



The Integration of Lean and Human Resource Management Practices as an Enabler for Lean Deployment- A Systematic Literature Review

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Abstract

Purpose – The current research aims to map and investigate how Human Resource Management and Lean practices can be integrated. This investigation will help identify the Human Resource Management aspects critical in the success of Lean initiatives while exploring the research gaps in the existing literature. The review also aims to delineate the benefits and challenges of integrating Lean with Human Resource Management systems to discuss further research and practice areas.

Design/methodology/approach – This study utilizes a Systematic Literature Review method to identify and synthesize the existing literature. As part of the process, a protocol that provided a plan for the review was followed, including the research questions and the data to be extracted.

Findings– The study results indicate that aspects of Human Resources Management practice and policies such as Training & Development, Teamwork, Motivation, Communication, Leadership, are key enablers of Lean initiative deployment and success. The benefits of the integration of Human Resources with Lean can help in Lean training and development, communication of Lean initiatives and successes, allocating and hiring continuous improvement personnel, and supporting leadership in Lean deployment. Challenges to integrating Lean and HRM practices included lack of integration and collaboration between disciplines. Further exploration areas in successful Lean deployment would be practical longitudinal case studies on Lean deployments with HR partnerships and involvement.

Practical implications – This review paper has crucial implications for practice relating to, integration of Lean with Human resource management structures and tailoring Human resource management initiatives to ensure the success of Lean deployment and reduce risks of failure.

Originality/value – The Systematic literature review study conducted in this paper is the first of its kind to integrate and map the human resource management concepts that can be integrated with Lean to deploy the initiative successfully. This mapping is critical for ensuring the success of Lean methodologies within an organization and paves the way for future research. In addition, managers and organizations can find support and guidance from this study to focus on vital areas of partnership between their Lean and HR programs.

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3 29 Keywords – Lean Management, Workforce Management, Human Resource Management, Human Related
4 30 Lean Practices

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7 31 Paper type- Literature review
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10 32 1. Introduction

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12 33 Enormous changes are being experienced by the global economy and industries concerning technological
13 34 disruption, expedited development, market structures and changing government policies (Elrehail *et al.*,
14 35 2020). Increased competitiveness among organizations in all sectors has created an urge to improve
15 36 operational efficiencies to gain a competitive advantage as a key driver to stay ahead in business (Antony
16 37 *et al.*, 2019; Vashishth *et al.*, 2019). One of the most widely adopted quality initiatives is Lean
17 38 Management (LM) (Altria *et al.*, 2009). LM is one of the most widely accepted management styles
18 39 deployed globally to improve business performances (Antony *et al.*, 2020). LM is a strategy to identify
19 40 business problems continuously and search for better solutions through standardization and simplification
20 41 of work processes (Shin and Alam, 2020). Thus, Lean is an essential continuous quality improvement (CQI)
21 42 process that organizations can leverage in a Volatile, Uncertain, Complex and Ambiguous (VUCA)
22 43 environment. A multitude of research work and attention has been focused on LM and process-oriented
23 44 improvement; however, the human and people aspect of such practices must also be focused on. More
24 45 emphasis on human resource management in the context of its relationship to Lean is an influential research
25 46 agenda (Gao and Low, 2015). It has been shown that when transitioning to Lean practices that HR can help
26 47 facilitate this process by employing HRM practices (Gollan *et al.*, 2015).

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30 48 Lean principles are based on models developed from years of experience, and this entire process of
31 49 continuous improvement requires the involvement and engagement of people at the grassroots level
32 50 (Sparrow and Otaye-Ebede, 2014). Keeping the people concept in mind, Moyano-Fuentes & Sacristán-
33 51 Díaz (2012) define LM as a summation of all employees' practices and their underlying thinking patterns
34 52 in everyday behavior. True Lean manufacturing principles encourage every individual to continuously
35 53 improve value-generating activities and exclude non-value generation activities leading to increased
36 54 efficiency. Respect for people is a core concept within Lean, as is the concept of involving everyone from
37 55 all levels of the organization. Indeed the 8th waste in Lean has been identified as “under-utilization of
38 56 employee skillset” (Womack & Jones, 1996).

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42 57 Consequently, the involvement of an HR department in a Lean deployment is crucial to the success of a
43 58 Lean program. Furthermore, LM can only be successfully practiced in an organization by carefully
44 59 attending to the various HR issues (Sohal *et al.*, 1993). Over time there have been numerous research
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3 60 works on the human variable effect on the success of Lean (Bonavia and Marin-Garcia, 2011). Research
4 61 by (Martínez-Jurado *et al.*, 2013) identifies the effect of HRM practices that leads to cultural changes
5 62 while adopting lean management. The study stated that various HR practices like training,
6 63 communication, rewards, job design and work organization play an important role during LP
7 64 adoption. However, the other aspects and practices of HRM like leadership, mentoring,
8 65 development, career management, recruitment and selection, performance appraisal were rarely
9 66 considered. Moreover, the study is limited to the aeronautical industry only.

15 67 Similarly, a study by (Tortorella and Fogliatto, 2014) integrates HRM, Organizational learning, and
16 68 Lean. The case study method was applied as the research was limited to a single manufacturer
17 69 located in Brazil. The study's major strength was that it considered 15 sets of HRM practices at
18 70 the individual, team, and organizational levels. In a recent study (Wickramasinghe and
19 71 Wickramasinghe, 2020) on Srilanka's manufacturing firms, a model was proposed and tested to
20 72 see the effect of HRM practices on Lean production practices, which affect organizational and firm
21 73 performance. The study recommended that HRM practices strongly influence lean production and
22 74 thus affect overall performance. However, the study focused upon only those HRM practices
23 75 which are already implemented but did not include the HRM practices that are not being
24 76 implemented fairly.

32 77 Much current research considers HRM as a bundle of Lean and not a separate set of activities that
33 78 affect lean (Al-Hyari, 2020; Furlan *et al.*, 2011). Few studies have been identified which
34 79 exclusively examines the effect of HRM on lean (Hernandez-Matias *et al.*, 2019; Moyano-Fuentes
35 80 and Sacristán-Díaz, 2012; Tortorella and Fogliatto, 2014). However, these studies are limited to a
36 81 particular sector or industry or a particular set of HR practices. The study of (Tortorella and
37 82 Fogliatto, 2014) instilled a method to guide the adoption of HRM practices for better lean
38 83 implementation. It stated that in the future, researchers need to collect data to verify the impact of
39 84 the evolution of HRM practices on an organization's performance indicators during lean
40 85 implementation. It is crucial to extend the research work on the instigation of HRM and Lean for
41 86 all these reasons. It is necessary to identify the various HRM practices to be adopted at the
42 87 organizational level and see how these practices can be integrated with Lean-to embark a lean
43 88 culture for enhanced organizational performance.

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89 Keeping this in mind, the present study aims to synthesize the Lean literature by mapping it with Human
90 Resource Management. Supporting these strong imperatives, the research will present the progression of
91 LM and HRM practices throughout the years by answering the following research questions:

- 92 • *How has the research on LM and integration with HR practices progressed through the years in*
93 *terms of time and industry perspectives?*
- 94 • *What are the prominent LM practices which can be integrated with HRM?*
- 95 • *What driving factors can motivate HR Managers to integrate LM and HRM methods?*
- 96 • *What are the benefits, critical success factors, and challenges in applying HRM principles and*
97 *practices to LM deployment?*
- 98 • *What are the key gaps which need to be addressed in the LM-HRM integration field?*

99 In line with the objectives mentioned above, our contribution identifies various HRM practices and LM
100 practices that can be integrated and the driving factors that necessitate this integration. Synthesis of existing
101 literature also helps us mention the benefits and challenges of Lean and HRM integration. It helps
102 understand how HRM be deployed and integrated into Lean Management, thus helping HRM practitioners
103 and managers rethink HR policies in line with Lean deployments. Finally, it also helps us set a research
104 agenda for future studies in LM.

105 The study is organized as follows: the introduction highlighting the need for the study and research
106 objectives followed by a discussion of review methodology. The review findings follow the methodology
107 and are succeeded by discussion and implications. The last section concludes the study by determining the
108 research gaps, limitations of the current research work, and future research opportunities within this study
109 area.

110 **2. Methodology**

111 The wide availability of literature on both key concepts of the present study, i.e., LM and HRM, makes it
112 challenging to locate, summarise and, synthesize the research and implicate it in practice (Psomas and
113 Antony, 2019; Samuel *et al.*, 2015; Yadav *et al.*, 2017). Therefore, a systematic quantitative literature
114 review (SQLR) process was adopted to achieve the objectives, and the present study aims to identify and
115 map the research carried out on the intersection of LM and HRM. An SQLR differs from traditional
116 literature review methods of meta-analyses and narrative reviews on multiple aspects. Firstly, the emphasis

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3 117 on the systematic process of literature search, extraction, and synthesis is higher in SQLRs than in other
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5 118 forms of review, making the work more scientific and replicable (Tranfield *et al.*, 2003; Yang *et al.*,
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7 119 2017). Flowcharts are a critical part of SQLRs that enhance review transparency (Petticrew and Roberts,
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9 120 2006; Yang *et al.*, 2017). We have adopted a system flowchart designed utilizing Lucid software for this
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11 121 work, as outlined in Figure 1. Adopting a systematic flowchart assists future researchers in replicating and
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13 122 implication of the research findings (Petticrew and Roberts, 2006). Besides, SQLR is recommended when
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15 123 the area under study is interdisciplinary and conducted in different settings using various research designs
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17 124 (Pickering and Byrne, 2014). Given the research objective of this research in reviewing all the available
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19 125 literature to identify the role of HRM practices in LM, the nature of the intersection of fields becomes multi-
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21 126 and interdisciplinary; therefore, an SQLR was deemed the most appropriate synthesis tool.

2.1. Phase I: Planning the Review Process

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23 128 After identifying the need to conduct a literature review, a review team was formed to plan the review
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25 129 protocol and its execution (Tranfield *et al.*, 2003). The meetings also included formulating the research
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27 130 questions to best meet the research objectives after discussing and identifying various concurrent dialogues.

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29 131 Scopus database by Elsevier provides two critical benefits in the review process: (a) the vast
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31 132 multidisciplinary repository of the database allows the expansion of search area; (b) database's
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33 133 predetermined selection and filtration options (language, subject, year of publication) allow automation of
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35 134 the filtration process while making it time-efficient (Pham *et al.*, 2021; Thakur *et al.*, 2021). Therefore,
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37 135 Scopus was selected for the literature search and, only peer-reviewed academic publications were included,
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39 136 excluding books, project reports, teaching cases, editorial notes, conference papers, and unsubstantiated
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41 137 grey literature at the preliminary stage of the search process (Psomas and Antony, 2019). Furthermore, from
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43 138 the myriad of conceptual, descriptive, and exploratory articles screened, literature reviews and meta-
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45 139 analyses were excluded from the review to avoid the repetition of information (Fischl *et al.*, 2014).

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47 140 The time frame for the review was limited to the past decade on reviewing previous studies, which have
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49 141 recommended that researchers analyze more recent research to delineate the emerging trends in the selected
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51 142 field under study (Sadeghi Moghadam *et al.*, 2021). This selection is also justified because the number of
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53 143 research articles in LM has increased substantially after 2010 (Erthal and Marques, 2018; Henao *et al.*,
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55 144 2019; Samuel *et al.*, 2015). Search terms for the review included the following: Lean Management (LM),
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57 145 Six Sigma, Quality Management (QM), HRM and Workforce Management. To ensure any relevant articles
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59 146 were not excluded, a second review of the abstracts and titles of the excluded articles was carried out.

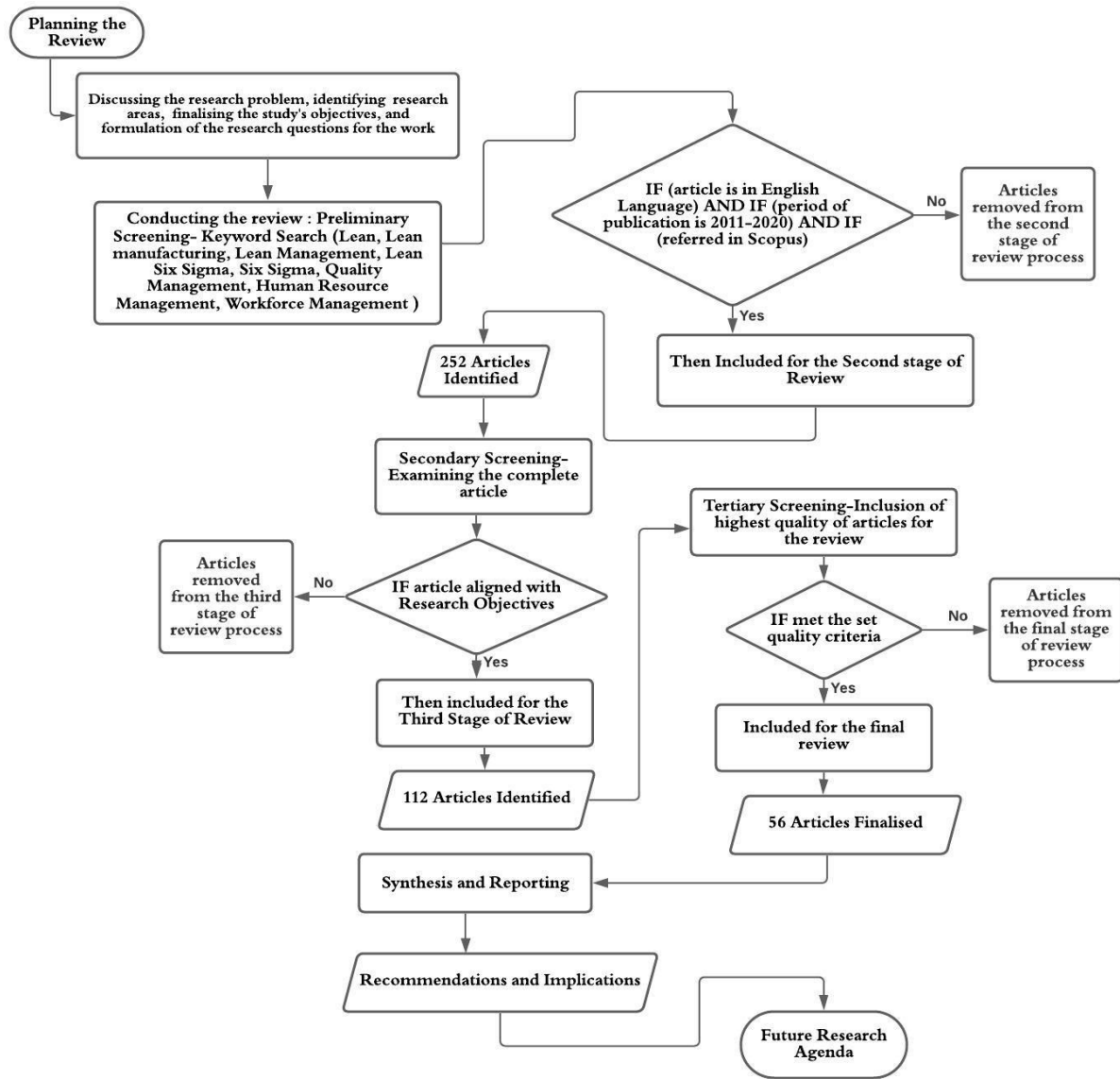
2.2. Phase II – Conducting the Review

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3 148 The second step in the review process included constructing search strings based on the search terms
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5 149 identified by the review team in the primary stage. For example, a sample search string was ["Human
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7 150 Resource Management"] AND ["Lean"]. An initial search using the selected strings in SCOPUS resulted
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9 151 in 252 articles. In the multi-level screening process, primary screening involved examining the title, abstract
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11 152 and keyword; secondary screening included full-body relevance examination followed by the tertiary
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13 153 screening of matching the remaining articles against the inclusion and exclusion criteria to include only the
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15 154 highest quality articles (Psomas and Antony, 2019). Articles that did not align with the review aims were
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17 155 excluded at each step, resulting in a final 56 articles selected for review and synthesis (Figure 1). The
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19 156 complete process of article selection, screening, and removal was overseen by the review team, and any
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21 157 disputes regarding inclusion or exclusion of any article were addressed and resolved during the review
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23 158 meetings (Tranfield *et al.*, 2003).

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25 159 Bibliographic information was downloaded from Scopus with additions of keywords from the full text
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27 160 included manually for the comprehensive overview. The addition of benefits and challenges in adopting
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29 161 HRM initiatives within LM initiatives was suggested to be also entered as a keyword search based on other
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31 162 similar works carried out by (Psomas and Antony, 2019).

32 163 **2.3. Phase III – Reporting and Dissemination of Findings**

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34 164 Following the guidelines of recent reviews in LM (Antony *et al.*, 2020; Psomas and Antony, 2019), the
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36 165 present state of research, an in-depth synthesis, and future research agenda are presented in the following
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38 166 section. This presentation and reporting will help map the growth within the LM and HRM field and areas
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40 167 to work on, both for academics and practitioners working in these fields.
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Figure 1: Flowchart demonstrating selection process of the articles

170 **3. Classification and Analysis**

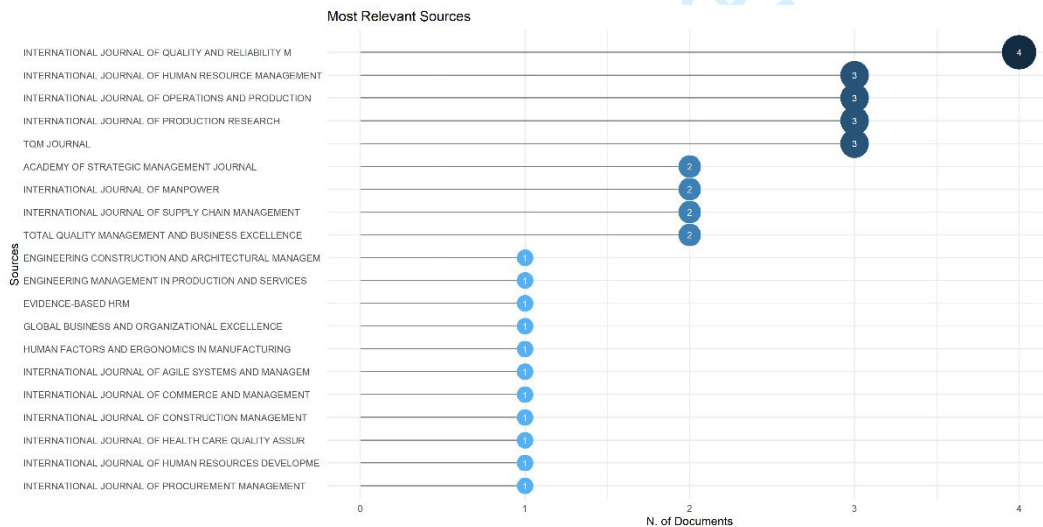
171 After a detailed process of article review and selection, the finalized articles were subjected to critical
 172 evaluation and analysis. In order to analyze the selected articles Bibliometric tools were applied
 173 (Donthu *et al.*, 2020). Bibliometric analysis applies statistical methods to identify the qualitative and
 174 quantitative changes in the given field of scientific study by establishing the profile of publications in
 175 the study area and recognize tendencies within a discipline (Rey-Martí *et al.*, 2016). A web application
 176 named biblioshiny under the R package (Aria and Cuccurullo, 2017) was used to perform bibliometric
 177 analysis which includes descriptive and relational analysis related to the study area (Paposa and Paposa,
 178 2022) .

179 **Descriptive Analysis**

180 Descriptive analysis denotes the current research trends on the integration of LM and HRM. In this
 181 study, various descriptive analysis indicators like the total number of publications, citations per
 182 publications, sources of publications, annual scientific production, country scientific production, type
 183 of research article and research methods employed, and finally, the word cloud with the key indicators
 184 are presented.

185 *Number of published papers in leading journals:*

186 In line with previous studies (Antony *et al.*, 2020; Bhamu and Sangwan, 2014; Psomas and
 187 Antony, 2019), the reviewed articles’ distribution based on the journals they published is presented in
 188 Figure 2.

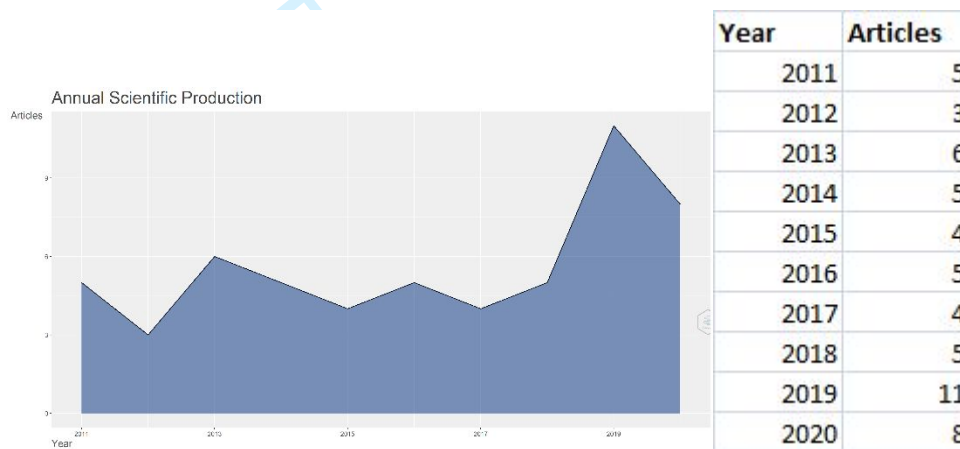


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190 Figure 2: Journals with publications on HRM and LM.

191 *Number of published papers in the last decade:*

192 Figure 3 shows the number of articles published in the last decade. It is clear from the results that
 193 most articles <40% were published in the last two years alone. The frequency of the year of
 194 publication helps ascertain the stages of the history of the current research context (Danvila-del-
 195 Valle *et al.*, 2019). Thus, from Figure 3, light can be shed on how the research on LM practices
 196 in conjunction with HRM has progressed in the last decade. It also signifies the rising importance
 197 of the human side of quality management.



198 Figure 3: Articles on HRM and LM per year

199 *Number of published papers Country-Wise*

200 The countries with the highest number of studies from the selection are Spain (21), the USA (12),
 201 Iran (10), Jordan (9), and India (9), as depicted in Figure 4.

Country Scientific Production

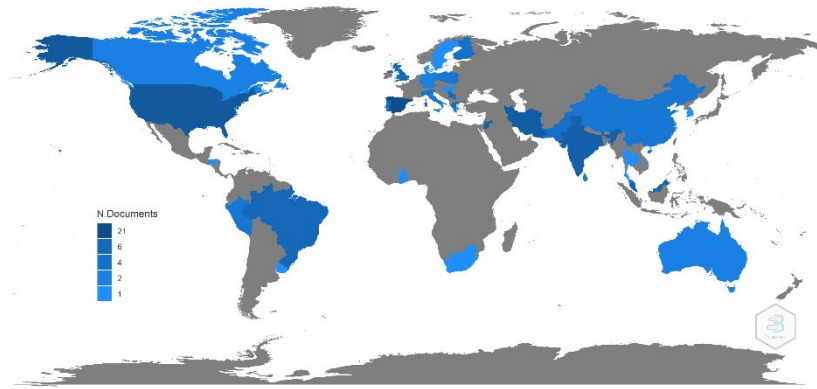


Figure 4: Country-Wise Scientific Production

Distribution as per Research Methodology

Figure 5 demonstrates the research methodology of the selected articles, and it is apparent that the majority were quantitative studies (38; 68%) followed by qualitative ones (12; 21%). Only a handful of studies from the selection used mixed method research (6; 10%). Questionnaires and surveys were popular data collection tools in quantitative studies, while authors for qualitative studies used a myriad of data collection tools, including personal interviews, documentary analysis, literature reviews, and documentaries. The vast majority of the selected articles were empirical (42; 75%), followed by case studies (10; 18%) and conceptual studies (4; 7%), as demonstrated in Figure 6.

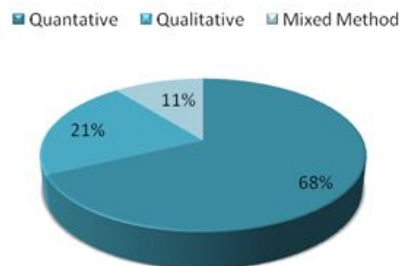


Figure 5: Research Methodology wise Distribution

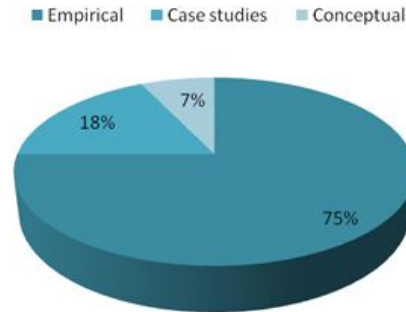


Figure 6: Research Article wise distribution

Most Globally Cited Documents

Citation analysis on the selected articles is performed on the assertion that authors cite a document only when considered significant for the research purpose (Danvila-del-Valle *et al.*, 2019). It signifies which publications and what type of research have influenced the literature related research variables (de Bakker *et al.*, 2005). Figure 7 gives a graphical representation of the frequency distribution of the most globally cited documents on the research topic. According to the top-cited author from the selection, LM and HRM help achieve organizational performance through Environmental Management (EM) (Jabbour *et al.*, 2013). However, LM has a more substantial influence and significance on EM than HRM. The second highest cited article was by (Furlan *et al.*, 2011) and stated that companies need to recognize the fundamental role of HRM in successfully implementing Lean practices in the organization. The article stated that managers need to ensure that people at every level are wholly involved and highly committed to successfully implementing a Lean philosophy and making Lean bundles (like JIT and TQM) the backbone of the company's operations.

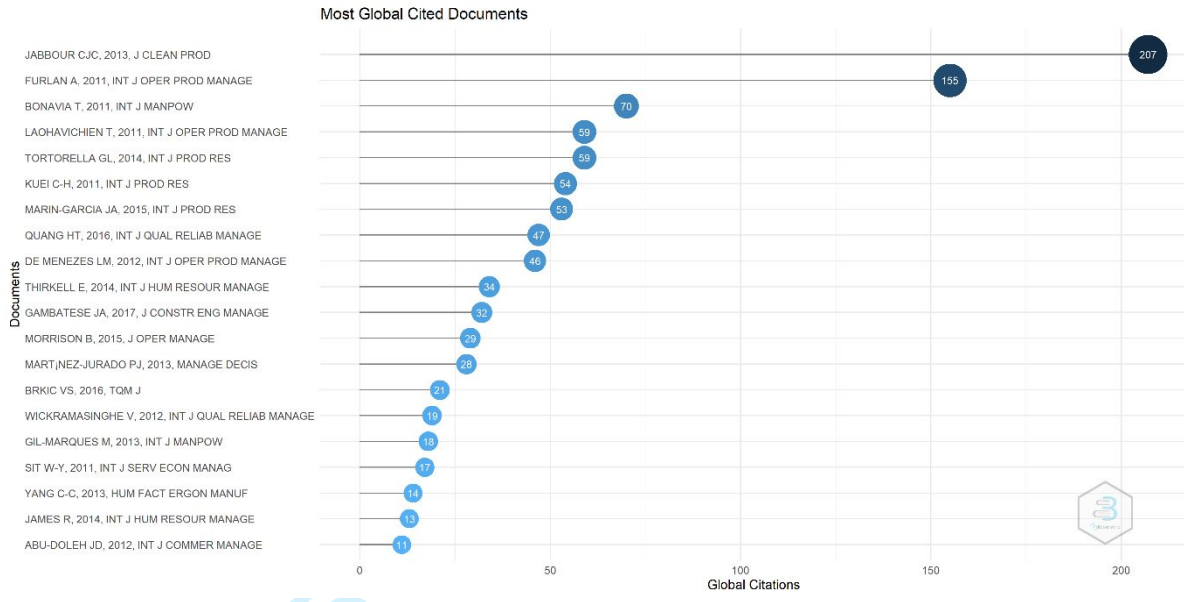


Figure 7: Most Globally Cited Research Articles

Most Frequently used Author Keywords

The word cloud is depicted in Figure 8. It highlights the most frequently utilized author keywords in the selected works. The word's size and centrality in the cloud represent its relative prominence in terms of the respective theme (Baker *et al.*, 2021). The main keywords that appear include quality management, training, communication, Lean production, employee involvement, human resource management, Lean production, just in time, Lean manufacturing, top management commitment, and operational performance. It can also be stated that most of the studies predominantly revolve around the manufacturing sector or the production industry.



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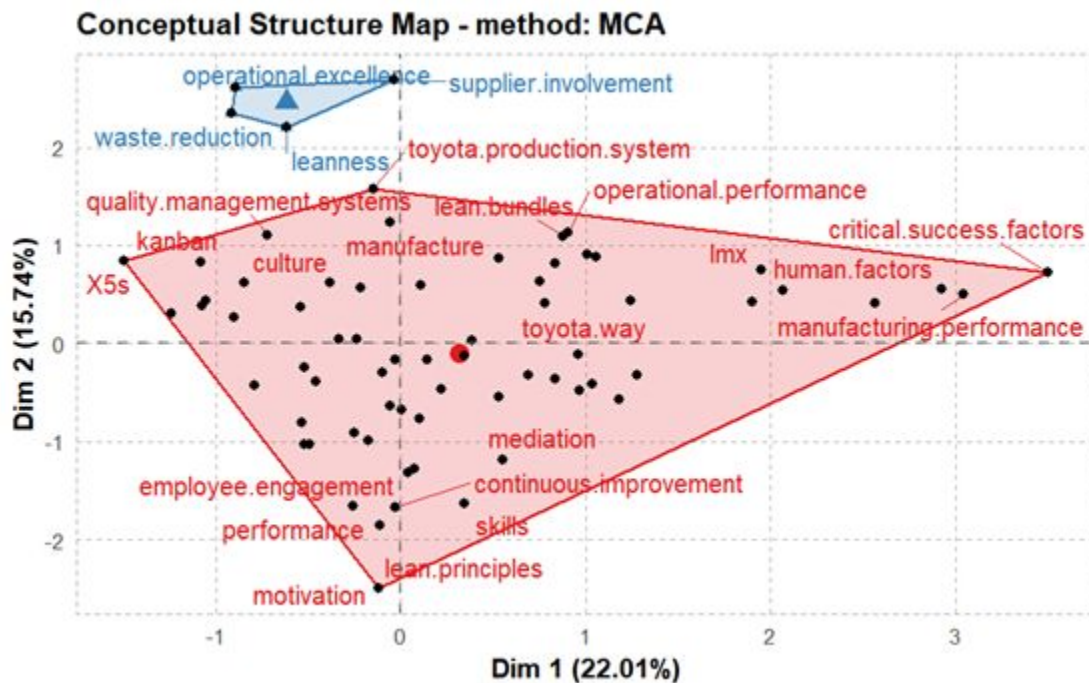
244 Figure 8: Word cloud generated from selected keywords

245 *Relational Analysis*

246 The relational analysis is a widely used technique for studying a discipline's semantic and
 247 conceptual structure. The tools and indicators of relational analysis help study the level of
 248 complexity and identify the intellectual and social structures of the field. Thus, Relational Analysis
 249 helps discover the relationships among the published research articles through their citation, author,
 250 author's affiliation and keyword to conduct co-occurrence analysis (Koseoglu *et al.*, 2016). The
 251 various indicators of relational analysis include co-citation analysis, co-word analysis, co-
 252 authorship analysis and bibliographic coupling. In addition, various indicators like conceptual
 253 structures through factorial analysis, co-occurrence networks, and thematic maps are indicators for
 254 the present study.

255 *Conceptual structure through Factorial network from Author Keyword*

256 Figure 9 highlights the essential factors from all the extracted and selected research work. It can be
 257 seen that two factors have emerged prominently. The first one is depicted in red, which shows Lean
 258 and HRM practices. Secondly, the blue colour depicts various outcomes like Leanness, operational
 259 excellence, waste reduction, and supplier involvement.



261 Figure 9: Conceptual structure through Factorial network

262 *Conceptual structure through Co-occurrence network from Author Keywords*

263 The conceptual structure shows mainly three clusters - Human Resource Management, Total
 264 Quality Management, and Training (Figure 10). When taken in conjunction with LM, it can be
 265 interpreted that HRM will improve operational performance and quality.



266

267 **Figure 10:** Conceptual structure through Co-occurrence network

268 *Conceptual Structure through Thematic Map from Author Keywords*

269 Thematic mapping helps identify the four different typologies of research themes depicting their importance
 270 and development (della Corte *et al.*, 2019). Figure 11 represents a thematic map based on density (y-axis)
 271 and centrality (x-axis). Density measures the development of chosen research theme, and centrality
 272 measures the importance of the research theme. Thus, the graph is divided into four different parts. Author
 273 keywords have been taken as an input to the query to thematic map

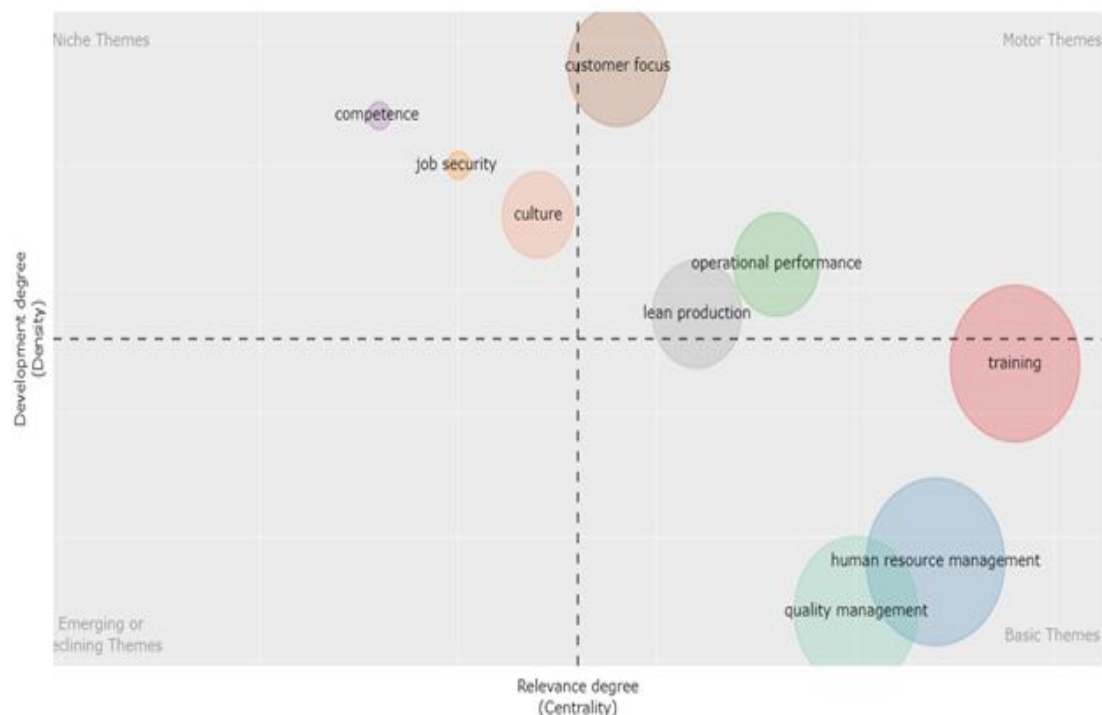
- 274 • **Themes that appear in the lower-left quadrant** are the emerging or declining themes.
 275 These themes can either be emerging themes or were themes that have dropped off from the
 276 research area. There is no such keyword from this study under this theme, suggesting a dearth of

277 research. This conclusion is backed up by the fact that just under 40% of the research published in
 278 this area has been published in the last two years alone (see Figure 2).

279 • **Themes that appear at the lower right quadrant** are the primary or transversal themes.
 280 These themes represent low density but high centrality, indicating the high frequency of research
 281 done on these areas. It includes human resource management and quality management. However,
 282 training has some parts in basic themes, and some under motor themes indicate its high relevance
 283 and importance. From the thematic map, it can be observed that the construct HRM and TQM are
 284 intersecting at a point depicting some common areas of research. It signifies the importance of the
 285 two constructs taken together and their colossal scope within the study field.

286 • **Themes that appear in the upper right quadrant** are named motor themes which are
 287 developed and essential. It includes customer focus, operational performance and Lean production.
 288 This SLR backs up developing themes as many of the articles selected focus on LM and its benefits
 289 to operational performance.

290 • **Themes that appear in the upper left quadrant** represent high density but low centrality.
 291 These themes are highly developed but isolated. For example, it includes employee job
 292 competencies, job security and culture, which are HR practices that have a bearing on the success
 293 of LM but are not explored in the literature.



294

295 **Figure 11:** Conceptual Structure through Thematic Map

296 **4. RESEARCH FINDINGS**

297 This section presents the critical findings regarding HR and Lean aspects identified from the
 298 selected articles. It also highlights the benefits, motivations, and challenges of blending the
 299 organization’s HR with its Lean aspects. Moreover, it sheds light on the prominent Lean principles
 300 and the roles of employee and HR initiatives to implement Lean initiatives successfully.

301 **Key HRM aspects discussed in the literature.**

302 The various HR aspects were identified from the selected articles, and it can be observed that HM
 303 practices like Training and development, Communication, Management & Leadership, Motivation,
 304 and Teamwork play a crucial role in Lean & initiatives (Figure 12).

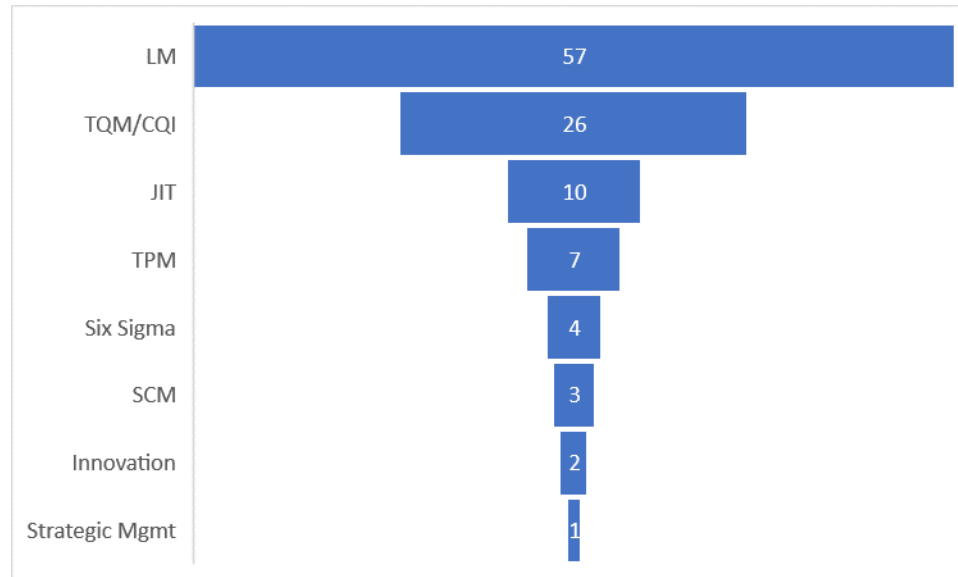


305
 306 **Figure 12:** Different HRM aspects discussed in selected literature

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308 **Key Lean aspects discussed in the literature:**

309 Figure 13 showcases various Lean initiatives identified from the selected review papers and shows
 310 that LM and TQM/CQI were by far the most utilized aspects discussed in the literature to represent
 311 Lean.



312
 313 Figure 13: Different LM aspects discussed within the selected articles

314 **Benefits of implementing HRM and Lean practices:**

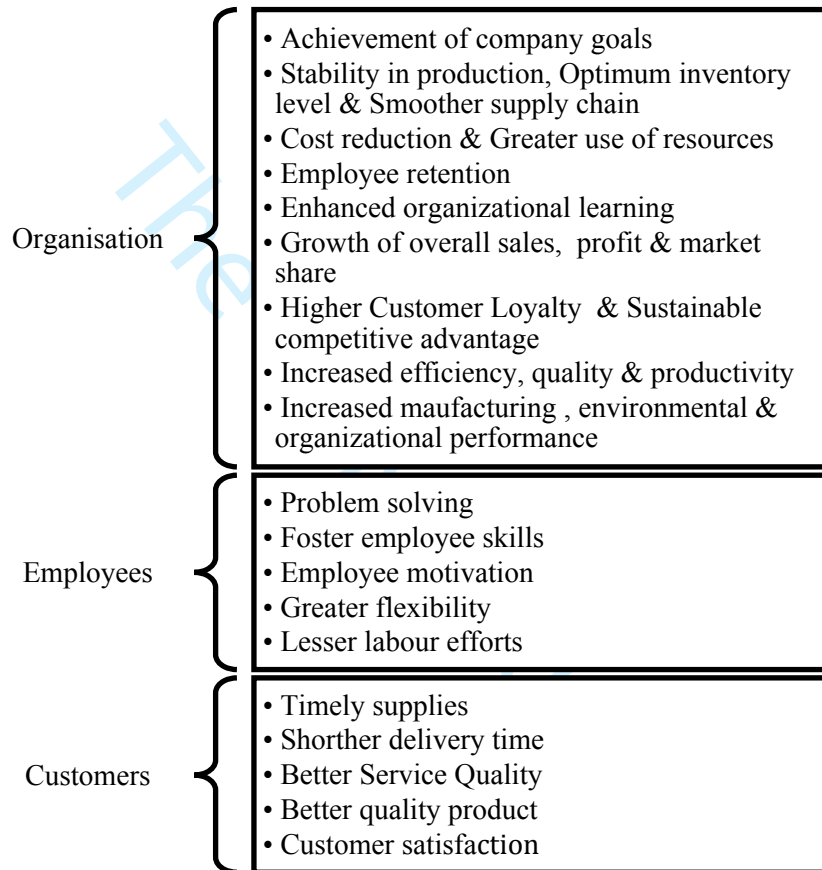
315 The success of Lean practices hugely relies upon humans' ability to recognize, understand, and
 316 resolve complex industrial problems. Additionally, these practices are based upon systematic and
 317 continuous improvement of business processes, and to do so, humans employed in the company
 318 must be embedded entirely with all the systems and processes with maximum speed. Implementing
 319 Lean practices with a blend of HRM practices indicates a significant surge in job autonomy, job
 320 satisfaction, and operational performance (Vukadinovic *et al.*, 2019). Additionally, HRM practices
 321 are essential determinants in implementing LM. If a firm exploited (developed, instituted, and
 322 implemented) HRM practices to their highest potential over time, it might create a production
 323 system that yields the highest performance through incremental improvement (Wickramasinghe
 324 and Wickramasinghe, 2020).

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327 **Motivating Factors for blending HRM and LM.**

328 After an intense analysis of all the selected articles, the various motivating factors that enable an
 329 organization to integrate HRM with LM have been listed in Figure 14. The motivating factors have
 330 been divided into three main categories: Organisational, Employees, and Customers, depending
 331 upon how it contributes to these stakeholders.



332

333 Figure 14: Motivating factors for integration of HRM and LM.

334 **Principles of LM, Associated Employee Roles, and HR Initiatives**

335 An attempt has been made to identify the employee role and HR initiatives required to implement
 336 LM. It is a step towards total quality management of an organization wherein the management
 337 develops a corporate culture characterized by increased customer satisfaction through continuous
 338 improvement in which the firm's employees continuously participate.

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Sr. No	Lean Principles	Basic Understanding	Role of Employees	HR Initiatives	Relevant Sources
1	Understanding customer value	Identifying and prioritizing customer value	Employees' priorities customer values and search for innovative solutions to enhance customer value	Teamwork, knowledge sharing, Innovative culture	(Al-Hyari, 2020; Andersson <i>et al.</i> , 2006; Ramos <i>et al.</i> , 2019; Shin and Alam, 2020)
2	Value stream analysis	Eliminating non-value adding processes	Employees develop new methods and ensure continuous improvement through optimum use of resources and removing non-value adding activities.	Mentorship, suggestive employee systems, motivating employees	(Al-Hyari, 2020; Andersson <i>et al.</i> , 2006; Ramos <i>et al.</i> , 2019)
3	Flow	Ensuring continuous improvement flow in the	Employees ensure standardization of work,	Reliable and proven technology, Ergonomics, levelled workload, training	(Alkhaldi and Abdallah, 2019;

		production processes and supply chain	discipline, and control to enhance overall service quality.	and development of employees, participation, empowerment Continuous information flow and communication	Andersson <i>et al.</i> , 2006; Furlan <i>et al.</i> , 2011; Gao and Low, 2015)
4	Pull	Flowing the product at the pull of the customer and avoiding stocks	Employees identify new ways for reducing setup times to facilitate pull production flow	Work standardization, Teamwork, Training, Commitment, Positive Morale	(Andersson <i>et al.</i> , 2006; Yang and Yang, 2013)
5	Perfection	Continuously reducing time, space, cost, mistakes and efforts with a pursuit of perfection.	Employees strive hard to sustain continuous perfection. They evaluate how their work contributes to the improvement of the whole company.	Motivation and incentives, Quality culture, innovative suggestions, multi-skilled employees, empowerment, Job rotation	(Andersson <i>et al.</i> , 2006; Yang and Yang, 2013)

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3 **344 Challenges associated while considering Lean and HRM together**
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6 **345** As discussed by the authors, Lean initiatives or practices depend on a myriad of HRM policies and
7 **346** initiatives (Psomas and Antony, 2019); however, challenges are often observed in integrating the different
8 **347** systems. Different challenges identified and highlighted by the authors in selected articles are showcased
9 **348** in Table 2.
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13 Table 2 Challenges in the integration of Lean and HRM.
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Keywords related to challenges	Explanation	Supporting references
Integrated LM and HRM structures	The HR department should be directly involved in designing, implementing, and developing Lean & quality management systems.	(Abu-Doleh, 2012; Ahmad and Schroeder, 2003; Al-Hyari, 2020; Alkhaldi and Abdallah, 2019; Alkhazali <i>et al.</i> , 2019; Asante and Ngulube, 2020; Bahadori <i>et al.</i> , 2018; Báthory, 2020; Bello-Pintado <i>et al.</i> , 2018; Furlan <i>et al.</i> , 2011; Irfan and Kee, 2013a; Kaynak, 2003; Laohavichien <i>et al.</i> , 2011; Leyer <i>et al.</i> , 2021; Marin-Garcia and Bonavia, 2015; Mellat-Parast, 2013; de Menezes, 2012; de Menezes and Wood, 2015; Ramos <i>et al.</i> , 2019; Tsiotras <i>et al.</i> , 2016; Tunku <i>et al.</i> , 2011; Vukadinovic <i>et al.</i> , 2019)
Tailored HRM practices	HR and Lean quality management systems should develop HRM practices collectively to achieve the common goal.	(Abu-Doleh, 2012; Ahmad and Schroeder, 2003; Al-Hyari, 2020; Asante and Ngulube, 2020; Báthory, 2020; Furlan <i>et al.</i> , 2011; Furman and Kuczyńska-Chałada, 2016; Kharub and Sharma, 2018; Kuei <i>et al.</i> , 2011; Leyer <i>et al.</i> , 2021; Madanat and Khasawneh, 2017; Oleyaei-Motlagh and Bonyadi-Naeini, 2014; Para-González <i>et al.</i> , 2016; Ruiz <i>et al.</i> , 2019; Shin and Alam, 2020; Tortorella and Fogliatto, 2014; Tunku <i>et al.</i> , 2011; Voss <i>et al.</i> , 2005; Wickramasinghe and Wickramasinghe, 2020; Wolniak, 2019)

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Identification of specific HRM factors	Inherent HRM factors of lean systems other than leadership, training and communication need to be identified for developing sustainable QM systems.	(Al-Hyari, 2020; Gao and Low, 2015; Gil-Marques and Moreno-Luzon, 2013; Hernandez-Matias <i>et al.</i> , 2019; Kuei <i>et al.</i> , 2011; Marin-Garcia and Bonavia, 2015; Mellat-Parast, 2013; Para-González <i>et al.</i> , 2016; Tortorella and Fogliatto, 2014; Tsiotras <i>et al.</i> , 2016)

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350 5. Discussion and Implications

351 Being the first article to systematically map HRM integration with Lean, this review has significant
 352 implications for managers and policy leaders from the discussion to develop and effectively
 353 manage an integrated framework for the Lean environment. Results of the current review are
 354 specifically critical for researchers and academicians in both the disciplines of LM and HRM to
 355 explore the constructs further and examine how the relationships between them can be fruitfully
 356 harnessed for better and effective results.

357 Three types of analysis were done in the current review for the in-depth examination of various
 358 relationships and patterns in the academic literature at the conjunction of LM and HRM –
 359 descriptive analysis, relational analysis and qualitative analysis. The descriptive analysis described
 360 the bibliometric aspects of the selected articles, while relational analysis explored the semantic
 361 and conceptual structure of the concepts in focus through author keywords and identified themes.
 362 Qualitative analysis dealt with delineating different factors associated with HRM and LM
 363 integration.

364 The examination of the publication outlet demonstrates that most of the authors selected journals
 365 dedicated to Quality and Lean management for their research output. While the finding is
 366 uncommon and in line with previous multidisciplinary research in QM (Antony *et al.*, 2018;
 367 Vashishth *et al.*, 2019), authors must explore different avenues for research outlets rather than
 368 monopolizing the sector. A crucial reason for this suggestion stems from the importance of HRM
 369 in LM research. The current review demonstrates that soft factors such as leadership and
 370 communication play a critical role in the success of the LM environment (Jain and Ajmera, 2019;

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3 371 Laohavichien *et al.*, 2011); however, the focus of research has seldom been on HRM factors.
4 372 Rather, the majority of authors from the selection have clubbed multiple HRM factors under
5 373 popular umbrella terms such as *HRM factors* (Alkhalidi and Abdallah, 2019; Ramos *et al.*, 2019),
6 374 *HR initiatives* (Kuei *et al.*, 2011), or *soft factors* (Asante and Ngulube, 2020; Hernandez-Matias *et*
7 375 *al.*, 2019). It is suggested that future researchers explore LM integration with a focus on specific
8 376 HRM factors rather than clubbing them within the umbrella term of HRM (e.g., (Leyer *et al.*,
9 377 2021)). Another important aspect of the discussion noticed in the current review is the lack of
10 378 specific relations (e.g., causality) of the HRM factors on LM factors. Therefore, future researchers
11 379 should narrow the research area rather than keep it broad. For demonstration, a sample research
12 380 question can be: what is the impact of leadership on LM execution?; or, how is job satisfaction
13 381 related to LM?

14 382 The publication trend of articles is encouraging for future researchers and practitioners equally.
15 383 The upward trend of publications is a clear sign of the growing interest of academia in exploring
16 384 factors at the conjunction of HRM and LM. This trend should encourage future researchers to build
17 385 on the existing and upcoming literature to devise and execute in-depth studies which bring more
18 386 clarity to the role played by HRM in the L.M. Given the importance of organization framework
19 387 and its related factors (such as communication and leadership) on LM deployment that has been
20 388 pronounced in the current review (see (Hernandez-Matias *et al.*, 2019; Tsiotras *et al.*, 2016)),
21 389 industry practitioners must collaborate with researchers to design exploratory case studies before
22 390 executing LM tools enabling them to save costs and explore which tools work best for their
23 391 organizational structure.

24 392 Results of the country-wise scientific output and the methodology adopted in the selected articles
25 393 showcased that most of the studies are from the western countries (Spain and USA), using
26 394 quantitative research methods. While the finding aligns with the recent studies in LM and HRM
27 395 disciplines, it is necessary to explore how HRM factors on LM structures vary in Asian countries
28 396 than in European or American ones. The proposed difference in effects stems from the findings of
29 397 the current review, where authors have highlighted that cultural differences play a crucial role in
30 398 LM (Mellat-Parast, 2013; Yang and Yang, 2013). The importance of culture has also been
31 399 emphasized by authors to be of high significance but was not discussed adequately (as
32 400 demonstrated by high density and low centrality in Figure 11). Also, since cultural and
33 401 organizational diversity within nations is subjective (Wheeler, 2003), these differences must be
34 402 explored with qualitative research tools. Future researchers can add significant value to the current
35 403 understanding of the HRM and LM integration by in-depth interviews from Asian LM
36 404 practitioners while comparing the output with Western practitioners. It will also be fruitful to

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3 405 compare the effectiveness of HRM initiatives for LM deployment depending on the culture, i.e.,
4 406 explore the mediating or moderating effects of various cultural differences like power distance
5 407 (Martins *et al.*, 2016), high or low-context of communication (Bjerregaard *et al.*, 2009) and gender
6 408 roles (Martins *et al.*, 2016) among others. Future researchers should also consider case studies of
7 409 organizations that will assist practitioners in identifying best practices in the industry depending
8 410 on the country.

9 411 Relational analysis of author keywords and identified themes delineated three crucial aspects of
10 412 the current research on HRM and LM integration; the first is the obvious significance of HRM
11 413 factors in the success of LM demonstrated in Figures 10 & 11. Training is showcased as one of
12 414 the most significant HRM initiatives supported by the cluster formation in Figure 10. Studies from
13 415 the selection demonstrate that training has a significant effect on employee factors such as
14 416 communication (Asante and Ngulube, 2020; Hernandez-Matias *et al.*, 2019), employee
15 417 involvement (Furlan *et al.*, 2011), employee empowerment (Alkhaldi and Abdallah, 2019) and
16 418 employee commitment (Furlan *et al.*, 2011; de Menezes, 2012) which further impact the LM
17 419 within the organization. While this importance of training within LM has also been emphasized in
18 420 parallel LM works (Bouranta *et al.*, 2021), the increased focus on training often translates to a
19 421 decreased focus on other HRM initiatives, as demonstrated by the current review (Figure 12).
20 422 Future researchers are encouraged to examine HRM aspects other than training, which
21 423 significantly impact the LM in the organization.

22 424 Job crafting, where employees are allowed the freedom to modify their tasks and relational duties
23 425 at the workplace (Lichtenthaler and Fischbach, 2018), is one of the HRM constructs that is directly
24 426 related to employee performance and productivity (Guan and Frenkel, 2018) and has found little
25 427 space in the discussion (Figure 12). Therefore, future researchers are encouraged to pursue the
26 428 relationship between job crafting and LM deployment. Exploration of causal effects of job crafting
27 429 on LM will also be an interesting avenue for future research. Leadership was discussed in many
28 430 studies within the selection; however, the leader-member relationship (or LMX) found scarce
29 431 space (Figure 12). While leadership is undoubtedly critical for lean deployment in the
30 432 organization, examining how the LMX impacts the LM is also crucial. The importance of LMX
31 433 for successful LM deployment has been highlighted by recent research (Donnelly *et al.*, 2021),
32 434 where it is also distinguished that strong leadership does not always translate to successful LM
33 435 within the organizations. This failure of leadership is attributed to other HRM factors such as
34 436 culture, communication, and power distance (Bouranta *et al.*, 2021; Donnelly *et al.*, 2021),
35 437 eventually working through the LMX. Therefore, along with the importance of a leader in the
36 438 organization, it is critical to examine the impact of LMX on the LM implementation. Future

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3 439 researchers should explore the causal relationships between LMX and LM and any other mediating
4 440 or moderating variable.

5 441 An in-depth qualitative analysis was carried out to understand the benefits, motivation, and
6 442 challenges associated with the integration of LM and HRM highlighted by the authors of the
7 443 selected articles for the current review. Findings of the current review demonstrate that integration
8 444 of HRM factors with LM has a significant impact on the output quality of the firm, both in terms
9 445 of product and services (Irfan and Kee, 2013b; Mellat-Parast, 2013). This enhancement of quality
10 446 output works through increasing the skills and competencies of the employees along with other
11 447 job-related factors such as motivation (Jain and Ajmera, 2019; Womack and Jones, 1997) and
12 448 satisfaction (Bahadori *et al.*, 2018; de Menezes, 2012), helping the organization to achieve its
13 449 desired goals. Although different relationships have been explored in the selected papers for the
14 450 review, a dearth of research remains where a direct relationship among HRM factors leading to
15 451 organizational success is established. Previous research on the LM deployment and organizational
16 452 structure highlights the importance of different HRM factors [ref], but they are yet to be
17 453 empirically tested. Therefore, future researchers should explore which HRM factors play a more
18 454 significant role in organizational success through LM. It will also be interesting to compare
19 455 different HRM factors in a series of studies. This exploration will be especially useful for the
20 456 practitioners as it can guide developing and modifying HRM policies. Practitioners should also
21 457 collaborate with researchers on integrating LM and HRM as one of the most critical challenges
22 458 identified in 56 selected articles revolves around integrating and tailoring the HRM practices
23 459 around LM goals (see Table 2). Therefore, future research should add to the literature exploring
24 460 additional HRM factors than leadership and training (Table 12) while developing practical models
25 461 for execution in the industry.

40 462 **6. Conclusion**

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43 463 The current review is the first study to systematically map the importance of HRM practices as
44 464 enablers for LM within the organizations. In doing so, this study identified the benefits, motivation,
45 465 and challenges associated with the integration of HRM practices with the LM deployment as
46 466 highlighted in the existing academic literature. The analysis of 48 articles after screening through
47 467 252 articles demonstrates that critical engagement of the practices within the academic literature
48 468 remains scarce and needs scholarly attention. Within the selected articles, HRM as an umbrella
49 469 term was used instead of specific practices being the focus of the discussion. Although the
50 470 publication trend and the journal outputs were satisfactory, most authors resorted to discussing
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3 471 training and leadership as a focal practice rather than delving into nuances of complex HRM
4 472 practices within the organization.

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6 474 Given the increasing focus on discovering the mechanisms of human resources practices that act
7 475 as the determining factor for the success of LM within organizations [ref], the current review has
8 476 several theoretical and practical contributions. As demonstrated in the discussion, future research
9 477 needs to focus on studying the integration of HRM and LM practices within Asian and African
10 478 countries to diversify and compare the effectiveness of different practices based on cultural
11 479 differences. Scholars also need to explore nuances of different HRM practices that significantly
12 480 affect LM deployment. Given the importance of HRM practices on the quality output of the
13 481 organizations, it is also recommended that scholars explore the HRM practices related which
14 482 moderate the quality production within Lean environment. On similar lines, the review is
15 483 essentially useful for practitioners on two crucial fronts, with the first is identifying the benefits of
16 484 LM and HRM integration. Our review results demonstrate that HRM practices can make or break
17 485 the LM initiatives supported by previous literature. Therefore, practitioners should pay more
18 486 attention to the HRM initiatives within the organization rather than focusing solely on the rules
19 487 and regulations of the LM deployment. The second important finding critical for practitioners is
20 488 the tailoring of the HRM practices. Review results indicate that majority of the organizations do
21 489 not pay attention to modifying the HRM practices depending on the culture and the internal and
22 490 external environment, which becomes a critical challenge for the LM initiatives. Therefore,
23 491 practitioners should stop using the one-size-fits-all approach with HRM practices and develop
24 492 tailored practices while considering the employees' specific needs involved in the LM deployment.
25 493 While all possible care was taken during the selection and review process, this work is not free
26 494 from limitations. Three limitations were identified associated with the current review and should
27 495 be addressed in future works. First, the keywords used for the training were limited. Although the
28 496 keywords were selected after the discussion among authors, there is a possibility that we might
29 497 have missed out on searching through a few documents from the literature search. Second, full-
30 498 text screening was carried out only on SCOPUS. While previous authors have noted the SCOPUS
31 499 as a comprehensive database, few relevant academic articles may have been published on other
32 500 databases. Future research should therefore include other databases such as Web of Science. A
33 501 literature search based on publishing houses such as Elsevier and Emerald might also show some
34 502 relevant articles we might have left out. The third limitation concerns the subjectivity of
35 503 interpretation of the review results. While the results were discussed among the authors
36 themselves, they should be replicated with caution.
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504 Despite the limitations observed in the study, the current work lays the foundation of future
505 research and practice as the results of the current review demonstrate the importance of the
506 integration of HRM and LM practices within the industry. As globalization is increasing and the
507 pandemic brought business operations within our homes, it is important to focus on the soft factors
508 related to the humans working within the lean systems rather than just going by the book.

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