations management. *International Journal of Production Research* 53 (8), 1–24.
- [59] Peillon, S., Dubruc, N., 2019. Barriers to digital servitization in French manufacturing SMEs. *Procedia CIRP* 83 (1), 146–150.
- [60] Gebhardt, J., Grimm, A., Neugebauer, L.M., 2015. Entwicklungen 4.0–Ausblicke auf zukünftige Anforderungen an und Auswirkungen auf Arbeit und Ausbildung. *Journal of Technical Education (JOTED)* 3 (2), 45–61.
- [61] Hoe, S.L., 2019. Digitalization in practice: the fifth discipline advantage. *TLO* 27 (1), 54–64.
- [62] Issa, A., Hatiboglu, B., Bildstein, A., Bauernhansl, T., 2018. Industrie 4.0 roadmap: Framework for digital transformation based on the concepts of capability maturity and alignment. *Procedia CIRP* 72, 973–978.
- [63] Lammers, T., Tomidei, L., Trianni, A., 2019 - 2019. Towards a Novel Framework of Barriers and Drivers for Digital Transformation in Industrial Supply Chains, in: 2019 Portland International Conference on Management of Engineering and Technology (PICMET). 2019 Portland International Conference on Management of Engineering and Technology (PICMET), Portland, OR, USA. 25.08.2019 - 29.08.2019. IEEE, pp. 1–6.
- [64] Leipzig, T. von, Gamp, M., Manz, D., Schöttle, K., Ohlhausen, P., Oosthuizen, G., Palm, D., Leipzig, K. von, 2017. Initialising Customer-orientated Digital Transformation in Enterprises. *Procedia Manufacturing* 8, 517–524.
- [65] Mielli, F., Bulanda, N., 2019 - 2019. Digital Transformation: Why Projects Fail, Potential Best Practices and Successful Initiatives, in: 2019 IEEE-IAS/PCA Cement Industry Conference (IAS/PCA). 2019 IEEE-IAS/PCA Cement Industry Conference (IAS/PCA), St Louis, MO, USA. 28.04.2019 - 02.05.2019. IEEE, pp. 1–6.
- [66] Rautenbach, W.J., Kock, I.d., Jooste, J.L., 2019 - 2019. The development of a conceptual model for enabling a value-adding digital transformation: A conceptual model that aids organisations in the digital transformation process, in: 2019 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC). 2019 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), Valbonne Sophia-Antipolis, France. 17.06.2019 - 19.06.2019. IEEE, pp. 1–10.
- [67] Rotzinger, J., 2017. Unternehmen erfolgreich in (die) Zukunft führen. *Gr Interakt Org* 48 (4), 273–278.
- [68] Solis, B., Li, C., Szymanski, J., 2017. The 2017 state of digital transformation. *Altimeter Group* 1 (1), 1–33.
- [69] Wolf, M., Semm, A., Erfurth, C., 2018. Digital Transformation in Companies – Challenges and Success Factors, in: Hodoň, M., Eichler, G., Erfurth, C., Fahrnberger, G. (Eds.), *Innovations for Community Services*, vol. 863. Springer International Publishing, Cham, pp. 178–193.

- [70] Yucel, S., 2018 - 2018. Modeling Digital Transformation Strategy, in: 2018 International Conference on Computational Science and Computational Intelligence (CSCI). 2018 International Conference on Computational Science and Computational Intelligence (CSCI), Las Vegas, NV, USA. 12.12.2018 - 14.12.2018. IEEE, pp. 221–226.
- [71] Fitzgerald, M., Kruschwitz, N., Bonnet, D., Welch, M., 2014. Embracing digital technology: A new strategic imperative. MIT sloan management review 55 (2), 1.
- [72] Warner, K.S.R., Wäger, M., 2019. Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. Long Range Planning 52 (3), 326–349.
- [73] Ulich, E., 2020. Arbeitspsychologie. vdf Hochschulverlag AG.
- [74] Schuh, G., Anderl, R., Gausemeier, J., Hompel, M. ten, Wahlster, W., 2017. Industrie 4.0 maturity index. Managing the digital transformation of companies. Munich: Herbert Utz.
- [75] Henke, M., Besenfelder, C., Kaczmarek, S., Hetterscheid, E., Schlüter, F. Dortmund management model—a contribution to digitalization in logistics and supply chain management, in: Proceedings of the 9th International Scientific Symposium on Logistics: ISSL, pp. 13–14.
- [76] Molina, K.-M., Kaiser, S., Widuckel, W., 2018. Kompetenzen der Zukunft-Arbeit 2030: als lernende Organisation wettbewerbsfähig bleiben. Haufe-Lexware.

Biography

Hanna Middendorf, M.A. (*1988) studied social science innovation research at the TU Dortmund and has worked as a research assistant at the Chair of Enterprise Logistics (LFO) since 2020.

Dipl.-Päd. Sandra Kaczmarek (*1986) studied educational science with a focus on vocational education at the TU Dortmund University and has worked as a research assistant at the Chair of Enterprise Logistics (LFO) and the Fraunhofer Institute for Material Flow and Logistics (IML) since 2014.

Dipl.-Log. Natalia Straub (*1978) studied logistics at the TU Dortmund and has worked as a Chief Engineer at the Chair of Enterprise Logistics (LFO) since 2011.

Alexander Kreyenborg, M. Sc. (*1988) studied automotive mechatronics at Munich University of Applied Sciences and industrial engineering at Münster University of Applied Sciences. Since 2016, he is research assistant at the TU Dortmund University at the Chair of Enterprise Logistics.

Maximilian Austerjost, M. Sc. (*1986) studied mechanical engineering with economics at the South Westphalia University of Applied Sciences in Meschede and the University of Paderborn. He has worked as a research assistant at the Chair of Enterprise Logistics (LFO) and the Fraunhofer Institute for Material Flow and Logistics (IML) since 2014.

Prof. Dr. Michael Henke (*1971) has been in the leadership of the Chair of Enterprise Logistics (LFO) and institute director of the Fraunhofer Institute of Material Flow and Logistics (IML) at the TU Dortmund University since 2013. He is also an adjunct professor for Supply Chain Management at the School of Business and Management at the Lappeenranta University of Technology in Finland since 2015.