Shaping Digital Sustainable Development in Chemical Companies

CHEM4CHEM® Whitepaper

Authors:	Dr. Wolfram Keller	Nadine Bette
	CHEM4CHEM®	CHEM4CHEM®
	wkeller@chem-4-chem.com	nbette@chem-4-chem.com

October 2019

chem-4-chem.com CHEM4CHEM CHEM4CHEM @Chem4C

Introduction

Germany's chemical industry has taken a leading role in Responsible Care (VCI, 2011) – nowadays referred to as Sustainable Development (Sachs, 2015) – since about 25 years. Digitalization, a second, steeply evolving megatrend, is not new either. However, its breakthrough in the chemical industry has begun only recently, marking the beginning of Digital Sustainable Development (RNE, 2018). An empiric survey among 60 chemists identifies some preconditions and obstacles for "Corporate Digital Sustainable Responsibility", the extended corporate governance (Werder, 2018), Digital Sustainable Development, the process to make this happen, and ultimately the desired Sustainable Development Goals (United Nations, 2015).

Progress of Sustainable Development in the chemical industry

The origin of sustainability is closely connected to major accidents, e.g. at Seveso (Kramer et al., 2019), Bhopal (Eckerman and Børsen, 2018), Houston Chemical Complex (U.S. Department of Labor, 1990) and Exxon Valdez (Cohen, 1995) in the 1970es and 1980es. In the mid 1980es the global chemical industry took counter action in response to these disasters and to gain back its ruined trustworthiness. Today, sustainability is subject of numerous multi stakeholder initiatives like Responsible Care (VCI, 2019, I, II; Delmas and Montiel, 2008; King and Lenox, 2000), Together for Sustainability (TfS, 2019), Chemie^3 (Chemie^3, 2019), Platform for Accelerating the Circular Economy (PACE, 2019) and Alliance to End Plastic Waste (AEPW, 2019), and an integral element of many big chemical companies' strategy (BASF, 2019; Clariant, 2019; Evonik, 2019; Linde, 2019; Wacker, 2019, I). In this decade chemists and chemical engineers have developed first technically *and* – at least partially - economically feasible industry scale approaches for product redesign, reuse, mechanical and chemical recycling (Werner & Mertz, 2016; Johnson, 2018; Stark, 2019; Stephan, 2019; Strathmann, 2019). The chemical industry is on a good way to achieve the desired Sustainable Development Goals and by 2050 likely able to be carbon neutral.

Progress of Digitalization in the chemical industry

Unlike Sustainable Development, digitalization in the chemical industry is in its early stages yet. Since about 5 to 10 years, bigger rather than mid-size chemical companies have begun to leverage ITC, electronics, and automotive industries' experience with digital technologies and applications (DECHEMA, 2016). Many of them have appointed Chief

Digital Officer(s) whose primary task it is to define and execute their company's digital transformation roadmap (Schmidt-Stein, 2018; Wacker, 2019, II; BusinessTech-Company, 2019, I to VI). Still, often the emphasis of the digital transformation roadmap is on technical aspects. True Corporate Digital Responsibility, CDR, needs to go far beyond, e.g. including compliance with legal obligations, digital ethics, interactions with society and chemical industry, and the enablement of employees for chemical industry 4.0 with its modified jobs and competences (Keller, 2018; BAVC, 2018; Lade, 2019).

Corporate Digital Sustainable Responsibility, a feasible composite?

What does it take chemical companies to exploit potential synergies between the two megatrends sustainability and digitalization when striving to fulfill their Sustainable Development Goals?

The authors have undertaken an empiric survey among 60 chemists in Germany's chemical industry to identify the relative importance of sustainability and digitalization by 2025. They look at mutual interdependencies and potentially missing competences required to pursue Digital Sustainable Development, DSD.

Participants represent different levels of education (Bachelor, Master, PhD), years on duty, company size (corporation, big, mid-size and small company) and management level (1 through 4). The survey is hypotheses based, with respondents indicating their degree of agreement with each proposed hypothesis, using a per cent scale.

The first hypothesis *"By 2025 Digitalization will play a major role for chemists and engineers"* achieves 83% level of agreement (sample size 56). The distribution of responses is surprisingly homogenous. There is no trend between the responses and the level of education, years on duty, company size, and management level.

78% level of agreement (sample size 56) is a clear indication that also *"Sustainability will play a major role by 2025 for chemists and engineers"*. The pattern of responses is almost identical with that of the role of digitalization by 2025.

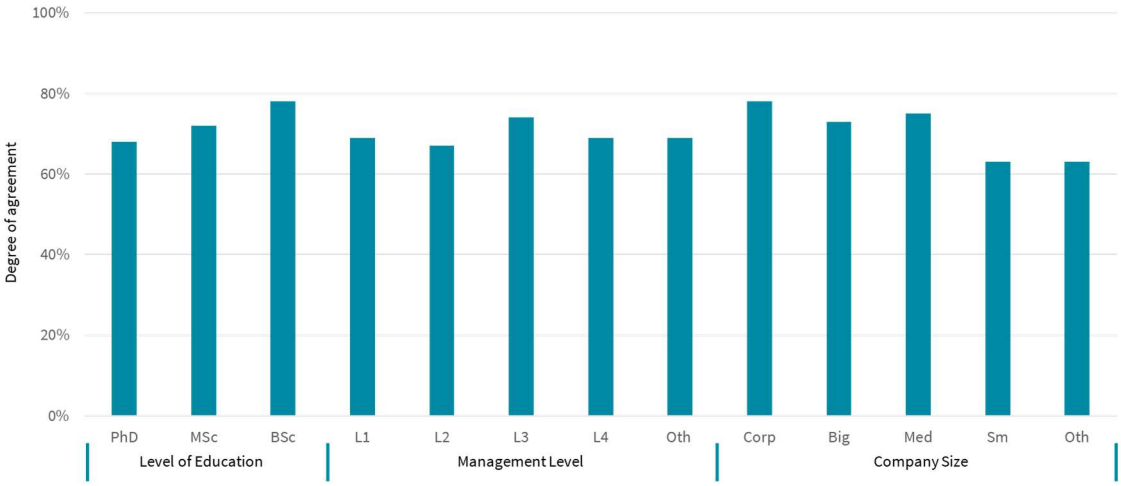

Figure 1: Degree of agreement to the hypothesis „Digitalization is a driver for Sustainable Development" depending on the level of education, management level and company size.

The average level of agreement that *"Digitalization is a driver for Sustainable Development"* scores at 70% (sample size 53, Figure 1). This view is very consistent within each and across all clusters. In addition, 53 data sets including values for each of the three hypotheses were sorted in declining order choosing *"Digitalization is a driver of sustainability"* as lead parameter, shown as solid line in Figure 2. The depending parameters *"importance of digitalization"* and *"importance of sustainability"* are displayed as radar charts underneath. The heterogeneity of the diagram corresponds well with poor correlation coefficients of -0.10 in case of digitalization and +0.07 regarding sustainability.

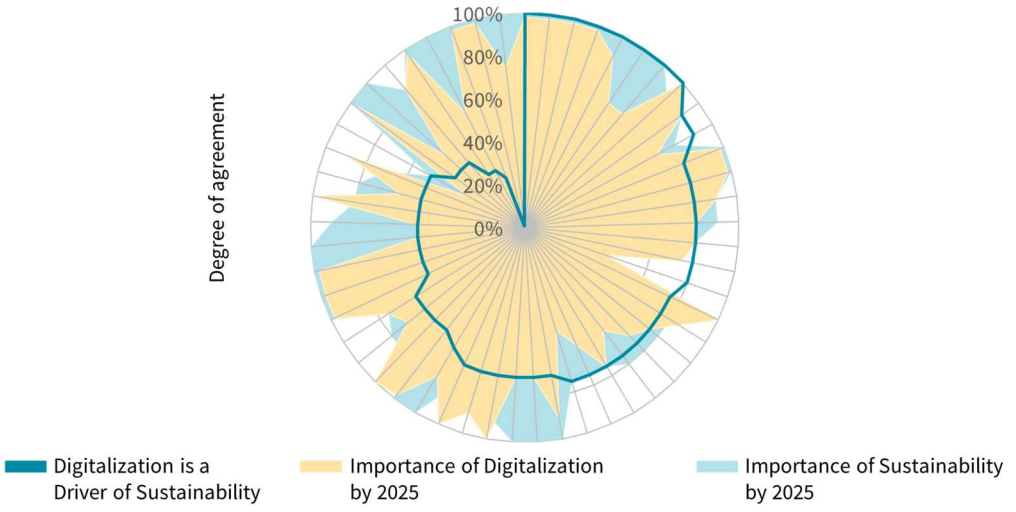

Figure 2: Lacking correlation between the ability of digitalization as a driver for sustainability and the importance of digitalization and sustainability by 2025.

To understand the full bandwidth of related comments from 100% euphoria to 100% skepticism, all comments made were classified in five clusters, business, mindset, responsibility, society, and technical. Within each cluster responses were distinguished by supporting and impeding notions. The number of comments in each (sub-)cluster was divided by the total number to calculate comments' relative frequency.

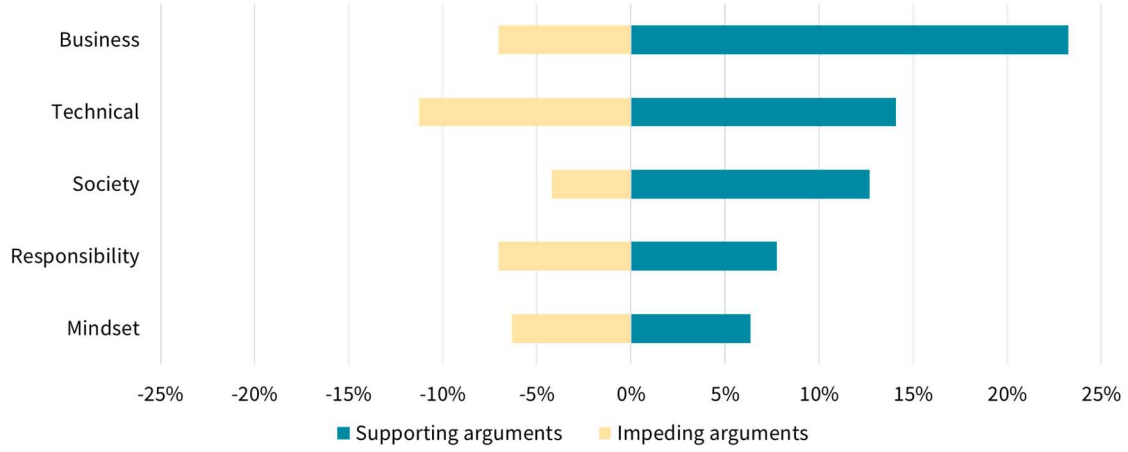

Figure 3: Hypothesis "Digitalization is a driver of sustainability".
Distribution of supporting and impeding arguments by cluster and overall

Business cluster: Key arguments that *"Digitalization is a driver of sustainability"* include the better control of sustainability related technical and management processes and energy management, all leading to higher technical and human resource efficiency and bottom-line improvements. Major concerns address data availability, format, integrity, and security and management decision making timeliness and effectiveness.

Technical cluster: On the positive side, benefits through big data and artificial intelligence to drive sustainable processes, products etc. dominate by far. Excessive energy consumption, high dependency on state-of-the-art IT infrastructure and the ability to handle giant quantities of data are the top concerns.

Society cluster: Respondents are – with few exceptions - aware of the driver role of politics, educational institutions, and the chemical industry in defining and providing boundary conditions for DSD. There is considerable skepticism that educational institutions assume sufficient responsibility by not including digitalization and sustainability comprehensively enough in their curricula.

Responsibility cluster: Respondents consider clear responsibilities instrumental for DSD. Only 20% see their company in charge, not a clear vote for "corporate responsibility". The lack of commitment to digitally enable sustainable chemical and management processes and management's hesitation to invest in the required training are the two main

concerns. 80% of respondents believe DSD responsibility is primarily with politics and educational organizations.

Mindset cluster: Only 12% of all comments address the attitude of managers and employees. Leadership by example and individual freedom to act are seen instrumental for DSD. The biggest concern addresses low willingness and readiness across all levels of the company, from shop floor to C-level, to cope with change associated with DSD.

In summary, regardless which role digitalization and sustainability will play by 2025, 58% of the participants (degree of agreement ≥ 67%) are strong believers that digitalization is a key enabler for DSD, 32% (agreement between 34% and 66%) have mixed feelings, and 9% (agreement ≤ 33%) see no or a limited driving role of digitalization.

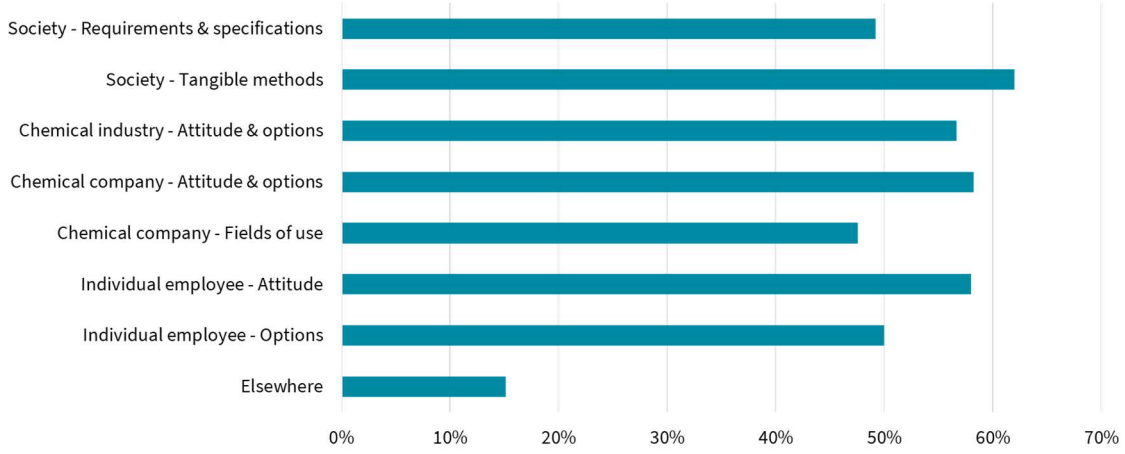

Figure 4: Hypothesis *"This specific Sustainable Development area represents the highest training need"*. Degree of agreement in % for each individual answer, not additive.

DSD is significantly affecting chemists' job profiles, required skill sets and training needs. Training needs in the context of digitalization (Keller, 2018; Gruß, 2018; Lade, 2019) and those addressing sustainability (Keller and Knoll, 2020; ILO 2019; Graf and Reuter, 2017; ILO and CEDEFOP, 2011) have been defined. Contrary to digitalization skills, respondents consistently claim (degree of agreement between 48% and 62%, Figure 4) that there is no single highest priority for sustainability related training. Instead training covering requirements, specifications, methods, applications, attitude and options to act for each area, society, company and individual chemist is required. 68% of the participants request their company to take primary responsibility for subject specific training in the context of Sustainable Development, somewhat is misfit with the low overall responsibility (20%).

Conclusions

By 2025 digitalization (83% agreement) and sustainability (78% agreement) will be even more instrumental elements of Sustainable Development in Germany's chemical industry than today, as the results from an empiric survey among 60 chemists suggest. 70% agreement to the hypothesis *"Digitalization is a driver of sustainability"* and the in-depth evaluation of respondents' comments reveal key input for Corporate Digital Sustainable Responsibility.

Firstly, there is *no quantitative correlation* between the importance of digitalization and sustainability by 2025 and the ability of digitalization to drive sustainability. Secondly, chemists have already an extensive repertoire of *ideas supporting* Corporate Digital Sustainable Responsibility and *counter arguments impeding it*. Thirdly, there are major concerns regarding scope and maturity of digital and social responsibility competences required for Sustainable Development.

A balanced *technical, people and society oriented* Corporate Digital Sustainable Responsibility is required to drive the process of Digital Sustainable Development which in turn helps to achieve Digital Sustainable Development Goals.

About the Authors

Dr. Wolfram Keller holds a diploma degree in Macromolecular Chemistry and a Ph.D. degree in Biochemistry from the Technical University Darmstadt. He spent 8 years in the chemical and pharmaceutical industries in Germany and Asia and 22 years as a business consultant all over the world.

In 2019 he founded the independent competence network CHEM4CHEM® (www.chem-4-chem.com). He regularly conducts studies on current topics in the chemical industry, gives lectures and publishes.

Nadine Bette received her master's degree in Chemistry from the TU Bergakademie Freiberg in 2012. In Freiberg, she also does her PhD in Physical Chemistry and studies Hydrotalcite-based Nickel catalysts for the methanation of CO2.

She joined CHEM4CHEM® as an intern to learn about the challenges and chances digitalization bears for the chemical industry. Since the start of CHEM4CHEM® in 2019, she supports various publications on digitization and sustainability.

References

EPW (2019): *Alliance to End Plastic Waste*, available at https://endplasticwaste.org/, accessed at 18 October 2019.

BASF (2019): *BASF-Bericht 2018*, available at https://bericht.basf.com/2018/de/serviceseiten/downloads/files/BASF_Bericht_2018.pdf, accessed at 18 October 2019.

BAVC (2018): *Mithalten durch Mitarbeiter*, available at https://www.chemie-arbeitgeber.de/digitalisierung/lernen-fuer-die-digitalisierung/, accessed at 18 October 2019.

BusinessTech-Company (2019): *Wie setzt der BASF CDO die Digitalisierung um?*, Chief-Digital-Officers.com, available at https://chief-digital-officers.com/de/wie-setzt-der-basf-cdo-die-digitalisierung-um/, accessed 18 October 2019.

BusinessTech-Company (2019): *Wie setzt der Henkel CDO die Digitalisierung um?*, Chief-Digital-Officers.com, available at https://chief-digital-officers.com/de/wie-setzt-der-henkel-cdo-die-digitalisierung-um/, accessed 18 October 2019.

BusinessTech-Company (2019): *Wie setzt der Bayer CDO die Digitalisierung um?*, Chief-Digital-Officers.com, available at https://chief-digital-officers.com/de/wie-setzt-der-bayer-cdo-die-digitalisierung-um/, accessed 18 October 2019.

BusinessTech-Company (2019): *Wie setzt der Merck CDO die Digitalisierung um?*, Chief-Digital-Officers.com, available at https://chief-digital-officers.com/de/wie-setzt-der-merck-cdo-die-digitalisierung-um/, accessed 18 October 2019.

BusinessTech-Company (2019): *Wie setzt der Linde CDO die Digitalisierung um?*, Chief-Digital-Officers.com, available at https://chief-digital-officers.com/de/wie-setzt-der-linde-cdo-die-digitalisierung-um/, accessed 18 October 2019.

BusinessTech-Company (2019): *Wie setzt der Covestro CDO die Digitalisierung um?*, Chief-Digital-Officers.com, available at https://chief-digital-officers.com/de/wie-setzt-der-covestro-cdo-die-digitalisierung-um/, accessed 18 October 2019.

Chemie^3 (2019): *Chemie^3 – Die Nachhaltigkeitsinitiative der deutschen Chemie*, available at https://www.chemiehoch3.de/home.html, accessed at 18 October 2019.

Clariant International AG (2019): *Integrierter Bericht 2018*, available at http://reports.clariant.com/2018/integrated-report/servicepages/downloads/files/integrierter_bericht_clariant_ar2018.pdf, accessed at 11 October 2019.

Cohen, M. J. (1995): Technological Disasters and Natural Resource Damage Assessment: An Evaluation of the Exxon Valdez Oil Spill, *Land Economics*, **71** (1), 65-82.

DECHEMA (2016): *Digitalisierung in der Chemieindustrie*, available at https://dechema.de/dechema_media/Downloads/Positionspapiere/whitepaper_digitalisierung_final-p-20003450.pdf, accessed at 18 October 2019.

Delmas, M., Montiel, I. (2008): The Diffusion of Voluntary International Management Standards: Responsible Care, ISO 9000, and ISO 14001 in the Chemical Industry, *Policy Studies Journal*, **36** (1), p. 65-93.

Eckerman, I., Børsen, T. (2018): Corporate and Governmental Responsibilities for Preventing Chemical Disasters: Lessons from Bhopal, *HYLE – International Journal for Philosophy of Chemistry*, *24*, p. 29-53.

Eskenazi, B., Warner, M., Brambilla, P., Signorini, S., Ames, J., Mocarelli, P. (2018): The Seveso accident: A look at 40 years of health research and beyond, *Environmental International*, **121** (1), p. 71-84.

Evonik Industries AG (2019), Nachhaltigkeitsbericht 2018: Zukunftsfähigkeit ist unser Geschäft, available at https://corporate.evonik.com/downloads/corporate%20responsibility/evonik_nachhaltigkeitsbericht_2018.pdf, accessed at 18 October 2019.

Graf, S., Reuter, K. (2017): *Greening der Berufe und nachhaltige Arbeitswelt: Auf dem Weg zu einer kohlenstoffarmen und ressourceneffizienten Wirtschaft*, Qualitative Studie des UnternehmensGrün e.V., available at https://www.gruene-arbeitswelt.de/images/PDFs/Studie_Greening-der-Berufe.pdf, accessed at 20 October 2019.

Gruß, A. (2018): Berufe 4.0 – neue Techniken erfordern neue Kompetenzen, CHEManager online, available at https://www.chemanager-online.com/themen/personal/berufe-40-neue-techniken-erfordern-neue-kompetenzen, accessed at 18 October 2019.

Johnson, J. (2018): *Ineos joins in PS recycling project*, Plastic News Europe, available at https://www.plasticsnewseurope.com/article/20180920/PNE/180929995/ineos-joins-in-ps-recycling-project, accessed at 18 October 2019.

Keller, W. (2018): Berufe 4.0 – Wie Chemiker und Ingenieure in der digitalen Chemie arbeiten, available at https://www.gdch.de/fileadmin/downloads/Netzwerk_und_Strukturen/Fachgruppen/Vereinigung_fuer_Chemie_und_Wirtschaft/whitepaper_initiative_berufe_4.0_2018.pdf, accessed at 18 October 2019.

Keller, W., Knoll, K. (2020): *Anforderungen und Kompetenzen für die neue, nachhaltige und digitale Arbeitswelt in der Chemie- und Pharmabranche*, in: Bertelsmann Stiftung (ed.), *CDR Booksprint*, 1st ed., Bertelsmann Verlag, Gütersloh.

King, A. A., Lenox, M. J. (2000): Industry Self-Regulation Without Sanctions: The Chemical Industry's Responsible Care Program, *Academy of Management Journal*, **43** (4), p. 698-716.

Kramer, P., Braun, M., Bendels, M. H. K. (2019): Der Chemieunfall von Seveso, *Zentralblatt für Arbeitsmedizin, Arbeitsschutz und Ergonomie*, **69** (5), p. 319-326.

Lade, O. (2019): *Digitalization in the Process Industries: Humans as Success Factor in Production*, Capgemini, available at https://www.capgemini.com/2019/10/digitalization-in-the-process-industries-humans-as-success-factor-in-production/, accessed at 18 October 2019.

Linde Group (2019): *Corporate Responsibility*, available at https://www.the-linde-group.com/de/corporate_responsibility/index.html, accessed at 11 October 2019.

Lloyd, C., Creson, D. L., D'Antonio, M. S. (1993): A Petrochemical Plant Disaster: Lessons for the Future, in: Allen, R. D., *Handbook of post-disaster interventions*, Select Press, Corte Madera, CA, p. 281.

PACE (2019): *Platform for Accelerating the Circular Economy*, available at https://www.acceleratecircularеconomy.org/, accessed at 18 October 2019.

Sachs, J. D. (2015): *The age of sustainable development*, 4th ed., Columbia University Press, New York, Chichester, West Sussex.

Schmidt-Stein, M. (2018): *Wacker Chemie: Internationale Digitalprojekte „nicht auf einen Schlag" ausrollen*, CDO Insight, available at https://www.cdo-insight.com/organisation/wacker-chemie-internationale-digitalprojekte-nicht-auf-einen-schlag-ausrollen-241/, accessed at 18 October 2019.

Stark, A. (2019): *Covestro entwickelt Konzept zur Wiederverwertung von Polycarbonat*, PROCESS, available at https://www.process.vogel.de/covestro-entwickelt-konzept-zur-wiederverwertung-von-polycarbonat-a-873245/?cmp=nl-98&uuid=5F934058-7AE2-42B1-8E2B83C6D6FAB5BE, accessed at 14 October 2019.

Stephan, D. (2019): *Naphta aus dem gelben Sack? – So kann Chemisches Recycling aus Plastikmüll Rohbenzin machen*, PROCESS, available at https://www.process.vogel.de/naphtha-aus-dem-gelben-sack-so-kann-chemisches-recycling-aus-plastikmuell-rohbenzin-machen-a-818828/, accessed at 15 October 2019.

Strathmann, S. (2019*)*: *Circular Economy – Grundlage einer nachhaltigen Verpackungsstrategie*, available at https://www.vci.de/ergaenzende-downloads/2019-02-15-vci-workshop-zirkulaere-wirtschaft-vortrag-05-strathmann-henkel.pdf, accessed at 11 September 2019.

TfS (2019): *Together for Sustainability*, available at https://tfs-initiative.com, accessed at 18 October 2019.

United Nations (2015): *Transforming our World: The 2030 Agenda for Sustainable Development*, available at https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20 Sustainable%20Development%20web.pdf, accessed at 20 October 2019.

U.S. Department of Labor (1990): *Phillips 66 Company Houston Chemical Complex Explosion and Fire: A Report to the President*, available at https://ncsp.tamu.edu/reports/phillips/first%20part.pdf, accessed at 18 October 2019.

Varma, R. Varma, D. R. (2005): The Bhopal Disaster of 1984, *Bulletin of Science, Technology & Society*, **25** (1), p. 37-45.

VCI (2019): *Responsible Care*, available at https://www.vci.de/nachhaltigkeit/responsible-care/uebersichtsseite.jsp, accessed at 11 October 2019.

VCI (2019): *Responsible-Care-Bericht 2018*, available at https://www.vci.de/vci/downloads-vci/publikation/responsible-care-bericht-2018.pdf, accessed at 18 October 2019.

Wacker Chemie AG (2019): *Nachhaltigkeitsbericht 2017/2018*, available at https://berichte.wacker.com/2018/nachhaltigkeitsbericht/serviceseiten/downloads/files/gesamt_wacker_csr1718.pdf, accessed at 18 October 2019.

Wacker Chemie AG (2019): *Taking Changes Together: Wacker Digital*, available at https://www.takingchancestogether.com/de/, accessed at 18 October 2019.

Werder, A. von (2018): Corporate Governance, in: *Gabler Wirtschaftslexikon*, Springer, Wiesbaden, available at https://wirtschaftslexikon.gabler.de/definition/corporate-governance-28617/version-367554, accessed at 20 October 2019.

Werner & Mertz (2016): *Weltneuheit: Werner & Mertz startet mit 100-Prozent HDPE-Recyclat*, available at https://werner-mertz.de/Pressecenter/Pressetexte/Detail_3776.html, accessed at 11 October 2019.

Williams, D. E., Treadaway G. (2009): Exxon and the Valdez accident: A failure in crisis communication, *Communication Studies*, **43** (1), p. 56-64.