Revista Ibero-Americana de Estratégia
Iberoamerican Journal of Strategic Management

C O P E
JM14473

e-ISSN: 2176-0756
https://doi.org/10.5585/2024.25650
Received: 06 Dec. 2023 / **Approved:** 21 Feb. 2024
Evaluation Process: Double Blind Review
Editor in Chief: Heidy Rodriguez Ramos
Co-editor: Ivano Ribeiro
Assistant Editor: Leandro Rodrigues de Oliveira

Check for updates

DESIGN SCIENCE IN BUSINESS ADMINISTRATION: THE INTELLECTUAL STRUCTURE OF THE PARADIGM

Cristiane Drebes Pedron[1] **Rosária de Fátima Segger Macri Russo**[2] **Diego Nogueira Rafael**[3] **José da Assunção Moutinho**[4]

Abstract

Objective of the study: This article aims to analyse the intellectual structure of Design Science in Business Administration. It Identifies the most influential works and journals, the theoretical approaches for the generation of artifacts, and discusses the intellectual structure of the emerging literature on Design Science.
Methodology: The research used bibliographic coupling and citation analyses in the Scopus and Web of Science databases.
Originality/relevance: This research contributes to a better understanding of the design science in Business Administration.
Main results: The articles are, in the main, theoretical, demonstrating that Design Science is still in an initial maturity phase. As for the empirical and theoretical (illustrated) articles, their respective authors indicate as artifacts: framework, method, and instantiation, in addition to Design Propositions, Design Principles, and Technological Rules. The articles that constitute DS's intellectual structure are predominantly in the Systems Information area and, to a lesser degree, in Service Design and Operations Management.
Theoretical/methodological contributions: The article contributes to the scientific discussion on design science by identifying the main areas that use the paradigm to conduct research in Business Administration.

Keywords: design science, business administration, bibliometrics, artifacts; maturity

Cite as / Como citar

American Psychological Association (APA)

Pedron, C. D., Russo, R. F. S. M., Rafael, D. N., & Moutinho, J. A. (2024, Jan./Apr.). Design Science in business administration: the intellectual structure of the paradigm. *Iberoamerican Journal of Strategic Management (IJSM)*, *23*(1), 1-32, e25650. https://doi.org/10.5585/2024.25650

(ABNT – NBR 6023/2018)

PEDRON, C. D.; RUSSO, R. F. S. M.; RAFAEL, D. N.; MOUTINHO, J. A.. Design Science in business administration: the intellectual structure of the paradigm. *Iberoamerican Journal of Strategic Management (IJSM)*, v. 23, n. 1, p. 1-32, e25650, Jan./Apr. 2024. https://doi.org/10.5585/2024.25650

Acknowledgment: CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior). CNPq - Conselho Nacional de Desenvolvimento Científico e rants: #310709/2022-9

[1] Philosophy Doctor. Universidade Nove de Julho - Uninove. São Paulo, SP - Brazil. cdpedron@gmail.com
[2] Philosophy Doctor. R2DM. São Paulo, SP - Brazil. romacrirusso@gmail.com
[3] Philosophy Doctor. Escola Superior de Propaganda e Marketing - ESPM. São Paulo, SP - Brazil. diego_dnr@hotmail.com
[4] Philosophy Doctor. Universidade Estadual do Rio de Janeiro – UERJ. Rio de Janeiro, RJ – Brazil. moutinho_pmp@yahoo.com.br

Design Science na administração de empresas: a estrutura intelectual do paradigma

Resumo

Objetivo do estudo: Este artigo tem como objetivo analisar a estrutura intelectual da *Design Science* (DS) na Administração de Empresas. Ele identifica as obras e periódicos mais influentes, as abordagens teóricas para a geração de artefatos e discute a estrutura intelectual da literatura emergente sobre *Design Science*.
Metodologia: A pesquisa utilizou o pareamento bibliográfico e análises de citação nas bases de dados *Scopus* e *Web of Science*.
Originalidade/relevância: Esta pesquisa contribui para uma melhor compreensão da *Design Science* na Administração de Empresas.
Principais resultados: Os artigos são, em sua maioria, teóricos, demonstrando que a *Design Science* ainda está em uma fase inicial de maturidade. Quanto aos artigos empíricos e teóricos (ilustrados), seus respectivos autores indicam como artefatos: *frameworks*, método e instanciação, além de *Design Propositions*, *Design Principles* e *Technological Rules*. Os artigos que constituem a estrutura intelectual da DS estão predominantemente na área de Sistemas de Informação e, em menor grau, em *Service Design* e Gestão de Operações.
Contribuições teóricas/metodológicas: O artigo contribui para a discussão científica sobre *Design Science*, identificando as principais áreas que utilizam o paradigma para conduzir pesquisas em Administração de Empresas.

Palavras-chave: *design science*, administração de empresas, bibliometria, artefatos, maturidade

Design Science en la administración de empresas: la estructura intelectual del paradigma

Resumen

Objetivo del estudio: Este artículo tiene como objetivo analizar la estructura intelectual de la Design Science (DS) en la Administración de Empresas. Identifica las obras y revistas más influyentes, las aproximaciones teóricas para la generación de artefactos y discute la estructura intelectual de la literatura emergente sobre Design Science.
Metodología: La investigación utilizó el emparejamiento bibliográfico y análisis de citas en las bases de datos Scopus y Web of Science.
Originalidad/Relevancia: Esta investigación contribuye a una mejor comprensión de la Design Science en la administración de empresas.
Principales resultados: Los artículos son, en su mayoría, teóricos, demostrando que la Design Science aún está en una fase inicial de madurez. Respecto a los artículos empíricos y teóricos (ilustrados), sus respectivos autores indican como artefactos: frameworks, método e instanciación, además de Design Propositions, Design Principles y Technological Rules. Los artículos que constituyen la estructura intelectual de la DS están predominantemente en el área de Sistemas de Información y, en menor medida, en Service Design y Gestión de Operaciones.
Contribuciones teóricas/metodológicas: El artículo contribuye a la discusión científica sobre Design Science, identificando las principales áreas que utilizan el paradigma para llevar a cabo investigaciones en Administración de Empresas.

Palabras clave: design science, administración de empresas, bibliometría, artefactos; madurez

1 Introduction

The need for the Business Administration area to produce research and results relevant to practitioners is a concern in countless studies (Carton & Mouricou, 2017; Kieser, Nicolai & Seidl, 2015). This question propels research that follows the Design Science (DS) paradigm, given that its nature is to produce practical knowledge (Kieser et al. 2015), employing the creation and evaluation of artifacts that seek to solve organisational problems (Hevner, March, Park & Ram, 2004). DS ultimately diverges from traditional patterns since it aims to propose something practical, prescriptive, and pragmatic (Carton & Mouricou, 2017).

In the DS paradigm, which is considered a problem-solving process (Hevner et al., 2004), there needs to be an in-depth collaboration between researchers and practitioners to achieve a better understanding of work practices, adequate problem formulation, and a proposal for better and more creative solutions (Fendt & Kaminska-Labbé, 2011), with the generation of visible and trackable results (Mesny & Mailhot, 2012). In addition to these questions that refer to relevance, there is also the concern with rigour, which comes from the definitions for developing the theory and methodological procedures (Venable & Baskerville, 2012). Design Science Research (DSR) is a method that stands out. It operationalizes the conduction of the research intending to produce prescriptive knowledge that supports the solution to a real problem, often in the form of an artifact (Dresch, Lacerda & Miguel, 2015).

In the last few years, the community has invested efforts in developing research into DS, with special editions in journals evolving the theme (for example, Hevner, Brocke & Maedche, 2019). In 2020, the Brazilian Administration Review also published a Special Issue on Design Science in Organizations (Lacerda & Dresch, 2020), highlighting the importance and application of DS and DSR to the Administration field. The initiative demonstrates the journal's interest in disseminating research initiatives in this area and the theme's relevance in the scientific community. In addition, there has also been the proposal of themes involving DS in conferences (for example, ECIS – European Conference on Information Systems, on Design Research in Information Systems). However, although these initiatives increase the visibility of DS in the Business Administration field, it is not known up to what point academics in the area have managed to appropriate the paradigm. In other words, it is unknown what areas of Business Administration have published on the paradigm, if adaptations have been made to the proposed theories that emerged in other areas, what journals are opening space or even stimulating the development of research on DS, etc.

This paper aims to analyse the intellectual structure of Design Science in Business Administration. To this end, a bibliometric study was carried out, using the bibliographic coupling technique (Zupic & Čater, 2015). Three objectives were specified to achieve the general aim established: (1) identify the most influential works and journals on DS research; (2) identify the theoretical approaches for the generation of artifacts in DS; (3) discuss the intellectual structure of the emerging literature on DS. To the best of our knowledge, there are no records of research published in the databases used for this article (Scopus and Web of Science), taking into account the bibliometric methodology strategy of bibliographic coupling on DS. From this perspective, the originality of this research is presented as a contribution to filling this scientific gap.

2 Methodological Procedures

The bibliometric method was chosen for the research development since the results of bibliometric research based on peer-reviewed articles are very useful for evaluation in research areas (Martin, 1996; Raan, 1996). Citation analysis was used to explore the main authors and journals published on DS. It presents objectively measured results and uses bibliographic data from publication databases to construct an intellectual structure of scientific fields (Garfield, 1979). Citation analysis makes it possible to quickly find the most important research in the scientific field (Zupic & Čater, 2015). Moreover, it is a bibliometric method that reveals the research with the most significant contribution, impact and quality in a given area (Kaparthi, 2012; Shiau, Dwivedi & Yang, 2017).

Intending to achieve one of the purposes of the research, on the subjects that emerge from DS, this study employs bibliographic coupling analysis using the Bibexcel tool (Zupic & Čater, 2015). Other tools and research techniques were used for the presentation of the results, for example, Principal Component Analysis based on the multidimensional scaling technique, and carried out employing SPSS statistics software and social network analysis to identify the components that emerged from DS (Singh, Verma & Chaurasia, 2020). The network analysis of the entire base and centrality of the articles were developed with the support of UCINET/Netdraw social network analysis software (Borgatti, Everett & Freeman, 2002).

The two main scientific databases, Scopus and Web of Science (WoS) were used for data collection to perform the bibliographic coupling analysis (Zupic & Čater, 2015). The collection criteria were the same for both bases. Data was collected in February 2020, using the term ‘Design Science’ (title, abstract, and keywords). Filters applied were: document type

'article' and science areas/categories 'management' and 'business'. The results considered articles published in English and Portuguese. The two database results were overlapped to form a single base, composed of 243 articles (42.6%) exclusively from Scopus, 121 (21.2%) from the WoS base, and 206 articles (36.2%) from both. The final result was 570 different articles.

Despite the recommendation made regarding the partitioning of the database for bibliographic coupling analysis in periods of up to 10 years (Glänzel & Thijs, 2012), the approach taken was different, taking into account that the theme under research – Design Science – is a research paradigm only recently disseminated in academic literature (Kieser et al., 2015). A detailed analysis of the period of the publications shows that 87% date from the last ten years. This percentage reaches 97.7% when the base is extended to the previous 15 years, though the first publication with this term was published in 1988. No period filter was applied to the database collection.

With the article base unified, it was possible to obtain some descriptive data, such as the analysis of publications within the period, authors, and journals that comprise the integrated sample. The data were inserted into the Bibexcel software to extract the database in such a format to enable data refinement. The aim was to correct the inconsistencies in the references. With the support of an electronic spreadsheet, 6,273 references (18.71%) were updated manually, from a total of 33,513. Technical questions relative to the databases in bibliometric research, such as unification problems and reference errors, have already been documented (Buchanan, 2006; MacRoberts & MacRoberts, 1996; Pislyakov, 2009). A square co-occurrence matrix was obtained as a result of the bibliographic coupling procedures on Bibexcel software. The pairing matrix was inserted into Ucinet/Netdraw software to make the database cutoff point. This cutoff point was based on the network analysis, with nine or more pairs (>=11), resulting in 190 ties and 73 nodes. The data were then inserted into the SPSS statistics software for Principal Component Analysis. The data reduction followed the statistical criteria established by Hair, Black, Babin, Anderson and Tatham (2009). In its final form, the Principal Component Analysis comprises 5 components and 44 variables (scientific articles), which enabled, as a next step, the development of the network, centrality, cohesion and density analyses.

A qualitative analysis (Marshall & Rossman, 2006) was carried out on these 44 articles after the bibliometric phase to find elements for the relations grounded by the Principal Component Analysis and to meet two secondary aims. Using a template with diverse information from the articles that comprise the bibliographic coupling analysis, such

as the methodological base used, the results found, the possibilities for future studies, type of artifact, theoretical and practical contribution, in addition to the theoretical slant of each article, we identified elements that characterized the article, the research and the findings that were codified and categorized, achieving the following descriptive results.

3 Results

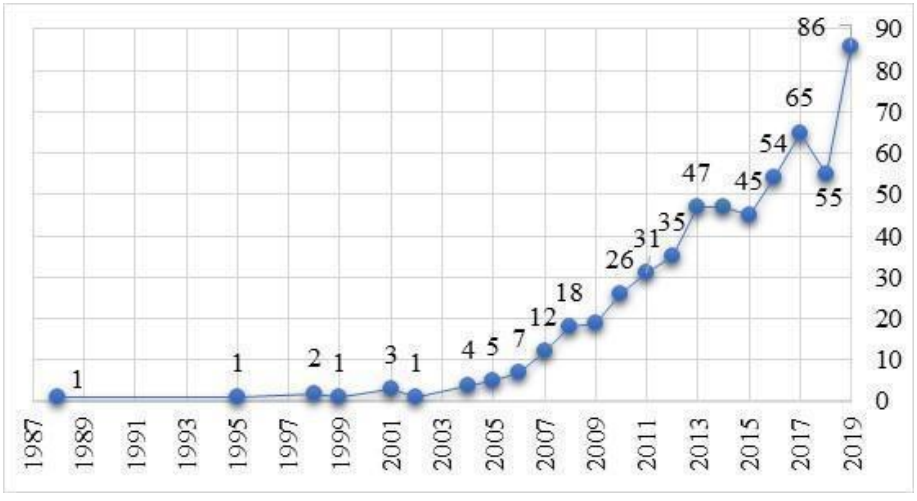
The articles selected and the above-mentioned components resulting from the bibliometric method will be discussed below.

3.1 Article analysis

This research collected 570 articles, with a total of 33,513 references. Figure 1 presents the publications per year. The journals that published the most on leveraging DS in the initial decade (the 2000s) were MIS Quarterly, with 11 articles and Decision Support Systems, with 8. Both journals have the highest number of publications when one observes the citation analysis from the whole sample period, with 28 and 23 publications, respectively. The list progresses with Information Systems and E-Business Management (21 articles), Journal of Management Information Systems (20 articles), and Business Process Management Journal (16 articles).

Figure 1

Publications per year



It is possible to observe in the sample that, although the first study on DS was in 1988, only in the 2000s did publications on DS begin to be widely spread. Also, considering the citation analysis presented in Table 1, some of the main authors on DS started their research in the same decade, for example, Alan Hevner, Ken Peffers, Joan van Aken, Shirley Gregor and Salvatore March, the last mentioned having published an article in 1995. The citation analysis described in Table 1 presents the most cited studies.

Table 1

Citation Analysis

Authors	Titles	Year	Journal	Nº of Citations
Hevner *et al.*	Design Science Research in Information Systems	2004	MIS Quarterly	311
Peffers *et al.*	Design Science Research Methodology for Information Systems Research	2007	Journal of Management Information Systems	141
March and Smith	Design and Natural Science Research on Information Technology	1995	Decision Support Systems	132
Simon	The Science of The Artificial	1969	MIT Press	127
van Aken	Management Research on the Basis of the Design Paradigm: The Quest for Field-Tested and Grounded Technological Rules	2004	Journal of Management Studies	88
Gregor and Hevner	Positioning and Presenting Design Science Research for Maximum Impact	2013	MIS Quarterly	85
Gregor and Jones	The Anatomy of a Design Theory	2007	Journal of the Association of the Information Systems	65
Walls *et al.*	Building an Information System Design Theory for Vigilant EIS	1992	Information Systems Research	54

3.2 Bibliographic coupling and network analysis

As previously mentioned, the Principal Component Analysis comprises 44 articles from the Web of Science (12) and Scopus (14) bases, with 18 articles from both databases. These articles were reduced multidimensionally into 5 components. The rotated component matrix with the component loadings, the general reliability indices, and the total explained variance are presented in Table 2.

The network analysis was developed from the result of the Principal Component Analysis. In addition to the 5 components in Table 2, the central articles are indicated according to the centrality analysis. The cohesion analysis shows that Component 1 (DS in Information Systems) interacts poorly with the other components (1.71), as seen in Table 1. Component 3 (*Design Science: collaboration, relevance, and impact*) also has a high level of cohesion, presenting a greater relationship with the articles in the component itself. On the other hand, Component 5 (DS in Operations Management) presents high interaction with the other components (0.85). The network diagram shown in Figure 2 contributes to infer cohesion analysis. In this case of Component 5, the low cohesion indicator is because the component is made up of only three articles, which generates greater dependence on relationships with articles from other components. As for the density analysis, the coefficients in Table 2 prove that the articles composing each component partially follow their agendas in standard bases, which can be observed in the network analysis (Figure 2) through the homogeneity of the components in the diagram as a confirming analysis.

3.3 Analysis of articles resulting from the components

Of the articles resulting from the bibliographic coupling, eight are from the *British Journal of Management*, five from the *MIS Quarterly*, and five from *Information Systems and E-Business Management*, with the remaining spread among various other articles.

Table 2

Exploratory component and qualitative analyses of the articles

Rotated component matrix – Bibliographic coupling General reliability KMO: 0.801

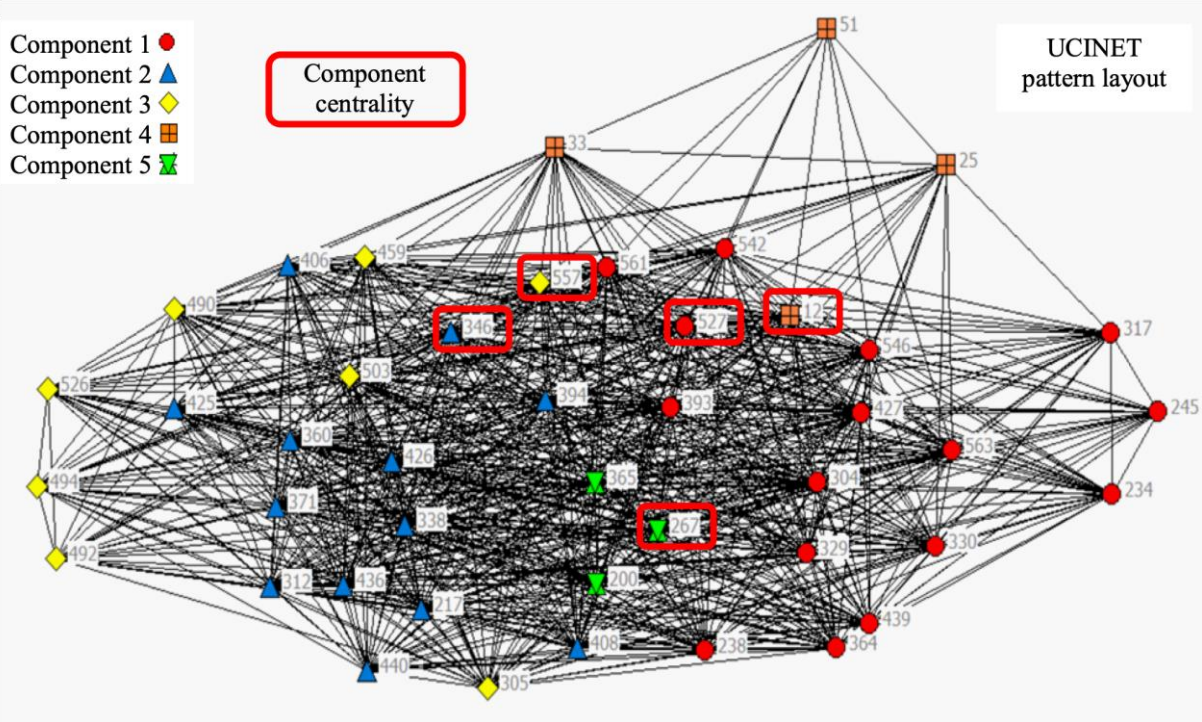
Compo-nent	#	Article	1	2	3	4	5	Area	Article Type
1	238	Gregory & Muntermann, 2014	**.866**	.055	.027	.160	.100	IS	**Theoretical
1	330	Carcary, 2011	**.855**	.119	.128	.178	.084	IS	Empirical
1	563	Aier & Fischer, 2011	**.851**	.103	.138	.195	.052	IS	Theoretical
1	546	Gregor & Hevner, 2013	**.833**	.026	.112	.228	.019	IS	Theoretical
1	542	Löhe & Legner, 2014	**.825**	.095	.015	.312	.047	IS	Empirical
1	304	Venable & Baskerville, 2012	**.817**	.067	.096	.093	.168	B&M	Theoretical
1	561	Carlsson *et al.*, 2011	**.817**	.016	.179	.217	.085	IS	Theoretical
1	329	Venable, 2011	**.800**	.100	.041	.081	.287	IS	Empirical
1	234	Arnott & Pervan, 2005	**.777**	.201	.126	.032	.024	IS	Theoretical
*1	527	Baskerville *et al.*, 2015	**.751**	.046	.059	.186	.170	IS	Theoretical
1	439	Hevner *et al.*, 2004	**.735**	.172	.161	.017	.245	IS	Theoretical
1	427	Gregor, 2006	**.723**	.097	.152	.030	.093	IS	Theoretical
1	245	Miah & Gammack, 2014	**.714**	.193	.108	.081	.073	IS	Empirical
1	317	Miah *et al.*, 2012	**.698**	.257	.142	.061	.143	IS	Empirical
1	364	Abbasi *et al.*, 2010	**.697**	.061	.147	.049	.047	IS	**Theoretical
1	393	Holmström *et al.*, 2009	**.555**	.422	.244	.062	.039	OM	Theoretical
2	426	Huff *et al.*, 2006	.010	**.842**	.281	.038	.110	Mgm	Theoretical
2	408	Denyer *et al.*, 2008	.011	**.834**	.202	.037	.115	O&M	**Theoretical
2	394	Aken & Romme. 2009	.021	**.816**	.278	.048	.145	O&M	Theoretical
2	406	Hamlin & Bassi, 2008	.098	**.800**	.339	.016	.121	HRM	Empirical
2	436	Aken, 2005	.079	**.793**	.102	.067	.031	Mgm	Theoretical
2	440	Aken, 2004	.038	**.771**	.008	.027	.005	O&M	Theoretical
*2	346	Fendt & Kaminska-Labbé, 2011	.042	**.769**	.178	.081	.023	Org	Theoretical
2	371	Pandza & Thorpe, 2010	.012	**.750**	.465	.063	.066	Mgm	Theoretical
2	360	Avenier, 2010	.080	**.746**	.475	.042	.169	Org	Theoretical
2	425	Burgoyne & James, 2006	.149	**.722**	.560	.070	.051	Mgm	Theoretical
2	312	Mesny & Mailhot, 2012	.080	**.663**	.571	.075	.102	Mgm	Theoretical
2	338	Hodgkinson & Starkey, 2011	.087	**.647**	.553	.080	.065	B&M	Theoretical
2	217	Romme *et al.*, 2015	.088	**.609**	.592	.067	.094	Mgm	Theoretical
3	492	Wells & Nieuwenhuis, 2017	.121	.142	**.903**	-.068	.049	OM	Empirical

3	526	Kieser *et al.*, 2015	-.129	.185	**.884**	-.022	-.016	Mgm	Theoretical
3	494	Sealy *et al.*, 2017	-.186	.208	**.847**	-.075	.055	Mgm	Theoretical
3	503	Vo & Kelemen, 2017	-.094	.450	**.796**	-.033	.115	Mgm	Theoretical
3	459	Guerci *et al.*, 2019	-.129	.307	**.783**	-.044	.078	HRM	Theoretical
*3	557	Marcos & Denyer, 2012	-.055	.435	**.770**	-.059	.071	Mgm	Empirical
3	490	Carton & Mouricou, 2017	-.189	.296	**.767**	-.068	.044	Mgm	Theoretical
3	305	Hodgkinson & Starkey, 2012	-.011	.537	**.682**	-.058	.155	Mgm	Theoretical
4	51	Sudbury-Riley *et al.*, 2019	.131	-.094	-.090	**.840**	-.039	SD	Empirical
4	25	Dellermann *et al.*, 2019	.242	-.114	-.081	**.785**	.009	DM	Empirical
4	33	Yassaee *et al.*, 2019	.456	-.043	-.044	**.713**	-.026	HM	Empirical
*4	12	Teixeira *et al.*, 2019	.286	-.092	-.137	**.581**	.338	SD	**Theoretical
*5	267	Lacerda *et al.*, 2013	.385	.364	.194	.029	**.618**	OM	Theoretical
5	200	Dresch *et al.*, 2015	.284	.267	.239	.096	**.602**	OM	Theoretical
5	365	Holmström *et al.*, 2010	.309	.328	.154	.006	**.596**	OM	Empirical
Reliability per Cronbach Alpha			0.96	0.95	0.95	0.77	0.65		
Density per component			0.88	0.57	0.78	0.40	0.50		
Cohesion per component			1.71	1.08	1.53	1.33	0.85		
Rotation sums of squared loadings as % (cumulative)			23.8	44.5	62.1	68.0	71.8		

Note. IS: Information Systems; OM: Operations Management; Org: Organisations; B&M: Business and Management; O&M: Organisation and Management; HRM: Human Resource Management; SD: Service Design; HM: Health Management; Mgm: Management; DM: Decision Making; #: Article number. *Variables that present component centrality; ** Theoretical (illustrated)

Figure 2

Network analysis



As can be observed in Table 2, the Information Systems (IS) area is the largest, with 14 articles, Operations Management (OM) has 5 articles, Service Design (SD) and Human Resource Management (HRM) have 2 each. There are also articles from such specific areas as Research Management (5) or a wide range, for example, Management (5), Organisations (2), and Business and Management (2).

Observing Table 3, the method used was that of Peffers, Tuunanen, Rothenberger and Chatterjee (2007) in 4 articles, with the others using diverse methods, such as that of Hevner (2007), Gregor and Jones (2007), van Aken (2004). Five articles with a theoretical approach base also feature in the articles resulting from the components (Carlsson, Henningsson, Hrastinski, & Keller, 2011; Denyer, Tranfield & van Aken, 2008; Hevner et al., 2004; Holmström, Ketokivi & Hameri, 2009; van Aken, 2004). Most of the articles (31) are theoretical, 3 of which illustrate the theory with examples. Of the empirical articles, only 11 generate artifacts such as framework, method, and instantiation, in addition to Design Propositions, Design Principles, and Technological Rules. It is also important to point out that artifacts were generated in the article without a precise method, as in the case of Denyer et al. (2008) and Guerci, Radaelli and Shani (2019). The artifact illustrated the theory in the former, but there was no respective validation of the generated framework in the latter.

Table 3

Articles selected by bibliographic coupling with the production of an artifact

Compo-nent	Citation	Article type	Theoretical Approach	Artifact
1	Abbasi *et al.*, 2010	Theoretical (illustrated)	Hevner *et al.*, 2004	Method and instantiation
1	Carcary, 2011	Empirical	Hevner, 2007	Framework
4	Dellermann *et al.*, 2019	Empirical	Peffers *et al.*, 2007	Design Principles
2	Hamlin and Bassi, 2008	Empirical	Aken, 2004	Technological Rules
5	Holmström *et al.*, 2010	Empirical	Denyer *et al.*, 2008 and Holmström *et al.*, 2009	Design Propositions
1	Löhe and Legner, 2014	Empirical	Gregor and Jones, 2007	Design Principles
1	Miah *et al.*, 2012	Empirical	Peffers *et al.*, 2007	Approach
1	Miah and Gammack, 2014	Empirical	Carroll and Swatman, 2000	Framework
4	Sudbury-Riley *et al.*, 2019	Empirical	Peffers *et al.*, 2007	Method
4	Teixeira *et al.*, 2019	Theoretical (illustrated)	Peffers *et al.*, 2007	Method
4	Yassaee *et al.*, 2019	Empirical	Carlsson *et al.*, 2011	Design Principles

4 Component Details

As can be identified in Figure 2, five components were chosen as the basis for bibliographic coupling. We can see that two components were on the left (Component 2 and 3), which discuss questions related to the application of the method of DS research more theoretically and in-depth, and in the centre and on the right are components (1, 4 and 5), which highlight the management areas where the method was researched, as will be discussed in the following paragraphs.

The similarity or proximity between the more theoretical components (2 and 3) can also be seen in the cross-loading highlighted in Table 2. Component 2 has 6 articles with a high load in component 3, and this latter has 3 articles with a high load in component 2. For

example, Romme et al. (2015) have an almost equal load between components (0.609 and 0.592). We will discuss each of the components, but we observe that both, with discussions through various themes and approaches, emphasize the pressing need for research in Business Administration to dialogue more effectively with practice, negotiating the objectives of both in such a way as to meet their purposes and responsibilities. There is almost no occurrence of cross-loading in the other components.

4.1 Component 1 – Design Science in IS (Information Systems)

This component is formed mainly by a growing body of articles from the IS area that appropriates DS, presenting methodological specificities, concepts, and practices. The central article from this group argues that the aim of knowledge evolution using this paradigm can be divided into various genres, as affirmed by Baskerville, Kaul and Storey (2015). These authors explain that one cannot generalise about DS research processes using just one way of producing knowledge but must take into consideration the duality between design and science, in addition to the duality between ideographic (the treatment of facts considered individually) nomothetic (relative to the humanities as a whole).

When carried out from the DS perspective, research can approach types of problems that demand human creativity and innovative solutions (Carcary, 2011). Thus, DS has been used as a methodological approach for issues of different natures in the information systems area, for example, fake websites (Abbasi, Zhang, Zimbra, & Chen, 2010), the implanting of Enterprise Architecture Management (Löhe & Legner, 2014) and Decision Support System (DSS) (Arnott & Pervan, 2005; Miah, Debuse, & Kerr, 2012; Miah & Gammack, 2014). Carlsson et al. (2011) proposed a DS approach that responds to practical development not only for the design of new information technologies but also for IS governance and management. There is even an example of a possible DSR course in a business course (Venable, 2011).

Gregor (2006) analyses the nature and generation of theory in IS, highlighting DS in the Design and Action type of theories. That is why Venable and Baskerville (2012) argue for the use of DSR, with rigour observed, defining more precise declarations on the theory of design and a rigorous evaluation of the method of research used. Therefore, directives to understand, execute, and evaluate research into DS in the IS area are necessary (Hevner et al., 2004). Considering Kuhn's premise that science and progress are strongly interrelated, Aier

and Fischer (2011) defined and exemplified progress criteria for design theories in their article.

Despite these previous efforts, Gregor and Hevner (2013) considered that DSR had not reached its potential in the IS area due to the lack of structure to organise and communicate the knowledge generated. Other authors are concerned with how design theories are generated; Gregory and Muntermann (2014) developed a normative structure for the creation of design theories based on heuristics, considering the importance of an engaged relationship between academics and practitioners. Still questioning the generation of theory, we have the article by Gregor et al. (2009), which suggests a four-phase process, beginning with the incubation of the solution, refinement of the solution, the generation of a substantive theory, which aims to understand the theory in a context of specific application, and ending with the generation of a formal theory, applicable to all contexts.

4.1.2 Component 2 – Design Science: opportunities and challenges between practice and theory

The management field of study has a significant and growing knowledge base. Still, it has been criticised for its fragmentation and little relevance to practice (van Aken & Romme, 2009) or for rarely affecting practice (Huff, Tranfield, & van Aken, 2006). Conventional research, of a predominantly descriptive nature, oriented by academic rigour, could have the problem of relevance mitigated by the complementation of research guided towards prescription (Burgoyne & James, 2006; Huff et al., 2006; van Aken, 2004). However, it is necessary to draw attention to instrumental relevance complemented by conceptual relevance, even though the latter instigates research by trackability and control over knowledge utilisation (Mesny & Mailhot, 2012). Romme et al. (2015) argue that more and better negotiation zones are necessary to allow more significant dialogues regarding the main practical and theoretical management challenges.

In the constructivist view of DS, knowledge can be generated and utilised in such a way as to enrich the academy and practice (Avenier, 2010). This explains the component centrality in the article by Fendt and Kaminska-Labbé (2011). These authors introduce the notion of pragmatic adequacy to explain how research-action approaches oriented towards design can reduce the difference of relevance, facilitate change and increase creativity. Even with all the allegations, the proponents of DS and management, based on evidence, still need

to gather proof of quality concerning the nature and size of the alleged gaps in a sufficient body of compelling cases illustrating their resolution (Hodgkinson & Starkey, 2011).

The central mission of DS is to develop valid knowledge that practitioners can use to design solutions to their concrete problems (Pandza & Thorpe, 2010). The use of management research based on evidence, through a synthesis of research oriented towards design, makes it possible to decrease segmentation in the uniting of various lines of research, enabling the addressing of questions more relevant to practice and the development of technological rules or Design Propositions for certain classes of problems (van Aken, 2005; van Aken & Romme, 2009), with a possible extension utilising CIMO (Context, Intervention, Mechanism & Outcome) logic (Denyer et al., 2008). The production of prescriptive knowledge in management supports evidence-based practice (Hamlin & Bassi, 2008), even though operational questions create tensions inherent to mode 2 research (Burgoyne & James, 2006), which is a 'knowledge production system conducted in the context of application' (p. 304). Pandza and Thorpe (2010) contribute to the debate on DS in management by identifying three types of design: deterministic, path-dependent, and path-creation.

4.1.3 Component 3 – Design Science: collaboration, relevance, and impact

As with component 2, this component is essentially composed of theoretical articles. The discussion of rigour versus relevance (or impact) of the various methods in Business Administration can be seen here. Several articles emphasize the importance of significance but discuss rigour more (Kieser et al., 2015). Many discuss collaboration as a means of obtaining relevance for practitioners (Sealy, Doldor, Vinnicombe, Terjesen, Anderson, & Atewologun, 2017; Vo & Kelemen, 2017). Carton and Mouricou (2017) characterize DS within the Paradigm Shift group, which represents new research methods that use practitioner collaboration and evaluate the products generated. However, the authors state that DS does not yet clearly focus on the common good they advocate as the relevance to be pursued. Others suggest using different methods jointly with DS, for example, critical realism, to give more rigour to the method (Hodgkinson & Starkey, 2012).

The central article for this component is Marcos and Denyer (2012), which encourages collaborative research between academics and practitioners or even encourages practitioners themselves to be researchers (Guerci et al., 2019). Nevertheless, this collaboration has implications for negotiation zones between the various actors involved in the research (Sealy

et al., 2017; Vo & Kelemen, 2017). Engagement for change in society with the support of academia is fundamental for the impact of research (Wells & Nieuwenhuis, 2017).

4.1.4 Component 4 – Design Science in Service Design

The central article for this component is a conceptual one (Teixeira, Patrício, & Tuunanen, 2019), which argues for using DSR to develop concepts, models, and methods for the Service Design area. These authors discuss generating a method (Service Design for Value Networks). As a contribution, Sudbury-Riley, Hunter-Jones, Al-Abdin, Lewin and Naraine (2019) developed a methodology, the Trajectory Touchpoint Technique, to create more value and innovations based on the user's experience in generating services.

The use of design principles was distinctive in this group. Yassaee, Mettler, and Winter (2019) defined design principles to implement a staff health and welfare monitoring system, which has relevant social implications for employees that should be considered. The design principles for a system of decisions for business models were the focus of study in Dellermann, Lipusch, Ebel and Leimeister (2019), with the authors generating a tool that has become a consulting resource to support startups and incubators. This component is composed of more recent articles, with a high component load, as can be seen in Table 2. Hence, this theme is probably a hot topic, that is, it must greater be developed in the coming years.

4.1.5 Component 5 – Design Science in Operations Management

This component has two connecting aspects between the three articles: the application of DSR in operations management and using Design Propositions as an artifact. The central article for this component is that by Lacerda, Dresch, Proença and Antunes (2013), which proposes more detailed stages for the application of DSR in this area. This article emphasizes the importance of the method to join rigour to the relevance of the research for practice. In a second study, Dresch et al. (2015) point out the differences between the DSR method, action research and case study, and typical methods in operations management. The main differences between the methods are in the objectives (in the first, it is to design and describe, while in the others, it is to explore, describe, explain, and predict) in the results (artifacts versus constructs, hypotheses, descriptions, explanations, and actions); in the specifics of the research result, for in DSR, it can be general for a determined class of problems, while in others it is for a specific situation. The article by Holmström, Främling and Ala-Risku (2010) synthesizes research

conducted over ten years in Design Propositions for the utilization of product tracking. The propositions are tracking in project delivery, managing industrial assets and service industry deliveries. To finish the description of the components derived from the bibliographic coupling analysis, Table 4 summarises the sample characteristics.

Table 4

Sample characteristics of the bibliographic coupling

Type	Characteristics	Quantity
Type of artifact	Design Principles	3
	Method	2
	Framework	2
	Technological Rules	1
	Design Propositions	1
	Approach	1
	Method and Instantiation	1
Research area	Information Systems	14
	Management	12
	Operations Management	5
	Organisations and Management	3
	Business and Management	2
	Human Resource Management	2
	Organisations	2
	Service Design	2
	Decision Making	1
	Health Management	1
Article Type	Empirical	12
	Theoretical	32

Note. The "Type of artifact" corresponds to the 11 articles that produced the artifact. The "Research Area" and "Article Type" correspond to all articles in the sample (44).

5 Discussion

It is important to emphasise that all the following discussions are based on the sample resulting from bibliographic coupling analysis. It could be said that DS is very promising,

with a great deal of theory being developed and some artifacts being constructed and instantiated. This is affirmed by a large number of theoretical articles (32) compared to empirical articles (12), as seen in Table 2. This shows that DS, despite being in its initial stages, is advancing in its process of maturity.

One can see that the IS area is more mature in the application of the method, for in addition to having more articles selected in the bibliographic coupling with the densest component, it has various articles that are concerned with developing the theory (Carlsson et al., 2011; Löhe & Legner, 2014) or even creating criteria to evaluate the progress of this theory (Aier & Fischer, 2011). Some can consider this area independent of Management Science (Kuechler & Vaishnavi, 2008), but our results showed they continue to be significantly related. It is important to consider that the method is also advancing in such areas as Service Design and Operations Management, as highlighted in components 4 and 5. However, many articles defend the use of the method in the management area in general.

Among the critics, some question the obligation to produce a prescriptive result and advocate that this DS process is still unexplored (Vo & Kelemen, 2017). In the same vein, Kieser et al. (2015) defend the use of descriptive methods focus on how to practice using the research results in Business Administration. This method is a base for programmatic research, in which they classify DS, among other methods. They view the paradigm as an extension, not an alternative to Mode 2 knowledge production. They emphasise the insecurity on the part of managers concerning the adoption of prescriptions, often conflicting, even if supported by strong evidence. Besides, the authors turn to Jelinek, Romme and Boland (2008) and Romme (2003) to criticise the use of theories that are not in harmony with the current reality in organisations, in predominantly descriptive and explanatory approaches that omit the complexity of reality and academic interest through prescription. They indicate that, according to Donaldson (2002), the suppositions on which the theories of management studies are based can conflict to improve management practices.

Hodgkinson and Starkey (2012) affirm that critical realism can be used jointly with DS to leverage the increase of rigour and the relevance of the study, in addition to promoting changes in practice. They also draw attention to the fact that DS includes the thinking of open systems oriented by abductive reasoning, such as the logic of exploration. Guerci et al. (2019) see DS as a paradigm to solve problems used extensively in MBA courses, aiming to train students as researchers. Pandza and Thorpe (2010) criticise the interpretation given by several authors regarding Simon's supposed division of social science into explanatory and prescriptive. These authors question the omission, on the part of Design defenders in the

management field, of the involvement of designers in solutions, adding uncertainty to the process. They are also sceptical about the possibility of defining technological rules or other deterministic projects in the management area. In addition, Gregor and Hevner (2013) argue that the lack of understanding of DSR impedes the presence of the method in a more marked form in the field of Information Systems.

One of the essential characteristics of DS is the creation of artifacts, which are not always very well understood. Artifact typologies emerged from Simon's concept of artificial (1996), taking into consideration, primarily, the context of the information systems area, as in March and Smith (1995), Walls, Widmeyer and Sawy (1992), Purao (2002) and Venable (2006). However, the artifacts can be seen, more generically, as the symbolic representation or the physical instantiation of the design concepts (Gill & Hevner, 2011).

Component 1 (DS in IS) has more research that produced artifacts, with 5 articles, followed by Component 4 (DS in Service Design). Several authors use Design Principles (Dellermann, Lipusch, Ebel and Leimeiste., 2019; Yassaee, Mettler and Winter, 2019) under Gregor's understanding (2006). For this author, the theory for Design and Action is one of the five existing types (the others are analysing and describing; understanding; predicting; explaining and predicting). In this theory, design principles are design and knowledge decisions that appear or are encapsulated in an artifact. These principles are similar to propositions in the formulation of traditional theory. In their research, Dellermann et al. (2019) generated Design Principles (for form and function), along with Design Implementation, in a system of support for an intelligent hybrid decision for the validation of business models.

One of the articles that most explain the artifact of the Design Propositions type is that by Denyer et al. (2008), who define the entry for the design of a solution for any problem no matter what it is, rejecting the term Technological Rules. These authors generated a methodology (Research Synthesis) that aims to create this type of artifact. On the other hand, van Aken (2004) defends the use of the term Technological Rules, defined as a 'chunk of general knowledge, linking an intervention and artifact with a result or desired outcome or performance' (p. 228). Hamlin and Bassi (2008) used this type of artifact fact to set up a global framework of management competencies and Löhe and Legner (2014), focusing on developing Design Theory for an architecture directed towards the management of Information Technology.

Holmström, Ketokivi and Hameri (2009) suggest that Means-end Proposition should be created at the end of the research. This type of proposition should represent the

formalisation of the theory, which means that it should be used to arrive at an end based on exhaustive application and refinement of the artifact generated. One example is the research by Holmström et al. (2010), which generated Design Propositions for the utilisation of product tracking.

Some researchers generated a framework through the DSR method. According to Carcary (2011, p. 115), frameworks 'are located between model and method in the sense that a) they offer state descriptions on the current maturity level assessment and b) guidelines concerning how organisations can achieve higher maturity.' Another example of the framework is Miah and Gammack's (2014), who describe an IS artifact and its dimensions for generating a DSS. Abbasi et al. (2010) generated a method and instantiated it in a prototype for a false website detection system.

Guerci et al. (2019) generated a theoretical framework to implement research Mode type 2 in the Human Resource area. These authors include the DS in this research category, which is not a consensus. Mode 2 research aims to include practitioners from the beginning to the end of the study, without a hierarchy between practitioners and researchers, and a relevant result developed with high rigour. The taxonomy of the artifacts is still not defined, and therefore Miah et al. (2012) generated an approach to validate a DSS.

For Peffers et al. (2007), the definition of artifact includes any object designed with a built-in solution for a problem covered in the research. In this way, the typology of artifacts indicated in the literature cannot necessarily represent the exhaustive set of possibilities of solutions applicable to organisational management, such as human resources, strategy, production, marketing, finances, projects, etc. It is therefore recommended that a typology of artifacts be developed, which could consider characteristics of this area.

6 Conclusions

The application of bibliometric research met the aim of analysing the intellectual structure of DS in Business Administration. Citation analysis identified the most influential works and journals. Bibliographic coupling analysis with the application of Principal Component Analysis, complemented by network analysis, identified the existing components (dimensions) in DS in Business Administration, thus generating the intellectual structure to be analysed. In this analysis, qualitative techniques in the articles resulting from the components were applied to highlight the main theoretical approaches for generating DS artifacts and the intellectual structure of the emerging literature.

The components emphasized two lines of action in the paradigm in Business Administration: the areas in which DS is being used and the theoretical discussion on its application. The paradigm was shown to be widely disseminated in Information Systems, allowing for a more profitable discussion of the difficulties in the application of the method and forms of complementing or guaranteeing rigour. The use of DS is also growing in the areas of Service Design and Operations Management, as can be observed in the components generated. Other areas also use the paradigm, such as studies on Organisations, Human Resource Management, Health Management, and Decision Making, but to no great extent as yet. A deeper discussion of the rigour necessary to all methods can be seen in the more theoretical components, but mainly to those linked to this paradigm, given its recent application; the effective relevance of the result of the research and its impact on society; the collaboration between researchers and practitioners; and the opportunities and challenges regarding the application of the paradigm.

In its purpose of generating products relevant to practice collaboratively with practitioners, the Design Science paradigm is recent. In addition to being affirmed by various authors, this can be observed by the fact that the majority of the main works selected were published from 2000 on (see Table 1). As a theoretical and methodological approach for the development of artifacts, it can be seen that Hevner, Peffers, van Aken, Denyer, Gregor and Jones are prominent regarding the Design Science Research method.

Another highlight is the multiplicity of types of artifacts that can be generated, with no ample, validated taxonomy yet defined. An example of this is Design Propositions, which some call Technological Rules, Design Principles, able to generate Design Implementation. Future studies can therefore be suggested for a wider evaluation of the artifacts, the stages and most used methodological and validation procedures in such a way as to give initial support to researchers beginning to study the paradigm. For this type of study, we suggest a systematic review of the literature based on evidence supported by real cases experienced.

Some limitations are observed in bibliometric research, but technical problems of mapping based on data can be singled out. The random nature of errors in the sample obtained through the two main scientific indexers can be considered a common error among all the components of the sample. Despite the correction made in the database in the attempt to mitigate the inconsistencies of the references, it is understandable that it does not fully exclude any type of problem. Thus, we suggest a systematic review of the literature in such a way as to cover all the literature available in the past few years, to identify works little known by the academy, but with relevant results for the area.

Another limitation of the research was the minority of articles with the production of artifacts. Even so, we observe that the current typology does not meet the classification utilized by the researchers, for example, for the use of types of framework and approach. Thus, we recommend the development of a typology of artifacts that can contemplate characteristics of this area, through research that uses the meta-synthesis method, in which the focus would be the articles of the area that produced artifacts, permitting an in-depth, comparative analysis of each one in such a way as to evolve the current typology base.

References

Abbasi, A., Zhang, Z., Zimbra, D., & Chen, H. (2010). Detecting Fake Websites: The Contribution of Statistical Learning Theory. *MIS Quarterly*, *34*(3), 435–461, doi: https://doi.org/10.2307/25750686

Aier, S., & Fischer, C. (2011). Criteria of Progress for Information Systems Design Theories. *Information Systems and EBusiness Management*, *9*(1), 133–172, doi: https://doi.org/10.1007/s10257-010-0130-8

Arnott, D., & Pervan, G. (2005). A Critical Analysis of Decision Support Systems Research. *Journal of Information Technology*, *20*(2), 67–87, doi: https://doi.org/10.1057/palgrave.jit.2000035

Avenier, M. J. (2010). Shaping a Constructivist View of Organizational Design Science. *Organization Studies*, *31*(9-10), 1229–1255, doi: https://doi.org/10.1177/0170840610374395

Baskerville, R. L., Kaul, M., & Storey, V. C. (2015). Genres of Inquiry in Design Science Research: Justification and Evaluation. *MIS Quarterly*, *39*(3), 541–564.

Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). *Ucinet for Windows: Software for Social Network Analysis.* Harvard, MA: Analytic Technologies.

Buchanan, R. A. (2006). Accuracy of Cited References: The Role of Citation Databases. *College & Research Libraries*, *67*(4), 292-303.

Burgoyne, J., & James, K. T. (2006). Towards Best or Better Practice in Corporate Leadership Development: Operational Issues in Mode 2 and Design Science Research. *British Journal of Management*, *17*(4), 303–316, doi: https://doi.org/10.1111/j.1467-8551.2005.00468.x

Carcary, M. (2011). Design Science Research: The Case of the It Capability Maturity Framework (IT CMF). *Electronic Journal of Business Research Methods*, *9*(2), 109–118.

Carlsson, S. A., Henningsson, S., Hrastinski, S., & Keller, C. (2011). Socio-Technical is Design Science Research: Developing Design Theory for is Integration Management. *Information Systems and E-Business Management*, *9*(1), 109–131, doi: https://doi.org/10.1007/s10257-010-0140-6

Carton, G., & Mouricou, P. (2017). Is Management Research Relevant? A Systematic Analysis of the Rigor-Relevance Debate in Top-Tier Journals (1994-2013). *Management (France)*, *20*(2), 166–203, doi: https://doi.org/10.3917/mana.202.0166

Dellermann, D., Lipusch, N., Ebel, P., & Leimeister, J. M. (2019). Design Principles for a Hybrid Intelligence Decision Support System for Business Model Validation. *Electronic Markets*, *29*(3), 423–441, doi: https://doi.org/10.1007/s12525-018-0309-2

Denyer, D., Tranfield, D., & van Aken, J. E. (2008). Developing Design Propositions Through Research Synthesis. *Organization Studies*, *29*(3), 393–413, doi: https://doi.org/10.1177/0170840607088020

Donaldson, L. (2002). Damned by Our Own Theories: Contradictions Between Theories and Management Education. *Academy of Management Learning & Education*, *1*(1), 96–106, doi: https://doi.org/10.5465/amle.2002.7373701

Dresch, A., Lacerda, D. P., & Miguel, P. A. C. (2015). Uma Análise Distintiva Entre o Estudo de Caso, a Pesquisa-Ação e a Design Science Research. *Revista Brasileira de Gestão de Negócios*, *17*(56), 1116–1133, doi: https://doi.org/10.7819/rbgn.v17i56.2069

Fendt, J., & Kaminska-Labbé, R. (2011). Relevance and Creativity Through Design-Driven Action Research: Introducing Pragmatic Adequacy. *European Management Journal*, *29*(3), 217–233, doi: https://doi.org/10.1016/j.emj.2010.10.004

Garfield, E. (1979). Is Citation Analysis a Legitimate Evaluation Tool? *Scientometrics*,*1*(4), 359-375.

Glänzel, W., & Thijs, B. (2012). Using ‘Core Documents’ for Detecting and Labelling New Emerging Topics. *Scientometrics*, *91*(2), 399-416.

Gregor, S. (2006). The Nature of Theory in Information Systems. *MIS Quarterly*, *30*(3), 611–642, doi: https://doi.org/10.2307/25148742

Gregor, S., & Hevner, A. R. (2013). Positioning and Presenting Design Science Research for Maximum Impact. *MIS Quarterly*, *37*(2), 337-355.

Gregor, S., & Jones, D. (2007). The Anatomy of a Design Theory. *Journal of the Association for Information Systems*, *8*(5), 312–335, doi: https://doi.org/10.17705/1jais.00129

Gregory, R. W., & Muntermann, J. (2014). Heuristic Theorizing: Proactively Generating Design Theories. *Information Systems Research*, *25*(3), 639–653, doi: https://doi.org/10.1287/isre.2014.0533

Guerci, M., Radaelli, G., & Shani, A. B. (2019). Conducting Mode 2 Research in HRM: A Phase-based Framework. *Human Resource Management*, *58*(1), 5–20, doi: https://doi.org/10.1002/hrm.21919

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2009). *Multivariate data analysis*, Prentice Hall, Upper Saddle River, NJ.

Hamlin, R. G., & Bassi, N. (2008). Behavioural Indicators of Manager and Managerial Leader Effectiveness: An Example of Mode 2 Knowledge Production in Management to Support Evidence-Based Practice. *International Journal of Management Practice*, *3*(2), 115–130, doi: https://doi.org/10.1504/IJMP.2008.018366

Hevner, A. R. (2007). A Three Cycle View of Design Science Research. *Scandinavian Journal of Information Systems*, *19*(2), 87–92. https://aisel.aisnet.org/sjis/vol19/iss2/4

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information System Research. *MIS Quarterly*, *28*(1), 75–105.

Hevner, A., Brocke, J. vom, & Maedche, A. (2019). Roles of Digital Innovation in Design Science Research. *Business & Information Systems Engineering*, *61*, 3–8, doi: https://doi.org/10.1007/s12599-018-0571-z

Hodgkinson, G. P., & Starkey, K. (2011). Not Simply Returning to the Same Answer Over and Over Again: Reframing Relevance. *British Journal of Management*, *22*(3), 355–369, doi: https://doi.org/10.1111/j.1467-8551.2011.00757.x

Hodgkinson, G. P., & Starkey, K. (2012). Extending the Foundations and Reach of Design Science: Further Reflections on the Role of Critical Realism. *British Journal of Management*, *23*(4), 605–610, doi: https://doi.org/10.1111/1467-8551.12001

Holmström, J., Främling, K., & Ala-Risku, T. (2010). The Uses of Tracking in Operations Management: Synthesis of a Research Program. *International Journal of Production Economics*, *126*(2), 267–275, doi: https://doi.org/10.1016/j.ijpe.2010.03.017

Holmström, J., Ketokivi, M., & Hameri, A. P. (2009). Bridging Practice and Theory: A Design Science Approach. *Decision Sciences*, *40*(1), 65–87, doi: https://doi.org/10.1111/j.1540-5915.2008.00221.x

Huff, A., Tranfield, D., & van Aken, J. E. (2006). Management as a Design Science Mindful of Art and Surprise - A Conversation Between Anne Huff, David Tranfield, and Joan Ernst van Aken. *Journal of Management Inquiry*, *15*(4), 413–424, doi: https://doi.org/10.1177/1056492606295900

Jelinek, M., Romme, A. G. L., & Boland, R. J. (2008). Introduction to The Special Issue Organization Studies as a Science for Design: Creating Collaborative Artifacts and Research. *Organization Studies*, *29*(3), 317–329, doi: https://doi.org/10.1177/0170840607088016

Kaparthi, S. (2012). A bibliometric analysis. *Journal of Decision Systems*, *14*(1-2), 157-177.

Kieser, A., Nicolai, A. T., & Seidl, D. (2015). The Practical Relevance of Management Research. *The Academy of Management Annals*, *9*(1), 143–233.

Kuechler, W.L., & Vaishnavi, V.K. (2008). The emergence of design research in information systems in North America. *Journal Design Research*, *7*(1), 1–16.

Lacerda, D. P., Dresch, A. (2020). Impact beyond Impact Factor: The Design-Science Way. *BAR – Brazilian Administration Review*, *17*(1): doi: https://doi.org/10.1590/1807-7692bar2020200054

Lacerda, D. P., Dresch, A., Proença, A., & Antunes Júnior, J. A. V. (2013). Design Science Research: Método De Pesquisa para a Engenharia de Produção. *Gestão e Produção*, *20*(4), 741–761, doi: https://doi.org/10.1590/S0104-530X2013005000014

Löhe, J., & Legner, C. (2014). Overcoming Implementation Challenges in Enterprise Architecture Management: A Design Theory for Architecture-Driven It Management (ADRIMA). *Information Systems and E-Business Management*, *12*(1), 101–137, doi: https://doi.org/10.1007/s10257-012-0211-y

MacRoberts, M., & MacRoberts, B. (1996). Problems of Citation Analysis. *Scientometrics*, *36*(3), 435-444.

March, S. T., & Smith, G. F. (1995). Design and natural science research on information technology. *Decision Support Systems*, *15*, 251-266.

Marcos, J., & Denyer, D. (2012). Crossing the Sea from They to we? The Unfolding of Knowing and Practising in Collaborative Research. *Management Learning*, *43*(4), 443–459, doi: https://doi.org/10.1177/1350507612440232

Marshall, C., & Rossman, G. B. (2006). *Design qualitative research*, 4th ed., Sage, Thousand Oaks, CA.

Martin, B. (1996). The Use of Multiple Indicators in The Assessment of Basic Research. *Scientometrics*, *36*(3), 343-362.

Mesny, A., & Mailhot, C. (2012). Control and Traceability of Research Impact on Practice: Reframing The 'Relevance Gap' Debate in Management. *Management (France)*, *15*(2), 180–207.

Miah, S. J., & Gammack, J. G. (2014). Ensemble Artifact Design for Context Sensitive Decision Support. *Australasian Journal of Information Systems*, *18*(3), 5–20.

Miah, S. J., Debuse, J., & Kerr, D. (2012). A Development-Oriented DSS Evaluation Approach: A Case Demonstration for Conceptual Assessment. *Australasian Journal of Information Systems*, *17*(2), 43–55, doi: https://doi.org/10.1017/CBO9781107415324.004

Pandza, K., & Thorpe, R. (2010). Management as Design, But What Kind of Design? An Appraisal of the Design Science Analogy for Management. *British Journal of Management*, *21*(1), 171–186, doi: https://doi.org/10.1111/j.1467-8551.2008.00623.x

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, *24*(3), 45–77, doi: https://doi.org/10.2753/MIS0742-1222240302

Pislyakov, V. (2009). Comparing Two 'Thermometers': Impact Factors of 20 Leading Economic Journals According to Journal Citation Reports and Scopus. *Scientometrics*, *79*(3), 541-550.

Raan, A. van (1996). Advanced Bibliometric Methods as Quantitative Core of Peer Review Based Evaluation and Foresight Exercises. *Scientometrics*, *36*(3), 397-420.

Romme, A. G. L. (2003). Making a Difference: Organization as Design. *Organization Science*, *14*(5), 558–573, doi: https://doi.org/10.1287/orsc.14.5.558.16769

Romme, A. G. L., Avenier, M. J., Denyer, D., Hodgkinson, G. P., Pandza, K., Starkey, K., & Worren, N. (2015). Towards Common Ground and Trading Zones in Management Research and Practice. *British Journal of Management*, *26*(3), 544–559, doi: https://doi.org/10.1111/1467-8551.12110

Sealy, R., Doldor, E., Vinnicombe, S., Terjesen, S., Anderson, D., & Atewologun, D. (2017). Expanding the Notion of Dialogic Trading Zones for Impactful Research: The Case of Women on Boards Research. *British Journal of Management*, *28*(1), 64–83, doi: https://doi.org/10.1111/1467-8551.12203

Shiau, W. L., Dwivedi, Y. K., & Yang, H. S. (2017). Co-citation and Cluster Analyses of Extant Literature on Social Networks. *International Journal of Information Management*, *37*(5), 390-399.

Simon, H. A. (1996). *The science of design: creating the artificial*, MIT Press, London.

Singh, V., Verma, S., & Chaurasia, S. S. (2020). Mapping the Themes and Intellectual Structure of Corporate University: Co-citation and Cluster Analyses. *Scientometrics*, *122*(3), 1275-1302.

Sudbury-Riley, L., Hunter-Jones, P., Al-Abdin, A., Lewin, D., & Naraine, M. V. (2019). The Trajectory Touchpoint Technique: A Deep Dive Methodology for Service Innovation.

Journal of Service Research, *23*(2), 229-251, doi: https://doi.org/10.1177/1094670519894642

Teixeira, J. G., Patrício, L., & Tuunanen, T. (2019). Advancing Service Design Research with Design Science Research. *Journal of Service Management*, *30*(5), 577–592, doi: https://doi.org/10.1108/JOSM-05-2019-0131

van Aken, J. E. (2005). Management Research as a Design Science: Articulating the Research Products of Mode 2 Knowledge Production in Management. *British Journal of Management*, *16*(1), 19–36, doi: https://doi.org/10.1111/j.1467-8551.2005.00437.x

van Aken, J. E. (2004). Management Research Based on the Paradigm of the Design Sciences: The Quest for Field-Tested and Grounded Technological Rules. *Journal of Management Studies*, *41*(2), 219–246, doi: https://doi.org/10.1111/j.1467-6486.2004.00430.x

van Aken, J. E., & Romme, A. G. L. (2009). Reinventing the Future: Adding Design Science to the Repertoire of Organization and Management Studies. *Organisation Management Journal*, *6*(1), 5–12, doi: https://doi.org/10.1057/omj.2009.1

Venable, J. (2011). Incorporating Design Science Research and Critical Research into an Introductory Business Research Methods Course. *Electronic Journal of Business Research Methods*, *9*(2), 119–129.

Venable, J., & Baskerville, R. (2012). Eating our own Cooking: Toward a More Rigorous Design Science of Research Methods. *Electronic Journal of Business Research Methods*, *10*(2), 141–153.

Vo, L. C., & Kelemen, M. (2017). Collaborating Across the Researcher-Practitioner Divide: Introducing John Dewey's Democratic Experimentalism. *Journal of Organizational Change Management*, *30* (6), 858–871, doi: https://doi.org/10.1108/JOCM-03-2016-0054

Walls, J. G., Widmeyer, G. R., & El Sawy, O. A. (1992). Building an information system design theory for vigilant EIS. *Information Systems Research*, *3*, 36-59.

Wells, P., & Nieuwenhuis, P. (2017). Operationalizing Deep Structural Sustainability in Business: Longitudinal Immersion as Extensive Engaged Scholarship. *British Journal of Management*, *28*(1), 45–63, doi: https://doi.org/10.1111/1467-8551.12201

Yassaee, M., Mettler, T., & Winter, R. (2019). Principles for the Design of Digital Occupational Health Systems. *Information and Organization*, *29*(2), 77–90, doi: https://doi.org/10.1016/j.infoandorg.2019.04.005

Zupic, I., & Čater, T. (2015). Bibliometric Methods in Management and Organization. *Organizational Research Methods*, *18*(3), 429-472.