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Department of Technology Management and Supply

Master Thesis

MSc Business Administration – Purchasing and Supply Management

Design Science Research throughout the years: an in-depth analysis of papers published in the Journal of Purchasing and Supply Management and Journal of Supply Chain Management supported by Artificial Intelligence

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Index of abbreviations

AI	Artificial Intelligence
ARFF	Attribute-Relation File Format
CAQDAS	Computer Assisted Qualitative Data Analysis Software
DSR	Design Science Research
GTM	Grounded Theory Method
IS	Information Systems
IT	Information Technology
JPSM	Journal of Purchasing and Supply Management
JSCM	Journal of Supply Chain Management
ML	Machine Learning
PDF	Portable Document Format
PPM	Purchasing Process Model
PSM	Purchasing and Supply Management
QFD	Quality Function Deployment
SPSS	Statistical Package for the Social Sciences
WEKA	Waikato Environment for Knowledge Analysis

1. Introduction

1.1 The application of science for solving problems appears in multiple academic fields

Designing man-made objects is a widely performed human activity that contributed to the evolution of humanity in a significant way.[1] For instance, when the wheel was invented to transport objects, it was considered a milestone in human history.

Nowadays, design science takes place in academic fields such as Information Systems (IS) research, where designing objects allows to develop concepts, models, or artifacts to solve organizational and social problems.[2] Furthermore, the field of IS consists of a discipline located at the nexus of technical research on Information Technology (IT), the application and business uses of IT, and the natural, social and behavioural scientific dimensions of IT.[3] As designing artifacts is a crucial part of the discipline, design science research (DSR) emerged as a different research model.[4] This is because, in contrast to natural science, design science is focused on the artificial.[5] Simon (2019) describes natural science as a knowledge about natural objects and phenomena, while "artificial" science knowledge refers to objects and phenomena produced by art rather than nature, being associated with the adjectives manufactured and unnatural.[6]

When e-business, e-commerce and the new economy were blooming, many people in business and academe used to believe that the Internet would make existing business rules or even economic theories and laws obsolete.[7] Furthermore, the concern was that traditional business models were dead and that new business models were emerging.[8] Therefore, in a dynamic business context, where most business model research stays at a non-conceptual and sometimes even vague level, design science research aids IS in developing effective software-based business model tools, which are used to improve managing the rapidly moving, complex and uncertain business environment.[9] For example, the newspaper industry was challenged by unsustainable business models, as publishers opted for digital subscriptions for generating additional revenue streams.[10] Large publishers benefited from

[1] See Klesel and Henseler (2020), p. 117.
[2] See Klesel and Henseler (2020), p. 117; Hevner et al. (2004), p. 96.
[3] See Baskerville et al. (2018), p. 358; Heeks and Ospina (2019), p. 73.
[4] See Hevner et al. (2004), p. 98.
[5] See Simon (2019), p. 3.
[6] See Simon (2019), p. 4.
[7] See Merrifield (2000), p. 10.
[8] See Wood (2000), p. 76.
[9] See Osterwalder (2004), p. 2.
[10] See Kazan et al. (2020), p. 5086.

rising subscription numbers, but smaller publishers were challenged to achieve the same results. Some of the root causes of such challenges were high turnover rates, adoption costs and lock-in effects of subscription services.[11] Nevertheless, the shortcomings were addressed through a design science approach that involved a prototype in which a collaborative subscription service was designed and allowed the creation of positive conditions in the newspaper industry, by building on the digital platform, strategic alliance, and business model literature.[12]

In the Journal of Purchasing and Supply Management (JPSM), an example of applying design science to solve organizational problems is provided by the work of Humphreys et al. (2007), who developed an effective mechanism which was used to evaluate supplier involvement in the product development process, with the main goal of selecting suitable suppliers for the focal company.[13] Additionally, the tool included four types of distinctive indices to measure supplier involvement in the design process, and to measure the extent to which customer requirements and the supplier capabilities match or mismatch, thus reflecting the potential or risk of signing a project contract.[14] Eventually, in order to assess its effectiveness, the proposed mechanism was analysed in the context of a multinational telecommunication company.[15]

Similarly, Ansari and Modarress (1994) published in the Journal of Supply Chain Management (JSCM) their design paper about the role of suppliers in the Quality Function Deployment (QFD), in which they offered a prescriptive approach for involving potential suppliers in the product development process that focuses on their roles in the different phases of QFD.[16]

Since the apparition of design science in the 1960s, many design oriented papers were published in scholarly journals, especially in the old days.[17] However, over the past few decades, design-oriented papers seem to face more and more difficulties in being accepted at any academic journal.[18] Moreover, as the scientific literature focuses to a high extent on the evolution of DSR in the discipline of IS, there is little reveal about the development of DSR

[11] See Kazan et al. (2020), p. 5087.
[12] See Kazan et al. (2020), p. 5093.
[13] See Humphreys et al. (2007), p. 42.
[14] See Humphreys et al. (2007), p. 45.
[15] See Humphreys et al. (2007), p. 48.
[16] See Ansari and Modarress (1994), p. 29.
[17] See Chatterjee (2015), p. 2.
[18] See Eder (1999), p. 6.

throughout the years in academic journals such as JPSM or JSCM.[19] Consequently, there is enough room left to research the evolution of design science over the years in various academic fields (e.g. marketing, management education, information management).[20] Hence, the main goal of this study is to explore the progress of design-oriented publications in the JPSM and JSCM, from the apparition of journals and up to 2021, by analysing whether the number of design publications has steadily disappeared over time.

1.2 Design Science takes place in every person's life

An interesting fact is that, even without being aware of using DSR, the application of science for solving problems still occurs in people's lives. An example of this would be the traditional hacking at the ground with a pick and shovel to dig a well to provide the household with drinking water. Secondly, by designing a water wheel to generate power from the river, households could benefit from solving the problem of electricity.[21]

On the other hand, design science also takes place in medicine. By designing an artifact (e.g. a drug), and then investigating its interaction with the required context (e.g. human body), the desired effects can be analysed.[22] Moreover, an investigation can also be made by designing a machine learning algorithm (i.e. an artifact) for medical diagnosis (i.e. required context) and then analysing their interaction and effects in solving medical problems.[23] Hence, the health professionals who prescribe drugs and use algorithms for medical diagnosis are surrounded by design science.

According to Lee and Lee (2019), since society becomes more complex, social problems occur more broadly across the globe, leading to the term of "wicked problems" introduced by Rittel (1972) in the science of design.[24] Wicked problems are complex problems that an individual, group, or organization cannot solve easily alone.[25] Thus, the demand for design science increases with the complexity of society, as more wicked problems occur worldwide.[26]

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[19] See Vom Bocke et al. (2020), p. 521.
[20] See Collins (1992), p. 17; Costa, Soares, and Sousa (2020), p. 5; Kamran et al. (2020), p. 998; Keskin and Romme (2020), p. 2.
[21] See Shannon (1996), p. 6.
[22] See Latil et al. (2021), p. 1313.
[23] See Rajula et al. (2020), p. 5.
[24] See Lee and Lee (2019), p. 40.
[25] See Rittel (1972), p. 391.
[26] See Lee and Lee (2019), p. 50.

Accordingly, this research project will investigate the development of design science publications over time, and the differences between design and traditional paradigms, such as explanatory and descriptive research, as ways of creating knowledge in the academic environment of purchasing. The investigation will be done through multiple methods of analysis, including the use of artificial intelligence (AI) in classifying academic publications which will be described in a guideline manner in the following chapters, with the purpose of encouraging its usage by other researchers willing to classify academic review data. Moreover, the focus of this study will be set on the papers published in the JPSM and JSCM from the apparition of journals until the last published issues of 2020 (i.e. JPSM – Volume 26, Issue 5; JSCM – Volume 56, Issue 4). The rest of this study is structured as follows: *Chapter 2* will analyse the theory behind design science and explanatory research. After that, the evolution of purchasing throughout the years will be explored in *Chapter 3*. Next, the research problem and purpose will be elaborated in *Chapter 4*. Following, the applied methodology and findings will be discussed in *Chapters 5* and *6*. Eventually, the discussion and conclusion are described in *Chapters 7* and 8.

2. Theoretical Explanation

2.1 History and definition of Design Science: solving problems through science

According to Wastell, Sauer, and Schmeink (2009), DSR is a recent and mostly unexplored research technique and thus continues to be recognized as a minority practice.[27] Researchers who are dedicated to the field of design science highlight the importance of studies that help to make DSR more approachable and less puzzling.[28] Nowadays, researchers have noticed that it is challenging to publish DSR papers in the best journals.[29] Over time, with the great number of guidelines, rules, and frameworks, researchers of DSR found themselves faced with an excess of advice and expectations for how to carry out a DSR paper, which creates further difficulties.[30] The numerous guidelines and objectives published in journals make it complicated and costly to carry out DSR projects. The challenges apply to all people involved in a DSR project, from its preparation up to its publication, as "authors, reviewers, and editors struggle to understand and follow a well understood formula for writing and

[27] See Wastell, Sauer, and Schmeink (2009), p. 336.
[28] See Baskerville, Kaul, & Storey, 2015, p. 542.
[29] See Conboy, Fitzgerald, and Mathiassen (2012), p. 115.
[30] See Peffers, Tuunanen, and Niehaves (2018), p. 130.

reviewing design science articles"[31] (p. 4).[32] However, these circumstances are comprehensible when taking into consideration that DSR is recent and still developing.[33]

DSR is a relatively young discipline which has emerged in the late 1960s, by focusing on the study of the process of transforming needs and demands into structures that would be able to fulfil those demands.[34] Furthermore, DSR is largely understood as having been created by Herbert Simon's influential monograph on the 'Sciences of the Artificial', in which he differentiated between the natural sciences aimed at analysing the world and the design sciences aimed at shaping the world.[35] In the field of IS, design science is applied to structures (i.e. artifacts) including algorithms, computer interfaces, design methodologies, service models and languages.[36] The need of IS researchers to present their research outside the original social sciences framework of design science has led to the rise of the DSR paradigm.[37] Therefore, design science is established around three interconnected cycles, namely the relevance cycle, which provides the research problem and the criteria for the artifact's utility in the application field; the design cycle, that supports the actual design/re-design of the artifact; and the rigor cycle, that covers how the artifact design is based on existent knowledge.[38] Moreover, Hevner (2007) states that in order for a research project to be classified as a DSR project, the three cycles must be present and clearly identifiable.[39] Besides, DSR is associated with a pragmatic philosophy.[40] Pragmatism is a school of thought that takes into account practical consequences or real effects as vital components of both meaning and truth.[41] Hence, DSR is contended to be essentially pragmatic in nature due to its emphasis on relevance, which makes a clear contribution into the application environment.[42] However, practical utility alone does not define a comprehensive DSR, due to the fact that the synergy between relevance and rigor, together with the contributions along both the relevance cycle and the rigor cycle define a complete DSR.[43]

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[31] Goes (2014), p. 4.
[32] See De Sordi et al. (2020), p. 2.
[33] See De Sordi et al. (2020), p. 3.
[34] See Hubka and Eder (1996), p. 222.
[35] See Henseler and Guerreiro (2020), p. 4; Simon (2019), p. 114.
[36] See Gregório et al. (2021), p. 3.
[37] See Hevner et al. (2004), p. 78.
[38] See Hevner (2007), p. 89.
[39] See Hevner (2007), p. 88.
[40] See Iivari and Venable (2009), p. 3.
[41] See Hevner (2007), p. 91.
[42] See Hevner (2007), p. 91.
[43] See Hevner (2007), p. 92.

Nonetheless, DSR is a research technique that aims to generate knowledge on designing artifacts or even prescribing solutions.[44] A research based on the design science paradigm aids in attracting researchers and members of organizations in order to generate useful knowledge to solve real problems.[45] Thus, DSR enables the conduction of research in several areas, such as IS, operations management, and purchasing and supply management.[46] Regarding these areas, DSR is appropriate since it may help to reduce the existing gap between theory and practice by engaging in issues of interest to both professionals and academics.[47] Moreover, DSR provides a systematic procedure which guides the conduction of studies that aim to design artifacts or even prescribe solutions.[48] Another concern of DSR is to perform an evaluation to developed artifacts. This is due to the fact that such an evaluation is performed in order to verify the effective range of the objectives to which the artifact was intended.[49] Hence, the development of an artifact is not enough to characterize an investigation as DSR, but it is essential to certify that the device achieved the objectives originally proposed by the researcher.[50] A last feature of DSR is that, although it is a method focused towards problem-solving, its objective is not developing an optimal solution, but rather a satisfactory solution compared to an existing one.[51]

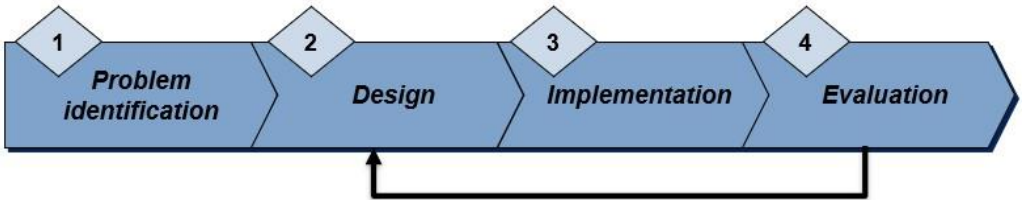

Figure 1. The process model of DSR (Bilandzic and Venable, 2011, p.10).

Finally, the process of conducting DSR is briefly illustrated in *Figure 1* above. This states that to make improvements, problems must be investigated and diagnosed, with the help of empirical methods and paradigms, to inform design of artifacts using the DSR paradigm.[52] After the development of artifacts, they should be implemented and evaluated to provide evidence that the model has utility with respect to solving the relevant problem or making the

[44] See Dresch, Lacerda, and Antunes (2015), p. 68.
[45] See Bayazit (2004), p. 18.
[46] See Holmström, Hameri, and Ketokivi (2006), p. 2; Srai and Lorentz (2019), p. 80; Vaishnavi and Kuechler (2009), p. 4.
[47] See Collatto et al. (2018), p. 244.
[48] See Dresch, Lacerda, and Antunes (2015), p. 69.
[49] See Çağdaş and Stubkjær (2011), p. 78.
[50] See Dresch, Lacerda, and Antunes (2015), p. 72.
[51] See Dresch, Lacerda, and Antunes (2015), p. 79.
[52] See Bilandzic and Venable (2011), p. 9.

desired improvements. Eventually, it is the proper way of evaluating that justifies the use of the word “science” within DSR.[53]

2.2 A research to clarify the exact nature of the problem to be solved: Explanatory Research

In recent years, more natural and social sciences researchers have been using explanatory research in order to conduct their studies.[54] Explanatory research is a method used in investigating a phenomenon that had not been studied before or had not been previously explained in an understandable manner.[55] Furthermore, with this type of research, researchers can get a general idea, and use research as a tool to guide them towards the issues that might be addressed in the future.[56] Hence, the goal of explanatory research is to find the 'why' for an object of study.[57] According to Theron (2019), explanatory research is responsible to find the 'why' of the events through the establishment of causal relationships between variables.[58] Besides, Gratton and Jones (2014) state that much explanatory research is interested in the relationship between two or more variables, as this is the realm of inferential statistics.[59] Additionally, inferential statistics assess the association between independent and dependent variables used in conducting explanatory research.[60] Therefore, studies that are explanatory in nature can deal with the determination of causes and effects, by testing hypotheses.[61]

While conducting explanatory research, the main sources of information used come in the form of literature or published articles and are purposefully chosen to create a broader and more balanced understanding of the topic in research.[62] Thus, by following an explanatory research, researchers strive for a better understanding about a specific topic of interest. Even if the research may not offer conclusive results, the researcher can find the reasons of why a phenomenon occurs.[63] This is because explanatory research allows researchers to replicate studies in order to give them greater depth and gain new insights into the phenomenon in cause.[64]

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[53] See Bilandzic and Venable (2011), p. 10.
[54] See Ivankova, Creswell, and Stick (2006), p. 4.
[55] See Mõttus et al. (2020), p. 1178.
[56] See Mõttus et al. (2020), p. 1177.
[57] See Theron (2019), p. 17.
[58] See Theron (2019), p. 18.
[59] See Gratton and Jones (2014), p. 224.
[60] See Gratton and Jones (2014), p. 224.
[61] See Thagard (2018), p. 83.
[62] See Chakkarwar and Tamane (2020), p. 190.
[63] See Mohajan (2018), p. 31.
[64] See Mõttus et al. (2020), p. 1181.

To clarify the exact nature of problem to be solved, researchers have the opportunity to choose among different methods of conducting explanatory research, such as observations, literature research, case studies, focus groups, or in-depth interviews.[65] According to Singh and Thurman (2019), literature research is one of the quickest means of collecting information and determining the research hypotheses, as it involves searching for literature which can be conducted online or in libraries.[66] When there is a need to use the experience or expertise of professionals, researchers can benefit by conducting in-depth interviews, which involve the process of talking to people who are knowledgeable about the topic of research.[67] Through a focus group analysis, researchers bring together several people who have information about the phenomenon under research, and organize different sessions to obtain various data that will aid in conducting the research.[68] By pursuing case studies, researchers can understand and tackle their research more efficiently by dealing with the deliberately selected cases, as the examination of companies which experienced similar situations can help with the conduction of research.[69] Last but not least, observations involve researchers watching individuals in natural settings or situations, with the goal of allowing the researcher to capture what individuals do as opposed to what they say.[70] Consequently, explanatory research is conducted with the purpose of allowing researchers to become familiar with the topics that need to be examined.

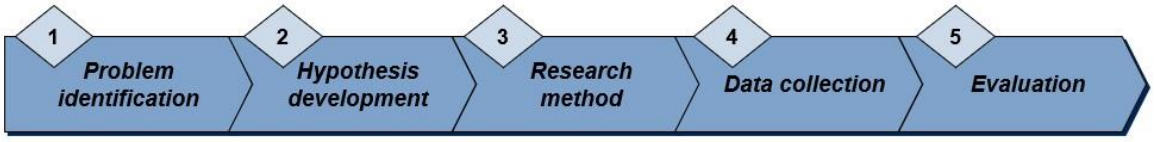

Figure 2. The process model of Explanatory Research (Gratton and Jones, 2014, p.16).

The process of conducting explanatory research is illustrated in *Figure 2* above. This states that to conduct explanatory research, a first step would be to find the subject of investigation, considering the question that needs to be answered, which usually involves a 'why', and identifying the cause-and-effect relationship between variables. As a next step, the development of hypotheses for the explanatory research plays a key role, as hypotheses are

[65] See Rahi (2017), p. 2.
[66] See Singh and Thurman (2019), p. 295.
[67] See Rutakumwa et al. (2020), p. 570.
[68] See Plummer (2017), p. 348.
[69] See Goodrick (2020), p. 1.
[70] See Yao and Liu (2018), p. 5581.

proposed explanations for why a situation occurs.[71] Further, a method of research (e.g. case studies, focus groups, in-depth interviews) needs to be selected to gather data. The choice of method may depend on the research budget or other factors such as time or the topic of choice.[72] The fourth step consists in collecting the data necessary for conducting the research. This can be done through the recording of findings (e.g. taking notes or audio recordings during a focus group analysis or in-depth interview) that can be used later in the research.[73] Eventually, the evaluation of data from the research conducted is reviewed. Furthermore, while explanatory research does not necessarily create formal conclusions, results can still be helpful to the academic literature and organizations.[74]

2.3 Distinguishing between three types of scientific reasonings

2.3.1 Inductive reasoning: making generalised conclusions based on specific observations

Reasoning can be defined as the goal-driven process of drawing conclusions which informs decision-making and problem-solving efforts.[75] According to Sternberg, Sternberg, and Mio (2012), in the process of reasoning "we move from what is already known to infer a new conclusion or to evaluate a proposed conclusion"[76] (p. 507).[77]

Academic research in inductive reasoning began at the beginning of the 20th century, in the context of intelligence research, when Spearman found that his 'g' factor of general intelligence was mainly determined by inductive processes "eduction of relations".[78] Later on, dimension analytic research also identified inductive processes as central intellectual factors identified as reasoning or fluid intelligence.[79] Meanwhile, in the fields of psychology and education the research focus revolved around the analysis of cognitive processing when students started to solve inductive reasoning and other types of problems.[80] Therefore, scientific research in the cognitivist tradition has been engaged in exploring inductive processes, by focusing on the cognitive processing involved in series completion, analogies, classifications, categorizations, and matrices.[81] According to Holland et al. (1989), scientific research in the field of AI has constructed computer programs based on process models that

[71] See Gratton and Jones (2014), p. 225.
[72] See Gratton and Jones (2014), p. 230.
[73] See Gratton and Jones (2014), p. 228.
[74] See Darling et al. (2021), p. 2.
[75] See Csapó (2020), p. 2; Leighton and Sternberg (2004), p. 294.
[76] Sternberg, Sternberg, and Mio (2012), p. 507.
[77] See Csapó (2020), p. 2.
[78] See Klauer and Phye (2008), p. 86; Spearman (1923).
[79] See Cattell (1963), p. 6; Klauer and Phye (2008), p. 87.
[80] See Klauer and Phye (2008), p. 85.
[81] See Klauer and Phye (2008), p. 106.

aim to solve certain types of problems to test theories related to inductive reasoning.[82] Moreover, sophisticated mathematical models that are able to predict how people process inductive problems have also been developed and tested (e.g. causal models, Bayesian models).[83] Besides, inductive reasoning provides a fundamental basis both for the understanding of generation of concepts and for the regularities of knowledge used in daily life.[84] When unfamiliar problems arise, the process of inductive reasoning helps in generating hypothetical rules which will be assessed by further actions and observations.[85]

Hayes and Heit (2018) state that the process of inductive reasoning consists in making probabilistic predictions about novel objects or situations based on existing knowledge.[86] For instance, the saying that Siberian tigers have a certain kind of empathy might be moderately confident, but by no means certain, that this property generalises to other tigers.[87] Thus, most of the reasoning that people do on a daily basis is inductive.[88] Predicting whether it is likely to catch a cold, or whether the cryptocurrency market will grow in the next couple of months, both involve some form of induction. In addition, induction is involved in a range of cognitive activities such as probability judgment, analogical reasoning, scientific inference, and decision-making.[89] Hence, academic research on inductive reasoning plays an important role due to the fact that it informs understanding of how children and adults make rational inferences from evidence.[90] Besides, much of what was learned about the cognitive processes involved in inductive reasoning has come from studies of category-based induction.[91] According to Feeney (2017), category-based induction implies inferring the properties of the members of a conclusion category, based on knowledge about the properties of premise categories.[92] For example, a property of the premise category of "Siberian tigers" might be generalised to the conclusion category of "all tigers" because of the knowledge of the relations between these categories.[93]

[82] See Holland et al. (1989), p. 3.
[83] See Rehder and Burnett (2005), p. 269; Yoon et al. (2018), p. 7344.
[84] See Klauer and Phye (2008), p. 88.
[85] See Perret (2015), p. 391.
[86] See Hayes and Heit (2018), p. 1.
[87] See Hayes and Heit (2018), p. 2.
[88] See Buckley et al. (2018), p. 65.
[89] See Hayes and Heit (2018), p. 2.
[90] See Klauer, Willmes, and Phye (2002), p. 7.
[91] See Feeney (2017), p. 168.
[92] See Feeney (2017), p. 169.
[93] See Hayes and Heit (2018), p. 3.

As a result, inductive reasoning starts with specific observations that are limited in scope, and proceeds to generalised conclusions that are likely, but not certain, in the light of gathered evidence.[94] Hence, inductive reasoning shifts from the specific towards the general. Furthermore, conclusions that are reached by the inductive method are not necessarily logical necessities, as no amount of inductive evidence guarantees the conclusion.[95] This is due to the fact that there are low chances to know that all the possible evidence has been accumulated, and that there does not exist further evidence that might invalidate hypotheses, but has been missed.[96] For example, while scientific literature itself uses more cautious language, the newspapers might report the conclusions of academic research as absolutes.[97] To sum up, the process of inductive reasoning is one of the core mental abilities that contribute to intelligent behaviour, and plays a key role in understanding science and application of knowledge in unfamiliar situations.[98]

Over the last few decades, research on induction reasoning has been developing on a broader scale.[99] Moreover, an extended understanding of induction has been achieved through the evolution of more sophisticated computational models.[100] Simultaneously, there has been an increase of research examining the links between induction and other cognitive activities.[101] Accordingly, induction characterizes the rich inferences that are spreading widely in everyday reasoning, while at the same time having important theoretical connections to other cognitive activities.[102] Therefore, even if the cognitive science research improved significantly throughout the years when it comes to studying inductive reasoning, this will continue to expand and further deepen its knowledge by keeping inductive reasoning as a topic of main focus.[103]

[94] See Pellegrino and Glaser (1980), p. 178.
[95] See Pellegrino and Glaser (1980), p. 181.
[96] See Lee et al. (2019), p. 290.
[97] See Aghdam and Hadidi (2015), p. 12.
[98] See Csapó (2020), p. 3; Kinshuk, Lin, and McNab (2006), p. 155.
[99] See Hayes and Heit (2018), p. 10.
[100] See Hayes and Heit (2018), p. 10.
[101] See Gill et al. (2020), p. 2; Stephens et al. (2020), p. 1.
[102] See Gill et al. (2020), p. 5.
[103] See Hayes and Heit (2018), p. 11.

2.3.2 Deductive reasoning: backing up generalised statements based on specific scenarios

By definition, the process of deduction (i.e. logical reasoning) generates valid conclusions, which have to be true considering that their premises are true as well.[104] Some deductions are more difficult than others, and the failure to draw particular valid conclusions probably contributed to many man-made disasters.[105] In spite of such mistakes, the evolution of life depends on the ability to make deductions.[106] Individuals differ when it comes to making deductions, and those who are better at it, appear to be more successful in life.[107] For example, a person who is poor at reasoning is also more prone to making mistakes in daily life.[108] This is because, people of higher intelligence are more sharp in making deductions, which are at the base of rationality.[109] To support this statement, Newstead et al. (2004) also examined individual differences in deductive reasoning as a function of intellectual ability and thinking style, and discovered that intellectual ability was a good predictor of logical performance regarding syllogisms.[110] As a consequence, without the process of deduction, there would be no logic or mathematics.[111]

In their work, Sternberg, Sternberg, and Mio (2012) affirm that deductive reasoning goes on the same path as conditional clauses, and connects conclusions with premises.[112] If all premises are true, the terms are comprehensible, and the rules of deduction are followed, then the conclusion reached must be true.[113] Besides, deductive reasoning differs from inductive reasoning because in deductive reasoning, a conclusion is reached by applying general rules which hold over the entire domain of discourse, shrinking the range under consideration until only the conclusions are left.[114] Additionally, there is no uncertainty in the process of deductive reasoning.[115] In contrast, in inductive reasoning the final decision is reached by generalizing from specific cases to general rules, resulting in a conclusion that has a certain level of uncertainty.[116] Furthermore, the process of inductive reasoning is not the same as induction used in mathematics, as induction in mathematics represents a form of deductive

[104] See Johnson-Laird (1999), p. 110.
[105] See Johnson-Laird (1999), p. 111.
[106] See Rothchild (2006), p. 2.
[107] See Rothchild (2006), p. 2.
[108] See Rothchild (2006), p. 9.
[109] See Johnson-Laird (1999), p. 111.
[110] See Newstead et al. (2004), p. 35.
[111] See Johnson-Laird (1999), p. 112.
[112] See Sternberg, Sternberg, and Mio (2012), p. 488.
[113] See Sternberg, Sternberg, and Mio (2012), p. 489.
[114] See Stephens et al. (2020), p. 2.
[115] See Ricco (2017), p. 160.
[116] See Sternberg, Sternberg, and Mio (2012), p. 490.

reasoning.[117] According to Morsanyi, McCormack, and O'Mahony (2018), there is a link between deductive reasoning and mathematics, as both transitive inferences (i.e. the involvement of comparison between items on the basis of a certain property) and conditional inferences (i.e. the ability to reason on the basis of 'if a then b' type of statements) are connected to mathematics skills.[118] Moreover, academics such as Piaget (1952) and Russell (1919), have considered for a long time that deductive reasoning and mathematics skills are closely related.[119]

In the process of deductive reasoning the following steps are needed to reach an outcome: (1) a major or initial premise, (2) a minor or secondary premise, (3) testing, and (4) the conclusion itself.[120] Therefore, in the first step, the process of deductive reasoning begins with an assumption, which usually involves a generalized statement that if something is true, then it must be true in all situations. Following, a second assumption is created in relation to the first assumption, in which if the first statement is true, then the second related statement must be true as well. The third step involves testing, where the deductive assumption is tested in different scenarios. Accordingly, a conclusion is reached in the fourth step, based on the results of testing, where the information is determined whether to be valid or invalid.[121] For instance, syllogism are a common form of deductive reasoning, in which a major premise and a minor premise generate a logical conclusion.[122] This is due to the fact that syllogisms are considered to be a good way to test deductive reasoning in order to validate arguments.[123] For example, the major premise "all cats are sneaky" could be followed by the minor premise "Ollie is a cat." Hence, those statements would lead to the conclusion "Ollie is sneaky."

Nonetheless, the benefit of deductive reasoning is that it allows the use logic to justify decisions.[124] Even in cases in which the decision does not work out, this can explained by the rationale behind taking the decision.[125] By understanding the process of deductive reasoning, the application of logic to solve problems becomes less difficulties.[126] As deduction uses only

[117] See Morsanyi, McCormack, and O'Mahony (2018), p. 236.
[118] See Morsanyi, McCormack, and O'Mahony (2018), p. 238.
[119] See Morsanyi, McCormack, and O'Mahony (2018), p. 239; Piaget (1952); Russell (1919).
[120] See Coetzee and Monti (2018), p. 1852.
[121] See Coetzee and Monti (2018), p. 1855.
[122] See Evans (2016), p. 176.
[123] See Evans (2016), p. 177.
[124] See Wissman, Zamary, and Rawson (2018), p. 401.
[125] See Wissman, Zamary, and Rawson (2018), p. 402.
[126] See Bhat (2016), p. 80.

information assumed to be accurate, it disregards emotions, feelings, or assumptions without evidence, because it is challenging to determine the correctness of such information.[127]

2.3.3 Abductive reasoning: selecting the most suitable explanation for a set of observations

Historically, the term 'epagoge' (i.e. the adducing of certain examples in order to obtain a universal conclusion) used by Aristotle, has referred to a syllogism in which the primary premise is known to be true, but the secondary premise is only presumptive.[128] Later on, the philosopher Charles Sanders Peirce is often considered to be the founding father of pragmatism, although he spent much of his work investigating the processes of induction and deduction, which were the traditional models of reasoning and inference.[129] However, in his research, Charles used a bag of beans to cultivate a formative distinction between three forms of reasoning, namely deduction, induction, and also abduction.[130] According to Behfar and Okhuysen (2018), the process of deductive reasoning builds on generalizable theories to create particular arguments, whereas inductive reasoning proceeds from particular observations to clarify more generalizable theories.[131] On the other hand, the abductive reasoning process produces exploratory hypotheses.[132] Shani, Coghlan, and Alexander (2020) state that out of the three forms of reasoning, the claim of abduction to certainty is the most indefinite one. Furthermore, Charles Sanders Peirce further explained the outcome of his research, as "deduction proves that something must be; induction shows that something actually is operative; abduction merely suggests that something may be"[133] (p. 230).[134] For more than a century after the research done by Charles, the term of abduction is still debatable in philosophy, psychology, and even computer science.[135] For instance, Walton's 'Abductive Reasoning' work is one of the most recent attempts to struggle with this problem, and one of the most remarkable in his interdisciplinary academic research, in which he describes abduction as inference to the best explanation.[136]

In most cases, the process of abductive reasoning begins with an observation or a set of observations and proceeds to the most likely explanation for the set.[137] Unlike deductive

[127] See Blanchette, and Leese (2010), p. 8.
[128] See Azimi (2019), p. 173.
[129] See Fischer (2001), p. 364.
[130] See Paglieri (2004), p. 271.
[131] See Behfar and Okhuysen (2018), p. 325.
[132] See Shani, Coghlan, and Alexander (2020), p. 64.
[133] Pierce (1903), p. 230.
[134] See Shani, Coghlan, and Alexander (2020), p. 65.
[135] See Paglieri (2004), p. 271.
[136] See Paglieri (2004), p. 272; Walton (2014).
[137] See Belzen, Engelschalt, and Krüger (2021), p. 1.

reasoning, the process of abductive reasoning generates plausible conclusions, but does not positively verify them.[138] Thus, abductive conclusions are prone to uncertainty, which is expressed in terms such as 'best available' or 'most likely'.[139] Additionally, abductive reasoning provides the kind of decision-making that does its best with the information at hand, which is often incomplete.[140] Furthermore, abductive reasoning can be understood as inference to the most likely explanation, even if not all usages of the terms abduction and inference to the best explanation are entirely equivalent.[141] In the last few decades, as computing advanced, the fields of law, computer science, and AI research displayed an increased interest in the topic of abduction.[142] For example, a medical diagnosis is a scenario where abductive reasoning takes place.[143] This is because, given a set of symptoms, the diagnosis that would best explain most of them needs to be found.[144] Similarly, Juba (2016) explains that abductive reasoning aims at determining the precondition, as it is using the conclusion and the rule to assume that the conclusion could be explained by the precondition.[145] An example of this would be: when it is winter, the roads becomes frozen; the roads are frozen, so it must be winter.

According to Meyer (2015), design science uses abductive reasoning as a third way of reasoning that is added to deduction and induction.[146] Furthermore, a problem-solving cycle is formed, in which abduction is used for the generation of ideas and solutions, followed by deduction for the prediction of consequences for those ideas, and then to induction for the testing and generalization of proposed solutions.[147] Eventually, this problem-solving cycle yields data that is sent back to abductive reasoning for the process to start over.[148]

Instead of inductive and deductive reasoning, researchers in design science generally promote the abductive process as a form of logical reasoning that is the core of creative design.[149] In classical logical reasoning, abduction proposes the most restrictive explanation for a set observations.[150] In DSR, abductive reasoning is implicated in two important situations,

[138] See Campos (2011), p. 422.
[139] See Campos (2011), p. 423.
[140] See Belzen, Engelschalt, and Krüger (2021), p. 3.
[141] See Sober (2020), p. 41.
[142] See Ignatiev, Narodytska, and Marques-Silva (2019), p. 1515.
[143] See Baik (2019), p. 2.
[144] See Baik (2019), p. 2.
[145] See Juba (2016), p. 999.
[146] See Meyer (2015), p. 42.
[147] See Meyer (2015), p. 43.
[148] See Johansson-Sköldberg, Woodilla, and Çetinkaya (2013), p. 132.
[149] See Dong, Lovallo, and Mounarath (2015), p. 39; Dorst (2011), p. 523.
[150] See Dong, Lovallo, and Mounarath (2015), p. 39.

namely in the combination of complex and contradictory information to yield insight, and in the reasoning toward new solutions for design problems.[151] The former form of abduction has been referred to as explanatory abduction, whereas the latter form has been labelled innovative abduction.[152] In innovative abduction, researchers have speculated that designers create a concept, a set of solution principles, and a form that describes and connects a form to the desired function.[153] Therefore, abductive reasoning presents itself as a cognitive strategy that has been argued as being the core of design thinking, which is, one of the "quite specific and deliberate ways of reasoning"[154] (p. 531) related with the practice of design science.[155]

In a few wards, abductive reasoning can be creative, intuitive, and even revolutionary.[156] As an example, the work of Albert Einstein was not just deductive and inductive, but it also involved creativity, imagination, and visualisation.[157] Besides, there was so much of Einstein's work done as a ‘thought experiment’ that some of his scientific colleagues discredited it as unrealistic.[158] However, Einstein appears to have been right in his theories until nowadays, although his remarkable statements about space and time continue to be examined by scientists.[159]

2.4 Nature of science field development: Design Science surpassed by Explanatory Research?

2.4.1 Distinguishing between traditional paradigms and DSR paradigm as sources of knowledge creation

Cross (1982) states that design science is a way of thinking which comes from a different type of knowing.[160] The different type of knowing refers to the way through which people interact with their world and desires to form their environment.[161] For example, handcrafted tools used to cut, dig, and hammer, which are over two and a half million years old, have been found by anthropologists.[162] Cross (1982) describes such artifacts as proof of how ancient people, in a prehistoric way of reforming their environment, were capable of a type of

[151] See Kolko (2010), p. 17; Koskela, Paavola, and Kroll (2018), p. 166.
[152] See Koskela, Paavola, and Kroll (2018), p. 155; Roozenburg (1993), p.7.
[153] See Dong, Lovallo, and Mounarath (2015), p. 40.
[154] Dorst (2011), p. 531.
[155] See Dong, Lovallo, and Mounarath (2015), p. 39; Roozenburg (1993), p. 8.
[156] See Thagard and Shelley (1997), p. 414.
[157] See Thagard and Shelley (1997), p. 417.
[158] See Thagard and Shelley (1997), p. 418.
[159] See Webb (2019), p. 44.
[160] See Cross (1982), p. 224.
[161] See Cross (1982), p. 225.
[162] See Cross (1982), p. 226.

knowing that is more mature than sciences, humanities, and even language.[163] Although Cross (1982) is connecting the field of design to sciences and humanities, his work on 'Designerly ways of knowing' created the foundation for seeing design as a discipline with its own forms of knowledge.[164]

On the other side, Schön (1987) had an interest regarding the relationship of practice competence, which involved skills of designers, and professional knowledge, namely theory and science.[165] Moreover, the researcher noticed that theory, which comes from the application of scientific knowledge, has a peak performance when it comes to solving problems that are well-formed and instrumental in nature.[166] However, real work problems do not fall in the category of well-formed constructs.[167] Instead, such problems tend to be intermediate situations that are messy in nature.[168] Therefore, Schön (1987) concentrated his research on the way in which designers cope with such messy situations, and noticed that designers obtain their skills through practice, instead of study.[169]

Combining the works of Cross (1982), Meyer (2015), and Schön (1987), *Table 1* below briefly illustrates the three ways of knowing together with the three ways of reasoning, with their respective operating realm and ways of testing. As noted in *Chapter 2.2*, researchers of natural and social sciences have been using explanatory research to conduct their studies. Therefore, the ways of knowing through ‘science’ and ‘humanities’ fall under the category of explanatory research, and the way of knowing through ‘design’ belongs to DSR. Furthermore, there are two important ways of knowledge creation, namely traditional research paradigm which is based on realism, and DSR paradigm that is based on pragmatism.[170] In traditional research paradigm, the primary applied reasoning is inductive and deductive, and research strategies mainly focus on experiments and evaluations, which produce knowledge that is descriptive in nature.[171] Additionally, descriptive knowledge refers to the 'what' knowledge of natural phenomena and the laws among phenomena, while prescriptive knowledge considers the 'how' knowledge of manmade artifacts.[172] On the other

[163] See Cross (1982), p. 226; Meyer (2015), p. 43.
[164] See Cross (1982), p. 227; Cross (2001), p. 51.
[165] See Meyer (2015), p. 43; Schön (1987).
[166] See Meyer (2015), p. 43; Schön (1987).
[167] See Meyer (2015), p. 43.
[168] See Meyer (2015), p. 43.
[169] See Meyer (2015), p. 43; Schön (1987).
[170] See Gregor and Hevner (2013), p. 342.
[171] See Sik (2015), p. 2142.
[172] See Gregor and Hevner (2013), p. 343.

hand, research under design follows a pragmatic way of producing knowledge, together with the application of abductive reasoning and research strategies that focus on the DSR.[173] Hence, the two ways of knowledge creation used in this research are explanatory research, which belongs to the traditional research paradigm, and the DSR paradigm.

Ways of knowing	*Operative realm*	*Means of displaying and testing*	*Primary applied reasoning*
Science	**Natural phenomena**	**Controlled experiments Classification Analysis**	**Inductive Deductive**
Humanities	**The human experience**	**Analogies Metaphors Evaluations**	**Inductive Deductive**
Design	**A created, manmade, artifical world**	**Visualization Mock-ups Prototyping**	**Inductive Deductive Abductive**

Table 1 . Traditional paradigms and DSR paradigms illustrated by ways of knowing (based on Meyer, 2015, p. 44).

2.4.2 Traditional descriptive paradigm appears to be the dominant research used to produce and publish academic research

While natural and social sciences aim at understanding and explaining phenomena, design science aims to develop means through which human goals can be achieved.[174] Moreover, as natural and social sciences are prone to basic research, and design science tends to be applied research, they are not necessarily parallel.[175] For example, a natural science report of IS failure could be more relevant to practice than to develop a new data format.[176] Besides, the reasoning is also relevant as a distinction frequently employed by decision researchers.[177] As discussed in *Chapter 2.4.1*, natural and social sciences are descriptive and explanatory in intent, whereas DSR generates prescriptions and creates artifacts that embody those prescriptions.[178] Taking the example of IT, there are two kinds of scientific interest, namely

[173] See Peffers et al. (2007), p. 84.
[174] See March and Smith (1995), p. 254.
[175] See March and Smith (1995), p. 255.
[176] See March and Smith (1995), p. 255.
[177] See Bell, Raiffa, and Tversky (1988), p. 17.
[178] See Sik (2015), p. 2142; Peffers et al. (2007), p. 85.

descriptive and prescriptive.[179] Firstly, research that is descriptive aims to understand the nature of IT.[180] It comes as a knowledge-producing activity that corresponds to natural science.[181] Secondly, prescriptive research aims to improve the performance of IT, and is a knowledge-using activity which corresponds to DSR.[182] Furthermore, the debate in the research of IT is similar to the debate between engineering and physics.[183] This is because the upper hand in such debates goes to traditional knowledge-producing science.[184] However, the situation is different in IT, as it is possible to argue that the research aimed to develop IT systems and improve the practice of IT has been more successful and gained more importance than the traditional research attempts to understand it.[185] Nonetheless, March and Smith (1995) state that the issue between descriptive and prescriptive research remains undecided, and the field of IT is left in a deadlock.[186]

Similarly, in the field of IS, the dominant research paradigm used to produce and publish academic research for the well-known research outlets, continues to be descriptive research, which is taken from the natural and social sciences.[187] However, in the last few years, interpretive research paradigms were accepted into the IS culture, but the resulting research output is still for the most part explanatory.[188] While DSR is an accepted research paradigm in other disciplines (e.g. engineering), this knowledge creation method has been active in just a small amount of research papers published in the best IS journals, which were used to produce artifacts of practical value, for academia and professionals.[189]

A promising step is the fact that in the last few decades, more scientists have succeeded in bringing design science into the light of IS research community, while successfully making the case for the validity and value of DSR, and incorporating design as a major component of research.[190] Despite such successful steps, few DSR papers have been successfully published in the literature of IS.[191] Consequently, the missing link may be a conceptual model

[179] See March and Smith (1995), p. 251.
[180] See March and Smith (1995), p. 251.
[181] See Hu (2021), p. 167.
[182] See Simon (2019), p. 3.
[183] See March and Smith (1995), p. 252.
[184] See March and Smith (1995), p. 257.
[185] See March and Smith (1995), p. 259.
[186] See March and Smith (1995), p. 263.
[187] See Peffers et al. (2007), p. 85.
[188] See Peffers et al. (2007), p. 84.
[189] See Peffers et al. (2007), p. 87.
[190] See Hevner et al. (2004); March and Smith (1995); Peffers et al. (2007); Walls, Widmeyer, and El Sawy (1992).
[191] See Walls, Widmeyer, and El Sawy (2004), p. 45.

indicating how researchers can successfully carry out DSR, together with a template for readers and reviewers to recognize and evaluate it.[192] Fortunately, such guidance is provided through a framework created by Gregor and Hevner (2013), for DSR positioning and publishing.[193] Hence, this could mean that important and relevant academic research will be able to reach more people, both in terms of scientific research and professional practice.[194]

In the favour of creating more DSR papers, a study conducted by Aken (2004) investigates the quest for prescriptions in the field of management.[195] Aken (2004) states that the idea of prescription should not reinvented, and to rather take management research that is driven by prescriptions serious in the academic environment, through strict rules and tests.[196] The main point of the research conducted by Aken (2004) is that the relevance problem of academic management research can be reduced if more space for 'Management Theory' research would be created, based on the paradigm of DSR, next to the more traditional 'Organization Theory' research, based on the explanatory sciences paradigms.[197] Furthermore, both knowledge creation paradigms can contribute to the academic literature by operating together.[198] This is due to the fact the understanding of problem could be provided by 'Organization Theory' research, while 'Management Theory' research could provide further insight into the nature of managerial processes and the generation of additional research questions.[199] Subsequently, an increasing interest in the management research which is driven by prescriptions, could guide towards an integrated theoretical framework that is correlated with an active stream of empirical research, and provides distinct views on organizations.[200] However, a more ambitious outcome would take the shape of a partnership between description-driven and prescription-driven research in many schools of thought.[201]

Based on the studies mentioned above, the balance seems to be in the favour of explanatory research, especially when it comes to the fields of IS and Management. However, this research will further analyse the development of DSR in the field of purchasing throughout the years, by focusing on the JPSM and JSCM.

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[192] See Peffers et al. (2007), p. 90.
[193] See Gregor and Hevner (2013), p. 338.
[194] See Gregor and Hevner (2013), p. 338.
[195] See Aken (2004), p. 220.
[196] See Aken (2004), p. 237.
[197] See Aken (2004), p. 239.
[198] See Aken (2004), p. 239.
[199] See Aken (2004), p. 240.
[200] See Aken (2004), p. 242; Mckinley, Mone, and Moon (1999), p. 635.
[201] See Aken (2004), p. 242.

3. Evolution of Purchasing

3.1 Starting as an operational function

Having the traditional attitude that purchasing can be done by anyone, was one of the main barriers in the development of supply management.[202] In comparison to other functions of the company, purchasing has been lacking academic and practical recognition as an important function in achieving sustainable competitive advantages.[203]

The majority of papers published at the beginning of 1900s discusses about legal issues of buying, the shaping of the ordering process, and the characteristics needed in order to be a successful buyer.[204] In the middle of the 20th century, purchasing departments were mainly about finding suppliers, as large parts of the world economy were destroyed because of the 2nd World War, pushing companies to focus their purchasing activities internationally.[205] Moreover, during late 1950s, the work of Sundhoff (1958) was the first piece of research to distinguish short-term day-to-day activities and long-term purchasing.[206]

Over the last decades, multiple debates have been developed in the Purchasing and Supply Management (PSM) research about the role of purchasing in organizations.[207] According to Luzzini and Ronchi (2016), purchasing activities have gained more importance over time due to the increasing rate of decisions regarding outsourcing.[208] Besides, purchasing spend kept increasing throughout the years and nowadays companies might pass up to 80% of turnover to their suppliers.[209] Yet, the actual role of the purchasing function appears to be in a continuous academic debate, as researchers and practitioners do not seem to frequently share similar views.[210] Furthermore, although purchasing is considered to be a department necessary for companies, practitioners tended to disregard purchasing's role as a strategic function in firms for a long period of time.[211] This is because other departments, such as marketing, sales, and finance, were perceived to have a more strategic role in improving the performance of companies, than purchasing.[212]

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[202] See Kaufmann (2002), p. 5.
[203] See Kaufmann (2002), p. 5.
[204] See Kaufmann (2002), p. 6.
[205] See Kaufmann (2002), p. 7.
[206] See Kaufmann (2002), p. 7; Sundhoff (1958).
[207] See Bernardes and Zsidisin (2008); Mehra and Inman (2004); Ogden, Rossetti, and Hendrick (2007).
[208] See Luzzini and Ronchi (2016), p. 788.
[209] See Ramsay and Croom (2008), p. 195.
[210] See Cousins (2005), p. 408; Mol (2003), p. 45.
[211] See Cox and Lamming (1997), p. 54.
[212] See Luzzini and Ronchi (2016), p. 789.

A study conducted by Gelderman and Van Weele (2005) describes that the purchasing function needs to facilitate activities on three different levels, namely operational, tactical, and strategic.[213] Additionally, Gadde and Wynstra (2018) state that the profession of purchasing nowadays includes several sub-functions belonging to the three levels described by Gelderman and Van Weele (2005), namely ordering, negotiating, and sourcing.[214] Firstly, ordering represents a pure operational level of purchasing as it mainly involves the administrative side of purchasing in the form of expediting orders.[215] Secondly, on the tactical level, the negotiation of deals takes place, together with the selection of most suitable suppliers from the list of approved vendors.[216] Eventually, purchasing is considered to be strategic when sourcing involves the function of purchasing in procurement decisions, before the decision of approved list of vendors.[217] According to Quayle (2005), the three sub-functions should not be kept away from one another, as it is possible to increase efficiency through specialization, either by allocating expediting and strategic issues to separate people, or by doing the operational work which could lead to the selection of more reliable suppliers.[218]

In the view of Ramsay (2001), the purchasing function is irrelevant to the strategy of companies, as it embodies just an operative function.[219] Besides, Ramsay (2001) affirms that purchasing is an operational function by arguing that the only strategic decision in the process is the make-or-buy decision.[220] Also, the researcher states that companies only outsource their non-core operations, including purchasing, which are considered to be non-strategic, but operational in nature.[221]

When it comes to operational purchasing, the main focus is on the short-term rather than the long-run.[222] This is due to the fact that purchasing on the operational level of organization deals with the transactional, day-to-day operations.[223] Apart from expediting orders, operational purchasing also involves records and system maintenance, invoice clearance,

[213] See Gelderman and Van Weele (2005), p. 3.
[214] See Gadde and Wynstra (2008), p. 128.
[215] See Gadde and Wynstra (2008), p. 129.
[216] See Gadde and Wynstra (2008), p. 131.
[217] See Gadde and Wynstra (2008), p. 133.
[218] See Quayle (2005), p. 43.
[219] See Ramsay (2001), p. 258.
[220] See Ramsay (2001), p. 259.
[221] See Ramsay (2001), p. 261.
[222] See Ahola et al. (2008), p. 88.
[223] See Ahola et al. (2008), p. 91.

quotations, and price determinations.[224] According to Johnson, Leenders, and Flynn (2021), operational purchasing is characterized as trouble avoidance, while strategic purchasing is about seeking opportunities.[225] In addition, the operational function appears to be the most familiar for companies.[226] This is because employees inside the organization are disturbed when supply does not meet the minimum expectations.[227] For example, inadequate quality, wrong quantities, and deliveries that are late may negatively affect the end users of a company's products or services.[228] On the operational level, a simple indicator of a good purchasing performance could even be the fact that there are no complaints regarding supplies.[229] Moreover, the operational purchasing can be designed to create routines and automate many of the daily transactions, thus freeing up space and time for purchasers to focus on the managerial and strategic levels of purchasing.[230]

3.2 Moving towards the tactical/managerial level

The field of PSM has begun an important and critical activity of organizations, aiding them in dealing with multiple stakeholders in the increasingly more complex supply networks in which they operate.[231] Starting from the second half of the 20th century, there has been a trend of companies mainly focusing on their core competences, while outsourcing all other activities that external companies can execute for better conditions, such as lower costs, higher quality, and more flexibility.[232] Furthermore, supply chains have started to operate worldwide, regardless of the higher levels of risk associated with supply, thus positioning purchasing in a more managerial role in multiple companies.[233] As a consequence, PSM has evolved significantly both academically and professionally over the last few decades, eventually partaking in the C-suite of many companies, together with a board level presence in various listed firms.[234]

As a response to the rising competition and cost pressures in the 1980s and 1990s, the purchasing function of companies began to rely on cost reduction techniques in order to

[224] See Johnson, Leenders, and Flynn (2021), p. 90, 258, 262.
[225] See Johnson, Leenders, and Flynn (2021), p. 8.
[226] See Johnson, Leenders, and Flynn (2021), p. 9.
[227] See Blowfield (2005), p. 122.
[228] See Mmutle and Shonhe (2017), p. 2.
[229] See Johnson, Leenders, and Flynn (2021), p. 9.
[230] See Johnson, Leenders, and Flynn (2021), p. 10.
[231] See Van Weele and Van Raaij (2014), p. 57; Wynstra, Suurmond, and Nullmeier (2019), p. 2.
[232] See Bäckstrand et al. (2019), p. 1; Prahalad and Hamel (1997), p. 973.
[233] See Bäckstrand et al. (2019), p. 2; Spina et al. (2013), p. 1204.
[234] See Bäckstrand et al. (2019), p. 2.

further enhance their profitability.[235] Such cost reduction tactics have guided outsourcing processes by emphasizing on the total cost of ownership in purchasing tasks, which eventually led to the rise of supply chains that operate globally.[236] Consequently, disaggregated value creation among multiple stakeholders in supply chains has accelerated the acknowledgment of purchasing as an important function in obtaining sustainable competitive advantage.[237] Even if the research provided by Kraljic (1983) was a major building block, the purchasing function was still struggling in being perceived as a strategic contributor to the company.[238] An explanation for this struggle would be the fact that managerial purchasing was still focusing on the direct buyer-supplier interface rather than on the value chain as a whole.[239]

Apart from relying on cost reduction techniques, purchasing at the managerial level was also considering buying decisions, negotiations, budgeting, and contracting.[240]

As mentioned earlier, due to the increased purchasing significance, purchasing decisions became more important. In this regard, companies tended to be more dependent on their suppliers, and the consequences of poor decision-making became more severe.[241] For instance, in industrial companies, decision-making about purchasing tactics ultimately impacted the profitability of the firm.[242] Besides, developments such as globalisation and the Internet further complicated purchasing decision-making, as they enlarged the choice set of purchasers.[243] In addition, dynamic customer preferences required a more quick and flexible supplier selection.[244] Therefore, such developments had direct effects on the complexity and importance of buying decisions.[245] These developments also required a more systematic approach to purchasing decision-making, especially when it comes to the area of supplier selection.[246] In the contemporary research, a range of techniques and tactics was provided, that proved helpful to the purchasing decision-making with regards to the increased complexity and importance of the decisions needed to be taken.[247] For example, techniques

[235] See Carter and Narasimhan (1996), p. 24; Foerstl, Schleper, and Henke (2017), p. 1.
[236] See Foerstl, Schleper, and Henke (2017), p. 1; Trent and Monczka (2003), p. 609.
[237] See Foerstl, Franke, and Zimmermann (2016), p. 353; Tchokogué, Nollet, and Robineau (2017), p. 108.
[238] See Foerstl, Schleper, and Henke (2017), p. 2; Kraljic (1983).
[239] See Foerstl, Schleper, and Henke (2017), p. 2.
[240] See Johnson, Leenders, and Flynn (2021), p. 97, 121-122, 302, 493.
[241] See De Boer, Labro, and Morlacchi (2001), p. 75.
[242] See De Boer, van der Wegen, and Telgen (1998), p. 110.
[243] See De Boer, Labro, and Morlacchi (2001), p. 76.
[244] See De Boer, Labro, and Morlacchi (2001), p. 76.
[245] See De Boer, Labro, and Morlacchi (2001), p. 84.
[246] See De Boer, Labro, and Morlacchi (2001), p. 79.
[247] See Matthews (2005), p. 387.

like problem structuring approaches, and data mining have been supporting purchasers in their buying decisions.[248]

Another important aspect on the managerial level is that purchasing consists of transactions which result from various negotiation processes between the buying firm and its suppliers.[249] In the business-to-business context, negotiations determine whether the buying company manages to close a deal and find the most suitable supplier, when it comes to the costs and benefits incurred, for a given product or service.[250] If an agreement is being reached, this in turn defines the gives and takes of each party, the adequate economic impact, and how well the parties succeed to integrate their interests to reach the agreement.[251] Because of the importance of negotiations in business-to-business purchasing, the academic literature has identified several determinants of the negotiation process, such as personality factors, cultural aspects, and power dependence relations, which can expand the set of tactics purchasers possess.[252]

On the budgeting side, the process of purchasing usually begins with a review of supply goals, which is followed by a forecast of actions and resources needed to meet the goals, and then the budged is being developed.[253] According to Johnson, Leenders, and Flynn (2021), there are four separate purchasing budgets, namely materials purchase budget which begins with an estimate of expected operations based on sales forecasts and plans, the maintenance, repairs, and operations budget that covers a purchase plan for a 12-month period, the capital budget which is an expenditure plan that often has a multiyear horizon, and the annual administrative budget that is based on anticipated operating workloads and includes all of the expenses incurred in the operation of the supply function.[254]

When a company outsources services to suppliers, the overall performance of the buying firm becomes dependent on the performance of its suppliers.[255] For instance, a buyer might contract a supplier to deliver services directly to the customers of the buying firm, and in the case of a poor performance by the supplier, customer satisfaction will immediately be

[248] See Lisnawati and Sinaga (2020), p. 16; Medeiros and Ferreira (2018), p. 572.
[249] See Geiger (2017), p. 91.
[250] See Wilken et al. (2010), p. 70.
[251] See Lax (2021), p. 279.
[252] See Lax (2021), p. 280; Rubinstein (2021), p. 117; Schaerer et al. (2020), p. 47; Sharma et al. (2018), p. 146.
[253] See Johnson, Leenders, and Flynn (2021), p. 493.
[254] See Johnson, Leenders, and Flynn (2021), p. 494.
[255] See Broekhuis and Scholten (2018), p. 2.

affected.[256] Moreover, the interconnection between buyer, customer and supplier can be perceived as a 'service triad', in which each actor participating in the triad has a direct connection with the other two actors.[257] As a consequence, buyers and suppliers started to use formal contracts to reduce risks and to safeguard service delivery to customers.[258] Such formal contracts were negotiated over in the 'ex-ante' contracting phase, where partners generated expectations that needed to be satisfied and managed 'ex-post' after closing the contract.[259]

Accordingly, purchasing at the tactical level includes additional tasks and techniques for purchasers than purchasing at the operational level, while focusing on mid-term objectives.

3.3 Becoming a strategic role in the organisation by creating sustainable competitive advantage

Since the end of the 20th century, purchasing has been receiving more attention as an important contributor to the strategic success of the company.[260] Based on the more recent academic literature, it appears that the function of purchasing has started to play a more important role when it comes to the strategy of the company.[261]

Going back to the roots of purchasing, the function's evolving role in corporate strategy was firstly noticed in the field of marketing, specifically in investigations regarding the industrial buying behaviour.[262] Hence, during the 1970s, Ammer (1974) stated that purchasing has been seen by top management as having a passive role in the company.[263] Later on, Porter's (1980) seminal research focused on the five forces that shape the industry competitiveness, thus identifying buyers and suppliers as two of the five industry forces.[264] From this point, the strategic importance of suppliers and the focal firm as a buyer started to receive recognition in the academic strategy literature.[265] Moreover, during the 1990s, scientific literature began identifying that the purchasing function can be recognized as a more significant contributor to the sustainable competitive advantage of companies.[266] For example, in their research, Watts,

[256] See Van der Valk and Van Iwaarden (2011), p. 199.
[257] See Van der Valk and Van Iwaarden (2011), p. 200.
[258] See Broekhuis and Scholten (2018), p. 2.
[259] See Broekhuis and Scholten (2018), p. 3.
[260] See Ellram and Carr (1994), p. 10.
[261] See Ellram and Carr (1994), p. 10.
[262] See Ellram and Carr (1994), p. 11.
[263] See Ammer (1974); Ellram and Carr (1994), p. 11.
[264] See Ellram and Carr (1994), p. 13; Porter (1980).
[265] See Ellram and Carr (1994), p. 14.
[266] See Hall (1993), p. 608.

Kim, and Hahn (1995) created a framework used to connect purchasing to the competitive strategy of companies, and to the strategies of other departments as well.[267] Besides, their research focuses on the impact of the buyer-supplier relationship in order to elevate the purchasing function in the corporate strategy.[268] The main point in Watts, Kim, and Hahn's (1995) study is that connecting purchasing to the corporate strategy would require a new relationship with suppliers based on partnership, which has a strategic emphasis, and it is characterized by single sourcing, and a constant improvement in cost, dependability, flexibility, and quality.[269] Consequently, the strategy of purchasing has to be supportive with the strategies on the corporate and functional levels in order to achieve sustainable competitive advantage.[270]

Similarly, Giunipero and Monczka (1997) focus on how corporate and purchasing strategies are influenced by the introduction of a sourcing policy operating internationally.[271] In their research, the authors affirm that the objectives and strategy at the corporate level must be connected to the company's future objectives.[272] Therefore, the purchasing's objectives have to be defined in accordance with the corporate objectives, in order to be supportive regarding those objectives.[273]

At the same time, Carter and Narasimhan (1996) describe the importance of strategic planning for purchasing managers, contributing to a competitive purchasing function.[274] Their research further discusses the integration of the purchasing function into the strategic planning process of companies.[275] However, for the purchasing function to impact decisions about long-term planning at the corporate level, purchasing have to develop strategic planning at the departmental level.[276]

Alternatively, Carr and Smeltzer (1999) discovered that decisions related to supply illustrate the required inputs used in the planning of corporate activities.[277] Additionally, the purchasing function can contribute to the strategic planning at the corporate level by

[267] See Watts, Kim, and Hahn (1995), p. 4.
[268] See Watts, Kim, and Hahn (1995), p. 2.
[269] See Watts, Kim, and Hahn (1995), p. 5.
[270] See Watts, Kim, and Hahn (1995), p. 7.
[271] See Giunipero and Monczka (1997), p. 321.
[272] See Giunipero and Monczka (1997), p. 322.
[273] See Giunipero and Monczka (1997), p. 322.
[274] See Carter and Narasimhan (1996), p. 21.
[275] See Carter and Narasimhan (1996), p. 23.
[276] See Carter and Narasimhan (1996), p. 26.
[277] See Carr and Smeltzer (1999), p. 43.

monitoring trends in the supply market, supporting the company and strategic business unit strategies through the identification of necessary inputs, and supply alternatives development.[278] Eventually, Carr and Smeltzer (1999) concluded that the need of strategic planning skills possessed by purchasing managers has increased in importance for a company to remain competitive in the market.[279]

A few years later, in a study conducted by Mol (2003), the researcher views purchasing as a strategic function, by arguing that in addition to decisions regarding make-or-buy, there are other decisions that require strategic attention, such as strategies necessary in collaborating with selected suppliers.[280] Besides, Mol (2003) notices the long-term orientation of strategic purchasing, as the relationships with suppliers provide opportunities for the focal company to capture external resources under its control, that are valuable, rare, inimitable, and non-substitutable.[281] In addition, strategic purchasing also takes into account the collaboration between buyer and suppliers when it comes to trust, which is gained over time, and can significantly contribute to sustaining the competitive advantage of the buying firm.[282]

Nowadays, although it is still lacking in digitalization when compared to other business functions, the purchasing function is moving towards AI, a process called ‘procurement 4.0’.[283] As a consequence, the intelligent information systems used by purchasing managers progressively include decision-support, strategic monitoring, predictions, and technologies used in collaborations.[284] Also, the topic of strategic sustainable purchasing (SSP) in a supply chain has been recently developed by Arora et al. (2020), and is used in combining the concepts of strategic purchasing and environmental purchasing, with the objective of attaining sustainable competitive performance for the company.[285]

During the evolution of purchasing throughout the years, the function's transition from daily operations to long-term strategic orientation ultimately took shape. There were more and more researchers who noticed the importance of purchasing in organizations and believed that the function can contribute to the success of companies by supporting their overall strategies. As mentioned before, to provide support to the strategy of the firm, purchasing

[278] See Carr and Smeltzer (1999), p. 44.
[279] See Carr and Smeltzer (1999), p. 48.
[280] See Mol (2003), p. 44.
[281] See Mol (2003), p. 46.
[282] See Mol (2003), p. 47.
[283] See Bienhaus and Haddud (2018), p. 965.
[284] See Allal-Chérif, Simón-Moya, and Ballester (2021), p. 70.
[285] See Arora et al. (2020), p. 709-710.

have to acknowledge the main firm's strategy, and then get involved in the strategic planning process of the organization.

Eventually, as strategic support and involvement have been developed over time, the purchasing function improved its chances to transition from operational and tactical levels to strategic levels in organizations, hence contributing to the achievement of sustainable competitive advantage that is seen today, and continually evolving by adopting new technologies such as AI, that can further support purchasing's performance.[286]

3.4 Transitioning from a design-oriented field to a more explanatory topic?

In *Chapters 3.1*, *3.2*, and *3.3*, the evolution of purchasing from operational levels to strategic levels has been explained. However, for the purpose of this research, it would be interesting to see whether the field of purchasing has also developed in terms of DSR publications over the years, while making the transition over the three organizational levels. Furthermore, as shown in *Chapter 2.4*, explanatory research takes over DSR in various academic fields regarding publications, yet researchers continue to promote the use of DSR in the academic literature.

Prior to the main in-depth analysis of the JPSM and JSCM in the attempt of identifying the evolution of DSR publications throughout the years, which will take place in the following chapters, a literature review is provided in this chapter with the purpose of identifying whether purchasing shifted from a design-oriented field towards a more explanatory topic.

By taking into consideration that purchasing started as an operational function, this research study assumes that more DSR papers have been published in the early days, when compared to the later DSR publications associated with the managerial and strategic levels of purchasing. The reason behind this assumption is due to the fact that, nowadays, traditional descriptive paradigm appears to be the dominant research used to produce and publish academic research, as described in Chapter *2.4.2*. In addition, Carr and Smeltzer (1999) state that although strategic purchasing has become more interesting to managers and researchers, the more the function shifts from operational levels to strategic levels, the more abstract the literature associated with will become.[287] Hence, the probable transition of purchasing from a design-oriented field to a more explanatory topic.

[286] See Phan (2021), p. 55.
[287] See Carr and Smeltzer (1999), p. 43.

Although the academic literature appears to be scarce regarding the scientific evolution of DSR publications associated with purchasing, a study conducted by Bäckstrand et al. (2019) can be used as guidance in investigating this evolution.[288] In addition, it is worth mentioning that Wynstra, Suurmond, and Nullmeier (2019) conducted a review of 2,522 purchasing publications in a multidisciplinary context of 18 high-impact management journals, published in the period 1995-2014, in the attempt of understanding how purchasing research has developed over time, quantitatively and content-wise, when it comes to the topics and theories addressed.[289] However, the authors did not consider the purchasing field's evolution at the level of knowledge production (i.e. DSR or traditional paradigms), but concluded that the total number of PSM research output tripled between 2010-2014 (1030 publications) when compared to 1995-1999 (334 publications).[290]

According to Bäckstrand et al. (2019), many researchers of PSM are familiar with various forms of purchasing process models (PPMs).[291] A PPM is defined as a visual representation of the particular order of activities that constitute the field of PSM.[292] Such visual representations consist of tools used in teaching and solving PSM problems, because they provide an overview of processes which are otherwise intangible.[293] In addition, PPMs can also be used as representations to help students understand the identity of PSM, giving insight into what PSM is about.[294] In the practical world, companies use PPMs to help control, monitor and standardise activities related to purchasing.[295] With PPMs that are properly defined, organizations can educate their employees when it comes to the meaning of purchasing and how it should be conducted considering the overall strategy of the organization.[296] Besides, PPMs aid in making employees understand the main purchasing processes and activities which can be used for decision-making and problem-solving.[297]

In their research, Bäckstrand et al. (2019) present a methodical overview of different types of PPMs, together with their evolution, based on a survey with PSM educators and literature review.[298] The outcome of the research conducted by Bäckstrand et al. (2019) consists of a

[288] See Bäckstrand et al. (2019), p. 1.
[289] See Wynstra, Suurmond, and Nullmeier (2019), p. 1.
[290] See Wynstra, Suurmond, and Nullmeier (2019), p. 6.
[291] See Bäckstrand et al. (2019), p. 1.
[292] See Bäckstrand et al. (2019), p. 2.
[293] See Bäckstrand et al. (2019), p. 2.
[294] See Bäckstrand et al. (2019), p. 3.
[295] See Bäckstrand et al. (2019), p. 1.
[296] See Bäckstrand et al. (2019), p. 1.
[297] See Bäckstrand et al. (2019), p. 1; March (2006), p. 202.
[298] See Bäckstrand et al. (2019), p. 9-10.

total of 70 PPMs, out of which 33 PPMs have been identified through sampling PSM papers from various academic journals (e.g. Journal of Marketing, International Journal of Operations & Production Management, European Journal of Purchasing & Supply Management, and more), between 1965 and 2018.[299] Additionally, the 33 PPMs appear to predominate the 1980s and 1990s, as 19 PPMs were published before 1998, and 14 PPMs after 2001.[300] Interestingly, the higher number of PPMs that are design-oriented belong to the 19 PPMs published before 1998, while fewer design science PPMs were published after 2001. In this case, a first descending trend regarding the evolution of DSR throughout years emerges from the study conducted by Bäckstrand et al. (2019). Moreover, the outcome of Bäckstrand et al. (2019) provides an initial insight into the probable distribution of DSR and explanatory-oriented publications in the academic literature. Besides, this outcome would be congruent with Peffers et al. (2007), who states that the dominant research paradigm used to produce and publish academic research for the well-known research outlets, continues to be descriptive instead of prescriptive research.[301] Hence, it would be possible to conclude that the transition of purchasing from a design-oriented field to a more explanatory topic becomes more apparent, giving the presumed answer that design science has steadily disappeared from PSM over time.

4. Research Problem and Purpose

4.1 Problem Statement: traditional research paradigms appear to outweigh DSR paradigms in the discipline of PSM

Early academic research generated multiple design papers with the purpose of solving societal, organizational, and technological problems, as identified by Hevner et al. (2004). Frequently, a purchasing-related academic paper would contain a tool, such as the Kraljic (1983) matrix, or a PPM like the ones found by Bäckstrand et al. (2019). However, over the past few decades, DSR papers seem to face more and more difficulties in being accepted at any academic journal.[302] In addition, DSR scholars often fail to notice the opportunities of linking newly developed artifacts to valuable environmental impacts and contributions.[303]

Apparently, recent research in PSM is subject to a disproportionate weight in favour for traditional research paradigm (i.e. explanatory, descriptive research), and against DSR

[299] See Bäckstrand et al. (2019), p. 9-10.
[300] See Bäckstrand et al. (2019), p. 9.
[301] See Peffers et al. (2007), p. 85.
[302] See Eder (1999), p. 6; Peffers et al. (2007), p. 85.
[303] See Vom Brocke and Seidel (2012), p. 296.

paradigms.[304] Besides, academics in the field of PSM can produce knowledge under various scientific paradigms using explanatory research or DSR, yet the literature seems to focus on the traditional knowledge production process, which causes a gap in prescriptive knowledge creation, that further reduces its relevance and rigor.[305] This is because researchers in PSM mainly use inductive and deductive reasoning, and the focus of their research is on evaluations and experiments.[306] In addition, the proper construction of knowledge must occur from the research process, in accordance with pragmatism, which includes interaction between the object and observer.[307]

The lack of relevance caused by the primary production of descriptive research has an effect on the existing world. Although people are familiar with natural sciences, such as physics and biology, the existing world is currently more artificial than natural.[308] A reason for this would be the fact that the world revolves around mankind's goals.[309] Therefore, the current world requires science which can address its artificial state, and encompass both natural and goal-dependent (i.e. artificial) phenomena.[310] According to Hevner (2007), the science of the artificial actually represents the science (either analytic or descriptive) of engineering.[311] At the same time, the lack of rigor regarding new methods and artifacts, together with opportunities missed from connecting the produced artifacts to the environmental impacts as described by Vom Brocke et al. (2020), affects the overall quality of recently published DSR.[312]

In the academic literature of PSM, there are several recent works, such as the ones produced by Bäckstrand et al. (2019), and Wynstra, Suurmond, and Nullmeier (2019), which focus on the development and evolution of PSM as a field, yet there are no publications to analyse the evolution of PSM regarding its state of knowledge creation. Furthermore, the evolution of DSR paradigm in the field of purchasing has not been covered by any recent research. Therefore, the gap left in the academic literature will be addressed by this research

[304] See Aken (2004), p. 239.
[305] See Bäckstrand et al. (2019), p. 1.
[306] See Sik (2015), p. 2142.
[307] See Hevner (2007), p. 91.
[308] See Lambert (2019), p. 383.
[309] See Hevner (2007), p. 92
[310] See Simon (1996), p. 3.
[311] See Hevner (2007), p. 93.
[312] See Sovacool, Axsen, and Sorrell (2018), p. 13; Vom Brocke et al. (2020), p. 3.

study, which will focus on the evolution of knowledge creation in the field of purchasing, by looking at the performance of DSR publications over time, in the JPSM and JSCM.

4.2 Purpose of the Research: an in-depth analysis of the evolution of DSR publications over time in the JPSM and JSCM

The purpose of this research is to explore the evolution of DSR publications throughout the years in the field of purchasing, by analysing the entire journals of Purchasing and Supply Management, and Supply Chain Management respectively. Various methods of analysis, such as manual coding, the identification of DSR papers based on specific keywords used in a Microsoft Excel spreadsheet, together with data mining through the WEKA software that uses machine learning, will be used in analysing and identifying design-oriented publications. Furthermore, it will be investigated whether DSR publications have steadily disappeared over time from the academic literature of PSM. Accordingly, the aim of this study is to identify all DSR-oriented publications in the JPSM and JSCM, in conjunction with their development throughout the years.

This research study can contribute to both theory and practice, considering that there is a strong desire for more DSR publications in the academic literature, which goes hand in hand with Hevner's (2007) and Vom Brocke et al.'s (2020) affirmations about the current world that is more artificial than natural, due to its revolution around the goals of mankind, yet the recently published DSR is being challenged both in terms of its lack of rigor regarding new methods and artifacts, and the opportunities missed from connecting the produced artifacts to the environment.[313] Besides, thinking of future world developments, with little to no DSR papers published, the academic research might become uninteresting for practitioners.[314] This is because the gap between theory and practice will keep widening, despite decades of academic literature addressing this issue.[315] As a consequence, the evolution of purchasing from operational to strategic levels led the academic literature of PSM in more abstract and explanatory areas.[316]

Hence, this research project has the purpose of challenging authors to publish more design-oriented papers, and journals to support authors by solving the problem of acceptance regarding DSR publications, as the academic world of purchasing and practitioners can

[313] See Aken (2004), p. 220; Hevner (2007), p. 92; Vom Brocke et al. (2020), p. 3.
[314] See Otto and Osterle (2012), p. 3.
[315] See Otto and Osterle (2012), p. 4.
[316] See Carr and Smeltzer (1999), p. 43.

benefit from publications aimed at solving more recent organizational, technological, and social problems.[317] For instance, as Bäckstrand et al. (2019) identified the PPMs used by academics to teach students PSM, and companies to educate their employees, more DSR publications can be created to teach students and educate employees regarding more recent purchasing-related topics, such as the use of AI to solve problems in PSM.[318]

In addition, this research contributes to the practice of academia by encouraging and guiding researchers to use novel methods of analysis when classifying literature review data, such as diverse AI tools, especially computer-based programs that use machine learning in order to mine data (e.g. WEKA). The reason behind this is the fact that AI proved to save time and effort through its efficiency in simulating human tasks, both in this research study and in other studies identified in the academic literature, that will be explained more extensively in the following chapters.

4.3 Research Hypotheses: less DSR publications means a more explanatory field?

In *Chapter 2.4.2*, using the studies conducted by Aken (2004), Hevner et al. (2004), March and Smith (1995), Peffers et al. (2007), and Walls, Widmeyer, and El Sawy (2004), it was explained that the balance of knowledge creation appears to be in the favour of explanatory, descriptive research, rather than design-oriented, prescriptive research. Furthermore, it seems that the academic literature focuses more on natural and social sciences, which aim at understanding and explaining phenomena by using inductive and deductive reasoning, rather than on DSR, which aims to develop means through which human goals can be achieved, and problems to be solved, using abductive reasoning as well. Consequently, recent research that is less rich in DSR publications might become uninteresting for purchasing professionals, who need prescriptions and artifacts that can guide them in dealing with different organizational, societal, and environmental problems.[319] Besides, more DSR publications could assist the PSM discipline in narrowing down the gap between theory and practice, by providing practitioners with the tools needed in solving various problems.[320]

When thinking about the evolution of purchasing throughout the years, the amount and quality of DSR papers published in PSM appears to have been decreasing, while the abstraction of the field started to become more apparent alongside the shift of purchasing

[317] See Hevner et al. (2004), p. 78; Walls, Widmeyer, and El Sawy (2004), p. 45.
[318] See Bäckstrand et al. (2019), p. 1; Phan (2021), p. 55.
[319] See Walls, Widmeyer, and El Sawy (2004), p. 45.
[320] See Otto and Osterle (2012), p. 4.

towards a more strategic position in the company.[321] In addition, by also considering the transition of purchasing that was explored in *Chapter 3.4*, where the study conducted by Bäckstrand et al. (2019) to find PPMs in the academic literature showed a decreasing trend of DSR-oriented PPMs in PSM over time, this research study assumes the following hypothesis:

Hypothesis 1: The number of DSR papers published in the JPSM and JSCM has steadily decreased throughout the years.

At the same time, when DSR appeared to be an accepted research paradigm in a discipline like engineering, this knowledge creation method has been active in only a small number of research papers published in the most known IS journals, which were used to produce artifacts of practical value for academia and professionals, while the dominant research continued to be explanatory research, taken from natural and social sciences.[322] On top of that, by taking into account the idea that the balance of knowledge creation lies in the favour of explanatory, descriptive research, rather than design-oriented, prescriptive research, as described by multiple researchers who reflected on disciplines such as IT and Management, together with the fact that DSR publications have been steadily disappeared, at least from the discipline of PSM as shown by the PPMs listed by Bäckstrand et al. (2019), the following hypothesis is proposed by this research study:

Hypothesis 2: The more a field will be explored academically, the less design and the more explanatory its research will become.

5. Methodology

5.1 Research design: analysing the JPSM and JSCM using novel methods of research

In this chapter, the methods of this empirical research study will be outlined, through an extensive elaboration on the setup of quantitative and research, which involves the numerical representation of observations for the purpose of describing and explaining the phenomena behind the reflected observations.[323] Simultaneously, qualitative research methods will be used in coding and identifying DSR publications. Due to the limitations associated with the current academic literature about the knowledge creation of PSM, this research study

[321] See Carr and Smeltzer (1999), p. 43.; Vom Brocke et al. (2020), p. 3.
[322] See Peffers et al. (2007), p. 85, p. 87.
[323] See Sukamolson (2007), p. 2.

provides further investigations by aiming at understanding past and current research, planning for future research, and eventually promoting the development of DSR papers in the discipline of purchasing. To successfully complete the investigation, the analysis requires a large time span in order to fill the gap in the literature research. Furthermore, large sets of publications are considered for a better representative image of the research in PSM discipline. Therefore, in this research study, all publications in the JPSM and JSCM will be used, from the apparition of journals and up to the completion of this study. More precisely, 809 publications ranging from 1994 to 2021 will be analysed in the JPSM, and 1088 publications ranging from 1965 to 2021 will be analysed in the JSCM. Hence, a sample of 1897 publications will be used in analysing and assessing the evolution of DSR in purchasing over time. At the same time, multiple analysis methods will aid in identifying design science papers in PSM, such as manual coding via the ATLAS.ti computer program, cross-checking with three other researchers, the use of Microsoft Excel based on specific keywords, and eventually the general analysis will be completed using AI, through data mining and classifications which the Waikato Environment for Knowledge Analysis (WEKA) software will provide.[324]

First, JPSM (former known as European Journal of Purchasing and Supply Management) digital copies of publications were collected from ScienceDirect database. Similarly, the digital copies of publications in the JSCM were collected from Wiley Online Library. Moreover, to have access to the digital copies of the two journals, multiple subscriptions offered by University of Twente helped the process.

Secondly, after the collection of digital publications, the next step was to code them manually through the ATLAS.ti software. Further, the potential DSR papers identified were sent to peers for a cross-check analysis. As a next step used in speeding up the process of DSR paper identification, specific design-oriented keywords were developed and used in Microsoft Excel, together with the text of all the JPSM and JSCM publications, which was sorted on a score-based approach. Besides, the text of the 1897 papers was not manually copied form the Portable Document Format (PDF) format of papers to the spreadsheet of analysis, rather a program coded in Python was developed and used in automatically copying the text to Microsoft Excel. After the outcome of the spreadsheet based on keywords, the potential DSR publications identified (i.e. publications that scored more than 16 design-

[324] See Hussain et al. (2018), p. 448.

related keywords in Microsoft Excel) were once again manually coded and analysed, then sent to peers for cross-check analysis. Ultimately, the DSR publications found in the JPSM and JSCM using Microsoft Excel, manual coding, and cross-checking with other researchers, were prepared for being used in the WEKA software, to run against explanatory publications for further validation and prediction.

Finally, in previous chapters, a theory explanation and an evolution of purchasing have been conducted using the academic literature. Hence, specific terms used for conducting this research study have been searched in multiple online databases and search engines, such as ScienceDirect, Web of Science, Wiley Online Library, Scopus, Emerald Group Publishing, and Google Scholar. Additionally, access to such databases was once again provided through subscriptions offered by University of Twente. In a similar manner, the specific terms used in the upcoming chapters have been extracted from the databases.

5.2 Data collection

5.2.1 Collecting data: accessing digital copies of online journals through digitization

Academic publishing has been influenced in every aspect by the digitization process, that has been the driver behind ways in which the impact of publications is currently measured and how academic work can be found and accessed.[325] According to Björkdahl (2020), digitization is defined as the process of converting information into digital formats, with the purpose of representing objects, images, sounds, or documents.[326] Furthermore, digitization has helped in the publication of more journals to the point where in 2018, there were around 33,100 peer-reviewed journals written in English, which generated together more than 3 million publications a year, and the number is constantly increasing on a yearly basis.[327] Besides, through digitization, many more journals become accessible to people around the world, than it was the case in the past.[328]

At the same time, most journals nowadays use digital platforms and databases for the entire publication process, starting from the submission of academic papers, to the review process, the submission of revisions, and the sending of proofs to authors, followed by the final publication of papers in the journals.[329] As a consequence, academic papers are published and

[325] See Paltridge (2020), p. 148.
[326] See Björkdahl (2020), p. 18.
[327] See Johnson, Watkinson, and Mabe (2018), p. 119.
[328] See Paltridge (2020), p. 148.
[329] See Paltridge (2020), p. 149.

are available more quickly to readers in digital formats.[330] Moreover, readers can access digital publications from anywhere, and anytime, as long as an Internet connection is available, together with an access to digital journals which can be provided by various institutions, through a subscription-based model, one-time payment, or even open access.[331]

Quicker communication of academic knowledge, new levels of accuracy and work preservation, together with the ability to easily connect academic publications to other similar publication, are all consequences of digitization.[332] For example, digitization makes it easier for academics to stay up to date with recent published research through digital journals and databases which can send e-mail alerts, and also to share their work with other people by using online platforms such as LinkedIn, Twitter and other preferred blogs.[333] Therefore, digital media impacts the way researchers are able to communicate their work through the use of digital platforms, where authors are able to present their work to a higher diversity of audience, with different ranges of expertise in their topics.[334] Additionally, academic publications became more multimodal in creating them, due to the increasing accessibility of digital technologies.[335] When it comes to the actual writing of academic papers, documents can be created, stored and shared in a number of different online spaces that go the beyond the mere individual computers.[336] Online services through cloud computing, such as Dropbox, OneDrive, and Google Drive, allow researchers to benefit from storing and sharing their work.[337] Simultaneously, researchers are also able to use such online services for creating research projects in collaboration with their peers, who may be in different physical locations.[338] Software programs for citation management such as Endnote, Mendeley, RefWorks and Zotero, also help researchers in writing their work by creating digital citations and references which can be automatically generated in text, rather than manually.[339] For such computer programs, the review process of citations and references is also handled and shared with other authors and reviewers online.[340]

[330] See Björkdahl (2020), p. 20.
[331] See Paltridge (2020), p. 149; Reinsfelder and Pike (2018), p. 139.
[332] See Paltridge (2020), p. 150.
[333] See Barton and McCulloch (2018), p. 9.
[334] See Luzón (2017), p. 462.
[335] See Pérez-Llantada (2016), p. 22.
[336] See Paltridge (2020), p. 150.
[337] See Tinani et al. (2020), p. 153.
[338] See Tinani et al. (2020), p. 155.
[339] See Ivey and Crum (2018), p. 399.
[340] See Ivey and Crum (2018), p. 403.

Nonetheless, in the case of this research study, the 809 digital academic papers of the JPSM were collected from the ScienceDirect platform, which represents an online database and search engine of academic journals and publications.[341] Similarly, the 1088 digital publications of the JSCM were collected from the Wiley Online Library database. In addition, the subscriptions offered by University of Twente helped in accessing and downloading digital copies of all the publications in both journals.

5.2.2 Digitization in the JPSM and JSCM: automatically converting the PDF text to Microsoft Excel using a Python-based tool

As all 1897 papers from the JPSM and JSCM were collected from their respective online platforms, these were downloaded and stored in PDF formats. According to Marinai, Marino, and Soda (2011), a PDF format is designed to allow users to exchange, view, and print electronic documents, while preserving their look in their natural architectures.[342] Initially, the PDF format of papers sufficed as a tool used in analysing the two journals. However, since other methods of analysis were further developed, the text of such PDF papers had to be imported into a Microsoft Excel spreadsheet. Moreover, because the spreadsheet only allows numbers and tables to be automatically imported from a PDF file, the text of each PDF paper had to be copied manually.[343] Hence, a tool that automatically imports the entire text of a PDF cells into the spreadsheet, has been developed by a computer science student who provided support to this research. This tool was programmed in Python, using the Python language. Python language is developed by Python Software Foundation and represents an interpreted high-level and general-purpose programming language, which has a design philosophy that emphasizes code readability with its use of significant indentation, together with language constructs and object-oriented approaches that aim to help programmers write clear, logical codes for small and large-scale projects.[344] In addition, Python language is commonly used in AI and machine learning projects.[345]

The Python tool developed for this research consists of two parts. Firstly, there is a folder named ‘pdf’, in which the PDF files that must be imported into a Microsoft Excel spreadsheet can be copied. Secondly, there is a ‘main.py’ file, which represents the main program that does the conversion automatically. Once opened, ‘main.py’ will automatically import the text

[341] See Tober (2011), p. 140.
[342] See Marinai, Marino, and Soda (2011), p. 478.
[343] See Neyeloff, Fuchs, and Moreira (2012), p. 2.
[344] See Oliphant (2007), p. 11.
[345] See Piatetsky (2018), p. 1.

from all PDF documents from the folder ‘pdf’ into a single Microsoft Excel spreadsheet that will be created in the folder where the tool is located, upon the completion of the conversion. Furthermore, the entire text from each PDF document will be imported into single cells in the spreadsheet, which are sorted on rows. For instance, the text from ‘PDF_1’ will be imported into ‘Cell 1A’, the text from ‘PDF_2’ will be imported into ‘Cell 2A’, and so on.

It is worth mentioning that the folder ‘pdf’ has no capacity limits, as the 809 PDF documents of the JPSM, and the 1088 PDF documents of the JSCM, were converted at once, the only separation being two spreadsheets created for each journal. This is because, once the ‘main.py’ finishes its conversion, a new Microsoft Excel spreadsheet called ‘results.xlsx’ is created in the folder in which the tool is located. Also, the time needed for ‘main.py’ to compile the PDF documents that are in the ‘pdf’ folder will depend on the processing power of each computer.[346] In the case of this research, the PDF documents of the JPSM were imported into an Excel spreadsheet in around two hours and fifteen minutes, while the PDF documents of the JSCM were imported into another Excel spreadsheet in roughly three hours.

To make the spreadsheets easier to read and analysis for the purpose of this research, the ‘main.py’ was further programmed to generate each PDF document in the spreadsheet format, but on three different columns, which were named ‘Document name’, ‘Text’, and ‘Text lower case’. For example, ‘PDF_1’ was imported into Microsoft Excel as ‘Document name’ (i.e. the name of the PDF document, which was the name of the specific academic paper) in ‘Cell 2A’, ‘Text’ (i.e. the entire text of the paper) in ‘Cell 2B’, and ‘Text lower case’ in ‘Cell 2C’. Although it sounds self-explanatory, the only difference from ‘Text’ and ‘Text lower case’ was that in the latter, the entire text from the PDF document was in lower case letters. This column of text in lower case letter helped the research further, by making it easier to apply a Microsoft Excel formula used in the identification of DSR papers, which will be described in the coming chapters.

Eventually, the creation of such a Python computer program proved useful both in terms of precious time that was saved through automatically copying the text of papers into the spreadsheet, and in terms of efficiency, which was related to the management of both spreadsheets containing 809 PDF papers, and 1088 PDF papers respectively, which were ready to be further analysed in the attempt of identifying DSR publications.

[346] See Manjunath and Larkin (2021), p. 2.

5.3 Multiple analysis methods used in identifying design papers

5.3.1 Manual analysis: coding potential design-oriented papers

5.3.1.1 How to code a research paper through open coding strategy

In qualitative research, it is possible to analyse the opportunities associated with locating the origins of a phenomenon, the exploration of possible reasons for its occurrence, together with the codification of what the experience provided by such a phenomenon meant to people involved, and the determination of whether the experience generated a theoretical frame or a conceptual understanding associated with the phenomenon.[347] While quantitative research seeks to count and offer statistical relevance with regard to how often a phenomenon occurs and then generalize the findings, qualitative research provides opportunities to investigate into such a phenomenon and determine its significance during and after its occurrence.[348] Regardless of the research method chosen (i.e. qualitative or quantitative), the methodology employed for data collection and organization has to be understandable and repeatable, further enabling data to be analysed.[349]

Because qualitative research has evolved over time and methodologies for collecting and managing data have become more mature, certain structures for managing data in such areas have emerged and become common practice nowadays.[350] Consequently, coding represents an important data organizing structure in qualitative research.[351] Saldaña (2021) states that codes in qualitative research are most often identified as words or short phrases, that symbolically assign a cumulative, remarkable, and reminiscent attribute for a piece of data, which can be language-based or visual.[352] According to Cooper, Hedges, and Valentine (2019), coding plays a key role in the synthesis of research, as it is an attempt to reduce a complex, disorderly, and quantification-resistant reality to a matrix of numbers. Hence, it will always be challenging to fit the numerical scheme to the reality, and the fit will not be perfect in most instances.[353]

In general, the method of qualitative research and Grounded Theory Methods (GTMs) specifically, represents an inductive, non-deductive, approach in doing qualitative research.[354]

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[347] See Williams and Moser (2019), p. 45.
[348] See Williams and Moser (2019), p. 45.
[349] See Williams and Moser (2019), p. 46.
[350] See Saldaña (2016), p. 36.
[351] See Saldaña (2016), p. 37.
[352] See Saldaña (2011), p. 3.
[353] See Cooper, Hedges, and Valentine (2019), p. 128-129.
[354] See Williams and Moser (2019), p. 46.

As explained throughout *Chapter 2.3*, deductive reasoning focuses on casualty and testing theory, while inductive reasoning focuses on generating theory from collected data. For instance, in the GTM approach, activities related to data collection, such as interviews, observations, and artifact reviews, require researchers to be present and aware of the dynamic nature of the data, its thematic interconnection, and the emergence toward theory creation.[355] According to Charmaz (2008), there is a reciprocal relationship between data collection, data analysis and the theory generation, which requires a continuous interplay between the researcher and the data.[356]

The core of the coding process consists in ensuring that coding procedures are rigorously defined and consistently applied in order to conform with validity and reliability standards that belong to the qualitative research.[357] Furthermore, coding plays a crucial role in facilitating the researchers' abilities to advance effectively the research process, by recognizing the interdependent relationship among data organization, categorization, and theory development.[358] For instance, the open coding strategy enables a recurrent and evolving data method in which researchers can interact, constantly compare data, and apply data reduction, together with data consolidation techniques.[359] As the coding process advances, its dynamic functions enable essential themes to be identified, codified, and interpreted for the purpose of the research study, thus contributing to the academic literature.[360] Moreover, this coding method requires researchers to understand the data by continuously reading and re-reading the collected data in order for theory to develop.[361]

According to Blair (2015), in the open coding process, researchers are identifying different concepts and themes used for categorization.[362] Besides, in open coding, data is organized by generating wide initial thematic domains for data assembly.[363] Flick (2018) affirms that the aim of open coding is to express data and phenomenon in the form of concepts, through units of meaning which classify expressions such as single words, or short sequences of words, in order to attach concepts and annotations.[364] In practice, researchers have to examine the

[355] See Williams and Moser (2019), p. 47.
[356] See Charmaz (2008), p. 399.
[357] See Williams and Moser (2019), p. 47.
[358] See Saldaña (2011), p. 5.
[359] See Williams and Moser (2019), p. 48.
[360] See Williams and Moser (2019), p. 48.
[361] See Williams and Moser (2019), p. 48.
[362] See Blair (2015), p. 17.
[363] See Blair (2015), p. 20.
[364] See Flick (2018), p. 307.

responses offered by informants, and organize similar words, phrases, and concept indicators, in wide initial thematic domains.[365]

5.3.1.2 Coding purchasing papers using ATLAS.ti software with the purpose of identifying DSR publications

As described in the previous chapter, open coding in qualitative research presents opportunities for organizing data.[366] Determining what data to capture and how to exhibit it, represents a key aspect of the research design.[367] According to Williams and Moser (2019), data illustration in open coding can be managed through the presentation form that directly reflects the processes of data collection.[368] As an example, words, phrases, or fragments from sentences of different emergent themes can be illustrated on different pages, and field notes with the purpose of counting the number of times a word was repeated in an interview or document can be traced, while relevant characteristics from photographs of informants can be referenced in the archive of an album.[369] Eventually, the result of open coding should consist of a list that characterizes codes and categories attached to the text and supported by code notes that were produced to explain the content of codes.[370] In addition, such notes could be observations and thoughts that are relevant in developing the theory.[371]

Before the apparition of software programs that support coding in qualitative research, organizing data for open coding required researchers to possess a multisided skill set.[372] This is because researchers in the past had to read and re-read interview transcripts, field notes, and other data sources involved in the data collection, with the purpose searching for thematic connectivity that would eventually lead to thematic patterns.[373] Afterwards, researchers would use different colours to code the aligned themes, or cut the themes out, and adhere the paper fragments on index cards in preparation for more accurate assessments.[374] However, such approaches were often subject to possible errors regarding overlooking or miscoding.[375]

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[365] See Williams and Moser (2019), p. 48.
[366] See Saldaña (2011), p. 7.
[367] See Saldaña (2011), p. 8.
[368] See Williams and Moser (2019), p. 49.
[369] See Williams and Moser (2019), p. 49.
[370] See Flick (2018), p. 310.
[371] See Flick (2018), p. 312.
[372] See Williams and Moser (2019), p. 49.
[373] See Saldaña (2011), p. 10.
[374] See Saldaña (2011), p. 14.
[375] See Linneberg and Korsgaard (2019), p. 268.

Nowadays, qualitative software programs are available to researchers, in order to enable the same coding process using complex data analysis tools.[376] The development of such qualitative computer programs (e.g. ATLAS.ti, NVivo Plus, Quirkos) has expanded the ways that researchers can work through the coding processes.[377] Besides, more advanced qualitative computer programs, such as ATLAS.ti 9, come with packages that provide opportunities for brief statistical analyses of the coding process.[378] However, the researchers still have to complete each stage of coding, as the computer programs only support an easier and quicker capture of the researchers' coding and construction of theory.[379]

In this research study, ATLAS.ti 9 was the main program used for coding purchasing papers. ATLAS.ti was created by Thomas Muhr as part of a larger research project at the Technical University of Berlin, between 1989 and 1992.[380] The software was developed with the purpose of managing large sets of data that was collected to analyse the impact of the Chernobyl nuclear misfortune which occurred in 1986.[381]

According to Soratto, Pires, and Friese (2020), ATLAS.ti is a Computer Assisted Qualitative Data Analysis Software (CAQDAS), which is currently being used by professionals in healthcare, and researchers from various fields of knowledge, such as criminology, education, engineering, and management.[382]

The first step in the coding process of this research was to import the two journals into ATLAS.ti. In contrast to importing the text of PDF documents into Microsoft Excel, the process of importing PDF documents into ATLAS.ti was much easier as the software allows such documents to be directly imported. Besides, all the papers of a journal can be imported at once, as ATLAS.ti creates a list of the imported documents, which is efficient to access and use when coding papers. Afterwards, to identify DSR purchasing papers, 68 codes have developed in the Code Manager of ATLAS.ti, which were then used to underline and label the text of papers in the JPSM and JSCM. For example, such codes consisted of words like 'design', 'artifact', 'prototype, and sequences of words such as 'design science approach', 'developing solutions', 'abductive reasoning', 'prescription-based study'. At the same time, certain codes (e.g. 'explanatory research', 'descriptive') were created for a quicker

[376] See Saldaña (2021), p. 25.
[377] See Williams and Moser (2019), p. 49.
[378] See Afriansyah et al. (2019), p. 2.
[379] See Williams and Moser (2019), p. 50.
[380] See Rambaree (2014), p. 1.
[381] See Rambaree (2014), p. 2.
[382] See Soratto, Pires, and Friese (2020), p. 2.

identification of non-design publications. Furthermore, throughout the process of identifying DSR publications, new codes have been created and minor adjustments to the code list have been made. During the identification of design-oriented papers, the open coding strategy was implemented, through which the text of papers has been scanned for specific DSR words, sequence of words, and phrases, which were eventually labelled by applying the developed codes that were suitable for them. After a PSM paper was fully coded, it was possible to draw a conclusion whether it was a DSR publication or not. Furthermore, sometimes it was possible to quickly assess a DSR publication by simply coding its abstract, artifact, testing, and conclusion. Similarly, it was possible to identify a non-design paper by coding its abstract and several chapters afterwards that would further validate its category.

5.3.2 Using triangulation in the identification process: agreeing with other researchers and AI on the DSR papers found

According to Denzin (2012), triangulation represents a research method used to increase the credibility and validity of research findings.[383] Furthermore, credibility refers to how trustworthy a research study is, where validity is concerned with the extent to which a study accurately reflects the concept or ideas under investigation.[384] Triangulation can be achieved by combining theories, methods, or even observers in a research study, having the purpose of ensuring that fundamental biases emerging from the use of a single research method or a single observer are overcome.[385] In addition, triangulation also represents an input in helping to explore and explain complex human behaviour, using multiple methods to offer more well-balanced explanations to readers.[386] This is because triangulation is a procedure that enables validation of data, which can be used in quantitative and qualitative research studies.[387]

Noble and Heale (2019) state that triangulation can enrich the ongoing research as it offers a variety of datasets used in explaining the various aspects of a phenomenon of interest.[388] It also contributes to rejection, where one dataset invalidates an assumption generated by another.[389] Besides, It can assist in the confirmation of a hypothesis, where one set of findings

[383] See Denzin (2012), p. 82.
[384] See Noble and Heale (2019), p. 67.
[385] See Noble and Heale (2019), p. 67.
[386] See Renz, Carrington, and Badger (2018), p. 825.
[387] See Denzin (2012), p. 83.
[388] See Noble and Heale (2019), p. 67.
[389] See Noble and Heale (2019), p. 67.

confirms another set of findings.[390] Nonetheless, triangulation can help in better explaining the results of a research study.[391]

At the core of triangulation lies the notion that methods leading to the same results give more confidence and validity in the findings of the research.[392] Moreover, Denzin (1978) proposes four types of triangulation, namely data triangulation, which involves matters such as time, space and people; investigator triangulation, which includes the use of multiple researchers in a research study; theory triangulation, which promotes more theoretical schemes to enable interpretation of a phenomenon; and methodological triangulation, which encourages the use of various data collection methods, such interpretations, observations, interviews, or case studies.[393]

While triangulation can enrich and provide more clarity to a research study, the process has limitations as well.[394] For instance, triangulation adds to the complexity of the research, by making it more time-consuming, due to the multiple analyses involved.[395] Apart from that, when used as a method for combining multiple research methodologies, there is the possibility that triangulation is not achieved in a consistent manner.[396] Additionally, there may be times when multiple comparisons of the results are inconsistent or conflicting, and more time and analysis will be necessary to reach a final agreement.[397]

In this research study, the methods of investigator triangulation and methodological triangulation have been used to decide upon the DSR purchasing papers identified. According to Carter et al. (2014), investigator triangulation involves the participation of two or more researchers in the same research study to provide multiple observations to reach clear and valid conclusions.[398] Furthermore, with this type of triangulation, both confirmation of findings and different perspectives are brought to the research, while adding enrichment to the topic of interest.[399]

[390] See Carter et al. (2014), p. 545.
[391] See Carter et al. (2014), p. 545.
[392] See Renz, Carrington, and Badger (2018), p. 826.
[393] See Denzin (1978), p. 291.
[394] See Heale and Forbes (2013), p. 98.
[395] See Johnson et al. (2017), p. 2.
[396] See Johnson et al. (2017), p. 3.
[397] See Noble and Heale (2019), p. 68.
[398] See Carter et al. (2014), p. 545.
[399] See Denzin (1978), p. 292.

This research study began with an initial analysis of 100 papers published in the JPSM, which was conducted by a single researcher. The papers were firstly coded in ATLAS.ti, then decided on whether they belong to the DSR category. Afterwards, the identified DSR papers were sent out to three other researchers for further validation. However, as this process was too time-consuming, the method which involves using Microsoft Excel was developed and applied, to filter potential DSR papers from the 1897 publications of both journals combined, as it will be explained in the following chapter. After the identification of potential DSR publications in both journals using Microsoft Excel, the papers were shared with the other three researchers to confirm and validate which papers out of the potential DSR papers found in Microsoft Excel are actual DSR publications. As a final step, the DSR publications identified by researchers have been run in the WEKA software for further validation, against other papers found in the spreadsheet, that were classified as explanatory purchasing papers. Hence, a mixture of investigator triangulation and methodological triangulation, as described by Denzin (1978), by sharing the potential DSR papers with other researchers, double-checking with Microsoft Excel and manual coding, and afterwards using the support of AI through the WEKA software, helped this research in identifying DSR purchasing papers in the JPSM and JSCM.

5.3.3 The use of Microsoft Excel in identifying DSR papers based on specific keywords

5.3.3.1 Qualitative and quantitative data analysis through Excel spreadsheets

Microsoft Excel is a renowned spreadsheet software that belongs to the Microsoft Office family, and provides powerful tools which can be used to analyse, visualise, distribute, and manage information to make accurate decisions or conclusions which are supported by data.[400] Whereas researchers conducting quantitative research prefer statistical software such as Statistical Package for the Social Sciences (SPSS) for data analysis, and researchers performing qualitative research seek special software like ATLAS.ti, Microsoft Excel is widely used for quantitative data analysis as it is both readily available and familiar to most people.[401] Meyer and Avery (2009) argue that Microsoft Excel is often viewed as a number software that is associated with quantitative data analysis, but this proves to be useful as a qualitative tool as well, because it can handle large amounts of data, provide multiple attributes, and allow for multiple illustrative techniques.[402]

[400] See Niglas (2007), p. 297.
[401] See Niglas (2007), p. 297.
[402] See Meyer and Avery (2009), p. 91.

In addition, Microsoft Excel employs many features that make the handling and integration of various types of data flexible, giving it potential to be used within a mixed research approach more beneficially than just a substitute for statistical packages.[403] For instance, Microsoft Excel's categorized spreadsheet provides a flexible structure for recording both notes and keywords from unstructured raw data, such as in the course of a meta-analysis of literature or published academic studies.[404] According to Barowy, Berger, and Zorn (2018) a spreadsheet is represented by a software used in the organisation, examination, and storage of data in tabular forms.[405]

Spreadsheets in Microsoft Excel can be used to record both pre-structured quantitative data from survey or structured coding sheets, and unstructured qualitative data from open questions or interview transcripts, simultaneously and in the same database.[406] Hence, spreadsheets in Microsoft Excel can contain different types of data, being qualitative, quantitative, or both.[407]

There are several tools provided by Microsoft Excel which make reviewing data on the spreadsheet effective and easy to manage.[408] Firstly, the 'Sort' tool allows users to sort both rows and columns using up to three criteria, which is useful for getting an overview of certain subgroups in the data.[409] Secondly, the 'AutoFilter' tool might be the most reasonable choice when the aim is to review information in a systematic manner right on the spreadsheet.[410] The 'Sort' and 'AutoFilter' tools can also provide a quick overall idea of the variability of entries and frequencies with which specific keywords have been entered, either through reviewing the sorted records or the cell entries which can be listed alphabetically in the 'AutoFilter' menu.[411] Thirdly, the 'Pivot Table' tool can be used for obtaining more exact numerical results.[412]

Nevertheless, sorting and filtering tools used independently or in combination with a 'Pivot Table', can facilitate the integration of quantitative and qualitative data in a research

[403] See Niglas (2007), p. 298.
[404] See Niglas (2007), p. 298.
[405] See Barowy, Berger, and Zorn (2018), p. 1.
[406] See Bree and Gallagher (2016), p. 2812.
[407] See Bree and Gallagher (2016), p. 2813.
[408] See Palocsay, Markham, and Markham (2010), p. 192-193, 198.
[409] See Palocsay, Markham, and Markham (2010), p. 192.
[410] See Palocsay, Markham, and Markham (2010), p. 193.
[411] See Palocsay, Markham, and Markham (2010), p. 196.
[412] See Palocsay, Markham, and Markham (2010), p. 198.

analysis.[413] Therefore, specific tools used in Microsoft Excel make it possible to learn from qualitative data to inform about decisions, while analysing and interpreting quantitative data.[414]

5.3.3.2 Specific keywords have been developed to identify DSR publications in the Excel spreadsheets of JPSM and JSCM

In this research, two different spreadsheets have been used in identifying DSR papers in two purchasing journals. While one spreadsheet has been used to identify DSR publication in the JPSM, the other spreadsheet helped in identifying DSR papers in the JSCM. Apart from the different number of publications, namely 809 papers in the JPSM, and 1088 papers in the JSCM, there has not been any difference in the spreadsheet analysis. Once imported in the Microsoft Excel spreadsheet, all the JPSM papers have been sorted based on their publication dates in column A, which was named 'Document name'. Additionally, in column B, named 'Text', the text of papers was imported. In column C, called 'Text lower case', the text of papers from column B was imported, but in lower case only, using the Excel formula '=LOWER()'. This further helped in counting and summing up each keyword (starting from column E) from the text of a paper in lower case, by using the formula (text in row 3, column C): '=SUMPRODUCT((LEN(C3)-LEN(SUBSTITUTE(C3;E2;"")))/LEN(E2))' (formula used in column E, row 3). More precisely, row number 1 was used to sum up specific keywords of all papers in the spreadsheet (e.g. 'action research' = 200, 'pragmatism' = 4) by using the formula (for the first keyword starting from column E) '=SUM(E3:E812)', row number 2 was used for labels such as 'Document name' (column A), 'Text' (column B), 'Text lower case' (column C), 'Score' (column D), and keywords (from column E to column AM), while the actual imported papers started from row 3 up to row 812. As each paper had a certain number of specific keywords, the total number of keywords in a paper was illustrated in column D, named 'Score' using the formula (for row 3; first paper) '=SUM(E3:AM3)'. Furthermore, the development of keywords used in identifying DSR purchasing papers in the JPSM and JSCM are illustrated in *Table 2* below.

[413] See Meyer and Avery (2009), p. 92; Palocsay, Markham, and Markham (2010), p. 191.
[414] See Meyer and Avery (2009), p. 110.

Initial keywords used	Keywords added over time	Exclusion of unnecessary keywords
action research	pragmatism	propose
artifact	prescribe	create
design science	prescription	build
design research	pragmatic	requirements
synthesize	mixed methods	how can
propose	synthesise	
formulate	how should	
prototype	how can	
create	ideation	
build	utility	
efficacy	Van Aken	
usefulness	abduction	
artificial	kernel	
intervention	design perspective	
abductive		
requirements		
engaged scholarship		
design theory		
recipe		
design approach		
design process		

Table 2. The development of DSR-related keywords

In *Table 2*, the first column displays the initial keywords used in identifying DSR publications. Since the first journal of analysis was JPSM, the keywords from "Initial keywords used" were only used to identify DSR papers in this journal. Over time, more keywords have been introduced for a more accurate identification of DSR papers. These new keywords are illustrated in the second column called "Keywords added over time". Additionally, because the sum of all papers using keywords such as 'create', 'propose', 'requirements', 'how can', and 'build' was very high, specific papers that scored more on these keywords were carefully analysed, as there were high chances to obtain many points on the 'Score' column, while only scoring on those five keywords, and almost no points for the rest of the keywords. Eventually, the five keywords from the third column, "Exclusion of unnecessary keywords", were removed from the identification of DSR publications since they proved to create additional work that was unnecessary for the research. This was because most papers contained the five excluded keywords, hence it was biasing the total score of keywords for each paper. Eventually, 30 out of 35 keywords (excluding the five red coloured keywords from *Table 2*) used in identifying DSR were selected for the final identification of DSR publications in both the JPSM and JSCM.

At the end of the list, on row 813, a formula was used to filter all papers that scored equal or more than 16 keywords on the 'Score' column. After multiple examinations with the other

three researchers, the number of keywords a paper shall possess to qualify as a potential DSR publication and to be further analysed, was set on equal or higher than 16. Hence, the formula used on row 813 was '=COUNTIF(D3:D812;">=16")', which counted and summed up all papers that had 16 or more keywords in their text. Eventually, each paper that scored 16 or more was underlined in the spreadsheet, then coded manually, and sent for an investigator triangulation process with the other three researchers, to agree whether it qualifies as DSR publication. Also, the same method was applied to the papers in the JSCM, the only difference being the number of spreadsheet rows, which was 1091.

5.3.4 General analysis complemented by AI

5.3.4.1 Definition and history of AI: A supportive tool for researchers

Image recognition, speech recognition,, machine learning, and self-driving cars, are all possible due to advances in AI.[415] In spite of not having a common accepted definition in the academic literature, AI is often referred to as the ability of systems to correctly interpret data, learn from such data, and eventually use the learnings to achieve specific goals and tasks through dynamic adaptation.[416] Moreover, the AI's definition is not viewed as a problem by the scientific literature, as many scientific concepts only get stable definitions after they have matured enough.[417] Since AI is considered to be at its conception, and given the complexity and breadth the concept has, it may not be feasible to expect AI to have a determined definition yet.[418]

Apparently, the academic literature finds it is difficult to pinpoint the exact roots of AI, but they can be traced back to the 1940s, when the writer of Science Fiction, Isaac Asimov, published his work called 'Runaround'.[419] The plot of 'Runaround', which is a story about a robot developed by two engineers, evolves around the three laws of robotics, which state that a robot may not harm a human being, a robot must obey the orders given by human beings except where such orders would conflict with the first law, and a robot must protect its own existence as long as such protection would not conflict with the first two laws.[420]

[415] See Kaplan and Haenlein (2019), p. 16.
[416] See Kaplan and Haenlein (2019), p. 17.
[417] See Collins et al. (2021), p. 2.
[418] See Collins et al. (2021), p. 2.
[419] See Haenlein and Kaplan (2019), p. 6.
[420] See Haenlein and Kaplan (2019), p. 6.

Furthermore, through 'Runaround', Asimov managed to inspire future generations of scientists in the field of robotics, AI, and computer science.[421]

AI is said to have a longer history than it is commonly understood, ranging from the fields of science and philosophy, all the way back to ancient Greece.[422] However, the modern iteration of AI owes to Alan Turing and the conference in Dartmouth College in 1956, where the term of AI was officially defined by John McCarthy as the engineering and science of creating intelligent machines.[423] In addition, Russel and Norvig (2010) also view the conference in Dartmouth as the birth of AI.[424]

An initial paradigm of AI was that it developed around high level cognition.[425] This was not the ability to recognise concepts, perceive objects, or execute complex motor skills, which is also shared by most animals, but rather the potential to engage in multiple reasoning analyses, to understand the meaning of natural language, to design novel artifacts, to create new plans that achieve goals, and even to reason about their own reasoning.[426]

According to Russel and Norvig (2010), AI has seen many ups and downs since its early inception in the 1950s, which is usually referred to as 'summers' and 'winters' of AI.[427] However, since 2010, AI has once again entered a summer period, due to the considerable improvements in computing power of computers, and the access to massive amounts of data.[428] Moreover, this rebirth of AI research is the result of three major discoveries, namely the introduction of a more sophisticated class of algorithms, the arrival on the market of low-cost graphics processors capable of performing large amounts of calculations in a couple of milliseconds, and the availability of large databases, which are correctly annotated and allow for more sophisticated learning of intelligent systems.[429]

The terms Machine Learning (ML) and AI, together with the terms data mining and Deep Learning (DL), often occur in similar contexts and sometimes they are used interchangeably.[430] While the terms are common in various disciplines, their particular usage

[421] See Haenlein and Kaplan (2019), p. 6.
[422] See Dennehy (2020), p. 23.
[423] See Collins et al. (2021), p. 2.
[424] See Russel and Norvig (2010), p. 7.
[425] See Collins et al. (2021), p. 2.
[426] See Langley (2011), p. 1.
[427] See Russel and Norvig (2010), p. 12.
[428] See Collins et al. (2021), p. 3.
[429] See Collins et al. (2021), p. 3.
[430] See Kühl et al. (2020), p. 1.

and meaning differs widely.[431] For instance, int the field of computer science, ML has the aim to design efficient algorithms used in solving problems with computational resources.[432] On the other hand, DL models consist of multiple processing layers which are capable of learning representations of data with many levels of abstraction.[433] In addition, DL has improved multiple capabilities of the way ML operates, such as the ones used in speech and image recognition.[434]

In relation to the previous terms, data mining refers to the process on how to apply quantitative analytical methods in research, which help in solving real-world problems as well, like business contexts.[435] In the case of ML, data mining is the process of generating meaningful ML models.[436] Besides, data mining studies algorithms and computational paradigms that allow computers to discover structures in databases, perform prediction and forecasting, and generally improve their performance through interaction with data.[437] Here, the goal is not to develop further knowledge about ML algorithms, but to apply them to data in order to gain further insights in the study process.[438] Therefore, ML can be viewed as the foundation of data mining.[439] In contrast to the other three terms, AI applies techniques like ML, deep learning, or descriptive statistics, to simulate human intelligence in systems and provide support for researchers in conducting their studies.[440]

5.3.4.2 Using AI's support through WEKA software to further validate and predict DSR publications

The software used in completing this research is the perfect example of an AI tool that aims to provide a comprehensive collection of ML algorithms and data mining tools to researchers and practitioners.[441] Such tasks include basic statistics and visualization tools, together with tools for pre-processing, classification, and clustering, all available through an easy to use graphical user interface.[442] Furthermore, the software is called WEKA, and nowadays it is recognized as a landmark system in data mining and ML.[443] As a matter of

[431] See Kühl et al. (2020), p. 1.
[432] See Zhang (2020), p. 224.
[433] See Kühl et al. (2020), p. 2.
[434] See Zhang (2020), p. 226.
[435] See Schommer (2008), p. 4.
[436] See Kühl et al. (2020), p. 3.
[437] See Russel and Markov (2006), p. 11.
[438] See Kühl et al. (2020), p. 3.
[439] See Witten and Frank (2002), p. 76.
[440] See Kühl et al. (2020), p. 3.
[441] See Frank et al. (2009), p. 1269.
[442] See Russel and Markov (2006), p. 12.
[443] See Russel and Markov (2006), p. 20.

fact, WEKA has achieved worldwide acceptance within academia and business contexts, and has become a widely used tool for data mining research.[444] Besides, little of the software's success would have been possible if the system would have not been released as open source software.[445] This is because, by offering users the possibility to access the source code, a thriving community emerged, which helped in developing multiple projects that incorporate or extend WEKA.[446]

An important aspect of WEKA is that it allows users to use structured and unstructured data (i.e. quantitative and qualitative), through supervised and unsupervised learning. According to Smith and Frank (2016), in supervised learning, the data used for learning is treated as an exemplar that has been annotated with the thing to be learned, having the goal of finding a characterisation of examples so that judgments can later be made for new instances.[447] In addition supervised learning comes in two principal forms, namely classification, which refers to something that tries to be predicted and has a discrete value, and regression, which involves the attempt to predict a numeric value that has the objective to find a certain formula for generating a good estimate of the true value.[448] In contrast, unsupervised learning is where the right answer is not known ahead of time for any of the data, meaning that there is no prior basis to judge how good the obtained results are.[449] Here, the goal is not to be able to make judgments that are right or wrong, but to find interesting and useful generalities within the data.[450] For example, a common form of unsupervised learning is clustering, which involves the separation of instances, in a given collection of data, into two or more groups, called clusters, based upon their similarities.[451]

Before launching WEKA, it is important to prepare the data needed to be analysed.[452] This can be done either in a plain text document (e.g. Notepad), a spreadsheet, or any other text-editing or data-entry document.[453] After the data has been prepared, the file needs to be converted into the Attribute-Relation File Format (ARFF) format, using the '.arff' extension, in order to be run by WEKA.[454] In the newly created ARFF file, which can be opened for edit

[444] See Hall et al. (2009), p. 10.
[445] See Hall et al. (2009), p. 11.
[446] See Hall et al. (2009), p. 11.
[447] See Smith and Frank (2016), p. 2-3.
[448] See Smith and Frank (2016), p. 3.
[449] See Smith and Frank (2016), p. 4.
[450] See Smith and Frank (2016), p. 4.
[451] See Smith and Frank (2016), p. 5.
[452] See Aksenova (2004), p. 3.
[453] See Aksenova (2004), p. 4.
[454] See Aksenova (2004), p. 4.

with a text-editing document, three tags have to be added in the first rows, namely '@relation tag', which refers to the name of the dataset, '@attribute tag', which reflects the information of the attribute, and '@data', which represents the created data. For example, in this research, the tags were used as follows: '@relation ArticleClassification', '@attribute article string', '@attribute article class {design, explanatory}', and '@data', which was followed by rows containing the text of each paper using single quotes (') at the beginning and end of the text for each instance, followed by a comma (,) and the class (design or explanatory). However, when predicting, the class of every paper was replaced from design or explanatory into a question mark (?).

Once prepared, the ARFF file can be opened using various WEKA applications, such as 'Explorer', 'Experimenter', 'KnowledgeFlow', 'Workbench', and 'Simple CLI'.[455] However, the only application used in this research was WEKA Explorer. In the Explorer application, the ARFF file can be chosen and opened. Once opened, the Explorer interface will display various information of the ARFF file, such as the attributes used, and the number of instances (i.e. papers in this research). In addition, this step in the Explorer application is labelled 'Pre-process'. The next step is to use one of the 'Classify', 'Cluster', or 'Associator' windows, to analyse data.

In this research, the papers were analysed in the 'Classify' window, as they have been classified using supervised learning, that was mentioned before. In the 'Classify' window, a classifier can be chosen for analysis. For example, the classifier used in this study was a meta classifier called 'FilteredClassifier – J48 algorithm'. Moreover, this type of classifier was used in a study conducted by Kawade, Dipak, and Kavita (2015) with the purpose of identifying or classifying spam messages.[456] The reason behind using 'FilteredClassifier' in this research is that it gains the highest accuracy when classifying.[457]

After the selection of 'FilteredClassifier', its filter has been replaced from 'Discretize' to 'StringToWordsVector', having an 'IteratedLovinsStemmer' stemmer, which is the stemming algorithm used for identifying words in the ARFF file.[458] In addition, the 'StringToWordsVector' is converting the text of papers to lists of words that contain the occurrence of each word in the category.[459] After applying the text mining framework

[455] See Kotak and Modi (2020), p. 2.
[456] See Kawade, Dipak, and Kavita (2015), p. 43.
[457] See Kawade, Dipak, and Kavita (2015), p. 46.
[458] See Al-Ayyoub et al. (2016), p. 534.
[459] See Al-Tabbakh, Mohammed, and El-zahed (2019), p. 607.

provided by the WEKA, 'StringToWordsVector' executes the pre-processing step, hence usual techniques of stemming text, removing stop-words, removing less significant words, changing all text to lower case letters, and erasing punctuation and numeric characters.[460] As a consequence, this will produce a list count of each word in the dataset of the ARFF file, before a document matrix is ready to give each word or term its weight in the whole list.[461]

The final step in WEKA was to run the test analysis using the training set created in the ARFF file. Once started, the classifier output was displayed in the software. Moreover, a summary of the total number of instances, total number of correctly and incorrectly classified instances, together with a detailed accuracy by class, and a confusion matrix, was displayed to assess the outcome performance. During the analysis, the primary information used in the identification of DSR publications, based on the academic literature, was illustrated by the confusion matrix and the number and percentage of correctly classified instances (i.e. papers).[462] A confusion matrix is formed based on the four outcomes of binary classification, meaning that the dataset usually involves two labels such as positive (P) and negative (N).[463] Additionally, the outcomes can be true positive (TP), involving correct positive predictions, true negative (TN), meaning correct negative predictions, false positive (FP), regarding incorrect positive predictions and false negative (FN), when it comes to incorrect negative prediction.[464] Furthermore, after obtaining the results of the first analysis, a second analysis was conducted in order to predict DSR papers. Here, the class of papers in the ARFF file was switched from design or explanatory to a quotation mark. Afterwards, a supplied test was run in WEKA based on the already trained algorithm from the first analysis. Eventually, in the outcome of the supplied test based on predictions, it was possible to see the distribution of DSR publications in the dataset.

6. Findings

6.1 Description of the DSR purchasing space identified in the JPSM and JSCM

A total of 1897 publications have been analysed in this research project. More precisely, 809 papers have been analysed in the JPSM, and 1088 papers have been analysed in the JSCM. As this study began with the manual coding of the first 100 publications in the JPSM using ATLAS.ti, and the aim to code manually the rest of publications, other methods have

[460] See Al-Tabbakh, Mohammed, and El-zahed (2019), p. 607.
[461] See Al-Tabbakh, Mohammed, and El-zahed (2019), p. 607.
[462] See Aksenova (2004), p. 21.
[463] See Hussain et al. (2018), p. 450.
[464] See Hussain et al. (2018), p. 450.

been developed down the road, such as the use of Microsoft Excel to analysis publications based on specific keywords, and the analysis through AI using WEKA's ML capabilities to mine and predict data. In addition, the latter two methods used in the analysis proved to be efficient and save precious time as well.

Using Microsoft Excel, 102 potential DSR publications have been identified in the JPSM using the specific keywords listed in *Chapter 5.3.3*. After the identification of purchasing papers using Microsoft Excel, the next step was to manually code them. Furthermore, the potential DSR publications were coded by four researchers and eventually agreed upon their categorisation (i.e. whether they are DSR publications). The outcome of the identified DSR publication in the JPSM is 30 out of 102 potential DSR publications, which is also illustrated in *Table 3* below. Moreover, *Table 3* lists the 30 identified DSR publications in the JPSM, which are sorted in an ascending order based on their publication years. Besides, each paper in *Table 3* informs about the number of keywords scored in Microsoft Excel, and whether it was validated by WEKA as being a DSR publication.

According to *Table 3*, the only JPSM publication that was not validated by WEKA belongs to Ronchi et al. (2010). However, after a thoughtful analysis of the research written by Ronchi et al. (2010), it was decided that the publication belongs to DSR, regardless of the outcome provided by WEKA.

Year | Author and Title |	Excel keywords |	Validated by Weka
(1994) Holt, Olomolaiye, and Harris – Applying multi-attribute analysis to contractor selection decisions	23	Yes
(1996) Haavengen and Sena – The development of a purchase manager's decision support system for budgeting…	34	Yes
(2000) Barker, Hong-Minh, and Naim – The terrain scanning methodology	21	Yes
(2000) Wynstra and ten Pierick – Managing supplier involvement in new product development: a portfolio…	38	Yes
(2001) Palaneeswaran, Kumaraswamy, and Zhang – Reforging construction supply chains: a source selection…	27	Yes
(2002) Momme and Hvolby – An outsourcing framework: action research in the heavy industry sector	23	Yes
(2003) de Boer and van der Wegen – Practice and promise of formal supplier selection	17	Yes
(2003) Holweg and Miemczyk – Delivering the '3-day car' – the strategic implications for automotive logistics…	34	Yes
(2006) Bevilacqua, Ciarapica, and Giacchetta – A fuzzy-QFD approach to supplier selection	26	Yes
(2007) Humphreys et al. – Integrating design metrics within the early supplier selection process	32	Yes
(2009) Ancarani – Supplier evaluation in local public services: Application of a model of value for customers	22	Yes
(2009) Luo et al. – Supplier selection in agile supply chains: An information-processing model and an illustration	22	Yes
(2009) Micheli, Cagno, and Di Giulio – Reducing the total cost of supply through risk-efficiency-based supplier…	44	Yes
(2010) Le Dain, Calvi, and Cheriti – Developing an approach for design-or-buy decision-making	18	Yes
(2010) Ronchi et al. - What is the value of an IT e-procurement system?	16	No
(2011) Giannakis and Louis – A multi-agent based framework for supply chain risk management	21	Yes
(2011) Jolay et al. – Integrating fuzzy TOPSIS and multi-period goal programming for purchasing multiple…	26	Yes
(2012) Costantino et al. – Balancing the additional costs of purchasing and the vendor set dimension to reduce…	23	Yes
(2012) Padhi, Wagner, and Aggarwal – Positioning of commodities using the Kraljic Portfolio Matrix	23	Yes
(2013) Bergman and Lundberg – Tender evaluation and supplier selection methods in public procurement	18	Yes
(2013) Choudhary and Shankar – Joint decision of procurement lot-size, supplier selection, and career selection	26	Yes
(2013) Liu, Liu, and Ge – An order allocation model for the two-echelon logistics service supply chain based on…	57	Yes
(2015) Sjoerdsma and van Weele – Managing supplier relationships in an NPD context	17	Yes
(2016) Huang and Wu – A portfolio theory based optimization model for steam coal purchasing strategy…	35	Yes
(2017) Kirilmaz and Erol – A proactive approach to supply chain risk management: Shifting orders among…	33	Yes
(2017) Lee – A fuzzy multi-objective programming approach for determination of resilient supply portfolio…	24	Yes
(2019) Srai and Lorentz – Developing design principles for the digitalisation of purchasing and supply management	39	Yes
(2020) Holma et al. – Service specification in pre-tender phase of public procurement – A triadic model of…	23	Yes
(2020) Kalchschmidt et al. – The geography of suppliers and retailers	28	Yes
(2020) Ukko, Juhani, and Saunila – Understanding the practice of performance measurement in industrial collab.	19	Yes

Table 3. DSR purchasing papers identified in the JPSM.

In the JSCM, 92 potential DSR papers out of 1088 publications have been identified using the specific keywords used in Microsoft Excel. Similar to the potential DSR publications identified in the JPSM, the 92 potential DSR publication identified in the JSCM have been coded manually and categorised as a next step after the Microsoft Excel analysis. Since the JSCM is composed of 279 more papers than the JPSM, and is almost 30 years older, it was surprising to see the outcome of potential DSR publications offered by Microsoft Excel. The final outcome regarding the DSR publications in the JSCM counts 32 publications, which are illustrated in *Table 4* below. Once again, the DSR papers listed in *Table 4* are sorted in an ascending order based on their publication years. Furthermore, each paper from *Table 4* informs about the number of keywords identified in Microsoft Excel and whether it was classified by WEKA as a DSR publication. Similar to the outcome of JPSM, there is only one publication, i.e. the work of Brito and Miguel (2017), that was not classified by WEKA as DSR. However, the paper of Brito and Miguel (2017) went through a second in-depth analysis with the final outcome that classifies it as a DSR publication.

Year | Author and Title |	Excel keywords |	Validated by Weka
(1971) Burt – Effect of The Number of Competitors on Costs	57	Yes
(1983) Buffa and Jackson – A Goal Programming Model for Purchase Planning	22	Yes
(1984) Lambert – Managing Inbound Transportation: A case study	16	Yes
(1986) Narasimhan and Stoynoff – Optimizing Aggregate Procurement Allocation Decision	20	Yes
(1990) Hahn, Watts, and Kim – The supplier development program: A conceptual model	20	Yes
(1992) Cook – Expert Systems in Purchasing: Applications and Development	16	Yes
(1992) Dowlatshahi – Purchasing's Role in a Concurrent Engineering Environment	25	Yes
(1992) Trent – Worldwide Sourcing: Assessment and Execution	53	Yes
(1994) Ansari and Modarress – Quality Function Deployment: The Role of Suppliers	24	Yes
(1996) Murphy and Heberling – A Framework for Purchasing and Integrated Product Teams	16	Yes
(1997) Cook – Case-based reasoning system in purchasing: Applications and Development	19	Yes
(1999) Jayaraman, Srivastava, and Benton – Supplier Selection and Order Quantity Allocation: A Comprehensive…	16	Yes
(2002) Looman, Ruffini, and de Boer – Designing Ordering and Inventory Management Methodologies for…	20	Yes
(2002) Muralidharan, Anantharaman, and Deshmukh – A Multi-Criteria Group Decision-making Model for…	25	Yes
(2004) Handfield – The impact of energy deregulation on sourcing strategy	19	Yes
(2004) Pagell et al. – Does the Competitive Environment Influence the Efficacy of Investments in Environmental…	33	Yes
(2007) Stading and Altay – Delineating the "Ease of Doing Business" Construct within the Supplier-Customer…	18	Yes
(2008) Wacker – A conceptual understanding of requirements for theory-building research: Guidelines for…	32	Yes
(2010) Liao, Hong, and Rao – Supply Management, Supply Flexibility and Supply Performance Outcomes:…	18	Yes
(2010) Roy – So you already have a survey database? – A seven-step methodology for theory building from…	22	Yes
(2011) Choi and Wacker – Theory building in the OM/SCM field: Positioning to the future by looking at the past	39	Yes
(2011) Ketchen Jr. and Hult – Building theory about supply chain management: some tools from the…	34	Yes
(2013) Ellram, Tate, and Feitzinger – Factor-market rivalry and competition for supply chain resources	19	Yes
(2013) Salvador and Villena – Supplier integration and NPD outcomes: Conditional moderation effects of…	19	Yes
(2015) Handfield et al. – How can supply management really improve performance? A knowledge-based model…	23	Yes
(2016) Wowak et al. – Toward a "Theoretical Toolbox" for the supplier-enabled fuzzy front end of the NPD…	24	Yes
(2017) Brito and Miguel – Power, Governance, and Value in Collaboration: Differences between Buyer and Supplier	17	No
(2018) Gualandris and Klassen – Delivering transformational change: Aligning supply chains and stakeholders…	38	Yes
(2020) Quarshie and Leuschner – Interorganizational interaction in disaster response networks: A government…	29	Yes
(2020) Skilton et al. – The structure of absorptive capacity in three product development strategies	20	Yes
(2020) Sodhi – Supply Chain Management for Extreme Conditions: Research Opportunities	32	Yes
(2020) Touboulic, McCarthy, and Matthews – Re-imagining supply chain challenges through critical engaged…	18	Yes

Table 4. DSR purchasing papers identified in the JSCM.

As previously mentioned, it was surprising to see the number of papers identified in the JSCM, considering the differences in both the total number of publications and years between the two journals. Based on the number of DSR papers identified, the percentage of DSR publications in the JPSM is 3.71%, while the percentage of DSR publications in the JSCM is

2.94%. This result shows that JPSM performs better JSCM in terms of purchasing DSR publications and provides a first clue about the *Hypothesis 1* of this research.

In addition to the outcome presented above, *Figure 3* below displays the distribution of DSR publications in the JPSM throughout the years. Based on *Figure 3*, the DSR papers published in the JPSM mostly counted 1 publication every year, from 1994 to 2007, with 2 publications 2000 and 2003. Furthermore, a spike of 3 DSR papers appears in 2009, as illustrated in *Figure 3*, which descends to 2 DSR publications per year from 2010 to 2012, followed by another spike of 3 DSR publications in 2013, then a descending trend that counts only one DSR publication per year in 2015 and 2016, followed by 2 DSR publications in 2017, 1 DSR publication in 2019, and a last ascending trend in 2020 that counts 3 DSR purchasing papers. Finally, by looking at *Figure 3*, the highest number of DSR publications per year is between 2009 and 2013, with an ascending continuation in 2020.

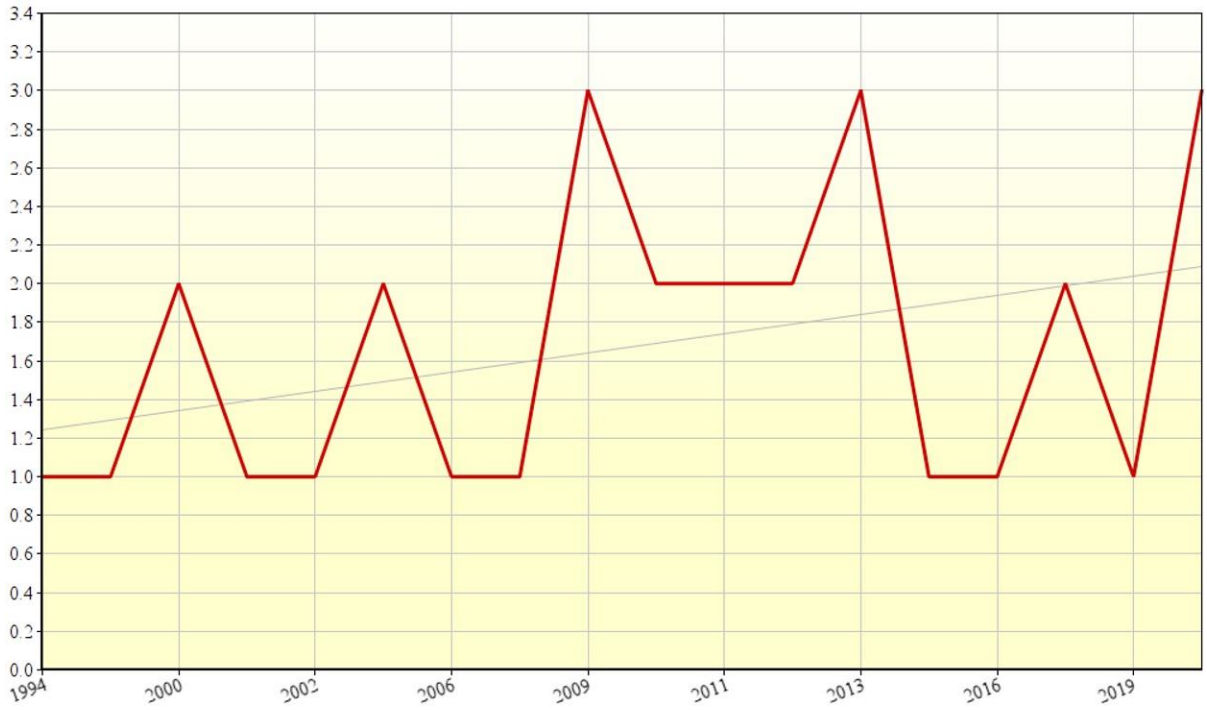

Figure 3. Distribution of DSR purchasing publications in JPSM throughout the years (# of papers on y-axis, years on x-axis).

Similar to the distribution of DSR publications in the JPSM, *Figure 4* below displays the distribution of DSR publications in the JSCM. According to *Figure 4*, the JSCM is hosting only one DSR publication per year between 1971 and 1990, followed by a spike of 3 DSR publications in 1992, and a continuation of one DSR publication per year from 1992 to 2002.

Moreover, in 2002 and 2004, there were 2 DSR publications per year, followed by one DSR publication in 2007 and 2008, then again 2 DSR publications per year from 2010 to 2013. After 2013, there was one DSR publication each year from 2015 to 2018, followed by a spike of 4 DSR publications in 2020, which is similar to the last spike identified in JPSM. When looking at the distribution of JSCM illustrated in *Figure 4*, apart from the 3 DSR papers published in 1992, the highest number of DSR publications per year is between 2002 and 2004, together with 2010 and 2013, followed by the highest number of publications per year in 2020.

Figure 4. Distribution of DSR purchasing publications in JPSM throughout the years (# of papers on y-axis, years on x-axis).

Besides the years that have a high number of DSR publications, JSCM has 4 DSR publications between 1971 and 1986, 8 DSR publications between 1990 and 1999, 6 DSR publications between 2002 and 2008, and 14 DSR publications between 2010 and 2020. At the same time, JPSM has 13 publications between 1994 and 2009, and 17 publications between 2010 and 2020. Based on the outcome of identified DSR papers in the JPSM and JSCM, the number of DSR publications appears to increase throughout the years, which means that *Hypothesis 1* does not receive support.

To strengthen the previously mentioned findings about the number of identified DSR publications in the JPSM and JSCM, an overview of the AI analysis using WEKA is provided below.

A summary of the 102 potential DSR publications in the JPSM is illustrated in *Table 5*. Here, the accuracy of the correctly classified instances is 99.01%, meaning that 101 out of 102 papers were correctly classified as design or explanatory. Furthermore, the Kappa statistic of 0.9762 is high, which shows that the model is statistically significant.[465] In the confusion matrix, 29 out of 30 papers were correctly classified as design, while 1 design paper belongs to the explanatory side, according to WEKA. Moreover, in the same confusion matrix, 72 papers were correctly classified as explanatory.

```
=== Summary ===

Correctly Classified Instances         101               99.0196 %
Incorrectly Classified Instances         1                0.9804 %
Kappa statistic                          0.9762
Mean absolute error                      0.0189
Root mean squared error                  0.0971
Relative absolute error                  4.5228 %
Root relative squared error             21.3079 %
Total Number of Instances              102

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0,967    0,000    1,000      0,967    0,983      0,976    0,994     0,985     design
                 1,000    0,033    0,986      1,000    0,993      0,976    0,994     0,995     explanatory
Weighted Avg.    0,990    0,024    0,990      0,990    0,990      0,976    0,994     0,992

=== Confusion Matrix ===

  a  b   <-- classified as
 29  1 |  a = design
  0 72 |  b = explanatory
```

Table 5. WEKA summary of DSR papers against the rest of potential DSR papers identified in Excel (JPSM)

In *Table 6* below, the outcome of the manually classified instances in JPSM is presented, showing that the 11th instance classified as design, should be classified as explanatory. Furthermore, this instance represents the research conducted by Ronchi et al. (2010), which was ultimately classified as DSR.

[465] See Hussain (2018), p. 455.

inst#	actual	predicted	error	prediction
1	1:design	1:design		1
2	1:design	1:design		1
3	1:design	1:design		1
4	1:design	1:design		1
5	1:design	1:design		1
6	1:design	1:design		1
7	1:design	1:design		1
8	1:design	1:design		1
9	1:design	1:design		1
10	1:design	1:design		1
11	1:design	2:explanatory	+	0.958
12	1:design	1:design		1
13	1:design	1:design		1

Table 6. The paper classified as explanatory by WEKA (continuation of Table 5.)

After the classification of the 102 potential DSR publications, an unclassified analysis of the entire JPSM was ran by WEKA, based on the already trained algorithm from *Table 5* and *Table 6*, predicting the same DSR publications as prior identified. The outcome of this prediction can be found in *Table 7* below. Moreover, the rest of predictions of the JPSM are classified as explanatory by WEKA.

=== Predictions on test set ===

inst#	actual	predicted	error	prediction
1	1:?	1:design		1
2	1:?	1:design		1
3	1:?	1:design		1
4	1:?	1:design		1
5	1:?	1:design		1
6	1:?	1:design		1
7	1:?	1:design		1
8	1:?	1:design		1
9	1:?	1:design		1
10	1:?	1:design		1
11	1:?	2:explanatory		0.958
12	1:?	1:design		1
13	1:?	1:design		1
798	1:?	2:explanatory		1
799	1:?	2:explanatory		0.958
800	1:?	2:explanatory		1
801	1:?	2:explanatory		1
802	1:?	2:explanatory		1
803	1:?	2:explanatory		1
804	1:?	2:explanatory		1
805	1:?	2:explanatory		1
806	1:?	2:explanatory		1
807	1:?	2:explanatory		1
808	1:?	2:explanatory		1
809	1:?	2:explanatory		1

=== Evaluation on test set ===

Table 7. Weka predictions for the entire JPSM based on unclassified data (', ?').

The summary of the 92 potential DSR publications in the JSCM is illustrated in *Table 8*. In this case, the accuracy of the correctly classified instances is 98.91%, meaning that 91 out of 92 papers were correctly classified as design or explanatory. Additionally, the Kappa statistic of 0.9759 is also high for the JSCM publications, which shows that the model is statistically significant.[466] Furthermore, in the confusion matrix, 31 out of 32 papers were correctly classified as design, and 1 design paper was classified as explanatory by the WEKA

[466] See Hussain (2018), p. 455.

algorithm. Finally, in the same confusion matrix, 60 explanatory papers were correctly classified.

```
=== Summary ===

Correctly Classified Instances          91               98.913  %
Incorrectly Classified Instances         1                1.087  %
Kappa statistic                          0.9759
Mean absolute error                      0.0214
Root mean squared error                  0.1033
Relative absolute error                  4.6959 %
Root relative squared error             21.693  %
Total Number of Instances               92

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0,969    0,000    1,000      0,969    0,984      0,976    0,986     0,980     design
                 1,000    0,031    0,984      1,000    0,992      0,976    0,986     0,985     explanatory
Weighted Avg.    0,989    0,020    0,989      0,989    0,989      0,976    0,986     0,983

=== Confusion Matrix ===

  a  b   <-- classified as
 31  1 |  a = design
  0 60 |  b = explanatory
```

Table 8. WEKA summary of DSR papers against the rest of potential DSR papers identified in Excel (JSCM)

In *Table 9*, the outcome of the manually classified instances in JPSM is presented, showing that the 4th instance classified as design, should be classified as explanatory. This specific instance consists in the work of Brito and Miguel (2017), which was categorised as DSR after a thoughtful analysis.

```
=== Predictions on training set ===

    inst#     actual  predicted error prediction
        1   1:design   1:design       1
        2   1:design   1:design       1
        3   1:design   1:design       1
        4   1:design 2:explanatory   +   0.982
        5   1:design   1:design       1
        6   1:design   1:design       1
        7   1:design   1:design       1
        8   1:design   1:design       1
        9   1:design   1:design       1
       10   1:design   1:design       1
```

Table 9. The paper classified as explanatory by WEKA (continuation of Table 8).

After classifying the 92 potential DSR publications based on the explanatory or design class, an unclassified analysis of the entire JSCM was performed by WEKA, based on the already trained algorithm from *Table 8* and *Table 9*. However, while the work of Briton and

Miguel (2017) was classified as explanatory in *Table 9*, WEKA algorithm predicts it as design in *Table 10* below.

```
=== Predictions on test set ===

    inst#     actual  predicted error prediction
        1        1:?   1:design       1
        2        1:?   1:design       1
        3        1:?   1:design       1
        4        1:?   1:design       1
        5        1:?   1:design       1
        6        1:?   1:design       1
        7        1:?   1:design       1
        8        1:?   1:design       1
        9        1:?   1:design       1
       10        1:?   1:design       1
     1078        1:? 2:explanatory    0.982
     1079        1:? 2:explanatory    0.982
     1080        1:? 2:explanatory    0.982
     1081        1:? 2:explanatory    1
     1082        1:? 2:explanatory    0.982
     1083        1:? 2:explanatory    0.982
     1084        1:? 2:explanatory    1
     1085        1:? 2:explanatory    0.982
     1086        1:? 2:explanatory    1
     1087        1:? 2:explanatory    1
     1088        1:? 2:explanatory    1

=== Evaluation on test set ===
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Table 10. Weka predictions for the entire JPSM based on unclassified data (', ?'). Predicting the previously identified explanatory paper (instance #4 from Table 9) as design.

Similar to the prediction outcome of the JPSM, the rest of predictions in the JSCM are classified as explanatory by WEKA. To further reinforce the external validity of the AI's results, 20 explanatory and 20 design papers identified by the predictive algorithm of WEKA have been manually checked to identify whether the software was correct in classifying the papers. After the manual analysis of the 40 papers, it was clear that WEKA has been correctly classifying the explanatory and design papers.

While the output of DSR publications increased in certain years, such as 2020, the output of traditional science paradigms increased as well, which taken together with the prediction outcomes of WEKA in the JPSM and JSCM, can provide support for *Hypothesis 2*. Additionally, Wynstra, Suurmond, and Nullmeier (2019) discovered that the output of PSM publications between 2010 and 2014 tripled, at 1030 publications, when compared to 1995-1999 that only generated 334 publications.[467]

6.2 Relation to the theory: DSR falls behind in the knowledge creation paradigm

The percentage of DSR publications identified in this research study is represented by 3.71% DSR papers in the JPSM, and 2.94% DSR papers in the JSCM, and shows that 96.29% of publications are based on a traditional form of knowledge creation in the JPSM, and 97.06% of publications are limited to a traditional way of producing knowledge in the

[467] See Wynstra, Suurmond, and Nullmeier (2019), p. 6.

JSCM. Furthermore, this ratio of prescriptive and traditional knowledge creation was also identified in the academic literature, which was described in *Chapter 2.4.2*.

For instance, in the field of IS, Peffers et al. (2007) identified that the dominant research paradigm used to produce and publish academic research for the well-known journals continues to be the descriptive research.[468] In addition, over the past few years, the prescriptive knowledge creation paradigms began to be accepted into the IS environment, but the overall research output was mainly explanatory.[469] Therefore, the outcome of this research regarding the DSR purchasing publications identified in the JPSM and JSCM proves to be similar to what Peffers et al. (2007) identified in the discipline of IS, meaning that more DSR publications emerged throughout the years, but the dominant knowledge creation paradigm continues to be descriptive.

Similarly, Walls, Widmeyer, and El Sawy (2004) noticed that even if more researchers were able to bring DSR into the light of the IS discipline over the last few years, few DSR papers have been published when compared to descriptive publications.[470] Furthermore, Peffers et al. (2007) believe that what stops DSR from growing as a paradigm of knowledge creation is a conceptual model that could guide researchers to successfully carry out DSR publications, together with a template used by readers and reviewers when evaluating DSR papers.[471] However, Gregor and Hevner (2013) created such a model for DSR guidance.[472] Additionally, this conceptual model created by Gregor and Hevner (2013) could explain the recent increase of DSR publications identified in the JPSM and JSCM.

In the field of Management, Aken (2004) realised through his research that more prescriptive knowledge should be created next to explanatory sciences paradigms.[473] This is because both paradigms can contribute to the enrichment of the Management academic literature, by benefiting both researchers and practitioners.[474] On top of that, Aken (2004) affirms that an increasing interest in the research of Management, which is driven by prescriptions, could guide towards an integrated theoretical framework that is correlated with an active stream of empirical research, and provides distinct views on organizations.[475]

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[468] See Peffers et al. (2007), p. 85.
[469] See Peffers et al. (2007), p. 84.
[470] See Walls, Widmeyer, and El Sawy (2004), p. 45.
[471] See Peffers et al. (2007), p. 90.
[472] See Gregor and Hevner (2013), p. 338.
[473] See Aken (2004), p. 239.
[474] See Aken (2004), p. 240.
[475] See Aken (2004), p. 242.

Finally, the work of Bäckstrand et al. (2019) presents a different evolution of the PSM field through various PPMs identified in the academic literature throughout the years.[476] Based on their analysis, it was possible to have a first glance in the development of PPM artifacts over the years. Besides, their work provided insight to this research study considering multiple DSR publications identified in the evolution of PPMs throughout the years. Although the design-oriented PPMs identified by Bäckstrand et al. (2019) appeared to be more numerous before the 2000s, these were collected from multiple academic journals that go beyond JPSM and JSCM.[477] Eventually, the authors managed to identify 70 PPMs through sampling a bibliographic database consisting of 2,472 PSM publications, yielding a total of 2.83% PPMs identified, which comes close to the outcome of this research study when thinking of the number of DSR publications identified in the JPSM and JSCM, that consists of models as well, and can be compared to the left percentage of traditional knowledge creation publications.[478] Finally, because the PPMs that were design-oriented appeared to be more numerous before the 2000s, together with the fact that out of 2,472 PSM publications only 2.83% of such publications consisted of PPMs, which were not necessarily design-oriented, the conclusion that the field of PSM becomes less DSR-oriented and more oriented towards traditional science paradigms can be drown from the research of Bäckstrand et al. (2019), which is consistent with the *Hypothesis 2* of this research.[479]

6.3 AI in the finding process

6.3.1 Human brain simulated by machines: effectiveness of AI

Apart from being intelligent, human beings are also emotional, and therefore emotion should be considered when trying to simulate how people will react under certain situations.[480] Furthermore, emotions play a major role in the decision-making process of humans, so these must be embedded in the reasoning process when trying to shape human reactions, particularly when such reactions may affect the behaviour of other people.[481]

In recent years, distributed AI techniques have been evolved towards multi-agents systems, in which each agent is an intelligent system that solves specific problems.[482] Moreover, agents in the system work together, communicate, and negotiate among them, to reach common

[476] See Bäckstrand et al. (2019), p. 1.
[477] See Bäckstrand et al. (2019), p. 2.
[478] See Bäckstrand et al. (2019), p. 2.
[479] See Bäckstrand et al. (2019), p. 9-10.
[480] See Martinez-Miranda and Aldea (2005), p. 323.
[481] See Martinez-Miranda and Aldea (2005), p. 324.
[482] See Martinez-Miranda and Aldea (2005), p. 324.

goals.[483] Currently, multi-agents systems shape a multi-disciplinary approach where social science, psychology and cognitive science theories are implemented in a multi-agent environment, and are used to simulate the human mind to analyse collective behaviour in macro-societies and micro-societies.[484]

Lee et al. (2017) identify AI as an intelligence system that is meant to simulate the human brain processes.[485] With quick developments in the discipline of computer science, AI has recently been applied to many areas by large IT companies.[486] The defeat of a human Go champion by Google DeepMind AlphaGo surprised the public worldwide and demonstrated that AI may even be superior to the human brain in some decision-making processes.[487]

Even though AI can be effective in certain areas, such as in the decision-making processes, intelligent systems and machines still lack in many fields. For example, with the rapidly advancing field and the commercial drive to integrate AI algorithms into clinical practice as soon as possible, the current evidence base for effectiveness of AI interventions is still weak.[488] At the same time, Cresswell et al. (2020) state that the of effectiveness of data-driven artificial intelligence to support decision-making in health and social care settings is currently limited.[489] In a different discipline, Mokhtari, Yen, and Liu (2021) conclude that AI yields a median performance when predicting stock markets, implying that with the current technology of AI, it is too early to claim that AI can be more effective than humans in analysing and predicting stock markets.[490]

When it comes to this research study, AI proved to be effective in analysing and predicting DSR publications in both journals. However, this does not mean that AI was not flawless, since it classified a design publication in the JSCM as being explanatory first, and then it predicted to be a design-based publication when analysing the entire JSCM journal. Apart from that instance, the performance of AI in supporting this research was quite high.

6.3.2 Time and effort benefits of AI go beyond identifying DSR publications

At the beginning of this study, the first method used to analyse and identify DSR publications in the JPSM was through the manual coding of every single publication.

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[483] See Martinez-Miranda and Aldea (2005), p. 324.
[484] See Martinez-Miranda and Aldea (2005), p. 325.
[485] See Lee et al. (2017), p. 277.
[486] See Lee et al. (2017), p. 277.
[487] See Lee et al. (2017), p. 277.
[488] See Charalambides et al. (2021), p. 381.
[489] See Cresswell et al. (2020), p. 2183.
[490] See Mokhtari, Yen, and Liu (2021), p. 1.

However, as the manual coding of 100 publications in the JPSM with the purpose of identifying DSR publications proved to be inefficient and time-consuming, other methods have been developed. One of the most efficient methods in analysing the 1897 publications was through AI. Here, the only time-consuming task was to prepare the data necessary to be ran by the WEKA algorithm. In contrast to coding papers manually, the preparation of such datasets (i.e. the entire JPSM or JSCM) took half of the time needed to code 100 papers. Once prepared, the process of loading the dataset into the WEKA Explorer and the choice of classifier used in identifying DSR publications took few minutes. Furthermore, the time needed for AI to analyse 809, and 1088 publications respectively, was a matter of seconds after pressing the 'Start' button, and the entire process of identifying DSR publications through the WEKA software was effortless.

In addition to being efficient in classifying DSR publications, AI proves to save time and effort in multiple disciplines. For example, to classify images in medical imaging, there are several requirements such as suitable machine learning algorithms, support vector machines, conditional random fields, and random forests.[491] Furthermore, such ML methods were effective previously, but often required years of software development, and faced challenges of developing accurate extraction methods, together with selecting appropriate ML algorithms.[492] However, recent advances in AI have replaced previous engineering with a more time-efficient process of ML from large sets of labelled training data using neural networks with many layers, which is the process known as deep learning that was described in previous chapters.[493]

Another example from medicine shows that AI is expected to extract important information from the electronic footprint of patients, which will be viewed as a process that can save time and improve efficiency, and following adequate testing, it will also directly guide patient management.[494]

According to a novel review performed by Bullock et al. (2020) regarding the use of AI applications against COVID-19, studies have shown that AI can be as accurate as humans, can save important time of radiologists, and perform a diagnosis quicker and cheaper than with standard COVID-19 tests.[495] On the other side, in the banking and financing industry,

[491] See Langlotz et al. (2019), p. 781.
[492] See Langlotz et al. (2019), p. 781.
[493] See Langlotz et al. (2019), p. 781.
[494] See Buch, Ahmed, and Maruthappu (2018), p. 143.
[495] See Bullock et al. (2020), p. 807; Naudé (2020), p. 1.

chat bots operated using AI have proved themselves as an efficient technique for customer service.[496] On top of that, they appear to be an important resource for organizations since AI-operating chat bots are found to save time and money for the companies that use them.[497] Similarly, the agriculture domain will face many innovations through AI in the near future due to regional requirements and diverse climatic conditions.[498] For instance, AI enabled machines are going to revolutionize the farm sector through the use of autonomous tractors for performing multiple tasks which not only saves time but also money and effort in terms of labour.[499] Additionally, such self-driving tractors are enabled with computer programs to independently perform harvesting, weed control operations, and decide the speed without any interrupting obstacles such as objects, humans and animals, while performing different tasks.[500]

Finally, in education, studies demonstrate that the applications of AI can perform assessments and evaluations at very high accuracy and efficiency levels, thus saving valuable time and effort.[501] However, due to the need to calibrate and train the systems through supervised ML, they are more applicable to courses or programs with large numbers of students.[502]

7. Discussion

7.1 Theory: continuous small-scale DSR

The main goal of this research was to analyse and demonstrate the evolution of DSR throughout the years in the JPSM and JSCM. Furthermore, reaching the goal was made possible by using diverse methods of analysis such as manual coding in ATLAS.ti, filtering publications based on specific design-oriented keywords in Microsoft Excel, validating the identified potential DSR publications found in the spreadsheets with other three researchers, and eventually validating the DSR papers agreed upon using the support of AI through WEKA, together with predicting the entire JPSM and JSCM by benefiting from the capabilities of ML and data mining.

[496] See Malali and Gopalakrishnan (2020), p. 56.
[497] See Malali and Gopalakrishnan (2020), p. 56.
[498] See Nawaz et al. (2020), p. 24.
[499] See Nawaz et al. (2020), p. 24.
[500] See Nawaz et al. (2020), p. 24.
[501] See Zawacki-Richter (2019), p. 17.
[502] See Zawacki-Richter (2019), p. 17.

Contrasting the initial belief of this study that DSR has steadily disappeared from the PSM literature throughout the years, the number of DSR publications in the JPSM and JSCM, have in fact increased over the years. While the output of PSM research increased each year in the last two decades, as demonstrated by Wynstra, Suurmond, and Nullmeier (2019), the number of DSR publications somewhat managed to keep up with this increased output.[503] This was also illustrated in *Figure 3* and *Figure 4*, where DSR publications in the JPSM and JSCM have seen an increase in the last two decades. Hence, despite the difficulties associated with the requirements and levels of acceptance of DSR publications at any academic journal, the prescriptive knowledge creation has not disappeared from the PSM literature. Besides, researchers like Aken (2004), Peffers et al. (2007), and March and Smith (1995) noticed the benefits associated with having more DSR publications in the literature of IS and Management. Moreover, Aken (2004) even encourages researchers to generate more prescriptive knowledge in the literature of Management, and states that a more ambitious research outcome would be possible through a partnership between description-driven and prescription-driven research in multiple disciplines.[504]

Since DSR is not disappearing from the academic literature of PSM, this continues to be published at small scales when compared to traditional ways of knowledge creation. Because of researchers like Gregor and Hevner (2013), who provided guidance on how to conduct and review DSR through their designed framework, the prescriptive way of creating knowledge continues to be supported, together with the researchers who participate or desire to begin their journeys in creating DSR publications.[505]

Additionally, if a higher number of researchers would start producing more DSR papers, and the levels of acceptance of DSR publications at well-known research journals would become less strict, the academic research might improve its reach and usability for practitioners, who view prescriptive knowledge as being more interesting than descriptive knowledge for their professions, considering that the existing world has become more artificial than natural.[506] This is also because natural and social sciences are descriptive and explanatory in their intent, whereas DSR generates prescriptions and creates artifacts that embody those prescriptions due to its pragmatic nature, and therefore becomes a more useful knowledge creation

[503] See Wynstra, Suurmond, and Nullmeier (2019), p. 6.
[504] See Aken (2004), p. 242.
[505] See Gregor and Hevner (2013), p. 338.
[506] See Simon (2019), p. 3.

paradigm for practitioners.[507] Besides, the academic literature of PSM, together with professionals in the field of PSM and other fields related to purchasing, can benefit from more DSR publications in the PSM literature that are focused at solving organizational, technological, and social problems, considering the fact that the world is evolving at a fast pace and becomes more complex and challenging every day.[508]

7.2 Practice: Using AI to classify academic review data

As reviewed in *Chapter 6.3.1*, AI can be effective in specific areas, such as in the process of making decisions. However, intelligent systems and machines operated by AI are not perfect, since they still lack in multiple disciplines, as previously described. This can also be associated with the fact that AI is not a mature concept yet, as it is not properly defined by the academic literature, which appears to have difficulties in defining it.[509] While still being a young concept, AI proved to save time and effort through its efficiency in simulating human tasks, both in this research study and in other studies identified in the academic literature. In addition, AI also seems to do well in simulating daily operations at the workplace, such as the chat bots used for simulating customer service support in the banking industry, and the self-driving tractors used in agriculture.

Although it can be hesitating to pick AI as a first choice while deciding to do important tasks (e.g. analyses in research), considering that the concept is still far from being flawless, the outcome of using it may provide additional insight to the user, while the time needed to run an AI-based computer program can involve several minutes. For example, in academic education, AI is already being used to study the data available in the educational field and bring out the hidden knowledge from it, by using ML and data mining.[510] Through multiple classification methods of the AI software, the algorithm can be applied on the educational data for predicting the performance of students in examinations.[511]

While classifying research papers in the JPSM and JSCM, AI produced the same results as manual classification in a much less period of time, excepting the two DSR papers that were misclassified. In addition, the interface of WEKA was user-friendly, allowing for quick and comprehensible data analysis. This is because once launched, the algorithm provided an

[507] See Sik (2015), p. 2142.
[508] See Hevner et al. (2004), p. 78.
[509] See Collins et al. (2021), p. 2.
[510] See Yadav and Pal (2012), p. 51.
[511] See Yadav and Pal (2012), p. 51.

output log with all the necessary information for an in-depth analysis of the journal needed to be classified.

Although the algorithm was firstly trained to classify the papers using supervised learning, unsupervised learning helped later in predicting the category (i.e., either design or explanatory) of each paper, in order to find interesting and useful generalities within the data. Moreover, a further manual analysis of 20 explanatory and 20 design papers identified by WEKA predictive algorithm helped in confirming and reinforcing the external validity of AI's results.

Since AI proved successful in this study, the purpose of this research was to encourage other researchers to use AI in classifying academic review data. Besides, this study provides instructions about how to carry an academic review classification using ML and data mining in WEKA. Hence, journals such as the ones analysed and classified in this study can further be classified by researchers in the academic environment through the usage of AI, while being able to skip over some of the time-consuming steps such as the manual coding of hundreds of publications, and focus the time saved from using an AI-based software on other important tasks in the research.

8. Conclusion, Limitations, and Future Research: which path to choose now?

Starting as a mere operational function, purchasing managed to make its way towards the managerial level of organizations, eventually becoming a strategic role in companies by being able to create sustainable competitive advantage and get aligned with the overall strategies of corporations. Together with purchasing, the ways of providing knowledge to the field have also been developed throughout the years. Initial beliefs about strong DSR paradigms dominating the PSM field, turned the tables in the favour of traditional ways of producing knowledge, through explanatory and descriptive research, proving that abduction was surpassed by deduction and induction.

Having the chance to analyse 1897 publications from two journals (i.e. JPSM and JSCM) provided this research with the opportunity to reach its goals in identifying DSR papers, and in evaluating their development throughout the years, together with further classifications and predictions of publications supported by AI. Given the purpose of this study, a guideline used in classifying academic review data through AI has been created for future researchers willing to explore the realm of AI and apply the "magic" of ML and data mining in their research projects. At the same time, an encouragement movement has been initiated in

describing the importance of DSR publications in the existing world, by motivating authors to opt for prescriptive knowledge creation in the favour of explanatory, descriptive paradigms. Still, the decision remains with researchers regarding which path they choose to follow in producing future knowledge for the PSM field.

Although the benefits associated with using AI in research have been introduced, the purpose of this research was not to demonstrate that machines can do a better work than humans, but rather to show the advantages that can be obtained through using AI, such as the time and effort saved from not doing certain tasks, giving the possibility to switch the attention towards other critical aspects of the research to be conducted. After all, AI was not created with the purpose of outperforming human beings since its goal was just to be a supportive tool for them.[512]

This research comes with limitations too, as the development of DSR in the field of PSM has been analysed based on two journals only. Considering that there are many other journals consisting of PSM research, the conclusion that the number of DSR publications increased in the JPSM and JSCM over the years might not be similar to other possible conclusions drawn from analysing different PSM-related journals, hence providing different insights into the evolution of DSR in the field of purchasing. Another limitation consists in the fact that in the AI analysis through WEKA the only classifier used was 'StringToWordsVector'. For instance, it would have been interesting to compare various classifiers in identifying and predicting DSR publications in the two journals, and to assess their distinct performances.

A final limitation of this study is that apart from the actual and potential DSR papers identified in the JPSM and JSCM, the other papers of the journals have not been analysed and classified accordingly, since the only distinction made was between DSR publications and explanatory publications, in which the other non-DSR publications of both journals were categorised. Considering such limitations, future research might analyse different and multiple PSM-related journals in identifying DSR publications. Furthermore, as this study only focused on analysing DSR and explanatory research, future research might consider analysing other ways of creating knowledge, such as exploratory or confirmatory research. Finally, in the case of an academic literature classification through AI, future research might compare the results of different ML classifiers used in conducting the research.

[512] See Haenlein and Kaplan (2019), p. 7.

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