

Sustainability Reporting in Higher Education Institutions: a systematic approach using VOSViewer and Iramuteq softwares

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Keywords— Correspondence Factor Analysis (CFA), Descending Hierarchical Classification (DHC), Lexicographic analysis, Sustainability Disclosure.

Abstract— *There is a lack on the research of sustainability reporting by the higher education institutions, being in its early stages. The paper aims to add to the discussion on sustainability reporting in higher education institutions by identifying which themes are prioritized by authors in this field. The authors conducted systematic review to investigate abstracts using VOSViewer to generate co-authorship networks maps and Iramuteq software to generate Lexicographic analysis, Descending Hierarchical Classification and Correspondence Factor Analysis. Then we analysis the results identifying the main themes addressed by the articles. In this study we covered 50 abstracts from 2016 to 2020 about sustainability reporting in higher education institutions from SCOPUS and Web of Science platforms. The research is limited by the number of publications analyzed, and time frame. In this research, we find that the disclosure of sustainability reporting by HEIs is in its initial stage and diverges in a considerable way from each other. The results may be used by researchers, on account of the key themes presented and by the university's administrative bodies, in order to support the credibility of the sustainability reports published.*

I. INTRODUCTION

Higher Education Institutions (HEIs) are prominent in technological development and can assist in building a sustainable and just society. Environmental management in universities must include, among others, the evaluation of consistent environmental indicators [1]. In order to meet human needs, without compromising the resources of the next generations, innovation and sustainability must transform the university [2].

Sustainability assessment tools play an important role in contributing to the development and improvement of sustainable actions in Higher Education Institutions and can disclose the local situation contributing to the

advancement of sustainability in the institution. There is still much to be studied and developed in this area [3].

Sustainability reports are not widely used by higher education institutions and are at an early stage when compared to those used by companies. They can be improved and used to assess the social, environmental, economic, and educational dimensions of HEIs, in addition to being used as communication tools with stakeholders [4,5].

In this context, the research questions were outlined: (Q1) How are recent publications on sustainability reporting in higher education institutions? (Q2) Which journals and authors are the most prominent in the field? (Q3) Which themes are prioritized by authors in the field?

Thus, this paper aims to: O1) identify how are recent publications on sustainability reporting in higher education institutions, O2.1) identify which journals and (O2.2) which authors are the most prominent in the field and O3) identify which themes are prioritized by authors in the field.

The results of this investigation showed that the issue of sustainability reporting in HEIs, is a theme that is still in its initial stage and is increasingly relevant, due to universities commitment through the sustainability and society increasing interest. Thus, this research evidenced some key themes prioritized by authors from this field.

II. METHODOLOGY

We performed a search in title, abstract and key words using the directories "sustainability report*" AND ("universit*" OR "higher education institut*") in the Scopus and Web of Science platforms for articles and reviews published between 2016 and 2020. The articles were selected according to the following exclusion criteria: (a) absence of abstract available; (b) addressed to another type of institution that was not a HEI or (c) not about sustainability reporting.

To facilitate the management of the information of the articles and to exclude duplicates, we used Mendeley software. We also used Excel software to generate tables and figures. For co-authorship networks we used VOSviewer software, a freeware for constructing and viewing bibliometrics maps [6].

For textual content analysis [7], we used the software Iramuteq 0.7 Alpha 2 (Interface de R pour l'Analyse Multidimensionnelle de Textes et de Questionnaires). Iramuteq is a textual analysis software based on statistics (interface with R statistical software), which is useful to generate different analyses, such as: Specificities, Correspondence Factor Analysis (CFA), Reinert's Method or Descending Hierarchical Classification (DHC), Similitude Analysis and Word Cloud [8]. This software has been used in several studies [e.g.: 9, 10, 11].

First, we grouped the abstracts in a single textual corpus, then we prepared the text and imported to Iramuteq [8]. Next, we generated the statistics, the DHC and AFC graphs and analyzed them.

III. RESULTS AND DISCUSSION

The search for articles that were involved in research about sustainability reporting in universities resulted in a total of 97 articles in Scopus platform and 52 in Web of Science platform published between 2016 and 2020. Then,

we imported the occurrences to a reference manager (Mendeley software), grouped the 149 articles and removed duplicates, 107 articles remained. From this total, 57 articles were excluded from subsequent analysis, where 56 of them were not about higher education institutions and 13 of them were not about sustainability reporting, 12 were excluded by both criteria totaling 50 articles remaining for review of abstracts. The survey was carried out between 21 and 22 of November 2020.

In the next topic, we analyzed the publications per year.

3.1 Publication per year

The survey identified 50 articles on sustainability reporting in higher education institutions between 2016 and 2020. We found 134 authors and 27 journals.

As seen in Fig. 1, although the number of publications had an increase from 2017 to 2018 (3.8 times greater), in 2020, the number of publications within the scope of this research was 2.1 times lower than in 2019.

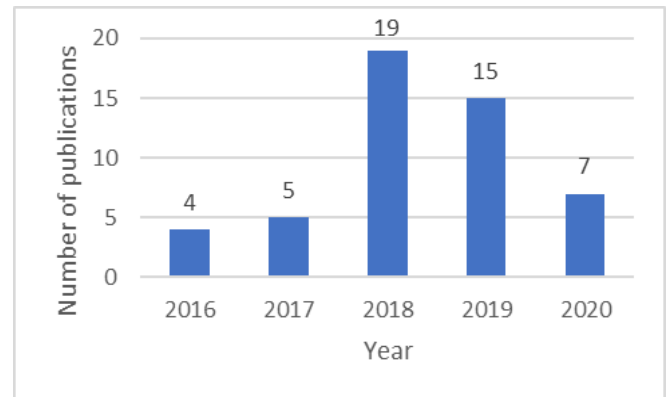


Fig. 1 - Number of publications per year from 2016 to 2020.

In the next topic, we analyze the co-authorship networks.

3.2 Co-authorship networks

From the 43 clusters generated by VOSviewer software, 4 of them has 6 authors in collaboration, 3 has 5 authors in collaboration, 8 has 4 authors in collaboration, 11 has 3 authors in collaboration, 13 has 2 authors in collaboration and 4 were standalone authors.

Considering the most collaborative networks, four of them deserves to be highlighted (Fig. 2) due to the number of publications: red (4 articles), yellow (3 articles), blue (2 articles) and purple (2 articles).

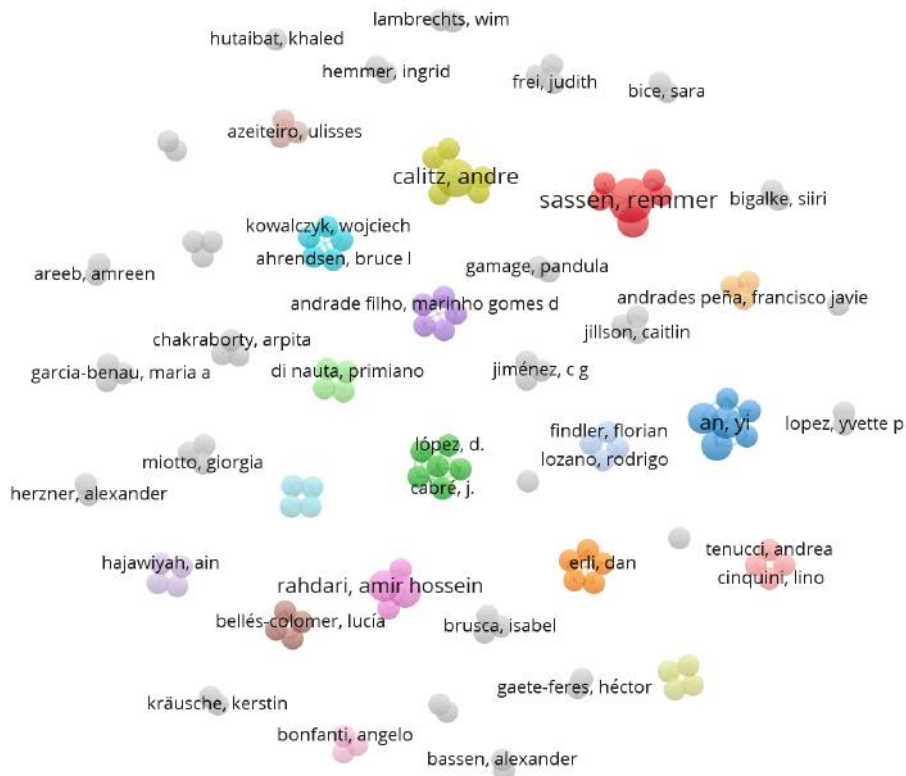


Fig. 2 - Co-authorship networks, generated in VOSviewer software.

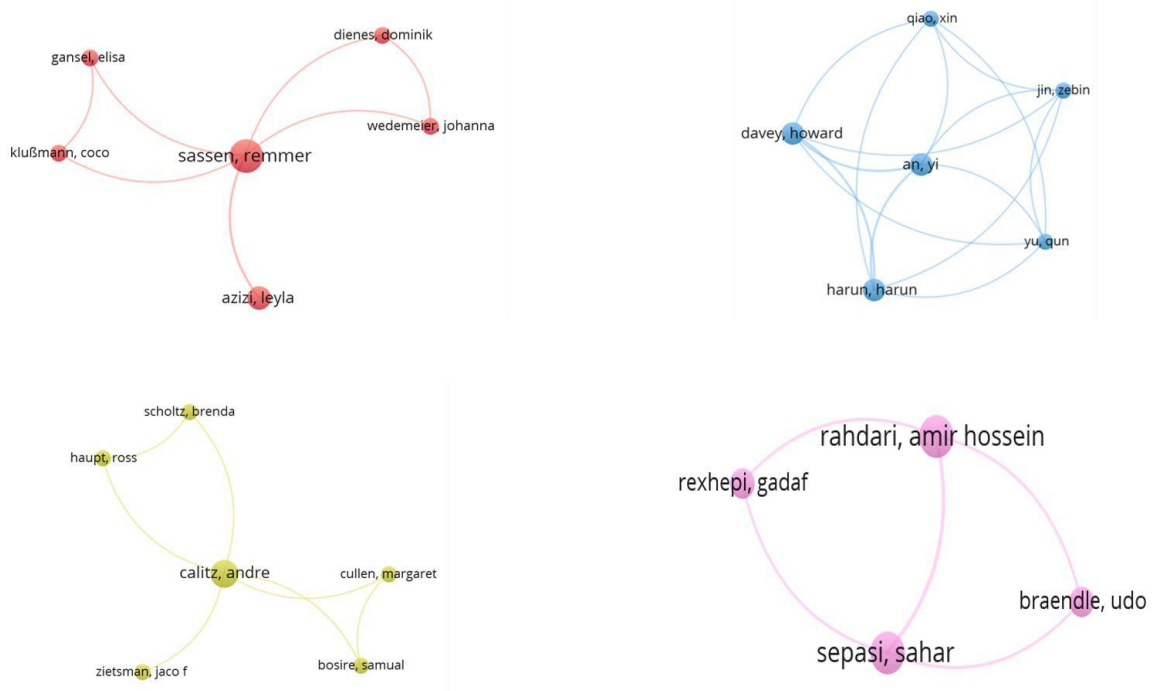


Fig. 3 - Main clusters from authorship networks.

In the red cluster, the two most cited articles: “Assessing sustainability reports of US universities” (26 citations) and “Voluntary disclosure of sustainability

reports by Canadian universities” (24 citations) evaluated sustainability reports from universities by conducting a content analysis [12, 13].

In the blue cluster, the article: “Online sustainability reporting at universities: the case of Hong Kong” (1 citation) examines the state of online sustainability of Hong Kong HEI sector by a multiple case study and the article “Sustainability reporting at a New Zealand public university: A longitudinal analysis” (23 citations) evaluated sustainability reports from a New Zealand public university by conducting a content analysis [14, 15].

In the yellow cluster, the two most cited articles were “A business intelligence framework for sustainability information management in higher education” (20 citations) and “The role of business intelligence in sustainability reporting for South African higher education institutions” (10 citations). The first article proposes a business intelligence framework for strategic sustainability information management addressed for HEIs, used a case study in a South African HEI [16]. The second article applied questionnaires at 21 South African and selected international HEIs aiming to show that business intelligence is important to sustainability reporting framework [17].

In the purple cluster, the article “Developing a sustainability reporting assessment tool for higher education institutions: The University of California” (12 citations) aimed to develop a sustainability reporting assessment tool for evaluating sustainability reporting in HEIs, the authors applied the framework named Environmental, Social, Educational, and Governance (ESEG) University Sustainability Reporting Assessment Tool in a case study in the University of California [18]. The article “Comprehensive sustainability reporting in higher education institutions” (13 citations) aimed to evaluate the comprehensiveness of sustainability reporting in HEIs by using a sustainability rating framework [19].

In the next topic, we analysis the journals that published the articles.

3.3 Journals analysis

A total of 27 journals were identified among 50 articles. As seen in Table 1, the International Journal of Sustainability in Higher Education has 13 articles published (26%), Sustainability has 9 articles (18%), Journal of Cleaner Production has 3 articles (6%), Account Forum has 2 articles (4%) and the others one each one.

The first three journals have together 63% of the citations. The most cited article “True green and sustainable university campuses? Toward a clusters approach”, with 74 citations, was published by one of those journals: Sustainability, the authors made a review of the most common Campus Sustainability Assessments, compared two case studies (The Politecnico di Torino, in Italy and the Hokkaido University, in Japan) and then propose a new Campus Sustainability Assessment that

encompasses clusters of homogeneous campus typologies for meaningful comparisons and university rankings [20].

Table 1 - Relevance of journals according to the number of articles on the topic of the research.

n	Journal	Number of articles	Total of citations	Average number of citations
1	International Journal of Sustainability in Higher Education	13	144	11,08
2	Sustainability	9	134	14,89
3	Journal of Cleaner Production	3	88	29,33
4	Accounting Forum	2	8	4
5	Accounting, Auditing & Accountability Journal	1	18	18
6	African Journal of Information Systems	1	3	3
7	Australian Journal of Public Administration	1	40	40
8	Business and Society Review	1	10	10
9	CIRIEC-España Revista de Economía Pública, Social y Cooperativa	1	1	1
10	Engenharia Sanitaria e Ambiental	1	0	0
11	Independent Journal of Teaching and Learning	1	0	0
12	International Journal of Innovation, Creativity and Entrepreneurship	1	0	0
13	International Journal of Sustainable Development	1	0	0
14	Journal of Business Economics	1	24	24
15	Journal of Environmental Planning and Management	1	17	17
16	Journal of Environmental Studies and Sciences	1	3	3
17	Journal of International Education in Business	1	0	0
18	Journal of Public Budgeting, Accounting & Financial Management	1	1	1
19	Revista de Docencia Universitaria	1	0	0
20	Revista Digital de Investigación en Docencia	1	0	0
21	Revista Iberoamericana de Educación Superior	1	16	16
22	Social Responsibility Journal	1	13	13
23	Sustainability Accounting, Management and Policy	1	1	1
24	Sustainable Development	1	12	12
25	Sustentabilidade em Debate	1	0	0
26	Tertiary Education and Management	1	40	40
27	The International Journal of Management Education	1	2	2

The second most cited article “The challenge of sustainability and integrated reporting at universities: A case study”, with 58 citations, was published by Journal of Cleaner Production, the authors analyses the process or implementing new models of reporting focusing on an innovative Spanish university and contributed, contributes by showing the challenges and main issues of the process of implementation [4].

In the next three topics, we performed the analyses using Iramuteq: Lexicographic analyzes, Descending Hierarchical Classification (DHC) and Correspondence Factor Analysis (CFA).

3.4 Lexicographic analysis

To perform the analyses using Iramuteq software we grouped the 50 abstracts in a single textual corpus, prepared the text and imported to Iramuteq. The lexicographic analysis of the textual corpus constituted by the 50 articles abstracts revealed a total of 10,323 occurrences; 1562 after de lemmatization of segments of the text by the software, where 1288 were active forms (82.4%) and 274 (17.5%) were supplementary forms. The corpus of analysis was made up 284 segments of the text, with 199 (70.07%) retention of the text segments in lexicographical analysis. We consider this analysis robust

because it has a retention greater than 70%, as in other studies [21, 10].

In the next topic, we analyze the Descending Hierarchical Classification.

3.5 Descending Hierarchical Classification (DHC)

From the DHC analysis was generated a dendrogram (a tree diagram), to produce this graph the software performs chi-square tests (χ^2), characterizing the bonding strength between form and class [22, 23].

The dendrogram presented in Fig. 4, has 5 classes of words, each class has the terms with the highest occurrence. With these classes it is possible to check the distance between the words from the branches present. In the present case, it is possible to notice that class 5 represents a branch, while classes 1, 2, 3 and 4 are part of another branch, divided into two groups: one containing class 4 and another containing classes 1, 2 and 3. The second group is divided in others two groups, one with class 3 and other with class 1 and 2. So, classes 1 and 2 have more similarities with each other than with class 5, and class 3 have more similarities with classes 1 and 2 than with class 5.

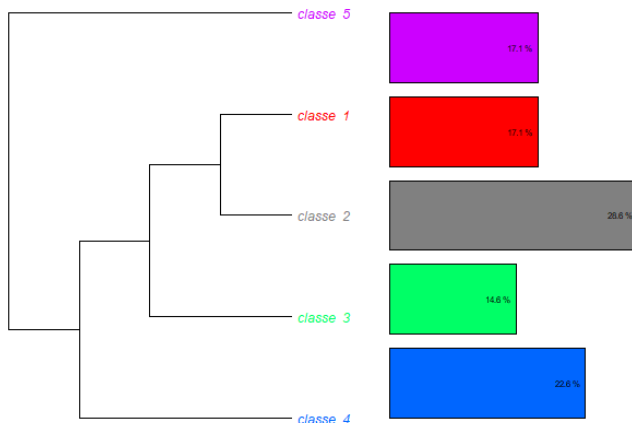


Fig. 4 - Dendrogram from Descending Hierarchical Classification (DHC).

In the class 1 the first forms are: “dimension”, “characteristic”, “show”, “finding”, “result” and “canadian”. In the class 2 the first forms are: “sustainability reporting”, “content analysis”, “university”, “purpose”, “sample” and “future”. In the class 3 the first forms are: “present”, “criterion”, “material”, “implementation”, “sustainable reports”, “discussion”, “engagement”, “define”, “aspect” and “quality”. In the class 4 the first forms are: “management”, “business intelligence”, “information”, “strategic”, “relate”, “plan”, “sustainable” and “assist”. In the class 5 the first forms are: “student”, “project”, “learn”, “write”, “part”, “prepare” and “create”. The level of statistical significance

(p) associated with the χ^2 of the forms presented here is $p < 0.0001$.

In the next topic, we analysis the Correspondence Factor Analysis.

3.6 Correspondence Factor Analysis (CFA)

At the cartesian level with CFA, it is possible to verify the distance from one class to another in a more intuitive way, as seen in Fig. 5. The classes are equally divided as in DHC, thus, Class 1: red; Class 2: grey; Class 3: green; Class 4: blue and Class 5: purple.

We can see that classes 1, 2 and 3 are interconnected, forming a single group (which has some forms highlighted: “sustainability reporting”, “university”, “study” and “paper”. In the class 4 the forms: “higher education institution”, “management” and framework are highlighted, while in class 5 the forms highlighted are: “sustainability report”, “student” and “project”.

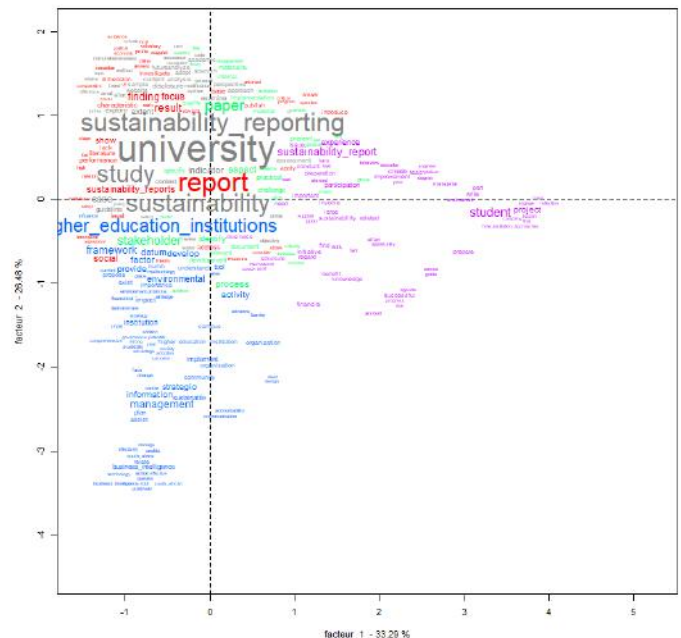


Fig. 5 - Correspondence Factor Analysis (CFA)- the most frequent active words in each of the lexical classes obtained in the DHC. Colors correspond to the lexical classes (Class 1: red; Class 2: grey; Class 3: green; Class 4: blue; Class 5: purple).

3.7 Main themes addressed by the articles

To facilitate interpretation of the results we named the classes subjectively considering top cited words of each class and their respective abstracts. Thus, the main themes prioritized by the authors in this field were obtained.

In the group of classes, composed by class 1, 2 and 3, the themes are interrelated.

Class 1 – “Sustainability Dimensions”:

As results of the research of [13], they find that there is a focus on the disclosure of the environmental dimension

of sustainability and a lack of coverage in social dimension in the Canadian universities, probably as result of their participation in the Sustainability Tracking, Assessment and Rating System (STARS) program. These authors concluded that for future studies would be interesting to investigate the voluntary behavior of universities' sustainability reports, in addition to conducting a mixed method survey and focusing on the complete portfolio of reports from these institutions, including annual and human resources reports [13].

Yalin et al. [24] addressed some characteristics of their findings in the study of sustainability reporting by China's HEIs. Among them, that economic dimension was not disclosed and the disclosure of the environmental, social and educational dimension were poor. The sustainability reporting by China's HEI is in the initial stage.

Class 2 – “Contents of the sustainability reports”:

Some research focus on evaluate the content of the sustainability reports (e.g. [19, 25, 26]).

The disclosure of sustainability reports in Turkey is still in its infancy, probably by some factors as: lack of motivations and low funding. The findings offer suggestions for developing extra sustainability indicators [25].

In the research of Zorio-Grima et al. [26] the results shows new characteristics of sustainable development strategies by Spanish public universities, such as devoting a specific sustainability reporting section in their websites, creating a sustainability body or submitting the sustainability report to external assurance. They also concluded that there are already pioneer universities in Spain with high levels of application and disclosure of sustainability reports using the sustainability indicators by the Global Initiative Report (GRI).

Class 3 – “Evaluation of sustainability reporting”:

In the study of Lubinger et al. [27], they aimed to investigate if the sustainability reporting practical of universities which had adopted the GRI guidelines really uses the materiality as a content-selection principle. They found that adoption of that principle by the universities is superficial.

Class 4 – “Sustainability reports as management tools”:

The sustainability reporting in a Spanish school of engineering has contributed among others to "develop a more comprehensive and strategic vision of the institution, which is now shared among key positions" helping the governing bodies and supporting strategic plans [28].

The authors proposed a business intelligence tool, that integrates data of multiple areas of sustainability and provides information to stakeholders, that helps to the improvement of the sustainability reporting in HEIs [16].

Class 5 – “Students involvement”:

By examining the participation of students in the writing of the sustainability report of a German university, they conclude that “students have to be aware of what they can expect from being a part of it – and what they cannot”, the students suggest to introduce of “special classes aiming at dealing with and writing the university’s report on sustainability” [29].

In order to illustrate an introductory project in an accounting course, the authors demonstrated that some students considered the project on financial / managerial accounting and sustainability reporting to be somewhat beneficial and others prefer to maintain the financial focus of the discipline [30].

IV. CONCLUSION

Based on this study, the following conclusions were obtained according to the research objectives:

- O1 - The recent publications in sustainability reporting demonstrates that the field of research is advancing, although there is much more to be researched.

- O2.1 – The top three most prominent journals in the field are: “International Journal of Sustainability in Higher Education”, “Sustainability” and Journal of Cleaner Production.

- O2.2 - The most prominent first authors in the field are: Remmer Sassen, Yi An, Brenda Scholtz, Andre Calitz and Sahar Sepasi.

- O3 – The key themes addressed by the authors in the field are: “Sustainability dimensions”, “Contents of the sustainability reports”, “Evaluation of sustainability reporting”, “Sustainability reports as management tools” and “Students involvement”.

Therefore, this article contributes on advancing of the research on sustainability reporting on HEIs and could be used by body of administration of HEIs, supporting the credibility of the sustainability reports released and by researchers on this field by addressing key themes.

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