



Design of Experiments (DoE) for the Service Industry

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Design of Experiments (DoE) for the Service Industry

by

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A thesis submitted in partial fulfillment of the requirements for the degree of

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Abstract

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In today’s economy, service industry plays a crucial role. Service industry encompasses sectors such as education, healthcare, hospitality and retail. Due to the nature of this sector, performance and service quality are crucial to the customer satisfaction which is an important driver of the sector. Design of experiments is a statistical tool that analyzes how changing inputs impact the output. In the context of the service industry, the use of design of experiments to improve service performance metrics is not as common as its use in the manufacturing sector. This thesis conducts a systematic literature review along with bibliometric analysis techniques in order to investigate how design of experiments have been used so far in the service industry with the goal of providing insights into the use of design of experiments to decision makers.

Indexing Terms: Design of Experiments, Service Industry, Systematic Literature Review, Bibliometric Analysis, DoE

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Declaration and Copyright

Declaration

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A handwritten signature in black ink, consisting of a large, stylized loop at the top, followed by a series of smaller loops and a long horizontal stroke extending to the left.

Date: 17/07/2023

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Chapter 1.0 Introduction

The service industry plays a crucial role in today's global economy, encompassing a wide range of sectors such as healthcare, hospitality, transportation, and financial services. In this sector, delivering high-quality services and ensuring customer satisfaction are paramount. To achieve these goals, organizations can leverage the power of DoE. DoE is a tool that allows its users to investigate systematically what are the factors that are most influential to target measurable output, enabling service providers to identify critical factors, enhance service quality, and improve operational efficiency [1]. The service industry presents unique challenges and opportunities for implementing DoE. Unlike manufacturing processes, services are often intangible, variable, and highly dependent on customer interactions. However, DoE can be adapted and tailored to suit the specific needs of service organizations.

Experimental design techniques, such as Taguchi methods, form the foundation of DoE success in the service industry. These methods enable service organizations to determine the appropriate levels of factors, allocate resources efficiently, and obtain reliable and statistically valid results, as reported by [2]. In healthcare, for instance, DoE can be utilized to optimize patient flow, staffing levels, and resource allocation in hospitals. By identifying key factors, such as appointment scheduling, triage processes, or layout design, healthcare providers can enhance patient experiences, reduce waiting times, and improve overall operational efficiency [3]. In the hospitality industry, as described by [4], DoE can be employed to optimize hotel services such as check-in and check-out processes, room cleanliness, or dining experiences. By conducting controlled experiments, hotels can identify factors that significantly impact customer satisfaction and make data-driven improvements.

Other case studies have demonstrated the effectiveness of DoE in the service industry. An experiment conducted in a call center aimed at improving call handling time and customer satisfaction. By utilizing DoE, the researchers identified critical factors, including call script content, training methods, and call volume, and optimized these factors to achieve substantial improvements in service [5]. Another experiment focused on finding the optimal layout and design of a restaurant to enhance customer experiences. By applying DoE principles, the researchers evaluated factors such as seating arrangements, lighting, and ambiance. The results revealed the optimal configuration that positively impacted customer satisfaction and the overall dining experience [6].

Despite the effectiveness of DoE in the service industry, it is still faced with certain limitations and challenges, such as ethical considerations [3], when conducting experiments that involve human subjects or impact patient care in the service industry that raise ethical concerns. Human subjects research and medical treatment raise unique ethical challenges because of the potential for experimentation or intervention to cause damage or undermine the well-being of study participants. If a service provider in the

healthcare industry, for example, wishes to try out a new treatment technique or procedure on their patients, they must make sure that the intervention does not pose any serious dangers to them. The study also ensures informed consent, privacy protection, and fair treatment of participants, which becomes crucial. Another study that also examined practical constraints was [4]. The study's findings revealed that implementing controlled experiments in real-time service delivery settings can be challenging. Operational disruptions, resource limitations, and the need for cooperation from multiple stakeholders can impact the feasibility of conducting experiments.

Another study in the field of dynamic service environments stated that services are often characterized by high variability and a dynamic nature. The complexity of service systems, customer heterogeneity, and environmental factors make it challenging to control all variables in experiments. [2] stated that skilled statistical expertise is required in order to effectively design and analyze experiments. It was also stated that the availability of skilled statisticians and data analysts can pose a challenge for service organizations, especially smaller ones. Similarly, [5] discussed the resource allocation for conducting experiments in the service industry, including time, personnel, and budget, can be demanding. Also balancing the need for experimentation with ongoing service delivery can be a challenge.

Therefore, these limitations and challenges highlight the need for careful consideration and adaptation of DoE techniques in the service industry. Addressing ethical concerns, developing innovative experimental designs, and promoting collaboration between researchers and service providers can help overcome these challenges. It is essential to grasp the basics of experimental design to understand how DoE is applied in the service industry. DoE involves the systematic manipulation of factors (independent variables) to observe and analyze their effects on specific responses (dependent variables). By carefully designing experiments, service providers can identify the most significant factors and optimize their impact on service outcomes.

Thus, the current research aims to systematically review recent literature on DoE in the service industry, and the purpose of this report is to explore the applications of DoE in the service industry.

This study aims to provide valuable insights to service organizations by conducting a rigorous review and analysis of the factors that influence service delivery and customer experiences. This involves identifying the authors and sources, understanding their research focus, examining their methodologies and implementation strategies, and evaluating the obtained research results. This current paper will provide an in-depth look into DoE in the service industry, covering fundamental principles, practical application, and real-world case studies. To accomplish this, the following research questions were addressed in this study:

RQ1: Which authors and journals lead the literature on the use of DoE in the service industry and which articles are cited the most?

RQ2: Mainly, what are the researched topics, which countries are leading the scientific contribution and what are the most used words in the literature on the use of DoE in the service industry?

RQ3: How can DoE be effectively applied to optimize customer experiences in the service industry?

RQ4: What are the key factors influencing service quality in the service industry, and how can DoE help identify and optimize them?

RQ5: What are the scientific contributions relating to the use of DoE in the service industry from an inductive analysis perspective?

Research question one seeks to investigate the application of DoE in optimizing customer experiences, with the goal of addressing challenges and issues identified in previous research. This study aims to gain insights into the current knowledge and approaches used in applying DoE in the service industry by analyzing relevant literature and identifying prominent authors and journals in the field. Service organizations can gain valuable knowledge and guidance on effectively utilizing DoE to enhance customer experiences and improve service quality by understanding the strategies, methodologies, and findings of relevant studies. This can lead to enhanced service quality, personalized offerings, and tailored experiences that meet customer expectations. The second research question will identify the key factors influencing service quality that are essential for the service industry to allocate resources effectively and prioritize improvement efforts. Also, the third question will assist by providing means by which service organizations can improve operational efficiency by identifying inefficiencies and bottlenecks within their processes. The fourth research question seeks to determine the primary factors that impact service quality in the service industry and explore how the use of DoE can aid in identifying and optimizing these factors.

The fourth research question will investigate the factors influencing service quality in various service sectors, including appointment scheduling, triage processes, layout design, and other relevant variables. Service organizations can use DoE principles and experiments to analyze the impact of various factors on service quality and make informed improvements.

The ethical challenges of DoE experiments in the service industry are distinct from the factors that influence service quality. Ethical challenges in research encompass various aspects, including obtaining informed consent, safeguarding privacy, ensuring fair treatment of participants, and conducting experiments involving human subjects or affecting patient care in a responsible manner. Ethical considerations play a

crucial role in the design and implementation of experiments, but they are not directly linked to the factors that influence service quality.

Understanding these ethical challenges allows organizations to design experiments that adhere to ethical guidelines, promote transparency, and safeguard the well-being of participants. While the last question will present unique, innovative experimental designs and techniques for implementing DoE in variability, customer heterogeneity, and real-time service delivery, By addressing these research questions, organizations can gain valuable insights, implement targeted improvements, and enhance various aspects of service delivery, ultimately leading to improved customer experiences, increased operational efficiency, and enhanced resource allocation.

Chapter 2.0 Research Methodology

The current review will follow the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines [7]. The methodology followed will be categorized into different phases, with the first phase being the creation of the protocol, the second phase being the formation of the inclusion and exclusion criteria, and the third phase being a literature search from the database, screening of papers by the researcher, covering the title and full-text screening, followed by extraction of data of interest from the included studies. While the fourth phase involves assessing the quality of the selected articles using the five criteria of questions mentioned by [8]. The remainder of the research will include results synthesis and discussion; a flow chart representing all phases is shown in Fig. 1.

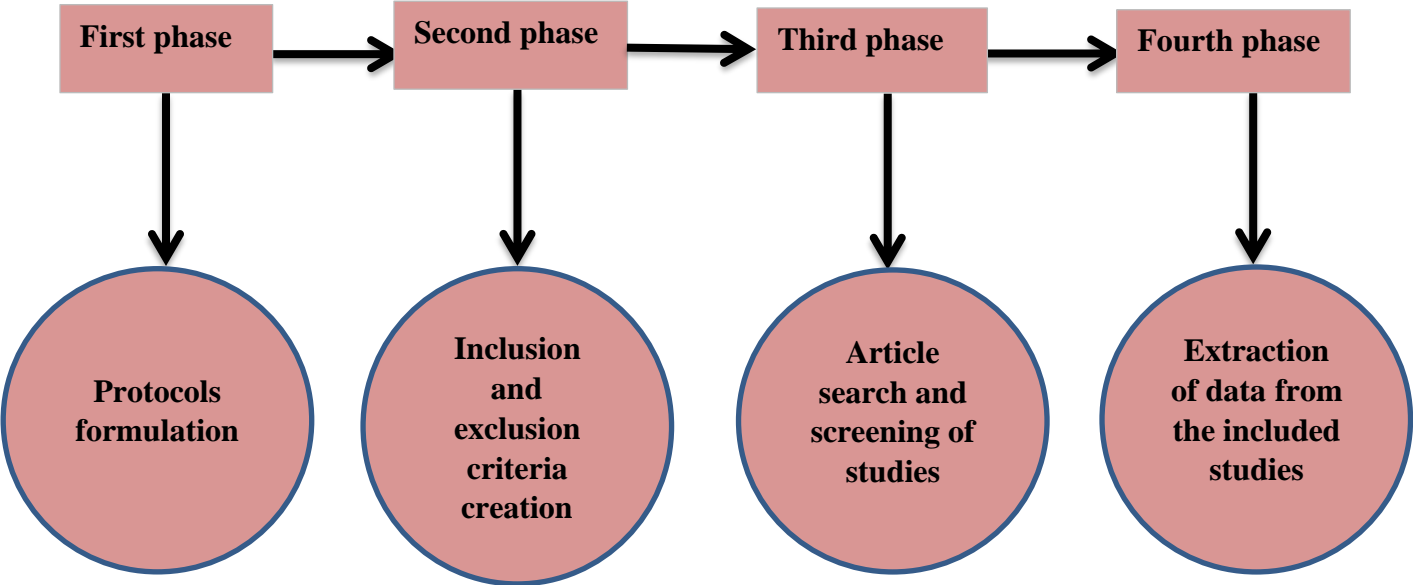


Figure 1: Research phases

2.1 The research protocol

The study protocol outlined the main research question that controlled the procedure for searching and choosing of papers, the data sources and search words, the standards for inclusion and exclusion, and the section on findings, The current review was guided by the following research question: *RQ1: Which authors and journals lead the literature on the use of DoE in the service industry and which articles are cited the most?; RQ2: Mainly, what are the researched topics, which countries are leading the scientific contribution and what are the most used words in the literature on the use of DoE in the service industry?; RQ3: How can DoE be effectively*

applied to optimize customer experiences in the service industry?; RQ4: What are the key factors influencing service quality in the service industry, and how can DoE help identify and optimize them?; RQ5: What are the scientific contributions relating to the use of DoE in the service industry from an inductive analysis perspective?

2.2 Inclusion criteria

In order to validate the general rationale of the systematic review on DoE in the service industry, included studies for the review were chosen using the following criteria: Relevant studies published between 1985 and 2023, studies published in English, studies published in an academic outlet such as original articles published in a peer review journals, and papers included case study were also included because the topic addressed the effectiveness of DoE in the service organization.

2.3 Exclusion criteria

The exclusion criteria comprised some standards evaluated in selecting publications that were less relevant to the research issue in question; this metric contained less relevant or lacking data that backed this kind of research, among other things. To carrying out adequate investigations, the following exclusion criteria were employed to identify "Not Useful" studies: conference papers and studies that used a quasi-experiment were excluded also, studies not published in English, and studies lacking relevant data to supplement the present study were all removed.

2.4 Data source and search process

The databases that were utilized for this review were Web of Science (WoS) and Scopus. The choice to use Web of Science (WoS) and Scopus as the databases for this review is justified due to their reputation and extensive coverage of academic literature across multiple disciplines. WoS and Scopus are reputable databases that offer extensive access to scholarly publications, such as journals, conference proceedings, and other relevant sources. Research articles are widely covered and commonly accessed by researchers and scholars for reliable and authoritative academic literature. This review aims to access a wide range of high-quality studies on the use of DoE in the service industry by utilizing various databases. The goal is to conduct a comprehensive analysis of the existing literature. The extent of the literature search was brought upon on the inclusion and exclusion criteria. Search started by combining two or more search terms to create keywords. The

keywords were searched for in the title, abstract, and link. Papers that are most relevant relating to the study topic were picked. Search terms can be found in table 1.

2.5 Study selection

The hits produced by the two databases amount to 6,299 articles, with 1,153 items from Scopus and 5,146 articles from Web of Science. The used keywords can be found in Table 1 below. The first stage of screening is duplicate removal, followed by screening the title and abstracts to select papers that fit the current research, the full text, and the authors look through the technique and results, excluding publications that are not relevant.

Table 1: Keywords used, and number of articles returned for each database.

Database	Keywords	Number of Articles
Web of Science	(("design of experiments" OR "designed experiments" OR "Experimental design") AND ("Factorial array" OR "Factorial design" OR "Taguchi" OR "Screening" OR "Plackett-burman" OR "plackett burman" OR "response surface methodology" OR "Fractional") AND ("Airline" OR "retail" OR "healthcare" OR "marketing" OR "law" OR "finance" OR "agriculture" OR "military" OR "service" OR "logistics" OR "Dairy" OR "Supply chain" OR "bank" OR "finance" OR "insurance" OR "education" OR "financial" OR "human resources" OR "sales" OR "transportation" OR "shipping" OR "software development")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English"))	5,146
Scopus	(("design of experiments" OR "designed experiments" OR "Experimental design") AND ("Factorial array" OR "Factorial design" OR "Taguchi" OR "Screening" OR "Plackett-burman" OR "plackett burman" OR "response surface methodology" OR "Fractional") AND ("Airline" OR "retail" OR "healthcare" OR "marketing" OR "law" OR "finance" OR "agriculture" OR "military" OR "service" OR "logistics" OR "Dairy" OR "Supply chain" OR "bank" OR "finance" OR "insurance" OR "education" OR "financial" OR "human resources" OR "sales" OR "transportation" OR "shipping" OR "software development")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English"))	1,153

2.6 Data Extraction

The following data was extracted from the included papers into a predefined sheet; Author name, title of article, studies design, Year of publication, affiliation, number of studied factors, DoE strategy, Main Findings, strategies employed, limitations, benefits, Contribution, and Conclusion.

Chapter 3.0 Results

3.1 Study Selection

The study procedure selection as displayed in Figure 2 displays the approach for obtaining papers obtained through query searches using keywords. The total number of papers obtained initially search was 6,299 from the two different databases Scopus and WOS. These papers were examined, and 3,785 duplicated papers were found which were eliminated from the rest of the studies. After carefully examining the titles and abstracts by the researchers, 1,304 conference studies were further removed due to articles not relevant to the current study, publications lacking an abstract, and techniques not provided in some articles. During whole-text screening a total of 1,203 papers were removed from which 945 used quasi-experiment, and 258 papers were removed from consideration due to irrelevant results and research with mixed participants. Due to insufficient data, 34 papers were included for the research. Figure 2 shows the study selection procedure.

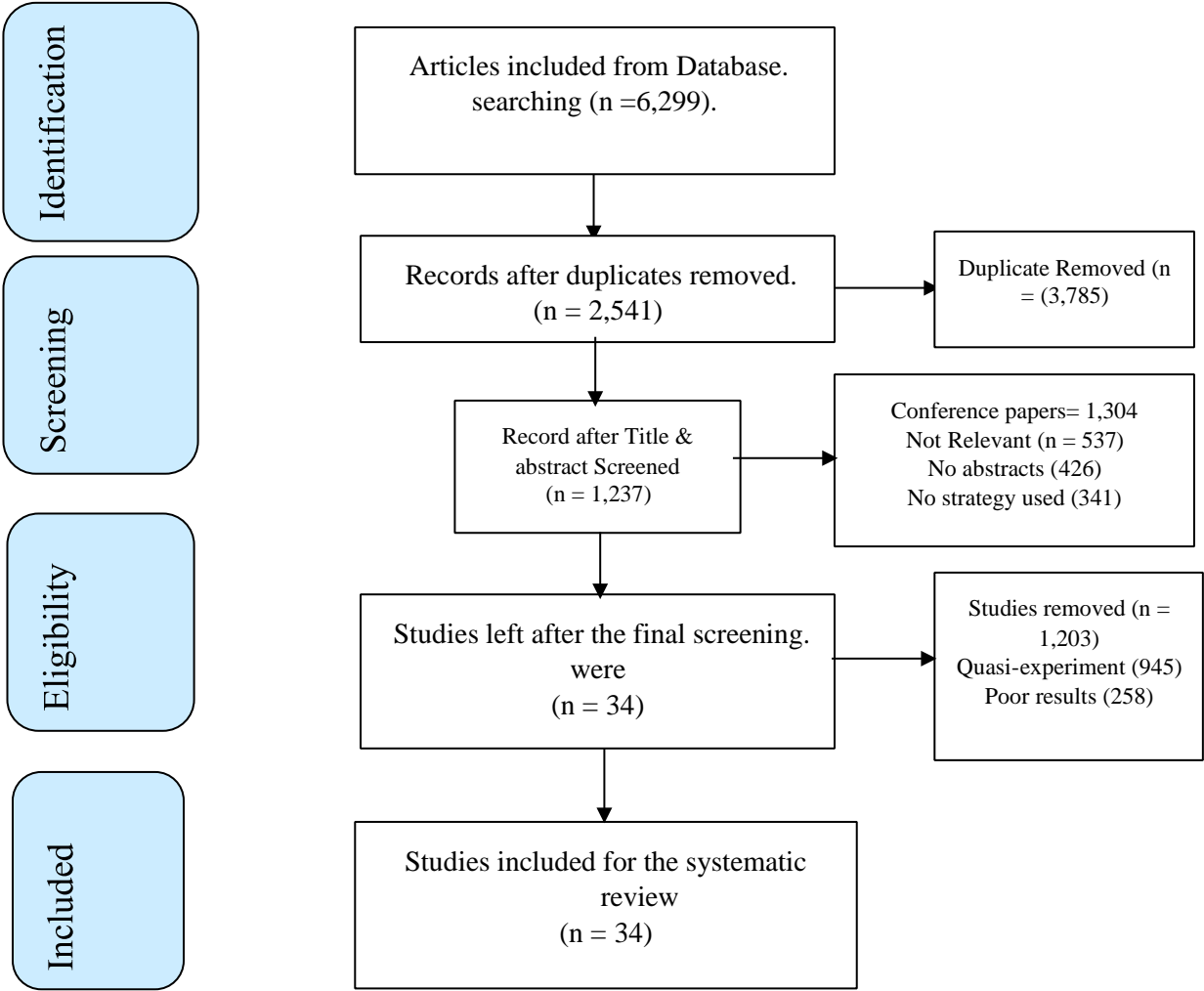


Figure 2: Study selection procedure

3.2 Characteristics of the included studies

Papers used for this review were displayed in table 2 which contains basic data of the studies such as Author's name, Article title, country of affiliation and year of publication. One researcher published a paper that reported three different DoE implementations in the healthcare industry while in the marketing industry, two experiments were performed and reported in the same paper. Overall, 59% of articles were obtained from Web of Science while Scopus accounts for 41% articles. The analysis examined the production of articles over a span of 26 years, from 1996 to 2021. The number of articles published each year varied, indicating fluctuations in research activity and interest in the topic over time. From 1996 to 2000, there were only a few articles published, with zero or minimal activity in some years. However, starting from 1999, there was an increase in the number of articles, with two articles published in that year. This upward trend continued in the following years, with occasional fluctuations and periods of lower publication activity. In the early

2000s, there were a few years with no articles published, indicating potential gaps or shifts in research focus during those periods. However, there were notable spikes in publication activity in 2005 (1 article), 2006 (2 articles), and 2008 (2 articles). The years 2011, 2012, and 2013 witnessed a relatively higher number of articles published, with each year having 1 or 2 articles. This suggests a period of increased research interest, or the emergence of new perspectives or methodologies related to the design of experiments in the service industry. From 2014 to 2016, the number of articles remained consistent, with 2 articles published each year. This indicates a sustained level of research output during this period. In 2015, there was a slight increase in the number of articles, with 3 articles published, suggesting a potential growth in research activity and the exploration of new dimensions within the topic. The most significant surge in research output occurred in 2011 to 2015, with 6 articles published. This indicates a notable increase in research interest and productivity in that particular year. In subsequent years, the number of articles decreased, with no articles published in 2017 and 2018, and no articles identified in 2020. However, there was one article published in 2021, indicating some level of continued research activity. The annual production overtime demonstrates variations in research output on the design of experiments in the service industry. The fluctuations suggest shifts in research focus, periods of increased or decreased interest, and potential emerging trends or areas of exploration within the field (Figure 3). Figure 4 shows the studies were carried out from different industries as healthcare industry with 8 papers performed as the most, 7 were from retail, 5 from marketing, 4 from customer service, 3 were studies from education while 2 were from aftersales and lastly one study each from catering, airport, military, restaurant, and tourism respectively.

Figure 3: Distribution of included studies by year of publication

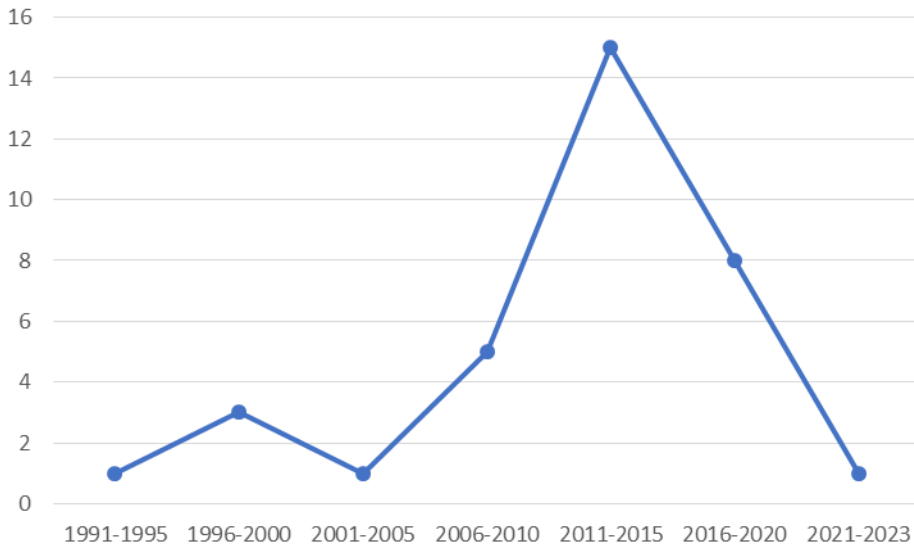
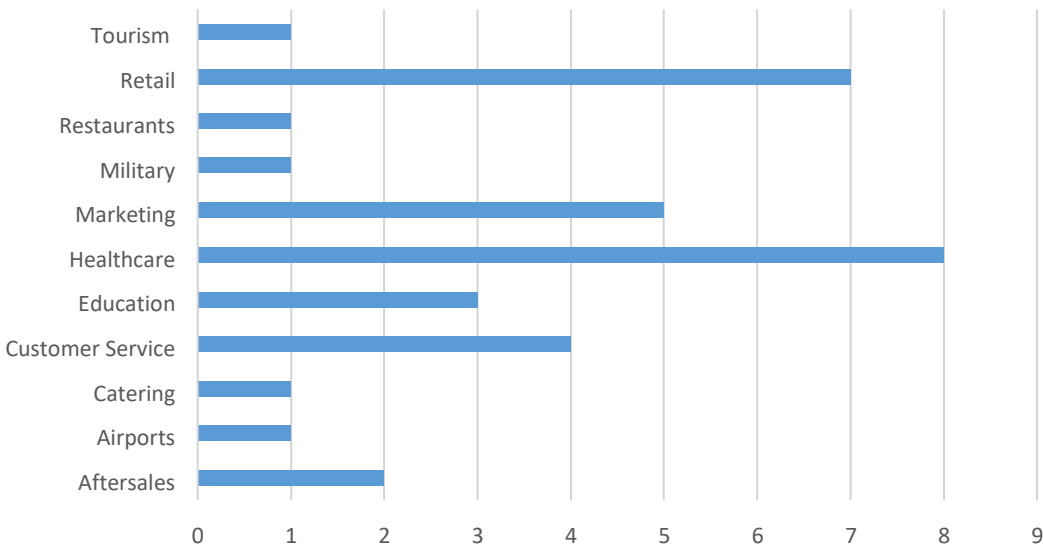


Figure 4: DoE applications by service industry



The study found that experiment types were determined by either physical or simulation-based methods. According to Figure 5, 71% engaged in physical experiments compared to simulation-based experiment with 29%. Figure 6 shows reported number of replications, 17 studies were replicated once, 7 studies report 2 to 10 replications, while 4 studies reported replications between 11 to 100 and finally, more than 100 replications were reported by the remaining 6 studies. It was

also observed that the experiments with 50 and 30 replications used simulation to carry out the experiments. Simulation provides the advantage of easily replicating experiments compared with physical experiments [A25]. However, some sectors could be an exception. For example, a study in the marketing sector was replicated 2500 times due to the nature of the sector. The design of experiment strategy used by the studies were classified into different categories. According to figure 7, The most adopted DoE strategy was full factorial with 47%, followed by taguchi with 35% while screening method, and fractional factorial have least studies with 9, 6, and 3 percent respectively.

Figure 5: Distribution of conducted experiments by type

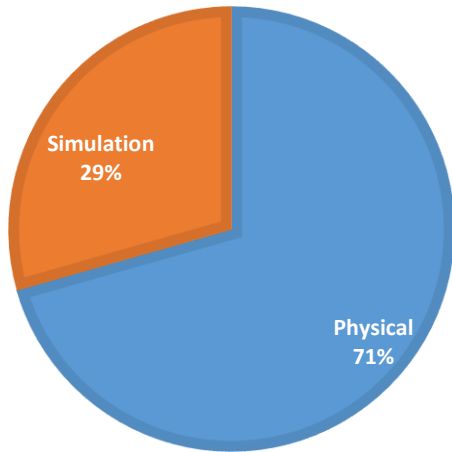


Figure 6: Distribution of conducted experiments by number of replications

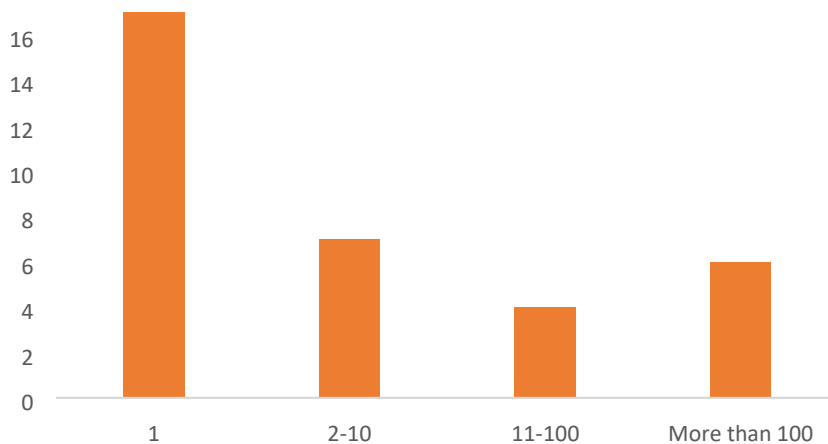
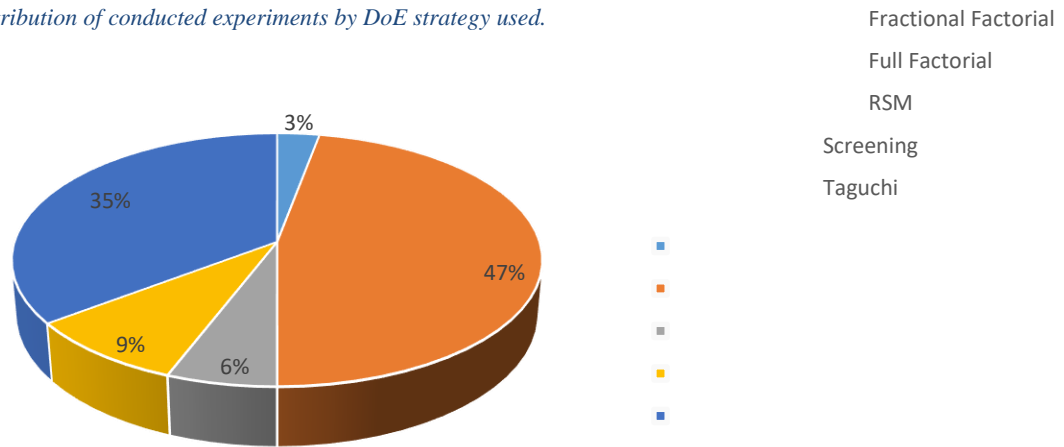


Figure 7: Distribution of conducted experiments by DoE strategy used.



According to figure 8, 24 experiments used factors with two levels in the DoE application, while 8 experiments used factors with three levels, and the remaining two experiments feature factors with more than three levels necessitating fewer experiments to keep the scale reasonable. According to figure 9, In 11 studies, number of factors investigated was between 0-3, 12 studies have 4-6 factors studied, 7 studies contain 6 to 9 factors while 3 studies have more than 12 number of factors studied. As the number of factors increase, the number of experiments needed to investigate all factors also increases which increases time and cost of carrying out the experiments. Out of the total number of studies analyzed, 25 optimized a single response while 9 optimized multiple responses. From the output measured, 19 studies were continuous, 14 attributes and 1 study measured both types. Experiment types were 24 studies physical and 10 were simulation, 21 studies adopted randomization and while the rest 13 studies did not report randomization in their studies. tools used for these studies were also reported as 15 studies adopted ANOVA, 7 papers each used S/N analysis and interaction plot, 6 studies adopted main effect plot, 5 used pareto charts while 4 studies adopted regression analysis, 2 papers adopted half-normal plot, and one paper each was reported using normal probability plot, surface plot, effects estimate, and goodness of fit. Although the benefits and practical findings are very specific to each application, it was possible to address the research questions regarding which authors and journals lead the literature on the use of DoE in the service industry, the main topics that are researched, which countries contribute most success factors, application of DoE in the service industry to optimize customer experience, key factors that can influence service quality in the service industry and key lessons learned from the DoE applications in the service industry from an inductive analysis perspective.

Figure 8: Distribution of experiments by factor level

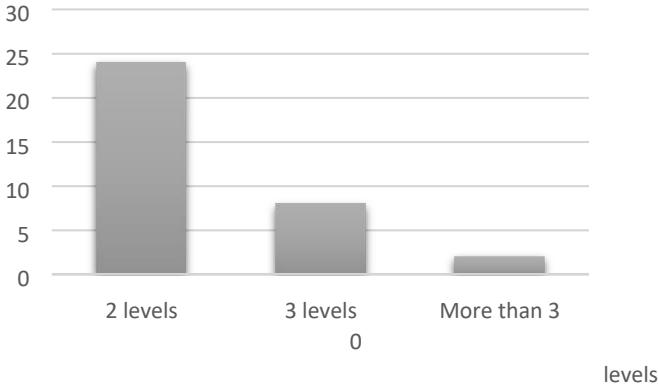


Figure 9: Distribution of conducted experiments by number of studied factors

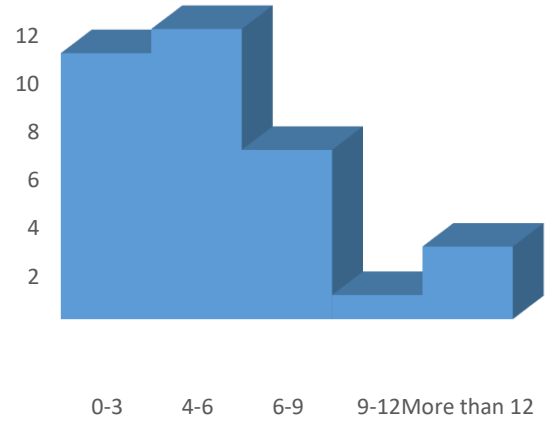


Table 2: Included studies.

Authors	Article Title	Affiliations	Publication Year
Antony et al., [A9]	Design of Experiments in a higher education setting	USA	2014
Antony et al., [A10]	Understanding and evaluating teaching effectiveness in the UK higher education sector using experimental design: a case study	UK	2019
Asadzadeh et al., [A11]	Multi-objective optimization of Gas Station performance using response surface methodology	Iran	2021
Aslan [A12]	Design of experiment (DoE) case studies in healthcare	Turkey	2015
Aslan [A13]	Design of experiment (DoE) case studies in healthcare	Turkey	2015
Aslan [A14]	Design of experiment (DoE) case studies in healthcare	Turkey	2015
Baril et al.[A15]	Discrete-event simulation and design of experiments to study ambulatory patient waiting time in an emergency department	Canada	2019
Bell et al., [A16]	Experimental design on the front lines of marketing: Testing new ideas to increase direct mail sales	USA	2006
Bell et al., [A17]	Experimental design on the front lines of marketing: Testing new ideas to increase direct mail sales	USA	2006
Bleier et al. [A18]	Creating Effective Online Customer Experiences	USA	2019
Blosch and Antony [A19]	Experimental design and computer-based simulation: a case study with the Royal Navy	UK	1999

Chackelson et al., [A20]	“Evaluating order picking performance trade-offs by configuring main operating strategies in a retail distributor: a Design of Experiments approach	Spain	2013
Chen and Ou [A21]	Sales forecasting system based on Gray extreme learning machine with Taguchi method in retail industry	Taiwan	2011
Chuang and Oliva [A22]	Inventory record inaccuracy: causes and labor effects	Taiwan	2015
El-Banna [A23]	Patient discharge time improvement by using the six-sigma approach: a case study	Jordan	2013
Galankashi et al., [A24]	Performance evaluation of a petrol station queuing system: A simulation-based design of experiments study	Malaysia	2016
Holcomb [A25]	Customer service measurement: a methodology for increasing customer value through utilization of the Taguchi strategy	USA	1994
Kolker [A26]	Process modeling of emergency department patient flow: Effect of patient length of stay on ED diversion	USA	2008
Krishnamoorthy and Kapadia [A27]	A methodology of enhancing profitability through the utilization of experimental design: a catering business case study	India	1999
Kumar et al. [A28]	An application of Taguchi’s robust experimental design technique to improve service performance	USA	1996
Ledolter and Swersey. [A29]	Using a fractional factorial design to increase direct mail response at Mother Jones magazine	USA	2006
Lima et al. [A30]	Service levels of highway toll plazas: the influence of factors on manual customer service	Brazil	2019
McQuilken., et al [A31]	Perceptions of mobile plan unit pricing and terms and conditions	Australia	2016
Mishra and Gangele [A32]	Application of Taguchi’s Method of Optimization in analysis and quantification of factors affecting the success of retail outlets	India	2013
Moreo et al., [A33]	Connection or competence: Emotional labor and service quality's impact on satisfaction and loyalty	USA	2019
Rajpoot et al. [A34]	Application of Taguchi design to retail service	USA	2008
Ree et al., [A35]	A study on education quality using the Taguchi method	Korea	2014

Ree et al., [A36]	A study on education quality using the Taguchi method	Korea	2014
Rejikumar et al., [A37]	Healthcare service quality: a methodology for services cape re-design using Taguchi approach	India	2019
Rodger et al., [A38]	Using a randomized experiment to test the causal effect of service quality on visitor satisfaction and loyalty in a remote national park	Australia	2015
Shahin et al., [A39]	Service quality robust design - With a case study in airport services	Iran	2012
Zhao et al., [A40]	Bottleneck detection for improvement of emergency department efficiency	Canada	2015
Sharma and Garg [A41]	Performance optimization of automobile service center using Taguchi approach	India	2012
Tsang and Tse [A42]	A hedonic model for effective web marketing: an empirical examination	China	2005

3.3 Bibliometric Information

The analysis identified 76 authors who have contributed to the literature on the design of experiments in the service industry. These authors have provided their expertise and insights through their published works, contributing to the knowledge base in the field. The results about the main information are mentioned in Table 3.

Table 3: Study overview

Main Information	Observation
Timespan	1996:2021
Document Average Age	10.6
Average citations per doc	26.45
References	1129
AUTHORS	
Authors	76
Authors of single-authored docs	2

AUTHORS COLLABORATION	
Single-authored docs	2
International co-authorships %	27.59

3.3.1 Most Relevant Sources:

Table 4 lists the sources along with the number of articles published in each source. Among the identified sources, the International Journal of Quality and Reliability Management and the Journal of Operations Management stand out as the most prominent, with three articles each. These journals have consistently published research on the topic, indicating their significance in the field. Other notable sources include Quality Engineering, which has published two articles, and various journals with one article each, such as Advances in Engineering Software, Business Process Management Journal, Expert Systems with Applications, Industrial Management and Data Systems, International Journal of Commerce and Management, International Journal of Contemporary Hospitality Management, International Journal of Production Research, International Journal of Productivity and Performance Management, International Journal of Productivity and Quality Management, International Journal of Research in Marketing, International Journal of Services and Operations Management, Journal of Marketing, Journal of Medical Systems, Journal of the Operational Research Society, Managing Service Quality: An International Journal, Marketing Intelligence and Planning, Production, Total Quality Management, Total Quality Management and Business Excellence, Tourism Management, and TQM Journal. The presence of these diverse sources indicates that research on the design of experiments in the service industry is being published in a wide range of academic journals, spanning fields such as quality management, operations management, engineering, marketing, hospitality management, and more. This interdisciplinary coverage reflects the multifaceted nature of the topic and the recognition of its relevance across different domains. Researchers and practitioners interested in the design of experiments in the service industry can refer to these sources to access available knowledge and insights. These journals serve as valuable platforms for disseminating research findings, theories, methodologies, and practical applications related to the topic, contributing to the advancement of knowledge in this field.

Table 4: Most Relevant Sources

Sources	Articles
INTERNATIONAL JOURNAL OF QUALITY AND RELIABILITY MANAGEMENT	3
JOURNAL OF OPERATIONS MANAGEMENT	3
QUALITY ENGINEERING	2
ADVANCES IN ENGINEERING SOFTWARE	1
BUSINESS PROCESS MANAGEMENT JOURNAL	1
EXPERT SYSTEMS WITH APPLICATIONS	1
INDUSTRIAL MANAGEMENT AND DATA SYSTEMS	1
INTERNATIONAL JOURNAL OF COMMERCE AND MANAGEMENT	1
INTERNATIONAL JOURNAL OF CONTEMPORARY HOSPITALITY MANAGEMENT	1
INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH	1
INTERNATIONAL JOURNAL OF PRODUCTIVITY AND PERFORMANCE MANAGEMENT	1
INTERNATIONAL JOURNAL OF PRODUCTIVITY AND QUALITY MANAGEMENT	1
INTERNATIONAL JOURNAL OF RESEARCH IN MARKETING	1

INTERNATIONAL JOURNAL OF SERVICES AND OPERATIONS MANAGEMENT	1
JOURNAL OF MARKETING	1
JOURNAL OF MEDICAL SYSTEMS	1
JOURNAL OF THE OPERATIONAL RESEARCH SOCIETY	1
MANAGING SERVICE QUALITY: AN INTERNATIONAL JOURNAL	1
MARKETING INTELLIGENCE AND PLANNING PRODUCTION	1
TOTAL QUALITY MANAGEMENT	1
TOTAL QUALITY MANAGEMENT AND BUSINESS EXCELLENCE	1
TOURISM MANAGEMENT	1
TQM JOURNAL	1

3.3.2 Sources' Impact

Table 5 presents the impact metrics of the sources in the field of design of Experiments in Service Industry. The table includes various metrics such as h-index, g-index, m-index, total citations (TC), number of publications (NP), and the starting year of publication (PY_start) for each source. The h-index reflects the number of articles that have received at least h citations, indicating the impact and productivity of a source. The g-index represents the highest number of articles that together received g^2 citations. The m-index is a measure of the average number of citations per article. Looking at the h-index, g-index, and m-index values, the impact of each source can be assessed. For example, the "International Journal of Quality and Reliability Management," "Journal of Operations Management," and "Quality Engineering" have an h-index and g-index of 2, indicating that they have at least two articles with two or more citations. However, in terms of m-index, "Journal of Operations Management" has the highest value of 0.222, suggesting a relatively higher average number of citations per article compared to the other two sources. The total citations (TC) column provides the total number of citations received by articles published in each source. For instance, the "Journal of Marketing" has accumulated 160 citations, indicating its significant impact within the field. The number of publications (NP) column shows the total number of articles published by each source. In most cases, the sources in this table have published only one article, except for some sources such as the "International Journal of Quality and Reliability Management" and "Journal of Operations Management," which have three articles each. Lastly, the PY_start column indicates the starting year of publication for each source. It ranges from 1996 to 2019, showing the temporal spread of the sources. These metrics provide insights into the impact and productivity of the sources in the applications of design of experiments in the service industry. Researchers can use this information to identify influential sources, gauge the level of impact of their publications, and consider the historical development of research in the field.

Table 5: Sources Impact

Source	h_index	g_index	m_index	TC	NP	PY_start
INTERNATIONAL JOURNAL OF QUALITY AND RELIABILITY MANAGEMENT	2	3	0.071	50	3	1996
JOURNAL OF OPERATIONS MANAGEMENT	2	3	0.222	40	3	2015
QUALITY ENGINEERING	2	2	0.111	26	2	2006
ADVANCES IN ENGINEERING SOFTWARE	1	1	0.125	27	1	2016
BUSINESS PROCESS MANAGEMENT JOURNAL	1	1	0.111	22	1	2015

EXPERT SYSTEMS WITH APPLICATIONS	1	1	0.077	89	1	2011
INDUSTRIAL MANAGEMENT AND DATA SYSTEMS	1	1	0.053	22	1	2005
INTERNATIONAL JOURNAL OF COMMERCE AND MANAGEMENT	1	1	0.063	14	1	2008
INTERNATIONAL JOURNAL OF CONTEMPORARY HOSPITALITY MANAGEMENT	1	1	0.2	29	1	2019
INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH	1	1	0.091	42	1	2013
INTERNATIONAL JOURNAL OF PRODUCTIVITY AND PERFORMANCE MANAGEMENT	1	1	0.1	14	1	2014
INTERNATIONAL JOURNAL OF PRODUCTIVITY AND QUALITY MANAGEMENT	1	1	0.083	14	1	2012
INTERNATIONAL JOURNAL OF RESEARCH IN MARKETING	1	1	0.056	26	1	2006
INTERNATIONAL JOURNAL OF SERVICES AND OPERATIONS MANAGEMENT	1	1	0.083	9	1	2012
JOURNAL OF MARKETING	1	1	0.2	160	1	2019
JOURNAL OF MEDICAL SYSTEMS	1	1	0.063	77	1	2008
JOURNAL OF THE OPERATIONAL RESEARCH SOCIETY	1	1	0.2	17	1	2019
MANAGING SERVICE QUALITY: AN INTERNATIONAL JOURNAL	1	1	0.04	10	1	1999
PRODUCTION	1	1	0.2	2	1	2019
TOTAL QUALITY MANAGEMENT	1	1	0.04	8	1	1999
TOTAL QUALITY MANAGEMENT AND BUSINESS EXCELLENCE	1	1	0.1	18	1	2014
TOURISM MANAGEMENT	1	1	0.111	42	1	2015
TQM JOURNAL	1	1	0.2	9	1	2019

3.3.3 Authors

Out of the 76 authors, only two authors have published single-authored documents. This suggests that collaboration and co-authorship are common in this research area, as most documents involve multiple authors. Single-authored docs: The analysis found that two documents were single-authored, indicating instances where authors have independently conducted research and published their findings without collaboration. This finding highlights the presence of both collaborative and individual research efforts in the field. International co-authorships %: The analysis reveals that 27.59% of the documents involved international co-authorships. This indicates that researchers from different countries have come together to collaborate on the topic of design of experiments in the service industry, fostering a global perspective and knowledge exchange.

Table 6 includes the author's name, the year of publication, the frequency of publications (freq), the total number of citations (TC), and the average citations per year (TCpY). In 2021, author AKHAVAN B published two articles; however, these articles did not receive any citations, resulting in a TCpY of 0.

Similarly, author ASADZADEH S published one article in 2021, but it also did not receive any citations. Author ANTONY J has publications in two different years, 1999 and 2014, with one article in each year. The 1999 publication received 10 citations, while the 2014 publication received 14 citations. This implies that the average citations per year (TCpY) for ANTONY J's publications are 0.4 and 1.4, respectively. Author ASOKAN AJITHA A published one article in 2019, which received 9 citations, resulting in a high TCpY of 1.8. Similarly, author BARIL C published one article in 2019 and obtained 17 citations, leading to a TCpY of 3.4. Author BEDNALL D's single publication in 2016 did not receive any citations, resulting in a TCpY of 0. Author CHUANG HH-C has publications in two consecutive years, 2015 and 2016. The 2015 publication received 37 citations, while the 2016 publications received three citations. Consequently, the TCpY for CHUANG HH-C's 2015 publication is 4.111, whereas for the 2016 publications, it is 0.375. Similarly, author LEDOLTER J has two publications in 2006, accumulating a total of 39 citations. This corresponds to a TCpY of 2.167. Lastly, OLIVA R has publications in both 2015 and 2016. The 2015 publication received 37 citations, resulting in a TCpY of 4.111. The 2016 publications, however, received only three citations, leading to a lower TCpY of 0.375. These statistics provide insights into the production and impact of individual authors over time in the field of "Design of Experiments in Service Industry." Researchers can analyze this information to identify prolific authors, assess the impact of their publications, and explore trends in author productivity and citation patterns.

Table 6: Author production and impact

Author	year	freq	TC	TCpY
AKHAVAN B	2021	2	0	0
ANTONY J	1999	1	10	0.4
ANTONY J	2014	1	14	1.4
ASADZADEH S	2021	1	0	0
ASOKAN AJITHA A	2019	1	9	1.8
BARIL C	2019	1	17	3.4
BEDNALL D	2016	1	0	0
CHUANG HH-C	2015	1	37	4.111
CHUANG HH-C	2016	2	3	0.375
LEDOLTER J	2006	2	39	2.167
OLIVA R	2015	1	37	4.111
OLIVA R	2016	2	3	0.375
SWERSEY AJ	2006	2	39	2.167

3.3.4 Countries contribution

Table 7 presents an analysis of the countries' scientific production. The table displays the countries and the corresponding frequency of scientific production associated with each country. According to the data, the United States (USA) has the highest scientific production with 20 articles. The USA demonstrates a strong research presence and significant contributions to the design of experiments in the service industry. Canada and India follow closely with nine articles each, indicating their substantial involvement in research related to the topic. Australia and Iran rank next with eight and six articles, respectively, showcasing their active research engagement in this field. The United Kingdom (UK), China, and Malaysia demonstrate comparable scientific production, with six and five articles, respectively. These countries have shown a notable research output and participation in the design of experiments in the service industry. Other countries that have contributed to the scientific production include Spain with four articles,

Brazil, and South Korea with three articles each, and Austria, Germany, Jordan, and Pakistan with one article each. Although their contribution is relatively lower in terms of frequency, these countries have still made notable contributions to the field. The analysis of countries' scientific production provides insights into the global distribution of research in design of experiments in the service industry. It highlights the countries that have shown significant research activity and those with a relatively smaller presence in terms of published articles.

Table 7: Number of papers affiliated with countries.

Region	Freq
USA	20
CANADA	9
INDIA	9
AUSTRALIA	8
IRAN	6
UK	6
CHINA	5
MALAYSIA	5
SPAIN	4
BRAZIL	3
SOUTH KOREA	3
AUSTRIA	1
GERMANY	1
JORDAN	1
PAKISTAN	1

3.3.5 Countries' Impact

Table 8 provides an analysis of countries' scientific impact in the field. The table includes the countries, their total citations (TC), and the average number of citations per article. The United States (USA) leads in terms of total citations with a TC of 186, indicating a strong impact and recognition of their research in this field. On average, articles from the USA receive 26.6 citations, suggesting a high level of influence and visibility. China demonstrates a significant TC of 89, indicating a substantial impact of their research. Additionally, each article from China receives an average of 89 citations, highlighting their strong research output and influence. Spain follows with a TC of 42 and an average of 42 citations per article, indicating a noteworthy research impact in the design of experiments in the service industry. Canada, with a TC of 39, shows a respectable research output, and on average, their articles receive 19.5 citations. The United Kingdom (UK) and Malaysia demonstrate a similar pattern with TCs of 29 and 27, respectively, and an average of 14.5 and 27 citations per article. India and Korea both have a TC of 18, indicating a moderate research impact. On average, articles from these countries receive 9 and 18 citations, respectively. Iran and Jordan have TCs of 14 and 13, with an average of 7 and 13 citations per article, respectively, showcasing their research contributions in this field. Brazil has a TC of 2, and Australia has a TC of 0, indicating a relatively lower research impact in terms of total citations. The analysis of countries' scientific production

and their average article citations provides insights into the research impact and recognition of different countries in the field of the design of experiments in the service industry. It highlights the countries with significant citation counts and those with relatively lower citation counts, indicating variations in research influence and visibility across different nations.

Table 8: Countries Impact

Country	TC	Average Article Citations
USA	186	26.6
CHINA	89	89
SPAIN	42	42
CANADA	39	19.5
UNITED KINGDOM	29	14.5
MALAYSIA	27	27
INDIA	18	9
KOREA	18	18
IRAN	14	7
JORDAN	13	13
BRAZIL	2	2
AUSTRALIA	0	0

3.3.6 Countries Collaboration

Table 9 and figure 10 present the Collaboration Network (Countries) analysis results. The table contains information about the countries (nodes), their clusters, and various centrality measures, including Betweenness Centrality, Closeness Centrality, and PageRank Centrality.

Cluster 1 includes two nodes: "india" and "united kingdom." "india" has a Betweenness Centrality of 0, indicating it does not act as a bridge between other countries. The Closeness Centrality value for "india" is 0.066667, indicating its relative proximity to other nodes in the cluster. The PageRank Centrality value for "india" is 0.08031, suggesting its influence in the collaboration network. In contrast, the "united kingdom" has a high Betweenness Centrality value of 5, indicating its significance as a bridge between other countries in the cluster. The Closeness Centrality value for the "united kingdom" is 0.1, indicating its proximity to other nodes in the cluster. The PageRank Centrality value for the "united kingdom" is 0.138545, suggesting its influence in the collaboration network.

Cluster 2 contains four nodes: "usa," "china," "austria," and "germany." The country "usa" has the highest Betweenness Centrality value of 14, indicating its crucial role as a bridge between other countries in the cluster. The Closeness Centrality value for "usa" is 0.142857, indicating its relative proximity to other nodes in the cluster. The PageRank Centrality value for "usa" is the highest among the cluster nodes, suggesting its high influence in the collaboration network. The remaining three countries, "china," "austria," and "germany," have a Betweenness Centrality value of 0, indicating they do not act as bridges between other countries. The Closeness Centrality values for these countries are 0.083333,

indicating their relative proximity to other nodes in the cluster. The PageRank Centrality values for these countries are relatively lower compared to "usa."

The Collaboration Network (Countries) analysis in Table 8 provides insights into the collaborative relationships among countries within the identified clusters. The centrality measures reveal the relative importance and influence of these countries within their clusters. Countries with higher Betweenness Centrality values, such as "usa" and "United Kingdom," play a more significant role in connecting and collaborating with other countries. The Closeness Centrality values indicate the proximity of countries to other nodes within their respective clusters. The PageRank Centrality values reflect the overall influence and prominence of countries in the collaboration network. These findings help understand the collaborative structure and relationships among countries in the analyzed field and can guide further international collaborations and partnerships.

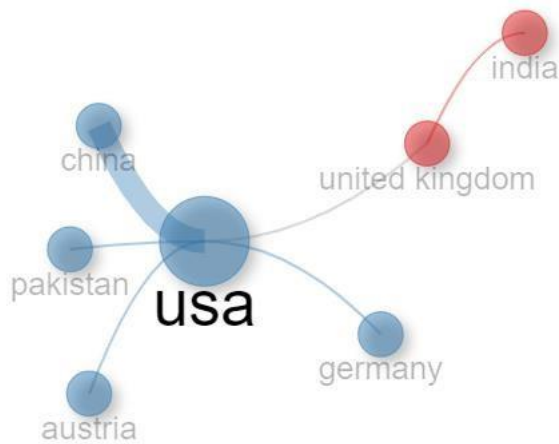


Figure 10: Collaboration Network (Countries)

Table 9: Collaboration Network (Countries) Results

Node	Cluster	Betweenness	Closeness	PageRank
India	1	0	0.066667	0.08031
United Kingdom	1	5	0.1	0.138545
USA	2	14	0.142857	0.402315
China	2	0	0.083333	0.167986
Austria	2	0	0.083333	0.070281
Germany	2	0	0.083333	0.070281
Pakistan	2	0	0.083333	0.070281

3.3.7 Word Cloud

Analyzing the text of the identified papers a world cloud of most frequent words is generated. A histogram of the word cloud can be found in the appendix. The detailed interpretation of word cloud displayed in figure 11 is as follows:

Design of Experiments: This term has the highest frequency, indicating that it is a central concept in the field of service industry research. The high occurrence suggests that the application of experimental design techniques is of significant interest and importance in studying and improving service industry processes.

Simulation: The term "simulation" appears frequently, indicating that researchers are using simulation techniques to model and analyze various aspects of the service industry. Simulation allows for the study of complex systems and can provide insights into performance, efficiency, and optimization.

Case Study: The presence of "case study" suggests that researchers are employing qualitative research methods to investigate specific instances or examples within the service industry. Case studies provide in-depth understanding and contextual insights into real-world scenarios.

Bayesian Inference: The term "Bayesian inference" appears multiple times, indicating that researchers are using Bayesian statistical methods to analyze data and make inferences in the service industry. Bayesian inference provides a framework for updating beliefs or probabilities based on prior knowledge and observed data.

Consumer Behavior: "Consumer behavior" and "consumer perceptions" signify the interest in studying customer-related factors within the service industry. Understanding consumer behavior and perceptions is crucial for designing and delivering services that meet customer needs and expectations.

Econometrics: The occurrence of "econometrics" suggests that researchers are applying econometric methods to study relationships and dynamics within the service industry. Econometrics combines economic theory, statistical analysis, and mathematical modeling to quantify economic relationships and test hypotheses.

Emergency Department: The term "emergency department" indicates a focus on studying the operations, processes, and efficiency of emergency departments within the service industry. This suggests an interest in improving emergency healthcare services and patient experiences.

Higher Education: The occurrence of "higher education" suggests that researchers are investigating the application of design of experiments and related methods in the context of higher education institutions. This indicates an interest in enhancing educational processes, student outcomes, and institutional performance.

Length of Stay: "Length of stay" refers to the duration a customer spends in a service facility or system. However, the term is mainly used in healthcare context. Researchers are investigating factors influencing length of stay and exploring strategies to reduce waiting times and enhance overall service efficiency.

Process Improvement: The occurrence of "process improvement" suggests a focus on enhancing operational processes and workflows within the service industry. Researchers may be investigating methodologies to optimize service delivery, streamline operations, and minimize inefficiencies.

another cohesive subgroup within the broader context of the service industry and experimental design. However, it is worth noting that none of the nodes in Cluster 2 have any significant Betweenness values, indicating a lack of prominent bridging roles within the network. The Closeness and PageRank values for these nodes are also relatively lower compared to those in Cluster 1.

The co-occurrence network analysis in Table 19 provides insights into the relationships and interconnectedness of key concepts within the field of "Design of Experiments in Service Industry." The clustering of nodes allows researchers to identify groups of related concepts, while network metrics like Betweenness, Closeness, and PageRank provide information about the centrality and importance of specific nodes in the network. These findings can inform researchers about the core concepts, potential research areas, and interdependencies within the field, facilitating further exploration and investigation.

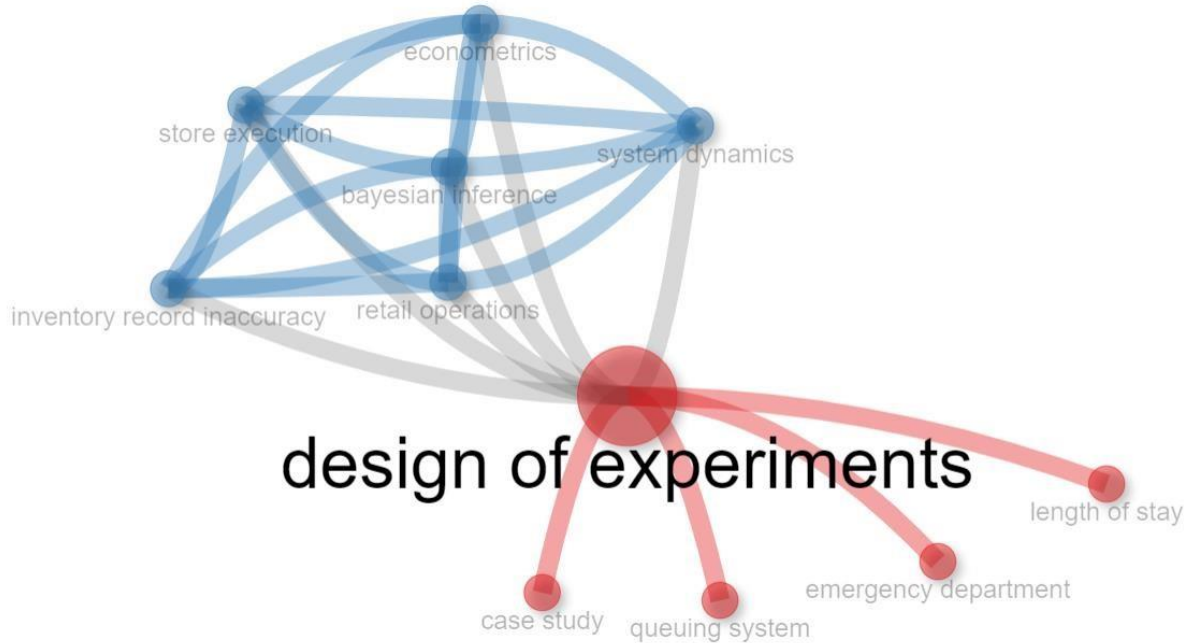


Figure 12: Co-occurrence Network

Table 10: Co-occurrence Network results

Node	Cluster	Betweenness	Closeness	PageRank
design of experiments	1	30	0.1	0.215289
case study	1	0	0.052632	0.031936
emergency department	1	0	0.052632	0.031936
length of stay	1	0	0.052632	0.031936
queuing system	1	0	0.052632	0.031936
bayesian inference	2	0	0.071429	0.109495
econometrics	2	0	0.071429	0.109495
inventory record inaccuracy	2	0	0.071429	0.109495
retail operations	2	0	0.071429	0.109495
store execution	2	0	0.071429	0.109495
system dynamics	2	0	0.071429	0.109495

Chapter 4.0 Discussion

A literature review uncovers exciting findings regarding the application of the DoE in the service industry. The findings and implications of each question are discussed below.

The primary aim of this study was to identify the main contributors to the literature on the application of DoE in the service industry and to determine the most highly cited journals and articles in this field. Aslan has gained recognition as a prominent author in the DoE field due to their three healthcare-related case studies. This indicates that there is recognition of the potential of DoE techniques to enhance healthcare delivery. The healthcare industry had the most cited publications, highlighting its importance as a leading sector where DoE is implemented in the service industry. The RSM-based experimental design was employed in a study [A15] to enhance the optimization of healthcare delivery systems. The researchers discovered significant time reductions, improving efficiency and faster patient service. The authors of [A18] used factorial experimentation to investigate the correlation between ambulance diversion time, waiting room line length, and LOS. These findings demonstrate the potential of DoE to improve healthcare delivery processes.

The second research question aimed to explore frequently used phrases, extensively researched topics, and leading countries regarding scientific contributions to the application of DoE in the service industry. Research findings indicate that the United States is the leading publisher in this field, contributing over eight publications out of the identified. The literature extensively discusses marketing and retail, as evidenced by [A8], [A9], [A10], [A21], and [A26]. Numerous studies have explored the potential productivity-enhancing applications of DoE across different industries.

DoE systematically analyzes and enhances different factors that influence customer satisfaction and engagement in the service industry. Critical elements of customer service encompass service quality, staff demeanor, waiting durations, pricing, service personalization, and accessibility. By identifying and analyzing these factors, businesses can gain insights into their impact on customers' perceptions of the company and the quality of services received. [A22] conducted a study to investigate and address the challenges of providing efficient manual customer assistance at toll booths. Their discoveries improved toll operations and enhanced the efficiency of human customer service.

The fourth research question of this study aimed to examine the potential benefits of using DoE in identifying and improving the key factors that impact service quality. Various factors, irrespective of the industry, have been found to influence service quality. This category encompasses the dependability of service providers in meeting deadlines and providing accurate information, as well as their preparedness

and responsiveness to consumer needs. DoE offers a systematic framework to assist firms in evaluating, ranking, and improving these essential success criteria. One study [A16] examined methods to enhance gas station queueing systems, while another study [A22] explored strategies to increase the efficiency of human customer service employees at toll booths. DoE can assist businesses in analyzing and enhancing the factors contributing to customer service satisfaction. However, the feasibility of accomplishing experiments in actual-time service shipping settings and the need for cooperation from a couple of stakeholders present demanding situations that need to be addressed for a successful implementation. Operational disruptions, aid obstacles, and the complexities of coordinating experiments across unique organization settings can impact the feasibility of carrying out experiments. Overcoming those challenges requires careful planning, collaboration, and flexibility in balancing the need for experimentation with ongoing carrier shipping.

Question 5 focused on the inductive analysis of scientific contributions to the service industry. Through conducting an inductive analysis of the existing literature, common issues and opportunities for improving the utilization of DoE in various service industries were identified. Classroom experiments were conducted to test the impact of different pedagogical strategies on students' learning [A1], [A2]. Prominent areas of research in the healthcare industry encompass optimal medication delivery, patient care, and resource utilization [A7], [A15], [A18], [A32]. Several studies [A1], [A14], [A15], [A21] highlighted challenges related to cost reduction and staying updated with technological advancements. Additionally, time and financial constraints were identified as obstacles in studies [A33] and [A29].

A comprehensive analysis of relevant literature provided valuable information on the prominent authors, journals, and countries involved in applying the DoE in the service industry. This study has provided insights into the books with the highest readership, the topics that receive the most academic attention, and the key factors that play a crucial role in assessing service quality. Implementing the DoE can enhance business offerings and consumer experience. Through inductive research, scientific analysis has revealed common patterns, challenges, and practical strategies in the service industries. The study's findings will benefit academics and service industry professionals interested in researching and implementing DoE.

DoE may be a very beneficial strategy for improving procedures and maximizing results in the service business. It helps with methodical optimization. DoE is a systematic methodology for identifying and enhancing the factors influencing service quality, client experiences, and operational efficiency. This enables service providers to decide which elements are most important and in what settings they should be used to get desired outcomes. By employing DoE, service providers may identify inefficiencies or

bottlenecks in their operational processes and test several configurations to find the ones that perform at the highest levels of efficiency. This phenomenon might result in lower prices, better resource allocation, and more efficient service delivery.

Additionally, DOE helps service providers understand the crucial components that profoundly influence client experiences, enabling them to enhance such experiences. Service providers may improve customer satisfaction, loyalty, and overall experience by improving these factors, promoting customer retention, and generating positive word-of-mouth. Lastly, the DoE enables service providers to make informed decisions based on statistical evidence, facilitating data-driven decision-making. This data makes it possible to evaluate the influence of various factors on results. This technique encourages better-informed and scientifically supported decision-making processes by reducing dependence on intuition or guesswork.

The prospective areas where the adoption of DoE might generate the most substantial advantages in the service business depend on the service provider's specific environment and aims.

DoE may be used to obtain insights into the numerous aspects that affect customer experiences, allowing for improving such situations. Service providers may enhance client experiences and build different value propositions using various factors such as service design, interactions, and tailored products. However, there are limitations to this area like generalizability. The results of a DoE research undertaken in one unique service setting may not be easily relevant or transferrable to another. The effectiveness of DoE results may be affected by the service sector's various characteristics, the targeted customer categories, and the channels through which services are delivered. Additionally, there is the practical restrictions limitation. Functional constraints may arise when conducting DoE in real-world service situations. Operational problems, ethical limitations, and limited resources may impede the full adoption of DoE results or the capacity to undertake lengthy studies. Therefore, service providers must carefully analyze these constraints and adapt DoE procedures to their unique situations and goals. Individuals may use this technique to maximize the advantages while avoiding the potential restrictions of applying DoE in the service industry.

4.1 Findings

The systematic review identified a range of things influencing the quality of service in distinct service sectors. These elements encompass appointment scheduling, triage methods, format design, check-in and check-out processes, room cleanliness, and more. Expertise and optimizing those factors can lead to improved service quality and customer experience.

Programs in exclusive service Sectors: The overview highlighted numerous applications of DoE in various service sectors, together with healthcare, hospitality, retail, advertising, training, and more. Each sector

supplied precise opportunities and demanding situations for enforcing DoE to decorate service delivery and customer experience.

Powerful utility of DoE: The systematic overview explored powerful strategies and methodologies for applying DoE in the service industry. It recognized complete factorial design, Taguchi methods, and screening techniques as usually used strategies. These methods permit carrier companies to systematically manipulate factors, have a look at their outcomes, and optimize provider results.

4.2 Benefits

Improved service quality: The application of DoE in the service enterprise offers the capability to beautify service quality by identifying key elements that impact client experiences and optimizing their effect on service outcomes. By means of systematically manipulating those factors, service providers could make data-pushed upgrades and tailor their services to fulfill consumer expectations.

Improved Operational Efficiency: DoE enables service companies to optimize aid allocation, staffing stages, and technique layout, mainly to progress operational efficiency. By way of identifying crucial factors and their premier levels, service providers can streamline their operations, reduce waiting times, and enrich overall efficiency.

Data-Driven Decision Making: DoE gives a rigorous and systematic method to experimentation in the service enterprise. With the aid of engaging in controlled experiments and studying the consequences, service companies can gather empirical evidence and make data-driven selections. This technique lets in for proof-based enhancements and targeted interventions.

4.3 Challenges

Ethical considerations: carrying out experiments within the service enterprise that contain human subjects or affect patient care raises ethical issues. Making sure knowledgeable consent, confidentiality, and honest remedy of individuals is important while designing and implementing experiments in service settings. Service providers have to navigate these ethical challenges to conduct accountable research.

Complexity and Variability: Service systems are characterized by excessive complexity and variability, making it tough to control all variables in experiments. Consumer heterogeneity, environmental factors, and dynamic provider environments add to the complexity. Balancing the want for managed experiments with the realities of actual-time service delivery poses demanding situations for service organizations.

Resource Limitations: undertaking experiments within the service industry requires the allocation of resources, which include time, employees, and budget. The provision of skilled statisticians and data analysts can be a threat, mainly for smaller service companies. Balancing the need for experimentation with ongoing service delivery can also strain the available resources.

Chapter 5.0 Conclusions, Limitations, and Future Research

5.1 Conclusions

This study provides a systematic evaluation of the available literature on the implementation and consequences of DoE in the service sector, focusing on its influence on service quality. According to the study's results, implementing the DoE favors several aspects of the service industry. Improving the quality of replies to customer inquiries, performing systematic analytics, and reacting to variables impacting customer experiences are all examples of these characteristics. As a result, adopting DoE may improve overall service performance, boost customer satisfaction, and produce more revenues for firms. This study's thorough assessment covers various experiment types, techniques, and influential authors, journals, and nations using DoE in the services context. This coverage is a helpful resource for companies looking to improve service quality, increase operational efficiency, and increase client satisfaction. Most studies in this field, were carried out in the United States and concentrated on sectors such as marketing and retail. This indicates the widespread interest and implementation of DoE in these industries, aiming to improve operational efficiency and enhance customer experiences.

Additionally, the study's inclusion and exclusion criteria were established to guarantee that only high-quality papers were included in the analysis. access to relevant and authoritative academic literature for the review was eased by using respected databases such as Web of Science (WoS) and Scopus. The outcomes of this research highlight the importance of DoE methodologies in improving healthcare service delivery. Aslan's research has achieved significant advances in DoE, notably in its use in the medical sector. The study finds common trends, roadblocks, and practical solutions in the service industry. This material may help academics and practitioners in the service sector interested in researching and applying the DoE. The study's results have the potential to contribute to future research and give recommendations for the establishment of best practices in the use of DoE in the service sector. The examples of the usefulness of the DoE in the service business constitute an excellent resource for service providers, academics, and researchers interested in the study and implementation of DoE. The paper makes a significant intellectual addition to the subject due to its detailed evaluation of the existing literature, identification of widespread trends and constraints, and offering pragmatic techniques for applying DoE in the service business.

5.2 Limitations

Acknowledging the limitations encountered in this research is crucial. The limited accessibility of specific publication papers due to fast access may have led to the exclusion of relevant studies. Furthermore, it is essential to consider potential biases in the studies included, such as language and geographic biases. This is because non-English language publications and research from specific regions

may not have been adequately represented in the analysis. The ever-changing nature of the DoE in the service industry presents challenges in comprehending its extensive scope and usefulness.

5.3 Future Research

Additional research is required to address the limitations identified in this analysis in order to gain a comprehensive understanding of how DoE can be applied in the service industry. Here are potential future directions for researchers to pursue.

Future research should expand its scope to explore the potential applications of DoE in other service industries beyond those that have been examined in this study. This will facilitate a comprehensive examination of the benefits and drawbacks it may present in different service industries.

Conducting research on the effectiveness of different DoE strategies in the service sector can help identify the most suitable approaches for diverse contexts. These analyses can shed light on the strengths and weaknesses of various DoE approaches.

Researchers can conduct longitudinal studies to assess the long-term effects of implementing DoE strategies on service quality, customer satisfaction, and organizational performance.

Further exploration of the potential of (DoE) to enhance service quality in the digital era can be achieved through the integration of other advanced technologies. These technologies encompass artificial intelligence (AI), machine learning (ML), and data analytics. Further research is needed to explore how these technologies can enhance and enhance the application of DoE in the service sector.

Cross-cultural research can enhance comprehension of how cultural factors impact the implementation and efficacy of DoE in the service sector. This study has significant implications for businesses aiming to improve service delivery by tailoring DoE strategies to different cultural contexts.

To maximize the benefits of DoE in enhancing service quality, customer satisfaction, and organizational performance, it is imperative to investigate these unexplored areas of research.

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Appendix

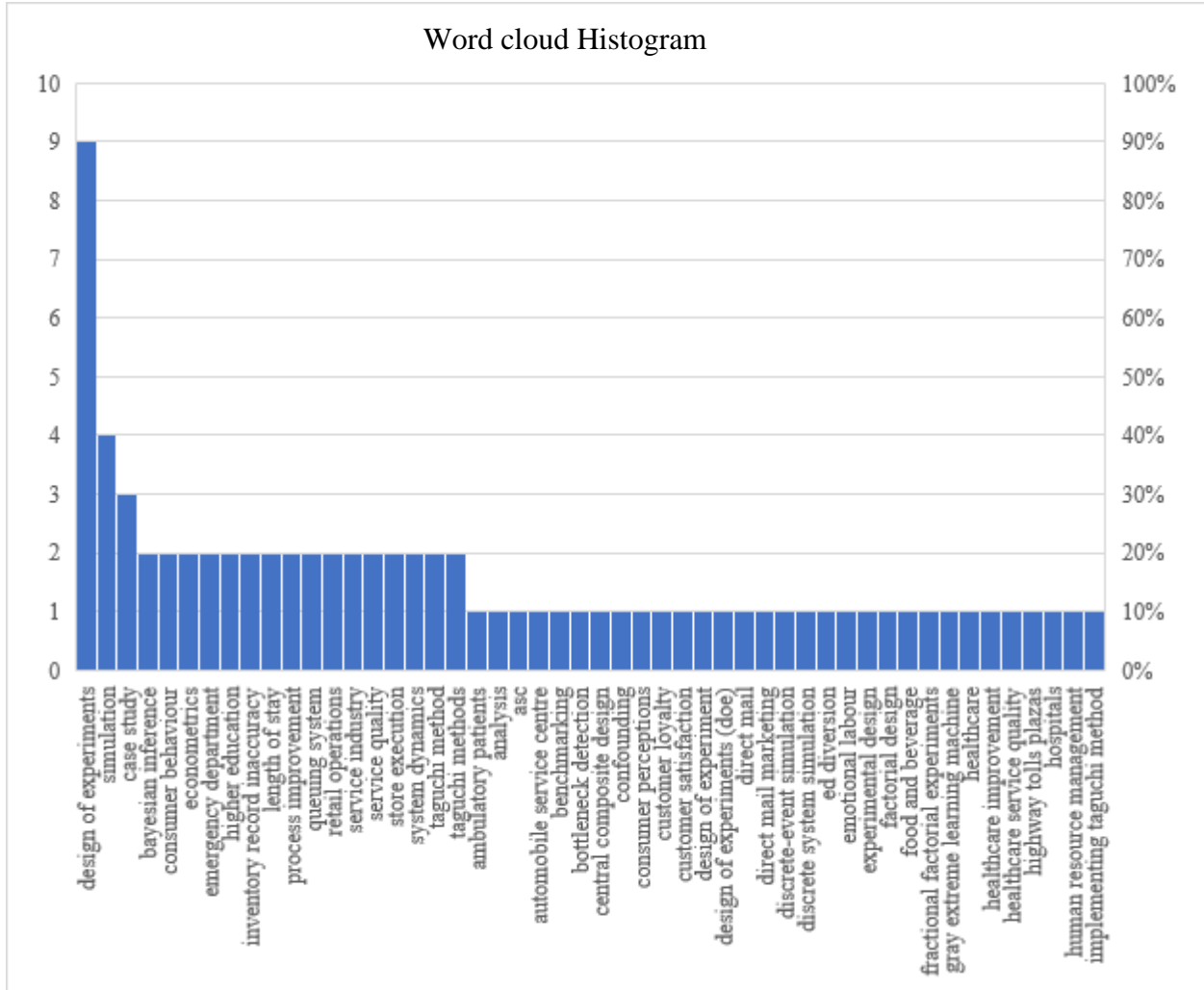


Figure 13: Word cloud histogram