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Mapping futures studies scholarship from 1968 to present: A bibliometric review of thematic clusters, research trends, and research gaps

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ABSTRACT

This article provides a visual, objective and comprehensive review of the academic activity in futures studies from its origin (*Futures*, Volume 1, 1968) to present. Several bibliometric visualizations of the cumulated 50 years of futures studies scholarship are created to show 1) thematic clusters of research, 2) research intensity, 3) recent research trends, 4) research trajectory by cluster over time, 5) relative clusters' representation within and across journals and 6) research locations. The 6 research clusters identified by the clustering algorithm are renamed *corporate foresight; past & futures; humanity at the limen; environmental futures; post-normality & complexity*, and *technological trends*, according to their underlying themes, and discussed in depth one by one. Several objective observations on the maps' structure uncover the main research gaps in the literature. Based on these observations, the article provides 6 recommendations on how to fill these research gaps to improve the discipline's fragmentation. Based on the visualizations, it can also be observed that the majority of futures studies publications belong to two clusters: *past & futures* and *corporate foresight*, and that the sudden increase in the total number of futures studies articles citations after 2004 is attributable to the corresponding increase in the relative percentage of research activity in one cluster: *corporate foresight*.

1. Introduction

In an essay written in honor of the 40th birthday of the journal *Futures*, Dator (2008) noted that seldom did recent publications in the journal cited previous futures research. He pointed out that recent ideas were largely derivative: pressing issues 40 years before seemed to be the same pressing issues in 2008! This statement was reflective of a significant fragmentation in the field, a problem that has been noted by several authors (Bell, 1997; Kuosa, 2011; Marien, 2002; Son, 2015), and that still affects futures studies today, leading to a lack of widespread knowledge about what other futures researchers and practitioners have done before and are working on in the present, and to a lack of unified research direction and goals. Unfortunately, these are serious potential threats not only to the growth, establishment and recognition of futures studies as an academic field of inquiry, but also to the incremental accumulation of knowledge about the futures and generation of new insightful methods and ideas. Without a common knowledge about previous works on the futures and current research gaps, fragmentation is here to stay: we simply cannot know which areas of research are 'fragmented'.

This is not to say that current futures researchers and practitioners are to blame. On the contrary, as scholars and practitioners work on significantly different issues, ranging from climate change to the weights of history, from cybersecurity to the futures of the

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global economy; and as they use disparate methods, ranging from scenarios in organizations to causal layered analysis, from technology roadmapping to the Delphi, understanding the entire field is a daunting task, and even more so as there are no comprehensive reviews examining past futures scholarly activity, distinguishing futures research areas, and investigating research trends and research gaps.

Therefore, we pressingly need comprehensive information on the past cumulated research in the field so that we can determine what are the research gaps in the futures literature, how to redress them, and how to work together to establish a ground of common knowledge about the futures and, from this, improve further.

Bibliometric mapping offers us the opportunity to intuitively visualize past academic research activity in futures studies, and to infer its current research gaps and fragmentations. Bibliometrics is a field of inquiry concerned with the statistical analysis of written publications, such as books and journal articles (Bibliometrics, 2013). A bibliometric map is a visual representation of bibliometric data. Among the many methods to create bibliometric maps, VoS Viewer has been specifically designed to create visually pleasant and easy-to-interpret maps (Van Eck & Waltman, 2009a, 2009b). In the maps created with VoS viewer, streams of research are depicted and organized in clusters by color. For each cluster, we can visualize the most cited topics. The distance between the clusters is reflective of the research gaps in the literature.

This article uses bibliometric maps created with VoS Viewer to present several objective and comprehensive bird eye visualizations of the scholarly activity in the field of futures studies cumulated over 50 years from its very first publication (*Futures,* Volume 1, 1968) to present. These visualizations allow us to 1) classify futures studies scholarly activities in 6 main streams of research, or clusters; 2) visualize the streams of research that are currently most 'trendy', as well as those that are cooling off; 3) determine which streams of research have the highest number of published articles; 4) trace the development of the streams of research over time and their relative representation within and across journals; 5) visualize the most active research locations, by countries as well as by institutions, and the interrelation between them; and finally and most importantly 6) identify the main research gaps between streams of research and suggest clear ways to overcome them.

It is the aim of this article to provide a clear picture, in its metaphorical as well as literal sense, of where the field of futures studies currently stands, what has been studied before, where it is most fragmented, and what we can do to make it less so. Section 2 reviews previous thematic reviews of futures studies and further discusses the rationale behind the need of a new objective bibliometric review of the field. Section 3 explains the methodology used to create the bibliometric maps. Section 4 discusses the results of the maps, analyzing research clusters one by one, observing research gaps between the clusters, and providing recommendations for future research on how to fill these gaps. Section 5 traces the trajectory of research clusters from 1968 to present, as well as their relative representation within and across journals. Section 6 analyzes the network structure of the main locations (institutions and countries) where futures research is produced.

2. Previous reviews of futures studies scholarship

The study of the futures draws great fascination. Understanding its origin, evolution and thematic concerns has been understandably dealt extensively by many. These several reviews and categorizations, however, take into consideration futures thinking, a general and non-occupational inquiry into the future practiced since the ancient times, as well as futures scholarship, that is, the more recent systematic and rigorous exploration, design and evaluation of alternative, possible, plausible, probable and preferable futures. These works don't focus on the analysis of the recent scholarly activity in futures studies, an academic discipline devoted to this latter more systematic subset of investigations on the future.

Indeed, if we analyze the many reviews and categorizations of futures studies, we can see that the research developments and research gaps of futures studies specifically as an academic discipline are left largely uninvestigated.

Perhaps the most detailed documentation of futures studies influential and pioneering figures, organizations, activities, efforts, and themes is found in Bell (1997). Bell collates all of the streams of intellectual thoughts that have influenced, led to or embodied futures studies since the beginning of the 20th century, including the first works on social trends undertaken by specialists under the Hoover's administration in the 1920s' USA, the communist Russia's five years planning tradition, the establishment of the French journal *Prospective* in the 1950s, the emergence of military futures thinking and the first futures think tanks since the late 1940s (RAND, Hudson Institute), the best-selling books by Alvin Toffler and by The Club of Rome in the 1970s, until the creation of modern futurists' federations and academic journals, among others. Dator (2011) also overviewed the evolution of contemporary futures studies, mentioning the first, most influential and pioneering scholars in the 1950s, as well as the first futures policy activities in Europe in 1940s and 1950s, through the 'space-age' and obsession for cyborgs and flying cars of the 1960s and 1970s, until the more recent corporate and governmental foresight practices.

Other scholars have focused on segmenting futures studies' history in phases. Kuosa (2011) divided the history of futures thinking in two overarching paradigms. A first, deterministic and mystical paradigm, when the future was predicted by experts such as shamans, contrasting with the modern undeterministic paradigm, when the future is deemed unpredictable. The modern paradigm is in turn subdivided in three phases that prioritize three different futures approaches: a positivist and strategic phase (1940s–1950s), a phase committed to solve the grand challenges of humankind (1960s–1970s) and the recent phase, involved with the creation of a wide array of strategic foresight methods, but also largely fragmented (1980s–2011). Along these lines, Son (2015) also classified western futures studies in three periods, from 1945 to 2015, characterized by different thematic and practical concerns: the rationalization period (1945–1960s), the global institution and industrialization period (1970s–1980s) and the most recent neoliberal and fragmented period (1990s–2015). Schultz (2015) also provided an historical overview of futures thinking since its very origins of oral traditions, through middle age prophecies, the enlightenment, industrialization, until today's practices and associations, as well as

most recent trends, such as new influences drawn from integral theory, post-structuralism (CLA), and systems thinking. Finally, Masini (2006) traced the history of futures studies activities in Europe since World War II, and tentatively categorized futures scholarship into three perspectives: technologically oriented, sociologically oriented, and globalistically oriented.

Unfortunately, in these comprehensive reviews, future predictions practiced by ancient gatekeepers of the profession are categorized along strategic foresight practices, professional association activities as well as academic futures research. Therefore, although highly informative of the early origins of the field, and not less insightful on its latest developments, the extant literature makes it impossible for us to establish what are the main research areas and research gaps of futures studies specifically as an academic field. Moreover, these reviews are largely subjective in nature.

The only objective study that attempted to sketch a complete picture of the research areas of futures studies was provided by Lu, Hsieh, and Liu (2016), who used clustering techniques to divide the discipline into 6 research categories: technology foresight, futures studies, technology forecasting, scenario analysis, TFA, and TFDEA and outlined the research trajectory of each research category over time. However, this study doesn't allow us to visualize the topics of interest for each cluster, to infer the relation between the clusters from their distance, and, most importantly, to establish the main research gaps in the literature.

In view of the above, this research sets out to map the structure of the scholarly field of futures studies from 1968 to present with bibliometric mapping techniques to determine the main research areas (clusters) in the literature, and intuitively visualize the main topics in each cluster, the trajectory of clusters over time, the research activity within and across journals, the main locations of futures research, as well as the gaps between research areas.

3. Methods

3.1. Software

To analyze the structure of the scholarly field of futures studies, I have used VoS Viewer (Van Eck & Waltman, 2010). VoS Viewer is a bibliometric mapping software that allows us to visualize large amount of bibliometric data through easy to understand and intuitive two-dimensional maps. This software provides us with an objective and rigorous representation of large amount of scholarly records without losing details. To date, VoS Viewer has enjoyed considerable attention in a variety of fields and it has been used to review scientific research in several domains across the sciences (VoS viewer Publications, 2018).

3.2. Sample

To collect a sample of bibliographic data representing the extant scholarly research in futures studies, I have used Web of Science, an online scientific indexing database. From the Web of Science, I have exported full records[1] of scholarly articles in futures studies published since 1968 until present from the journals *Futures, Foresight, Journal of Futures Studies, European Journal of Futures Research, Technological Forecasting and Social Change, Long Range Planning, Policy Futures in Education, The International Journal of Forecasting, Journal of Forecasting* and *On the Horizon*[2]. The records have been downloaded between August the 2nd and August the 9th 2018.

For the journals *Futures*, *Foresight, Journal of Futures Studies* and *European Journal of Futures Research,* I haven't used topic keywords, as I assumed that all the records in these journals belong to futures research. This query resulted in 4866, 580, 595 and 133 articles records, respectively. For the journals *Technological Forecasting and Social Change* (TFSC), *Long Range Planning* (LRP), *Policy Futures in Education* (PFE)*, The International Journal of Forecasting* (IJF), *Journal of Forecasting* (JF) and *On the Horizon,* I have used topic keywords to subset the query only to articles pertaining to futures research. Indeed, these journals also feature articles pertaining to other related fields of inquiry[3] (the specific keywords and operators used in the query are provided in Appendix A). This query resulted in 1159 additional articles' records. All the extracted records add up to a total of 7333 articles' records, that constitute the working sample of the study. The trajectory of the total number of articles by year from 1968 to present is shown on Graph 1 along the total number of articles' citations. These records are arranged in .txt files, serving as input source for the VoS Viewer software.

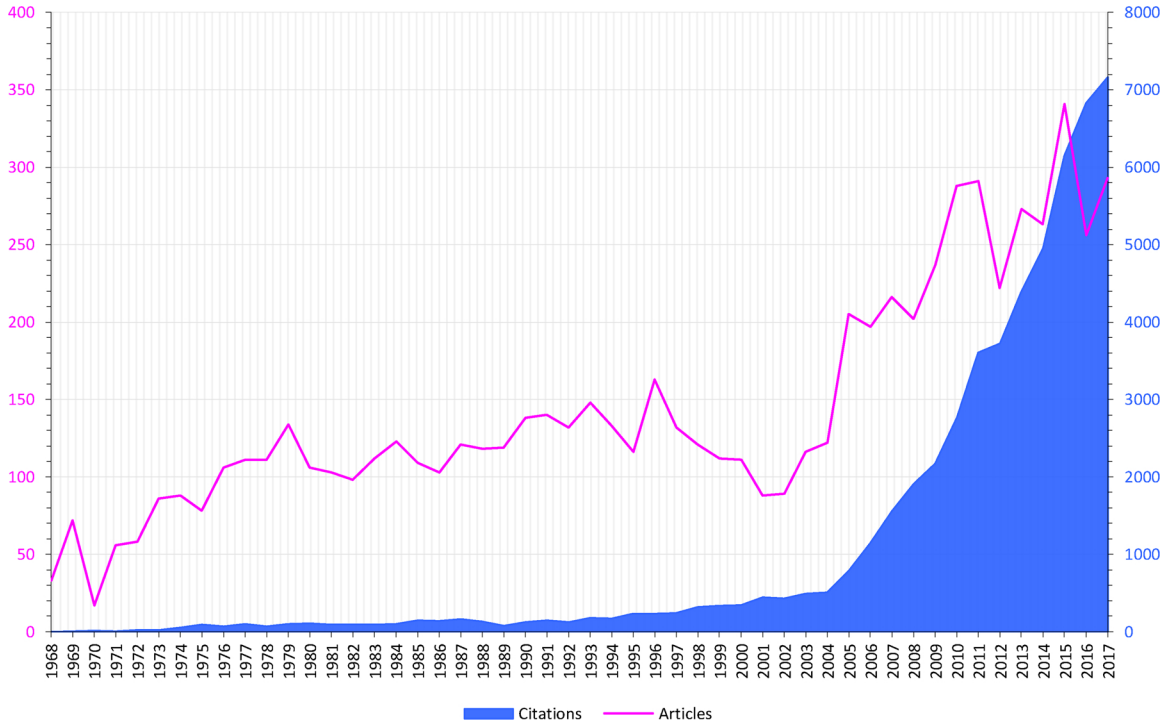
3.3. Analyses

Once the .txt files including the working sample of full articles records are provided to Vos Viewer, the software identifies and extracts key terms (nouns or noun phrases) from records' titles and abstracts through natural language processing techniques. The software then asks the user to adjust the terms' threshold, a number representing the minimum number of times a term needs to be mentioned across the sample to be displayed in the bibliometric map. I have used the default threshold, 10 occurrences, as this has

[1] A full record consists of a textual data including the title, author, abstract, keywords and references of a scientific publication.

[2] It's wasn't possible to access records of the journal *World Future Review* as this journal is not indexed on Web of Science.

[3] TFSC also publishes research in corporate strategy, system engineering, big data, economics and technology assessment, among other topics. LRP also publishes research in management, strategy, business models, entrepreneurship and innovation, among other topics. PFE also publishes research in economic development, sociology and education policy, among other topics. IJF also publishes research in economic, econometric, and marketing, among other topics. JF also publishes research in forecasting modelling and statistics, among other topics. OTH also publishes research in organizational behavior and educational trends, among other topics.



Graph 1. Total number of articles and citations by year.

been indicated as a desirable number to effectively cancel misspelled as well as nugatory terms (Van Eck, 2011). The software then measures the *association strength* of the remaining terms that meet the set threshold. The association strength between two terms is a measure of term similarity that represents the extent to which the two terms co-occur as compared to the extent to which they occur along other terms in the sample of records (Van Eck & Waltman, 2009a, 2009b). A list of terms is then displayed, allowing the user to delete terms that are meaningless for the thematic mapping visualization. With the help of this list, I have delated frequent generic terms that, being mentioned in almost all the records, did not carry particular meaning, such as *comment* or *correlation*, as well as geographical locations, such as *Germany*, or *USA*. Finally, the map of the terms is displayed. Three different visualizations of this map (Fig. 1–3) are discussed in section 4.

In the map, groups of terms are divided into thematic clusters by color. Thematic clusters are different streams of scholarship made up by terms that tend to be mentioned together. VoS Viewer creates these clusters by running an algorithm that maximizes the sum of the association strength between pairs of terms in each cluster and minimizes the number of cluster nodes (Waltman & van Eck, 2013). In this study, the software has identified 6 clusters.

As VoS Viewer allows us to identify the corresponding terms that belong to each cluster, I have extracted these terms and computed the most frequently mentioned and impactful (greater total association strength) terms for each cluster with the software R. I have removed the most generic terms (e.g. *judgement*, or *new approach*), obtaining a list of top terms per cluster. From these lists, I have selected the most meaningful 7–12 terms for each cluster, and re-queried the Web of Science with these terms as keywords to search for the most cited articles for each cluster among all of the journals considered in the study (the specific keywords used in the query are provided in Appendix A). For each cluster, I report in Table 1 the most representative 5 articles showing up in the first 3 pages resulting from the queries of the most cited articles using these keywords, along with its top terms, its size and number of cluster-specific articles. Several other influential references on each cluster are discussed in section 4.1 below.

Subsequently, I have exported document-level data from VoS Viewer, and classified articles by cluster based on the most frequently recurring cluster-specific terms mentioned in them that were present in the map using R. Specifically, an article was classified in a specific cluster if the majority of its terms belonged to that cluster. This analysis resulted in 5399 cluster-specific articles[4], which I have used to plot the trajectory of research clusters over time from 1968 to present and their relative percentages within and across journals, which are shown on Graph 2 (a and b) and 3, respectively, and discussed in Section 5.

Finally, I have plotted two additional maps to reveal the network structure of the locations from where futures studies scholarship mainly originates, both at the institutions level (Fig. 4) and at the national level (Fig. 5). To create these maps, I have used the original working sample of articles records as a .txt files input to VoS Viewer, and used *citation* as an index of between-terms distance and clustering. These maps are discussed in Section 6.

[4] As the omitted articles have not a majority of cluster specific terms, their content likely features a mix of different topics from different clusters.

Table 1
Key facts for each cluster.

Cluster	Cluster size	Number of cluster-specific articles	Top terms	Top articles
Cluster 1: Corporate foresight	Large	1760	Practical implication, company, forecast, firm, manager, scenario planning, strategic foresight, competitiveness, roadmap	Börjeson et al. (2006). Scenario types and techniques: Towards a user's guide. Phaal et al. (2004). Technology roadmapping—A planning framework for evolution and revolution. Daim et al. (2006). Forecasting emerging technologies: Use of bibliometrics and patent analysis. Bradfield et al. (2005). The origins and evolution of scenario techniques in long range business planning. Van Notten et al. (2003). An updated scenario typology.
Cluster 2: Past & futures	Large	1934	History, culture, discourse, alternative future, image, politic, conflict, narrative, worldview, tradition, causal layered analysis, metaphor, university, student, school	Inayatullah (1998). Causal layered analysis: Post-structuralism as method. Inayatullah (2008). Six Pillars: Futures Thinking For Transforming. Turnbull (1997). Reframing science and other local knowledge traditions. Sardar (2010a). The Namesake: Futures; futures studies; futurology; futuristic; foresight—What's in a name? Escobar (1992). Reflections on development – Grass-root approaches and alternative politics in the third world.
Cluster 3: Humanity at the limen	Medium	955	Population, crisis, globalization, nation, decline, democracy, revolution, capitalism, war, poverty, survival, collapse, humanity, existence	Florida (1995). Toward the learning region. Booth (2006). Demographic forecasting: 1980–2005 in review. Grübler et al. (2007). Regional, national, and spatially explicit scenarios of demographic and economic change based on SRES. Hubacek et al. (2007). Changing lifestyles and consumption patterns in developing countries: A scenario analysis for China and India. Cohen (1997). Risk society and ecological modernisation alternative visions for post-industrial nations.
Cluster 4: Environmental futures	Medium	593	Energy, demand, production, reduction, climate change, emissions, ghg, greenhouse gas, fossil fuel, environment	Riahi et al. (2007). Scenarios of long-term socio-economic and environmental development under climate stabilization. Gilg et al. (2005). Green consumption or sustainable lifestyles? Identifying the sustainable consumer. Fischer et al. (2007). Climate change impacts on irrigation water requirements: Effects of mitigation, 1990–2080. Roy (2000). Sustainable product-service systems. Lempert and Groves (2010). Identifying and evaluating robust adaptive policy responses to climate change for water management agencies in the American west.
Cluster 5: Post-normality & complexity	Small	70	Post-normal science, stake, transdisciplinarity, interdisciplinarity, social learning, complex, 20th century, 21st century, epistemology, wicked problem	Funtowicz and Ravetz (1993). Science for the post-normal age. Wickson et al. (2006). Transdisciplinary research: characteristics, quandaries and quality. Kay et al. (1999). An ecosystem approach for sustainability: addressing the challenge of complexity. Bruce et al. (2004). Interdisciplinary integration in Europe: the case of the Fifth Framework programme. Sardar (2010b). Welcome to postnormal times.

(*continued on next page*)

Table 1 (*continued*)

Cluster	Cluster size	Number of cluster-specific articles	Top terms	Top articles
Cluster 6: Technological trends	Small	69	Communication technologies, ict, artificial intelligence, robotic, robot, cyberspace, telecommunication, leisure, travel, entertainment, home	Berkhout and Hertin (2004). De-materialising and re-materialising: Digital technologies and the environment. Hacklin et al. (2009). Coevolutionary cycles of convergence: An extrapolation from the ICT industry. Choi et al. (2007). A patent-based cross impact analysis for quantitative estimation of technological impact: The case of information and communication technology. Denyer et al. (2011). "Social", "Open" and "Participative"? Exploring Personal Experiences and Organisational Effects of Enterprise2.0 Use. Handy and Mokhtarian (1996). The future of telecommuting.

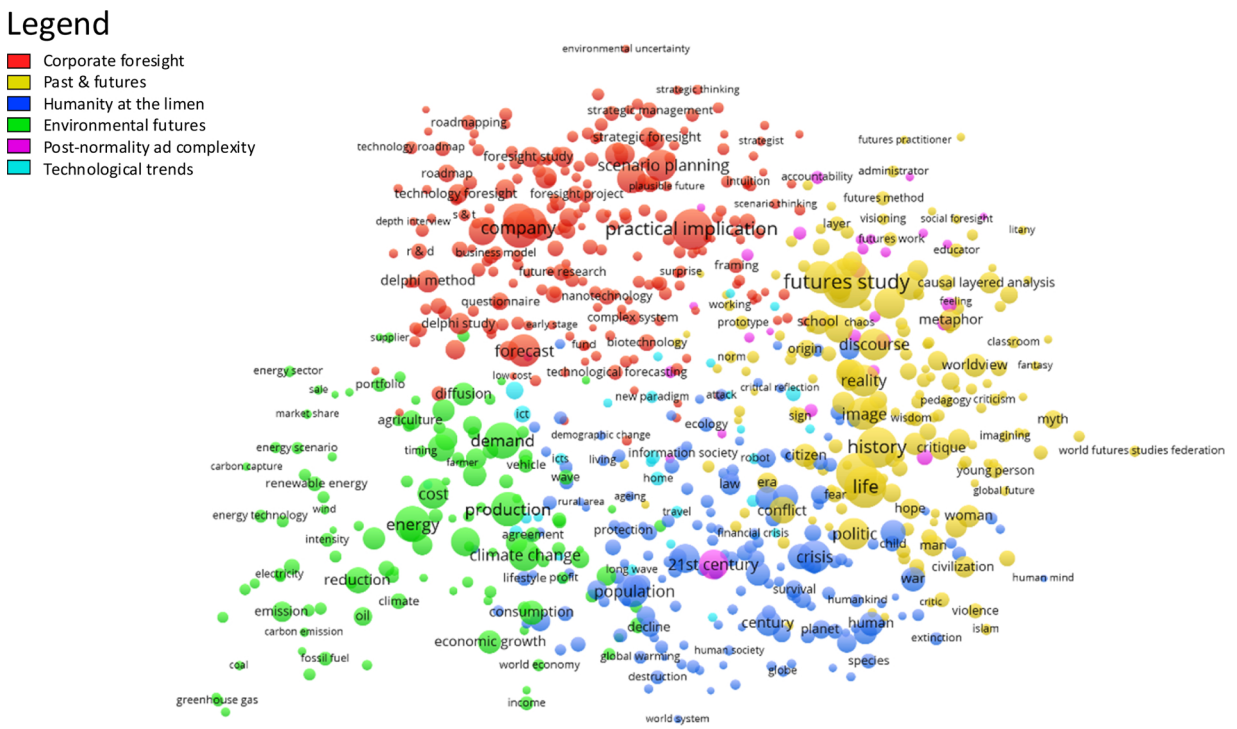


Fig. 1. Main map with cluster visualization (For interpretation of the references to colour in the text, the reader is referred to the web version of this article.).

4. Results and discussion

4.1. Visualizations

The *main map* (network map visualization) allows us to visualize the most meaningful terms in a two-dimensional space (Fig. 1). In the map, the distance between two terms represents the association strength between them.

Each term, that can be interpreted as a topic of scholarly research, is represented by a circle. The dimension of the circles represents the number of article records mentioning the terms and, therefore, the importance of topics.

Groups of terms with higher association strength between each other are separated in clusters. The 6 clusters that the software has identified are discernible on the main map through different colors. Clusters can be interpreted as macro-areas of research, or research streams, each containing several topics (as represented by the terms inside them). According to the most frequently mentioned terms in each cluster and to their corresponding research themes, these 6 research clusters have been renamed as: *corporate foresight; past, & futures; humanity at the limen; environmental futures; post-normality & complexity*, and *technological trends*, which are discussed in the following subsection. Each cluster's size has been categorized as *large, medium* or *small*, relative to other clusters (see Table 1).

A second visualization is afforded by the *density map* (Fig. 2). This map distinguishes areas of different research intensity by color. Research intensity represents the number of articles mentioning the topics (terms) on the map. Areas of higher research intensity are displayed in red, while areas of lower research intensity are displayed in green.

A third visualization is afforded by the *overlay map* (Fig. 3). This map allows us to distinguish currently trendy research topics, i.e. topics appearing more often in articles that have been recently published, in warmer colors (red, orange, yellow, represent scholarly activity in the last 5–8 years), as compared to research topics appearing more often in older articles (green and blue represent scholarly activity that was trending before 10 years ago). For instance, *strategic foresight* is a relatively trendier topic and its average publication year is 2011, while *war* is a relatively older topic and its average publication year is 1999.

In the following subsection, each research cluster is discussed in greater detail. A discussion of the overall maps' structure and research gaps between the clusters is then provided, along with recommendations on how to fill these gaps.

4.2. The 6 clusters of futures studies scholarship

4.2.1. Cluster 1: corporate foresight

This cluster of topics is concerned with exploiting futures studies techniques to produce actionable insights to benefit organizations. Based on the most frequently mentioned terms in this cluster, such as *practical implication, company, forecast, firm, manager,* or

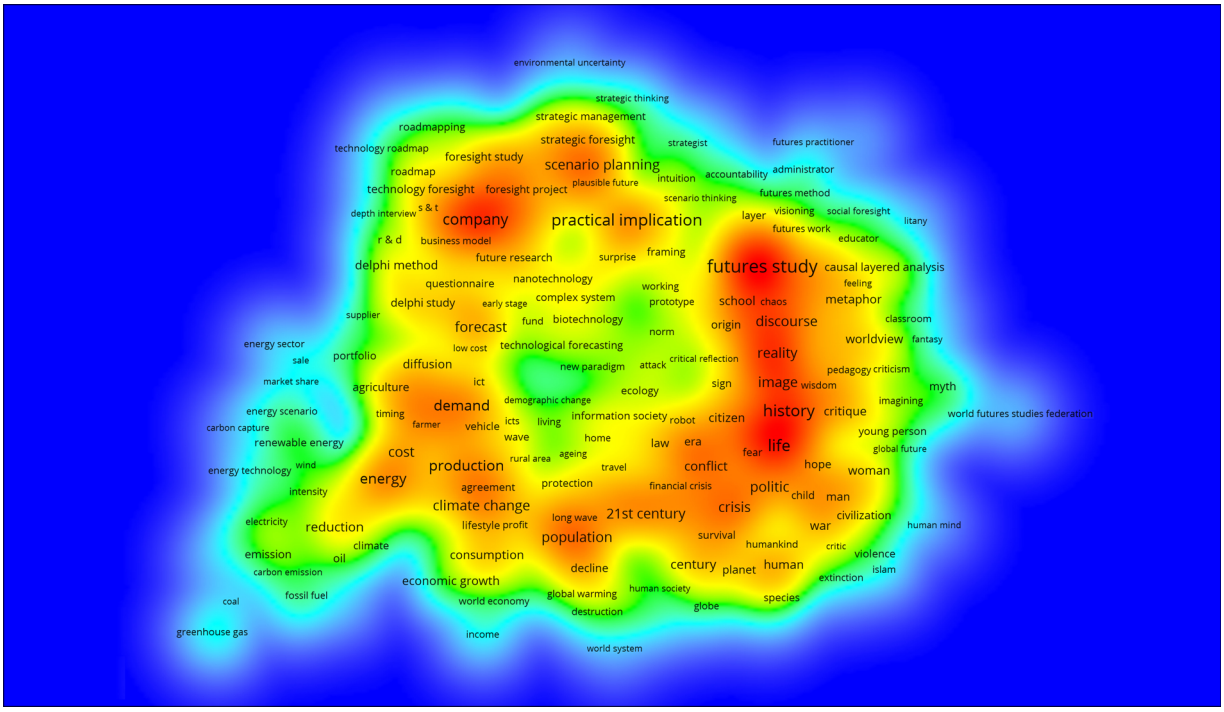


Fig. 2. Density map (For interpretation of the references to colour in the text, the reader is referred to the web version of this article.).

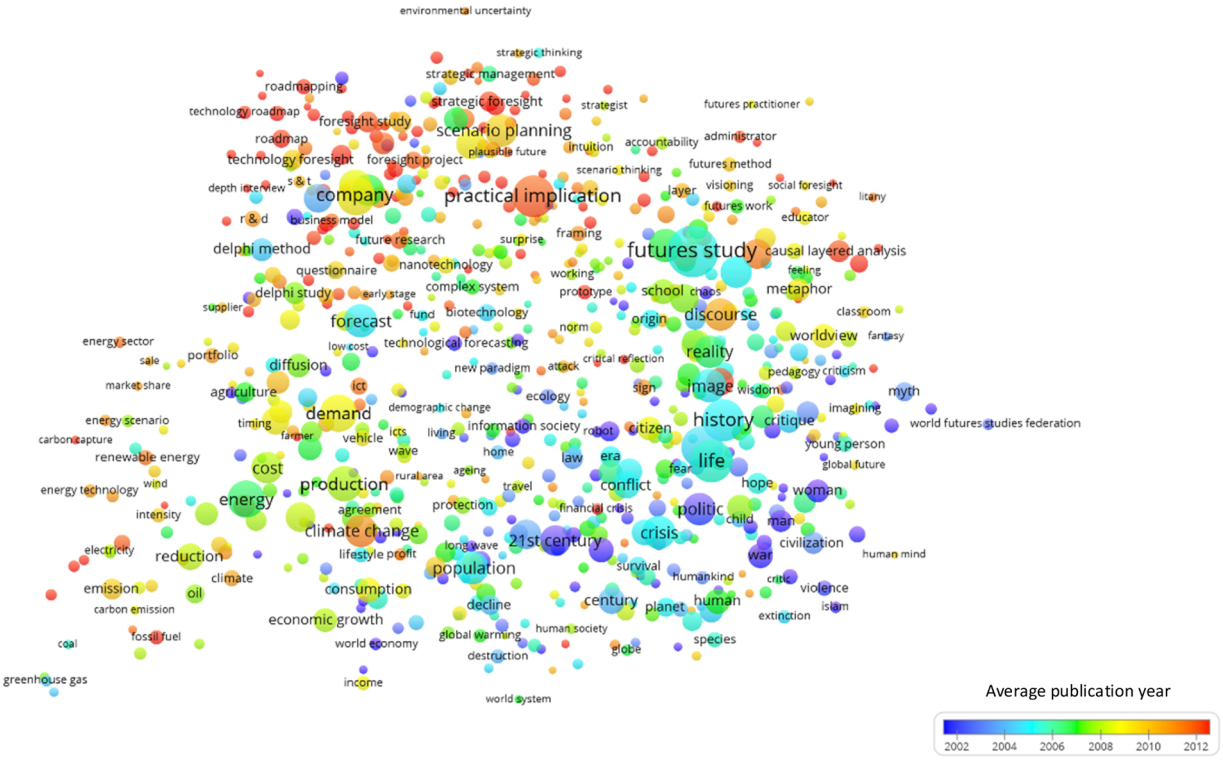


Fig. 3. Overlay map (For interpretation of the references to colour in the text, the reader is referred to the web version of this article.).

scenario planning (a complete list is provided on Table 1), this cluster has been renamed *corporate foresight*. It is here that the terms *foresight,* or *strategic foresight* are more often used, rather than futures studies, to denote the activity of looking into the futures. It is discernible on the upper side of the main map (Fig. 1) in red. Relative to other clusters, the size of this research cluster is *large* (1760 cluster-specific articles are associated with this cluster).

Here, scenario planning comes to the fore. The method is used, dissected, explained and critiqued in a variety of ways, without losing sight of its practical implications for firms. The first, and still influential article in this regard was Duperrin and Godet (1975), that discussed how cross impact analysis can improve scenarios forecasts. Briefly afterward, organizational scenario planning methods were first formally outlined (Vanston, Frisbie, Cook Loperato, & Boston, 1977). Later, as the use of scenarios started to take off in the corporate world, different corporate scenario planning techniques were compared (Huss & Honton, 1987) and reviewed along guidelines on how to use scenarios in business settings (Schnaars, 1987). Godet (1982) introduced a comprehensive foresight and scenario planning method: *la prospective*, later elaborated in Godet and Roubelat (1996) and Godet (2000). Gausemeier, Fink, and Schlake (1998) graphically explained the many phases of scenario development to achieve organizations competitiveness; Roubelat (2006) highlighted the fruitfulness of scenarios in challenging the strategic paradigms of the organization and foreseeing emerging ideologies; Bezold (2010) shared insights learned in his experience in developing organizational scenarios at the Institute for Alternative Futures; and Sarpong and Maclean (2011) showed how scenario planning can contribute to find opportunities for product innovation in product innovation teams. These articles also often include examples of companies that successfully managed to put the scenarios exercise into practice, while other focus on reporting more in-depth case studies of these activities, such as Moyer (1996) who documented a scenario planning exercise undertaken by the British Airways, and Pagani (2009) who used scenarios and cross impact analysis to map the futures of the 3G wireless industry. The many comprehensive reviews of scenario planning methods also fall in this cluster (Bradfield, Wright, Burt, Cairns, & Heijden, 2005; ; Amer, Daim, & Jetter, 2012; Bishop, Hines, & Collins, 2007; Börjeson, Höjer, Dreborg, Ekvall, & Finnveden, 2006; Van Notten, Rotmans, Asselt, & Rothman, 2003).

But scenarios are not the only concern of this stream of works. Forecasting technologies and keeping abreast of latest technological drivers are salient priorities when using futures methods for the strategic benefit of the firm. Although seamlessly embedded in scenario planning, these topics are also discussed on their own. Technology roadmapping, originally developed in undustrial settings in the 1970s and 1980s was first formally introduced in the futures studies literature by Barker and Smith (1995) and later comprehensively reviewed by Phaal, Farrukh and Probert (2004). Vecchiato and Roveda (2010) explained how firms carrying out strategic foresight activities can benefit from the understanding of the consequences of the drivers of change, rather than their direction. Battistella and Toni (2011) put forward a corporate foresight methodology to assess whether a company's product and vision are coherent with the industry trends.

Throughout this stream of research, a common recommendation is to use a combination of multiple methodologies, a key to forecast emerging technologies and discover new business opportunities (Daim, Rueda, Martin, & Gerdsri, 2006; Heger & Rohrbeck, 2012).

Finally, methodological discussions of the Delphi method also belong to this cluster, as this method has been, since its very beginning, closely knit with scenario planning, technology forecasting, and with practical implications for organizations. Throughout the 1970s, 80s and 90s, the Delphi was fervently discussed, and a number of scholars expounded how to improve its design, use, and accuracy (Bardecki, 1984; Gordon & Hayward, 1968; Hill & Fowles, 1975; Parente', Anderson, Myers, & O'Brien, 1984; Riggs, 1983; Rowe & Wright, 1999; Rowe, Wright, & Bolger, 1991; Salancik, Wenger, & Helfer, 1971; Turoff, 1970; Woundenberg, 1991). Having reached a significant body of literature, 20 years of scholarship on the Delphi methodology and applications were first comprehensively reviewed by Gupta and Clarke (1996), after which, with the exception of a few influential studies (e.g. Landeta, 2006), discussions on this method lost momentum.

4.2.2. Cluster 2: past & futures

This cluster of topics is the very nucleus of the study of the futures. Relative to other clusters, the size of this research cluster is *large*. In fact, this is currently the largest cluster in the literature (1934 cluster-specific articles are associated with this cluster). As exemplified by its most frequently mentioned terms, such as *history, culture, discourse, alternative future, image, politic, conflict, narrative, and worldview* (a complete list is provided in Table 1), articles in this cluster reflect on the role, purposes and achievements of the discipline, and debate the many ways it can look into the past, investigating our history, worldviews, culture and traditions, to discover images of alternative futures. Therefore, this cluster has been renamed *past & futures*. It is discernible on the right side of the main map (Fig. 1) in yellow.

It was in the early 1990s that this stream of research started to gain momentum, as well as citations, with few influential studies written before. The first influential studies in this cluster were mainly epistemological. Inayatullah (1990) distinguished and examined three different epistemological approaches to the future -predictive, cultural and critical. Others expounded an important tenet of the study of the futures: flexibility to different approaches to understanding, particularly originating from the global south. Escobar (1992) questioned the concept of western development from a 'third world scholars' perspective. Turnbull (1997) questioned the role of western science vis-à-vis other knowledge traditions.

It is in this cluster that we later see a meta-discourse on the very essence of futures studies. From Marien (2002), who highlighted the many cultural, thematical, stylistic and ideological fragmentations in the field and suggested ways to rectify them, to Sardar (2010a), who proposed to allege to the very name 'futures studies' to emphasize the plurality of the future. From the seminal contributions of Inayatullah, who introduced Causal Layered Analysis (1998), integrated several foresight methods in a uniquely comprehensive mapping framework (2008), and called attention on narratives to deepen the understanding of alternative futures (Milojević & Inayatullah, 2015), to several articles attempting to integrate futures studies with Ken Wilber's integral theory (Riedy,

2008; Slaughter, 1998, 2008).

In this research cluster, the futures of futures studies are understandably also often debated. Slaughter (1996) envisioned a preferred future where futures studies will have a radical impact on every institution in society, and Inayatullah (2002) outlined five factors that will shape the future of the discipline.

Historical and thematic reviews of the discipline also fall in this cluster (Kuosa, 2011; Son, 2015).

Finally, teaching the futures to improve the global stalemate educational system is a practical goal that all of the theoretical and methodological concerns as above don't lose sight of. As cultures shape individuals' ways of thinking, Wildman and Inayatullah (1996) stressed the importance of unpacking learners' mental models with causal layered analysis when teaching the futures. Hursh (2005) described the neoliberal educational reforms in USA and UK, as well as their contradictions; Gidley and Hampson (2005) traced the history of futures studies in school education and used integral theory to suggest ways to improve futures studies schools' literacy; and Blass, Jasman, and Shelley (2010) built five scenarios of the futures of the education system in the UK.

4.2.3. Cluster 3: humanity at the limen

This cluster of topics documents dramatic changes in the balance of power, questions the upper boundaries of demographic increases and economic progress, proposes alternatives to the capitalistic system, and is alleged to alleviate global poverty. In short, articles in this cluster study the liminal period of global systematic transition that humanity is standing on, as reflected by the most frequently cited terms in this cluster, such as *population, crisis, globalization, decline, democracy, revolution, capitalism, war, poverty, survival,* or *collapse* (a complete list is provided on Table 1). Therefore, this cluster has been renamed *humanity at the limen*. It is discernible on the lower-central part of the main map (Fig. 1) in blue. Relative to other clusters, the size of this research cluster is *medium* (955 cluster-specific articles are associated with this cluster).

Influential studies in this cluster of research start to appear in the late 1980s, when the changing nature of capitalism, as well as the prospect of the emergence of new economic paradigms, were beginning to be explored. Rooneek (1987) noted that technological shifts were engendering a new political-economic framework, away from the *Fordist* mass production, and towards greater flexibility. Florida and Kenney (1993) noted that capitalistic firms were transitioning into a relatively more innovation-led production system. Florida (1995) reaffirmed the importance of regions amidst increasing globalization trends. Cohen (1997) critiqued and integrated two theories of social progress and modernization. Mathews (2011) proffered a way for capitalism to continue to persist in a more sustainable way in the future.

In the 2000s, projections of the future global population and economy become protagonists of the scholarly debate in this cluster. Booth (2006) reviewed the extant methods of demographic forecasting; Grübler et al. (2007) projected global as well as national population and GDP scenarios up to the year 2100; Hubacek, Guan, and Barua (2007) outlined the key drivers of economic and demographic change in China and India; and Boretos (2009) used a logistic substitution model to forecast the future global population, GDP, GDP per capita as well as change in global economic balance of power, concluding that China will eventually overtake the West in its contribution to global GDP by 2050.

Envisioning better alternative global futures is the ultimate outcome of this stream of research. The concerns for a more balanced and sustainable economy ultimately led to the formulation of the scenario archetypes method, a scenario technique to envision four overarching global alternative future narratives, called *continuation, collapse, discipline and transformation* (Dator, 2009), while preferable futures for the global south were put forward by Jansen and Gupta (2009), who envisioned alternative futures of poverty alleviation through biotechnology, and by Agoramoorthy (2008) who proposed an alternative irrigation model for meeting future food demand in India.

4.2.4. Cluster 4: environmental futures

This cluster of topics explores better futures for the planet's ecosystem, is concerned about the alarming levels of greenhouse gas emissions, and committed to find solutions to reduce them. Indeed, some of the most frequently mentioned terms in this cluster are *energy, reduction, climate change, emissions, greenhouse gas,* and *environment* (a complete list is provided on Table 1). Therefore, this cluster has been renamed *environmental futures*. It is discernible on the bottom-left corner of the main map (Fig. 1) in green. Relative to other clusters, the size of this research cluster is *medium* (593 cluster-specific articles are associated with this cluster).

The first influential study in this cluster is found in Marchetti (1977) who put forward a model to simulate energy substitution based on other commodities' substitution. Later influential studies were majorly concerned with a common theme: the design of alternative scenarios of the future of climate change. Indeed, the most cited article in this cluster used environmental futures scenarios to find economically feasible strategies for the reduction of greenhouse gas emissions (Riahi, Grübler, & Nakicenovic, 2007). Along these lines, Fischer, Tubiello, Velthuizen, and Wiberg (2007), projected different climate change scenarios until the year 2080 and their impact on water usage requirements. Lempert and Groves (2010) explained how multiple scenarios built with statistical simulation helped the Empire Utilities Agency to implement adaptive strategies to deal with the cost of climate change in the Western United States.

But scholars active in this cluster are also concerned with other themes related to the environment, such as explaining under which circumstances the adoption of new agricultural technologies is effective (Feder & Umali, 1993), forecasting the equilibrium price of electricity (Conejo, Contreras, Espínola, & Plazas, 2005), and identifying the lifestyle(s) that lead to green and sustainable consumption (Gilg, Barr, & Ford, 2005).

Actionable insights were provided by Kemp (1994), who documented the reasons why it is difficult to swiftly adopt radically new sustainable technologies and offered public policy guidance on how to implement them; and by Roy (2000) who encouraged the design of products and services that are environmentally sustainable.

4.2.5. Cluster 5: post-normality & complexity

This cluster of topics is concerned with questioning the epistemological status quo of the social sciences, proposing that the complexity of the modern world demands new ways of knowing based on post-normality and interdisciplinarity. This is apparent from some of the most frequently mentioned terms in this cluster: *post-normal science, transdisciplinarity, interdisciplinarity, complex, epistemology,* and *wicked problem* (a complete list is provided on Table 1). Therefore, this cluster has been renamed *post-normality and complexity*. It is discernible in the main map (Fig. 1) in violet. Although relative to other clusters, the size of this research cluster is *small* (70 cluster-specific articles are associated with this cluster). This cluster permeates and honeycombs cluster 2: *past & futures*, as well as the very center of the map. Indeed, post-normality and complexity are key concepts undergirding the whole field of the futures, and a way of thinking that futurists need to espouse to be able to investigate the futures.

Although early studies encouraging interdisciplinary perspectives were put forward (e.g. Nanus, 1979), it is in the 1990s, with the introduction of the concept of post-normal science, that studies in this stream of research became influential.

Advocates of the post-normal approach argue that the Newtonian scientific paradigm, committed to explain reality through linear causality, is alas ill-equipped at fathoming a social environment of great uncertainty as we have entered a new era, dynamic rather than mechanistic (Hjorth & Bagheri, 2006), and dominated by complex systems (Batty & Torrens, 2005; Funtowicz & Ravetz, 1994), the era of post-normal science (Funtowicz & Ravetz, 1993; Ravetz, 1999; Kay, Regier, Boyle, & Francis, 1999). In times where we live with contradictions, chaos, and complexity, it is suggested that new virtues, such as humility, modesty, and accountability become indispensable, along the capacities to creatively imagine ways out of uncertainty and to abandon the notions of control over the environment, growth efficiency and management (Healy, 2011; Sardar, 2010b, 2015).

As wicked problems of the current times, such as environmental sustainability, have to be addressed by multiple perspectives, we also see influential studies investigating, documenting and encouraging transdisciplinary and interdisciplinary inquiries (Bruce, Lyall, Tait, & Williams, 2004; Lawrence & Després, 2004; Pohl, 2005; Wickson, Carew, & Russell, 2006). It is argued that organizations embrace complex, paradoxical and contradictory business models to achieve competitive advantage (Smith, Binns, & Tushman, 2010), and that policy analysts unlearn to forecast and create the future through backcasting to achieve the resolution of long-term complex problems (Dreborg, 1996; Robinson, 1988).

4.2.6. Cluster 6: technological trends

This cluster of topics is concerned with the study of recent technological changes, including information and communication technologies, telecommunications, artificial intelligence and robotics. This is apparent from some of its most frequently mentioned terms: *communication technologies, artificial intelligence, robot, cyberspace,* and *telecommunication* (a complete list is provided on Table 1). Therefore, this cluster has been renamed *technological trends.* It is discernible in the main map (Fig. 1) in light blue. Relative to other clusters, the size of this research cluster is *small* (69 cluster-specific articles are associated with this cluster). From the frequently mentioned terms *travel, leisure* and *entertainment*, we can see that technological change is also researched in its effects on our daily lives. Indeed, although this is the smallest cluster in the map, it is not less relevant, as it can be observed that light blue dots are intermittently scattered in the very core of the map.

With few exceptions (e.g. McNally & Inayatullah, 1988), it is understandable that influential studies in this cluster have appeared only relatively more recently, i.e. in the late 1990s. In this cluster, antecedents, characteristics and outcomes of technological change are studied in several ways, both in the future and in the present, from a study on the budding expansion and evolution of cyberspace (Batty & Barr, 1994), to the investigation of environmental and economic impact of information and communication technologies (Berkhout & Hertin, 2004), from a study on the convergence between different information and communication technologies (Hacklin, Marxt, & Fahrni, 2009), to the quantification of the cross-impact relation between technologies over time (Choi, Kim, & Park, 2007). Individuals' perception of technological change are investigated by Denyer, Parry, and Flowers (2011), who conducted a case study on employees' perception of technological use in a company employing web 2.0 technologies; by Keller and Gracht (2014), who used the Delphi method to study the future effects of information and communication technologies on the foresight profession; and by Baum, Goertzel, and Goertzel (2011), who interrogated experts on the likelihood of emergence of general AI.

Noteworthily, a few articles in this cluster are not shying away from the plausible, the probable, the possible and the preferable. McNally and Inayatullah (1988) advanced the argument that robots would eventually need to enjoy legal identity. Handy and Mokhtarian (1996) outlined the most salient trends affecting the future of telecommuting. Science fiction is also used as an exploratory method, featuring a scenario of a future Amsterdam populated by robot prostitutes (Yeoman & Mars, 2012), and a vignette on the research and generation of an emphatic care-giver robot (Stahl, Mcbride, Wakunuma, & Flick, 2014), among the others.

4.3. Structural observations on clusters and research gaps

The overall network and clusters structure of futures studies scholarship cumulatively produced from 1968 to present appears as a ring-shaped map, with thematic clusters positioned around its circumference, and a relatively hollower and less research-dense core. This structure is particularly clear from the density map (Fig. 2), and makes the map easy to interpret, as the interrelations and overlaps among cluster are not significant. On the other hand, however, this is a telling signal of a substantial fragmentation in the field and separation between research areas. Indeed, the three maps allow us to formulate several objective observations regarding the research gaps in the literature that would be otherwise difficult. These observations are discussed below, where the key terms per cluster are in italics:

Observation 1: corporate foresight (cluster 1) is isolated

On the top of the main map (Fig. 1), we can observe that research in corporate foresight (cluster 1), is relatively isolated from other research areas. Indeed, foresight in organizations, mainly in the form of *scenario* exercises and *technological roadmapping,* is performed to find *practical implications* for the benefit of firms. These practices appear to be detached from the deeper exploration of *tradition, cultures, worldviews* and *values*, as this cluster is severed from cluster 2 (past & futures); from more macroscopic economic sustainability concerns, as this cluster is far apart from cluster 3 (humanity at the limen); and from the consideration of environmental concerns, as this cluster is even further apart from cluster 4 (environmental futures).

Furthermore, poststructuralist and integral approaches are virtually unapplied in corporate foresight, as revealed by the distance between this cluster and terms such as *causal layered analysis*, *myth, metaphor* and *integral.*

Therefore, although corporate foresight is the trendiest research area of the field, as revealed by the orange colored dots disseminating its region on the overlay map (Fig. 3), and a substantially research-dense area, as revealed by its red color on the density map (Fig. 2), we observe salient research gaps in its separation from the other important concerns of the discipline: namely, unpacking the weights of the past (cluster 2), achieving better economic futures (cluster 3), and environmental futures (cluster 4).

Observation 2: scenario planning, technological roadmapping, and Delphi are seldom used outside the realm of organizational foresight

The inverse of observation 1 is that inquiries into the past to study the futures (cluster 2), into economic futures (cluster 3), and environmental futures (cluster 4) are not extensively utilizing several fruitful futures methods including scenario planning, technology roadmapping and the Delphi technique. Indeed, as one can see from the upper side of the main map (Fig. 1), terms such as *Delphi method, Delphi study, scenario planning, and technology roadmapping* are placed at the core of cluster 1(corporate foresight), far apart from other clusters in the map.

Observation 3: environmental futures (cluster 4), humanity at the limen (cluster 3), and past & futures (cluster 2) form a continuum, whose edges are far apart

From the bottom left part of the main map (Fig. 1), morphing sideway towards and until its upper right part, we can observe that the inquiry into better futures of the planet state of *climate change* (cluster 4), into more sustainable forms of *capitalism* to avoid *crisis* (cluster 3), and into *history* to discover *alternative futures* (cluster 2) form a continuum.

Indeed, it is expectable that designing sustainable environmental futures (cluster 4) is closely knit with designing sustainable economic futures (cluster 3). In turn, it is expectable that unpacking mental models hidebound in past *traditions* and *worldviews* (cluster 2) is closely knit with the formulation of alternative economic futures (cluster 3).

However, and unexpectedly, there aren't significant interrelations between inquiries into the past (cluster 2) and the formulation of environmental futures (cluster 4). Indeed, we can observe that methods of inquiry meant to unpack current mental models, traditions, and worldviews are almost completely not applied to the futures of the environment, as the main map reveals an appreciable distance between terms such as *causal layered analysis*, *worldview, metaphor, myth, integral* and *utopia* on the right side of the map, and terms such as *energy, climate change, fossil fuel, climate policy, greenhouse gas*, and *emission.*

We can therefore observe a salient research gap in the post-structuralist and integral deconstruction of current modi operandi in climate management to achieve better global environmental futures.

Observation 4: humanity at the limen (cluster 3) and past & futures (cluster 2) form a macro-cluster: core futures research, which is going out of fashion

Due to their intertwined nature, as revealed by a thematic and structural interrelation on the main map (Fig. 1), the formulation of alternative economic futures (cluster 3), and inquiries into the past to discover better futures (cluster 2) form, together, a macro-cluster. We can define this macro area *core futures research.*

Although this macro-cluster of research activity is by far the most research dense area in the field, as shown by the wide and long red stain on the right side of the density map (Fig. 2), scholars are also losing interest in this area of inquiry, as revealed, with the exception of causal layered analysis, by the relatively cooler colors used on the overlay map to indicate topics in this area (Fig. 3). In other words, although the great majority of articles in futures studies research pertains to the study of the past to discover preferable global futures, these articles have been written before 2008 (as from the legend on Fig. 3), and are not trendy anymore as of today.

Observation 5: corporate foresight (cluster 1) and environmental futures (cluster 4) eschew complexity

From the violet dots (cluster 5: post-normality &complexity) contrasting with yellow dots (cluster 2: past & futures) on the main map (Fig. 1), we can observe that the increasingly *post-normal* and chaotic nature of the environment is recognized by core futures research (clusters 2-3), but less so by corporate foresight (cluster 1) and environmental futures research (cluster 4). Indeed, we can observe very few violet terms overlapping the right side of cluster 1 (corporate foresight), and not any at all overlapping cluster 4 (environmental futures). In other words, the application of futures studies methods in organizations and in the design of environmental futures does not appear to take into close consideration the *complex* nature of the environment.

However, these conclusions are tentative as the dimension of cluster 5 (post-normality & complexity), reveals that it has not yet fully morphed into a substantial cluster on its own, thereby making any structural observations difficult. More research activity in this area of inquiry could clarify this issue.

Observation 6: corporate foresight research (cluster 1) and core futures research (cluster 2 and 3) in latest technologies (cluster 6) is scant

The exploration of latest technological drivers of change, mostly in *artificial intelligence, robotics* and *information technology* appears

to be scattered around the center of the map, as we can see form the light blue dots' (cluster 6: technological trends) position on the main map (Fig. 1). This reveals that this area of inquiry is not of particular interest to corporate foresight (cluster 1), nor to core futures research and environmental futures (clusters 2,3,4). Indeed, there is a virtual absence of light blue dots approaching the outer side of the circumference of clusters in our ring-shaped map. This could be explained by the relative tendency of research articles in these topics to fall under other publication venues, such as artificial intelligence and computer science journals, rather than futures studies journal.

However, these conclusions are also tentative as the dimension of cluster 6 (technological trends), reveals that it has not yet fully morphed into a substantial cluster on its own, thereby making any structural observations difficult. Indeed, there might be a greater amount of error in the clustering algorithm when this faces fewer and widely sparse terms as those pertaining to technological change. More research activity in this area of inquiry could clarify this issue.

4.4. Recommendations on how to fill research gaps

In view of the research gaps revealed by the observation of the three maps as above, it is possible to derive several recommendations for researchers in futures studies to focus on filling current research gaps, and, in so doing, decrease the fragmentation of the field:

Recommendation 1: integrating corporate foresight with global futures

Researchers may explore how the responsibility to create better future ecosystems and economies can be embedded in corporate foresight activities, thereby closing the research gap between corporate foresight and other clusters of research. This can be achieved, for instance, with reports on scenario exercises meant to simultaneously achieve organizational benefit and sustainable strategies, or with more applications of integral futures and causal layered analysis in organizational settings, rather than scenarios, to unpack strategists' mental models of responsibility towards the outer environment.

Recommendation 2: using scenario planning, technology roadmapping, and Delphi in core futures research

Other than in organizational foresight, where these methods are most often used, researchers may use scenarios to study the futures of capitalism, diplomacy, political conflict and wars; roadmapping to trace the development of democratizing technologies and cyberwarfare technologies; or Delphi to study the future impact of technology on social values and individuals' feelings, among the several important themes in core futures research.

Recommendation 3: using previously underutilized futures methods in environmental futures research

Researchers may revive environmental futures with causal layered and integral approaches, combinations of which we can observe a dearth of, thereby closing the separation between the two areas.

Recommendation 4: bringing core futures research themes back to fashion

To trend up the core research topics in futures studies (cluster 2 and 3), which appear to be cooling off as recently, researchers may want to explore the weights of the past in new lights. They could, for instance, explore how these shape, or hinder, strategy in organizational foresight settings (tied to recommendation 1); explore the contrast between tradition and the emergence of new technologies, such as artificial intelligence, robots, and nanotechnologies; explore economic and political ideologies in different post-capitalistic futures; or explore the integral dimension, myth and metaphors behind the futures of work.

Recommendation 5: not shying away from complexity

Researchers may investigate how complexity shapes, or hinders, corporate strategy, take post-normal recommendations into account in foresight scenarios exercises, and generally increase their familiarity with complexity science as we can observe a dearth of research in this important topical area.

Recommendation 6: designing the futures of the 'coolest' recent technologies

We can unfortunately also observe a dearth of inquiries into technological futures. Researchers may want to study the futures of the internet of things, of robots, of nanotechnologies, of biotechnologies, among other recent technological trends. These inquiries could provide us with pleasant reading material as well as rarely insightful pieces of scholarly work.

Beside these 6 important recommendations, the maps provide the reader with a useful reference instrument to discover further, counterintuitive, and potentially fruitful research opportunities. Noticing these opportunities will largely depend on the reader's interest, knowledge and proclivities. Indeed, the reader is encouraged to look for other terms whose placement on the map relative to other terms he/she finds *surprising*, therefore discovering further opportunities for topic integration. The reader can also look for the *absence* of terms, or analyze their *size* relative to other terms, to discover opportunities to develop new or underinvestigated research topics.

5. Research trends: clusters trajectories over time and research activity within and across journals

The bibliometric maps hitherto presented allow us to understand the *state of the art* of futures studies scholarship, i.e. summary information of futures scholarly activity cumulated over 50 years of research. We now know which are the most relevant thematic

areas of research (clusters). Thanks to the density and overlay visualizations (Figs. 2 and 3), we also know which topics have the greater research density across the 10 futures studies journals that have been included in the study, and which topics are most recently trending and cooling off. However, this compendious visual summary doesn't allow us to determine the trajectory of the different areas of research over time (from 1968 until present), nor their relative representation within each journal and across all the journals. The graphs presented and discussed in this section (Graphs 1–3) are meant to shed light on these issues. They further explain the development of the research clusters above discussed over time, and within and across journals.

Graph 1 traces the growth of the total number of articles of futures studies scholarship across the 10 journals from 1968 to present (pink colored line indexed on the left y-axis), along the growth of the total number of articles citations (blue colored stacked area indexed on the right y-axis). The total number of articles generally follows the economic cycle, as it can be observed from its major downturns corresponding to the 2000–2002 Dot-com bubble and to the late 2000s worldwide recessions, which is unsurprisingly a key driver of academic activity. Interesting, however, is that without dramatic increases in the total number of articles per year (the highest range is achieved in 2015 with 341 articles published, SD = 73.3), there has been a comparatively more dramatic increase in the total number of citations, that was steady and low until 2004, and started to skyrocket after that date (SD = 1872.5). Although this sudden increase is certainly partly explained by the development of online publication technologies, Graph 2 a and b provide a more complete picture of the dynamics behind it.

Graph 2 a and b trace the development of the 6 research clusters of futures studies scholarship across the 10 journals from 1968 to present. Panel 2a shows the absolute number of articles per cluster by year, while panel 2b shows the percentage of articles per cluster by year relative to the total number of articles in the futures studies literature (no. of articles/percentages of articles are indexed on the y-axis on both graphs, the clusters' colors from the main bibliometric map, Fig. 1, have been retained). From these graphs, beside the same general pattern that follows economic cycles as in Graph 1, it is noticeable that while until the late 1990s the relative portion of cluster 2 (past & futures) is dominant in the literature, cluster 1 (corporate foresight) starts to increase significantly after 2004, winning a significantly greater portion of the total number of articles, while other clusters' portions remain almost unchanged. This increase is almost specular to the increase in the total number of citations noted in Graph 1 . Therefore, these three graphs, if interpreted together, show that the increase in corporate foresight research is in great part responsible for the recent sudden increase in the number of citations of futures studies academic articles, particularly after 2004, as the dimension of other clusters remains almost unchanged over time.

Moreover, from Graph 2b, it is observable that the trajectory of research in cluster 1 (corporate foresight) follows a U-shaped curve: upon the very establishment of academic journals in the discipline (*Futures*, Volume 1, 1968; *Technological Forecasting and Social Change*, Volume 1, 1969), corporate foresight research was dominant. As research in other clusters increased throughout the 1980s and 1990s, particularly in cluster 2 (past & futures) and 3 (humanity at the limen), it later lost momentum, only to come back to fashion in the 2000s and reacquire its dominant position. Symmetrically, cluster 2 (past & futures) was dominant in the 1980s and 1990s, but has recently cooled off. This is reflecting of what has been previously noted by interpreting the density and overlay maps (Figs. 2 and 3, respectively): although the majority of publications in the literature still belong to cluster 2 (past & futures), this cluster is going out of fashion.

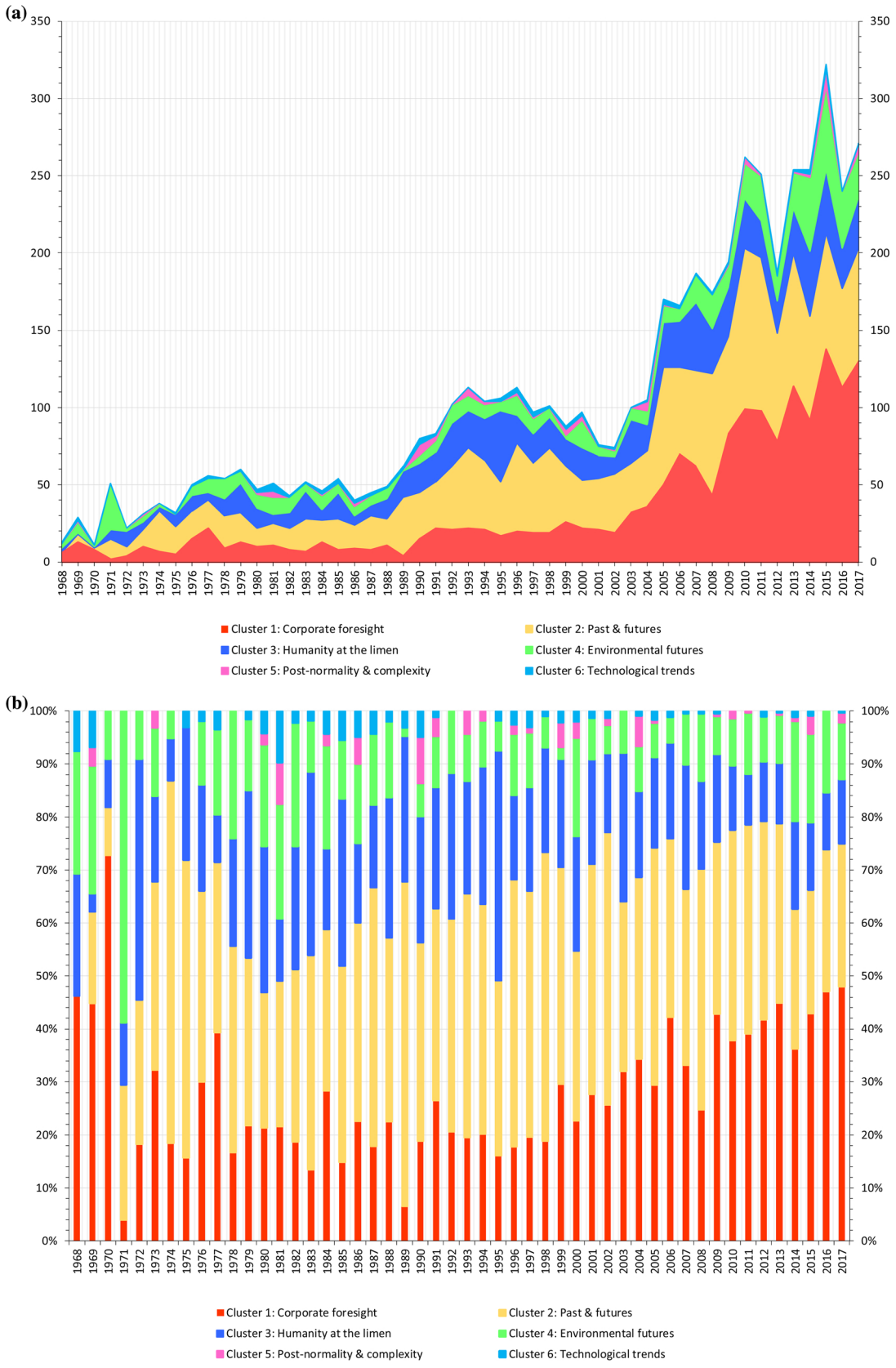
Finally, Graph 3 depicts the percentage of publications by cluster within 9 of the 10 journals considered in the study as well as across these 9 journals (the number of articles published on *Policy Futures in Education* that could be classified in any of the 6 research clusters was too small to achieve a valid percentage estimate, the clusters' colors from the main bibliometric map, Fig. 1, have been retained). From this graph (Total column), it is observable that cluster 1 (corporate foresight) and cluster 2 (past & futures) take up the great majority of futures studies research, with the latter at the first place (1934 articles) followed by the former at the second place (1760 articles). However, this ranking is likely going to be soon reversed if the trend noted in Graph 2 continues. As for within journals percentages, it is noticeable that a great majority of articles published on *Journal of Forecasting, International Journal of Forecasting, Technological Forecasting and Social Change, Long Range Planning* and *Foresight*, is devoted to corporate foresight, *while Futures, European Journal of Futures Research,* and *On the Horizon* are relatively more liberal. Among these, *Futures* has the most diverse representation of the 6 research clusters in the literature. *Journal of Futures Studies*, on the other hand, devotes a large number of its pages to research on cluster 2 (past & futures).

The interested reader can contact the author for additional analyses on the development of the relative percentages of research clusters over time within each journal.

6. The locations of futures studies research: major institutions and countries

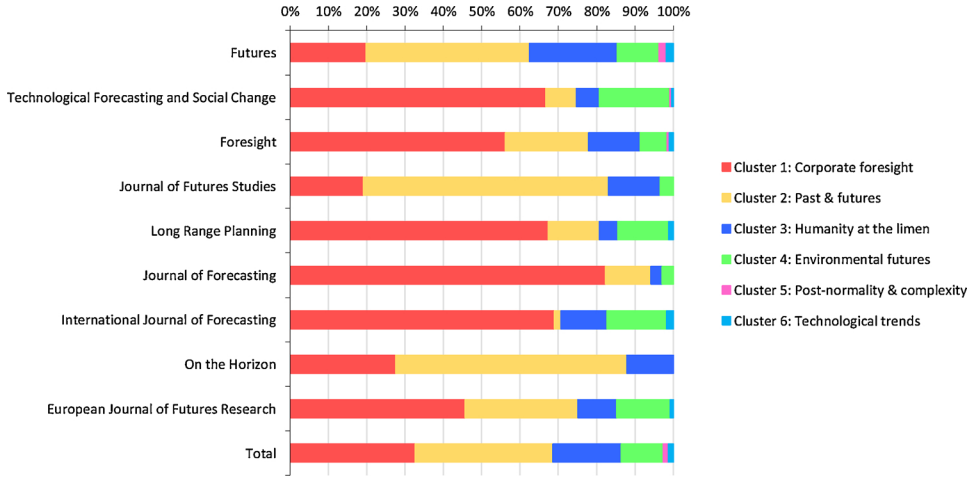
To obtain a full picture of the cumulated activity of 50 years of futures studies scholarship, this section presents the network structure of the locations from where futures studies scholarship mainly originates. This information is plotted on the institution map (Fig. 4), that allows us to visualize the most active universities producing futures research, as well as their interrelations; and on the countries map (Fig. 5), that allows us to visualize the major countries producing futures research, as well as their interrelations. In these maps, the distance between two institutions (Fig. 4) or countries (Fig. 5) represents the extent to which the two entities cite each other. The dimension of dots representing each entity, institution or country alike, is indicative of the number of citations of that entity.

From the institutions map, we can observe the international character of futures studies research, as revealed by the multi-cluster structure in the center of the map (Fig. 4). The close distance between entities in this structure reveals that the majority of institutions producing futures research are citing each other extensively. These are mainly located in Europe (e.g. University of Turku, Delft University of Technology), UK (e.g. Strathclyde University, University of Manchester, Oxford University), and USA (e.g. University of



(caption on next page)

Graph 2. (a). Number of articles per clusters by year. (b). Number of articles per clusters by year as percentages of futures studies literature.



Graph 3. Percentages of publications by cluster within and across journals.

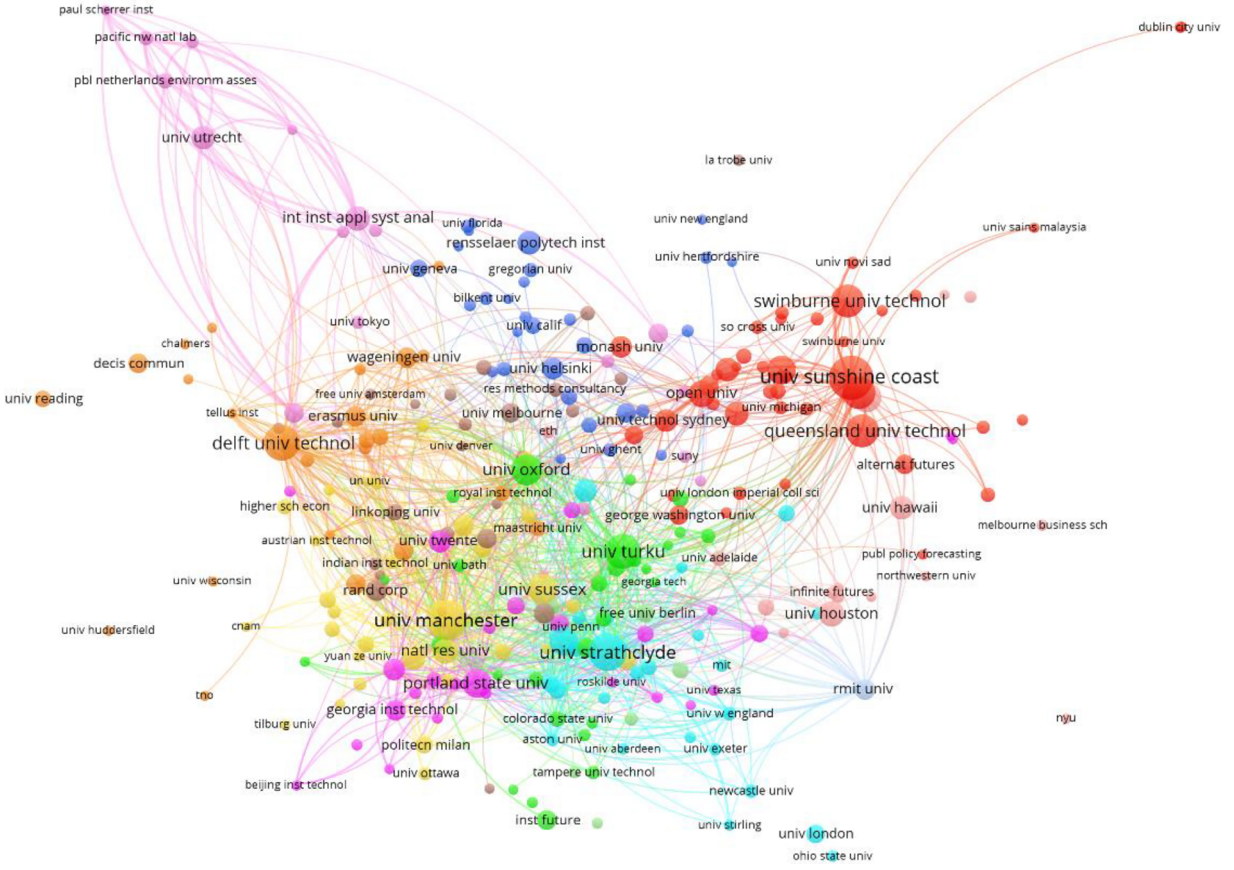


Fig. 4. Institutions map.

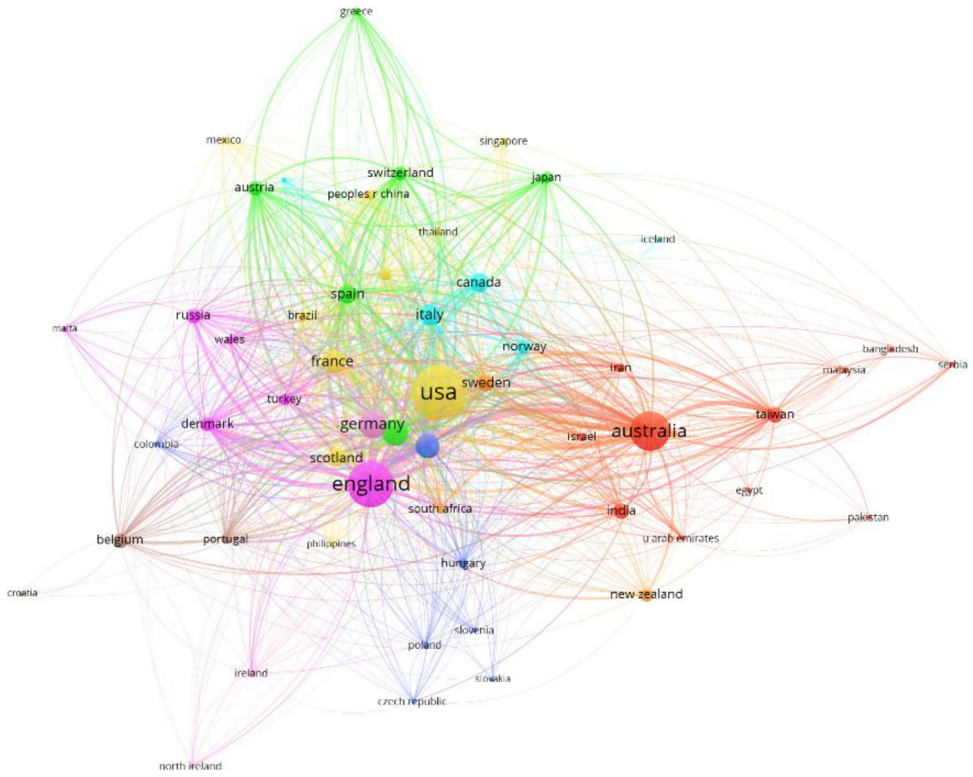


Fig. 5. Countries map.

Houston, Georgia Institute of Technology, Rand Corporation, Portland State University, University of Hawaii). We can also see a separated cluster of Australian institutions that, although highly active and cited, are relatively more self-referential and less involved in the global futures debate (e.g. Swinburne University of Technology, Queensland University of Technology, University of the Sunshine Coast). The relatively high activity of some institutions in northern Europe (e.g. Utrecht University, International Institute for Applied Systems Analysis) also appear to be driven by self-citation, as it can be seen on the top left corner of Fig. 4 that these are detached from the main multi-cluster structure in the center of the map.

This situation is mirrored in the countries map (Fig. 5), where USA, England, and other European countries are displayed in the center of the map and very close to each other, representing high co-citation activity, with USA and England winning the vast majority of citations. Australia is also quite highly cited, but this activity is reflective of internal dynamism rather than international dialogue, as revealed by its relatively outer-rim position on the right side of the map, more proximal to Taiwan than to other countries.

The interested reader can contact the author for additional analyses at the cluster, article or author level by location.

7. Conclusion

In response to the lack of previous objective studies specifically documenting the academic activity in futures studies research, and with the aim to review what has and has not been studied until present in the entire field, this article has presented several bibliometric visualizations of futures studies cumulated scholarship from 1968 to present. The visualizations show thematic clusters and research gaps (Fig. 1), research intensity (Fig. 2), recent research trends (Fig. 3), research trajectory by cluster over time (Graphs 1 and 2), relative clusters representation within and across journals (Graph 3), and research locations (Figs. 4 and 5). The VoS Viewer clustering algorithm has identified 6 research clusters, which have been renamed according to their corresponding themes as *corporate foresight; past & futures; humanity at the limen; environmental futures; post-normality & complexity*, and *technological trends*. These clusters have been discussed in depth one by one, along with the research gaps between them. This article has also provided 6 clear recommendations on how to fill these research gaps. Moreover, the trajectory of research clusters over time has shown that research in *past & futures* and *corporate foresight* take up the great majority of futures studies scholarship, with the former at the first place closely followed by the latter at the second place. However, a recent increase in the relative percentage of research in corporate foresight, which is likely responsible for a corresponding increase in the total number of articles citations, might soon invert this ranking. Finally, analyses at the location level have shown that futures studies research is mainly produced by an international group of closely knit and active institutions, majorly in Europe, UK, and USA, and by a few other active but relatively isolated institutions in Australia and northern Europe.

This research has some limitations. Indeed, the clustering technique can only aid, and not completely substitute, human analysis.

The interpretation and renaming of the clusters identified by the software are, after all, partly subjective. However, this method constitutes a great improvement from previous completely subjective reviews. Moreover, the discovery of research gaps on the map by interpreting the distance and separation between different research clusters is an objective analysis.

Smaller clusters can also carry some error of measurement, as a substantial amount of terms and citations, required to define their clustering classification, has not yet accumulated. For this reason, in Graphs 2 and 3, the relatively low percentage of cluster 5 (post-normality and complexity) and cluster 6 (technological trends) should be interpreted with caution. Indeed, as these clusters have less terms in the bibliometric maps, some articles whose terms are present in the maps and that are indeed concerned with the themes treated in these two clusters could have been labelled unclassifiable due to the absence of enough bibliometrically identified terms that represent them. These articles could therefore have been excluded from the graphs. If present, however, the amount of this error would be small, without any risk to affect the more solid conclusions that can be drawn on the other, more established clusters in the literature by interpreting these graphs.

If anything, this information should serve as an encouragement to produce more research in the areas of futures research that the clustering algorithm has identified as smaller clusters (cluster 5: post-normality & complexity and cluster 6: technological trends), thereby also constituting a guideline to future researches.

The clustering algorithm also doesn't do fair justice to some minor but nonetheless important topics, including but not limited to the futures of the liberal arts, the futures of transport, and of urban planning, among the others, which are present in the literature but weren't classified as separate clusters. As these topics are relatively underrepresented, the methods that this research has used, that focuses on the more prevalent and most cited topics, doesn't allow us to examine these minor research areas, which were incorporated in other major clusters. If anything, this should also serve as a guideline to conduct more research in these areas of inquiry so that a sufficient number of articles is reached for future bibliometric analysis.

It was the aim of this article to provide a useful reference for researchers and practitioners active in futures studies who care about contributing to the improvement of the discipline's body of knowledge as a whole, and who wish to lead the next generation of futures research, knowing what the discipline has achieved before, what it hasn't achieved yet, and attempting to fill its research gaps to diminish its perilous fragmentation.

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Appendix A

Following are the keywords and operators that have been used in the query of articles records in journals that cover topics including but not limited to futures research:

SO = (Technological Forecasting and Social Change OR Long Range Planning OR Policy Futures in Education OR International Journal of Forecasting OR Journal of Forecasting OR On the Horizon) AND TS = ("futures studies" OR "futures research" OR foresight OR "causal layered analysis" OR CLA OR "environmental scanning" OR scenario* OR delphi OR backcasting OR "cross impact analysis" OR "futures workshop*" OR "futures wheel" OR "technology roadmapping" OR "morphological analysis")

Following are the keywords that have been used in the query of top articles for each cluster among the journals considered for the research:

Cluster 1:
Company, forecast, firm, manager, scenario*, strategi*, foresight, competitive*, roadmap*

Cluster 2:
History, culture, discourse, "alternative future", politic*, conflict, narrative, worldview, tradition, "causal layered analysis", metaphor

Cluster 3:
Population, crisis, globalization, nation, decline, democracy, revolution, capitalism, war, poverty, survival, collapse

Cluster 4:
Energy, "climate change", emission*, ghg, "greenhouse gas", "fossil fuel", environment*

Cluster 5:
"Post normal*", postnormal*, transdisciplinar*, interdisciplinar*, "social learning", complex*, epistemolog*, "wicked problem*"

Cluster 6:
"Communication technolog*", ict, "artificial intelligence", robot*, cyberspace, telecommunication

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