Journal of Economics, Business & Organization Research

PROCEEDINGS OF THE THIRD ECONOMICS, BUSINESS AND ORGANIZATION RESEARCH (EBOR) CONFERENCE

ROME, ITALY, 2020

SUSTAINABILITY, DIGITAL TECHNOLOGIES AND FIRM'S PERFORMANCE: AN EMPIRICAL ANALYSIS

Grazia DICUONZO[1] Francesca DONOFRIO[2] Simona RANALDO[3] Vittorio DELL'ATTI[4]

1 Department of Economics, Management and Business Law - University of Bari Aldo Moro, grazia.dicuonzo@uniba.it

2 Department of Economics, Management and Business Law - University of Bari Aldo Moro, francesca.donofrio@uniba.it

3 Department of Economics, Management and Business Law - University of Bari Aldo Moro, simona.ranaldo@uniba.it

4 Department of Economics, Management and Business Law - University of Bari Aldo Moro, vittorio.dellatti@uniba.it

Abstract

The progressive spread of technological innovation has led to a radical transformation of corporate business models. The phenomenon known as the fourth industrial revolution through the application of digital innovations to processes, products and resources has improved the efficiency of business processes. Among the advantages related to the adoption of new technologies there is also the improvement of corporate sustainability, ensuring savings in time, costs and reduction of errors. The digitalization of processes therefore represents the tool through which to ensure not only the improvement of economic, financial and equity performance, but also of corporate sustainability. This paper intends to investigate the relationship between sustainability, technological innovation and firm's performance, trying to understand if companies more oriented towards sustainability are also the most innovative and the best performing. To test the relationship, we intend to estimate a regression model for the panel data considering a time horizon of 5 years with reference to a sample of listed companies operating in the public services sector in Europe and the United States. Since digitalization favors the cost-effectiveness and sustainability of corporate performance, we believe that the most innovative companies are those that have the best results in terms of profitability and sustainability. Since sustainability can be fostered by a higher level of digitization, it also favors the improvement of company performance, we expect that the most sustainable companies are also the most digitized and best performing.

Keywords: Processes Digitalization, Digital Technologies, Sustainability, Firm's Performance.

©EBOR Academy Ltd. 2020
Appolloni et al. (eds). Proceedings of the Third EBOR Conference 2020, pp. 309-324, 2020.

1. INTRODUCTION

The fourth industrial revolution brought about profound changes in the way of doing business (Jovanović et al., 2018). The continuous evolution and growing competitiveness of the markets has made the use of new digital technologies increasingly indispensable, exploiting the development of a valid competitive advantage (Pappas et al., 2018). Blockchain, Big Data, the Internet of Things, artificial intelligence are the tools available to companies to improve not only economic, but also social and environmental performance. Improving corporate performance is one of the main objectives of companies and, in this process, technology plays a crucial role, influencing the performance of economic, financial and equity performances (Dehning & Richardson, 2002; Mahmood & Mann, 2000; Wade & Hulland, 2004). In this regard, several studies have highlighted a positive relationship between thimble technologies and economic performance (Bughin et al., 2017; Croitoru, 2012), showing that greater innovation corresponds to higher corporate profitability (Geroski et al., 1993). In fact, the application of technological innovations to company processes allows obtaining advantages in terms of improving productivity, reducing product time-to-market as well as increasing process flexibility (BarNir et al., 2003). The latter aspect is particularly important, guaranteeing the company the ability to constantly adapt to changes in the context in which it operates (P. Keen & Williams, 2013). Furthermore, the instrumentality of digitization for the development of sustainable business models is recognized in the literature (Maffei et al., 2019; van der Velden, 2018). The digital transformation, in fact, favours the use of renewable energies, the saving of times, costs and the constant monitoring of energy consumption (Demartini et al., 2019). However, in order to take advantage of all the advantages associated with digitization, the company's ability to implement a real restructuring of business processes is fundamental (Abrell et al., 2016), transforming the existing business model with a more digital model (Henfridsson et al., 2014; Nylén & Holmström, 2015). The prevailing literature therefore states that technological innovation and the digitalization of processes favor the pursuit of sustainability objectives and increase corporate value through improved performance. This work aims to deepen the relationship between sustainability, technological innovation and business performance, trying to understand if companies more oriented towards sustainability are also the most innovative and the best performing. To test this relationship, we considered a sample of companies listed in the utilities sector in Europe and the United States, stimulating a regression model for the panel data considering a 5-year time horizon. Since sustainability can be fostered by a higher level of digitization, it also favours the improvement of company

©EBOR Academy Ltd. 2020
Appolloni et al. (eds). Proceedings of the Third EBOR Conference 2020, pp. 309-324, 2020.

performance, we expect that the most sustainable companies are also the most digitized and best performing. This study contributes to existing literature by improving the understanding of the variables that influence corporate sustainability, providing empirical evidence of how new digital technologies affect corporate sustainability performance.

The paper is structured as follows: section 2 presents the literature review; section 3 describes the research methodology; section 4 presents the results; section 5 discusses the results and finally section 6 presents the conclusions, the implications and the future research lines.

2. LITERATURE REVIEW: SUSTAINABILITY, DIGITAL TECHNOLOGIES AND FIRM'S PERFORMANCE

The phenomenon of the fourth industrial revolution, also known as Industry 4.0, is based on a concept of corporate strategy based on the application of digital technologies (Mosconi, 2015). This event has transformed every aspect of corporate life (Jovanović et al., 2018), making the adoption of technological innovation essential to continue competing in a competitive and constantly evolving market (Pappas et al., 2018).

In fact, technology allows companies to differentiate themselves from their competitors, differentiating their offer through the development of a solid competitive advantage (Tan & Teo, 2000). In order to benefit from the advantages inherent in new technologies, the transformation of the company business model (Abrell et al., 2016) from a non-digital one to a more digitized one (Henfridsson et al., 2014; Nylén & Holmström, 2015; Parida et al., 2019). The digital transformation currently underway requires a digitalization of the production system, greater automation of the processes and a link between the production sites that allows the automatic exchange of data and information (Almada-Lobo, 2016; Schlechtendahl et al., 2015). Therefore new technologies also influence business models with reference to communication along supply chains (Glova et al., 2014).

The investment in innovation allows companies to obtain an improvement in business processes thanks to the use of advanced digital devices that allow real-time control of all stages of production (Zammuto et al., 2007).

In this way, technology can increase corporate profitability (Kerin et al., 1992; Lieberman & Montgomery, 1988). Making economic, financial and property performance more efficient is one of the prerogatives of all corporate organizations and in achieving this goal new digital technologies are fundamental (Dehning & Richardson, 2002; Mahmood & Mann, 2000; Wade

©EBOR Academy Ltd. 2020

& Hulland, 2004). There is in fact a positive relationship between digital technologies and economic performance (Bughin et al., 2017; Croitoru, 2012). The most innovative companies are also those that have the greatest corporate profitability (Geroski et al., 1993).

Among the tools available to companies for improving their economy are Blockchain, Big Data, the Internet of Thing and artificial intelligence. These tools guarantee not only the improvement of economic performance, but also of social and environmental performance.

The issues of sustainability and the need to preserve the health of every living species are extremely important as well as current.

The industrial realities, due to the emissions of polluting substances due to the performance of the production activity, are among the main responsible for the environmental pollution. For this reason, the attention shown by companies towards these problems is increasing (Kotze et al., 2010). Indeed, a progressive adaptation of corporate culture to the principles of sustainability is being observed (Nowak et al., 2011). To implement this transformation, the management of business processes (BPM) must include a dimension of environmental sustainability within it (Nowak & Leymann, 2013; Reijers & Liman Mansar, 2005; Seidel et al., 2011), thus assuming the green BPM configuration (Maciel, 2017; Seidel et al., 2011; Stolze et al., 2012).

Green BPM ensures the efficiency of business processes, taking care not only of factors such as costs, quality, time, flexibility but also by looking at the ecological dimension. The aim is to reduce the environmental impact of company processes, through the use of sustainable or renewable resources, the reduction of energy or water wastes and carbon emissions according to an efficient use of resources (C. Cappiello et al., 2013; Recker et al., 2012).

Digital technologies are considered instrumental to sustainable development (van der Velden, 2018), guaranteeing the improvement of productivity, the reduction of the time-to-market of the product and increasing the flexibility of the production process in its entirety (BarNir et al., 2003). If we consider that companies operate in complex and continually perturbed environments, production flexibility ensures that the company can adapt quickly to changes in the scenario (P. Keen & Williams, 2013).

The digital transformation also favours the use of renewable energies, the saving of times, costs and the constant monitoring of energy consumption (Demartini et al., 2019).

In this sense, digitalization facilitates the development of sustainable business models which make the company more profitable (Maffei et al., 2019; van der Velden, 2018). It is an

©EBOR Academy Ltd. 2020

innovative business model (BMI), where digitalization is the tool that promotes business sustainability (Maffei et al., 2019). In line with the previous literature, the following hypothesis is suggested:

H1) Is there a positive relationship between the digitalization of business processes and sustainability?

3. RESEARCH METHOD

3.1. Sample and Data Collection

The analysis focuses on the utilities sector, with a focus on Europe and the United States. We have chosen to focus on the utilities sector as its attributes and responsibilities in society contribute to economic growth by offering goods and services (European Commission, 2019b, 2019a). In addition, as digital transformation is a core of the many companies' strategy, organizations need to be remodelled and reinvented to adapt to new ecosystems, to continue to create value and successfully address new business challenges. The digital age is asking companies to transform, and utilities are no exception. Given the potential of digital tools to achieve operational excellence and value creation, business units may be tempted to implement expensive digital solutions and beat the clock (Altran, 2019).

The universe of utility companies consists of 575 listed utilities. The original sample was cleaned up of any missing values, obtaining a final sample of 118 companies from European and US geographies in 2014-2018.

To answer the research question, we have created a five-year panel dataset (from 2014 to 2018, the last year available in our data sources). These longitudinal data have "observations on the same units in different time periods". A panel dataset has multiple entities, each of which has repeated measurements over different time periods. Panel data can have individual (group) effects, temporal effects, or both, which are analyzed using fixed-effect and/or random patterns. Data on the relationship between digitization, performance and sustainability comes from the Refinitiv database (formerly Thomson Reuters Asset4).

4. ANALYSIS

In the next section we intend to study the relationship between sustainability, digitalization and performance, through an econometric analysis involving panel data to control the distortion from omitted / unobserved variables.

©EBOR Academy Ltd. 2020

The analysis was carried out with the aid of the STATA software. Using the panel data technique, we can check some omitted variables without observing them and get information on changes in the dependent variable over time.

Furthermore, on the one hand, we can check the omitted variables which differ between the cases, but which are constant over time (fixed effects). On the other hand, we can also check the omitted variables which can be constant over time or vary over time (random effects). More specifically, the estimated model is as follows:

$$Y_{i,t} = \beta_0 + \beta_1 X_{i,t} + \alpha_i + u_{i,t}$$

In the model, the subscripts *i* and *t* represent ID company and period (year), respectively. The dependent variable ($Y_{i,t}$) is the *ESG Score*; β_0 is the constant and $X_{i,t}$ refers to a vector of independent variables.

4.1. Dependent Variable

In order to verify our research hypothesis, we have selected Refinitiv's ESG score dependent variable, which summarizes in itself data on environmental, social and business governance. More precisely, the overall ESG score is expressed as an arithmetic mean of the three scores: social, environmental and corporate governance. Its percentage value varies between 0 and 100.

The first dimension represented by environmental performance measures a company's ability to minimize environmental emissions and efficiently use natural resources in its processes.

As for social performance, they measure a company's ability to promote ethical values and build trust in its workforce, respect human rights, respect business ethics and create value-added products and services.

Finally, the area of corporate governance performance refers to the ability of the company to act in the interests of its shareholders through business management systems and processes. The latter is expressed in the structure, functions, roles and responsibilities of the board of directors and business committees, CSR policies, compensation policy, etc ...

©EBOR Academy Ltd. 2020

4.2. Independent Variables

To test our hypotheses, we used data on environmental innovation performance (environmental innovation score) from Asset4 as well as the traditional ROE (return on equity) ROA (return on assets) and ROI (return on investment) performance variables.

The score of the category of environmental innovation reflects the ability of a company to reduce environmental costs and burdens for its customers, thus creating new market opportunities through new environmental technologies and processes or eco-designed products. Environmental performance measures a company's ability to reduce environmental emissions, to efficiently use natural resources in production processes and to support research and development of eco-efficient products and services.

The independent variables included in our econometric models are the environmental innovation score, the CSR strategy and the guidelines for GRI reports, emissions score, the presence of a committee for sustainability, research development, return on assets, return on equity and return on invested capital.

To avoid model specification errors, we check for additional variables that could affect the ESG score. In line with existing literature, we used Size as a control variable.

Table 1 shows a summary of the measurement of all variables.

Table 1. - Variable description

Independent Variable	Variable code	Variable description
Environmental Innovation Score	Env_Inn_Sco	Environmental innovation category score reflects a company's capacity to reduce the environmental costs and burdens for its customers, and thereby creating new market opportunities through new environmental technologies and processes or eco-designed products.
CSR Strategy Score	CSR_Strategy	CSR Strategy Score reflects a company’s practices to communicate that it incorporates the economic (financial), social and environmental dimensions in its day-to-day decision-making processes.

©EBOR Academy Ltd. 2020
Appolloni et al. (eds). Proceedings of the Third EBOR Conference 2020, pp. 309-324, 2020.

GRI Report Guidelines	GRI_Guid	Is the company's CSR report published in accordance with the GRI guidelines?
Emission Score	Ems_score	Emission category score measures a company's commitment and effectiveness towards reducing environmental emission in the production and operational processes.
Sustainability committee	Sust_committee	Does the company have a CSR sustainability committee?
Research and development sales	R&D/sales	Profitability ratio given by the ratio between research and development expenses on net sales or revenues. Research and Development expense represents all direct and indirect costs related to the creation and development of new processes, techniques, applications and products with commercial possibilities.
Return on Investment	ROI	ROI (Return on Investments) represents the profitability of investments. It is given by the ratio between operating result and operating net invested capital.
Control variable	**Variable code**	**Variable description**
Total Assets	TA	Total Assets represent the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets.

4.3. Results and Discussion

The following table shows descriptive statistics for dependent and independent variables. The descriptive statistics table includes the minimum, maximum, average and standard deviation.

The average level of ESG performance (ESG SCORE) of the companies analyzed is 57,67%, with a maximum of 92,76%. This reveals that the sustainability performance of

©EBOR Academy Ltd. 2020

companies for the 2014-2018 period has been very satisfactory by the standards of the definition of the score.

Similarly, the level of the environmental innovation score reaches an average value (52.63%) and the maximum value is 99.4%, suggesting that many companies analyzed uses technologies to increase their level of sustainability. In addition, the CSR strategy also has an average value of 70%, as the score emission variable shows a positive trend (61%).

The two dummy variables included in the model are: GRI Report Guidelines and Sustainability committee. In both cases the average values are positive and tending to 100%. More specifically, in the first case the average value is 70% and in the second case 67%. The R&D/sales variable, it has an average value of 0.28%. Finally, as regards the performance variables, ROA shows an average value of 3.99 ROE of 7.11 and ROI of 5.55

Table 2. - Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Id	590	59.5	34,09	1	118
N_of_year	590	5	0	5	5
CSR_Strategy	488	70,279	24,270	0,5	99,76
ESG_score	488	57,674	17,858	14,01	92,76
Env_Inn_Sco	488	52,633	27,447	0,26	99,44
GRI_Guid	261	0,996	0,0619	0	1
Ems_score	488	61,36	27,64	0,79	99,71
Sust_committee	488	0,672	0,470	0	1
R&D/sales	102	0,28	0,31	0	1,41
ROI	584	5,55	10,65	-52,15	218,21
LnTA	586	16,38456	1,749009	11,64702	21,64297

The following table reports the main results obtained from the empirical analysis. We specify that the comments that will follow the estimates (tab. 4) will concern only the model identified by the Hausman test. Linear regressions were launched, with fixed and random effects, considering the independent variables present in the data set and introducing solidity both for heteroskedasticity and for the correlation. In order to identify the model that best specified the phenomenon under investigation, we performed the Housman test and

©EBOR Academy Ltd. 2020

subsequently the Breusch-Pagan test. To this end, the same regressions were launched without robustness. First, the Hausman test was launched to understand whether the fixed effects model or the random effects model should be used by specification 2; the test, presenting a p-value of the chi-square greater than 10%, tells us to use the random effects model. Subsequently, the Breusch-Pagan test was performed which, also presenting a p-value lower than 10%, confirms that it must use the second specification (if the p-value had been greater than 10%, it would have been appropriate to use the pooled model). Ultimately, from the results obtained from the Breusch-Pagan test, it is necessary to use the second specification and, since the p-value of the Hausman test is greater than 10%, it is necessary to use the random effects model.

The random effects model assumes that the variation between entities is random and unrelated to the predictor or independent variables included in the model.

To verify the joint statistical significance of the temporal effects, for each regression performed the test $ yeardum was started from which, in relation to the resulting p values, it is possible to affirm that the null hypothesis can be accepted and therefore the temporal effects are always, in the regressions performed, jointly statistically significant.

Table 5 - Regression results

Model	(A) Pooled OLS	(B) Fixed Effects	(C) Random Effects
	Coefficient (Robust SE)	Coefficient (Robust SE)	Coefficient (Robust SE)
Env_Inn_Sco	0.846 (0.064)	0.122*** (0.032)	0.124*** (0.035)
GRI_Guid	16.45*** (5.039)	5.73*** (2.221)	8.24*** (2.31)
CSR_Strategy	0.039 (0.117)	0.089 (0.079)	0.075 (0.0577)
Ems_score	0,221*** (0.063)	0,265*** (0.087)	0.25*** (0.579)
Sust_committee	19.928*** (7,56)	Omitted	14.33** (6.58)
R&D/sales	-2.025 (1.70)	3.74 (3.66)	1.01 (2.11)

©EBOR Academy Ltd. 2020

ROI	0.069 (0.62)	0.099*** 0.039)	0.097*** (0.036)
LnTA	1.234 (1.55)	-0.696 (2.57)	1.31 (1.39)
Hausman test	4.46 (p-value = 0.9244)		
Breusch and Pagan test	41.41 (p-value = 0.000)		
Years	2014 - 2018	2014 - 2018	2014 - 2018
Temporal effects	Yes	Yes	Yes
Standard errors - grouped data	Yes	Yes	Yes
R-square	63,62%	46,70%	59,93%
*** = significant at 1% ** = significant at 5% * = significant at 10%			

Using the random effects model, most coefficients are statistically significant at 1%. The exceptions are the variables "CSR strategy", "R&D/sales" and the natural logarithm of the total activities which are not significant. Consequently, it can be said that most of the variables considered influence the dependent variable (Y) which, in our case, represents the ESG score.

In line with other studies (van der Velden, 2018), there is a positive impact of the environmental innovation score on ESG scores. In fact, one percentage point higher than the environmental innovation score causes a 0.124% increase in the ESG score. Reading the data, we can find positive confirmation of the theory that the presence of a sustainability committee improves the company's sensitivity to sustainability problems.

The regressor of the Guidelines for GRI reports is a dummy variable and therefore, if it assumes a value of one, the company is assumed to adopt the GRI guidelines, vice versa if it assumes a value of 0.

In line with this consideration, it can be said that the adoption of the GRI guidelines positively affects the ESG score, resulting in an increase of the same by 8.24%.

As regards the ROI (return on investment) regressor, it is statistically significant at 1%. Therefore, it is possible to affirm a positive relationship between sustainability (ESG score) and company performance. In other words, consistently with what has been stated in the literature, the companies of the sample examined that are more sustainable are also the best performing.

©EBOR Academy Ltd. 2020
Appolloni et al. (eds). Proceedings of the Third EBOR Conference 2020, pp. 309-324, 2020.

In order for a regression model to be satisfactory, the theory reminds us that R-sq must have values greater than 50%. Although not all regressors are statistically significant, both individually and jointly, the overall R-sq, i.e. the average between the R-sq in the groups and the R-sq in the groups, is equal to 59.93%.

Finally, analyzing the temporal effects, they were statistically significant together with 10% (p value: 0.1078) and consequently it is possible to deduce that they also influence the dependent variable.

5. CONCLUSION

This work originates from the limited number of contributions that explain the relationship between sustainability, innovation and corporate performance in the utilities sector, which has always been the focus of attention in the world of research for its contribution to economic growth, thanks to its attributes and responsibilities in society.

Corporate social responsibility, i.e. the attention of companies to social, environmental and governance issues has radically transformed the relationship between businesses and the environment, favouring the adoption of more sustainable production policies (Kotze et al., 2010). New technologies have also influenced business processes. In line with this consideration, many companies are transforming their policies, moving towards the development of a digital business strategy (Bharadwaj et al., 2013), as a key factor to achieve a competitive advantage on an ever dynamic market (Peter Keen & Williams, 2013).

In addition to promoting a competitive advantage, new technologies are instrumental to sustainable development (van der Velden 2018).

The efficient use of resources favoured by digitalization allows to reduce the environmental impact (Cinzia Cappiello et al., 2013; Recker et al., 2012).

It is precisely in this context that the new Business Process Management configuration is placed, called BPM green (Maciel, 2017).

Based on previous literature which claims that innovation as well as business performance play a key role in the company's sustainability performance, this study investigates the relationship between sustainability (ESG score), innovation and economic performance in a large sample of 118 companies listed in Europe and the United States for the period 2014-2018. On the one hand, the main results reveal that innovation and digitalization of business processes positively influence a company's ESG performance. On the other hand, corporate performance

©EBOR Academy Ltd. 2020

is also positively associated with sustainability performance. For this reason, the hypothesis that a company more perforating and open to the challenges of digitization is considered an ethically sustainable and environmentally friendly company is considered probable.

The relationship between ESG performance and company size is negative. This underlines that the adoption of sustainable policies and ecological business models does not depend on the size of the company, but on other variables, such as the decisions of the board of directors or group policies.

Our contribution provides market participants with information on how digitization will impact environmental sustainability issues. Furthermore, from the management point of view, our work suggests that managers pay more attention to digitization and innovation to better meet the needs of a constantly evolving market. Precisely in this sense, digitization must be considered as an opportunity for the company to obtain a competitive advantage, as well as a reputational advantage linked to the better management of environmental problems. To improve performance in terms of sustainability, it is important to digitize processes, reduce the use of renewable resources and produce environmentally sustainable products.

Our research opens up many future research lines. First of all, the analysis could be extended to a larger sample, considering different industrial sectors. Furthermore, we have not examined the types of potentially adoptable technological innovations, but future research could go in this direction.

References

Abrell, T., Pihlajamaa, M., Kanto, L., Vom Brocke, J., & Uebernickel, F. (2016). The role of users and customers in digital innovation: Insights from B2B manufacturing firms. *Information and Management*, *53*(3), 324–335. https://doi.org/10.1016/j.im.2015.12.005

Almada-Lobo, F. (2016). The Industry 4.0 revolution and the future of manufacturing execution systems (MES). *Journal of Innovation Management*, *3,* 16–21.

Altran. (2019). *Digitalization of Utilities Operations. Triggering Value Creation*.

BarNir, A., Gallaugher, J. M., & Auger, P. (2003). Business process digitization, strategy, and the impact of firm age and size: The case of the magazine publishing industry. *Journal of Business Venturing*, *18*(6), 789–814. https://doi.org/10.1016/S0883-9026(03)00030-2

Bharadwaj, A., El Sawyandhi, O. A., Pavlou, P. A., & Venkatraman, N. (2013). DIGITAL BUSINESS STRATEGY: TOWARD A NEXT GENERATION OF INSIGHTS. *MIS Quarterly*. https://doi.org/10.1615/TelecomRadEng.v76.i10.20

Bughin, J., Catlin, T., Hall, B., & Time, R. (2017). Improving Your Digital Intelligence. *MIT Sloan Management Review*.

Cappiello, C., Plebani, P., & Vitali, M. (2013). Energy-Aware Process Design Optimization.

©EBOR Academy Ltd. 2020

International Conference on Cloud and Green Computing, Karlsruhe, 451–458.

Cappiello, Cinzia, Plebani, P., & Vitali, M. (2013). Energy-aware process design optimization. *Proceedings - 2013 IEEE 3rd International Conference on Cloud and Green Computing, CGC 2013 and 2013 IEEE 3rd International Conference on Social Computing and Its Applications, SCA 2013*, *September*, 451–458. https://doi.org/10.1109/CGC.2013.77

Croitoru, A. (2012). Schumpeter, J.A., 1934 (2008), The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle, translated from the German by Redvers Opie, New Brunswick (U.S.A) and London (U.K.): Transaction Publishers. *Journal Of Comparative Research In Anthropology And Sociology*. https://doi.org/10.1080/00343404.2017.1278975

Dehning, B., & Richardson, V. J. (2002). Returns on Investments in Information Technology: A Research Synthesis. *SSRN Electronic Journal*, *March 2019*. https://doi.org/10.2139/ssrn.302139

Demartini, M., Evans, S., & Tonelli, F. (2019). Digitalization technologies for industrial sustainability. *Procedia Manufacturing*, *33*, 264–271. https://doi.org/10.1016/j.promfg.2019.04.032

European Commission. (2019a). *Digital Transformation in Transport, Construction, Energy, Government and Public Administration*.

European Commission. (2019b). *H2020 Water Innovations for Sustainable Impacts in Industries and Utilities*.

Geroski, P., Steve, M., & Van Reenen, J. (1993). The Profitability of Innovating Firms. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699. https://doi.org/10.1017/CBO9781107415324.004

Glova, J., Tomáš, S., & Viliam, V. (2014). Business Models for the Internet of Things Environment. *Procedia Economics and Finance*, *15*, 1122–29.

Henfridsson, O., Mathiassen, L., & Svahn, F. (2014). Managing technological change in the digital age: The role of architectural frames. *Journal of Information Technology*, *29*(1), 27–43. https://doi.org/10.1057/jit.2013.30

Jovanović, M., Dlačić, J., & Okanović, M. (2018). Digitalization and society's sustainable development – Measures and implications. *Zbornik Radova Ekonomskog Fakultet Au Rijeci*, *36*(2), 905–928. https://doi.org/10.18045/zbefri.2018.2.905

Keen, P., & Williams, R. (2013). Value Architectures for Digital Business: Beyond the Business Model. *Management Information Systems Quarterly*, *37*, 642–647.

Keen, Peter, & Williams, R. (2013). Value Architectures for Digital Business: Beyond the Business Mode. *Management Information Systems Research Center, University of Minnesota*, *37*(2), 643–647. https://doi.org/10.1017/CBO9781107415324.004

Kerin, R. A., Varadarajan, P. R., & Peterson, R. A. (1992). First-Mover Advantage: A Synthesis, Conceptual Framework, and Research Propositions. *Journal of Marketing*, *56*(4), 33. https://doi.org/10.2307/1251985

Kotze, D., Malan, H., Ellery, W., Samuels, I., & Saul, L. (2010). Assessment of the environmental condition, ecosystem service provision and sustainability of use of two wetlands in the Kamiesberg uplands. In *Wetland health and importance research programme*.

Lieberman, M. B., & Montgomery, D. B. (1988). *First-mover advantages* (Vol. 9, Issue 1 S).

©EBOR Academy Ltd. 2020

https://doi.org/10.1002/smj.4250090706

Maciel, J. C. (2017). The Core Capabilities of Green Business Process Management – A Literature Review. *International Conference on Wirtschatsinformatik*, 1526–1537. https://pdfs.semanticscholar.org/ff31/a48a204e85ff3d13d6c76edf5f7ae17f777d.pdf%0A http://www.wi2017.ch/de/proceedings

Maffei, A., Grahn, S., & Nuur, C. (2019). Characterization of the impact of digitalization on the adoption of sustainable business models in manufacturing. *Procedia CIRP*, *81*, 765–770. https://doi.org/10.1016/j.procir.2019.03.191

Mahmood, M. O. A., & Mann, G. J. (2000). *Special Issue : Impacts of Information Technology Investment on Organizational Performance*. *16*(4), 3–10.

Mosconi, F. (2015). *The new European industrial policy: Global competitiveness and the manufacturing renaissance*. London, England: Routledge.

Nowak, A., & Leymann, F. (2013). Green Business Process Patterns—Part II. *International Conference on Service-Oriented Computing and Applications, Kauai, HI, USA*, 168–173.

Nowak, A., Leymann, F., & Schumm, D. (2011). The Differences and Commonalities between Green and Conventional Business Process Management. *Proceedings of the International Conference on Cloud and Green Computing*. https://doi.org/10.1109/DASC.2011.105}

Nylén, D., & Holmström, J. (2015). Digital innovation strategy: A framework for diagnosing and improving digital product and service innovation. *Business Horizons*, *58*(1), 57–67. https://doi.org/10.1016/j.bushor.2014.09.001

Pappas, I. O., Mikalef, P., Giannakos, M. N., Krogstie, J., & Lekakos, G. (2018). Big data and business analytics ecosystems: paving the way towards digital transformation and sustainable societies. *Information Systems and E-Business Management*, *16*(3), 479–491. https://doi.org/10.1007/s10257-018-0377-z

Parida, V., Sjödin, D., & Reim, W. (2019). Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises. *Sustainability*, *11*(2). https://doi.org/10.3390/su11020391

Recker, J., Rosemann, M., Hjalmarsson, A., & Lind, M. (2012). Modeling and Analyzing the Carbon Footprint of Business Processes. In S. Berlin/Heidelberg. (Ed.), *Green Business Process Management: Towards the Sustainable Enterprise* (pp. 93–109). https://doi.org/10.1007/s35114-019-0177-4

Reijers, H. A., & Liman Mansar, S. (2005). Best practices in business process redesign: An overview and qualitative evaluation of successful redesign heuristics. *Omega*, *33*(4), 283–306. https://doi.org/10.1016/j.omega.2004.04.012

Schlechtendahl, J., Keinert, M., Kretschmer, F., Lechler, A., & Verl, A. (2015). Making existing production systems Industry 4.0-ready. *Production Engineering*, *9*, 143–148. https://doi.org/10.1007/ s11740-014-0586-3

Seidel, S., Brocke, J., & Recker, J. (2011). Call for action : investigating the role of business process management in green IS . *SIGGreen Pre-ICIS Workshop : Information Systems and Environmentally Sustai?Nable Development*, *11*(2011). http://eprints.qut.edu.au/41450/

Stolze, C., Semmler, G., & Thomas, O. (2012). Sustainability in business process management research - a literature review. *18th Americas Conference on Information Systems 2012, AMCIS 2012*, *6*, 4343–4352.

©EBOR Academy Ltd. 2020

Tan, M., & Teo, T. S. H. (2000). Factors Influencing the Adoption of Internet Banking. *Journal of the Association for Information Systems*, *1*(1), 1–44. https://doi.org/10.1016/j.elerap.2008.11.006

van der Velden, M. (2018). Digitalisation and the UN Sustainable Development Goals: What role for design. *Interaction Design and Architecture(S)*, *37*, 160–174.

Wade, M., & Hulland, J. (2004). Review: The Resource-Based View and information systems research: Review, Extension, and Suggestions for Future Research. *MIS Quarterly: Management Information Systems*, *28*(1), 107–142. https://doi.org/10.2307/25148626

Zammuto, R. F., Griffith, T. L., Majchrzak, A., Dougherty, D. J., & Faraj, S. (2007). Information technology and the changing fabric of organization. *Organization Science*, *18*(5), 749–762. https://doi.org/10.1287/orsc.1070.0307

©EBOR Academy Ltd. 2020