Lean

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The term “lean”, as a management concept that allows organizations to remain competitive by removing waste from their processes, has been fully adopted by management researchers.

lean manufacturing | lean production systems | lean 4.0 | systematic literature review

1. Introduction

Over recent decades, markets have become more and more competitive as they progressively demand customized products and services at lower prices and with shorter delivery times [1]. In the operations field, lean has become a widespread management system that is suitable for achieving these competitiveness targets [2][3][4] through more efficient processes, shorter lead times, and greater flexibility in supplying a wide variety of products and services in small quantities [5].

As a consequence, the management concept of lean has spread profusely throughout industry and services over the last 40 years [3]. A huge amount of research is now available for scholars and practitioners, with the present work having identified 4962 academic papers with “lean” in the title and “lean manufacturing” generating 8,910,000 results through a Google search.

From a methodological point of view, this research has followed the principles of the systematic literature review (SLR). Templier and Paré [6] have classified literature reviews into four types: narrative (summarizes previous published research); developmental (provides new conceptualizations or methodological approaches); cumulative (compiles empirical evidence and draws conclusions about a topic of interest); and aggregative (tests specific research hypotheses or propositions, with three subtypes: systematic, meta-analysis and umbrella review). The historical approach of this research falls under both cumulative and aggregative literature reviews.

Tranfield et al. [7] propose methodologically adapting SLR from medical science to management science, while Denver and Transfield [8] developed their method even further. SLR has been used in previous studies on lean topics [3][4][9][10][11][12].

2. Lean

In 1991, Delbridge et al. [13] introduced “lean manufacturing” as a synonym for “lean production”, and this term became more popular after 2000. Nowadays, “lean manufacturing” is the preferred expression for referring to lean

in industrial operations (**Figure 1**).

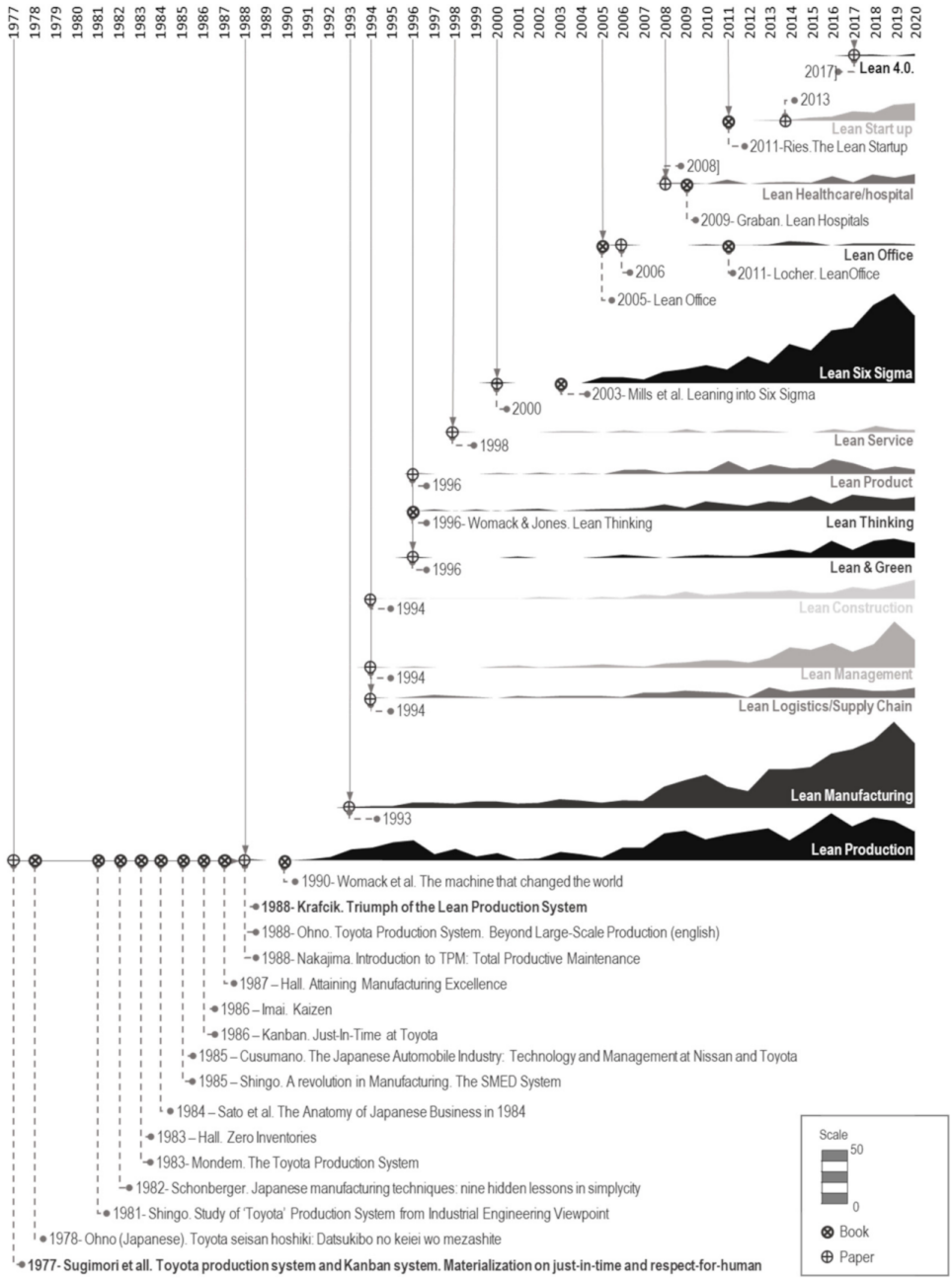

Figure 1. Historical evolution of the main lean categories and their foundational works.

In 2009, Mark Graban published the book Lean Hospitals [14] as a practical guide for adapting lean tools in hospital management.

In 2016 [15], Costa et al. presented a review based on six parameters: research method, country, healthcare area, implementation, lean tools and methods, and results.

At the present moment, only four papers have been found with “lean 4.0” in the title, although increasing interest (see **Figure 2**) is being generated in the relationships between Industry 4.0 and different lean aspects: lean

production [16][17], lean manufacturing [18][19], lean and green [20][21], lean construction [22], lean enterprise [23], lean healthcare [24], lean management [25], lean six sigma [26], lean supply chain [27], and lean thinking [28].

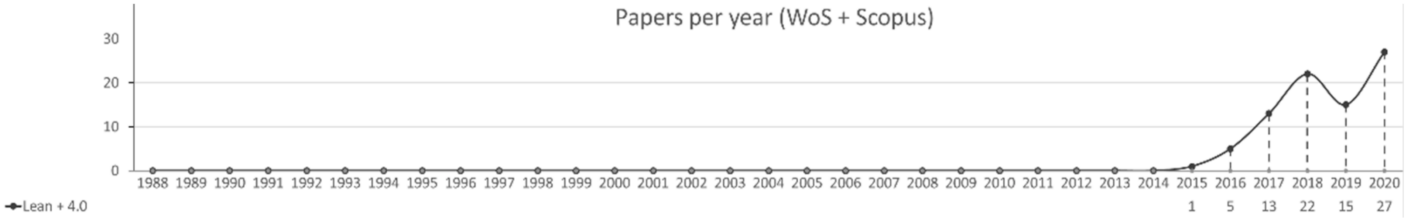

Figure 2. Papers about relationships between lean and Industry 4.0.

3. Conclusions

About the historical origin of the term “lean”: it was created in 1988 as “lean production system”, a generic denomination for the Toyota production system. The best-selling book, The Machine that Changed the World (1990), populated the term “lean production” by absorbing other alternative expressions that existed at that time.

Since 1990, the term lean has evolved over time. Its evolution and diversification can be explained through four mechanisms (combined over time): expansion, transfer, targeting, and combination. This resulted in the creation of a confusing puzzle of lean specifier.

This entry has outlined the paths of evolution by using the most cited specifiers in the academic literature: Between 1990 and 2000, the term lean remained mainly in its original field of operations management, with the following specifiers: lean production, lean manufacturing, lean logistics, lean supply chain, lean product, lean construction, and lean and green. The first attempt to upgrade the concept to a more conceptual level was greeted with initially limited academic interest: lean management, lean enterprise, and lean thinking. In 2000, the combined term “lean six sigma” emerged and up to the present has received much attention in both the manufacturing and service sectors. Since 2006, the term “lean” was progressively applied in the service field with new specifiers: lean service, lean hospital, lean healthcare, lean office, lean startup. The last specifier, lean 4.0., was created in 2017 as a synergetic combination between lean manufacturing (or lean production) and the Industry 4.0 paradigm. At the moment, it focuses only on the manufacturing field.

This entry reveals some implications for future research: The use of lean perspective can be further extended beyond its current development, adapting its principles and tools to different sectors or applications. The diversification mechanisms described above can open new research areas in a fast-changing, complex and competitive world. The lean approach combined with the new emerging disruptive technologies (so-called Industry 4.0) open new avenues for future research as intelligent construction, sustainability, smart cities, environmental improvement or public governance.

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