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## Innovation and Firm Performance: A bibliometric study

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**Abstract:** In response to a rising interest in the connection between innovation and firm performance, this paper researches this link and takes a closer look into the different domains in which the impacts of innovation on firm performance can be observed. The basis for this study is a bibliometric analysis of 3,458 scientific publications. We provide an overview of which indicators researchers used to measure innovativeness and firm performance and what methods they used to establish the link between the two. We identified 28 innovation domains with an influence on firm performance, show the rising interest in the topic and found that most types of innovation have a positive impact on firm performance. Additionally, we conduct a detailed analysis on the domain *Sustainability Strategy* and determine the exact impacts that innovations in this domain have on firm performance.

**Keywords:** innovation; firm performance; bibliometrics; innovation domains; Sustainability; innovativeness; innovation effects; timeline.

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## **1 Introduction and Motivation:**

One of the major influences on firm performance is the ability to develop and implement innovations (Kauffeldt et al. 2012; Hashi and Stojčić 2013). To determine the exact effects of this feature, several broad analyses have been conducted regarding specific domains in which innovation can be linked with firm performance, e.g. outsourcing (Awe et al. 2018), strategic planning (Miller and Cardinal 1994), data privacy (Martin et al. 2017) or green innovations (Bossle et al. 2016).

In reviewed publications which examine the relationship between innovativeness and firm performance, most authors base their research on their own empirical data rather than provide an overview of current research (Gunday et al. 2011; Clercq et al. 2011). Varis and Littunen (2010) study different types of innovation and examine their impact on firm performance, but also use their own empirical data and focus on small and medium enterprises.

An overview of current research on firm performance and innovation is provided by Rosenbusch et al. (2011), but they only concentrate on small and medium enterprises. Bibliometric analyses in this field also do not give an overview of different innovation domains, which we see as a field in which innovations with an influence on firm performance emerge. For example, Marzi et al. (2017) did a bibliometric analysis on process innovation in manufacturing, but did not research different domains and determine their importance.

Even though several analyses have been done regarding different domains of firm performance, such as the ones mentioned above, the research lacks an overview on the domains that influence the relationship between innovativeness and firm performance according to the authors' knowledge. Likewise, there is also no systematic review of the indicators used to determine these domains' positive or negative influence, methods to examine the relationship or samples used to conduct these studies.

Therefore, researchers are neither able to compare different domains in a structured way nor determine their importance, detect gaps in current research or find new methods to conduct their own studies. This complex and unstructured field also makes it difficult to detect trends or new ideas where innovation domains influence a firm's performance.

## **2 Research question:**

In this paper, we systematically identify innovation domains with an influence on a firm's performance. Therefore, we examine the following questions:

- What innovation domains influence firm performance and what are their effects on firm performance?
- Which domains are the focus of research and which are especially important?
- Which indicators are used to measure the influence of innovation on firm performance?
- What methods are used to establish a connection between innovation and firm performance?

### **3 Methodology:**

The paper is based on a bibliometric analysis, a method used to review and evaluate large amounts of literature (Bellis 2009). The method's ability to develop citation networks and provide structured insights in different research fields render it applicable to the analysis of literature on innovation management (Brötz et al. 2018). The first step is to determine a Web of Science search strategy, which is designed to answer this submission's scientific questions.

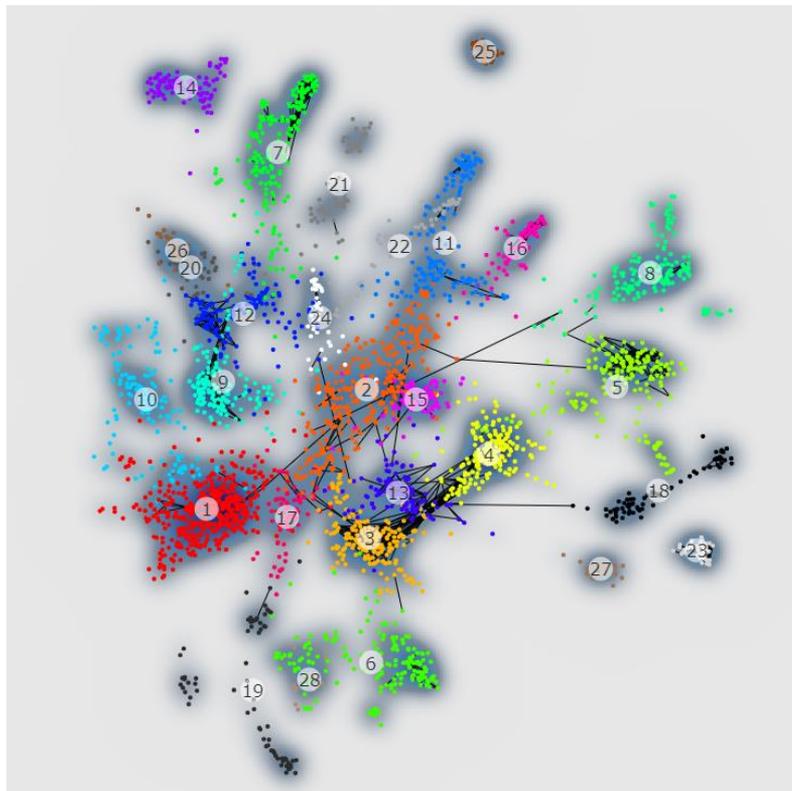
The next step is to calculate research fronts, which are determined by a hybrid similarity measure. Research fronts represent increasing interest in research that is indicated by a growing number of publications on a specific topic (Schiebel 2012). The hybrid similarity measure consists of a lexical measure and bibliographic coupling (Meyer-Brötz et al. 2017).

The clusters are analysed and named based on the corresponding papers. One of the used measures to name the clusters is the term frequency-inverse document frequency (TF-IDF) in the publication's titles and abstracts, which shows the most used terms in relation to the total number of words in a text. Relevant papers are identified through a search in the respective cluster for publications that establish a link between innovation and firm performance in the identified domain.

In our approach, we also include another step of extracting selected papers and performing an additional analysis on them by calculating their network and research fronts. We performed this second step with papers that directly investigate the impacts of innovation on firm performance, indicated by the term "firm performance" in the title, and papers from the domain *Sustainable Strategy*.

#### 4 Findings:

The search terms “innovation” AND “firm performance” resulted in 3,458 articles within a chosen time period of 2000-2019. Date of access was the 15<sup>th</sup> of January 2019. The search included all Web of Science categories. The search strategy was based on the research questions to create a comprehensive overview of innovation domains and firm performance.



**Figure 1:** Research Fronts “Complete Dataset”. Software: Netculator

The calculation of research fronts resulted in 28 distinct research frontiers, each representing a different innovation domain. The domains are listed in descending order of numbers of publications in the respective research fronts; this reflects their importance in the scientific community.

In this context, the research front *business models* was the most important with 416 publications. The papers in this front mostly involve the connection between business models, innovativeness and firm performance. The second most important research front was *firm capabilities* and *innovation* with 301 publications; the most frequent terms in the abstract of the papers’ abstracts involving (TOP-TFIDF) are *knowledge*, *capability*, *absorptive*, *external*, and *technology*. The third most important research front, *market strategy* and *innovation performance*, has TOP-TFIDF terms of *orientation*, *market*,

customer, brand, and npd. Table 1 shows every domain and a relevant paper that examines the connection between the identified domain, innovation and firm performance.

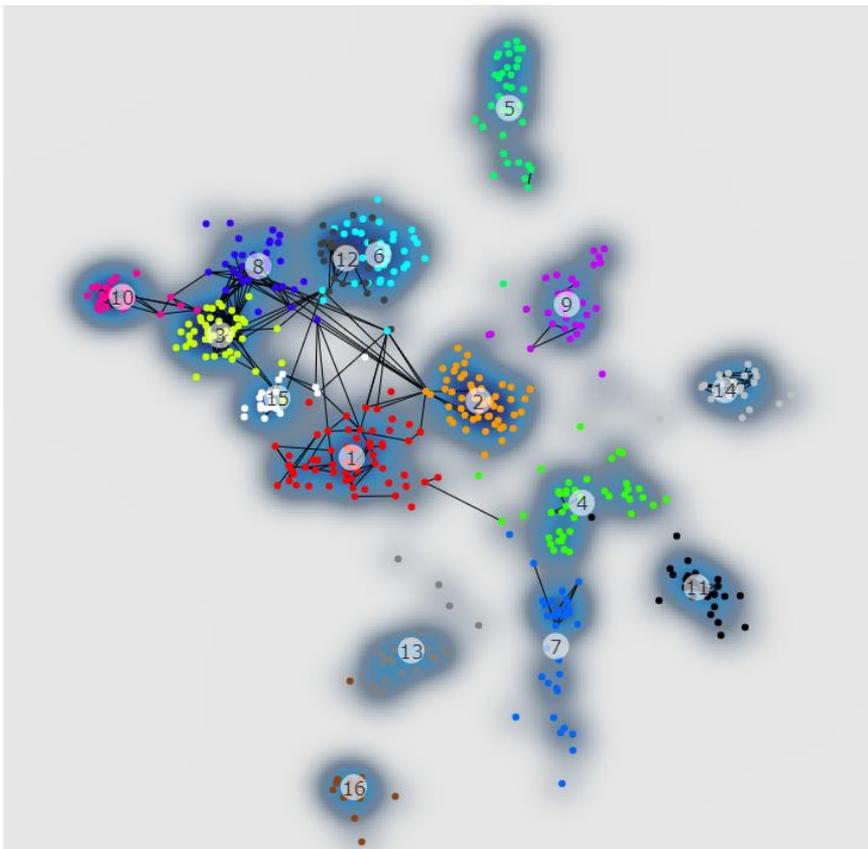
**Table 1** Research Fronts

#	Cluster Name / Domains	Relevant Paper	Publ.
1	Business Models	<i>How business model innovation affects firm performance in the energy storage market (Hamelink and Opdenakker 2019)</i>	416
2	Absorptive Capacity	<i>How collaborative innovation networks affect new product performance: Product innovation capability, process innovation capability, and absorptive capacity (Najafi-Tavani et al. 2018)</i>	301
3	Market Orientation	<i>How market orientation contributes to innovation and market performance: the roles of business analytics and flexible IT infrastructure (Ashrafi and Zare Ravasan 2018)</i>	199
4	Entrepreneurship	<i>Market, entrepreneurial, and technology orientations: impact on innovation and firm performance (Kocak et al. 2017)</i>	198
5	R&D Alliances	<i>Improving firm performance through inter-organizational collaborative innovations: The key mediating role of the employee's job-related attitudes (Hernandez-Espallardo et al. 2018)</i>	195
6	Service	<i>Linking service innovation to firm performance: The roles of ambidextrous innovation and market orientation capability (Tsai and Wang 2017)</i>	176
7	Sustainability Strategy	<i>Eco-innovation measurement: A review of firm performance indicators (García-Granero et al. 2018)</i>	176
8	Human Resources	<i>Organizational climate for innovation and organizational performance: The mediating effect of innovative work behaviour (Shanker et al. 2017)</i>	158
9	Supply Chains	<i>Market orientation, innovation commercialization capability and firm performance relationships: the moderating role of supply chain influence (Lim et al. 2017)</i>	152
10	Diversity and Internationalization	<i>The relationship between business diversification and productivity: considering the impact of process innovation at different corporate life cycles (Chang and Lee 2016)</i>	148
11	Enterprise Networks	<i>Do foreign subsidiaries innovate and perform better in a cluster? A spatial analysis of Japanese subsidiaries in the US (Poon et al. 2013)</i>	141
12	Intellectual Capital	<i>Building small firm performance through intellectual capital development: Exploring innovation as the "black box"(McDowell et al. 2018)</i>	123

13	<i>Organizational Learning</i>	<i>Technological distinctive competencies and organizational learning: Effects on organizational innovation to improve firm performance (Bolívar-Ramos et al. 2012)</i>	108
14	<i>Governance Structures</i>	<i>Female board representation, corporate innovation and firm performance (Chen et al. 2018)</i>	94
15	<i>Ambidexterity</i>	<i>A joint analysis of determinants and performance consequences of ambidexterity (Pertusa-Ortega and Molina-Azorín 2018)</i>	82
16	<i>Open Innovation</i>	<i>How an Open Innovation Strategy for Commercialization Affects the Firm Performance of Korean Healthcare IT SMEs (Kim and Kim 2018)</i>	73
17	<i>Dynamic Capabilities</i>	<i>Dynamic Capabilities, Innovation and Organizational Learning: Interrelations and Impact on Firm Performance (Giniuniene and Jurksiene 2015)</i>	73
18	<i>Team Diversity</i>	<i>Employing an Innovation Strategy in Racially Diverse Workforces: Effects On Firm Performance (Richard et al. 2003)</i>	71
19	<i>Information Technology</i>	<i>The Impact of Dynamic Information Technology Capability and Strategic Agility on Business Model Innovation and Firm Performance on ICT Firms (Djaja and Arief 2015)</i>	71
20	<i>Patents</i>	<i>Patents, real options and firm performance (Bloom and van Reenen 2002)</i>	64
21	<i>Governmental and Political</i>	<i>The Impact of Government Subsidies on Private R&amp;D and Firm Performance: Does Ownership Matter in China's Manufacturing Industry?(Jin et al. 2018)</i>	60
22	<i>Corporate Social Responsibility</i>	<i>The bright and dark side of CSR in export markets: Its impact on innovation and performance (Costa et al. 2015)</i>	55
23	<i>Family Firms</i>	<i>Innovativeness and family-firm performance: The moderating effect of family commitment (Hatak et al. 2016)</i>	45
24	<i>Organizational Culture</i>	<i>Organizational culture, innovation, and performance: A test of Schein's model (Hogan and Coote 2014)</i>	43
25	<i>Organizational Slack</i>	<i>Slack resources, exploratory and exploitative innovation and the performance of small technology-based firms at incubators (Soetanto and Jack 2018)</i>	42
26	<i>Corporate Flexibility</i>	<i>An Empirical Research on the Influence of Strategic Flexibility and Information Synergy on Nuclear Power Affiliated Enterprise's Innovation Performance (Li et al. 2014)</i>	33
27	<i>Leadership</i>	<i>The Influence of Innovation and Transformational Leadership on Organizational Performance (Samad 2012)</i>	31
28	<i>Quality Management</i>	<i>Measuring the impact of soft and hard quality practices on service innovation and organisational performance (Khan and Naeem 2016)</i>	25

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Further, we searched the extracted database for titles of papers using the term “firm performance” to refine the number of papers that only concentrate on the impact of different innovation domains on firm performance. This search resulted in 529 papers which can be divided into 16 research fronts. See Figure 2. This step was necessary because our original search, which used the terms “innovation” and “firm performance”, contained papers that had these two search terms either in title, abstract, author keywords or Web of Science keywords (Web of Science Core Collection Help 2019). Therefore, the papers may not have focused on firm performance, but only mentioned it. By concentrating on papers that have “firm performance” only in their titles, we received only papers that focused on it.



**Figure 2:** Research Fronts "Firm Performance". Software: Netculator

The analysis of the most cited relevant papers in these clusters and the clusters from Table 1 reveal that most researchers found a positive impact of innovation and similar activities on firm performance. However, there were also exceptions to this. For example, Artz et al. (2010) found a negative connection between the number of patents and firm performance in terms of Return on Assets and firm growth. Further, Atalay et al. (2013) found no significant or positive influence of organizational and marketing innovation on firm performance, even though they were able to prove a positive impact of technological innovation on firm performance. Similar results were found by Koellinger (2008), who

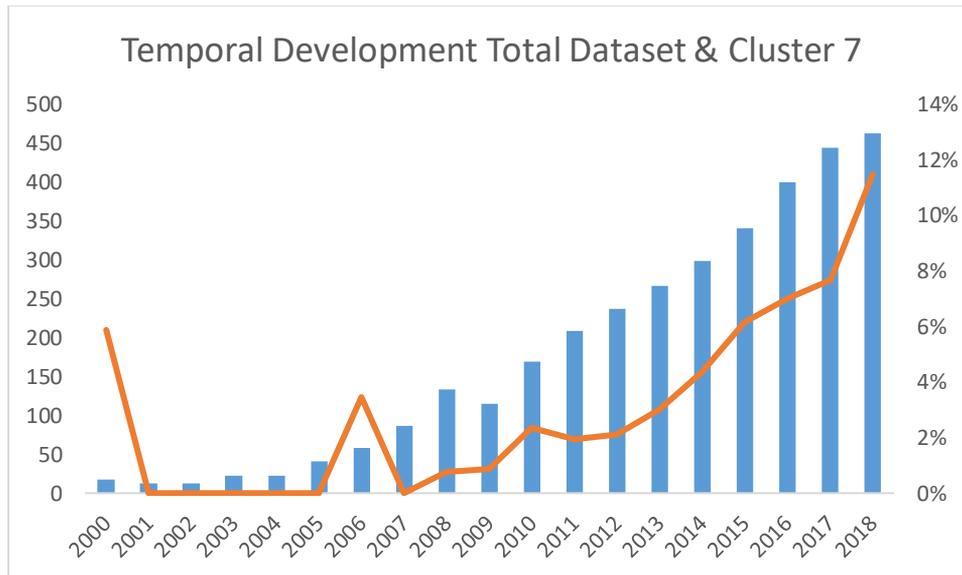
stated that product/service innovations are the only innovations positively associated with firm performance. According to the mentioned sources, innovations of processes do not have a positive relationship with firm performance. Protogerou et al. (2012) showed that dynamic capabilities, the ability of a firm to handle changing environments (Barreto 2010), does not have a direct and significant influence on firm performance, but rather impinges on operational capabilities which in turn positively effect firm performance. In the field of *Sustainable Strategy*, two noteworthy observations were made: Lee and Min (2015) found that while green research and development is positively associated with financial performance, it has a negative relationship with carbon emissions, meaning it contributes to reductions; Doran and Ryan (2016) found that one form of eco innovations, the improved recycling of products after use, reduces a firm's productivity. Another interesting observation was made by Bong Choi and Williams (2013), who examined the influence of innovation and firm performance in China and Korea and discovered that the relationship between these two topics was strongly influenced by the country in which a firm is situated.

Additionally, we also examined the indicators that were used to describe innovation and those that were used to describe firm performance. The latter was often represented by profitability measures, e.g., Return on Equity, Return on Assets or Return on Investment (Cho and Pucik 2005), growth indicators, e.g., sales growth or market share growth (Wang et al. 2015), firm value figures, e.g., Tobins Q (Hung and Chou 2013) and employee-related performance indicators, e.g., value added per employee or sales generated from new products per employee (Belderbos et al. 2004).

To measure innovation activities in a firm, authors also used a wide variety of indicators. For example, R&D activities were used, e.g., R&D ratio (Shin et al. 2009), measured R&D expenses divided by sales, or man power in the R&D department (Sher and Yang 2005), as well as patent-related activities, e.g., the number of granted patents of a firm (Lin and Chang 2015) or patent citations (Bloom and van Reenen 2002). Also, new product performance, seen as new product sales, profitability or market share (Olavarrieta and Friedmann 2008), was used to measure innovation. In addition to these indicators, authors also examined different determinants that were closely related to the innovation domain they examined, e.g., knowledge assets measured as a percentage of technical and professional staff in the workforce, the implementation of target costing (Huang et al. 2012) or external partner collaborations (Chen et al. 2009).

Regression analysis, especially ordinary least square regressions, was mostly used to determine the relationship between innovations and firm performance (e.g. Kalkan et al. 2014; Lee and Min 2015; Hatak et al. 2016).

Because of the rising interest, as displayed in Figure 3, we picked out the domain *Sustainable Strategy* to perform a more precise analysis by tracking the number of papers in the cluster over time as well as identifying sub-domains and determine the effects that innovations in this domain have on firm performance.



**Figure 3:** Temporal Development Sustainable Strategy & Total Dataset

Figure 3 displays the total number of papers in the dataset as bars and the share of papers from the domain *Sustainable Strategy* as the line. Two main conclusions can be drawn from this chart. First, it shows the rising interest of research in the connection between innovation and firm performance as indicated by the number of papers which increased from 17 in 2000 to 462 in 2018. Second, it shows the growing importance of the domain *Sustainable Strategy*. While the associated cluster has a share of 6% in 2000 and 0% from 2001 until 2005, it raised to 11% in 2018.

Further, we examined the publications in this cluster and then divided them into five sub-domains. In **Table 2**, we show all identified sub-domains, including a paper that was identified as relevant for the associated sub-domain and a short overview on the effects on firm performance.

**Table 2:** Sub-Domains Sustainable Strategy

<i>Sub-Domain</i>	<i>Relevant Paper</i>	<i>Observed Effects</i>
<i>Green Product Innovation</i>	<i>Market demand, green product innovation, and firm performance: evidence from Vietnam motorcycle industry (Lin et al. 2013)</i>	<ul style="list-style-type: none"> <li>• <i>Market demand has positive effects on green product innovation and firm performance.</i></li> <li>• <i>Green product innovation performance has positive effects on firm performance.</i></li> </ul>
<i>Green Service Innovation</i>	<i>Enhancing Green Absorptive Capacity, Green Dynamic Capacities and Green Service Innovation to Improve Firm Performance: An Analysis of Structural Equation Modeling (SEM) (Chen et al. 2015)</i>	<ul style="list-style-type: none"> <li>• <i>Green absorptive capacity has positive effects on green dynamic capacities, green service innovation, and firm performance.</i></li> <li>• <i>Green dynamic capacities have positive effects on green service innovation and firm performance.</i></li> <li>• <i>Green service innovation has positive effects on firm performance</i></li> </ul>
<i>Green Supply Chain Innovation</i>	<i>The Influence of Green Supply Chain Integration on Firm Performance: A Contingency and Configuration Perspective (Song et al. 2017)</i>	<ul style="list-style-type: none"> <li>• <i>The interaction between green internal integration and green customer integration has a positive effect on operational and financial performance</i></li> <li>• <i>The interaction between green internal integration and green supplier has a negative effect on financial performance.</i></li> <li>• <i>The interaction between green customer integration and green supplier integration was positively related to financial performance</i></li> </ul>

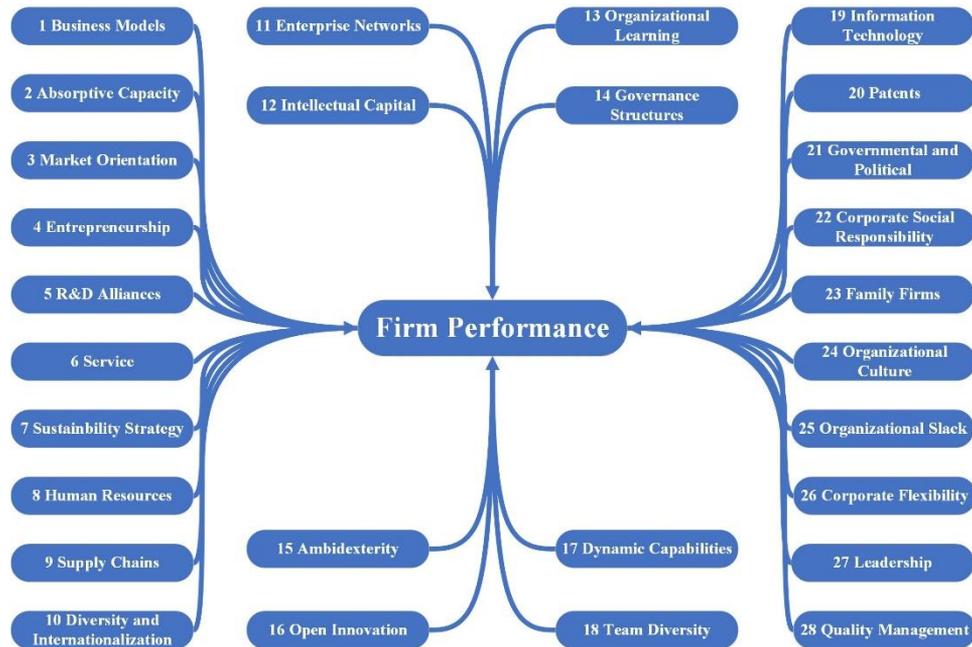
<i>Regulatory-Driven Environmental Innovation</i>	<i>The Impact of Regulation-Driven Environmental Innovation on Innovation Success and Firm Performance (Rennings and Rammer 2011)</i>	<ul style="list-style-type: none"> <li>• <i>Sustainable mobility regulations have positive effects on mobility firms' sales with market novelties</i></li> <li>• <i>Regulations in the field of water management lower sales with market novelties.</i></li> <li>• <i>New processes implemented in order to comply with environmental regulation requirements lead to a lower profitability.</i></li> <li>• <i>Innovations triggered by regulations on recycling and waste management as well as on resource efficiency lead to higher profit margins.</i></li> </ul>
<i>Green R&amp;D Investments</i>	<i>Green R&amp;D for eco-innovation and its impact on carbon emissions and firm performance (Lee and Min 2015)</i>	<ul style="list-style-type: none"> <li>• <i>Green research and development have a negative effect on carbon emissions</i></li> <li>• <i>Green research and development are positively related to financial performance at the firm level</i></li> </ul>

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## 6 Discussion:

The bibliometric analysis structured the vague field of innovation domains of firm performance, as seen in Table 1. We identified 28 domains, based on 28 Research Fronts that came up in a bibliometric analysis, ordered them according to their importance in the scientific community and identified papers that establish connections between the identified domains: innovation and firm performance. We see an innovation domain as a field in which innovations with influence on firm performance emerge. All domains are also displayed in Figure 4. As pointed out in Section 5, most domains have a positive influence on firm performance, only observations related to elements of the domains *Patents* (Artz et al. 2010) and *Sustainable Strategy* (Doran and Ryan 2016) were found to have a negative influence on firm performance. The research was especially focused on *Business model* (416 publications), *Absorptive Capacity* (301) and *Market Orientation* (199). Domains that lack importance in the scientific community are *Corporate Flexibility*, *Leadership* and *Quality Management*. The indicators used to determine the relationship between innovation and firm performance were mostly basic profitability measures, such as Return on Assets or Return on Interest, while indicators to measure innovation were mostly related to process outcomes, patents or employee-based figures. We identified

regression analysis as the main method to examine the relationship between innovation and firm performance.



**Figure 4:** Innovation Domains of Firm Performance. Own representation

## 7 Practical implications & Limitations:

The relationship between innovation and firm performance is widely examined, but research is divided into small niches. Academics have explored the influence of single domains on firm performance but have not given a clear overview of what domains influence firm performance in terms of innovation. In Figure 4, we provided a structured overview showing 28 different innovation domains of firm performance, which is helpful for practitioners in many ways. First, it illustrates which topics are important in terms of innovation and firm performance and shows that, besides a few exceptions, most have a positive influence. With this, managers can now examine their own company and discover which domains are already considered and which ones are not or are unfit for their firm. They can also take the indicators that were used to draw connections and use them to measure their own innovation inputs and outputs.

In academia, the outline can be used as a framework for further research in the precise effects of the different domains of firm performance. We provided a clear list that illustrates the most important topics researched in connection with innovation and firm performance and put them in order according to scientific interest. Additionally, we showed which methods are being used to research the connection between the different domains and firm

performance. Researchers can now either use these methods for their own research or use the list to identify gaps and apply new and innovative methods.

Two main problems can be drawn from the limitations of the dataset. First, the search string resulted in papers that contain the terms “innovation” and “firm performance” in their titles, abstracts or keywords, which does not necessarily mean that they were examining the relationship between these two entities. Further, many papers were about other topics and only loosely related to our research questions. Second, the database is not comprehensive; there are still publications that do not appear in the Web of Science database.

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