Manufacturing Science and Education 2025

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics, Mechanics, and Engineering
Vol. 68, Issue Special III, August, 2025

GLOBAL TRENDS IN SCIENTIFIC RESEARCH OF QUALITY MANAGEMENT IN THE AUTOMOTIVE INDUSTRY: A BIBLIOMETRIC ANALYSIS

Ana-Andreea MUȚIU, Oana DUMITRAȘCU, Dănuț Dumitru DUMITRAȘCU

Abstract: *In today's context of globalization, corporations show a trend in applying a company wide management strategy. The challenges faced here are directly proportional with the size of the company, the complexity and the international footprint. This is especially valid for the automotive industry. The aim of this paper is to identify the major focus points on the topic of management in the automotive industry. This research uses a methodology that combines both literature reviews and bibliometric analysis using VOSviewer. The research has identified recurring key focus point used across the industry, but a lack of research on modern topics and quality topics. The paper concludes with recommendations and providing insights for further research as derived from the research results.*
Keywords: *automotive industry, management, performance, quality, trends*

1. INTRODUCTION

The automotive industry, generating revenues of over 2.5 trillion dollars per year [1] is of global interest in the scientific community. Any discovery and improvement brought to this field generates financial benefits for companies, in terms of customer satisfaction, sustainability, etc. A focus point of the automotive industry is standardization. The need for standardization in multi-site companies should always be attempted. The major benefits are increasing efficiency by using lessons learned and results of continuous improvement gained by one location and applied in the entire company. This approach needs to be corelated with regional approaches, linkage between sites and local value chains [11].

The scientific articles indexed in Web of Science present a variety of topics. The main purpose of this research is to identify and examine the literature to underline the development of research in this field and potentially identify areas where research can be expanded and developed in future scientific publications focusing on the automotive industry in correlation with themes such as management and quality.

2. LITERATURE REVIEW

Quality in the automotive industry is defined as those features of a product which not only meet the customer needs, but also ensure the customer satisfaction and it can also be interpreted as a freedom from deficiency [6]. In the automotive industry, the trends show higher investments in processes or machines that improve the quality of the product and the robustness of the processes overall. [8]

The automotive industry is undergoing rapid transformation, driven by the need for smarter, more agile, and highly efficient manufacturing processes. Traditional manufacturing models, while effective in the past, have proven to be costly, inflexible, and slow in responding to dynamic market demands. [5]

It is also worth mentioning, that the industry needs to ensure their sustainability and concentrate on waste reduction and implement Lean Management throughout the company, but focusing on the supply chain. [9]

Another leading trend in the industry and scientific literature is Industry 4.0, which is taking advantage of the technological advancements, often emphasized on logistics, but which is most effective when implemented on all areas of a company, such as production, quality, human resources and innovation management. [10] Effective complaint management and quality control tools in an Industry 4.0 framework can improve automotive component production by identifying root causes of defects, implementing corrective measures, and enhancing customer satisfaction. [12]

Project management is also an underutilized resource, as strategic alignment with business goals can contribute to a greater resource optimization, enhance efficiency and competitiveness. [3]

However, the past years have shown a shift in focus, due to the many crises which the automotive industry has and is continuing to face. The most notable is the semiconductor crises, which some researchers corelate as a direct impact of Covid-19 [4]. This crisis has shifted the focus of researchers on matters of supply chain, especially focusing on bottle necks. The new trends in supply chain in the automotive industry include adapting company strategies to repurposing the resources they have, scalability, substitution, regionalization of supplier and many more. [2]

Lastly, there is a generic need for better data-driven decision-making, cross-functional collaboration, and digital transformation to improve Total Quality Management (TQM) and customer engagement. [7]

3. METHODOLOGY

This research uses a methodology based on literature review and bibliometric analysis, using Web of Science and VOSviewer. The research methodology fulfilled the proposed objectives by following the steps below:

Step 1 – Selection of bibliographic database: The data collection process uses the Web of Science database, selected for its significant and representative role in bibliometric research. The research was carried out in January 2025.

Step 2 – Establishing the filtering criteria: The topic was analyzed using a key word search. This was performed 3 times, refining the keyword list based on the results seen in the previous analysis. The filters used were in regards to limiting the language to English and only considering published scientific articles, excluding news, notes and discussions. The first search was performed using the syntagm “management” AND “Automotive” OR “Automotive Industry”.

Based on the first search, the second was performed using "Management" AND "Quality Management Systems".

After the second set was analyzed, the third and final analysis was performed using the following syntagm "Management" AND "Automotive" OR "Automotive Industry" AND "standardization" OR "Common process" AND "Manufacturing" AND "Quality".

Thus, a narrowing of the purpose and a focus on the most relevant content could be concluded.

Step 3 – Collecting the data from Web of Science: The first and biggest data set collected was of 3000 documents, of which all were in English, covering the period 1994-2024.

Step 4 – Exporting the results: Plain Text File (.txt) was chosen to export “Full Records and Cited References”. Each analysis generated one .txt file, thus the research used 3 files.

Step 5 – Import into VOSviewer: The files were imported into VOSviewer to undergo processing by the automatic protocols and algorithms and only keywords which appeared more than 5 times were retained for further processing.

Step 6 – Creation of the thesaurus file: To ensure a high-quality representation and analysis of the keywords, synonymous terms were identified, including singular and plural forms, and combined forms.

Through this procedure, the quality of the keywords was highly improved, thus forming the foundation for automatically generated maps based on bibliographic data.

Step 7 – Analyzing the data processed in VOSviewer: The focus of the VOSviewer analysis was the keywords clusters and improving them throughout the three analyses performed.

For each analysis the network visualizations and network maps were reviewed to establish the major focus point of the existing literature and which areas, even if of interest today, are not enough covered by the existing scientific articles.

4. RESULTS AND DISCUSSIONS

Based on collected documents, three analyses were generated. These were examined and the results are interpreted and summarized below, but also include the original figures as generated by VOSviewer.

4.1. First analysis

Using the keywords "management" together with "automotive" and "automotive industry" the first analysis was carried out.

The most relevant approximately 3000 scientific articles were processed, which are the common basis for the second and third analysis performed.

The data analyzed highlighted four groups of keywords, which can be seen in Fig.1 and interpreted as follows:

- The red group, which has terms of increased homogeneity, focuses on problems, applications, time, costs and tools.
- The green group is distinguished by a strong focus on performance, practices, implementation and relationships.
- The yellow group, smaller in size, focuses on suppliers.
- The blue group focuses on production, economy, countries and demand.

Fig.2 highlights the selected words on a time scale. The largest and oldest mentions are about suppliers, and the most recent and underrepresented are about employees, growth, experts and decision-making processes.

In Fig.3, the most common terms can be observed, and by observing their size, their homogeneity can also be observed.

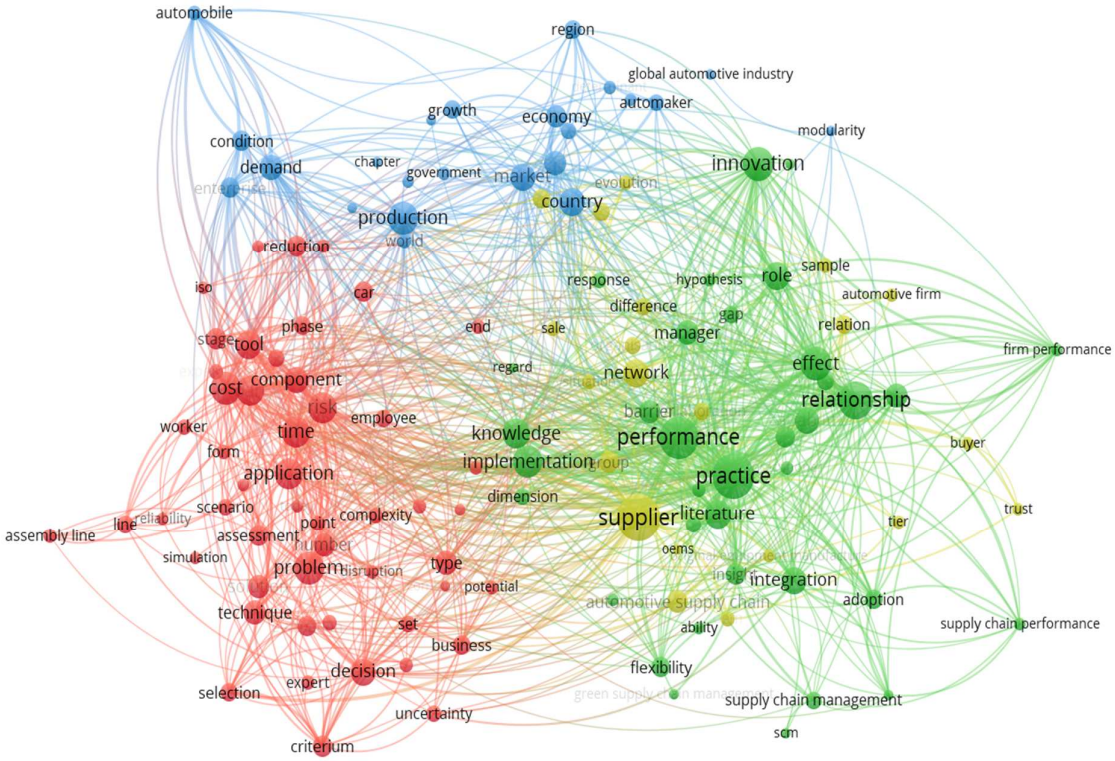

Fig. 1. First analysis – Network Visualization

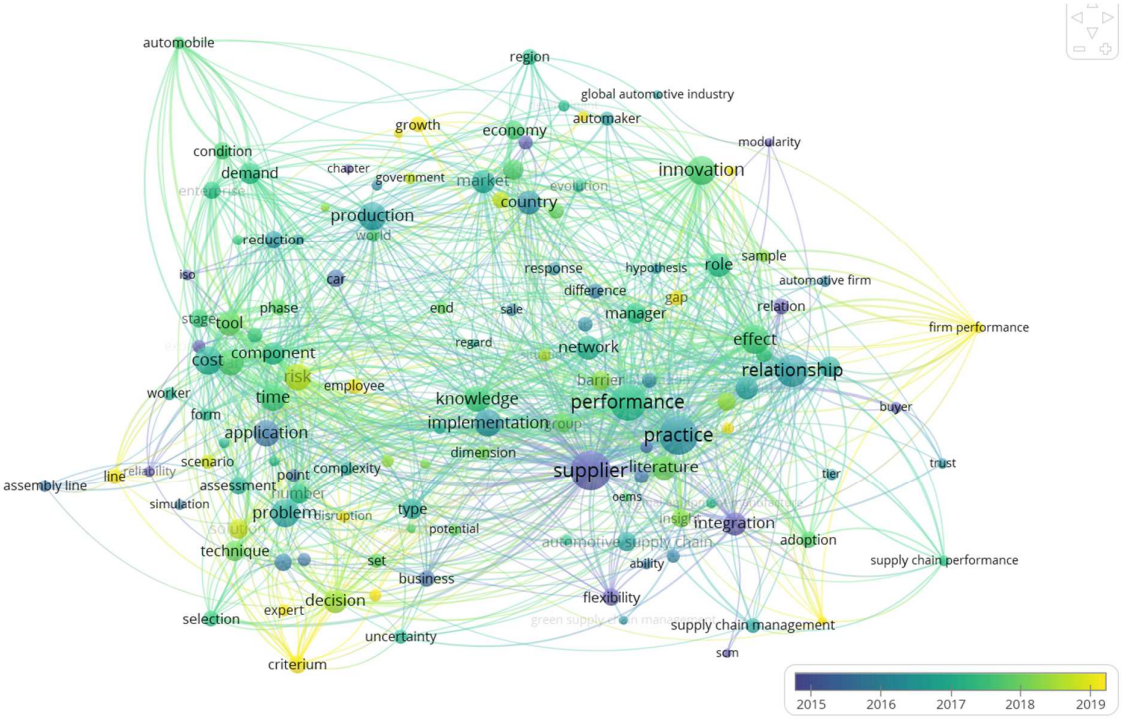

Fig.2. First analysis – Overlay Visualization

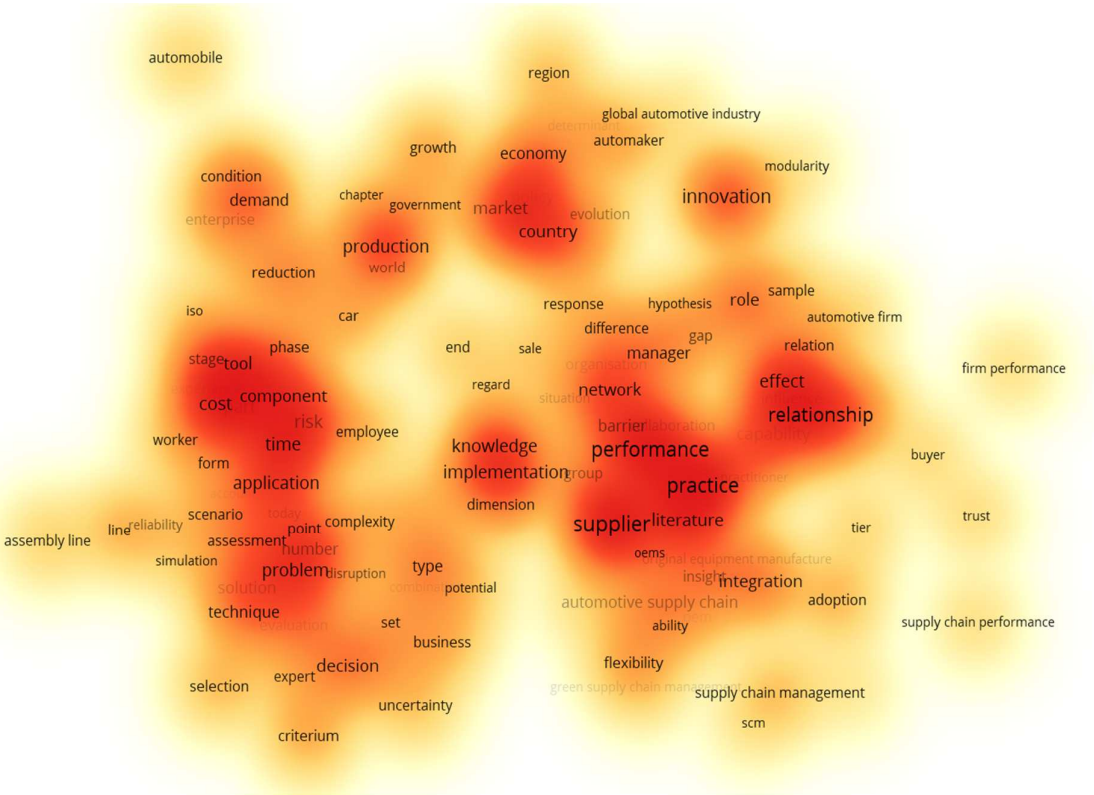

Fig. 3. First analysis – Density Visualization

4.2. Second analysis

After the first analysis, the focus was narrowed by using more specific keywords. The new search criteria included:

- "management"
- "automotive" and "automotive industry"
- "standardization"
- "common processes"
- "manufacturing
- "quality"

In Fig.4, four clusters can be observed, two of which predominate in size and amplitude. Predominantly in the group marked in red are correlations on the performance side and supply chain. In the group marked with green, the focus is on the system side, tools, costs and efficiency. In the yellow group, the emphasis is on the suppliers, and in the last group, marked in blue, the customer predominates.

Fig.5 also shows on a time scale the degree of use of keywords and the correlations formed. Thus, it can be concluded that the topic related to the supplier and product was published predominantly before 2015. Topics related to systems, performance and good practices came into focus around 2016. The least developed and recent points of interest refer to efficiency, risk, innovation and roles.

Analyzing Fig.6, the previous conclusion regarding the focus of scientific articles being predominant on the supplier side, production chain, performance and systems is highlighted.

Another conclusion that can be drawn from this analysis is that, although the initial keywords used were "quality", the number of terms found in the results of the analysis are very few.

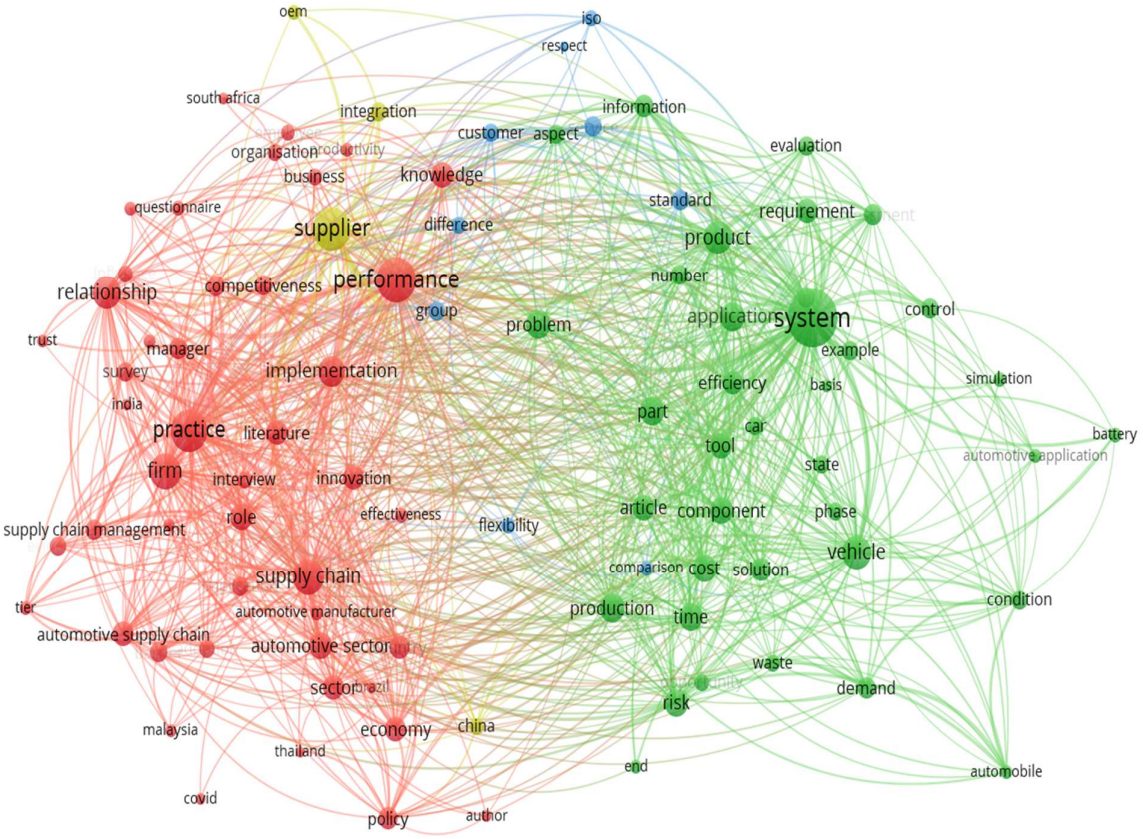

Fig.4. Second analysis – Network Visualization

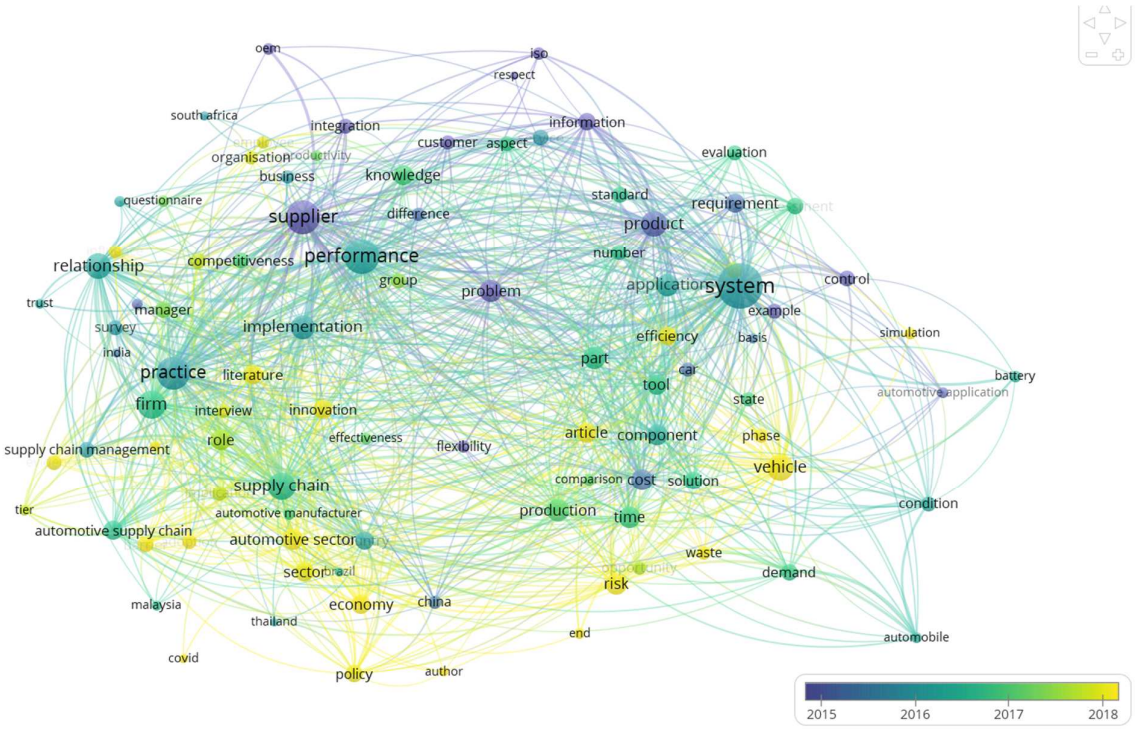

Fig.5. Second analysis – Overlay Visualization

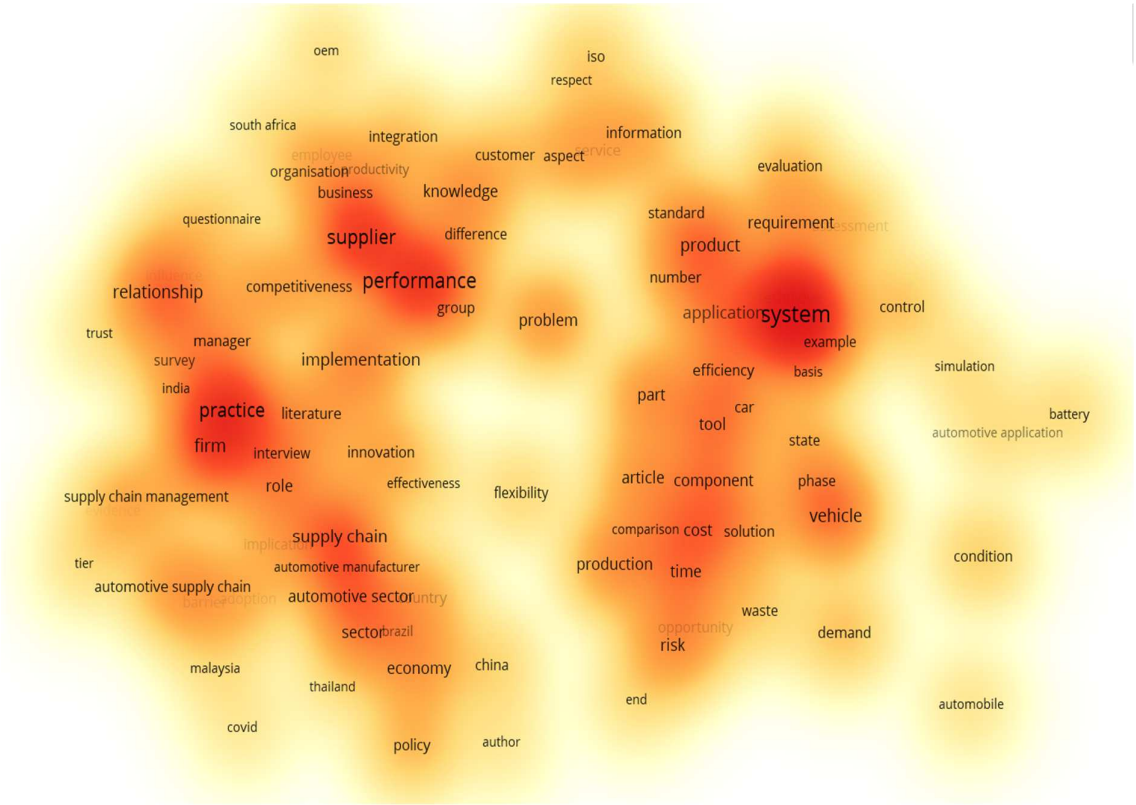

Fig.6. Second analysis – Density Visualization

4.3. Third analysis

Noting the lack of terminology in the field of quality, the third analysis was carried out using the keywords "management" and "quality management systems" using the most relevant approximately 1000 scientific articles that were processed.

In Fig.7, more groupings are found than in the previously analyzed cases, and the results focus on the following terms:

• The red group, which has terms of increased homogeneity and a relatively small size, focuses on procedures, quality assurance, risk and training.

• The green group stands out for its strong emphasis on benefits.

• The small yellow group focuses on the customer, customer satisfaction and solutions.

• The dark blue group focuses on quality management systems.

• The light blue group focuses on the concept of "total quality management"

• The purple group, highlights impact, innovation and performance.

• The orange group emphasizes classic terminology, referring to product, production and traceability.

In Fig.8, on a time scale, keyword usage is predominant in the 2021-2018 range. There is a recent emphasis in the specialized literature to refer to quality standards such as the IATF.

Analyzing Fig.9, the focus on impact, benefits, certifications, product and risk is highlighted.

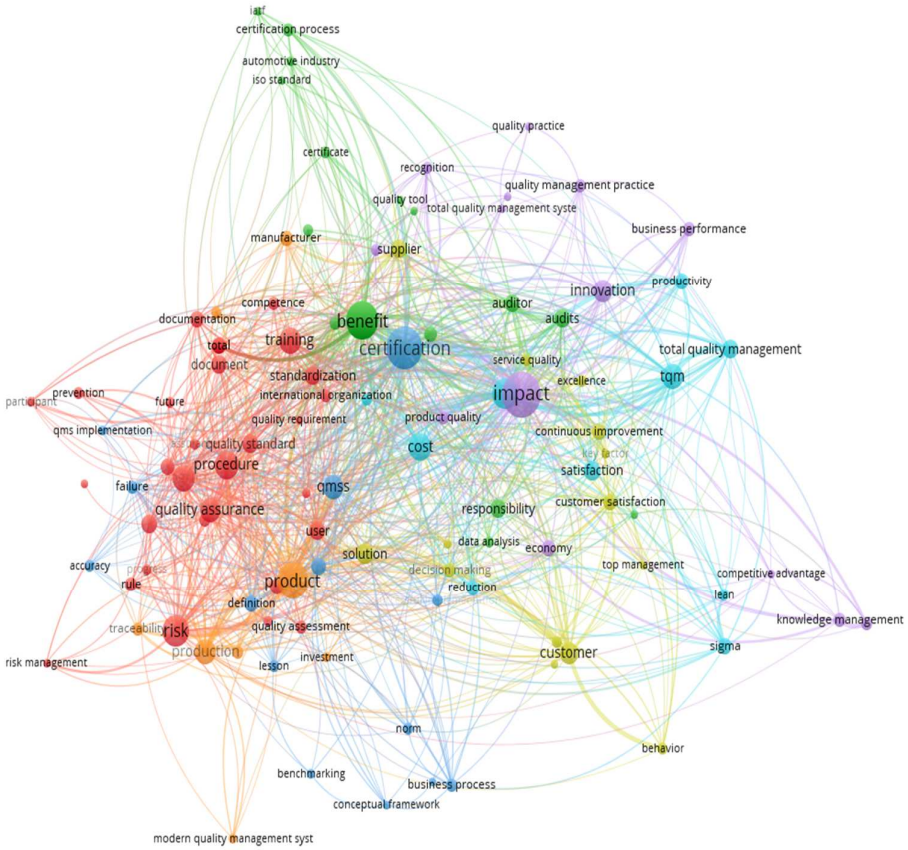

Fig.7. Third analysis – Network Visualization

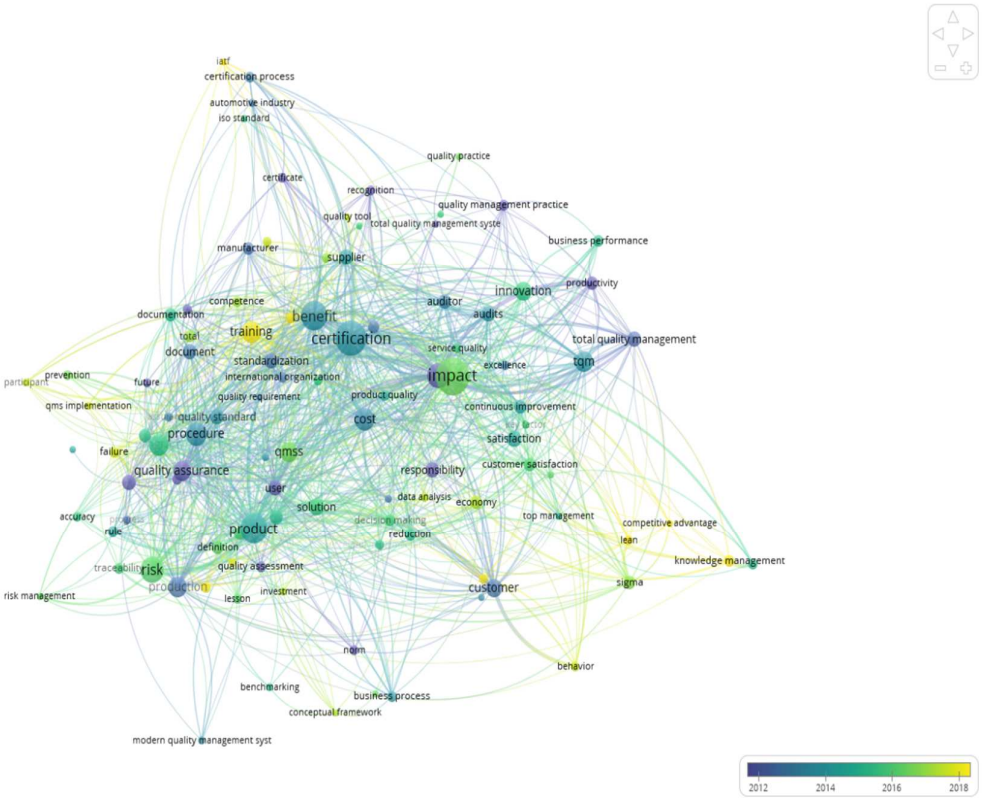

Fig.8. Third analysis – Overlay Visualization

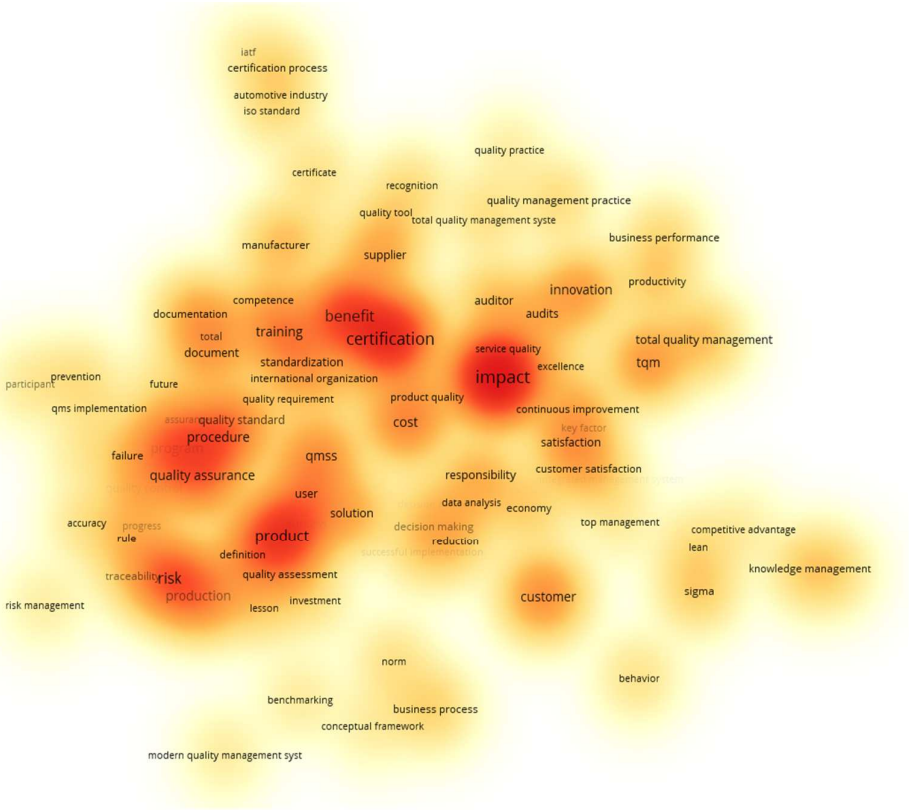

Fig.9. Third analysis – Density Visualization

5. CONCLUSION

The analysis provided was performed using a standardized methodology with professional software. The original contribution of selecting the most relevant keywords, but also the succeeding selection criteria of the scientific articles and the interpretation of the results are contributing with a new view of the topic within the field of interest.

The current global trends in the automotive industry, its management and thus available scientific literature are highly focused on the following topics:

- performance: referencing not only financial performance of companies, but also production capacity, the performance of human resources and performance management;
- the supply chain: focusing not only on financially advantageous suppliers, but mostly on a robust supply chain, avoiding bottle-necks and having multiple suppliers per part, thus creating flexibility in the supply chain;
- overcoming crisis or external impacting factors, which have been highlighted by recent events;

The focus on quality and internal improvement has been lacking in the past years, as it is not the biggest factor or the highest risk to the industry.

The analysis carried out on scientific articles in the field of management and the automotive industry aimed to identify the key words and main topics highlighted. The correlation with management and quality, aimed to highlight the main areas treated in the scientific literature. Also, the dispersion of articles on the theme of quality, in correlation with the theme of management, was highlighted.

It is also mentioned that this quantitative analysis of scientific articles has a limitation, i.e. it does not facilitate the analysis of these articles from the perspective of their quality. In order to incorporate qualitative analysis, a manual evaluation, without the assistance of bibliometric tools, of all articles would be necessary.

Nevertheless, the analysis provided has highlighted a potential niche in existing scientific literature which could and should be taken advantage of by further researchers and saturated.

The benefits of deep diving on the topic, finding further similarities and proposing new and modern solutions on the topic of quality, management and manufacturing targeted specifically on the automotive industry would benefit the entire industry.

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Analiza bibliometrică a tendinţele globale în cercetarea ştiinţifică a managementului în industria automotiv globală

În contextul globalizării curente, corporațiile semnalează o tendință în aplicarea unei strategii de management la nivel de companie. Provocările cu care se confruntă aici sunt direct proporționale cu dimensiunea companiei, complexitatea și amprenta internațională. Acest lucru este valabil mai ales pentru industria auto. Scopul acestei lucrări este de a identifica punctele de interes majore pe tema managementului în industria auto. Această cercetare utilizează o metodologie care combină atât recenziile literaturii de specialitate, cât și analiza bibliometrică folosind VOSviewer. Cercetarea a identificat un punct de focalizare recurent folosit în industrie, dar o lipsă de cercetare pe subiecte moderne și pe tema calității. Lucrarea se încheie cu recomandări și oferă perspective pentru cercetări ulterioare, derivate din rezultatele cercetării.

Ana-Andreea MUȚIU, PhD Candidate - Management, "Lucian Blaga" University of Sibiu, anaandreea.mutiu@ulbsibiu.ro, +40.720.064.338
Oana DUMITRAȘCU, Associate Professor, PhD, "Lucian Blaga" University of Sibiu, oana.dumitrascu@ulbsibiu.ro, +40.741.035.311.
Dănuț Dumitru DUMITRAȘCU, Professor, PhD, "Lucian Blaga" University of Sibiu, dan.dumitrascu@ulbsibiu.ro, +40.741.035.313