Literature Review

Technical Report

Digital Transformation Characterization

Initial Literature Review

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Abstract

Digital Transformation (DT) is a disruption phenomenon with an increasing interest and a knowledge body in accelerated expansion. This brings new challenges and opportunities. However, there is still a lack of converging ideas, definitions, approaches and practical experiences for actual DT planning, implementation and post-adoption considerations. This technical report explores available DT literature reviews as a tertiary study. The main goal is to characterize the *state-of-the-art* in DT area and to outline its corresponding main definitions, concepts, characteristics, gaps, research opportunities and practical challenges. From the set of returned papers, the selected reviews were published since year 2016, what can indicate DT as a recent area or theme of investigation. Multiple definitions were identified and the reviews themselves report a lack of consensus or a standard definition. A variety of research areas, themes and business/industry fields were pointed out involved in DT, which indicates a complementary and interdisciplinary aspect of this phenomenon. At the end, there are many research opportunities to support organizations in performing a DT successful project with a technological view aligned to strategic, innovative and educational aspects.

Resumo

A Transformação Digital (TD) é um fenômeno de disrupção com crescente interesse e um corpo de conhecimento em expansão acelerada. Isso traz novos desafios e oportunidades. No entanto, ainda falta uma convergência de ideias, definições, abordagens e experiências práticas para o real planejamento, implementação e considerações de pós-adoção da TD. Este relatório técnico explora revisões da literatura disponíveis sobre TD através de um estudo terciário. O objetivo principal é caracterizar o estado da arte da área e delinear suas principais definições, conceitos, características, lacunas, oportunidades de pesquisa e desafios práticos. Do conjunto de artigos retornados pela busca, as revisões de literatura selecionadas foram publicadas desde o ano de 2016, o que pode indicar a TD como área ou tema de investigação recente. Múltiplas definições foram identificadas e as próprias revisões relatam uma falta de consenso ou de uma definição padrão. Foram apontadas diversas áreas de pesquisa, temas e setores de negócios/ industriais envolvidos na TD, o que indica um aspecto complementar e interdisciplinar desse fenômeno. Ao final, são inúmeras as oportunidades de pesquisa para apoiar as organizações na realização de um projeto de sucesso de TD com uma visão tecnológica alinhada a aspectos estratégicos, inovadores e educacionais.

Contents

Introduction to Digital Transformation Research

A disruption process of transformation has been pursued in different scenarios, economies and societies. At the same time it can be viewed as a technological innovation process and a social and cultural change without cross-countries' boundaries.

In this context, Digital Transformation (DT) is a current phenomenon with a growing interest both in academic and practitioners' points of view. It is a topic being discussed by prominent research centers, professional experts from consulting companies and across different businesses and industries. It is also a recent but emerging field with a wide range of interest and a multidisciplinary perspective.

As an emerging field, the body of literature still provides limited value in terms of representative case study examples that practitioners can actually benefit from (Ivančić et al., 2019)[1]. This literature is still nascent in domains and many research gaps remain (Parida et al., 2019)[2].

This Report explores the DT phenomenon in order to characterize its *state-of-the-art* providing an overview of the DT area considering its main characteristics, research topics and gaps. Therefore, a literature review was performed as a tertiary study[3]. Considering it as a wide area of interest and with diverse contributions, this study can be considered a first effort in order to characterize DT in a general and holistic way. Therefore, the key themes explored were: (1) "*What are the existing DT literature reviews and consequently*

DT primary studies and references most cited?"; (2) "*Which individuals and institutions are involved in DT research in academic area*"; (3) "*What research and practice topics are being addressed?*"; and (4) "*What are the main challenges, limitations or future research opportunities of current DT research?*"

In order to answer these questions, a literature review was performed following a well-defined sequence of steps as described in its research protocol (review planning phase) and review execution – Sections I and II. Sections III and IV characterize the DT phenomenon by addressing the proposed questions. This technical report describes raw data extracted from the identified reviews and draws some initial analysis and conclusions, pointing some challenges, research gaps and future opportunities to be investigated.

Summarizing, it is a topic which deserves attention of academic, industry, government and society as a whole. It is an urgent need that the members of these fields discuss DT in a collaborative and complementary way. It is a widely phenomenon with many different aspects which deals with emergence digital technologies applied in business model innovation, industry ecosystems transformations and provoking changes in mindsets and accelerating impact across society.

At the end, it was possible to analyze that there is no standard or consensus in the area, many challenges are still open and there are many research opportunities to support organizations in performing a DT successful project both in a technological view and aligned to strategic, innovative and educational aspects.

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[1] Ivančić, L., Vukšić, V. B., & Spremić, M. (2019). Mastering the digital transformation process: Business practices and lessons learned. Technology Innovation Management Review, 9(2), 36-50.
[2] Parida, V., Sjödin, D., & Reim, W. (2019). Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises. Sustainability 2019, 11, 391.
[3] It aims to identify other literature reviews (secondary studies) that present findings in DT area.

I.   Research Protocol

This section describes this literature review planning phase. The research protocol is presented describing its main goals, research questions, data source, selection criteria, selection process, and data extraction form.

Formulation of objectives and research questions (RQ)

The aim of this SLR is to characterize the *state-of-the-art* and *practice* in Digital Transformation phenomenon. The *practice* is limited by the analysis of case studies and real applications presented in papers selected in this study.

This goal involves gathering and analyzing scientific publications on digital transformation with the purpose of characterizing related approaches from a researcher's point-of-view in the academic and industrial context.

To this end, the main research question (RQ) in this SLR is:

"What is the overview of digital transformation area considering its main characteristics and research topics?"

Secondary questions (SRQs) were defined to guide the relevant information acquisition in order to identify aspects and concepts of different subtopics included in the main RQ that need to be more deeply analyzed.

Id	Research Questions
RQ	***"What is the overview of digital transformation area considering its main characteristics and research topics?"***
SRQ1	"What are the existing DT SLRs and consequently DT primary studies and references most cited?"
SRQ2	"Which individuals and institutions are involved in DT research in academic area?"
SRQ3	"What research and practice topics are being addressed?"
SRQ4	"What are the main challenges, limitations or future research opportunities of current DT research?"

Table 1 – Research Questions – Main research question (RQ) and secondary questions (SRQs)

As a characterization review, this analysis can be viewed as a first attempt to understand the area and its main definitions, concepts, characteristics, contributions and challenges. After the first data extraction and reading, other topics and specific research questions can be derived with directions for future work.

Review Scope

The review scope was defined based on the PICO (*Population, Intervention, Comparison and Outcomes*) structure[4] (Table 2). Based on preliminary *ad-hoc* literature searches, some previously SLRs in the topic were identified. Considering this fact, this SLR will first consider this body of studies as our initial population.

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[4] Pai, M.;McCulloch, M.; Gorman, J.D.; Pai, N.; Enanoria, W. T. A.; Kennedy, G.E.; Tharyan, P.; Colford, J.M. (2004) "Systematic reviews and meta-analyses: an illustrated, step-by-step guide." In: The National medical journal of India 17 2 (2004) 86-95.

PICO structure	
Population (P)	Digital Transformation Literature
Intervention (I)	Digital Transformation reviews
Comparison (C)	Not applied. The SLR's objective is to characterize the area.
Outcome (O)	Definitions, researchers, characteristics, research topics, challenges, techniques, approaches, methods, methodologies, tools and processes that support Digital Transformation.

Table 2 – PICO structure

Specific scopes will be analyzed in future researches considering the results identified in this first investigation of digital transformation literature and combining the areas of process, software development, reuse, future jobs and education.

Control Papers

A set of papers were selected based on a previous *ad-hoc* literature review. As some SLRs were identified in the digital transformation topic, three were selected as control papers:

- Vial, G. (2019). "*Understanding digital transformation: A review and a research agenda*". In: The Journal of Strategic Information Systems, Volume 28, pp. 118-144.

- Reis, J., Amorim, M., Melão, N., & Matos, P. (2018, March). "*Digital transformation: a literature review and guidelines for future research*". In: Proceedings of World Conference on Information Systems and Technologies (pp. 411-421). Springer, Cham.

- Kutzner, K., Schoormann, T., and Knackstedt, R. (2018, November), "*Digital Transformation in Information Systems Research: A Taxonomy-Based Approach to Structure the Field*". In: Proceedings of 26th European Conference on Information Systems - Research Papers(56), Portsmouth, UK. Available on: https://aisel.aisnet.org/ecis2018_rp.

Search String Definition

The search string was defined based on the research scope considering the PICO structure, the SLR's objectives, the knowledge of the researches and keywords presented in control papers. Terms were applied associated with alternative spellings and synonyms connected by the logical operator "OR" and terms that compose the string are separated by the logical operator "AND". The set of control publications was also used to refine the initial strings. This was applied in the paper title, abstract or keywords during search execution.

First part: Systematic Literature Review or Survey
Keywords: ("systematic review" OR "systematic literature review" OR "systematic mapping" OR "systematic investigation" OR "systematic analysis" OR "mapping study" OR "structured literature review" OR "evidence-based literature review" OR "survey" OR "review of studies" OR "structured review" OR "literature review" OR "literature analysis" OR "meta-analysis" OR "analysis of research" OR "empirical body of knowledge" OR "overview of existing research" OR "body of published knowledge")

Second part: Digital Transformation area
Keywords: "digital transformation".

Different terms and phrases are being used as viable alternatives for *keywords* related to the digital transformation area. However, as this study aims to characterize the digital transformation area and to understand how this *buzzword* is semantically used across different researches' viewpoints and industries, only the digital transformation term was used in the final search string to reduce some noisy results. In future searches, other terms can be applied considering the mapping on how digital transformation is semantically used in the literature in this SLR.

The final search string used was:

("systematic review" OR "systematic literature review" OR "systematic mapping" OR "systematic investigation" OR "systematic analysis" OR "mapping study" OR "structured literature review" OR "evidence-based literature review" OR "survey" OR "review of studies" OR "structured review" OR "literature review" OR "literature analysis" OR "meta-analysis" OR "analysis of research" OR "empirical body of knowledge" OR "overview of existing research" OR "body of published knowledge")
AND
("digital transformation")

Data Source Definition

The search engine selected to be used in this study was chosen based on its ability to use logic expressions, full text recovery, automated searches of paper content and searches using specific fields (for example, *title, abstract, keywords*). The electronic database used was Scopus[5].

The definition of only one search base can be explained as it is a tertiary study contemplating scopes from secondary studies which considered other search engines and sources of information. Other sources can be identified through this SLR to be applied in further researches, considering the sources that the primary studies returned.

Future searches can consider more data sources to verify to what extent the resulted body of knowledge of this SLR was able to cover.

Inclusion and Exclusion Criteria

This set of criteria is used to support the selection process of studies that can be considered relevant to this review.

The study had to meet the following Inclusion Criteria (IC):

- IC1: The paper must present a systematic literature review, a survey or a similar study in the digital transformation area with its methodology description and review's details, which permits the identification of how the primary studies were selected and analyzed; and

- IC2: The full reading of the paper should allow the identification of at least one aspect that supports a digital transformation, including its definitions and characterization in a general viewpoint.

The study will be excluded if it meets at least one of the following Exclusion Criteria (EC), being considered outside the review scope:

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[5] http://www.scopus.com

- EC1: Papers that do partially or fully define a review in a specific DT area or context should not be included. Papers indicating DT in only one specific field should also not be considered, because it probably indicates a particular view that cannot be generalized to a broader analysis of the DT area;
- EC2: Papers that are duplicated;
- EC3: Papers described and/or presented as keynote speech, tutorials, conference proceedings, courses and similar items;
- EC4: Papers whose full content cannot be accessed; and
- EC5: Papers that are not written in English.

Papers Selection Process

A set of steps were defined to perform the paper selection process:

1. Relevant papers selection:
    1.1. First, the duplicated papers are extracted;

    1.2. Later, the remaining papers are classified as included or excluded by applying the inclusion and exclusion criteria;

    1.3. The set of excluded papers is reviewed by the other researcher in order to reclassify them or kept them out, minimizing the risk of excluding a possibly relevant paper at an early stage;

2. Full paper recovery and reading stage:
    2.1. The full content of each paper selected in the previous step is read. The set of papers whose full contents could not be retrieved is excluded from the set of possible reading papers by applying EC5 as previously described;

    2.2. During the reading stage, papers that do not present a review of the digital transformation area should be removed. In order to support this analysis, the following topics were considered: (1) the presence of keywords identified in the search string; (2) Digital transformation definitions and their main characteristics as described in the control papers; and (3) literature review explanation including the method used, including review scope, keywords used to search relevant studies, data source definition and review results as number of selected papers;

    2.3. After defining the final list of relevant publications, one of the researchers reads and extracts information using the data extraction form (see in the following);

    2.4. After this, a first analysis is performed to derive an overview of the area and to determine implications that can derive more detailed analysis of further information. At this point, the set of aspects should be considered: (1) year of review publication; (2) number of authors involved; (3) number of primary studies considered in each review; (4) research and industry area identified in the review; (5) studies per country distribution; (6) studies publishing venue distribution; (7) keywords and search engines used in each review; (8) number of citations; and (8) main contributions and challenges pointed out by each review; and

2.5. Secondary analysis should be performed with more detailed topics of attention after the first analysis cited above.

Data Extraction Form

Full paper reference		
This paper was cited by	x[6]	x[7]
This paper cited	x[8]	List of cited reviews
Authors	List of authors and their institution with countries identification	
Venue	Venue of study publication	
Year	XXXX	
Paper Keywords	List of the paper terms provided by the authors	
Number of references		
Some important observations about the paper		
A brief summary of the main review goal.		
Number of returned papers by review search	Xxx	
Number of selected papers by review process	Xxx	
Key terms	Keyword used in the review's search string	
Sources (library databases and search engines)	List of databases or other sources used The period of returned papers (initial and final years) Some important inclusion or exclusion criteria Other relevant information used during search and paper selection process	
Results • The digital transformation definition provided by the review authors; and • The review main contributions, important findings and challenges pointed by the authors through their analysis topics and conclusions.		

Table 3 – Data Extraction Form

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[6] Number of citations among the selected reviews
[7] Number of citations in general literature (Scopus as source of citation metric – consulted in July, 2020).
[8] Number of citations among the selected reviews

II. Literature Review Execution

This section describes this literature review execution phase including search execution and reviews selection. Also, the final list of selected reviews is presented in the end of this section.

Search execution and study identification

The search was performed in *January 2020*.

- A total of **310** papers were returned - including duplicated papers.
- The papers covered the period from 2007 until 2020.
- All control papers were returned in the search.
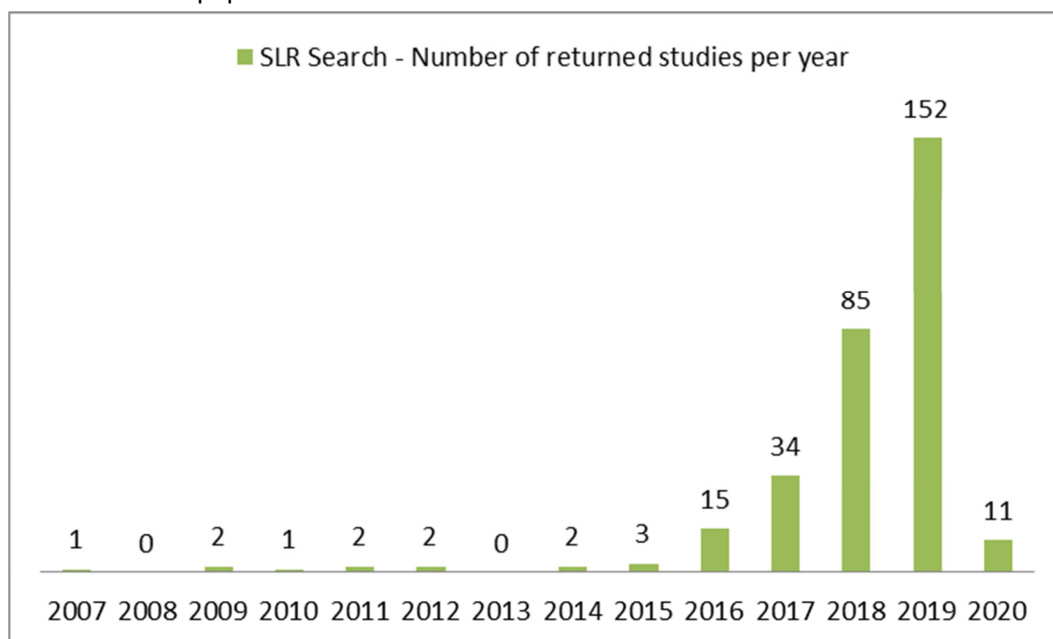
Figure 1 - Number of returned studies per year

Studies Selection

The selection process considered the inclusion and exclusion criteria described in Subsection I. Research Protocol - Inclusion and Exclusion criteria of this report. The selection was performed considered title and abstract during the relevant papers selection stage. In case of doubt, the paper was included to the next stage of full content reading.

From the total of papers returned, only one was duplicated.

Some of the papers mentioned the terms *Industry 4.0, Smart Manufacturing and Cyber-Physical Systems, Forth Industrial Revolution* as synonyms for Digital Transformation. However, these terms are more related to manufacturing industry, which is not the actual scope of this SLR. Other papers focused in as specific field as: educational area, health topics, financial sector, government and public services, agility concepts, digital assessment, risk management. These were also considered out of this review scope as the focus is to characterize the phenomenon in a broader scope and as a general area.

From the 310 papers, sixteen were selected to this review analysis, considering papers that addressed specifically the DT term and performed a literature review of the topic (Table 4/Figure 2).

Number of selected studies per year													
Year	2007	2009	2010	2011	2012	2014	2015	2016	2017	2018	2019	2020	**All**
# Returned	1	2	1	2	2	2	3	15	34	85	152	11	**310**
# Selected	0	0	0	0	0	0	0	1	2	5	7	1	**16**

Table 4 – Number of selected studies per year
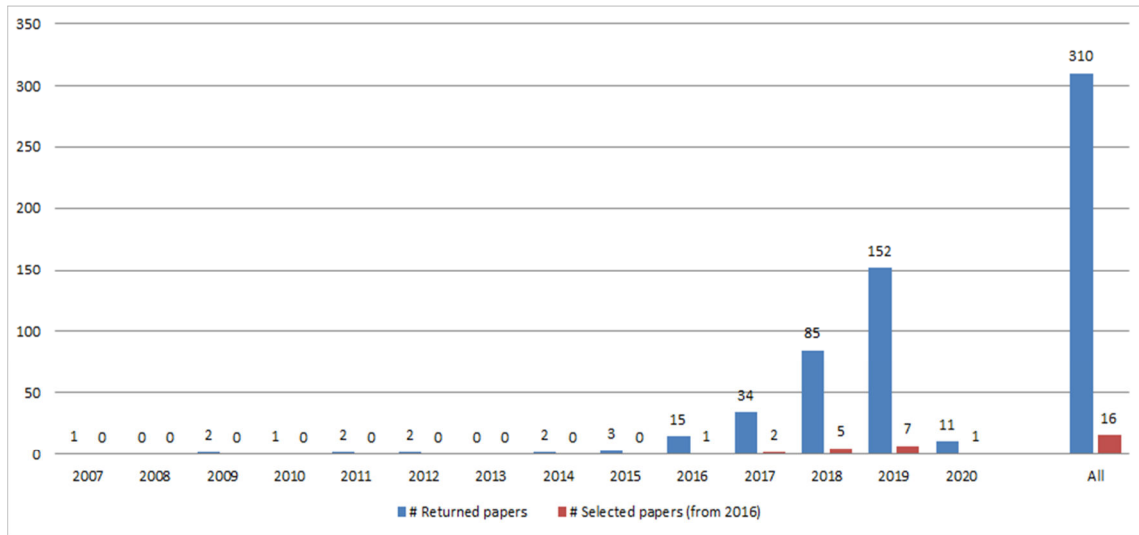
Figure 2 - Number of selected studies per year (filter 1)

During the full paper reading stage, three papers[9] were excluded:

- Ziyadin *et al*. (2020) mentioned a literature review as a base to DT fundamentals. However, it is described as a brief review and no details are provided to indicate how the six DT strategy frameworks were selected by the authors.

- Lammers *et al*. (2018) performed a systematic literature review focusing in a specific context - DT across key industries in Australia. The results can be interpreted from a "specific and practical" view but cannot generalize the findings. So, by applying the inclusion and exclusion criteria, this paper is considered out of scope, as described in EC1 exclusion criterion (Subsection I. Research Protocol - Inclusion and Exclusion criteria).

- Schallmo *et al*. (2017) as Ziyadin et al. (2020) used a brief literature review as a base to theoretical foundation for DT. However, no details are provided to indicate how the literature was identified by the authors.

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[9] Ziyadin, S., Suieubayeva, S., Utegenova, A. (2020) "Digital Transformation in Business". In: International Scientific Conference "Digital Transformation of the Economy: Challenges, Trends, New Opportunities (ISCDTE – April, 2019), Lecture Notes in Networks and Systems, Volume 84, pp. 408-415. DOI: https://doi.org/10.1007/978-3-030-27015-5_49.

Lammers, T., Tomidei, L., Regattieri, A. (August, 2018) "*What causes companies to transform digitally? An overview of drivers for Australian key industries*". In: Proceedings of Portland International Conference on Management of Engineering and Technology, PICMET 2018, pp. 1-8. IEEE. DOI: 10.23919/PICMET.2018.8481810

Schallmo, D., Williams, C.A., Boardman, L. (December, 2017) "Digital transformation of business models-best practice, enablers, and roadmap". In: International Journal of Innovation Management, Volume 21, Number 8, pp. 1-17.

Summarizing, from the 310 papers returned in the search, one duplicated paper was eliminated, 293 were excluded during the first filter (exclusion criteria application in title and abstract) and three papers were excluded during full reading stage, totalizing 297 papers clearly outside the scope of this review and fourteen selected papers (Table 5).

Summary	
Search date	January, 2020
Data Source	Scopus
Total of papers returned by search	310
Duplicated papers	1
Exclusion criteria application in title and abstract	293
Full reading stage (Exclusion criteria application in full content)	3
Total of excluded papers	297
Total of final selected papers	**13**

Table 5 - Final number of search execution and studies selection

Final list of selected review

The final list of papers included is presented in Table 6.

	Final List of Selected Papers
1	Teichert, R. (December, 2019) "*Digital Transformation Maturity: A Systematic Review of Literature*". In: Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensi, Volume 67, Issue 6, pp. 1673-1687. DOI: https://doi.org/10.11118/actaun201967061673
2	Hausberg, J.P., Liere-Netheler, K., Packmohr, S., Pakura, S., Vogelsang, K. (November, 2019) "*Research streams on digital transformation from a holistic business perspective: a systematic literature review and citation network analysis*". In: Journal of Business Economics, Volume 89, Issue 8–9, pp. 931–963. DOI: https://doi.org/10.1007/s11573-019-00956-z
3	Babar, Z., Yu, E. (October, 2019). "*Digital Transformation–Implications for Enterprise Modeling and Analysis*". In: Proceedings of 2019 IEEE 23rd International Enterprise Distributed Object Computing Workshop (EDOCW), Article number 8907284, pp 1-8, 28 - 31 October 2019, Paris France. IEEE. DOI: 10.1109/EDOCW.2019.00015
4	Brown, N., Brown, I. (September, 2019) "*From Digital Business Strategy to Digital Transformation – How? A Systematic Literature Review*". In: Proceedings of ACM SAICSIT conference (SAICSIT '19), article no.: 13, pp. 1-8, September 17–18, 2019, Skukuza, South Africa. DOI: https://doi.org/10.1145/3351108.3351122
5	Pihir, I., Tomičić-Pupek, K., Tomičić Furjan, M. (June, 2019). "*Digital Transformation Playground-Literature Review and Framework of Concepts*". In: Journal of Information and Organizational Sciences, Volume 43, Issue 1, 33-48, June, 2019. DOI: https://doi.org/10.31341/jios.43.1.3
6	Vial, G. (June, 2019). "*Understanding digital transformation: A review and a research agenda*". In: The Journal of Strategic Information Systems, Volume 28, Issue 2, pp. 118-144. DOI: https://doi.org/10.1016/j.jsis.2019.01.003
7	Kutnjak, A., Pihiri, I., Furjan, M. T (May, 2019) "*Digital Transformation Case Studies Across Industries–Literature Review*". In: Proceedings of 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), pp. 1293-1298, 20-24 May 2019, Opatija, Croatia. IEEE. DOI: 10.23919/MIPRO.2019.8756911
8	Gebayew, C., Hardini, I.R., Panjaitan, G.H.A., Kurniawan, N.B., Suhardi (October, 2018) "*A Systematic Literature Review on Digital Transformation*". In: Proceedings of 5th International Conference on Information Technology Systems and Innovation, ICITSI 2018, pp. 260-265. DOI: 10.1109/ICITSI.2018.8695912
9	Bockshecker, A. and Hackstein, S. Baumöl, U. (June, 2018) "*Systematization of the term digital transformation and its phenomena from a socio-technical perspective – A literature review*". In: Proceedings of 26th European Conference on Information Systems, ECIS 2018, Portsmouth, UK - Proceedings at AIS Electronic Library - Research Papers - 43. Link: https://aisel.aisnet.org/ecis2018_rp/43
10	Kutzner, K., Schoormann, T., Knackstedt, R. (June, 2018) "*Digital transformation in information systems research: A taxonomy-based approach to structure the field*". In: Proceedings of 26th European Conference on Information Systems, ECIS 2018, Portsmouth, UK - Proceedings at AIS Electronic Library - Research Papers - 56. Link: https://aisel.aisnet.org/ecis2018_rp/56
11	Reis, J., Amorim, M., Melão, N., Matos, P. (March, 2018). "*Digital transformation: a literature review and guidelines for future research*". In: Rocha Á., Adeli H., Reis L.P., Costanzo S. (eds) Trends and Advances in Information Systems and Technologies. World Conference on Information Systems and Technologies (WorldCIST'18 2018). Advances in Intelligent Systems and Computing, Vol. 745, pp. 411-421, Springer, Cham. DOI: https://doi.org/10.1007/978-3-319-77703-0_41
12	Morakanyane, R., Grace, A., O'Reilly, P. (June, 2017) "*Conceptualizing digital transformation in business organizations: A systematic review of literature*". In: Proceedings of 30th Bled eConference: Digital Transformation - From Connecting Things to Transforming our Lives, BLED 2017, pp. 427-444. Link: https://aisel.aisnet.org/bled2017/21
13	Berghaus, S. (June, 2016) "*The fuzzy front-end of digital transformation: Three perspectives on the formulation of organizational change strategies*". In: Proceedings of 29th Bled eConference: Digital Economy, BLED 2016, pp. 129-144. Link: https://aisel.aisnet.org/bled2016/40

Table 6 - Final List of Selected Papers

III. Characterization of Selected Reviews and Initial Data Analysis

This section includes information about each identified review including the distribution per year; publishing vehicles; main research topics related to studies goals and protocols; individuals and institutions involved; main findings of identified reviews and research gaps; citations and references overview. Also a list of publication venues is presented by conference, journal; books and reports. A list of primary studies which were referenced more than once is presented.

Brief characterization of selected reviews

Analysis of time period - Distribution of selected publications over time per year

Reviews distributed between 2016 and 2019

- o One in 2016
- o One in 2017
- o Four in 2018
- o Seven in 2019

This can indicate DT as a recent research theme and an increasing interest in the field.
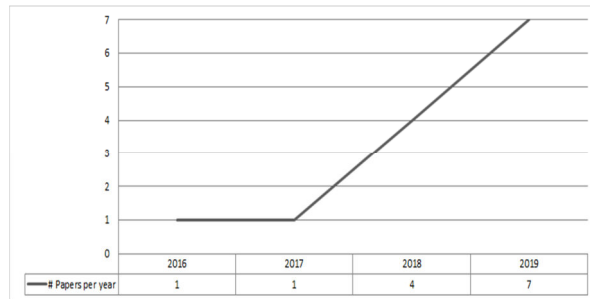

Figure 3 - Number of identified reviews per year

Reviews Publishing Vehicles Distribution

- Overview of publishing vehicles distribution and specifics venues

  o Most review papers were published in **conferences** (7 of 13 - 54%)

  o Four reviews were published in **journals** (4 of 13 – 31%). The journals are among the most recent papers, with all of them published in 2019. This can indicate maturation in the area and few works consolidated.

  o One review was published in a **convention**

  o One review was published in a **workshop**
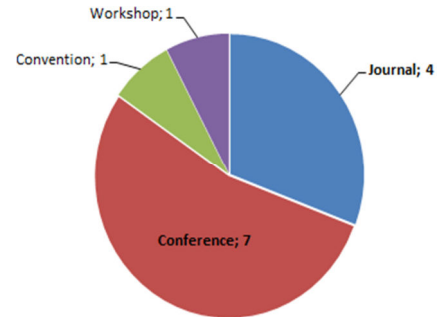
Publication Venue	SLR
Journal - Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis	Teichert (2019)
Journal - Journal of Business Economics	Hausberg et al. (2019)
Workshop - International Enterprise Distributed Object Computing Workshop (EDOCW)	Babar and Yu (2019)
Conference - ACM SAICSIT	Brown and Brown (2019)
JIOS - Journal of Information and Organizational Sciences	Pihir et al. (2019)
The Journal of Strategic Information Systems	Vial (2019)
Convention - International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)	Kutnjak et al. (2019)
Conference - International Conference on Information Technology Systems and Innovation (ICITSI)	Gebayew et al. (2018)
Conference - European Conference on Information Systems (ECIS)	Bockshecker et al. (2018)
Conference - European Conference on Information Systems (ECIS)	Kutzner et al. (2018)
Conference - World Conference on Information Systems and Technologies (WorldCIST)	Reis et al. (2018)
Conference - Bled eConference: Digital Transformation - From Connecting Things to Transforming our Lives	Morakanyane et al. (2017)
Conference - Bled eConference: Digital Economy	Berghaus (2016)

Table 7 - Studies Publishing Venues

Event	#reviews
Conference - Bled eConference	2
Conference - European Conference on Information Systems (ECIS)	2
Conference - World Conference on Information Systems and Technologies (WorldCIST)	1
Conference - International Conference on Information Technology Systems and Innovation (ICITSI)	1
Conference - ACM SAICSIT	1
Workshop - International Enterprise Distributed Object Computing Workshop (EDOCW)	1
Convention - International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)	1

Table 8 - List of events and number of occurrences

Distribution of selected reviews by countries and institutions - characterizing individuals and institutions are involved in DT research in academic area

- **Total of identified countries: eleven**

  Observation: one researcher was identified by two countries (Sweden and Turkey)

  German researchers have the highest number of papers published (3 of 13), followed by Canada and Croatia with 2 papers each. The other countries are represented by only one paper each.
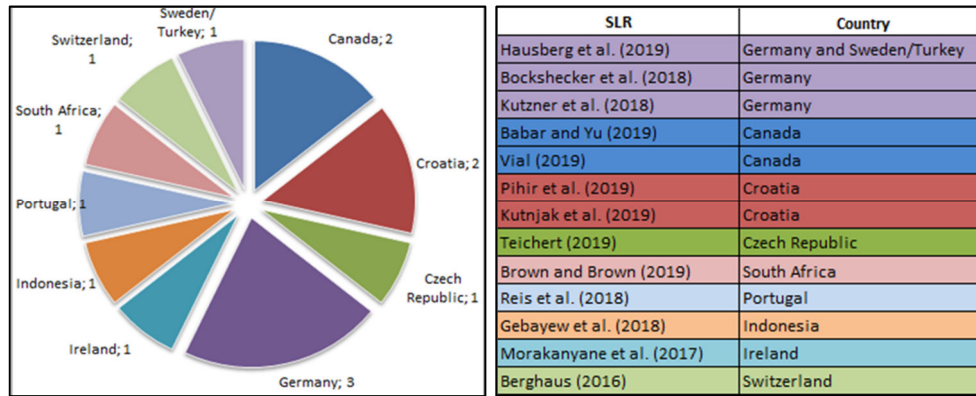

SLR	Country
Hausberg et al. (2019)	Germany and Sweden/Turkey
Bockshecker et al. (2018)	Germany
Kutzner et al. (2018)	Germany
Babar and Yu (2019)	Canada
Vial (2019)	Canada
Pihir et al. (2019)	Croatia
Kutnjak et al. (2019)	Croatia
Teichert (2019)	Czech Republic
Brown and Brown (2019)	South Africa
Reis et al. (2018)	Portugal
Gebayew et al. (2018)	Indonesia
Morakanyane et al. (2017)	Ireland
Berghaus (2016)	Switzerland

Figure 4 - Researches Distribution by Countries

SLR	Distribution of research work by countries - Number of researchers per publication										
	Canada	Croatia	Czech Republic	Germany	Ireland	Indonesia	Portugal	South Africa	Switzerland	Sweden	Turkey
Teichert (2019)			1								
Hausberg et al. (2019)				4						1	
Babar and Yu (2019)	2										
Brown and Brown (2019)								2			
Pihir et al. (2019)		3									
Vial (2019)	1										
Kutnjak et al. (2019)		3									
Gebayew et al. (2018)						4					
Bockshecker et al. (2018)				3							
Kutzner et al. (2018)				3							
Reis et al. (2018)							4				
Morakanyane et al. (2017)					3						
Berghaus (2016)									1		

Table 9 - Number of researches by country

- **Total of identified institutions: eighteen**

In eleven of the reviews no collaboration was identified among different countries and the researchers were from the same institution.

Most research came from university researchers, indicating a more academic viewpoint.

SLR	Institutions	
Teichert (2019)	Department of Management, Faculty of Business and Economics, Mendel University	
Hausberg et al. (2019)	Osnabrück University, Osnabrück, Germany Hamburg University, Hamburg, Germany	Malmö University, Malmö, Sweden Bahçeşehir University, Beşiktaş/Istanbul, Turkey
Babar and Yu (2019)	Faculty of Information - University of Toronto	
Brown and Brown (2019)	University of Cape Town, Department of Information Systems, Rondebosch Cape Town	
Pihir et al. (2019)	University of Zagreb, Faculty of Organization and Informatics, Varaždin	
Vial (2019)	Department of Information Technology, HEC Montreal	
Kutnjak et al. (2019)	University of Zagreb, Faculty of Organization and Informatics, Varaždin	
Gebayew et al. (2018)	School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung	
Bockshecker et al. (2018)	University of Hagen, Hagen	
Kutzner et al. (2018)	University of Hildesheim, Hildesheim	
Reis et al. (2018)	1. Department of Military Science and Technologies, and CISD&CINAMIL, Military Academy, Lisbon - 2. Department of Economics, Management and Industrial Engineering and Tourism, and GOVCOPP, Aveiro University, Aveiro - 3. Department of Management and CI&DETS, School of Technology and Management of Viseu, Polytechnic Institute of Viseu, Viseu - 4. Higher Institute of Social and Political Sciences, and CISD, Lisbon	
Morakanyane et al. (2017)	University College Cork, College Rd, Cork	
Berghaus (2016)	Institute of Information Management, University of St.Gallen	

Table 10 - List of institutions

Studies goals and protocols – characterizing research and practice topics being addressed

- **Question Formulation - Topic, Objectives and Research questions**

SLR	Research method	Topic	Objectives	Research Questions
Teichert (2019)	Systematic literature review	Digital maturity models	To present contemporary developments in the field of digital maturity models.	1. Who is driving the development of digital maturity models – practitioner or academic? 2. What are the different domains (industrial contexts) addressed by digital maturity models? 3. What are the most common maturity dimensions used in digital maturity models? 4. To what extent is organizational culture represented and which cultural attributes are addressed in digital maturity models?
Hausberg et al. (2019)	Systematic literature review	An overview of recent research streams and topics in the area of DT from a business perspective	An overview of the different disciplines of DT research from a holistic business perspective and citation network analysis.	No specific research questions identified. "To stay focused on the business and technology perspective, the research areas were restricted to operations research management science, business economics international relations, social sciences other topics, communication, behavioral sciences, social issues, and sociology."
Babar and Yu (2019)	Systematic literature review	Set of DT characteristics and a set of requirements for a future enterprise modeling framework	To identify research articles that define, discuss or share experiences regarding digital transformation in enterprises.	No specific research questions identified. The intent of determining the DT underlying characteristics (common underlying traits of DT) by identifying behavioral commonalities across multiple enterprises undergoing DT. Another contribution is to use these characteristics to come up definitive requirements for an enterprise modeling technique that would allow modeling and analyzing enterprise undergoing transformation due to emerging digital technologies.
Brown and Brown (2019)	Systematic literature review	To clarify the roles of both digital business strategy and DT, and how these concepts steer organizations to achieve DT in the quest to compete in digital age	To identify the core concepts that link digital business strategy to digital transformation so as to improve understanding of their dynamic interaction and outcomes	How do organizations achieve effective digital transformation based on a defined digital business strategy?
Pihir et al. (2019)	Bibliographic and literature analysis	Insights about the progressive area of DT	To provide insights into academic publishing trends and offers an analysis of scientific fields in which researches were made followed by a brief analysis of the most influential articles	No specific research questions identified. - research areas most of the papers were published - most cited papers - key determinants and influence factors of DT - new trends and some emerging technologies
Vial (2019)	Inductive approach to reviewing the literature on DT based on Wolfswinkel et al. (2013)[10]	Building blocks of the DT process and a research agenda	To take stock of current knowledge on the topic to build a framework of digital transformation articulated across eight building blocks Understanding of the benefits as well as the challenges associated with DT at multiple levels	"What do we know about digital transformation?" "The framework foregrounds digital transformation as a process where digital technologies create disruptions triggering strategic responses from organizations that seek to alter their value creation paths while managing the structural changes and organizational barriers that affect the positive and negative outcomes of this process".
Kutnjak et al. (2019)	Literature review	Overview of case studies by industry, i.e. how enterprise approaches the process of DT	Analysis of case studies to bring some light to real DT processes and their success in practice	No specific research questions identified. Focus: Papers which use the case study method in their researches and/or compare DT case studies across different industries.
Gebayew et al. (2018)	Systematic literature review	An overview of existing research on the DT with new IT perspectives such as: methodology, application and business areas, impact and benefits of DT on business	To give a general review of a systematic literature on DT from a previous study to the latest five years	1. What is the research methodology that implements DT? - Identify strategy, steps, or success key for designing and implementing DT 2. What kinds of sector that implement or apply DT?" - Identify sector and specific usage for its sector. 3. What are the impacts of digital transformation? - Identify the impact of DT for business organization
Bockshecker et al. (2018)	Systematic literature review	Suggestions of theoretically and practically relevant	Two goals: (1) the conceptualization of the terms digitization,	1. How can the terms digitization, digitalization, and DT be defined and what are the differences between the

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[10] Wolfswinkel, J.F., Furtmueller, E., Wilderom, C.P., 2013. Using grounded theory as a method for rigorously reviewing literature. Eur. J. Inform Syst. 22 (1), 45–55.

SLR	Research method	Topic	Objectives	Research Questions
		definitions for the terms digitization, digitalization, and DT and create an overview of relevant phenomena	digitalization, and DT, and (2) the systematization of the phenomena connected to digitization, digitalization, and DT	terms? 2. Which phenomena are mentioned in the context of digitization, digitalization, and DT and how are they interrelated?
Kutzner et al. (2018)	Literature review based on the rigorous procedure from vom vom Brocke et al. (2009)[11]	Research characteristics and topics of digital transformation in IS Research	In order to promote this evolving field, the aim is to develop a taxonomy that structures the DT field including research aspects (e.g., research methods) and topics (e.g., fields of investigation) as well as their relationships	1. What kind of IS research is conducted in DT? 2. What topics of interest are addressed from IS research in DT?
Reis et al. (2018)	Systematic literature review	Proposition a definition of DT, delivers a general overview of the literature, along with some suggestions for future research	To provide insights regarding the state of the art of DT, and to propose avenues for future research	No specific research questions identified. • A quantitative characterization of the selected publications • Content analysis of the selected articles
Morakanyane et al. (2017)	Systematic literature review	Conceptualization of DT phenomenon	To conceptualize DT phenomenon - what it is; how it behaves; what drives it; what impacts it creates, as well as where the impacts are felt	No specific research questions identified. • DT definition • DT characteristics • DT impacts • Transformed areas
Berghaus (2016)	Literature review	To take the unique perspective of the fuzzy front-end within DT	The research objective is to explore whether and to what extent the front-end stages of organizational change processes are considered within information systems (IS), organization science (OS) and management and strategy (MS). To systematically analyze the current knowledge on the front-end of organizational transformation processes in different disciplines, in order to better understand the phenomenon and inspire a body of knowledge on digital business transformation.	Characteristics of and challenges in formulating organizational change strategies are reviewed in three different domains: information systems (IS), management & strategy (MS), and organization science (OS). • To what extent is the FFE phase considered in the IS, ORG, and MS fields? • What are the important characteristics and challenges within the FFE of digital business transformation within the IS, ORG and MS fields?

Table 11 — Research method, topic, objectives and research questions

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[11] Vom Brocke, J., Simons, A., Niehaves, B., Reimer, K., Plattfaut, R. and A. Cleven (2009). "Recon-structing the Giant: on the Importance of Rigour in Documenting the Literature Search Process ." In: Proceedings of the European Conference on Information Systems. Verona: Italy

- **Search string keywords**

SLR	Keywords
Teichert (2019)	"Digital Maturity" / "Digital Transformation" + "Digital Maturity" / "Digital Transformation Maturity" / "Digital Maturity Levels" / "Digital Transformation Efforts" / "State of Digital Transformation" / "State of Digital Transformation" / "Digital Transformation Progress" / "Phases of Digital Transformation"
Hausberg et al. (2019)	OR (Cyber-physical-system/Digital transformation/ Cloud computing/Machine-to-machine communication/Machine learning/Augmented reality/Virtual reality/Artificial intelligence/Internet of things/Industry 4.0/Industrie 4.0/Cloud manufacturing/Big data/Smart factory/Advanced production system) AND OR(Management/Organization/Efficiency/ Effectiveness/Efficacy/Key performance indicator/ Controlling/Logistic/ Strategy/Human resources/Finance/ Marketing/Sales/Key markets/ Value chain/Accounting
Babar and Yu (2019)	"Digital Transformation"
Brown and Brown (2019)	"Digital Strateg*", "Digital Business Strateg*", "Digital Transformation"
Pihir et al. (2019)	"Digital Transformation"
Vial (2019)	Combinations of keywords containing the terms "digital" and "transform" or "disrupt"
Kutnjak et al. (2019)	"Digital Transformation"
Gebayew et al. (2018)	"Digital Transformation"
Bockshecker et al. (2018)	digitalization OR "digital transformation"OR digitization
Kutzner et al. (2018)	"digital transformation" AND ("Classification" OR "Taxonomy")
Reis et al. (2018)	"Digital Transformation"
Morakanyane et al. (2017)	"digital business strategy", "digital transformation" ,"digitalization", "IT-enabled Organizational Transformation", "IT-enabled Enterprise Transformation"; "digital technologies"
Berghaus (2016)	"organi?ational change" AND ("strategy formulation") OR ("strategy formation") OR ("strategic planning") AND (technology OR digital)

Table 12 — Search string keyword

- **Reviews' Protocols**

This item summarizes the main aspects and steps described in the review protocol. This includes the data source, the search date, number of reviewers involved in the selection process and some restrictions (time period, selection criteria, etc.), limitations and characteristics of the planning and selection phase.

SLR	Data source	# search sources	Search Date	# researchers	Restrictions, Limitations and Characteristics
Teichert (2019)	Google Scholar + Screening reference lists	1	October 2018 8October – 29October	One reviewer performed the review	- English language - No time period restriction - First 20 hits sorted by relevance - A research article / study - Addressing digital transformation maturity in a company context - Conceptualizing digital transformation maturity
Hausberg et al. (2019)	ISI Web of Science (WoS) + reference lists	1	November 2017	Not mentioned	- time period - last 20 years - from 1997 - restricted the research areas to operations research management science, business economics international relations, social sciences other topics, communication, behavioral sciences, social issues, and sociology
Babar and Yu (2019)	ProQuest database	1	Not mentioned	One reviewer performed the review	- time period – from 2010 - only journal articles and conference papers - quality appraisal: Does the article cover one of the following points in detail: 1. Define digital transformation?/ 2. Discuss its characteristics?/ 3. Discuss the primary drivers in its adoption?/ 4. Specify adoption challenges in enterprises?/ 5. Share experiences in real-world settings?
Brown and Brown (2019)	Web of Science (IS field[12] - 54 journals)	1	Not mentioned	Not mentioned "The final 53 papers were reviewed for relevance, rigor and credibility by the principle author."	- No time period restriction - Inclusion criteria: "Digital Strategy, Digital Business Strategy, Digital Transformation or strategizing for digital transformation as a focal concept within an organizational context" - Exclusion criteria: TP=Mainly technical paper, ORG=articles not mentioning digital strategy or transformation in an organizational setting, PRE=Papers not referring specifically to the current digital phenomenon but rather generic IT solutions, WIP=Research papers still in progress. - The study was limited to journal articles only
Pihir et al. (2019)	Web of Science (WOS) and Scopus	2	December 2018	Not mentioned	- time period – from 2000 - journal and conference papers - term appearing in the title of paper - paper type as journal article and conference proceedings
Vial (2019)	AIS Library, Business Source Complete, ScienceDirect + backward/ forward search	3	Not mentioned	Not mentioned	- No time period restriction - exclude works in progress, research outlets not ranked in the Journal Citation Reports index as well as teaching cases from our final sample.
Kutnjak et al. (2019)	Web of Science (WOS)	1	December 2018	Not mentioned	- time period – from year 2000 till 2019 - excluded books and other materials that are not scientific journal or conference proceedings papers.
Gebayew et al. (2018)	Scopus	1	Not mentioned	Not mentioned	- time period – from year 2014 till 2018 - The papers should be focus on DT -The papers must be written in English - The articles should be available in a scientific journal - Documents excluded: books, Non-peer-reviewed research articles, white paper, technical report, abstract and short paper - 1.92% of articles due to the constraints of time for quality assessment - Quality assessment: evaluation criteria – 10 questions
Bockshecker et al. (2018)	Association for Information Systems (AISeL) Information systems literature[13]	1	September and October 2017	Not mentioned	- time period – from year 2012 - peer-reviewed papers - exclude specific research fields such as health, music, government, and commerce - Focused on information systems literature and chose renowned conferences and journals in this field

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[12] Selected Journals: AIS Top 8 - EJIS, ISJ, ISR, JMIS, JSIS, MISQ, JIT, JAIS /Financial Times Top 50 – HBR, JMS, MGTSCI, MKTSCI, ORGSTUD,SMR, AME, AMJ, AMR, ASQ, JIBS, JMGT, JMKT, JMKTR, JAMS, MSCI, MITSMR, SMJ/IS & related Journals on WoS - BISE, DSS, ECRA, EIS, EJISDC, I&M, I&O, IJEC, IJIM , ISEBM, ISM, JGITM, JTAECR, MISQE
[13] Information systems conferences: American Conference on Information Systems (AMCIS), the European Conference on Information Systems (ECIS), the Hawaii International Conference on System Science (HICSS), the International Conference on Information Systems (ICIS) and the Wirtschaftsinformatik (WI) and 12 journals: Management Information Systems Quarterly (MISQ), Information Systems Research (ISR), Communications of the Association for Computer Machinery (ACM), Management Science, Journal of Management Information Systems (JMIS), European Journal of Information Systems (EJIS), Communication of the Association for Information Systems (CAIS), Academy of Management Journal, Journal of the Association for Information Systems, Information Systems Frontiers, Organization Science, Business & Information Systems Engineering (BISE).

SLR	Data source	# search sources	Search Date	# researchers	Restrictions, Limitations and Characteristics
					- excluded work with a sole technical focus - excluded unrelated research fields like artificial intelligence
Kutzner et al. (2018)	Association for Information Systems (AISeL)	1	June - July 2017	Not mentioned	- No time period restriction - Articles published in proceedings of renowned IS-conferences - Analysis of the term in title, abstract and keywords.
Reis et al. (2018)	Web of Science (ISI)	1	September 2017	Not mentioned	- No time period restriction - DT term in title, abstract, author and keywords - Journal articles and conference papers - English language
Morakanyane et al. (2017)	Academic databases - management reviews, academic conferences and journals	-	March, 2016 process ending in October	Not mentioned	- time period – from year 2010 - Articles should be written in English - Articles should have at least one of the keywords above listed as part of the keywords in the abstract - Academic journals and conference papers sorted according to relevance and only first 10 results were considered - Analysis of metadata to select papers that meet the criteria set.
Berghaus (2016)	Three baskets of journals in Information systems (IS), Management & Strategy (MS), and Organization Science (OS) – 39 journals	-	Not mentioned	Not mentioned	- time period – from year 2010 Limitations: • The research only took publications from highly ranked journals into account. • The publications have been assessed based on their abstracts.

Table 13 – Reviews' Protocols - data source, search date, restrictions, limitations and characteristics

Studies analysis and synthesis methods

SLR	Synthesis method	Tool Support
Teichert (2019)	**Data extraction**: Dimensions and specific attributes (content) - Number of maturity levels/stages - Number of assessment items. Focus of model (domain, general) - Application purpose (descriptive, prescriptive) - Maturing approach (linear, non-linear) - Application method (self-/ 3rd party assessment) - Developed by practitioner or academic. Culture reflected in the model (yes/no). **Identification of most common areas and categories of culture characteristics**	Not mentioned
Hausberg et al. (2019)	**Citation network analysis** - clusters representing different research streams. **Qualitative analysis**	Online tool **hammer.nailsproject.org**: Bibliometric analysis and co-citation node-edge-fles -> **Gephi** **Excel**
Babar and Yu (2019)	**Thematic analysis** through **papers analysis and qualitative reasoning**. Seven thematic areas were identified and used to "group and highlight underlying discussion points and patterns". Qualitative analysis to determine concrete DT characteristics. Abstraction of the characteristics to define a set of requirements for a modeling framework.	Not mentioned.
Brown and Brown (2019)	**Thematic analysis**. "Key themes and sub-themes were identified through repeat reading of the journal articles to ensure understanding".	**nVivo** - "a tool for identifying and collating themes, and to assist in identifying links between themes" and **MS Excel** – "to capture key theoretical concepts".
Pihir et al. (2019)	The specific methods of analysis were not detailed in the paper. Based on the results, it is possible to identify quantitative and qualitative analysis.	Not mentioned
Vial (2019)	**Data collection**: the publication outlet, the type of publication outlet research journal, conference proceedings, practitioner's journal), the type of paper (empirical, conceptual), the context of application (e.g., healthcare), the theoretical foundation used or developed, the methods, as well as any definitions of DT and other related concepts. **Open coding**: annotating sources based on the arguments and findings relevant to phenomenon. Two rounds of **axial coding** to refine the coding scheme - set of higher-order categories of relationships. Integrated relationships using **selective coding**.	All coding instances imported into a **relational database** to contrast and compare our emergent findings using SQL queries which we complemented with visualization techniques
Kutnjak et al. (2019)	The specific methods of analysis were not detailed in the paper. Following the results presented, it is possible to identify some quantitative and qualitative analysis. Some numbers are presented and an overview of case studies across six industries.	Not mentioned
Gebayew et al. (2018)	Descriptive Analysis	Not mentioned
Bockshecker et al. (2018)	Concept matrix - assigns the relevant papers to digitization, digitalization, and DT; social or more technical perspective; phenomena: sharing we identified collaboration, communication, connectivity, flexibility, mobility, and co-creation (at least in three of the papers).	Not mentioned
Kutzner et al. (2018)	**Taxonomy-development -** to classify the articles (Nickerson et al.,2013[14]): meta-characteristics as the components of DT distinguishing between research characteristics (dimensions: research approach, research design, research method and philosophical worldview) and research topics (dimensions: field of investigation, strategic alignment, people, culture, information technology and models). **Cluster analysis -** discover relationships of the identified characteristics by applying the K-means algorithm.	Not mentioned
Reis et al. (2018)	Two different approaches: a quantitative approach based on a bibliometric analysis and a qualitative approach centered on a content analysis of the literature. **Quantitative**: Publications distribution/ Distribution per author and journal/ Major research approaches/Keywords frequency and **Qualitative**: Content analysis - DT Definitions/Themes and categories	Not mentioned
Morakanyane et al. (2017)	Gass et al. (2015)'s 4 phase approach to literature analysis[15]. **Concept Matrix process** (Webster & Watson, 2002[16]) to synthesize the retrieved papers. **Thematic analysis** - to synthesize articles to create a body of literature using constructs (thematic areas: 1. What is DT; 2. Characteristics of DT; 3. Drivers of DT; 4. Impacts of DT and 5. Transformed Areas).	Not mentioned
Berghaus (2016)	Analysis of title, abstract and subject terms – papers coded based on a coding scheme (Strategy phases – Davis et al. (2010)[17]: vision, planning, implementation and outcome / Type of change strategy – Intentionality based on Mintzberg's types[18]: intended and emergent / Type of change strategy – Degree-Scope based on Norman & Verganti (2014)[19]: radical-disruptive or evolutionary – continuous.	Result lists were exported and coded in Excel

Table 14 – Studies analysis and synthesis methods/ tool support

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[14] Nickerson, R. C., Varshney, U. and J. Muntermann (2013). "A method for taxonomy development and its application in information systems." European Journal of Information Systems 22 (3), 336-359.

[15] Gass, O. et.al., (2015); Conceptualizing Individualization in Information Systems – A Literature Review; Communications of the Association for Information Systems, Vol 37 No. 3, Pp. 64-88.

[16] Webster, J. & Watson, R.T. (2002); Analyzing the Past to Prepare for the Future: Writing a Literature Review; MIS Quarterly, Vol 26 No. 2, Pp. 13-23.

[17] Davis, E. B., Kee, J., & Newcomer, K. (2010). Strategic transformation process: Toward purpose, people, process and power. Organization Management Journal, 7(1), 66–80.

[18] Mintzberg, H., & Waters, J. A. (1982). Tracking Strategy in an Entrepreneurial Firm. Academy of Management Journal, 25(3), 465–499.

[19] Norman, D. A., & Verganti, R. (2014). Incremental and Radical Innovation: Design Research vs. Technology and Meaning Change. Design Issues, 30(1), 78–96.

Primary studies included in the selected reviews

- **Analysis of number of studies returned from the search** – "potentially relevant papers" and the number of studies selected after the screening process (restrictions applications - inclusion and exclusion criteria as well as quality checks) – "relevant studies - included papers".

SLR[20]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
Potentially Relevant Studies	1,925	73244[21]	818	75	719	381	214	1564	736	150	260	-	-
Relevant Studies (Included)	24	728	36	53	528	282	88	30	46	36	206	53	112

Table 15 – Number of studies returned from searches per review

- **Access to the full list of primary studies**

SLR[20]	# primary studies	Full list of primary studies
1	24	Many primary studies are referenced along the review. Although, it is difficult to guarantee that the full list of primary studies is provided. No access to the full list of primary studies
2	728	Some primary studies are referenced along the review. Although, the full list of primary studies is not provided. No access to the full list of primary studies
3	36	References for the 36 selected papers
4	53	Some primary studies are referenced along the review. Although, it is difficult to guarantee that the full list of primary studies is provided. No access to the full list of primary studies
5	528	No access to the full list of primary studies
6	282	References for the 30 selected papers - complete list of works reviewed as Appendix (D)
7	88	Some primary studies are referenced along the review. Although, the full list of primary studies is not provided. No access to the full list of primary studies
8	30	References for the 30 selected papers
9	46	References for the 46 selected papers
10	36	References for the 36 selected papers
11	206	No access to the full list of primary studies (only contacting the first author)
12	53	Some primary studies are referenced along the review. Although, the full list of primary studies is not provided. No access to the full list of primary studies
13	112	No access to the full list of primary studies

Table 16 – Access to the list of primary studies

- **Distribution of primary studies over time per year**

o The distribution of primary studies in each review indicated a broad range of years (1969 - 2019).

o Reviews pointed that the most remote approaches dated from 1968 – 1969 or 1992.

o The majority of academic and practitioner approaches were identified since 2000's, with a real increase only after 2014.

o Some reviews even limited the investigation period considering approaches only after 2000 or even after 2010. This is explained considering the fact that "digital transformation" is a recent term and the restriction aims to avoid misunderstandings or misinterpretations.

SLR	Primary Studies - Years Range
Teichert (2019)	2011- 2018
Hausberg et al. (2019)	2000 – 2015
Babar and Yu (2019)	2010 – 2019
Brown and Brown (2019)	not direct distinguishable**
Pihir et al. (2019)	2000 – 2019
Vial (2019)	1992 (1 paper) and 2000 - 2018
Kutnjak et al. (2019)	not direct distinguishable**
Gebayew et al. (2018)	2014 – 2018
Bockshecker et al. (2018)	2012 – 2017
Kutzner et al. (2018)	2014 – 2017
Reis et al. (2018)	1968 - 2017 (after 2014 increased numbers)
Morakanyane et al. (2017)	2010 – 2016
Berghaus (2016)	1969 – 2015

** This means that it was not possible to identify the specific range reading the paper since the list of select papers was not provided and the paper did not discuss the final year distribution.

Table 17 - Primary studies – years range

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[20] [1] Teichert (2019) - [2] Hausberg et al. (2019) - [3] Babar and Yu (2019) - [4] Brown and Brown (2019) - [5] Pihir et al. (2019) - [6] Vial (2019) - [7] Kutnjak et al. (2019) - [8] Gebayew et al. (2018) - [9] Bockshecker et al. (2018) - [10] Kutzner et al. (2018) - [11] Reis et al. (2018) - [12] Morakanyane et al. (2017) - [13] Berghaus (2016)
[21] WoS 1876 +references 71.368 = 73244

- **List of primary studies**

Primary Study	Review
A	
Agarwal, R. et.al. (2010) "The Digital Transformation of Healthcare: Current Status and Road Ahead"; Information Systems Research, Vol 21 No. 4, pp. 796-809.	[05][06][11][12]
Alos-Simo, L., Alos-Simo, L., Verdu-Jover, A., Verdu-Jover, A., Gomez-Gras, J., Gomez-Gras, J. (2017) "How transformational leadership facilitates e-business adoption". Ind. Manage. Data Syst. 117(2), 382–397.	[03][11]
Andal-Ancion, A., Cartwright, P.A., Yip, G.S. (2003) "The digital transformation of traditional businesses". MIT Sloan Manage. Rev. 44 (4), 34–41.	[05][06]
Andersen, P. and J. W. Ross (2016). "Transforming the LEGO Group for the Digital Economy." In: Proceedings of the 37th International Conference on Information Systems (ICIS 2016). December 11-14. Dublin, Ireland.	[09][10]
Andriole, S.J. (2017). "Five myths about digital transformation". MIT Sloan Manage. Rev. 58 (3), 20–22.	[03][06]
Ardolino, M., Rappaccini, M., Saccani, N. et al. (2018). "The role of digital technologies for the service transformation of industrial companies". International Journal of Production Research, 56(6), 2116–2132.	[01][03]
B	
Barrett, M., Davidson, E., Prabhu, J., Vargo, S.L. (2015). "Service innovation in the digital age: key contributions and future directions". MIS Quart. 39 (1), 135–154.	[04][06]
Basole, R.C. (2016). "Accelerating digital transformation: Visual insights from the API ecosystem". IT Prof. 18 (6), 20–25.	[03][06]
Benlian, A. & Haffke, I. (2016). "Does Mutuality Matter? Examining the Bilateral Nature and Effect of CEO-CIO Mutual Understanding". Journal of Strategic Information Systems, Vol 25, pp. 104-126.	[06][11][12]
Berghaus, S., Back, A. (2016). "Stages in digital business transformation: Results of an empirical maturity study". Mediterranean Conference of Information Systems, Cyprus.	[01][06]
Berman, S. (2015). "Digital Transformation: Opportunities to Create New Business Models". Strategy & Leadership 40, 2 (2015), 16–24.	[03][04][05][12]
Berman, S. J. & Marshall, A. (2014). "The Next Digital Transformation: From an Individual-Centered to an Everyone-to-Everyone Economy". Strategy & Leadership, Vol 42 No.5, pp. 9-17.	[03][12]
Besson, P. & Rowe, F. (2012). "Strategizing Information Systems-Enabled Organizational Transformation: A Transdisciplinary Review and New Directions". Journal of Strategic Information Systems, Vol 21, pp. 103-124.	[12][13]
Bharadwaj, A. et.al. (2013). "Digital Business Strategy: Toward A Next Generation Of Insights". MIS Quarterly, 37(2), pp. 471-482.	[01][02][04][06][10][12][13]
Bley, K., C. Leyh, T. Schäffer (2016). "Digitization of German Enterprises in the Production Sector - Do they know how "digitized" they are?" In: Proceedings of the 22nd Americas Conference on Information Systems (AMCIS 2016). August 11-13. San Diego, California, USA.	[02][09]
Brynjolfsson E, McAfee A (2014). "The second machine age: work, progress, and prosperity in a time of brilliant technologies". 1st edn. W. W. Norton & Company, New York.	[02][09]
C	
Cha, J. K. & Lee, Z., (2013). "What Do We Mean by Information Technology Enabled Organizational Transformation". PACIS 2013 Proceedings, 235.	[12][13]
Chanias, S., Hess, T. (2016). "Understanding digital transformation strategy formation: insights from Europe's automotive industry". Pacific Asia Conference on Information Systems, Chiayi, Taiwan.	[06][12]
Chen, Y. K. et.al., (2014). "Effects of Digital Transformation on Organizational Performance of SMEs". Internet Research, 26 (1), pp. 186-212.	[11][12]
D	
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Table 18 – List of primary studies

Observations[22]

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[22] Although referenced by more than one review, the paper below was not included because it is of a specific area (health area):
Agarwal, R., Gao, G., DesRoches, C., Jha, A.: Research commentary – the digital transformation of healthcare: current status and the road ahead. Inf. Syst. Res. 21(4), 796–809 (2010).

Main results identified in selected reviews

Research Conclusions and Findings - Summary of the main results of each review

SLR	
Teichert (2019)	The review identified **22 different digital maturity models** - academics (12 models) and practitioners (10 models). First studies in digital maturity were published in 2011 and 2012 (practitioners). These models can be domain specific (mainly reflecting the manufacturing sector) or general. "There is **no consistent definition of digital maturity** available because all the different maturity models and their underlying definition of digital maturity show **heterogeneity in content and methodology** - maturity-dimensions, nomenclature, levels and characteristics applied". "Most companies rather focus on the exploitation of digital technology than on the exploration of digital innovation and development of new digital products and business models to generate new digital revenues." "Transformational management capabilities (e.g. vision, culture, leadership, governance, innovation, agility) or an organization's digital foundations (e.g. technology, digital skills, organization, strategy, customer experience) are not addressed sufficiently and systematically". The dimension of "culture": collaborative and innovative – "organizational culture is seen more and more as the number one hurdle to digital transformation". "There is a clear need to consistently **define attributes of a digital culture** enabling digital transformation and to systematically include these cultural attributes in digital maturity models". "More specific and granular model approaches providing **additional layers of detail** are required in order to reflect **industry-specific capabilities and characteristics** and give companies effective guidance towards digital maturity in different industrial and functional contexts". Most common area: **Digital Culture; Technology; Operations & Processes; Digital Strategy; Organization; Digital Skills; Innovation; Customer Insight & Experience; Governance; Vision; Digital Ecosystem; Leadership; Compliance & Security; Products & Services; Business Model.** Categories of culture attributes: **Knowledge sharing; Empowerment; Open communication; Ideating new digitalized working methods and services; Risk tolerance; Failure tolerance; Change-ability; Organizational learning; Agility & flexibility; Collaboration.**
Hausberg et al. (2019)	Technologies identified: Big data, Cloud Computing, Internet of Things, Artificial Intelligence, Machine learning, Augmented and Virtual reality. Cluster identified: Innovation; Manufacturing; Analytics, Society, Supply chain, Knowledge management, Tourism, Marketing and Finance. Two major research directions identified: individualization and widespread technology use where computer-controlled workflows impede human interaction. Research deficiencies areas: Accounting; (e-)human resource management; sustainability in combination with the mentioned fields of interest. Marketing, knowledge management, manufacturing and society + big data analytics.
Babar and Yu (2019)	This review highlighted eight DT characteristics as "behavioral commonalities across multiple enterprises underdoing digital transformation": Business strategy and business models; Enterprise agility; Customer centricity; Rapid cycles of solution delivery; multi-speed organizations; Data-driven decision making; Social and organizational aspects; Business Process Automation. Also the paper develops a set of ten requirements for a modeling framework – (1) relationship among processes – process architecture; (2) multiple types and levels of processes – multi-level process dynamics; (3) enterprise and process goals; (4) trade-off analysis; (5) abstract software artifacts design; (6) pushing design decisions downstream – design use; (7) upfront planning vs. deferred planning – plan-execute; (8) feedback and feedforward paths; (9) represent and reason about speed, timescales and process cycles; (10) social actors. These elements were related deriving a mapping among DT characteristics and framework requirements. This reviews analysis the relations among different organizational elements and entities and how decisions and actions in certain level impacts and drives actions in other levels. The understanding and visibility of this entire complexity network is important to drive decisions and implement innovation due to changes in the environment and customer demands. Flexibility, adaptability and agility are important features for processes and organizational responses.
Brown and Brown (2019)	The authors identified nine concepts related to DT aiming to "clarify the roles of both digital business strategy and digital transformation, and how these concepts steer organisations to achieve digital transformation in the quest to compete in the digital age". Four concepts were considered key themes in DT area: (1) digital technologies; (2) Digital Business Strategy; (3) Digital Transformation Strategy; and (4) Digital Transformation. The other five concepts are: Digital Leadership; Business models; Digital Innovation; Digital Transparency; and Digital maturity. A skillset is discussed as a "a broad digital competence hat encompasses skills directly related to digital innovation and technologies, and knowledge and experience of the digital economy and its effects on the business". "Four options for acquiring the relevant skills include: development of internal staff, sourcing externally, mergers and/or acquisitions of digitally competent companies, and partnering with a digital vendor"(Hess et al., 2015)[23]. Some future work opportunities are pointed out as: (1) the definition in more details "the various roles that will assist IS teams" – skills in business besides IT application systems, tools and infrastructure platforms; (2) investigation of leadership roles – CDOs and CIOs roles and responsibilities; skill set: "an entrepreneurial flair with a solid understanding of the digital competitive market"; and (3) investigation of "how contextual differences across economic, cultural, and behavioral contexts may influence the relationship between key drivers of the proposed digital transformation model"
Pihir et al. (2019)	The authors concluded that DT is "still a young area and has potential for further growth and maturity". The research areas identified pointed out that DT "**covers a variety of industries and fields of human activities**", with more attention to the <u>computer science field</u> "but also in all other fields of human activities, especially in: business, engineering, social sciences, information science, library science, education and educational research, decision science, medicine, protection of environment, law, material science, etc." Considering the top 10 most cited papers identified in the review, some topics were highlighted: **the field of medicine and health care** was the pioneers of DT from a historical point of view; "**general business change** trough DT"; future of DT and **post-adoption digital transformation determinants**; **SME entrepreneurs**; and **Chief Digital Officer (CDO)** role and responsibility. The authors identified key determinants and influence factors: **Strategy orientation** – clear vision statement, management, leadership (top managers); **Customer centricity** - tracking of customers' experiences (their know-how, new ideas and new technological possibilities, behavior and habits) , prediction of their needs (to influence, predict, levy or create new needs);

[23] Hess, T., Matt, C., Benlian, A. and Wiesböck, F. 2015. Options for Formulating a Digital Transformation Strategy. MIS Quarterly Executive 15, 2 (2015), 123-139.

	ICT and process infrastructure – ICT resources (used for changing products, services or processes), management of business processes; **Talent, capability and capacity strengthening** – culture of permanent investment in new skills, knowledge and capacities – "investments in human resource management, education and the "right people for the job to be done" are necessary"; **Innovation culture and organizational commitment** – commitment to organizational culture, innovation culture and organizational factors. "Every organization has to determine its current position and after that it needs to define the desired, future state for every identified determinant, identify activities that will lead to the future state that is digitally transformed, as well as perform them afterwards. The future state is defined by improvement initiatives or by ideas for a radical change, but legacy technologies influence DT as well." – **Digital Maturity Model** **Organisational agility** – organization capacity to identify the need for change and flexible adapt on time. "Mix of suitable technologies for supporting processes engaged in the digital transformation". **Digital technologies – emerging technologies**: "which have a potential to bring digital transformation into an organization, when they are introduced or used separately, or combined with another technology, with the challenge of choosing the right one." "Each technology and every combination of several of them is dependent on the industry the organization is placed in or its role within the industry." "Business related concepts have to be the starting point for choosing the right technology. These concepts can include: New business model development, building an Ecosystem with or within its environment, Improvement of customer value creation through development of customer journeys or any other idea of business improvement. The business improvement initiative arises from the need of the business to work better, not from the need to use a new technology just because it exists or is emerging in another industry."
Vial (2019)	The author derived a DT definition based on a semantic analysis of previously definitions found in literature. Conceptual definition of DT: "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies". This research also proposes a framework with eight building blocks describing DT as a process: 1. Use of digital technologies 2. Disruptions 3. Strategic responses 4. Changes in value creation paths 5. Structural changes 6. Negative impacts 7. Positive impacts 8. Organizational barriers This review proposed observations about DT versus other forms of IT-enabled transformation and concluded that DT is an evolution of T-enabled transformation. "DT better reflects the complexity of the environment within which firms operate and the disruptive impacts of digital technologies on individuals, organizations and society". The author pointed out two major themes as a research agenda: (1) dynamic capabilities and (2) incorporation of ethics in DT strategic.
Kutnjak et al. (2019)	A sample for 96 industrial use cases of DT were identified in the 88 selected papers. Top 10 research areas (Business economics, Computer Science, Engineering, Information Science Library Science, Education Educational research, Social Sciences other topics, Automation control systems, Communication, Government Law, Health care Science services) and countries/regions (Germany, United States of America, Russia, England, France, Sweden, Finland, Poland, Argentina, Austria). Case study researches in digital transformation according to industry (classification according to NACE[24]): **Information and Communication, Manufacturing, Education, Human Health and Social Work Activities, Electricity – Gas – Steam and Air, Wholesale and retail trade and repair of Motor Vehicles and Motorcycles**, Professional – Scientific and Technical, Public Administration and Defense, Administrative and Support Service, Agriculture – Forest and Fishing, Water Supply – Sewerage, Transportation and Storage. Financial and Insurance activities, Art –Entertainment and Recreation, Other Service activities. Observation: "it's challenging to separate what is the DT in IT industry and when it's just a case study made by IT people in some other industry". Different themes were identified in each industry (applied in specific sectors) – Cloud services; role of CIOs, senior executives, digital leaderships and CDOs; the assessment of DT organizational readiness; challenges in infrastructures, integration and architecting during and after digital transformation; digital connectivity; education and training – library digitalization, online learning (ex. MOOCS), competences and skills needs, gap between education and professional standards, technology implementation in Education versus financial constraints, teacher training, employees training and knowledge transfer; IT in the execution and redesign of business processes; IT department role and tasks - analyses the situation and define changes in practice, methodologies and IT systems; etc.
Gebayew et al. (2018)	The review pointed out that the major of primary studies are about **case studies; conceptual model, frameworks and strategies;** and **method**. The main application areas identified were: **Books; Governance; Public Service; Enterprise Architecture; Marketing;** and **Automotive**. Business areas**: Business processes; skills;** and **digital platforms**. Impacted areas: **Business models; Business activities/functions; Business processes; Customer, worker and partner approaches.** Benefits: 1.Increase customer satisfaction; 2.Increase customer experience; 3.Improvement in productivity; 4.Increase revenue from products and services; and 5.Cost reduction. *Application of technology to improve value and to lead to competitive scenarios. Influences on the structure, resources and business models. Application of "enterprise architecture to assist this transformation".*
Bockshecker et al. (2018)	The authors focused in discussing the differences among terms that are being used synonymously in DT context but with various definitions causing confusion: digitalization, digitization and digital transformation (DT). Also, the paper presented seven phenomena "connected to digitization, digitalization, and DT". For them, phenomena are defined "as situations or processes that are characterized by a bidirectional influence of society and technological developments". For the conceptualization of the terms digitization, digitalization, and DT, the authors used the concept of socio-technical system (STS), which consisted of two components: a technical system and a social system – "The technical system implies technical elements like processes, hardware, and technology while the social system addresses human actors with their characteristics like skills or behaviors". "Digitization is allocated to the technical system while digitalization comprises the social and the technical system.

[24] NACE, Glossary: Statistical classification of economic activities in the European Community (NACE), NACE rev. 2., 2018, https://ec.europa.eu/eurostat/statisticsexplained/index.php/Glossary:Statistical_classification_of_economic_activities_in_the_European_Community_(NACE) .

	Digitalization and DT enable the social and technical development of phenomena. The phenomena include changes in the behavior of society representing the social components of an STS. Furthermore, phenomena need a technological basis for their implementation. The phenomena trigger the process of DT as they allow for organizations to adopt social as well as technical changes." "Digitization takes into consideration mainly technical aspects." "Digitalization - the state of an organization or a society referring to its current digital development and usage of ICT innovations. Digitalization takes into account social as well as technical elements." "DT - the process of organizational or societal changes driven by innovations and developments of ICT. DT includes the ability to adopt technologies rapidly and affects social as well as technical elements of business models, processes, products and the organizational structure." "DT refers to the process of organizational or societal changes driven by innovations and developments of ICT, while digitalization describes the current digital development state." Phenomena identified: sharing, collaboration, communication, connectivity, flexibility, mobility, and co-creation.
Kutzner et al. (2018)	The authors developed taxonomy of DT considering research characteristics and research topics. Considering the research characteristics: the major research is **qualitative** as a research approach; the two most common used designs are **ground theory and case study**; most of the papers did a **literature review**, **a content analysis** and conducted **interviews** as a research method and concluded that there is a "lack of prior knowledge and theory"; and the major research has a **constructivist worldview** ("generating or inductively developing a theory or pattern of meaning"). Considering the research topics: there is a wide dispersion of different fields of investigation; the major of papers focused on **strategy** as a strategic alignment topic; related to people the **knowledge** and **internal/external collaborations** topics were most examined; and the **innovation** topic of Information Technology is addressed in almost papers. Clusters: "areas of digital transformation: (I) digital business strategies and business models, (II) working culture in a digitized environment, (III) digital innovations and technologies as well as (IV) knowledge as driver for digitalization". "Future endeavors including the calls for (a) conducting more design science research—design and evaluate artefacts in particular—, (b) developing more methods, (c) considering new fields of application such as creative industries, and (d) investigating security issues".
Reis et al. (2018)	The authors worked on a qualitative and quantitative analysis of DT phenomenon. The authors pointed out that the term is more popular among practitioners and scholars can improve researches in order to identify opportunities and challenges of DT. The review presented a brief discussion about the use of terms with close and similar meanings as DT, Digitalization and Digitization. And also provide an own definition that discusses three elements: technology, organization and social aspect. The DT phenomenon relates a **technological aspect to management practices**. It can be understand as an IT-enable change which depends on service, process, operations, business models and a whole organizational structures management changes. The **people view needs attention with an Education research area to develop important skills and analysis the social aspect involved as changing in customers' experience and engagement**. Most relevant areas and categories: **Information systems (IT/IS integration); Business economics (development of new business models – Digital business enterprise architecture); Education (training/education to add new skills); Management science (process and operations management); and Government (public sector transformation).**
Morakanyane et al. (2017)	The concept of DT is analyzed as the authors affirmed that "there is evidence of a lack of common understanding of this concept". The DT phenomenon was conceptualized based on five thematic areas (what it is, the characteristics, drivers, impacts and transformed areas). • **Definition** What is DT? – Strategy; Process; Business model; Paradigm shift. The paper proposes a DT definition as "… something with certain characteristics; that is driven by something; to create certain impacts; on certain aspects of the organization". **"an evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value".** • **Characteristics**: Behavioral traits displayed by this phenomenon. *What are its characteristics? – Radical; Disruptive; Evolutionary/continuous; Complex* DT as an <u>evolutionary process</u> – DT evolves over time as a continuous process that impacts bring about a radical change to the organization. • **Drives**: Attribute that influence and enable the process of DT to take place. What are the drivers of DT? – Digital technologies; Digital capabilities; Strategies; Business Models; Value chain - <u>Digital capabilities</u> - Organizations require particular skill set, mindset and culture that is digital. - <u>Digital technologies</u> – At the foundation of all DT efforts are digital technologies – technology based systems and emerging technologies. • **Impacts:** The effects that business organizations experience as a result of the transformation process which can be positive or negative. They can be organization-focused and customer-focused. What are the key impacts of DT? – Value creation; Operational efficiency; Create competitive advantage; Improved relationships; Customer experience/engagement The key impact is **value creation** - Value realized include many factors, but not limited to: operational efficiencies, improved customer experiences; enhanced business models; strategic differentiation, competitive advantage, improved stakeholder relationships, cost savings, etc. • **Transformed areas**: areas that are impacted during DT process. Where are these impacts felt (transformed areas)? – Business models; Operational processes; Customer experiences; Employees; Culture; Infrastructure. Key transformed areas: **Business Models, Operational Processes & Customer Experiences.**
Berghaus (2016)	DT is analyzed as an innovation process of an organization and as an organization change. Three perspectives were considered: Information systems (IS), management & strategy (MS) and organization science (OS). "Within the IS-domain, the perspective of IS has changed from a solely functional and process-oriented one to a broader strategic role. Therefore, a solid understanding of the dynamic development of digital technologies and its utilization is required within the strategy formulation process. The perspective of the MS domain of the fuzzy front-end is that it is often caused by external changes to which the company needs to react, whereby the top manager is mostly responsible for making sense of industry signals and initiating a viable strategy. However, organizational inertia often hinders the change process. The perspective of the OS domain is that strategy formulation is more a collaborative process formulation of a change strategy is seen as a collaborative process between than the task of the top executives."

Considering four strategy phases (vision, planning, implementation and outcome), it is pointed out that vision and outcome are phases that need more attention because the works concentrate in planning and implementation phases. So, there is a need to initial phase of strategy formulation and the work proposes to apply the concept of fuzzy-front end used in product development innovation to digital transformation process. This can leads to better understand of external signals that organizational needs to react and to identify patterns and procedures that can be bring more clarity to the DT process and to the design of viable options.

Some concepts can be identified:
- Innovation and organizational transformation strategies
- IT-enabled Digital Transformation
- Integration of business and IS-strategy – business and information technology, digital technology
- Digital, technology and IS skills integrated with business, management and leadership competences – integration of leaders, managers, top management, IS team and workforce.

Table 19 – Summary of the main results of each review

Research goals, main findings and research gaps

Classification based on Pertensen et al. (2008)[25]:

1. 'Identify Best and Typical Practices' – analyzes a set of empirical studies to determine which techniques are used and work in practice;

2. 'Classification and Taxonomy' a study creates a framework or classifies the existing research;

3. 'Emphasis on Topic Categories' means that the study identifies how much research is published in different sub-topics in the field of interest;

4.'Identify Publication Fora', identifies the journals, conferences and workshops relevant in the focus area.

SLR	Research Goal	Findings and research gaps or opportunities
Teichert (2019)	**2 and 3 - 'Classification and Taxonomy' and 'Emphasis on Topic Categories'** Focus of model (domain, general) - # dimensions / # maturity levels - Application purpose (descriptive, prescriptive) - Maturing approach (linear, non-linear) - Application method (self-/ 3rd party assessment) - Developed by practitioner or academic - Culture reflected in the model (yes/no) Most common digital maturity areas (Digital Culture; Technology; Operations & Processes; Digital Strategy; Organization; Digital Skills; Innovation; Customer Insight & Experience; Governance; Vision; Digital Ecosystem; Leadership; Compliance & Security; Products & Services; Business Model) and Categories of Cultural Attributes (Knowledge sharing; Empowerment; Open communication; Ideating new digitalized working methods and services; Risk tolerance; Failure tolerance; Change-ability; Organizational learning; Agility & flexibility; Collaboration).	22 different digital maturity models - No consistent definition or homogeneity in dimensions, levels and characteristics – need for a **standard approach.** - Need for models with criteria of assessment based on **industry-specific capabilities and characteristics.** - Need for more attention to digital innovation and new **digital products, services and business models.** - "Transformational management capabilities (e.g. vision, culture, leadership, governance, innovation, agility) or an organization's digital foundations (e.g. technology, digital skills, organization, strategy, customer experience) are not addressed sufficiently and systematically". - Need for more attention to **digital culture attributes** and their implantation.
Hausberg et al. (2019)	**3 and 4 - 'Emphasis on Topic Categories' and 'Identify Publication Fora'.** Research streams in nine main areas: Finance, Marketing, Innovation, Knowledge management, Analytics, Manufacturing, Supply chain management, Society and Tourism.	Nine business research areas were identified, with three dominant: Finance, Marketing and Innovation Management. Areas as accounting, (e-)human resource management, and sustainability still needs attention. The technologies most seen were Big data, Cloud computing, IoT, Artificial intelligence, machine learning, augmented and virtual reality. The paper presented research gaps in each one of the nine business research areas identified.
Babar and Yu (2019)	**1 and 3 - 'Identify Best and Typical Practices' and 'Emphasis on Topic Categories'** Eight DT characteristics: (C1) Business strategy and business models; (C2) Enterprise agility; (C3) Customer centricity; (C4) Rapid cycles of solution delivery; (C5) multi-speed organizations; (C6) Data-driven decision making; (C7) Social and organizational aspects; (C8) Business Process Automation. Ten requirements for a modeling framework: (R1) relationship among processes – process architecture; (R2) multiple types and levels of processes – multi-level process dynamics; (R3) enterprise and process goals; (R4) trade-off analysis; (R5) abstract software artifacts design; (R6) pushing design decisions downstream – design use; (R7) upfront planning vs. deferred planning – plan-execute; (R8) feedback and feedforward paths; (R9) represent and reason about speed, timescales and process cycles; (R10) social actors.	A mapping was derived among DT characteristics and the framework requirements: C1 – R3 e R4 C2 – R1, R2, R3 e R9 C3 – R3, R8, R9 e R10 C4 – R1, R2, R5, R6, R7 e R8 C5 – R2 e R9 C6 – R1 e R8 C7 – R4 e R10 C8 – R5, R6 e R9. R1 – C2, C4 e C6 R2 – C2, C4 e C5 R3 – C1, C2 e C3 R4 – C1 e C7 R5 – C5 e C8 R6 – C5 e C8 R7 – C5 R8 – C3, C4 e C6 R9 – C2, C3, C5, C8 R10 – C3 e C7
Brown and Brown (2019)	**1 and 2 - 'Identify Best and Typical Practices' and 'Classification and Taxonomy'** **Nine concepts identified:** • **Digital technologies** • **Digital Business Strategy** • **Digital Transformation** • **Digital Transformation Strategy** • Digital Leadership • Business Models • Digital Innovation • Digital Transparency • Digital Maturity	Key themes and subthemes were identified through repeat reading of the journal articles to ensure understanding. Nine concepts were identified as elements of a proposed digital transformation model. The role of leadership is crucial with "effective engagement of the CIO, senior business and IS leaders" that need to work together with collaboration and participation across "all levels of employees" within the organization. Business models need to reflect value creation with a customer centricity perspective and focus on "customer choice, flexibility and agility required to adjust as the customer preferences change though developing". Digital innovation is an important element "from the outside as well as from the inside" and the DT strategy will clearly define innovative ways to use digital technologies to co-create value with integration, collaboration, change management and "agreement on policies around digital transparency", "with imperfect proof of concepts, trial and error, and modifications to enable faster turnaround which bring creative new products and services to market".

[25] Petersen, K., Feldt, R., Mujtaba, S., & Mattsson, M. (2008, June). Systematic mapping studies in software engineering. In 12th International Conference on Evaluation and Assessment in Software Engineering (EASE) 12 (pp. 1-10).

SLR	Research Goal	Findings and research gaps or opportunities
		Some future work opportunities are pointed out as: (1) the definition in more details "the various roles that will assist IS teams" – skills in business besides IT application systems, tools and infrastructure platforms; (2) investigation of leadership roles – CDOs and CIOs roles and responsibilities; skill set: "an entrepreneurial flair with a solid understanding of the digital competitive market"; and (3) investigation of "how contextual differences across economic, cultural, and behavioral contexts may influence the relationship between key drivers of the proposed digital transformation model".
Pihir et al. (2019)	**2 and 3 - 'Classification and Taxonomy' and 'Emphasis on Topic Categories'** **Business related concepts**: improvements, increased effectiveness/efficiency; ecosystems/green tech; new business models; new services, competencies, skills; customer experience, journey; new alliances **Other ICT and digitalization concepts**: Social media and platforms; artificial intelligence and gamification; Metamodelling; IOT, Big data and Data analytics; Virtual technologies and Knowledge management; Robotics and Autonomous systems **Mainstream concepts**: Cloud technologies; Mobile technologies; Reference models; ERP and CRM; SCM and DWH; BPM and Performance management.	DT "covers a variety of industries and fields of human activities", with more attention to the computer science field. Key determinants and influence factors: Strategy orientation; Customer centricity; ICT and process infrastructure; Talent, capability and capacity strengthening. Digital Maturity Model. Organisational agility. Digital technologies – emerging technologies. "Business related concepts have to be the starting point for choosing the right technology". "Further research needs to be done in order to investigate feasible approaches for selecting the right combination of technologies." "The impacting factors for selection of future transformation initiatives should be investigated: new business models and their building elements, innovation diffusion as a result of the digital vortex in the operating industry, and skills for digital transformation officers assigned to lead the digital transformation."
Vial (2019)	**2 and 3 - 'Classification and Taxonomy' and 'Emphasis on Topic Categories'** This research also proposes a framework with building blocks describing DT as a process: 1. Use of digital technologies 2. Disruptions - Consumer behavior and expectations; Disrupting the competitive landscape and Increasing the availability of data. 3. Strategic responses 4. Changes in value creation paths - Value propositions; Value networks; Digital channels and Agility and ambidexterity. 5. Structural changes – Organizational structure; organizational culture; leadership; and employees roles and skills. 6. Barriers to changing the value creation process: inertia and resistance 7. Assessing the impacts of digital transformation: Organizational level impacts and Higher-level impacts	This review proposed observations about DT versus other forms of IT-enabled transformation and concluded that DT is an evolution of T-enabled transformation. "DT better reflects the complexity of the environment within which firms operate and the disruptive impacts of digital technologies on individuals, organizations and society". The research agenda presented by the author highlighted two themes: dynamic capabilities and the incorporation of ethics in DT strategy. The dynamic capabilities can be expanded in three areas of interest: "The first is the building of organizational dynamic capabilities to support the ongoing DT of a firm. The second is the role of integrative capabilities, an understudied form of dynamic capabilities, in the context of digital platforms and ecosystems. The third is the microfoundations that help us understand and explain how DT unfolds in practice". The same can be done with the ethics topic: "The first is the role of ethics as a means to account for the multilevel implications of DT. The second is the growing need for firms to balance the tension between organizational performance and ethics. The third is the use of ethics as a means to address the concurrent, and often conflicting needs of value co-creators."
Kutnjak et al. (2019)	**1 and 3 - 'Identify Best and Typical Practices' and 'Emphasis on Topic Categories'.** "Cross-industry analysis based on literature review of articles in these industries and most representative case studies were described". Identification of top 10 research areas, top 10 countries/regions and Digital Transformation Case Study per Industry.	The paper presents some findings of DT implementation in different industries. They pointed out that: "Companies are applying digital technologies for different purposes: to integrate business processes, create new business opportunities, innovate products, reduce costs and make new business models." Six industries were identified as the most researched industries with DT case studies.
Gebayew et al. (2018)	**3 - 'Emphasis on Topic Categories'** Research methodology; application areas; impacted areas; benefits.	The research methodology most presented is **case study**. **Books, government, public service** and **enterprise architecture** are the most cited application area. **Business models** are highly impacted. <u>DT Benefits</u>: 1.Increase customer satisfaction; 2.Increase customer experience; 3.Improvement in productivity; 4.Increase revenue from products and services; and 5.Cost reduction. *Application of **technology** to improve **value** and to lead to **competitive scenarios**. Influences on the **structure, resources and business models**. Application of "**enterprise architecture** to assist this transformation".*
Bockshecker et al. (2018)	**2 and 3 - 'Classification and Taxonomy' and 'Emphasis on Topic Categories'** Concept matrix - digitization, digitalization, and DT; social or more technical perspective; phenomena: sharing, collaboration, communication, connectivity, flexibility, mobility, and co-creation.	"Digitization takes into consideration mainly technical aspects while digitalization includes both components of an socio-technical system. Furthermore, digitalization focuses on the current status of an organization or society referring to its current digital development and usage of ICT. In contrast to this, DT describes the change process enabled through ICT innovations taking into account social and technical elements". Among the papers selected the social and technical perspectives were equally mentioned. The collaboration phenomenon was the most cited, followed by sharing,

SLR	Research Goal	Findings and research gaps or opportunities
		communication and connectivity.
Kutzner et al. (2018)	**2 and 3 - 'Classification and Taxonomy' and 'Emphasis on Topic Categories'** Research characteristics: research approach (quantitative, qualitative, mixed method, DSR); research design (experimental design, survey design, grounded theory, case study, literature research and longitudinal study); research method (literature re-view, interview, questionnaire, observation, Delphi study, statistical analysis and content analysis); and philosophical worldview (postpositivist worldview or constructivist worldview). Research topics: fields of investigation (manufacturing industry, creative industries, finance and insurance, retail, consulting, public sector, mobility and industry 4.0); strategic alignment (performance, strategy, process and an enterprise architecture); people (CIO/CDO, customer / end-user, partner, other actors, internal collaboration, external collaboration); culture (culture + values); Information technology (big data, IT sector, security, innovation); and models (maturity models, research models).	The major research is **qualitative** as a research approach; the two most common used designs are **ground theory and case study**; most of the papers did a **literature review, a content analysis** and conducted **interviews** as a research method and concluded that there is a "lack of prior knowledge and theory"; and the major research has a **constructivist worldview**. Considering the research topics: there is a wide dispersion of **different fields of investigation**; the majority of papers focused on **strategy** as a strategic alignment topic; related to people the **knowledge and internal/external collaborations** topics were most examined; and the **innovation** topic of Information Technology is addressed in most papers. "(I) digital business strategies and business models, (II) working culture in a digitized environment, (III) digital innovations and technologies as well as (IV) knowledge as driver for digitalization". Future research: "(a) conducting more design science research—design and evaluate artefacts in particular—, (b) developing more methods, (c) considering new fields of application such as creative industries, and (d) investigating security issues."
Reis et al. (2018)	**3 and 4 – 'Emphasis on Topic Categories' and 'Identify Publication Fora'.** Identify most relevant categories based on research areas and keywords: IT/IS integration; Development of new business models; Training/Education to add new skills; Process and operations management; and Ramification to other sectors (Government). Identification of major research approaches: conceptual, illustrative studies and literature review. Identification of three top countries, top 5 journals and top 10 most cited papers.	DT covers an IT-enable change with management practices in order to govern this complex transformation of services, product, process, business models and organizational operations. Beyond technological and organizational aspects, the social view explores: (1) enhancing customers' experience and engagement; and (2) education of workforce to add new skills in a digital workplace. Government is pointed out as a research area with promising themes as the governmental digitalization and healthcare development. The authors also propose "an in-depth research on the distinction of associated terms to Digital Transformation, and a maturity model to determine the organizational degree of Digital Transformation".
Morakanyane et al. (2017)	**2 - 'Classification and Taxonomy"** Concept Centric Matrix • What is Digital Transformation • Characteristics of Digital Transformation • Drivers of Digital Transformation • Impacts of Digital Transformation • Transformed Areas	DT fundamental concepts – definition, characteristics, drivers, impacts and transformed areas. It is need more research to understand the transformational effects on an organizational view and on specific industries. Also regarding value creation, it is important to investigate types of digital technologies and digital capabilities versus impacts and values created.
Berghaus (2016)	**2 and 3 - 'Classification and Taxonomy' and 'Emphasis on Topic Categories'** • Strategy phases and types of change strategy • Three domains: Information Systems, Management & Strategy, and Organization Science.	DT research needs to focus on initial phase of strategy formulation – application of fuzzy front end concept.

Table 20 – Research goals, main findings and research gaps

Literature citations

References among selected reviews

- Lack of relation among the reviews: only three reviews were cited by others.
  - Cited papers: Morakanyane et al. (2017) (4 citations), Reis et al. (2018) (2 citations) and Berghaus (2016) (1 citation).
  - Most-cited paper: Morakanyane et al. (2017) - Four citations in 2019.
- This scenario may lead to a mismatch of concepts or a lack of common understanding of this phenomenon.

	1	2	3	4	5	6	7	8	9	10	11	12	13			Authors	#citations
1												■			1	Teichert (2019)	0
2												■			2	Hausberg et al. (2019)	0
3												■			3	Babar and Yu (2019)	0
4															4	Brown and Brown (2019)	0
5															5	Pihir et al. (2019)	0
6												■			6	Vial (2019)	0
7															7	Kutnjak et al. (2019)	0
8											■				8	Gebayew et al. (2018)	0
9															9	Bockshecker et al. (2018)	0
10															10	Kutzner et al. (2018)	0
11															11	Reis et al. (2018)	2
12															12	Morakanyane et al. (2017)	4
13															13	Berghaus (2016)	1
	1	2	3	4	5	6	7	8	9	10	11	12	13				

Figure 5 - Graphical representation of citations among the selected reviews

Number of times each review has been cited in general literature

- This number can help to understand the visibility of the reviews.
- Scopus as source of citation metric – consulted in March, 2020 and in July, 2020.
- It is important to remember that these publications are recent, published from 2016.

SLR	Number of citations* (Scopus)
Teichert (2019)	0
Hausberg et al. (2019)	1
Babar and Yu (2019)	0
Brown and Brown (2019)	0
Pihir et al. (2019)	1
Vial (2019)	17
Kutnjak et al. (2019)	1
Gebayew et al. (2018)	1
Bockshecker et al. (2018)	2
Kutzner et al. (2018)	3
Reis et al. (2018)	24
Morakanyane et al. (2017)	10
Berghaus (2016)	2

*Numbers collected in March, 2020

Table 21 - Number of times each review has been cited in general literature

- Update of overview of citations for the reviews in the literature

Total of 126 citations are identified distributed by the 13 papers and along the last three years (2018 – 6, 2019 – 38 and 2020 – 66) in 108 papers. This information was collected from the electronic database Scopus in July, 2020.

- Most cited papers are:
  - Vial et al. (2019) – 54 citations
  - Reis et al. (2018) – 39 citations
  - Morakanyane et al. (2017) – 14 citations
- Only one of them does not have any citation and the others vary from one to four citations.

	Authors	Total of citations	2018	2019	2020	New papers in the list of 108 identified documents involving first authors identified in this SLR (see Table 23)
1	Teichert (2019)	1	-	-	1	1 paper
2	Hausberg et al. (2019)	1	-	-	1	0 paper
3	Babar and Yu (2019)	0	-	-	-	0 paper
4	Brown and Brown (2019)	0	-	-	-	0 paper
5	Pihir et al. (2019)	2	-	1	1	2 papers / 2 co-authors
6	Vial (2019)	54	-	8	46	0 paper
7	Kutnjak et al. (2019)	3	-	1	2	0 paper
8	Gebayew et al. (2018)	3	-	-	3	0 paper
9	Bockshecker et al. (2018)	2	-	2	-	0 paper
10	Kutzner et al. (2018)	4	1	2	1	1 paper / 5 co-authors
11	Reis et al. (2018)	39	2	15	22	5 papers / 9 co-authors
12	Morakanyane et al. (2017)	14	2	8	4	0 paper
13	Berghaus (2016)	2	1	1	-	1 paper / 1 co-author
	Total	126	6	38	67	10 papers

Table 22 - Overview of citations for the reviews in the literature

ID	Publication
1	**Berghaus, Sabine & Back, Andrea (2017). Disentangling the Fuzzy Front End of Digital Transformation: Activities and Approaches. 2017. - International Conference on Information Systems (ICIS) - Seoul.**
2	Reis, J., Santo, P. E., & Melão, N. (2019, April). Artificial intelligence in government services: A systematic literature review. In World conference on information systems and technologies (pp. 241-252). Springer, Cham.
3	Reis, J., Amorim, M., Cohen, Y., & Rodrigues, M. (2020, April). Artificial Intelligence in Service Delivery Systems: A Systematic Literature Review. In World Conference on Information Systems and Technologies (pp. 222-233). Springer, Cham.
4	Reis, J., Santo, P. E., & Melão, N. (2020, February). Artificial Intelligence Theory in Service Management. In International Conference on Exploring Services Science (pp. 137-149). Springer, Cham.
5	Rosete, A., Soares, B., Salvadorinho, J., Reis, J., & Amorim, M. (2020, February). Service Robots in the Hospitality Industry: An Exploratory Literature Review. In International Conference on Exploring Services Science (pp. 174-186). Springer, Cham.
6	Reis, J., & Menezes, S. Gender Inequalities in the Military Service: A Systematic Literature Review. Sexuality & Culture, 1-15.
7	Kutzner, K., Moskvina, A., Petzold, K., Roßkopf, C., Heid, U., & Knackstedt, R. Reviews of Cultural Artefacts: Towards a Schema for their Annotation. In: Workshop on Annotation in Digital Humanities, annDH 2018; Sofia; Bulgaria - CEUR Workshop Proceedings Volume 2155, 2018, Pages 17-23.
8	**Furjan, M. T., Pihir, I., & Tomičić-Pupek, K. (2019). Digital Transformation Playground Operationalization–How to Select Appropriate Technologies for Business Improvement Initiatives.**
9	**Tomičić Furjan, M., Tomičić-Pupek, K., & Pihir, I. (2020). Understanding Digital Transformation Initiatives: Case Studies Analysis. Business Systems Research: International journal of the Society for Advancing Innovation and Research in Economy, 11(1), 125-141.**
10	**Liere-Netheler, K., Vogelsang, K., Packmohr, S., Hoppe, U.: Towards a Framework for Digital Transformation Success in Manufacturing. In: Proceedings of ECIS, Portsmouth (2018).**

Table 23 – List of new papers

From the ten publications identified (see Table 23), four are directly related to DT theme and should be better investigated in future analysis.

Publications Venues

This topic identifies the publication venues of the studies set. The investigation was performed analyzing the primary studies list, when it was available, and the lists of references of each selected review. The results were divided in Journals and Conferences/Workshops/Symposiums as listed below. A summary of the most frequent venues are also presented in each category.

Journals

The most frequent journals considering an analysis of two aspects: (1) number of references and (2) number of this SLR's identified reviews on which a journal appeared.

- MIS Quarterly Management Information Systems (58 studies and 11 out of 13 reviews);

- MIT Sloan Management Review (27 studies and 9 out of 13 reviews);

- MIS Quarterly Executive (17 studies and 10 out of 13 reviews);

- Harvard Business Review (14 studies and 6 out of 13 reviews);

- Journal of Strategic Information Systems (14 studies and 6 out of 13 reviews);

- Communications of the Association for Information Systems (13 studies and 6 out of 13 reviews);

- European Journal of Information Systems (12 studies and 5 out of 13 reviews);

- Journal of Information Technology (12 studies and 3 out of 13 reviews);

- Business & Information Systems Engineering (11 studies and 11 out of 13 reviews);

- Strategic Management Journal (11 studies and 3 out of 13 reviews);

- Expert Systems with Application (10 studies and 1 out of 13 reviews) and;

- Information Systems Research (10 studies and 7 out of 13 reviews).

A total of 255 journals, annals and reviews were identified as listed below. The table also lists for each journal on which selected SLRs they are presented. Finally, the total number of studies in which the journal appeared is presented.

	Journals	SLRs on which a journal appeared	# studies
1	Academy of Management Annals	[06]	1
2	Academy of Management Journal	[06][13]	4
3	Academy of Management Perspectives	[06]	1
4	Academy of Management Review	[02][06][11]	4
5	Accounting and Business Research	[02]	1
6	Administrative Science Quarterly	[06][13]	2
7	Advances in Intelligent Systems and Computing	[03]	1
8	Advances in Social Science, Education and Humanities Research	[07]	1
9	The African Journal of Information Systems	[06]	1
10	Behaviour and Information Technology	[02]	1
11	Big Data and Society	[02]	3
12	British Journal of Management	[11]	1
13	BT Technology Journal	[03]	1
14	Business & Information Systems Engineering	[01][02][03][04][05][06][08][09][10][11][12][13]	11
15	Business and Society	[06]	1
16	Business Horizons	[01][02]	2
17	Business Process Management Journal	[02]	2
18	California Management Review	[05]	1
19	Capgemini Consulting (Digital Transformation Review)	[08][06][11][12]	3
20	Communication and Society	[08]	1
21	Communication Methods and Measures	[02]	1
22	Communication Research	[03]	1
23	Communications in Computer and Information Science	[11]	2
24	Communications of the Association for Information Systems	[02][04][06][08][10][12]	13
25	Communications, Politics, Culture	[02]	1
26	Communications of the ACM	[02][06]	2
27	Concurrent Engineering Research and Applications	[02]	1
28	Convergence: The International Journal of Research into New Media Technologies	[11]	1
29	Cornell Hospitality Quarterly	[02]	1
30	Crime, Law and Social Change	[02]	1

	Journals	SLRs on which a journal appeared	# studies
31	Decision Support Systems	[02]	2
32	Deloitte University Press	[12]	2
33	Design Issues	[13]	1
34	Design Research: Methods and Perspectives	[13]	1
35	Digital Journalism	[02]	1
36	Dimension Empresarial	[07]	1
37	Dyna (Spain)	[07]	1
38	Economic Affairs	[02]	1
39	Economic Annals-XXI	[07]	1
40	Electronic Commerce Research and Applications	[02][05]	2
41	Entrepreneurship and Sustainability Issues	[02]	2
42	Entrepreneurship Research Journal	[02]	2
43	European Journal of Information Systems	[04][05][06][10][13]	12
44	European Journal of Operational Research	[02]	1
45	European Management Review	[02]	1
46	Expert Systems with Applications	[02]	10
47	Foresight and STI Governance	[07]	1
48	Foundations of Management	[03]	1
49	Fujitsu Scientific and Technical Journal	[07]	1
50	Future Generation Computer Systems	[08]	1
51	Futures	[02]	1
52	Government Information Quarterly	[12]	3
53	Harvard Business Review	[02][04][06][09][10][12]	14
54	Harvard Law Review	[04]	1
55	Human Relations	[06]	1
56	Human Studies	[02]	1
57	Human Systems Management	[02]	1
58	IBM Systems Journal	[13]	1
59	IEEE Cloud Computing	[07]	1
60	IEEE Internet Computing	[02]	2
61	IEEE Systems Journal	[02]	2
62	IFAC-PapersOnLine	[01]	1
63	iJAC	[01][12]	1
64	Implementation Science	[02]	1
65	Industrial Management & Data Systems	[03][11]	1
66	Industrial Marketing Management	[11][13]	2
67	Information & Culture	[02]	1
68	Information & Management	[02][06][08][11][12]	5
69	Information and Organization	[02]	1
70	Information and Software Technology	[08]	4
71	Information Communication and Society	[02]	1
72	Information Knowledge Systems Management	[12]	1
73	Information Systems	[12][13]	1
74	Information Systems and e-Business Management	[04]	1
75	Information Systems Journal	[05][06]	3
76	Information Systems Research	[04][05][06][09][11][12][13]	10
77	Informing Science Journal	[02][09]	1
78	International Business Review	[11]	1
79	International Journal of Advanced Corporate Learning (iJAC)	[12]	1
80	International Journal of Computer Integrated Manufacturing	[02]	1
81	International Journal of Electronic Commerce	[06]	4
82	International Journal of Engineering Pedagogy (iJEP)	[11]	1
83	International Journal of Enterprise Information Systems	[03]	2
84	International Journal of Hospitality Management	[02]	1
85	International Journal of Human Resource Management	[02]	1
86	International Journal of Humanities and Arts Computing	[07]	1
87	International Journal of Information Management	[11][12]	2
88	International Journal of Information Systems and Project Management	[02][07]	2
89	International Journal of Information Systems and Supply Chain Management	[02]	1
90	International Journal of Innovation Management	[01][02][03]	2
91	International Journal on Leadership	[03]	1
92	International Journal of Logistics Management	[02]	1
93	International Journal of Medical Informatics	[08]	1
94	International Journal of Operations and Production Management	[02]	1
95	International Journal of Physical Distribution and Logistics Management	[02]	1
96	International Journal of Production Economics	[02][08]	7
97	International Journal of Production Research	[01][02][03]	5
98	International Journal of Productivity & Performance Management	[09]	1
99	International Journal of Technology Management (IJTM)	[03][11]	1
100	International Journal of Technology, Policy and Management	[03]	1
101	International Political Sociology	[02]	1

	Journals	SLRs on which a journal appeared	# studies
102	International Review of Law, Computers and Technology	[06]	1
103	Internet Research	[02][11][12]	4
104	IT Professional	[03][04][06]	6
105	Journal of Accounting Literature	[02]	1
106	Journal of Advertising	[02]	1
107	Journal of Applied Journalism & Media Studies	[07]	1
108	Journal of Broadcasting and Electronic Media	[02]	1
109	Journal of Business and Technical Communication	[02]	1
110	Journal of Business Logistics	[02]	4
111	Journal of Business Management	[09]	1
112	Journal of Business Research	[02]	7
113	Journal of Business Strategy	[01][03]	1
114	Journal of Cleaner Production	[02]	1
115	Journal of Communication Management	[02]	1
116	Journal of Competitiveness	[03]	1
117	Journal of Consciousness Studies	[02]	1
118	Journal of Consumer Research	[02]	1
119	Journal of Decision Systems	[02][03][12]	3
120	Journal of Destination Marketing and Management	[02]	3
121	Journal of Economic Behavior and Organization	[13]	1
122	Journal of Economic Perspectives	[02]	1
123	Journal of Global Business Management	[08]	1
124	Journal of Global Information Technology Management	[04]	1
125	Journal of Industrial Information Integration	[07]	1
126	Journal of Information Technology	[04][06][13]	12
127	Journal of Information Technology Theory and Application	[06][10]	2
128	Journal of Innovation Management	[03]	1
129	Journal of Intellectual Capital	[02]	1
130	Journal of Interactive Marketing	[02]	1
131	Journal of Knowledge Management	[02]	3
132	Journal of Legal Medicine	[07]	1
133	Journal of Machine Learning Research	[10]	1
134	Journal of Management	[06]	1
135	Journal of Management Information Systems	[02][06][09][10][11][13]	7
136	Journal of Managerial Issues	[01]	1
137	Journal of Manufacturing Systems	[02]	1
138	Journal of Manufacturing Technology Management	[01]	1
139	Journal of Marketing Research	[10]	1
140	Journal of Medical Internet Research	[07]	2
141	Journal of Operations Management	[06]	1
142	Journal of Organizational Behavior	[13]	2
143	Journal of Product Innovation Management	[02][03][13]	5
144	Journal of Purchasing and Supply Management	[02]	1
145	Journal of Service Research	[02]	1
146	Journal of Scientific and Industrial Research (JSIR)	[11]	1
147	Journal of State Taxation	[06]	1
148	Journal of Strategic Information Systems	[02][04][06][11][12][13]	14
149	Journal of Systems Science and Systems Engineering	[02]	1
150	Journal of Technology Transfer	[02]	1
151	Journal of the American Dental Association	[05]	1
152	Journal of the American Society for Information Science and Technology	[02]	1
153	Journal of the American Statistical Association	[10]	1
154	Journal of the Association for Information Systems	[06][09][10]	7
155	Journal of the Operations Research Society of China	[02]	1
156	Journal of the Royal Statistical Society	[10]	
157	Journal of Theoretical and Applied Electronic Commerce Research	[03][06]	1
158	Journal of Transformative Education	[12]	1
159	Leadership and Management in Engineering	[08]	1
160	Leadership Quarterly	[13]	1
161	Lecture Notes in Business Information Processing	[05][11]	2
162	Lecture Notes in Computer Science	[10][11]	2
163	LMU Munich, Munich School Management	[01]	1
164	Long Range Planning	[02]	1
165	Management Decision	[01][02][06][12][13]	4
166	Management Revue	[03]	1
167	Management Science	[02][06][13]	7
168	Managerial and Decision Economics	[06]	1
169	Manufacturing Systems and Technologies for the New Frontier	[02]	1
170	Marketing Intelligence Review	[06]	1
171	Medical Teacher	[02]	1
172	McKinsey&Company/McKinsey Quarterly	[01][07]	5
173	Millennium: Journal of International Studies	[02]	1

	Journals	SLRs on which a journal appeared	# studies
174	MIS Quarterly (Management Information Systems)	[01][02][03][04][05][06][09][10][11][12][13]	58
175	MIS Quarterly Executive	[01][02][04][05][06][07][08][11][12][13]	17
176	MIT Center for IS Research	[11]	1
177	MIT Sloan Management Review	[02][03][04][05][06][08][09][11][12]	27
178	NetworkWorld Asia	[06]	4
179	New Economic Windows	[06]	1
180	Northwestern Journal of International Law and Business	[06]	1
181	Oil & Gas Journal	[07]	1
182	Operations Report	[01]	1
183	Organization Management Journal	[13]	1
184	Organization Science	[01][04][06][09][10][13]	3
185	Patient Education and Counseling	[02]	1
186	Pattern Recognition	[02]	1
187	Pattern Recognition Letters	[02]	1
188	Philosophy and Technology	[06]	1
189	Physician executive	[05]	1
190	Procedia CIRP	[02][04][12]	3
191	Procedia Computer Science	[08]	1
192	Procedia Manufacturing	[01][08]	1
193	Production Planning and Control	[02][03]	4
194	Public Management Review	[06]	1
195	R and D Management	[02]	2
196	Research Journal of Textile and Apparel	[07]	1
197	Research Policy	[02][06][09][13]	5
198	Research Technology Management	[02][09][13]	3
199	Review of Finance and Banking,	[08]	1
200	RFID Journal	[02]	1
201	Scandinavian Journal of Information Systems	[06][10]	2
202	Security Dialogue	[02]	2
203	Service Industries Journal	[01]	1
204	Service Science	[02]	1
205	Sociologia Ruralis	[02]	1
206	Software and Systems Modeling	[06]	1
207	Space Policy	[02]	1
208	Sprouts: Working Papers on Information Systems	[02]	1
209	Strategic Change	[02][03][10]	3
210	Strategy & Leadership	[03][04][05][12]	5
211	Strategic Management Journal	[06][10][13]	11
212	Systems Research and Behavioral Science	[02]	1
213	Systems Engineering	[10]	1
214	Techné: Research in Philosophy and Technology	[09]	1
215	Technology Forecasting & Social Change	[02][08][12]	7
216	Technology Innovation Management Review	[01][03][08]	3
217	Technovation	[02][09]	2
218	Telecom Business Review	[03]	1
219	The DATABASE for Advances in Information Systems	[06]	1
220	The International Journal of Logistics Management	[02]	1
221	Tourism and Hospitality Research	[01]	1
222	Tourism Management	[01]	1
223	Value in Health	[01]	1
224	Young Economists Journal	[06]	1
225	World Journal of Computer Application and Technology	[12]	1

Table 24 – List of Journals

Conferences

The most frequent conferences considering an analysis of two aspects: (1) number of studies and (2) number of reviews on which a conference appeared.

- International Conference on Information Systems (ICIS) (53 studies and 8 out of 13 reviews);

- Hawaii International Conference on System Sciences (35 studies and 10 out of 13 reviews);

- European Conference on Information Systems (ECIS) (34 studies and 7 out of 13 reviews);

- Americas Conference on Information Systems (29 studies and 5 out of 13 reviews);

- International Conference on Wirtschaftsinformatik (12 studies and 4 out of 13 reviews);

- Pacific Asia Conference on Information Systems (PACIS) (12 studies and 4 out of 13 reviews);

- Bled eConference (11 studies and 5 out of 13 reviews); and

- Mediterranean Conference on Information Systems (MCIS) (7 studies and 7 out of 13 reviews).

A total of 47 events were identified as listed below. The table also lists for each event which selected SLRs they are presented. Finally, the total number of studies in which the event appeared is presented.

#	Conferences	# studies	Reviews on which a conference appeared
1	ACM Conference on Designing Interactive Systems	1	[12]
2	Americas Conference on Information Systems	29	[02][06][09][10][13]
3	Annual Conference on Information Technology Education	1	[08]
4	Annual International Conference on Business Strategy	1	[12]
5	Annual International Conference on Digital Government Research: Governance in the Data Age	1	[08]
6	Annual Meeting of the Academy of Management	1	[09]
7	Australasian Conference on Information Systems	2	[01][10]
8	Bled eConference	11	[01][02][03][06][12]
9	Central European Conference on Information and Intelligent Systems	1	[05]
10	Conference on Human Computer Interaction	1	[08]
11	Conference on Internet of Things and Business Models, Users, and Networks	1	[08]
12	Digital Innovation, Technology, and Strategy Conference	2	[06]
13	Digital Transformation and Global Society	1	[08]
14	DRUID	1	[08]
15	European Conference on Information Systems (ECIS)	34	[01][02][06][09][10][11][13]
16	European Conference on Information Systems Management	1	[08][11]
17	European Conference on Information Systems Management and Evaluation	1	-
18	European Conference on Knowledge Management	1	[09]
19	Hawaii International Conference on System Sciences	35	[01][02][04][05][06][08][09][10][11][13]
20	IEEE/ACM Joint 5th International Workshop on Software Engineering for Systems-of-Systems and 11th Workshop on Distributed Software Development, Software Ecosystems and Systems-of-Systems (JSOS)	1	[07]
21	IEEE/ACS International Conference on Computer systems and Applications	1	[08]
22	IEEE Global Engineering Education Conference (EDUCON)	1	[07][09]
23	IEEE Conference on Business Informatics	2	[08]
24	IEEE International Conference on Emerging Technologies and Innovative Business Practices for the Transformation of Societies	1	[08]
25	IEEE International Conference on Engineering, Technology and Innovation	1	[01]
26	IEEE International Requirements Engineering Conference	1	[08][11]
27	IFIP Working Conference on The Practice of Enterprise Modeling		[11]
28	International ACM SIGGROUP Conference on Supporting Group Work	1	[09]
29	International Conference of Education, Research and Innovation	1	[07]
30	International Conference on Design Science Research in Information Systems and Technology	3	[08][10]
31	International Conference on Information Resources Management	2	[06]
32	International Conference on Information Systems (ICIS)	53	[01][02][04][06][08][09][10][12]
33	International Conference on Information System and Artificial Intelligence	1	[02]
34	International Conference on Intelligent Environments	1	[06]
35	International Conference on Machine Learning	1	[10]

36	International Conference on Mobile Business	1	[06]
37	Joint International Information Technology, Mechanical and Electronic Engineering and Advances in Engineering Research	1	[11]
38	International Conference on Software Engineering and Information Management	1	[08]
39	International Conference on Subject-Oriented Business Process Management	1	[08]
40	International Conference on Smart Energy Research	1	[08]
41	International Conference on Wirtschaftsinformatik	12	[06][09][10][12]
42	International Workshop on Governance, Risk and Compliance	1	[10]
43	Mediterranean Conference on Information Systems (MCIS)	7	[01][03][06][08][10][11] [12]
44	Pacific Asia Conference on Information Systems (PACIS)	12	[06][10][12][13]
45	Symposium on Applied Computing	1	[10]
46	World Conference on Information Systems and Technologies	2	[08]
47	Workshop on Domain-Specific Visual Languages and ACM OOPSLA	1	[10]

Table 25 – List of Conferences

IV. Additional Analysis

Digital Transformation Definitions

SLR	DT Definition Analysis
Teichert (2019)	The review did not have the intention to derive a DT definition but presented different definitions existing in the literature. Two references were pointed out as good definitions of digital transformation (Henriette et al.(2016)* and of Morakanyane et al.(2017)**). - Morakanyane el at (2017) - *digital transformation is "an evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value"* - Henriette et al. (2016) – *"in the context of using and adopting digital technology a holistic transformation of an organization is required in order to create value".* References:* Henriette, E., Feki, M. and Bouchzala, I. 2016. Digital Transformation Challenges. In: MICS Proceedings 2016. Mediterranean Conference on Information Systems. AIS. /**Morakanyane, R., Grace, A. and O'Reilly, P. 2017. Conceptualizing Digital Transformation Business Organizations – A Systematic Review of Literature. 30thBled eConference.Bled, Slovenia.
Hausberg et al. (2019)	The review did not have the intention to derive a DT definition but presented different definitions existing in the literature to point out the technological aspect as a "driver of radical change" but also underlined DT impacting people, society and a whole organization. *"In summary, the DT of business leads to three significant changes* (Fitzgerald et al.(2014)*; Liere-Netheler et al. (2018)**) *(1) digitally supported and cross-linked processes, (2) digitally enabled communication, and (3) new ways of value generation based on digital innovations or gained digital data. These major changes can be found worldwide and in all industries."* The authors highlighted that *"in order to improve our understanding of possible implications of DT, it is critical to overcome uncertainties and to develop further a common understanding of this field." "However, a generally valid definition for the concept of digital transformation does not yet exist."* References: *Fitzgerald M, Kruschwitz N, Bonnet D, Welch M (2014) Embracing digital technology: a new strategic imperative. MIT Sloan Manag Rev 55:1–12/** Liere-Netheler K, Packmohr S, Vogelsang K (2018) Drivers of digital transformation in manufacturing. In: Proceedings of the 51st Hawaii international conference on system sciences. Honululu, USA, Shidler College of Business, 2018. p. 3926-3935.
Babar and Yu (2019)	The review did not have the intention to derive a DT definition but presented some definitions existing in the literature. It also presented its own interpretation of the DT phenomenon: "*Digital transformation affects products and services offered by the enterprise, the processes that produce those products and services, as well as the overall organization structure. For these enterprises, new disruptive digital models may result through the use of advanced technology and software which may both substitute or complement the traditional business model.*"
Brown and Brown (2019)	The review did not have the intention to derive a DT definition but presented different definitions existing in the literature and discussed some related concepts as digital business strategy and digital transformation strategy. "*Digital transformation is described as bringing about massive business improvement through deploying new innovative business models, optimizing operations and enhancing the value and experience for customers, through including in the business process, digital technologies such as embedded devices, social media, mobile, cloud, analytics and Internet of Things* (Matt et al., 2015)*". References: *Matt, C., Hess, T. and Benlian, A. 2015. Digital Transformation Strategies Business & Information Systems Engineering 57, 5 (2015), 339–343.
Pihir et al. (2019)	The review did not have the intention to derive a DT definition but presented its own definition: "*Digital transformation of enterprises is a new paradigm in both, IT and business world. The main goal of DT is to change organizations by implementing contemporary technologies and introduce new business processes in order to create new or improve existing products and services and deliver them to the global market faster, cheaper and in new innovative ways".*
Vial (2019)	The review derived a new definition based on previous definitions existing in the literature and using a semantic analysis, "systematically decomposing extant definitions into series of constituting primitives and compared those primitives across definitions to identify essential properties of DT: (1) target entity, i.e., the unit of analysis affected by DT; (2) scope, i.e., the extent of the changes taking place within the target entity's properties; (3) means, i.e., the technologies involved in creating the change within the target entity; and (4) expected outcome, i.e., the outcome of DT". Digital transformation is "*a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies.*"
Kutnjak et al. (2019)	The review did not have the intention to derive a DT definition but presented its own definition: "*Digital transformation is a complex and demanding process that requires the engagement of all enterprise resources - human, technological, physical, organizational and financial. It marks the digitalization and its implementation throughout the organization with a special focus on people and business processes. DT is the transformation of an organization driven by digital technology, and it directly affects the change of organization's core, that is, the change of its business model. As such, organizations open up possibilities for new business opportunities, innovations in product and/or service creation and opportunities to acquire new knowledge. One of the important factors of a successful DT is certainly an adequate digital strategy, tailored to the corporate structure.*"
Gebayew et al. (2018)	The review did not have the intention to derive a DT definition but presented different definitions existing in the literature. It also presented its own definition: "*The idea of the digital transformation divides into "digital" and "transformation". The term "digital" is used to be identical with "information technology". Nowadays, the term "digital" is a synonym for the pace of change that's occurring in today's world driven by rapid adopted of technology. The term "transformation" means that digital usages integrally enable new types of innovation and creativity in a particular domain, rather than just enhance and support traditional methods".*

Bockshecker et al. (2018)	The review derived a new definition based on previous definitions existing in the literature and discussing the similarities and differences among related terms: Digitalization, Digitization and Digital Transformation (DT). "These terms oftentimes share some similarities, but are also differing, even contradictory in other aspects". "Digitalization and DT enable the social and technical development of phenomena. The phenomena include changes in the behavior of society representing the social components of an STS. Furthermore, phenomena need a technological basis for their implementation. The phenomena trigger the process of DT as they allow for organizations to adopt social as well as technical changes". Digitization is "the technological transformation of "analog information into digital format" (Freitas Junior et al., 2016)* including the development of digital infrastructure. Objects of digitization are technological processes and "artefacts with their features, functionalities, and affordances" (Jackson, 2015)**". Digitalization is "the state of an organization or a society referring to its current digital development and usage of ICT innovations. Digitalization takes into account social as well as technical elements". Digital Transformation is "*the process of organizational or societal changes driven by innovations and developments of ICT. DT includes the ability to adopt technologies rapidly and affects social as well as technical elements of business models, processes, products and the organizational structure*". References: *Freitas Junior, J. C., A. C. Maçada, R. Brinkhues, and G. Montesdioca (2016). "Digital Capabilities as Driver to Digital Business Performance." In: Proceedings of the 22nd Americas Conference on Information Systems (AMCIS 2016). august 11-14. San Diego, California, USA./**Jackson, P. J. (2015). "Networks in a Digital World: A Cybernetics Perspective." In: Proceedings of the 23rd European Conference on Information Systems (ECIS 2015). may 26-29. Muenster, Germany.
Kutzner et al. (2018)	The review did not have the intention to derive a DT definition but presented different definitions existing in the literature and uses the follow definition: "*Digital transformation focuses on the key of business operations, it incorporates changes in products, processes, organizational structures and management concepts (Matt et al., 2015)*, and thus, is virtually a holistic concept of a firm. Therefore, on a strategical level, four main dimensions should be considered, namely: use of technology (e.g., ability to adopt new technological standards), changes in value creation (e.g., business model), structural changes (e.g., skills, organizational setup and products) and finance (e.g., as a driver or bounding force) (Matt et al., 2015). Accordingly, there is a need for being transformable on various levels, which is further emphasized by many researchers and practitioners.*" Other terms related to DT that were used in the study: **Business transformation** and **Digitalization**. The authors highlighted that: "*although digital transformation is of growing interest, it is still an emerging field and "the term [digital transformation] lacks a clear definition" (Haffke et al., 2016)**.* *No consolidated overview exists that structures the field of digital transformation and we currently lack of a well-accepted definition only limited studies aim to structure and specify the concept of digital transformation.*" Reference: * Matt, C., Hess, T. and A. Benlian (2015). "Digital transformation strategies". Business & Information Systems Engineering 57 (5), 339-343./ ** Haffke, I., Kalgovas, B. and A. Benlian (2016). "The Role of the CIO and the CDO in an Organization's Digital Transformation." In: Proceedings of the International Conference on Information Systems. Dublin: Ireland.
Reis et al. (2018)	The review derived a new definition based on previously definitions existing in the literature: "*Digital Transformation is the use of new digital technologies that enables major business improvements and influences all aspects of customers' life*". The analysis of different definitions for Digital Transformation (DT) was categorized in three distinct elements: "(1) Technological – DT is based on the use of new digital technologies such as social media, mobile, analytics or embedded devices; (2) Organizational – DT requires a change of organizational processes or the creation of new business models; (3) Social – DT is a phenomenon that is influencing all aspects of human life by e.g., enhancing customers experience."
Morakanyane et al. (2017)	The review derived a new definition based on previously definitions and the concept centric matrix developed: "*Digital transformation is "an evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value*". It was proposed a pattern that suggests that digital transformation is: "*… something with certain characteristics; that is driven by something; to create certain impacts; on certain aspects of the organization*". Something: strategy, process, business model and paradigm shift - Characteristics: radical, disruptive, evolutionary/continuous, complex - Drivers: digital technologies, digital capabilities, strategies, business models, value chain - Key impacts: value creation (reshapes, realign, redefine, integrate, collaboration), operational efficiency (optimize processes, omnichannel, agility, improved decision, making structural change), create competitive advantage, improved relationships (enhance customer experience, engagement) - Transformed areas: business models, operational processes, customer experiences, employees, culture, infrastructure).
Berghaus (2016)	The review did not have the intention to derive a DT definition but presented its own definition: "*Digital transformation can be seen as innovation process of an organization. It is defined as transformation at the organizational level that is disruptive, rather than a continuous learning process, which simultaneously affects multiple areas within the organization and requires a re-definition of the corporate strategy. Digital business transformation can be seen as a major reorientation for the organization and therefore has an extremely wide scope and a disruptive impact.*"

Table 26 – List of DT definitions

By analyzing these definitions it was possible to identify key terms that appeared several times. These terms were identified considering individual and groups of terms that are remarkable in the DT definitions and were used to conceptually define DT and its properties, characteristics and effects. Simple categories were used to organize the terms and word frequency was derived. These simple categories can derive different analysis perspectives or dimensions: conceptual terms; technological perspective; business perspective; process types; impacted entities; DT description/characteristics; and DT results.

Conceptual terms		Social	6
Digital	21	Human life	1
Digitization	3	Worldwide	1
Digitalization	6	Global market	1
Process Types		Competitive advantage	1
Process	22	Industry	1
Evolutionary Process	2	Organization	14
Optimize process	1	Organizational	8
Operational Process	3	Enterprise	4
Technological process	1	Corporate	2
Organizational process	1	Firm	1
Business Process	3	Management concepts	1
Digitally supported process	1	Finance	1
Cross-linked process	1	**Competences – Skills – Hability**	
Operational Efficiency	1	(Digital) Capability	3
Technological aspect		Skills	1
Tech (26)	26	Employess	1
Technical (4)	4	Culture	1
Digital Technology (8)	8	**Organizational elements**	
Technological (4)	4	Structur(e/al)	6
Technological Aspect		Infrastructure	2
Technological Basis		Resource	1
Technological transformation		Human resource - Technological resource	
Technological standards		- Physical resource - Organizational resource -	
Technology	4	Financial resource	
Advanced technology	1	**Impacts**	
Contemporary technology	1	Change	16
Information technology	2	Transformation	14
Software	1	Innovation	6
IT world	1	Innovative ways	1
Analog information	1	Disruptive	4
Digital data	1	Impact	4
embedded devices	2	Affect	4
social media	2	Improve (2)	2
mobile	2	Reshape	1
Cloud	1	Realign	1
analytics	2	Redefine	1
Internet of Things	1	Integrate	1
Computing	1	Reorientation	1
Connectivity technology	1	Driver	3
Business topics		Paradigm	2
Business	22	Phenomena/Phenomenon	5
(digital) Business transformation	2	Strategy	3
Business improvement	2	Holistic	2
Business Model	11	Radical	2
Customer aspects		Complex	2
Customer Experience	6	Evolutionary	3
Engagement	2	Continuous	2
Customer Life	1	Possibility	1
Omnichannel	1	Opportunity	2
(Business) Value		Bounding force	1
Value	8	**Others**	
Value generation/creation-create/	5	Agility	1
Enhancing the value/ Value chain		Knowledge	1
Communication		Creat	1
(Digitally enabled) Communication	2		
Improved relationships	1		
Collaboration	1		
Transformed elements			
Product	7		
Service	4		
Operation	2		
People	2		
Society	4		
Behavior	1		

Table 27 – List of key terms in DT definitions

Analysis of terms in Search Strings and Reviews' keywords

ID	SLR	Keywords - Search String	Review's keywords
1	Teichert (2019)	"Digital Maturity", "Digital Transformation + Digital Maturity", "Digital Transformation Maturity", "Digital Maturity Levels", "Digital Transformation Efforts", "State of Digital Transformation", "Stages of Digital Transformation", "Digital Transformation Progress", "Phases of Digital Transformation"	"systematic literature review", "digital transformation", "digital maturity", "digital maturity models", "digital transformation maturity", "digital culture"
2	Hausberg et al. (2019)	OR (Cyber-physical-system/Digital transformation/Cloud computing/Machine-to-machine communication/Machine learning/Augmented reality/Virtual reality/Artifcial intelligence/Internet of things/Industry 4.0/Industrie 4.0/Cloud manufacturing/Big data/Smart factory/Advanced production system) AND OR(Management/Organization/Efifciency/ Efectiveness/Efficacy/Key performance idicator/ Controlling/Logistic/ Strategy/Human resources/Finance/Marketing/Sales/Key markets/Value chain/Accounting	"Citation-network analysis", "Digital transformation", "Gephi", "Systematic review"
3	Babar and Yu (2019)	"Digital Transformation"	"enterprise architecture", "enterprise modeling", "digital transformation", "requirements engineering"
4	Brown and Brown (2019)	"Digital Strateg*", "Digital Business Strateg*", "Digital Transformation"	"Digital Business Strategy"," Digital Transformation Strategy", "Digital Technology"
5	Pihir et al. (2019)	"Digital Transformation"	"digital transformation", "literature review", "framework", "concepts", "digital transformation playground"
6	Vial (2019)	Combinations of keywords containing the terms "digital" and "transform" or "disrupt"	"Digital transformation", "IS strategy", "Literature review", "Digital technologies", "Organizational transformation", "Digital innovation"
7	Kutnjak et al. (2019)	"Digital Transformation"	"digital transformation"; "literature review"; "case study"; "industries"
8	Gebayew et al. (2018)	"Digital Transformation"	"DigitalTransformation", "Business Strategy", "Business Process", "Systematic Literature Review"
	Bockshecker et al. (2018)	digitalization OR "digital transformation"OR digitization	digitization, digital transformation, digitalization, literature review.
10	Kutzner et al. (2018)	"digital transformation" AND ("Classification" OR "Taxonomy")	" Digital Transformation", "Taxonomy", "Cluster Analysis", "Literature Review"
11	Reis et al. (2018)	"Digital Transformation"	"Digital Transformation", "Business strategy", "Processes Operations", "Systematic literature review"
12	Morakanyane et al. (2017)	"digital business strategy", "digital transformation" ,"digitalization", "IT-enabled Organizational Transformation", "IT-enabled Enterprise Transformation"; "digital technologies"	"digital business strategy", "digital transformation" ,"digitalization", "IT-enabled Organizational Transformation", "IT-enabled Enterprise Transformation"; "digital technologies"
13	Berghaus (2016)	"organi?ational change" AND ("strategy formulation") OR ("strategy formation") OR ("strategic planning") "organi?ational change" AND ("strategy formulation") OR ("strategy formation") OR ("strategic planning") AND (technology OR digital)	"Digital Transformation", "Organizational Change", "Strategy Formulation", "Strategic Planning", "Strategy Formation", "Fuzzy Front-End", "Literature Review"

Table 28 - List of terms and keywords extracted from each review

Number of occurrences of each identified term and its related reviews

Keywords - Search String	#	#	Review's keywords	References
"digital transformation"	12	12	"digital transformation"	All reviews
"digitalization"	2	2	"digitalization"	Bockshecker et al. (2018) and Morakanyane et al. (2017)
"digitization"	1	1	"digitization"	Bockshecker et al. (2018)
"disrupt"	1	-	-	Vial (2019)
-	-	1	"Digital Innovation"	Vial (2019)
organi?ational change AND ("strategy formulation") OR ("strategy formation") OR ("strategic planning")	1	1	"Organizational Change", "Strategy Formulation", "Strategic Planning", "Strategy Formation", "Fuzzy Front-End"	Berghaus (2016)
"digital business strategy"/"Digital Business Strateg*"	2	2	"digital business strategy"	Brown and Brown (2019) and Morakanyane et al. (2017)
-	-	2	"Business Strategy", "Business Process", "Processes Operations"	Gebayew et al. (2018) and Reis et al. (2018)
-	-	1	"enterprise architecture", "enterprise modeling", "requirements engineering"	Babar and Yu (2019)
"Digital Strateg*"	1	-	-	Brown and Brown (2019)
-	-	1	"Organizational transformation"	Vial (2019)
-	-	1	"Digital Transformation Strategy"	Brown and Brown (2019)
"IT-enabled Organizational Transformation"	1	1	"IT-enabled Organizational Transformation"	Morakanyane et al. (2017)
"IT-enabled Enterprise Transformation"	1	1	"IT-enabled Enterprise Transformation"	Morakanyane et al. (2017)
-	-	1	"IS strategy"	Vial (2019)
(technology OR digital) / "digital technologies"	2	3	"Digital technologies"	Berghaus (2016), Morakanyane et al. (2017), Brown and Brown (2019), Vial (2019)
OR (Cyber-physical-system/Digital transformation/Cloud computing/Machine-to-machine communication/Machine learning/Augmented reality/Virtual reality/Artifcial intelligence/Internet of things/Industry 4.0/Industrie 4.0/Cloud manufacturing/Big data/Smart factory/Advanced production system) AND OR(Management/Organization/Efifciency/Efectiveness/Efficacy/ Key performance idicator/ Controlling/Logistic/ Strategy/Human resources/Finance/Marketing/Sales/Key markets/Value chain/Accounting)	1	-	-	Hausberg et al. (2019)
"Digital Maturity", "Digital Transformation Maturity", "Digital Maturity Levels", "Digital Transformation Efforts", "State of Digital Transformation", "Stages of Digital Transformation", "Digital Transformation Progress", "Phases of Digital Transformation"	1	1	"digital maturity models", "digital culture"	Teichert (2019)

* The blue lines show terms that are treated in both the search string and keywords. The remaining lines deal with terms used only in one of the word groups.

Table 29 - Keywords analyzed

Main Research and Application/Industry Areas

Research and industry areas

Innovation, Manufacturing, Analytics, Society, Supply chain, Knowledge management, Tourism, Marketing and Finance (Hausberg et al., 2019)

Books, Governance, Public Service, Enterprise Architecture, Education, Market, Automotive (Gebayew et al., 2018).

Information Systems, Business economics, Education, Management Science, Government (Reis et al., 2018)

Top 10 research areas: Business economics, Computer Science, Engineering, Information Science Library Science, Education Educational research, Social Sciences other topics, Automation control systems, Communication, Government Law, and Health care Science services (Kutnjak et al., 2019). The manufacturing industry and the public sector are the most popular fields (Kutzner et al., 2018)

Case study researches in digital transformation according to industry (classification according to NACE): Information and Communication, Manufacturing, Education, Human Health and Social Work Activities, Electricity – Gas – Steam and Air Conditioning Supply, Wholesale and retail trade, repair of Motor Vehicles and Motorcycles, Professional – Scientific and Technical, Public Administration and Defense, Administrative and Support Service, Agriculture – Forest and Fishing, Water Supply – Sewerage, Transportation and Storage. Financial and Insurance activities, Art – Entertainment and Recreation, Other Service activities (Kutnjak et al., 2019)

Manufacturing industry and public sector are the most popular fields.

Topics such as strategic alignment (e.g., performance, business strategy, process and enterprise architecture), people (e.g., certain actors and different forms of collaboration, knowledge), culture issues (e.g., culture values and workplace identity), information technologies (e.g., big data and IT security) as well as use of models (e.g., maturity model and research model) to solve research problems are identified. Performing a cluster analysis, we discovered certain areas of digital transformation: (I) digital business strategies and business models, (II) working culture in a digitized environment, (III) digital innovations and technologies as well as (IV) knowledge as driver for digitalization.

The research areas identified pointed out that DT "covers a variety of industries and fields of human activities", with more attention to the computer science field "but also in all other fields of human activities, especially in: business, engineering, social sciences, information science, library science, education and educational research, decision science, medicine, protection of environment, law, material science, etc." (Pihir et al., 2019).

Countries that most contributed according to analysis carried out in the selected reviews

- United States of America, Germany and China (Reis *et al.*, 2018)

- Germany, United States of America, Russia, England, France, Sweden, Finland, Poland, Argentina, Austria (Kutnjak *et al.*, 2019)

SLR Researchers' Additional Production

The data analyzed in this section were collected from electronic database Scopus in June/July, 2020. The production was analyzed considering the first author of the selected DT SLRs. In some cases, complementary information was gathered analyzing authors' academic or professional pages as the additional papers mentioned below, which refers to documents published but not indexed by Scopus. The idea was to identify research networks, further DT publications and continuous work in the area.

Sabine Berghaus published three other papers in conferences (2014 to 2017), with one co-author, her adviser *Andrea Back from University of St.Gallen - Switzerland.* Only one of the papers was published after the identified SLR and can be considered an extension of application of the fuzzy front end concept to digital transformation[26]. This was the theme of her dissertation published in 2018[27], which was her last identified publication. Other themes treated were mobile business solutions and wearable devices. The four papers related to Berghaus were cited thirteen times in twelve documents from 2015 to 2019. Digital maturity was another theme treated by the author and it has been discussed in Digital Transformation Reports produced by University of St.Gallen and in one additional publication[28]. From the authors related to the SLRs identified in this review, only Vial cited the two Berghaus publications directly related to DT.

Resego Morakanyane published three papers including the selected SLR. The other two papers were published before the SLR and were not directly related to DT. More recently, an additional paper related to DT was published in a conference[29] with one more co-author, *John McAvoy - University College Cork*. The co-author *Audrey Grace* published fourteen documents with topics related to learning management systems, service co-creation, wellness, health and social care. *Philip O'Reilly* has sixty-five documents including topics as blockchain, bitcoins, social media, crowdfunding platforms, marketplaces, and healthcare, among others. The only collaboration among these authors was the DT SLR.

João Reis has twenty-two documents indexed by the database, including the DT SLR. This set of publication was developed with additional thirteen co-authors beyond the three presented in SLR. The most collaboration is made with *Nuno Melão* (11 documents) and *Marlene Amorim* (11 documents). Other themes investigated by the author involve multi-channel/omni-channel services, artificial intelligence in public administration, gender inequalities, and military topics, among others.

Kristin Kutzner published three documents including the DT SLR. This author collaborated with the two co-authors (*Thorsten Schoormann* and *Ralf Knackstedt*) in the other two publications with topics related to cultural artefacts and sustainability in business models.

Alina Bockshecker published four documents with two co-authors (*Sarah Hackstein* and *Ulrike Baumöl*). The documents include the DT SLR and other publications related to digital learning in higher education and business model for public enterprises. Other six co-authors also worked with Bockshecker in one publication.

Chernet Gebayew has two documents indexed including the SLR and another about enterprise architecture, not direct related to DT. Briefly investigating the four co-authors (*Hardini, I.R., Panjaitan, G.H.A., Kurniawan, N.B.* and *Suhardi*) publications, any other document directly related to DT was identified.

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[26] Berghaus, S., and Back, A. 2017. "Disentangling the fuzzy front end of digital transformation: Activities and approaches," International Conference of Information Systems, Seoul, South Korea.

[27] "The Fuzzy Front End of Digital Transformation. Activities and Approaches for Initiating Organizational Change Strategies" - PhD in business innovation (2018) - Institute of Information Management at the University of St.Gallen.

[28] Berghaus, S., & Back, A. (2016). Stages in Digital Business Transformation: Results of an Empirical Maturity Study. 10th Mediterranean Conference on Information Systems (MCIS 2016). Paphos, Cyprus.

[29] Morakanyane, R., O'Reilly, P., McAvoy, J., & Grace, A. (2020, January). Determining Digital Transformation Success Factors. In Proceedings of the 53rd Hawaii International Conference on System Sciences.

Kutnjak has only the DT SLR as a document indexed in database with two co-authors who were the same of another DT SLR in this review set (*Pihir* and *Furjan*). *Igor Pihir* has 19 documents and beyond the two DT SLRs, he has four other publications related to DT[30].

Vial has been investigating different themes including agility, database, teaching programming. The only paper directly related to DT is the identified SLR with no co-author.

Nancy Brown has two documents indexed, which one of them is the SLR and the other is not direct related to DT. The only co-author is *Irwin Brown* which has a diverse range of publications with different topics.

Zia Babar has published some documents related to i* framework, process architecture and software process configurations, enterprise adaptability among other themes. Beyond the DT SLR, another paper was published with the same co-author in 2015 about enterprise architecture in DT context[31].

Johann Piet Hausberg has a total of five documents with different topics investigated as crowdfunding, business incubators and accelerators, open source hardware development and the identified DT SLR. Beyond the SLR four co-authors, four researchers established collaboration, one by paper published. Although the only document directly related to DT was the SLR. Briefly investigating the co-authors is possible to identify some works related to DT in manufacturing context as Industry 4.0 topic treated by three authors (*Kirsten Liere-Netheler, Sven Packmohr* and *Kristin Vogelsang*) and an additional co-author – *Uwe Hopper*. Other themes investigated consider flipped classroom, blended learning environment, and social media. *Stefanie Pakura* has been working with open innovation, entrepreneurs and startups topics.

The only document indexed to *Roman Teichert* was the identified SLR with one citation. Also, there was no collaboration with other researchers.

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[30] (1) Furjan et al. (2020) "Understanding Digital Transformation Initiatives: Case Studies Analysis". In: Business Systems Research 11(1), pp. 125-141. (2) Hrustek et al. (2019) "Influence of digital transformation drivers on business model creation". In: Proceedings of 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2019 - pp. 1304-1308. (3) Furjan et al. (2019) "Digital transformation playground operationalization – How to select appropriate technologies for business improvement initiatives". In: Proceedings of CEUR Workshop - pp. 61-71. (4) Tomičić-Pupek et al. (2019) "Smart City initiatives in the context of digital transformation - scope, services and technologies. In: Management (Croatia) 24(1), pp. 39-54.

[31] Babar, Z., & Yu, E. (2015, June). Enterprise architecture in the age of digital transformation. In International Conference on Advanced Information Systems Engineering (pp. 438-443). Springer, Cham.

Conclusions

After analyzing these studies, it was possible to conclude that DT is an emergent and complex phenomenon with many challenges. It is a multidisciplinary process which deals with more than just a technological perspective. Strategy management, innovation management, business process management, software process development, organizational management, people management and talent development are some of the areas that need to work together and practices need to be aligned.

Although there is no common or general model to be followed, this study can highlight some aspects to the debate presented as follow.

1. Drivers – internal or external factors which impose actions of organization or individuals – Some factors lead to responses in order to change the environment aiming to take some advantage or to keep a scenario viable;
2. Implementation structure – elements or attributes that enable the DT process to be executed;
3. Transformed elements - elements or attributes affected by DT process implementation; and
4. Impacts – positive or negative DT outcomes. This involves the results or outcomes of a DT.

This report is a first step in a broader research. Many topics need to be better investigated both in the areas mentioned above and also in other research opportunities.

To be considered a successful project many aspects need to be understood and need to be addressed in a DT endeavor. Investigations should be performed to identify relations among the areas mentioned and analyze how DT challenges are being faced in current practical scenarios.

Drivers Elemenst or attributes that influence the DT process	**Implementation** Elements or attributes that enable the DT process	**Transformed elements** Elements or attributes affected by DT process implementation	**Impacts** Positive /negative Customer-focused /organization-focused
Environmental factors Practices spread in other organizations	Digital Strategy (Technolocy use, business process change and structural change)	Products Corporate Portfolio	Value creation
Competition Competitive context shifts	Management practices	Services	Increase customer experience and satisfaction Enhancing customer experiences
New markets Non-traditional sectors Market changes	Method (Tools and steps) Smaller steps of action and readjusting Incremental change	Processes	Creating new business models Enhanced business models
	Digital Models Digitally-based business models		Improvement in Productivity Improving operational processes
	Digital technologies Technological changes	Business models	Increase revenue from products and services
Customer Changing behavior of customers New customers needs	Digitization of physical assets and integration into digital ecosystems	Organizational Strucutre	Strategic differentitation
	Financial aspect (incentive or bounding force)		Competitive advantage
		People (Customer - Worker - Partner)	Improved stakeholder relationships
Digital technologies Technological changes (foundation of all DT efforts)	Human capital with digital intelligence Talent and skills development Training and Education Mindset and culture	Customer experience	Ramification to other business sections
			Cost reduction/savings
			IT/IS integration

Figure 6 – DT characteristics and key elements

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Appendix I - Data Extraction

I.1. Data Extraction of selected papers

Data Extraction Form (see Section Research Protocol - Data Extraction Form)

Teichert (2019)

This paper was cited by	0	1
This paper cited	1	Morakanyane *et al*. (2017)
Authors	Teichert, R. Department of Management, Faculty of Business and Economics, Mendel University in Brno, Czech Republic	
Venue	Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis	
Year	2019	
Keywords	systematic literature review, digital transformation, digital maturity, digital maturity models, digital transformation maturity, digital culture	
Number of references	50	
Observations: More information see Section Question Formulation - Topic, Objectives and Research questions		
Number of returned by search	1,925 first hits sorted by relevance	
Number of selected papers	11 studies + 13 studies from screening reference lists = 24	
Key terms	"Digital Maturity" / "Digital Transformation" + "Digital Maturity" / "Digital Transformation Maturity" / "Digital Maturity Levels" / "Digital Transformation Efforts" / "State of Digital Transformation" / "State of Digital Transformation" / "Digital Transformation Progress" / "Phases of Digital Transformation"	
Sources (library databases and search engines)	• Identification of literature: Google Scholar + Screening reference lists of already included papers • Search by 8 October 2018 – 29 October 2018 • More information see Section Reviews' Protocols	
Results		

Digital transformation definition: There is any proper definition. The authors use literature definitions - (See Introduction and Section 2 of the review –defining digital transformation and digital maturity).

Additional highlights: "Currently, there is no commonly accepted definition for the term "digital transformation" (Schallmo *et al*., 2017)". "There was less attention to the digital maturity in the past, and therefore academic research seems quite immature in that area".

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Hausberg et al. (2019)

This paper was cited by	0	1
This paper cited	1	Morakanyane et al. (2017)
Authors		Hausberg, J.P.[1], Liere-Netheler, K.[1], Packmohr, S.[2,3], Pakura, S.[4], Vogelsang, K.[1] 1. Osnabrück University, Osnabrück, Germany/2.Malmö University, Malmö, Sweden/3.Bahçeşehir University, Beşiktaş/Istanbul, Turkey/4.Hamburg University, Hamburg, Germany
Venue		Journal of Business Economics
Year		2019
Keywords		Citation-network analysis, Digital transformation, Gephi, Systematic review
Number of references		179
Observations:		The paper provides a holistic overview in DT topic identifying the major areas and research gaps. This is performed by a structured literature review and a citation network analysis. Nine areas were identified as superior research streams and many "articles discuss the application of digital technologies (internet of things, big data, cloud computing, artificial intelligence) to support or refine business". More information see Section Question Formulation - Topic, Objectives and Research questions
Number of returned by search		1876 papers with 71368 additional references = 73244 publications
Number of selected papers		728 papers. Qualitative analysis: 47+15+19+23+19+15+35+13+14+19+21+30+12+18+16+19+10+23+19

Key terms

OR	AND	OR
Cyber-physical-system Digital transformation Cloud computing Machine-to-machine communication Machine learning Augmented reality Virtual reality Artificial intelligence Internet of things Industry 4.0 Industrie 4.0 Cloud manufacturing Big data Smart factory Advanced production system	AND	Management Organization Efficiency Effectiveness Efficacy Key performance indicator Controlling Logistic Strategy Human resources Finance Marketing Sales Key markets Value chain Accounting Business model

Sources (library databases and search engines)

- Identification of literature -> Co-citation analysis -> Qualitative analysis
- ISI Web of Science (WoS)
- Search by November 2017
- "Limit the search period to the last 20 years because DT as used for the purpose of this article (described in the theoretical foundation) emerged as a topic in the 2000's. Nevertheless, we included research back to 1997 to miss no important groundwork. Before that time, digital technologies like the Internet just surfaced".
- To stay focused on the business and technology perspective, we restricted the research areas to operations research management science, business economics international relations, social sciences other topics, communication, behavioural sciences, social issues, and sociology.
- More information see Section Reviews' Protocols

Results

Digital transformation definition: There is any proper definition. The authors use literature definitions - (See introduction and Section 2 – theoretical foundation). "A generally valid definition for the concept of digital transformation does not yet exist."
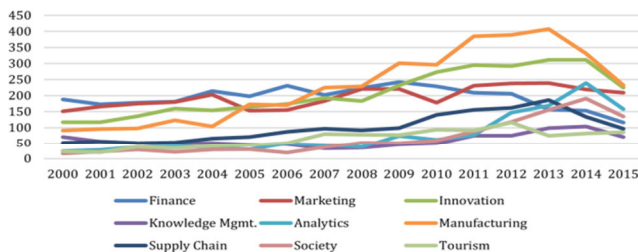
Journal most presented: "Expert Systems with Applications" - "Decision Support Systems" - "European Journal of Operational Research"

Digital technologies: Big data, Cloud Computing, Internet of Things, Artificial Intelligence, Machine Learning, Augmented and Virtual Reality.

Identified Research Streams: Finance, Marketing, Innovation (adoption/diffusion – business model & IoT – BD & innovation strategy – management digitization), Knowledge management (BD & IT in strategy), Analytics (BD and predictive analytics in business), Manufacturing, Supply Chain Management, Society (BD: policy, philosophy and society)and Tourism

Research gaps and opportunities:

- "We detect some research deficiencies in the areas of accounting and human resource management, as well as in sustainability in combination with the mentioned fields of interest".
- "Nearly all research recommendations of the defined clusters appreciate further investigations regarding the future

55

application and impact of digital technologies."

- o "We have explicitly identified the need for research in the area of big data analytics in the clusters of marketing, knowledge management, manufacturing and society".
- o "Ethical questions coming along with the accessibility of semi-public or public data for researchers and the other parties (e.g. industry, politics) are not yet sufficiently investigated."
- o "Research on the development of mathematical models for the application of BD and for machine learning to support decision making needs to be further focused."
- o "The use of blockchains is also an issue."
- o "In general, we emphasize a demand for more case studies describing the benefits, values and weaknesses of DT implementations in all clusters. In order to align the applications of DT with traditional research, the basic models should be tested for their suitability for the new, changed world."
- o "Researchers advise caution in the sense of security and safety of the data produced and collected."
- o "The implications on culture and society will be enormous, so further work, integrating the cultural, technological and business level would be appreciated."
- o "Long-term studies will show the real impact of the DT trend."
- o "How much of the enthusiasm is due to the novelty of the technology itself and how great are the long-term benefits?"
- o "The theorization of DT in general is not clear yet. First studies arise which collect different definitions. However, we do not see a conceptualization that is used interdisciplinary. Besides the definitions, characteristics as well as frameworks on DT are necessary."

Research gaps in DT research stream - Innovation

- The way innovations can be achieved needs further attention, like the foundation of start-ups for established companies. The findings in turn must be made useful for the companies.

- The drivers for DT as well as barriers are important topics to better understand adoption processes of DT.

- Antecedents and outcomes of business model innovation can lead to a better understanding of the construct.

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Babar and Yu (2019)

This paper was cited by	0	1
This paper cited	2	Morakanyane *et al*. (2017) Reis *et al*. (2018)
Authors		Babar, Z., & Yu, E. Faculty of Information - University of Toronto - Toronto, Canada
Venue		Workshop - International Enterprise Distributed Object Computing
Year		2019
Keywords		Enterprise architecture; Enterprise modeling; Digital transformation; Requirements engineering
Number of references		45

Observations: This research defines a set of "requirements for a future enterprise modeling framework that enterprise architects can use to model and analyze enterprises that are undergoing transformation due to emerging digital technologies". These requirements were derived from digital transformation characteristics identified through a systematic literature review.
- To develop an understanding of the key challenges in modeling enterprises that are underdoing digital transformation
- Qualitative reasoning and analysis of articles

More information see Section Question Formulation - Topic, Objectives and Research questions

Number of returned by search	818 – 120 duplicates= 698
Number of selected papers	36 Does the article cover one of the following points in detail: 1. Define digital transformation?/ 2. Discuss its characteristics?/ 3. Discuss the primary drivers in its adoption?/ 4. Specify adoption challenges in enterprises?/ 5. Share experiences in real-world settings?
Key terms	"Digital Transformation" in the paper title, abstract or keywords
Sources (library databases and search engines)	Database: ProQuest database • Time period from year 2010, "as digital transformation is a recent trend and we wanted to exclude papers that had a different (or earlier) interpretation of this term" • Only journal articles and conference papers • More information see Section Reviews' Protocols

Results

Digital transformation definition: Digital transformation affects products and services offered by the enterprise, the processes that produce those products and services, as well as the overall organization structure. For these enterprises, new disruptive digital models may result through the use of advanced technology and software which may both substitute or complement the traditional business model.

The thematic areas idenified were as follows:

- **Traditional and Digital Business Models**
- **Operational Processes**
- **Reliance on Emerging Digital Technologies**
- **Focus on Customer and Customer Experiences**
- **Impact on Organization Culture**
- **Considering Social and Employee Implications**

Characteristics	Papers
Business Strategy and Business Models	Berman [10]; Resca et.al. [11]; Lan & Lui [12]; Schallmo et.al. [13]; Remane et.al. [14]; Kotarba [15]; Matt et.al. [16]; Loonam et.al. [17]; Delmond et.al. [18]
Enterprise Agility	Delmond et.al. [18]; Earley [19]; Berman & Marshall [20]; Westerman [21]; Hossain & Lassen [22]; Heavin & Power [23]; Andriole [24]; Burden et.al. [25]; Shrivastava [26]; Narayanan [27]; Kaivo-Oja et.al. [28]; Shaughnessy [29]
Customer Centricity	Berman [10]; Loonam et.al. [17]; Shrivastava [26]; Narayanan [27]; Shaughnessy [29]; Wahi & Medury [30]; Weill & Woerner [31]
Rapid Cycles of Product and Solution Delivery	Kaivo-Oja et.al. [28]; Shaughnessy [29]; Wahi & Medury [30]; Weill & Woerner [31]; Masuda et.al. [32]; Troilo et.al. [33];
Multi-Speed Organizations	Berman & Marshall [20]; Hossain & Lassen [22]; Andriole [24]; Burden et.al. [25]; Shrivastava [26]; Narayanan [27]; Shaughnessy [29]; Wahi & Medury [30]; Troilo et.al. [33]; Masuda et.al. [37]; Basole [38]; Alos-Simo et.al. [39]; Ardolino et.al. [40]
Data-Driven Decision Making	Schallmo et.al. [13]; Delmond et.al. [18]; Berman & Marshall [20]; Westerman [21]; Hossain & Lassen [22]; Narayanan [27]; Troilo et.al. [33]; Gölzer & Fritzsche [34]; Pikkarainen et.al. [36]; Masuda et al. [37]
Social and Organizational Aspects	Resca et.al. [11]; Loonam et.al. [17]; Heavin & Power [23]; Andriole [24]; Narayanan [27]; Shaughnessy [29]; Kolbjørnsrud et.al. [35]; Alos-Simo et.al. [39]; Schwarzmüller et.al. [41]; Sainger [42]; Nwaiwu [43]; Andriole [45]
Business Process Automation	Schallmo et.al. [13]; Westerman [21]; Heavin & Power [23]; Andriole [24]; Kaivo-Oja et.al. [28]; Shaughnessy [29]; Weill & Woerner [31]; Kolbjørnsrud et.al. [35]; Weber & Monge [44]

Eight concrete characteristics
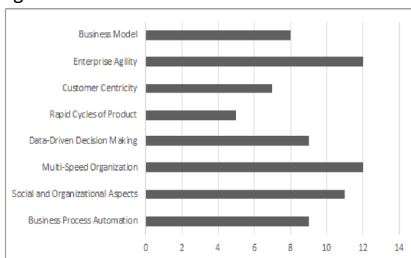
More information see Sections:
Digital Transformation Definitions and
Main results identified in selected reviews.

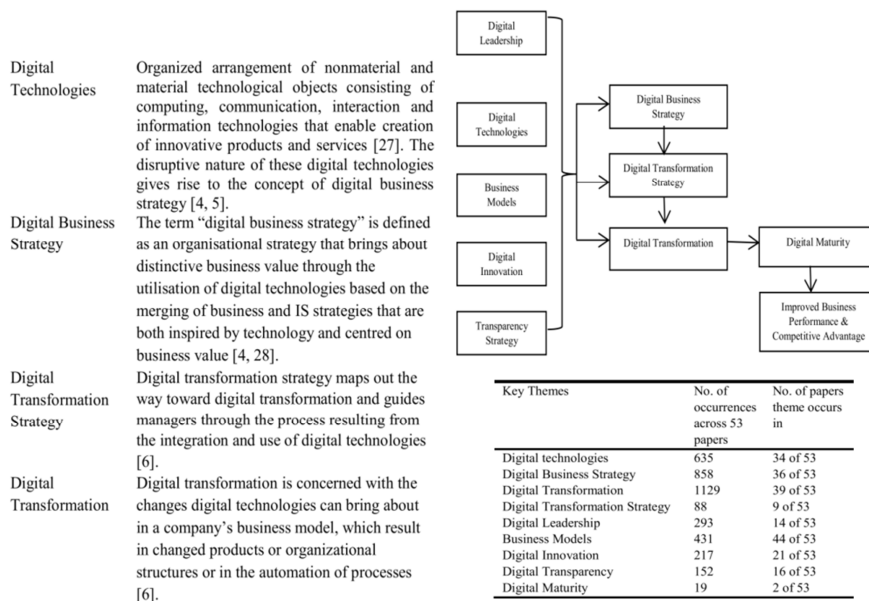| (C1) Business Strategy and Business Models	(C2) Enterprise Agility	(C3) Customer Centricity	(C4) Rapid Cycles of Solution Delivery	(C5) Multi-Speed Organizations	(C6) Data-Driven Decision Making	(C7) Social and Organizational Aspects	(C8) Business Process Automation	Selected Highlights for Requirements
	✓		✓		✓			(R1) Process Architecture: Represent the overall software ecosystem through processes and their relations. Configuring processes would allow for introducing different enterprise behaviors while attaining enterprise objectives.
	✓		✓	✓				(R2) Multi-Level Process Dynamics: Indicate several process types and their levels. Different levels can be demarcated through process boundaries, with each level having similar process behavioral attributes.
✓	✓	✓						(R3) Enterprise and Process Goals: Align enterprise strategy and business models to processes responsible for delivery of products and services. Shifting enterprise objectives are attained through process reconfigurations.
✓					✓			(R4) Trade-Off Analysis: Compare possible process configuration alternatives against priorities of process participants, systems complexity, enterprise objectives through trade-off analysis using enterprise non-functional objectives.
		✓					✓	(R5) Abstract Software Artifact Design: Consider bidirectional influences between the design of software artifacts, and the design of surrounding enterprise processes, with software being designed with flexibility and adaptably in mind.
		✓					✓	(R6) Design-Use: Differentiating between designing and usage processes allows for configuring the process domain (along with supporting software artifacts) for greater process automation or human dependency.
		✓						(R7) Plan-Execute: Differentiating between planning and executing processes allows for configuring the process domain for flexibility or stability of execution.
	✓	✓		✓				(R8) Feedback and Feedforward Paths: Rapidly incorporate feedback from sources for reconfiguring process architecture and associated software artifacts, thus enabling continuous and ongoing improvements.
	✓	✓		✓			✓	(R9) Process Cycles: Confirm faster software delivery cadence for improved customer centricity and enterprise agility while comparing and selecting against multiple possible process configuration and software automation.
		✓				✓		(R10) Social Actors: Include enterprise social actors (including customers) considerations while designing and configuring process architecture. Changes in process architecture are propagated to social actors for impact analysis.

Brown and Brown (2019)

This paper was cited by	0	0
This paper cited	0	-
Other systematic review in digital transformation area cited: -		

Authors	Nancy Brown and Irwin Brown University of Cape Town, Department of Information Systems, Rondebosch Cape Town, South Africa
Venue	Conference - South African Institute of Computer Scientists and Information Technologists
Year	2019
Keywords	Digital Business Strategy, Digital Transformation Strategy, Digital Technology
Number of references	61
Observations: This research developed a model which represents the core concepts that link digital business strategy to digital transformation so as to improve understanding of their dynamic interaction and outcomes. This was performed by a systematic literature review limited to journal articles only More information see Section Question Formulation - Topic, Objectives and Research questions	
Number of returned by search	75
Number of selected papers	53
Key terms	digital strategy, digital business strategy and digital transformation "Digital Strateg*", "Digital Business Strateg*", "Digital Transformation"
Sources (library databases and search engines)	Database: Web of Science Journals considered (Lowry, B., Moody, D., Gaskin, J., Galletta, F., Humpherys, L., Barlow, B. and Wilson, W. 2013. Evaluating Journal Quality and the Association for Information Systems Senior Scholars' Journal Basket via Bibliometric Measures: Do Expert Journal Assessments Add Value? MIS Quarterly 37, 4 (2013), 993-1012.) • AIS Top 8 - **EJIS, ISJ, ISR, JMIS, JSIS, MISQ,** JIT, JAIS • Financial Times Top 50 – **HBR**, **JMS**, MGTSCI, MKTSCI, ORGSTUD, SMR, AME, AMJ, AMR, ASQ, JIBS, JMGT, JMKT, JMKTR, JAMS, MSCI, **MITSMR**, SMJ • IS & related Journals on WoS - **BISE**, **DSS**, **ECRA**, EIS, EJISDC, I&M, **I&O**, **IJEC**, **IJIM** , **ISEBM**, ISM, **JGITM**, **JTAECR**, **MISQE** • More information see Section Reviews' Protocols

Results

Digital transformation definition: No proper definition. The authors use literature definitions.

Journal most presented: MIS Quarterly Executive, MIS Quarterly and MIT Sloan Management Review
Nine concepts were identified including four core concepts

Concept	Definition
Digital Technologies	Organized arrangement of nonmaterial and material technological objects consisting of computing, communication, interaction and information technologies that enable creation of innovative products and services [27]. The disruptive nature of these digital technologies gives rise to the concept of digital business strategy [4, 5].
Digital Business Strategy	The term "digital business strategy" is defined as an organisational strategy that brings about distinctive business value through the utilisation of digital technologies based on the merging of business and IS strategies that are both inspired by technology and centred on business value [4, 28].
Digital Transformation Strategy	Digital transformation strategy maps out the way toward digital transformation and guides managers through the process resulting from the integration and use of digital technologies [6].
Digital Transformation	Digital transformation is concerned with the changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or in the automation of processes [6].

Key Themes	No. of occurrences across 53 papers	No. of papers theme occurs in
Digital technologies	635	34 of 53
Digital Business Strategy	858	36 of 53
Digital Transformation	1129	39 of 53
Digital Transformation Strategy	88	9 of 53
Digital Leadership	293	14 of 53
Business Models	431	44 of 53
Digital Innovation	217	21 of 53
Digital Transparency	152	16 of 53
Digital Maturity	19	2 of 53

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Pihir et al. (2019)

Pihir, I., Tomičić-Pupek, K., & Tomičić Furjan, M. (2019). "Digital Transformation Playground-Literature Review and Framework of Concepts". In: Journal of Information and Organizational Sciences, 43(1), 33-48, June, 2019. DOI: **https://doi.org/10.31341/jios.43.1.3**		
This paper was cited by	0	2
This paper cited	0	-
Authors	Pihir, I., Tomičić-Pupek, K., & Tomičić Furjan, M University of Zagreb, Faculty of Organization and Informatics, Varaždin, Croatia	
Venue	Journal – J. of Information and Organizational Sciences (JIOS)	
Year	2019	
Keywords	digital transformation, literature review, framework, concepts, digital transformation playground	
Number of references	37	
Observations**:** "This research has been conducted as part of the wider research in the project Development of innovative platform for digital transformation of enterprises (RDI) which is funded by European Union through the European Regional Development Fund (ERDF)". This research performed a literature review in order to "provide insights into academic publishing trends and offer an analysis of scientific fields in which researches were made followed by a brief analysis of the most influential articles". Identification of "key determinants and influence factors of DT and some emerging trends and technologies, in order to explain organizational and technological context of DT" More information see Section Question Formulation - Topic, Objectives and Research questions		
Number of selected returned by search	WOS (279) + Scopus (440) = 719	
Number of selected papers	WOS (202) + Scopus (326) = 528	
Key terms	"Digital Transformation" in the title of papers	
Sources (library databases and search engines)	• Two most relevant and high-quality scientific databases: Web of Science (WOS) and Scopus • time period from year 2000 till 2019 - papers earlier of year 2000 were mainly dealing with transformation from analogue to digital media. • excluded books and other materials that are not scientific journal or conference proceedings papers. • More information see Section Reviews' Protocols	

Results

Digital transformation definition: Digital transformation of enterprises is a new paradigm in both, IT and business world. The main goal of DT is to change organizations by implementing contemporary technologies and introduce new business processes in order to create new or improve existing products and services and deliver them to the global market faster, cheaper and in new innovative ways.

The highest number of publications was published in the last 3 years, from year 2016, letting us conclude that this area is still young and has potential for further growth and maturity.

Research areas: business, engineering, social sciences, information science, library science, education and educational research, decision science, medicine, protection of environment, law, material science etc.

📄 **Framework of concepts on DT was developed - Digital transformation playground (DTP)**
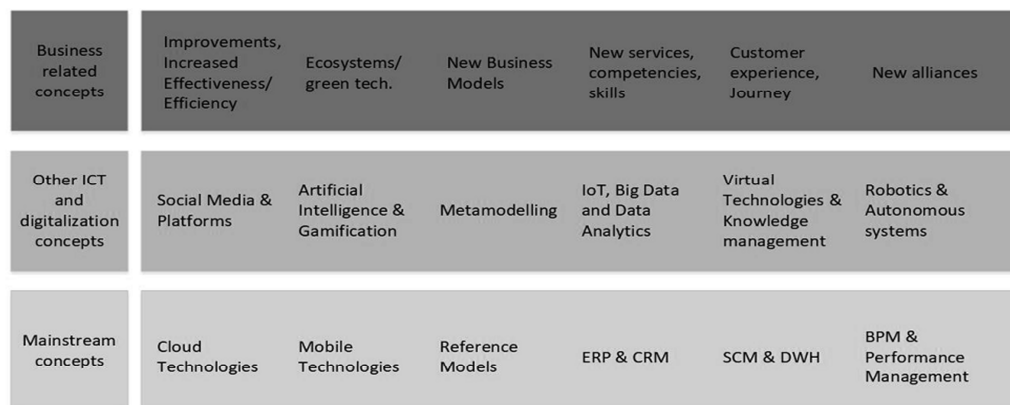
Figure 5. Digital Transformation Playground

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Vial, G. (June, 2019). "Understanding digital transformation: A review and a research agenda". In: The Journal of Strategic Information S33ystems, Volume 28, pp. 118-144.		
This paper was cited by	0	54
This paper cited	2	Morakanyane et al. (2019) Berghaus (2016)
Authors		Vial, Gregory Department of Information Technology, HEC Montreal, Canada
Venue		Journal – J. of Strategic Information Systems,
Year		2019
Keywords		Digital transformation, IS strategy, Literature review, Digital technologies, Organizational transformation, Digital innovation
Number of references		322
Observations: More information see Section Question Formulation - Topic, Objectives and Research questions		
Number of selected returned by search		381
Number of selected papers		248 works, which was subsequently augmented to 282 works through backward and forward search (226 from research outlets, 56 from practitioner-oriented outlets).
Key terms		Combinations of keywords containing the terms "digital" and "transform" or "disrupt"
Sources (library databases and search engines)		• IS literature - three databases AIS Library, Business Source Complete, ScienceDirect • Opted to exclude works in progress, research outlets not ranked in the Journal Citation Reports index as well as teaching cases from our final sample. • No time period • More information see Section Reviews' Protocols

Results

Digital transformation definition: The review derived a new definition based on previously definitions existing in the literature and using a semantic analysis, "systematically decomposing extant definitions into series of constituting primitives and compared those primitives across definitions to identify essential properties of DT: (1) target entity, i.e., the unit of analysis affected by DT; (2) scope, i.e., the extent of the changes taking place within the target entity's properties; (3) means, i.e., the technologies involved in creating the change within the target entity; and (4) expected outcome, i.e., the outcome of DT".

Digital transformation is "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies."

Fig. 1. Building blocks of the DT process. Note: The arrows do not represent a statistical relationship or a causality found in variance models. Rather, they detail an overarching sequence of relationships described by the literature on DT.

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Kutnjak et al. (2019)

This paper was cited by	1	3
This paper cited	0	-
Authors	Kutnjak, A., Pihiri, I., & Furjan, M. T University of Zagreb, Faculty of Organization and Informatics, Varaždin, Croatia	
Venue	Conference – MIPRO	
Year	2019	
Number of references	30	
Keywords	digital transformation; literature review; case study; industries	
Observations: More information see Section Question Formulation - Topic, Objectives and Research questions		
This research performed a literature review in order to identify "real digital transformation processes and their success in practice" by case studies methods description papers ("how enterprise approaches the process of digital transformation").		
Number of selected returned by search	214	
Number of selected papers	88 - "case study method as sample of digital transformation process in real life"/ 96 industrial use cases	
Key terms	"Digital Transformation" in the title of papers	
Sources (library databases and search engines)	Database: Web of Science • time period from year 2000 till 2019 - papers earlier of year 2000 were mainly dealing with transformation from analogue to digital media. • excluded books and other materials that are not scientific journal or conference proceedings papers. • Search date: December 2018 • More information see Section Reviews' Protocols	

Results

Digital transformation definition: Digital transformation is a complex and demanding process that requires the engagement of all enterprise resources - human, technological, physical, organizational and financial. It marks the digitalization and its implementation throughout the organization with a special focus on people and business processes. DT is the transformation of an organization driven by digital technology, and it directly affects the change of organization's core, that is, the change of its business model. As such, organizations open up possibilities for new business opportunities, innovations in product and/or service creation and opportunities to acquire new knowledge. One of the important factors of a successful DT is certainly an adequate digital strategy, tailored to the corporate structure. The transformation efficiency is seen in the following: **dynamic strategy (subject to constant change), exploitation of all available resources (human, technological) and quantitative measurement of DT success (determining measurable and achievable goals)** [Bughin et al., 2019].

Companies are applying digital technologies for different purposes: to integrate business processes, create new business opportunities, innovate products, reduce costs and make new business models. Companies should have a strategic approach to the process of DT.
* 96 industrial use cases of digital transformation
* top 10 research areas - top ten countries or regions – per industry (Statistical classification of economic activities in the European Community (NACE))

🔖 **Highlight: Education industry – references: [20][21][22][23]**
Other references form the research group:
https://library.iated.org/?adv_authors=%22Martina+Tomi%C4%8Di%C4%87+Furjan%22+%22Igor+Pihir%22+%22Katarina+Tomi%C4%8Di%C4%87-Pupek%22+
* IMPLEMENTATION OF DIGITAL TRANSFORMATION IN CURRICULA – INSIGHTS BASED ON ANALYZING LEADING UNIVERSITIES
* BUSINESS PROCESSES MANAGEMENT IN DIGITAL TRANSFORMATION OF EDUCATIONAL INSTITUTIONS
* EDUCATIONAL AND PRACTICAL VIEW OF KNOWLEDGE, SKILLS AND EXPERIENCE NEEDED BY A CHIEF DIGITAL OFFICER
More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Gebayew et al. (2018)

Gebayew, C., Hardini, I.R., Panjaitan, G.H.A., Kurniawan, N.B., Suhardi (October, 2018) *"A Systematic Literature Review on Digital Transformation"*. In: Proceedings of 5th International Conference on Information Technology Systems and Innovation, ICITSI 2018, pp. 260-265.

This paper was cited by	1	3
This paper cited	1	Reis *et al.* (2018)
Authors	Gebayew, C., Hardini, I.R., Panjaitan, G.H.A., Kurniawan, N.B. Suhardi School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Bandung, Indonesia	
Venue	Conference - International Conference on Information Technology Systems and Innovation (ICITSI)	
Year	2018	
Keywords	Business Process; Business Strategy; Digital Transformation; Systematic Literature Review	
Number of references	67	
Observations: More information see Section Question Formulation - Topic, Objectives and Research questions		
Number of returned by search	1564	
Number of selected papers	30	
Key terms	"Digital transformation"	
Sources (library databases and search engines)	Database: Scopus • Time period: five years – 2014 to 2018 • More information see Section Reviews' Protocols	

Results

Digital transformation definition: Considerations about the two terms: digital and transformation.

"digital" is a synonym for the pace of change that's occurring in today's world driven by rapid adopted of technology.

"transformation" means that digital usages integrally enable new types of innovation and creativity in a particular domain, rather than just enhance and support traditional methods.

Types of identified methodology: conceptual model, strategy (technology use, business process change, structural change, financial aspect) or framework; method (tool or step to implement DT); and case study (real case).

Application areas: Governance, Education, Market, Automotive, Public Service and Enterprise Architectures.

Books: [41][48][59][60][61][49][62][63][64]

Business Areas: Business Process, Digital Platform, Skills

Impacts: Business activities/functions; Business processes; Customer, worker and partner approaches; Business models

Benefits: 1.Increase customer satisfaction; 2.Increase customer experience; 3.Improvement in productivity; 4.Increase revenue from products and services; and 5.Cost reduction.

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Bockshecker et al. (2018)

Bockshecker, A. and Hackstein, S. and Baumöl, U. (June, 2018) *"Systematization of the term digital transformation and its phenomena from a socio-technical perspective – A literature review"*. In: ECIS 2018 Proceedings at AIS Electronic Library - Research Papers - 43.	
This paper was cited by	0 2
This paper cited	0 -
Authors	Bockshecker, A., Hackstein, S., Baumöl, U. University of Hagen, Hagen, Germany
Venue	Conference – European Conference on Information Systems (ECIS)
Year	2018
Number of references	67
Keywords	Digitization; digital transformation; digitalization; literature review
Observations: **Digitization, digitalization and digital transformation**. The terms are used synonymously and have various definitions. More information see Section Question Formulation - Topic, Objectives and Research questions	
Number of selected returned by search	736
Number of selected papers	46
Key terms	Digitalization OR "digital transformation" OR digitization
Sources (library databases and search engines)	Database: Coming from a socio-technical point of view, we focused on information systems literature and chose renowned conferences and journals in this field. We selected the following information systems conferences: American Conference on Information Systems (AMCIS), the European Conference on Information Systems (ECIS), the Hawaii International Conference on System Science (HICSS), the International Conference on Information Systems (ICIS) and the Wirtschaftsinformatik (WI). These conferences are thematically broad and discuss important and current topics of information systems research. All the related conference proceedings are listed in the electronic library of the **Association for Information Systems (AISeL).** We considered the following 12 Journals: Management Information Systems Quarterly (MISQ), Information Systems Research (ISR), Communications of the Association for Computer Machinery (ACM), Management Science, Journal of Management Information Systems (JMIS), European Journal of Information Systems (EJIS), Communication of the Association for Information Systems (CAIS), Academy of Management Journal, Journal of the Association for Information Systems, Information Systems Frontiers, Organization Science, Business & Information Systems Engineering (BISE). 30 top ranked journals found in Levy and Ellis (2006). • time period: from 2012 • Search date: September and October 2017 • More information see Section Reviews' Protocols

Results

Digital transformation definition: For the term digitalization we follow the idea by Yoo et al. (2010) that digitalization consists of two dimensions: the social and the technical dimension. This understanding is also in line with Legner et al. (2017), who highlight digitalization as "the manifold sociotechnical phenomena and processes of adopting and using these technologies in a broader individual, organizational and societal context". Our basic understanding of DT follows Herbert (2017), who states that DT is not about the pure implementation of new technology into the organizations' processes, but that "it's about directing an organization to be more adopting to change itself" including "adopting processes that allow [...] to investigate, experiment, and strategically employ new technology on an ongoing basis". Based on this understanding we decided to use the concept of socio-technical system (STS) for the conceptualization of the topic.

- **Digitization** is the technological transformation of "analog information into digital format" (Freitas Junior et al., 2016) including the development of digital infrastructure. Objects of digitization are technological processes and "artefacts with their features, functionalities, and affordances" (Jackson, 2015).
- **Digitalization is** the state of an organization or a society referring to its current digital development and usage of information and communication technologies (ICT) innovations. Digitalization takes into account social as well as technical elements.
- **DT** is the process of organizational or societal changes driven by innovations and developments of ICT. DT includes the ability to adopt technologies rapidly and affects social as well as technical elements of business models, processes, products and the organizational structure.

DT refers to the process of organizational or societal changes driven by innovations and developments of ICT, while digitalization describes the current digital development state.

source	terms			STS		phenomena						
	digitization	digitalization	digital transformation	social perspective	technical perspective	collaboration	sharing	communication	connectivity	flexibility	mobility	co-creation
Andersen and Ross (2016)		x		x		x	x		x			
Avital et al. (2014)					x	x	x				x	
Avital et al. (2015)				x				x				
Baalen, Fenema, and Loebbecke (2016)				x	x							
Blaschke et al. (2016)		x		x								
Bley, Leyh, and Schäffer (2016)	x		x	x								
Boughzala, Vreede, and Limayem (2012)				x	x	x			x			
Braccini and Federici (2013)				x	x							
Brenner et al. (2014)		x		x								
Collins and Gruzd (2017)				x		x	x					
Davison and Ou (2014)				x		x	x		x			
Deng and Christodoulidou (2015)				x	x			x	x	x		
Ebermann et al. (2016)				x								
Freitas Junior et al. (2016)	x		x		x			x	x			
Ghobadi (2014)				x								
Gimpel, Huber, and Sarikaya (2016)		x	x		x			x				
Grover and Kohli (2013)	x				x							
Haffke, Kalgovas, and Benlian (2016)	x		x	x	x			x	x			
Holler et al. (2017)		x			x							
Horlacher (2016)			x	x		x						
Jackson (2015)	x	x		x	x	x		x				
Kelestyn and Henfridsson (2014)	x			x	x	x	x	x		x		
Klötzer and Pflaum (2017)	x	x	x	x	x							
Köffer (2015)				x	x	x		x	x		x	
Lang, Shang, and Vragov (2015)				x	x	x	x					x
Legner et al. (2017)	x	x	x	x	x	x						
Li, Hong, and Zhang (2016)				x	x	x			x			
Lindberg et al. (2013)				x		x						
Literat (2017)				x		x						
Matt, Hess, and Benlian (2015)	x		x	x	x							
Mayer, Quick, and Hauke (2013)				x	x	x						
Mehra et al. (2014)	x			x								
Nambisan et al. (2017)	x				x							
Nastjuk, Hanelt, and Kolbe (2016)					x			x	x	x		
Negi and Brohman (2015)		x		x		x		x	x			x
Nwankpa and Roumani (2016)			x	x								
Paavola, Hallikainen, and Elbanna (2017)			x	x								
Plenter et al. (2017)						x	x					
Remane et al. (2017)			x	x	x							
Schmidt, Drews, and Schirmer (2017)		x	x	x	x			x				
Schneider (2017)	x			x	x			x				
Syler and Baker (2016)				x								
Wilms et al. (2017)		x	x	x	x	x		x				
Wulf et al. (2014)	x			x	x			x	x			x
Xue et al. (2013)	x				x							
Yoo et al. (2012)	x				x							
sum	15	10	13	31	31	19	11	11	10	3	3	3

Diagram (context):

context
social system — transferred to — human actors — part of — social group — has — social hierarchy
↔
digitalization | digitization — allow — phenomena — trigger — digital transformation

Phenomena

Single mention: involvement and co-modeling

Network diagram:
collaboration (19), flexibility (3), sharing (11), mobility (3), co-creation (3), communication (11), connectivity (10), with connection weights (2), (8), (2), (5), (4), (1), (1), (2), (6), (4).
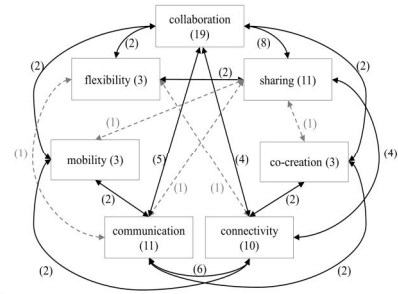
- **Collaboration:** "digitally-enabled collaboration" which refers to cooperation which "expands across space, time, and organizational boundaries" (Lindberg et al., 2013). "Collaboration is making a joint effort toward a group goal, where joint effort encompasses acts of shared creation and/or discovery" and that it "is one of the essential ingredients of organizational life" (Boughzala, Vreede, and Limayem, 2012)

- **Sharing:** leveraging "information technology to re-distribute unused or underutilized assets to people who are willing to pay for the services". Sharing of digital content or using platforms to share simplified and enable faster exchanges between people. Sharing economy and platform sharing.

- **Communication:** "the ability to inform others and being informed".

- **Connectivity:** technical view point of view, can be understood as internet connectivity which allows users to have access to information and the possibility to communicate with others.

- **Flexibility:** the flexible "use of digital technologies and services".

- **Mobility:** "users can readily access information online and communicate with others instantly when they are mobile." It is also important for organizations as it allows for the employees to use the ICT at anytime and anywhere.

- **Co-creation:** customers are involved in the value creation process, like involving customers in the designing of a product. To take place in online communities or social networks on platforms.

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Kutzner et al. (2018)

Kutzner, K., Schoormann, T., Knackstedt, R. (June, 2018) "Digital transformation in information systems research: A taxonomy-based approach to structure the field". In: Proceedings of 26th European Conference on Information Systems, ECIS 2018, Portsmouth, UK.	
This paper was cited by	0 4
This paper cited	0 -
Authors	Kutzner, K., Schoormann, T., Knackstedt, R. University of Hildesheim, Hildesheim, Germany
Venue	Conference – European Conference on Information Systems (ECIS)
Year	2018
Number of references	95
Keywords	Digital Transformation; Taxonomy; Cluster Analysis; Literature Review
Observations: Contribution - **Taxonomy** Related concepts: business transformation, digitalization and digital transformation More information see Section Question Formulation - Topic, Objectives and Research questions	
Number of papers returned by search	150
Number of selected papers	36
Key terms	"digital transformation" AND ("Classification" OR "Taxonomy")
Sources (library databases and search engines)	Database: Not explicit mentioned - articles published in proceedings of renowned IS-conferences - Association for Information Systems (AIS) • time period: no limitation • Search date: June to July, 2017 • More information see Section Reviews' Protocols

Results

Digital transformation definition: "although digital transformation is of growing interest, it is still an emerging field and "the term [digital transformation] lacks a clear definition".

Caption : not mentioned (-), directly mentioned (●), indirectly mentioned (○)

Taxonomy of digital transformation—research characteristics.

Taxonomy: based on Nickerson et al. (2013) - taxonomy development process

research characteristics: research approach, research design, research method and philosophical worldview (A postpositivist worldview - deductive proceedings starting with selected theories. Whereas a constructivist worldview aims at generating or inductively developing a theory or pattern of meaning).

Caption : not mentioned (-), directly mentioned (●), indirectly mentioned (○)

Figure 3.   *Taxonomy of digital transformation—research topics.*

research topics: field of investigation, strategic alignment, people, culture, information technology and models.

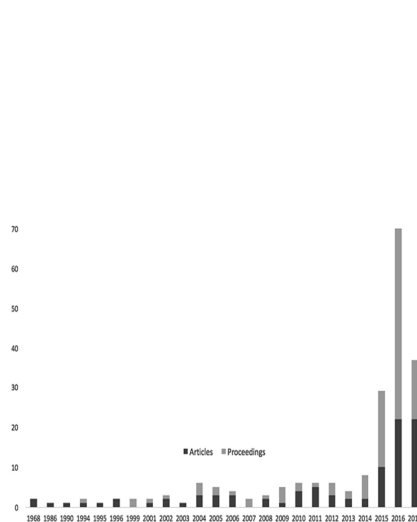More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Reis et al. (2018)

Reis, J., Amorim, M., Melão, N., & Matos, P. (March, 2018). "*Digital transformation: a literature review and guidelines for future research*". In: Proceedings of World Conference on Information Systems and Technologies (pp. 411-421). Springer, Cham

This paper was cited by	2	39
This paper cited	0	-
Authors	Reis, J.[1], Amorim, M.[2], Melão, N.[3], Matos, P.[4]	
	1. Department of Military Science and Technologies, and CISD&CINAMIL, Military Academy, Lisbon, Portugal	
	2. Department of Economics, Management and Industrial Engineering and Tourism, and GOVCOPP, Aveiro University, Aveiro, Portugal	
	3. Department of Management and CI&DETS, School of Technology and Management of Viseu, Polytechnic Institute of Viseu, Viseu, Portugal	
	4. Higher Institute of Social and Political Sciences, and CISD, Lisbon, Portugal	
Venue	Conference - World Conference on Information Systems and Technologies (WorldCIST)	
Year	2018	
Keywords	Digital Transformation; Business strategy; Processes Operations; Systematic literature review	
Number of references	42	
Observations: More information see Section Question Formulation - Topic, Objectives and Research questions		
Number of returned by search	260	
Number of selected papers	206	
Key terms	"Digital transformation"	
Sources (library databases and search engines)	Database: Institute for Scientific Information - Web of Science (ISI)	
	• Search Date: September 17, 2017	
	• Time period: No limitation	
	• Papers returned: 1968 a 2017 – highlight: After 2014 – Year 2016	
	• More information see Section Reviews' Protocols	

Results

Digital transformation definition: The different definitions for Digital Transformation (DT) may be categorized in three distinct elements: (1) Technological–DT is based on the use of new digital technologies such as social media, mobile, analytics or embedded devices; (2) Organizational–DT requires a change of organizational processes or the creation of new business models; (3) Social–DT is a phenomenon that is influencing all aspects of human life by e.g., enhancing customers experience. Digital Transformation is the use of new digital technologies that enables major business improvements and influences all aspects of customers' life.

Author(s)	Definition(s)
Fitzgerald *et al.* [1]; McDonald and Rowsell-Jones [27]	Use of new digital technologies, such as social media, mobile, analytics or embedded devices, in order to enable major business improvements like enhancing customer experience, streamlining operations or creating new business models [1]. As such, the Digital Transformation goes beyond merely digitizing resources and results in value and revenues being created from digital assets [27]
Solis *et al.* [28]	The realignment of, or new investment in, technology and business models to more effectively engage digital customers at every touch point in the customer experience lifecycle
Collin *et al.* [29]; Gimpel and Röglinger [30]; Kane *et al.* [31]	While digitization commonly describes the mere conversion of analogue into digital information, the terms Digital Transformation and digitalization are used interchangeably and refer to a broad concept affecting politics, business, and social issues
Martin [32]	Digital Transformation is now commonly interpreted as such usage of Information and Communication Technology, when not trivial automation is performed, but fundamentally new capabilities are created in business, public government, and in people's and society life
Westerman *et al.* [5]	Digital Transformation is defined as the use of technology to radically improve performance or reach of enterprises
Stolterman and Fors [33]	Digital Transformation is the changes that digital technology causes or influences in all aspects of human life

Research area	ISI cited keywords	Categories
Information systems	Industry 4.0	IT/IS integration
Business economics	Digital business enterprise architecture	Development of new business models
Education	Educational technology	Training/Education to add new skills
Management science	Management	Process and operations management
Government	Public sector transformation	Ramification to other sectors

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Morakanyane et al. (2017)

Morakanyane, R. and Grace, A. and O'Reilly, P. (June, 2017) "*Conceptualizing digital transformation in business organizations: A systematic review of literature*". In: Proceedings of 30th Bled eConference: Digital Transformation - From Connecting Things to Transforming our Lives, BLED 2017, pp. 427-444.

This paper was cited by	4	14
This paper cited	0	-
Authors	Morakanyane, R., Grace, A., O'Reilly, P. University College Cork, College Rd, Cork, Ireland	
Venue	Conference - Bled eConference: Digital Transformation - From Connecting Things to Transforming our Lives	
Year	2017	
Keywords	Digital Transformation; Digital Technologies; Concept Centric Matrix, Literature Review	
Number of references	72	
Observations: More information see Section Question Formulation - Topic, Objectives and Research questions		
Number of returned by search	Not mentioned	
Number of selected papers	53 - management reviews, academic conferences and journals	
Key terms	"digital business strategy", "digital transformation" ,"digitalization", "IT-enabled Organizational Transformation", "IT-enabled Enterprise Transformation"; "digital technologies"	
Sources (library databases and search engines)	Database: Not mentioned • Time period: from year 2010 • Analysis process: March to October, 2016 • More information see Section Reviews' Protocols	

Results

Digital transformation definition: The use of information and digital technologies to impact different aspects of the organization. As a result, these technologies transform the way business entities operate, creating value and bringing different experiences to various stakeholders involved.

Proposed pattern that suggests that digital transformation is: **"… something with certain characteristics; that is driven by something; to create certain impacts; on certain aspects of the organization"**

Digital transformation is: "an evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value".

Keyword	Simple Definition
Evolutionary Process	A gradual and ongoing series of activities that brings radical change over a period of time
Digital Capabilities	technology skills possessed or required by employees, customers and other stakeholders in different areas that can enable the organization to thrive in a digital environment
Digital Technologies	new and emerging technologies
business models, operational processes and customer experiences	Different areas of the organization which are bound to transform due to the digital transformation process
Value Creation	Organization wide effects and benefits realized as a result of the digital transformation effort, realized by both the organization and the customer

Thematic Areas Identified include:
• What is Digital Transformation
• Characteristics of Digital Transformation
• Drivers of Digital Transformation
• Impacts of Digital Transformation
• Transformed Areas

Thematic Analysis Technique used to develop the Concept Centric Matrix

What is Digital Transformation?	
Strategy	Bharadwaj, et.al. (2013); Matt, et.al. (2015); Mithas, et.al. (2013); Hansen & Sia (2015); Granados & Gupta (2013);
Process	Agarwal, et.al. (2010); Berman & Marshall (2014); Bharosa, et.al. (2013); Janowski (2015); Kreutzer (2014); Loebbecke & Picot (2015); Stieglitz & Brockmann (2012); Tamm, et.al. (2015); Wang, et.al. (2016); Hansen et.al. (2011);
Business Model	Henriette, et.al. (2015); Stieglitz & Brockmann (2012);
Paradigm Shift	Berman & Marshall (2014); Piccinini (2015a);
What are its Characteristics?	
Radical	Liu et.al. (2011); Berman (2012); Berman & Marshall (2014); Westerman et.al. (2011);
Disruptive	Berman (2012); Berman & Marshall (2014); Granados & Gupta, (2015); HBR Analytics Services (2014); Fitzgerald, M. et.al. (2013);
Evolutionary/continuous	Loebbeck & Picot (2015); Janowski (2015); Wang et.al. (2016); Liu et.al. (2011);
Complex	Janowski (2015); Bharosa et.al. (2013); Matt et.al. (2015); Agarwal (2010);

What are the Drivers of Digital Transformation?	
Digital Technologies	Agarwal, et.al. (2010); Berman (2012); Bharadwaj, et.al. (2013); Bharosa, et.al. (2013); Janowski (2015); Kreutzer (2014); Luna-Reyes & Gil-Garcia (2014); Mithas, et.al. (2013); Lucas, et.al. (2013); Stieglitz & Brockmann (2012); Setia, et.al. (2013); Wang, et.al. (2016); Berman & Marshall (2014); Loebbecke & Picot (2015); Westerman et.al. (2011);
Digital Capabilities	Berman & Marshall (2014); Loebbecke & Picot (2015); Matt, et.al. (2015); Schuchmann & Seufert (2015); Tamm, et.al. (2015); Wang, et.al. (2016); Westerman et.al. (2011);
Strategies	Berman & Marshall (2014); Bharadwaj, et.al. (2013); Matt, et.al. (2015); Stieglitz & Brockmann (2012); Tamm, et.al. (2015); Mithas, et.al. (2013);
Business Models	Agarwal, et.al. (2010); Berman & Marshall (2014); Bharadwaj, et.al. (2013); Janowski (2015); Loebbecke & Picot (2015); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Tamm, et.al. (2015); Stieglitz & Brockmann (2012);
Value Chain	Agarwal, et.al. (2010); Berman & Marshall (2014); Bharosa, et.al. (2013); Janowski (2015); Stieglitz & Brockmann (2012); Tamm, et.al. (2015); Wang, et.al. (2016);

What are the Key Impacts of Digital Transformation?	
Value Creation: Reshapes Realign Redefine Integrate Collaboration	Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Berman (2012); Bharadwaj, et.al. (2013); Luna-Reyes & Gil-Garcia (2014); Stieglitz & Brockmann (2012); Johnson & Lederer (2010); Berman & Marshall (2014); Chen et.al (2013); Bharosa et.al. (2013); Wang, et.al. (2016); Agarwal, et.al. (2010); Buschmeyer et.al. (2016); Westerman et.al. (2011);
Operational Efficiency: Optimize Processes, Omni Channel; Agility; Improved Decision Making Structural Change	Bharadwaj, et.al. (2013); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Lucas, et.al. (2013); Setia (2012); Kreutzer (2014); Stieglitz & Brockmann (2012); Tamm et.al. (2015); Berman & Marshall (2014); Loebbeck & Picot (2015); Hansen & Sia (2015); Janowski (2015); Bharosa et.al. (2013); Wang et.al. (2016); Agarwal et.al. (2010); Berman & Marshall (2014); Chen et.al (2013); Westerman et.al. (2011);
Create Competitive Advantage	Bharadwaj, et.al. (2013); Lucas, et.al. (2013); Matt, et.al. (2015); Schuchmann & Seufert (2015); Kreutzer (2014); Stieglitz & Brockmann (2012); Chen et.al (2013); Westerman et.al. (2011);
Improved Relationships: Enhance	Bharadwaj, et.al. (2013); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Schuchmann & Seufert (2015); Bharosa et.al. (2013); Wang et.al. (2016);
Customer Experiences; Engagement	Berman (2012); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Piccinini et.al. (2015a); Berman & Marshall (2014); Loebbeck & Picot (2015); Chen et.al (2013); Westerman et.al. (2011);

Where are these Impacts Felt (Transformed Areas)?	
Business Models	Berman (2012); Westerman et.al. (2011); Agarwal, et.al. (2010); Berman & Marshall (2014); Bharadwaj, et.al. (2013); Janowski (2015); Loebbecke & Picot (2015); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Tamm, et.al. (2015); Hansen et.al. (2011); Chen et.al (2013);
Operational Processes	Bharadwaj, et.al. (2013); Lucas, et.al. (2013); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Mithas, et.al. (2013); Schuchmann & Seufert (2015); Westerman et.al. (2011); Hansen et.al. (2011); Berman & Marshall (2014); Chen et.al (2013);
Customer Experiences	Berman (2012); Luna-Reyes & Gil-Garcia (2014); Matt, et.al. (2015); Schuchmann & Seufert (2015); Piccinini et.al. (2015a); Berman & Marshall (2014); Loebbeck & Picot (2015); Luna-Reyes & Gil-Garcia (2014); Westerman et.al. (2011); Gray et.al. (2013);
Employees	Schuchmann & Seufert (2015); Tamm et.al. (2015); Hansen & Sia (2015); Luna-Reyes & Gil-Garcia (2014); Hansen et.al. (2011); Janowski (2015);
Culture	Schuchmann & Seufert (2015); Hansen & Sia (2015); Berman & Marshall (2014);
Infrastructure	Tamm et.al. (2015); Hansen & Sia (2015); Kohli & Johnson (2011);

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

Berghaus, S. (June, 2016) *"The fuzzy front-end of digital transformation: Three perspectives on the formulation of organizational change strategies"*. In: Proceedings of 29th Bled eConference: Digital Economy, BLED 2016, pp. 129-144.

This paper was cited by	1 2
This paper cited	0 -
Authors	Sabine Berghaus Institute of Information Management, University of St.Gallen, Switzerland
Venue	Conference - Bled eConference: Digital Economy
Year	2016
Number of references	60
Keywords	Digital Transformation, Organizational Change, Strategy Formulation, Strategic Planning, Strategy Formation, Fuzzy Front-End, Literature Review
Observations: "In order to better understand this front-end phase of digital business transformation, this paper takes the unique perspective of the fuzzy front-end within organizational change processes." Areas considered: Information systems (IS), Management & Strategy (MS), and Organization Science (OS). More information see Section Question Formulation - Topic, Objectives and Research questions	
Number of selected returned by search	Not mentioned
Number of selected papers	112
Key terms	The term "**organizational change**" was found to provide the best results, since this is the generic term for transformation / change programs. It was combined with the terms **"strategy formation" / "strategy formulation" / "strategic planning",** in order to identify papers that specifically consider the initial strategy-building phase of the change process. In the MS basket, the terms "**digital**" OR "**technology**" were added, in order to restrict this number to specifically technology-induced changes.
Sources (library databases and search engines)	Database: 39 journals that have been ranked as A+ / A in the "VHB Jourqual 3" ranking. The research was restricted to the top journals. Areas considered: Information systems (IS), Management & Strategy (MS), and Organization Science (OS). Conceptual papers with an exclusively theoretical research were omitted from analysis. • time period: no limitation – results from 1969 to 2015 • Search date: Not mentioned. • More information see Section Reviews' Protocols

Results

Digital transformation definition: digital <u>business</u> transformation is defined as transformation at the organizational level that is disruptive, rather than a continuous learning process. It simultaneously affects multiple areas within the organization and requires a re-definition of the corporate strategy. Digital transformation is a specific kind of organizational change. Digital business transformation can be seen as a major reorientation for the organization and therefore has an extremely wide scope and a disruptive impact.

Concept: fuzzy front-end (FFE) - the initial phase of idea creation before the formal initiation of an innovation project. The fuzzy front-end is the precursor of the actual new product development project and covers the stages from idea generation until the start of the formal project. A theoretical model of the structure and process of the FFE identifies the boundary (between organization and environment), gatekeeping (between innovators and decision makers) and project (between decision makers and project managers) as the most relevant interfaces in this process, in order to ensure a sufficient information flow and improve the FFE (de Brentani & Reid, 2012).

Coding Scheme: Davis et al. (2010) – vision, planning, and implementation. "Outcome" was added for publications that consider the results, impact, and effects of a strategy or organizational change process and not the process itself. / Type of change strategy was

Strategy Phase	Type of change strategy

• Vision
• Planning
• Implementation
• Outcome
	Intentionality
	
	   • Intended
	   • Emergent
	
	Degree / Scope
	
	   • Radical / Disruptive
	   • Evolutionary / Continuous

derived from Mintzberg's types (intended, deliberate, emergent) (Mintzberg & Waters, 1982) / The degree - scope of change was derived from the types of innovation, which acknowledges that there are types of evolutionary and radical change (Norman & Verganti, 2014).
Most publications focus on the planning process and the implementation phase.
Research generally focuses rather on evolutionary and intended changes.
Within the IS-domain, the perspective of information systems has changed from a solely functional and process-oriented one to a broader strategic role. Therefore, a solid understanding of the dynamic development of digital technologies and its utilization is required within the strategy formulation process. The perspective of the management & strategy domain of the fuzzy front-end is that it is often caused by external changes to which the company needs to react, whereby the top manager is mostly responsible for making sense of industry signals and initiating a viable strategy.However, organizational inertia often hinders the change process. The perspective of the OS domain is that strategy formulation is more a collaborative process than the task of the top executives.

A topic of investigation consists to explore and explain patterns and procedures that may reduce the fuzziness and bring more clarity to the front-end stage of the transformation process (Berghaus, 2016). One step in improving the fuzzy front-end is understanding and improving the information flow and knowledge transfer, in order to improve the interpretation of external signals and ensure a sufficient information flow between hierarchies (Berghaus, 2016). Another promising field for more research might be to explore the appropriate roles and responsibilities in the fuzzy front-end of digital transformation strategies (Berghaus, 2016).

More information see Sections: Digital Transformation Definitions and Main results identified in selected reviews.

I.2. Data Extraction of papers excluded in full reading stage

This paper was cited by	1	Darkhan Onaltayev, Aigerim Kazhmuratova, Sandygul Akhmetkaliyeva, Rilla Malikova, Aliya Yelyubayeva, D. Rudoy and V. Murgul (2019) "Application of technological innovations in marketing activities of the enterprise". In: Journal: E3S Web of Conferences, 2019 - Innovative Technologies in Environmental Science and Education (ITESE-2019), Volume 135, pp. 04046. DOI: 10.1051/e3sconf/201913504046
This paper cited	0	-
Authors		Ziyadin[1], Suieubayeva[2], Utegenova[1] 1. Al-Farabi Kazakh National University, Almaty, **Kazakhstan** 2. D. Serikbayev East Kazakhstan State Technical University,Almaty, **Kazakhstan**
Venue		Conference – (ISCDTE – April, 2019)
Year		2019
Keywords		Business model, Digital transformation, Digitalization, Innovation

Obs: The literature review is briefly mentioned. It does not provide details of how the six strategy frameworks were selected by the authors.

<u>**For this reason this papers was considered outside this SLR scope and was excluded from the final list of selected papers.**</u>
(EC2 – Section 1.6).

Number of selected returned by search	-
Number of selected papers	Six digital transformation strategy frameworks [6,8,15,18,20,25]
Key terms	Not mentioned
Sources (library databases and search engines)	Not mentioned

Results

Digital transformation definition: This paper characterize digital transformation as the process through which organizations meet numerous new digital innovations, upgraded with universal network, with the expectation of achieving predominant execution and managed upper hand, by changing various business measurements, including the business model, the client encounter (involving digitally empowered items and administrations) and tasks (containing processes and basic leadership), and all the while affecting individuals (counting abilities ability and culture) and systems (counting the whole esteem framework).

Phases distinguished in Digital Transformation Frameworks:

- Initiation: Understanding digitalization openings, dangers and effect;
- Ideation: Imagining transformation measurements as alternatives for the business;
- Assessment: Evaluating digital preparation levels and distinguishing holes;
- Commitment: Communicating the vision and incorporating the fundamental individuals;
- Implementation: Proceeding with the activity plan in different areas; and
- Sustainability: Validating and streamlining the activity plan persistently.

Roadmap

- Digital reality: In this stage, Digital reality, the organization's current business model is outlined alongside an esteem added examination identified with partners and a study of client prerequisites. This gives a comprehension of the Digital Reality for this organization in various territories.
- Digital aspiration: Based on the Digital reality, targets with respect to digital transformation are characterized. These goals identify with time, accounts, space and quality. Digital desire hypothesizes which destinations ought to be considered for the business model and its components. Therefore, goals and business model measurements are organized.
- Digital potential: Within this Digital potential stage, best practices and empowering agents for the digital transformation are gathered. This fills in as a beginning stage regarding Digital potential and the outline of a future digital business model. For this reason, diverse alternatives are inferred for every business model component and consistently consolidated.
- Digital fit: The Digital Fit stage takes a gander at choices for the plan of the digital business model, which are assessed to decide Digital Fit with the current business model. This guarantees one satisfies client necessities and that business goals are accomplished. The assessed mixes are then organized.
- Digital integration: Digital usage incorporates conclusion and usage of the digital business model. The different mix alternatives are additionally tightened inside a digital execution system. The Digital usage likewise incorporates the plan of a Digital Customer Experience and the digital esteem creation organizes that portrays combination with accomplices. Moreover, assets and capacities are likewise recognized in this stage.

This paper was cited by	1	1. Dragičević, Z. and Bošnjak, S., 2019. Digital transformation in the mining enterprise: The empirical study. Mining and Metallurgy Engineering Bor, (1-2), pp.73-90. (by Google Scholar)
This paper cited	0	-
Authors	Lammers, T. [1], Tomidei, L., Regattieri, A.[2] 1. School of Systems, Management and Leadership, University of Technology Sydney, Australia 2. Department of Industrial Engineering, University of Bologna, Italy	
Venue	Conference – (PICMET – August, 2018)	
Year	2018	
Keywords	IEEE Keywords - Companies, Productivity, Australia, Agriculture, Manufacturing	

Obs: "The aim is to obtain a set of relevant papers, which includes information about drivers of digital transformation in Australia or describing how businesses in Australia are digitalizing".
Scope: "Papers that have been considered as 'relevant' are those including information about drivers of digital transformation in Australia or describing how businesses in Australia are implementing digitalization strategies."
For this reason this papers was considered outside this SLR scope and was excluded from the final list of selected papers (EC2 – Section 1.6).

Number of selected returned by search	Not mentioned
Number of selected papers	11+12+17+12+3+12=67 (international journals, Australian journals and reports)
Key terms	"The appropriate keywords used for the research have been extracted by either definitions of 'digital transformation' or information specific to the Australian context."
Sources (library databases and search engines)	• "Both international and Australian journals have been considered. The leading journals for each sector have been considered along with the Australian journals in the same industry and non-academic reports (Government and CSIRO reports)." • Period of time: From 2010 to 2017 ("the main digital technologies employed nowadays have been released later than 2010").

Results

Digital transformation definition: Not mentioned a definition of its own. References: [3][4][5]

Key drivers were identified in each sector and across sectors:

1. **Customer focus &value differentiation**
2. **Cost efficiency – process efficiency**
3. **Environmental sustainability**
4. **Workers safety**
5. **Productivity**
6. **Market focus/globalization**
7. **Decision making support**
8. **Idiosyncrasies of the industry**

This paper was cited by	29	Additional – Google Scholar: 65 citations
This paper cited	0	-
Authors	Schallmo, D.[1], Williams, C.A.[2], Boardman, L.[1] 1. University of Applied Sciences Ulm, Prittwitzstrasse 10, Ulm, 89075, Germany 2. Ulm University, Helmholtzstraße 16, Ulm, 89081, Germany	
Venue	Journal - International Journal of Innovation Management	
Year	2017	
Keywords	Digital Transformation; Digitisation; Business Model; Business Model Innovation; Enabler; Best Practices	

Obs: The literature review is briefly mentioned. It does not provide details.
For this reason this papers was considered outside this SLR scope and was excluded from the final list of selected papers (EC2 – S. 1.6).

| Number of selected returned by search	-
Number of selected papers	Three digital transformation approaches [Esser (2016), PwC (2013), Schaible (2015)] – Texts in another idiom other than English.
Key terms	Not mentioned
Sources (library databases and search engines)	Not mentioned

Results

Digital transformation definition: the definition is based on references. The DT framework includes the networking of actors such as businesses and customers across all value-added chain segments (BMWi, 2015, p.3; Bowersox et al., 2005,22ff.; Bouée and Schaible, 2015, p.6), and the application of new technologies (PwC, 2013, p.9;Westerman et al., 2011, p.5). As such, DT requires skills that involve the extraction and exchange of data as well as the analysis and conversion of that data into actionable information. This information should be used to calculate and evaluate options, in order to enable decisions and/or initiate activities(BMWi, 2015, p.3; Bouee and Schaible, 2015, p.6). In order to increase the performance and reach of a company (Westerman et al., 2011, p.5), DT involves companies, business models, processes, relationships, products, etc. (Bowersox et al., 2005,22ff.; Mazzone, 2014, p.8)

Reflection: Business process reengineering X DT - Rule-based systems are defined as sets of clearly assigned rule-based (algorithmic) processes which are automated by technologies. Instead of focusing on rule-based processes like BPR does, the main objectives of DT are obtaining new data and using this data to reimagine these old, rule-based processes (Proctor, 2017).

DT of business models: The DT of business models relates to individual business model elements, the entire business model, value-added chains, as well as the networking of different actors in a value-added network. The degree of DT includes the incremental (marginal) as well as the radical (fundamental) change of a business model. The reference unit with regard to the level of novelty is primarily the customer, but a DT can also affect its own business, partners,industry, and competitors. Within the DT of business models, enabler(s) and technologies (e.g., big data) are used to generate new applications or services (e.g., on-demand prediction). These enablers require skills that enable data collection and exchange as well as the ability toanalyse, calculate, and evaluate options. The evaluated options are used to initiate new processes within the business model. The DT of business models is based on an approach with a sequenceof tasks and decisions that are related to one another in a logical and temporal context. It affects four target dimensions: time, finance, space, and quality.

Roadmap

- **Digital Reality**: In this phase, Digital Reality, the company's existing business model is sketched along with a value-added analysis related to stakeholders and a survey of customer requirements. This provides an understanding of the Digital Reality for this company in different areas.
- **Digital Ambition**: Based on the Digital Reality, objectives with regards to DT are defined. These objectives relate to time, finances, space, and quality. Digital Ambition postulates which objectives should be considered for the business model and its elements.
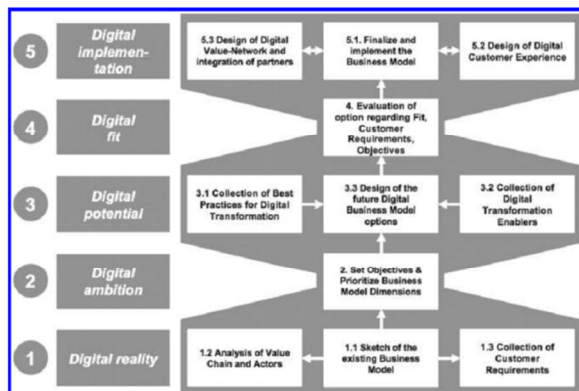
Subsequently, objectives and business model dimensions are prioritized.

- **Digital Potential**: Within this Digital Potential phase, best practices and enablers for the DT are established. This serves as a starting point in terms of Digital Potential and the design of a future digital business model. For this purpose, different options are derived for each business model element and combined logically.
- **Digital Fit**: The Digital Fit phase looks at options for the design of the digital business model, which are evaluated to determine Digital Fit with the existing business model. This ensures that one fulfills customer requirements and that business objectives are achieved. The evaluated combinations are then prioritized.
- **Digital Implementation:** Digital Implementation includes the finalization and implementation of the digital business model. The various combinations of options are further pursued within a digital implementation framework. The Digital Implementation also includes the design of a digital customer experience and digital value-creation network that describe integration with partners. In addition, resources and capabilities are also identified in this phase.

Enablers serve to allow applications or services to be used for the DT of the business model. Four categories for enablers and applications/services are detailed below:

. Digital Data: The collection, processing, and analysis of digitized data to facilitate and improve predictions and decisions.

. Automation: The combination of classical artificial intelligence technologies that enables autonomous work and self-organizing systems. This reduces error rates, increases speed, and makes it possible to reduce operating costs.

. Digital Customer Access: The mobile internet enables direct access to the client, who are thus provided with high levels of transparency and new services.

. Networking: Mobile or wired networking of the entire value-added chain via high speed broadband telecommunications allows for the synchronization of supply chains, which leads to a reduction in production times and innovation cycles.
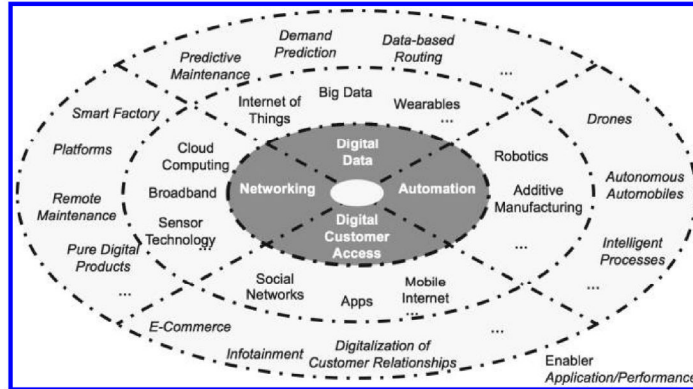

Fig. 2. Digital radar with enablers and applications (Boueé and Schaible, 2015).

Dimensions of analysis:

1. Customer dimension
2. Benefit dimension
3. Value-creation dimension
4. Partner dimension
5. **Financial dimension**