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Scenarios in business and management: The current stock and research opportunities

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ABSTRACT

The scenario technique is widely used to cope with uncertainties plan for alternate future situations. The extensive research led to a scattered literature landscape. To organize the field quantitatively, we conduct bibliometric performance analyses and a bibliographic coupling analysis. Results show an increased interest in scenario research since 2009 and clear distinctions between strategic and operational as well as methodological and applied research. Future research can be expected to further enhance the method towards robust decision making and to combine it with methods searching for most likely scenarios, such as prediction markets, crowdsourcing, and superforecasting. Additionally, cognitive and behavioral aspects of using the scenario technique might draw further attention. The scenario technique is expected to be applied across all industries and will probably play an increasing role in currently underrepresented business functions such as marketing and innovation.

1. Introduction

The scenario technique is an established method to cope with uncertainty by exploring multiple alternate future situations for strategic and operational planning purposes (Godet, 2000; Schoemaker, 1993, 1995; Wright & Goodwin, 2009; Tiberius, 2019). The method allows firms to adapt to dynamic environments and to enhance innovativeness (Rohrbeck & Gemünden, 2011; Worthington, Collins, & Hitt, 2009) and firm performance (Phelps, Chan, & Kapsalis, 2001; Rohrbeck & Kum, 2018). Widely used in practice, it has been subject to intense scholarly discussion and application. As a consequence, the literature landscape related to scenarios can be described as extensive and fragmented and is therefore in need of systematic organization.

Our research goal is to systematize the research landscape on scenarios in business and management. To achieve this, we use bibliometric analyses, more specifically, performance analyses and a bibliographic coupling. Focusing on the quantity of citations which are seen as the measure for scientific relevance and impact, bibliometrics objectively analyze publications in a field using statistical methods (Zupic & Čater, 2015). We explore the temporal distribution of scenario publications, paper types, productivity and impact of journals and authors, the most influential articles, and identify research themes to suggest future research opportunities.

Our research contributes to the literature on scenarios by providing a quantitative and objective perspective on published research and therefore mapping the research field. In the remainder of the paper, we explain which bibliometric analyses we conducted, present their results, highlight key interpretations, and provide future avenues for scenario research.

2. Methodology

2.1. Data collection and dataset

We collected our dataset of scholarly publications on scenarios from the *Web of Science* (*WoS*), which is considered as a comprehensive database of social science literature (Norris & Oppenheim, 2007) and has recently been used for bibliometric analyses (Castillo-Vergara, Alvarez-Marin, & Placencio-Hidalgo, 2018; Gaviria-Marin, Merigó, & Baier-Fuentes, 2019; Kruggel, Tiberius, & Fabro, 2020; Mulet-Forteza, Genovart-Balaguer, Mauleon-Mendez, & Merigó, 2019; Vallaster, Kraus, Lindahl, & Nielsen, 2019). We searched for publications with "scenario*" in the title. The asterisk allows for a simultaneous search for all terms starting with "scenario" such as scenario analysis, management, method, planning, and technique. Exclusively searching in the title, we ensure that the found publications deal with scenarios as the core topic (Kücher & Feldbauer-Durstmüller, 2019). The search was conducted on 18 January 2020 and resulted in 712 articles.

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2.2. Bibliometric methods

Noyons, Moed, and Luwel (1999) distinguish between performance analyses and science mappings as two distinct approaches in bibliometrics. Performance analyses measure scholarly productivity by publication number and scientific impact by citation numbers. In particular, our performance analyses comprise a temporal analysis of scenario-related research and the paper types, the productivity and impact of journals and authors, and the impact of the most relevant articles. Assuming a lifecycle of research, the temporal analysis allows for an assessment of the relevance of scenario research over time. For the analysis of the articles by type, we read all abstracts, and in case they were not informative, the articles, to identify whether a publication addresses methodological issues or develops specific scenarios in a practical field. The analysis of the productivity and impact of journals and authors and the impact of articles help to find the most relevant research.

For the performance analyses, we narrowed the dataset using the following restrictions. First, we limited the dataset to publications which belong to the categories "business" and "management". Second, we only included articles published in scholarly journals rather than books, proceedings, etc., because we wanted to include only high-quality research, and only for journals clear criteria, such as journal rankings or impact factors, exist. Third, we applied a quality threshold to the sample (Kraus, Breier, & Dasí-Rodríguez, 2020) such that articles published in journals assigned to the third or fourth quartile (Q3/Q4), according to the *Scimago Journal Ranking* (*SJR*), were excluded. We decided to use the *SJR* rather than the *Journal Citation Reports* (*JCR*) because the former includes more journals and the evaluation period was three years rather than two. Fourth, we only included research that was published before the end of 2019 because the temporal analysis would not have been representative for 2020. Fifth, we screened the abstracts of all remaining papers and excluded those which, despite the prior filtering, did not deal with scenario technique in business or management. As a result, the dataset was reduced to 407 articles.

Science mapping techniques cluster a research field based on the idea that strong links between citing and cited articles suggest that they deal with similar topics (Zupic & Čater, 2015). More specifically, we conducted a bibliographic coupling analysis, for which we used *VOS-Viewer* version 1.6.15, to visually map bibliometric data (Waltman, van Eck, & Noyons, 2010). Whereas co-citation analysis looks at an article which cites two older articles (Small, 1973), bibliometric coupling, reversely, looks at connections between two younger publications that jointly cite an older publication (Kessler, 1963). Therefore, this method better suits our interest in the more recent rather than historical structure of the scenario research field. To focus on the most relevant research and to reach a manageable number of cited references, which allows clear conclusions, we set the citations threshold to a minimum of ten. As a consequence, the former list of 407 documents was reduced to 233, of which 209 were connected.

3. Results

3.1. Performance analyses

Fig. 1 depicts the volatile development of the number of publications on scenarios. Whereas before 2008 many years produced four to six publications, with several interim peaks, a clear increase can be detected after 2009. The peak so far was in 2015 with 36 publications. Since then the productivity dropped, but is still on a pre-2009 level.

More specifically, we find 205 publications dedicated to methodological issues and 202 publications applying the scenario technique. Therefore, the research on scenarios is almost equally divided. A time analysis of the distribution between the two article types does not provide a clear picture (Fig. 2).

Fig. 3 lists the journals with the most published articles on scenarios in business and management, with at least three papers. It has to be noted again that we limited our performance analysis to the *WoS* categories "business" and "management" and to the first and second quartile in the *SJR*. As a consequence, several journals, which are very productive in scenario research, were excluded due to its different categorization or multidisciplinary orientation. Under this condition, the most productive journal in this field is *Technological Forecasting & Social Change*, which accounted for 159 articles (39 percent). It is followed by the *European Journal of Operational Research* with 49 (12 percent) and *Long Range Planning* with 33 (8 percent). These three journals together comprise 59% of all articles on scenarios. After the *Journal of the*

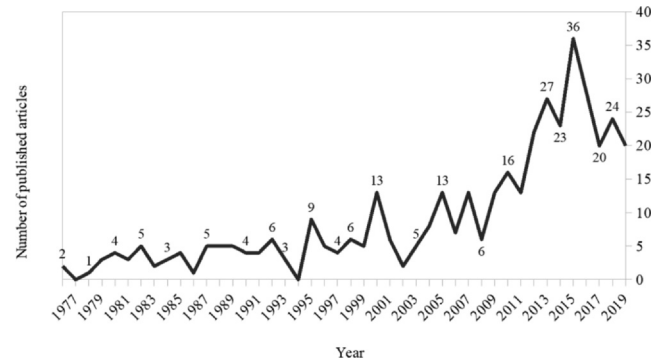

Fig. 1. Annual number of articles. Source: Own Elaboration.

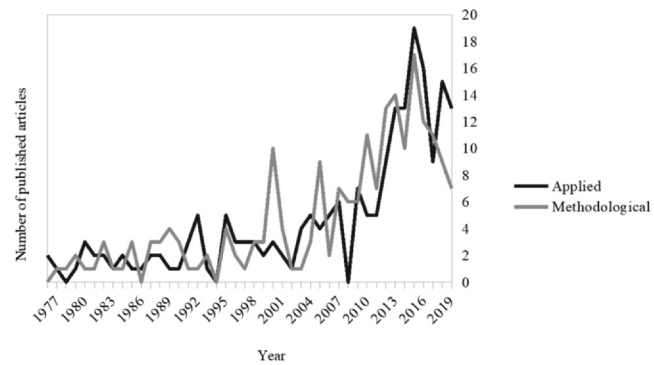

Fig. 2. Annual number of articles by type. Source: Own Elaboration.

Fig. 3. Most productive journals by published articles. Source: Own Elaboration.

Fig. 4. Most cited journals. Source: Own Elaboration.

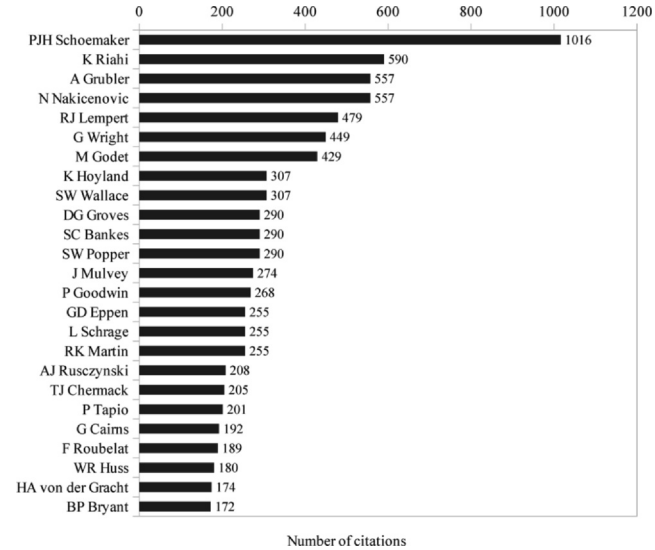

Fig. 6. Most cited authors. Source: Own Elaboration.

Operational Research Society with 13 articles (3 percent), all other journals have published a single-digit number of articles (2 percent or less).

Fig. 4 lists the journals with the highest impact, measured by the number of citations they received on articles on scenarios. The three most productive journals also have the highest impact with quite similar average numbers of citations per article. These are 29.5 for *Technological Forecasting & Social Change*, 27.3 for *European Journal of Operational Research*, and 26.7 for *Long Range Planning*. In comparison, scenario papers in the fourth most productive journal, the *Journal of the Operational Research Society*, were cited 7.2 times on average.

Fig. 5 lists the 25 authors with the most published articles. Without the filtering of our dataset to journals that are assigned to the *WoS* categories business and management and to *SJR* Q1/Q2, the list would show higher productivities and have a somewhat different order. According to this, George Wright is the most productive author and has published 12 articles thus far. His articles examine a broad range of aspects as they focus on the epistemological foundations (Cairns, Wright, & Fairbrother, 2016; Derbyshire & Wright, 2017), the enhancement of the scenario methodology (Cairns et al., 2016; Derbyshire & Wright, 2014; Wright & Goodwin, 2009; Wright, Bradfield, & Cairns, 2013), establishing a relationship of scenarios with other foresight

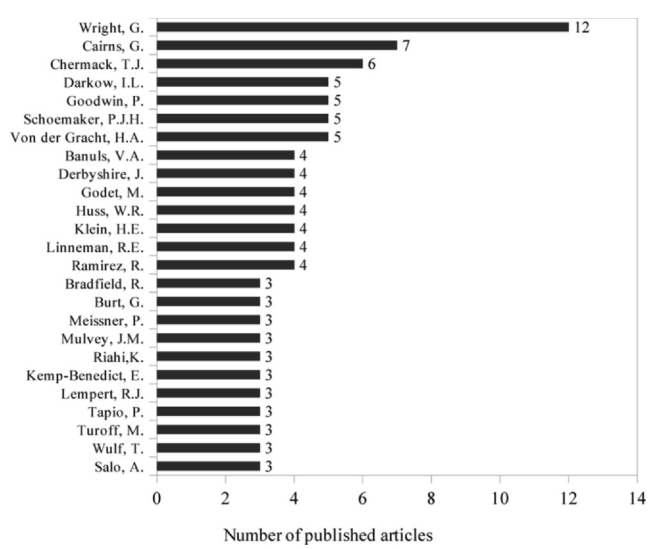

Fig. 5. Most productive authors by published articles. Source: Own Elaboration.

techniques or the strategy process (Goodwin & Wright, 2002; Rowe, Wright, & Derbyshire, 2017), and practical context factors of using the scenario method (Cairns, Ahmed, Mullett, & Wright, 2013; Cairns et al., 2016). George Cairns is the second most productive scenario scholar. All of his scenario-related articles in our dataset were co-authored with George Wright. Therefore, they have similar research profiles. Thomas J. Chermack, the third most productive author, also addresses the foundations of scenario planning (Chermack, 2005) and enhancements of the scenario process by using scenarios (Bodwell & Chermack, 2010), but has a stronger focus on organizational and individual side-effects of the scenario technique (Chermack & Nimon, 2008; Chermack, van der Merwe, & Lynham, 2007; Chermack, Coons, Nimon, Bradley, & Glick, 2015; Chermack, Coons, O'barr, & Khatami, 2017; Haeffner, Leone, Coons, & Chermack, 2012).

Fig. 6 shows the scholars with the highest citations. Paul J. H. Schoemaker is the scenario author with the highest citation number, 1,016. He is both highly productive and impactful in decision sciences and strategic management. His two seminal articles on scenario planning (Schoemaker, 1993, 1995) are the second and fourth most cited of his complete publication list. The energy and climate change scholar Keywan Riahi became second-most cited author with mainly one highly-cited article on greenhouse gas emission scenarios (Riahi, Grübler, & Nakicenovic, 2007), an applied paper. His two co-authors follow on the third and fourth place with that paper as their only scenario-relating article. George Wright, the most productive scenario author, is the fifth most-cited author.

Table 1 lists the 20 articles with the highest average annual citations. The ranking by average citations ensures that older publications are not privileged over younger ones. Several ranks are split by two articles because they have the same number of average citations. In the following, we briefly summarize the first ten articles which have more than 10 citations per year on average. The already mentioned applied paper, by Riahi et al. (2007), ranks first place with 42.8 annual citations on average. In second place, Lempert, Groves, Popper, and Bankes (2006) paper follows, with 20.7 citations per year. The paper suggests a method for robust decision making. The method helps to identify possible robust strategies for sets of possible future states and assesses possible hedging against failures. Schoemaker (1995) seminal paper on scenario planning reaches the third place with 20.1 citations per year. He addresses cognitive biases in decision making, such as overconfidence and tunnel vision, and provides scenario planning as a strategic tool to face these cognitive shortcomings. The author provides a step-by-step guideline on how to generate scenarios, and illustrates

Table 1
Most cited articles. Source: Own Elaboration.

R	Title, Author, Year	C	C/y
1	Scenarios of long-term socio-economic and environmental development under climate stabilization, K Riahi, A Grübler, N Nakicenovic, 2007	557	42.8
2	A general, analytic method for generating robust strategies and narrative scenarios, RJ Lempert et al., 2006	290	20.7
3	Scenario planning – A tool for strategic thinking, PJH Schoemaker, 1995	503	20.1
4	Thinking inside the box: A participatory, computer-assisted approach to scenario discovery, BP Bryant, RJ Lempert, 2010	172	17.2
5	Generating scenario trees for multistage decision problems, K Høyland, SW Wallace, 2001	307	16.2
6	Sustainable energy futures: Methodological challenges in combining scenarios and participatory multi-criteria analysis, K Kowalski et al., 2009	166	15.1
7	Combining participative backcasting and exploratory scenario development: Experiences from the SCENES project, K Kok et al., 2011	111	12.3
8	Multiple scenario development - Its conceptual and behavioral foundation, PJH Schoemaker, 1993	313	11.6
9	How to improve scenario analysis as a strategic management tool?, TJBM Postma, F Liebl, 2005	164	10.9
10	Scenario-based planning for partially dynamic vehicle routing with stochastic customers, RW Bent, P Van Hentenryck, 2004	164	10.3
11	Long-term energy scenarios: Bridging the gap between socioeconomic storylines and energy modeling, Fortes, Alvarenga, Seixas, & Rodrigues, 2015	50	10.0
12	The art of scenarios and strategic planning: Tools and pitfalls, M Godet, 2000	194	9.7
12	A scenario-based stochastic model for supplier selection in global context with multiple buyers, currency fluctuation uncertainties, and price discounts, Hammami, Temponi, & Frein, 2014	58	9.7
13	Decision making and planning under low levels of predictability: Enhancing the scenario method, G Wright, P Goodwin , 2009	101	9.2
13	Water demands for electricity generation in the US: Modeling different scenarios for the water-energy nexus, Liu et al., 2015	46	9.2
14	Does the intuitive logics method - and its recent enhancements - produce effective scenarios?, G Wright, R Bradfield, G Cairns, 2013	64	9.1
15	Heading towards a multimodal city of the future? Multi-stakeholder scenarios for urban mobility, Spickermann, Grienitz, & Heiko, 2014	52	8.7
16	Scenario building: Uses and abuses, P Durance and Godet, 2010	84	8.4
17	A new scenario decomposition method for large-scale stochastic optimization, JM Mulvey, AJ Ruszczynski, 1995	208	8.3
18	A scenario approach to capacity planning, GD Eppen, Martin, & Schrage, 1989	255	8.2
19	Dynamic scenario discovery under deep uncertainty: The future of copper, JH Kwakkel, WL Auping, E Pruyt, 2013	56	8.0
20	The vignette in a scenario-based role-playing experiment, Rungtusanatham, Wallin, & Eckerd, 2011	71	7.9
20	Scenario-based supply chain network risk modeling, W Klibi, A Martel, 2012	63	7.9

R: Rank, C: citations, C/y: average citations per year.

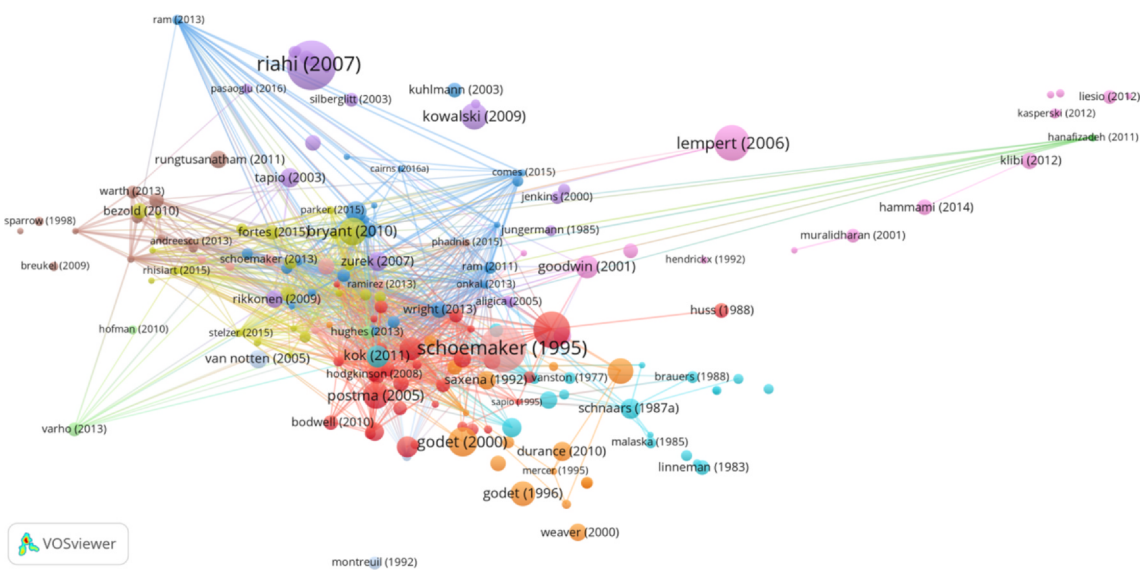

Fig. 7. Bibliographic coupling map. Source: Own Elaboration.

this with examples. In fourth place follows Bryant and Lempert (2010), which was cited 17.2 times per year on average. The authors address the problem that the diversity of stakeholders' interests and values can complicate the scenario generation process. They introduce a scenario discovery method which is participatory but also computer-based, using statistical or data-mining algorithms. Høyland and Wallace (2001), in their fifth placed paper with 16.2 citations on average per year, address the challenge of adequately representing uncertainties in a quantitative way. As a solution, they introduce a non-linear programming method, a scenario tree over several periods, which generates a manageable number of outcomes that can be used statistically. The sixth most-cited paper on an annual basis with 15.1 citations per year, is by Kowalski, Stagl, Madlener, and Omann (2009). The authors argue for a combination of the scenario technique with participatory multi-criteria analysis (Martinez, de Castro-Pardo, Pérez-Rodríguez, & Martín, 2019). The simultaneous application of both methodologies is considered to be resource intense but it allows for a participatory and robust decision-making process. Kok, van Vliet, Barlund, Dubel, and Sendzimir (2011) account for the seventh place, with 12.3 citations on average. Their paper applies the scenario technique to generate scenarios about Europe's fresh water future. However, it can also be considered as a methodological paper as it combines the scenario development process with participatory backcasting in order to identify obstacles and opportunities regarding the previously formulated narrative scenarios. In eighth place follows Schoemaker (1993) paper in which he describes the scenario technique as an innovative tool in strategic management, with its intellectual foundations. He discusses the benefits and obstacles including cognitive biases of using the scenario method in organizations. The author conducts experiments to test the effect of scenario planning on confidence and beliefs. Postma and Liebl (2005) who account for the ninth place with 10.9 citations per year on average, address methodological shortcomings of the scenario technique which

stem from contradictory, paradoxical, and overlooked trends. They provide several recommendations to improve the scenario process. Tenth place, with 10.3 annual citations, is taken by Bent and van Hentenryck (2004). The paper applies a multiple scenario approach to solve the multiple vehicle problem with time windows.

3.2. Bibliographic coupling

The bibliographic coupling analysis led to thirteen research clusters (Fig. 7). As the clusters are based on the strength of the links between two younger publications that jointly cite an older publication, there are no precise categories that only contain articles of a clearly defined topic. For two clusters, we did not find a common thread. The other clusters can be described as follows.

Exploring the future: This cluster contains 20 articles which mainly address the purpose of scenarios. Compared to the other clusters, the articles are older and deal with the origin and evolution of the scenario technique (Zentner, 1982), its relationship to forecasting (Van der Heijden, 2000), how to develop multiple scenarios (Schnaars, 1987), and how to use them in strategic management (Malaska, 1985) and turn them into opportunities (Gausemeier et al., 1998).

Strategy development: This cluster comprising 22 articles covers the use of the scenario technique in the strategy process. Scenarios can support strategy development (O'Brien & Meadows, 2013) and the evaluation of strategic options (Ram, Montibeller, & Morton, 2011), especially under low predictability (Wright & Goodwin, 2009) and uncertainty (Kwakkel, Auping, & Pruyt, 2013). The role of stakeholder interests in the scenario and strategy development process is also addressed (Cairns et al., 2013, 2016; Trutnevyte, Stauffacher, & Scholz, 2012).

Strategic radar for risk mitigation: This rather small cluster, more specifically than the prior one, covers the use of the scenario technique as an early warning system that increases managerial attention (Ramirez, Osterman, & Gronquist, 2013) and strategic thinking and helps to identify weak signals (Schoemaker, Day, & Snyder, 2013). The general purpose is to mitigate strategic risks and to increase innovativeness (Worthington et al., 2009).

Scenario technique in practice: Most of the 17 articles in this cluster take a pragmatic look at scenarios by addressing ways to simplify the method (Mercer, 1995), heuristics (Schoemaker, 1991), tools and pitfalls (Godet, 2000), and uses and abuses (Durance & Godet, 2010). Also specific firms, such as *Shell* (Jefferson, 2012; Mercer, 1995) and *British Airways* (Moyer, 1996), are referred to.

Cognitive and behavioral aspects of the scenario technique: The largest cluster, with 33 articles, addresses diverse aspects of scenarios. An identifiable common thread focuses on the human and social aspects of scenario processes. For example, articles deal with the impact of the scenario development on fostering strategic thinking (Millett, 1988), on cognitive biases and decision quality (Meissner & Wulf, 2013), on decision-making style (Chermack & Nimon, 2008), and on perceptions of organizational learning (Haeffner et al., 2012) or of strategic conversation quality (Chermack et al., 2007).

Enhancing and combining the scenario technique with other methods: In this cluster, several of the 21 articles discuss possibilities to refine the scenario technique, for example, by adding an evolutionary process (Saritas & Nugroho, 2012), allowing participation, or the use of computers (Bryant & Lempert, 2010). Scenarios can also be combined with other methods such as bibliometrics (Stelzer, Meyer-Broetz, Schiebel, & Brecht, 2015), the Delphi method (Tseng, Cheng, & Peng, 2009), or road-mapping (Amer, Daim, & Jetter, 2016).

Models and simulations: This cluster consists of 16 articles which are mainly published in operational research journals. Their prevailing topics are models and simulations as ways to generate (operational) scenarios (e.g., Islei, Lockett, & Naude, 1999) and to determine risk probabilities for decision-making (e.g., Klibi & Martel, 2012).

Scenarios for stochastic portfolio optimization: This cluster containing 24 articles also refers to operational research. Scenario planning and stochastic programming models are used to optimize investment portfolios (e.g., Hanafizadeh, Kazazi, & Bolhasani, 2011); Kouwenberg, 2001; Mulvey & Ruszczynski, 1995).

Scenarios for energy and sustainability: This cluster contains 20 articles of which the majority deals with the application of the scenario technique in both interconnected fields of energy and sustainability (Kowalski et al., 2009), or one of them (Silberglitt, Hove, & Shulman, 2003; Turton, 2006).

Scenarios for diverse industries: Similarly, this cluster consisting of 14 articles, mainly covers the application of the scenario technique in specific sectors. However, this cluster is broader and addresses sectors such as health insurance (Gnatzy & Moser, 2012), logistics (Hirschinger, Spickermann, Hartmann, von der Gracht, & Darkow, 2015), or materials production (Von der Gracht & Stillings, 2013).

Scenarios for HR assessment and training: This very small cluster with two articles, which were both published in the same issue of the *International Journal of Selection and Assessment*, addresses the use of (computer simulated) scenarios to assess and train human resources (Funke, 1998; Kleinmann & Strauss, 1998).

4. Discussion

4.1. Performance analyses

The general long-term trend of annual publications shows an increased interest in scenarios in business and management research. Interestingly, the detected increase of publications occurred shortly after the 2007/2008 financial crisis. Even though not many articles specifically deal with this crisis, it can be assumed that the general perception of risks and uncertainty has risen. As a consequence, the scenario technique, designed for coping with uncertainty, might have drawn increased attention. It can be assumed that scenario-related research further gains momentum due to the COVID-19 crisis (Kraus et al., 2020).

The fact that scenario research is almost equally distributed between methodological and applied papers is rather surprising. In comparison, just 9.12 percent of publications on the Delphi technique is methodological (Flostrand, Pitt, & Bridson, 2020). However, it has to be noted that 61.38 percent of all publications belong to healthcare research (Flostrand et al., 2020) where the method is mostly used as a consensus building tool without a forecasting orientation. Business and management papers only account for 7.35 percent of all Delphi publications. Unfortunately, the authors did not specifically report on the distribution between methodological and applied papers for this discipline. A reason for the probably still comparatively low share of applied papers in scenario research could be that scenario planning is predominantly applied by organizations as an antecedent of their idiosyncratic strategy formulation process, which contains proprietary information for their internal use only. In contrast, Delphi studies address rather publicly accessible topics on an industry or technology level.

The list of the most productive journals already shows on its first places that scenarios are mainly discussed and applied in the field of strategic management and strategic/corporate foresight, as well as in the field of operational research. This suggests that scenarios have a strong relation to decision-making irrespective of whether it addresses strategic or operational issues. Interestingly, the *Strategic Management Journal* only published three articles on scenarios and other top-tier strategy, and general management journals hardly cover scenario research recently. These two categories clearly outpace forecasting-related journals, which usually focus on methodologies which try to predict the most probable future rather than explore multiple alternative futures (Rohrbeck & Schwarz, 2013).

The comparison of the productivity and impact of authors shows that both not necessarily go hand in hand. However, as Riahi et al.

(2007) article is probably highly cited not due to its application of the scenario technique, but rather because of its focus on greenhouse gas emissions, it can be considered as an outlier, practically making Wright the second-most cited author. Considering the average citations per year, he would replace Schoemaker as first place because his publications are younger. George Wright's frequent co-author George Cairns and also Thomas J. Chemack, who are the second- and third most productive scenario authors, are, regarding citations, outpaced by other authors such as Michel Godet who wrote a highly-cited seminal paper (Godet, 2000).

Most of the most cited articles are methodological rather than applied articles, which suggest a strong interest in the scenario technique as a methodology. However, as the most cited article is an applied paper, it can be concluded that the scenario technique is also a recognized and generally accepted research method in which other scholars see a high value. Additionally, a closer look at the content of the ten most cited articles reveal that two distinct conceptualizations of scenarios can be distinguished. Generally speaking, strategic management and foresight scholars tend to work with narratives, thus leaning towards a qualitative formulation of scenarios. In contrast, researchers in operational research use a quantitative conceptualization.

4.2. Bibliographic coupling and future research opportunities

The bibliographic coupling analysis provides a differentiated picture of current scenario research, which also allows drawing conclusions for future research opportunities. The foundations and enhancement of the technique and its combination with other methods play an important role. However, a strong conceptual shift we expect to accelerate in research is from risk to uncertainty because of two reasons: First, the determination of the probabilities of individual scenarios might become more and more difficult. Second, with today's computer power, the number of scenarios can potentially tend towards infinite, meaning that all scenarios are treated equally, without an assigned likelihood. As a consequence, a shift from searching for optimal to robust decision-making is appropriate, which does not aim to identify the best option, but the one suitable for many possible future situations (Hall et al., 2012).

In contrast, we also expect a stronger focus on combining the scenario technique with methods which aim to identify the single most probable future. Apart from the Delphi method (Höhne & Tiberius, 2020; Tseng et al., 2009; Tiberius & Hirth, 2019), also prediction markets (Arrow et al., 2008; Tiberius & Rasche, 2011), crowdsourcing (Flostrand, 2017), and superforecasting (Schoemaker & Tetlock, 2016) could increase in relevance in this regard. As these techniques show high forecast accuracies, they can provide a focal scenario, which can be surrounded by alternate scenarios. Another methodological extension would be that scenarios do not only depict what the future might look like, but also theorize about the path that leads to them (Tiberius, 2012).

Apart from mere theoretical considerations, scholars also specifically address the use of scenarios in practice, including its pitfalls and abuses. Scholars also examine cognitive and behavioral aspects which can be observed when the scenario technique is used by (groups of) individuals. We see a potential to address further benefits and side-effects of scenarios in future research (Tiberius, 2019). Especially, scenario-based foresight seems to enhance a firm's dynamic capabilities (Haarhaus & Liening, 2020; Schwarz, Rohrbeck, & Wach, 2019; Semke & Tiberius, 2020), which needs further exploration.

A large section of research is dedicated to the application of the scenario technique to explore possible futures in several sectors. Whereas the energy sector stands out and several other sectors are addressed by individual papers, it can be expected that the scenario technique will be applied in all sectors which are challenged by a high degree of risk or uncertainty.

Besides the sector-specific application of the scenario technique, scholars also have a functional focus. Obviously, the relation between scenarios and strategy is paramount. Operational research applies the scenario technique to optimize production processes. The bibliographic coupling also reveals clearer insights into additional uses in this field. Especially, elaborations on mathematic modelling and simulations can be found, and stochastic, scenario-based portfolio optimization stands out as a specific research field. Similarly, scenarios are used in finance to optimize portfolios. However, the application of scenarios in other business functions or departments seem to be given less attention. For example, the use of scenarios for HR assessment and training represents a research niche. As uncertainty depicts normality for almost all business functions and the thinking in alternatives proves to be beneficial, we see a potential to use scenarios across all functions and departments. Especially in marketing and innovation, scenarios could play an increasing role. In marketing, scenario approaches can help explore new needs and wants of customers and thus new market opportunities (Højland & Rohrbeck, 2018; Verdenhofa, Afanas'jev, Panchuk, Kotelnykova, & Chumak, 2018). In innovation management, the range, number, and quality of ideas and concepts (Lee & Trimi, 2018; Rohrbeck & Gemünden, 2011; Worthington et al., 2009), and thus their agile implementation (Brand, Tiberius, Bican, & Brem, 2019), can be enhanced.

5. Conclusion

We structured the extensive and scattered research field of scenarios in business and management by using bibliometric performance analyses and science mappings. The scenario literature has been growing, especially since 2009, possibly triggered by the preceding financial crisis. Half of the publications are methodological, the other half applies the scenario technique to specific research questions. Whereas the share of methodological papers might decrease over time, we expect an ongoing scholarly discussion. Scholars publish in foresight and strategy or in operational management journals, splitting the research landscapes in two quite distinguishable sections. However, top-tier strategy and general management journals seem to be restrained regarding scenario papers. Scenarios are also not a prevailing topic for forecasting journals. Among the most cited journals, most are methodological, but applied papers with high citations show that the technique is highly accepted in other research fields.

The bibliographic coupling shows what the various aspects scenario researchers have focused on recently. Apart from basic methodological questions, the link to the strategy process is strong. The scenario technique is continuously enhanced and combined with other methods. We expect a stronger shift from risk to uncertainty and therefore from optimization to robust decision-making, but also an increasing focus on the combination with methods which search for the most probable scenario, such as prediction markets, crowdsourcing, and superforecasting. Also cognitive and behavioral aspects of using the scenario technique will probably continue to draw attention. Scenarios are used in many industries such as energy and sustainability. However, as most sectors increase in regards of dynamics and uncertainty, we expect scenarios to be applied almost everywhere. This is also expected regarding business functions. Whereas the scenario technique is well-established in strategy, operations, and finance, other functions are still underrepresented, such as marketing, procurement, and others.

As with all research, our study also comes with several (potential) limitations. First, the data was only collected from the Web of Science. While this database is considered to be comprehensive, it is probably not complete and might contain faulty entries and misspellings. Therefore, future research might also include other databases such as Scopus and/or Google Scholar. Second, our selection criteria and the manual selection of publications could have led to biased results. Future research might consider to be less selective. Third, whereas the clusters derived from the bibliographic coupling are based on citations and therefore objective, their content is somewhat blurry and makes the

identification of common research themes difficult. This process corresponds to a qualitative content analysis and is therefore partly subjective. As a consequence, other researchers might have labeled the identified clusters in a different way. Future research should increase the efforts to employ both quantitative and qualitative methods to grasp the state of scenario research. As bibliometric analyses and literature reviews are only snapshots of previous research, they have to be repeated periodically. Fourth, the Matthew effect has to be kept in mind when interpreting bibliometric analyses (García-Lillo, Úbeda-García, & Marco-Lajara, 2017; Kruggel et al., 2020), as highly cited articles could just be cited due to their high citations in the past or due to citation cartels. As a consequence, some publications would be considered as relevant or qualitative, from a bibliometric point of view, even if they contain little contributions. This also suggests the necessity of qualitative reviews.

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